Feedback delivery timing & behavior skills training: Training university students to perform DTT

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Feedback Delivery Timing & Behavior Skills Training:

Training University Students to Perform DTT

Matthew Taylor

A thesis submitted to the Graduate Faculty of

JAMES MADISON UNIVERSITY

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Abstract

Behavior Skills Training (BST) has been a common, efficient, and successful training strategy for teaching individuals to perform discrete trial teaching (DTT) although there is not much established information about the separate effects of its training components. Research on modeling and feedback alone as well as within BST, however, suggest that they may be the most significant contributors towards producing behavior change along with the regular recommendation that feedback is best delivered immediately after the occurrence of target behavior for reinforcement. Yet studies that have employed feedback before the occurrence of target behavior have observed no adverse or detrimental effects in the acquisition or performance of skills that were trained, which may indicate a misleading protocol for the timing of feedback delivery. In an effort to extend research on feedback timing as well as its role within BST and effectiveness in training DTT, BST was utilized to teach participants to perform discrete trial teaching (DTT) while Performance Feedback was delivered only before, after, or before and after DTT sessions towards reaching mastery criteria. The results support the role of feedback in behavior change as serving a more discriminative, rather than reinforcing, function to allow for much more efficient, effective, and productive training interventions for the serious level of need in proficient human service providers.

Keywords: Behavior Skills Training, Discrete Trial Teaching, Feedback Timing, DTTEF, University Students, Generalization


**Introduction**

*Treatment.* Amongst a rapidly growing field and multitude of services available in treating children with developmental disabilities, there is a considerable need for efficient, feasible, and effective training procedures for teaching individuals how to deliver behavior analytic services with fidelity (Thomson, Martin, Arnal, Fazzio, & Yu, 2009). More often than ever a substantial number of teachers, parents, paraprofessionals, and other related human-service personnel are being called upon to provide quality treatment programs (Thomson et al., 2012), especially as a part of Early Intensive Behavioral Interventions (EIBI). Comprised by the principles of Applied Behavior Analysis (ABA), EIBI appear to be the most promising and successful instructional programs for children with a range of developmental disabilities. As such, EIBI have been recognized as the gold standard of treatment for teaching communication skills, receptive abilities, academic behaviors, and appropriate social interactions to children with developmental disabilities as well as for managing other various maladaptive behaviors (Green, 1996; Leaf & McEachin, 1999; Lovaas, 1987; Matson & Smith, 2008; Matson & Sturmey, 2011; NYSDOH, 1999; Smith, 2001).

Students with special needs, particularly children with Autism Spectrum Disorder (ASD), have long benefitted from early intervention of ABA (Green, 1996; Lovaas, 1987; Smith, 2001) services in which specific behaviors are analyzed to determine their functional, environmental relations (Cooper, Heron, & Heward, 1987) to create effective, function-based interventions towards increasing various target behaviors with socially significant outcomes (Wolf, 1978). Though highly intensive, EIBI programs that employ direct, systematic delivery of ABA interventions for approximately 35 hours per
week for up to 2-3 years have produced dramatic communicative and academic gains for many children with autism (Green, 1996; Leaf & McEachin, 1999; McEachin, Smith, & Lovaas 1993; Smith, 2001; Thomson et al., 2009).

EIBI are further intensive in nature simply because of their extensive ABA approach that was conceptually outlined in Lovaas’ (1987) comprehensive work. Rather than simply identifying one behavior to treat or single target outcome, EIBI is generally composed of a package behavior interventions for several behaviors of interest that are normally treated altogether and modified as necessary over the course of a person’s lifetime (Lovaas, 1987). As such, a limitless number of possibilities and treatment packages exist when developing EIBI because every individual and their environment is unique. Children with developmental disabilities as well can present particular challenges (Pratt, Lantz, & Loftin, 2002) and while such complete, adaptable, individualized treatment is advantageous in many respects, by nature it requires some level of specialized professional service. Therefore, there is a considerable demand for individuals that are well-trained and practiced in providing such personalized, behavior analytic, services (Thomson et al., 2012).

A consistent behavior analytic teaching component provided within the vast majority of all early ABA interventions, Discrete Trial Teaching (DTT) has commonly been employed as a highly effective method in instructing and improving target behaviors for children with disabilities (Green, 1996; Lovaas, 1987; Matson & Smith, 2008; Smith, 2001). DTT is a highly efficient instructional method that individualizes teaching (Sarokoff & Sturmey, 2004) for people of all ages and populations (Leaf & McEachin, 1999), although it is most typically employed in EIBI. Specifically, DTT has been
especially useful in facilitating the learning of new behaviors for children with ASD or other developmental disabilities (Sarokoff & Strumey, 2004) and often used to teach receptive language abilities (Sarokoff & Sturmey, 2008), improve social and academic behaviors (Dib & Sturmey, 2007) as well as other various cognitive, communication, play, social, and self-help skills (Leaf & McEachin, 1999; Pratt et al., 2002). As an added benefit, DTT may also synchronously decrease disruptive or interfering student behaviors during teaching situations because it arranges a reinforcer-rich environment that (a) minimizes the aversive aspects of teaching situations to (b) more likely occasion appropriate academic behaviors (Dib & Sturmey, 2007). Interfering behaviors are also less likely to occur as they can be largely incompatible during DTT since teaching trials are delivered and reinforced in rapid succession during a learning session (Carnine, 1976; Thomson et al., 2009).

A DTT session usually consists of deconstructing a behavior or skill down to its specific parts or steps, allowing repeated practice, adding prompts, fading them over trials, and providing reinforcement (Leaf & McEachin, 1999). Whereas a single discrete trial itself is a small 5-20s unit of instruction (Thomson et al., 2009) that consists of one antecedent event, behavior, and consequence as a distinct three term contingency. In which case the event before the emission of the learner’s behavior (antecedent) is usually an instruction or direction of some form delivered by the instructor; commonly referred to as a discriminative stimulus (SD) for the learner. The learner is then expected to make a response (target behavior) and if necessary, prompts are provided to assist the student in emitting the correct behavior which are faded overtime. Contingent upon the emission of desired behavior from the learner, they are delivered reinforcement (consequence) to
conclude a single discrete trial. Whereas when an incorrect response occurs, usually teaching items are removed and the instructor pauses for 1-5s before beginning another trial (Leaf & McEachin, 1999).

In this way each teaching trial in DTT is discrete because after each trial materials are removed and then, again, on every single trial to follow the student is presented with a discriminative stimulus (e.g. a command such as “touch your nose”), is prompted to emit the target response (e.g. their hand is physically guided towards their nose) as necessary, and is presented with a programmed consequence to reinforce the response (e.g. a small edible item or token) (Dib & Sturmey, 2007). EIBI instructors employing DTT are also encouraged to maintain brief 1-5sec inter-trial intervals and systematically reduce prompts across trials until the student can independently engage in the target response when provided only a discriminative stimulus (Dib & Sturmey, 2007; Thomson et al., 2009) for developing independence and more effective learning.

While the learning effects demonstrated using DTT have been significant, provided its intensive nature and the recommended hours per week of EIBI across years of time to garner powerful effects (Green, 1996; Leaf & McEachin, 1999; McEachin et al., 1993; Smith, 2001), there is an especially large need for individuals to employ such services (Thomson et al., 2009; Thomson et al., 2012). Children with special needs receiving EIBI present more unique challenge to educators as each individual may likely need qualitatively different levels of educational and behavioral support (Pratt et al., 2002). Therefore to secure the provision of EIBI services, the demand is not simply for individuals to deliver them, but for well-trained and experienced individuals that can provide proper instruction and ABA appropriately (Thomson et al., 2012). To which
there is a considerably stronger need to develop practical, efficacious training interventions for instructing individuals how to enact behavioral interventions with proficiency (Thomson et al., 2009).

**Treatment Training.** In regard to training individuals to properly provide EIBI and perform DTT, numerous methods have been employed (Arco, 2008; Matson & Smith, 2008; Thomson et al., 2009) though among them Behavior Skills Training (BST) has been demonstrated to be remarkably feasible, acceptable, and effective (Sarakoff & Sturmey, 2008) in teaching parents (Crockett, Fleming, Doepke, & Stevens, 2007; Lafasakis & Sturmey, 2007; Ward-Horner & Sturmey, 2008), instructors, (Dib & Sturmey, 2007; Sarakoff & Sturmey, 2004), and even children with autism (Lerman, Hawkins, Hillman, Sherman, & Nissen, 2015) to deliver DTT. BST programs are comprised by employing the combined use of instructions, modeling, rehearsal, and feedback to teach individuals a wide variety of practical skills (Miltenberger, 2016) ranging from training parents to perform pediatric feeding (Mueller et al., 2003), caregivers to implement guided compliance (Miles & Wilder, 2009), instructors to follow behavior intervention plans (Hogan, Knez, & Kahng, 2015), safety skills such as preventing gun play (Miltenberger et al., 2004) and abductions (Johnson et al., 2005) to children’s social skills (Stewart, Carr, & Leblanc, 2007) and even playing blackjack (Speelman, Whiting, & Dixon, 2015) as only some examples from an infinite number of applications that exist.

The first component of BST, instructions, provide the learner a description of the target behavior (Miltenberger, 2016). Instructions can be presented verbally or in written format, but generally should be clear in describing the exact behaviors the learner will be
expected to emit, chained in their proper sequence, and consider contexts in which the behavior is expected to occur (Miltenberger, 2016). Next in modeling, a learner observes the demonstration of the target behavior(s). Modeling can be either live in which an instructor exhibits the behavior for the learner, symbolic where the correct behavior is displayed in a video (Ryan & Hemmes, 2005), audio (Krumhus & Malott, 1980), or done graphically using images of modeled actions (Miltenberger, 2016). The learner must then attend to the model and it is recommended that the complexity of the model be appropriate to the abilities of the learner, have relevance to them, resemble conditions in which they will be expected to engage in the target behavior, and that attending results in reinforcement for the learner (Miltenberger, 2016).

In rehearsal of BST, the learner is expected to imitate and practice the behaviors previously modeled which should take place in its appropriate context or close approximation, and guarantee the learner’s success (Miltenberger, 2016). Commonly performed in various role-play situations, rehearsal is a pivotal component in BST because it enables an instructor to assess the learner’s behavior so that they may provide feedback as the last component of BST. Feedback then allows the instructor to deliver praise for appropriate behaviors (supportive feedback) and additional instruction for any shortfalls (corrective feedback) in performance (Miltenberger, 2016). It is suggested that feedback be immediately delivered after the behavior (Codding, Feinberg, Dunn, & Pace, 2005; Luke & Alavosius, 2011; Parsons & Reid, 1995), be concise, direct (Green, Rollyson, Passante, & Reid, 2002) and descriptive of all aspects of the behavior as well as identify the correct behaviors to emit when providing corrective feedback (Miltenberger, 2016).
Altogether, the purpose of BST procedures is to train individuals to perform new skills and continue to use them appropriately after training concludes (Miltenberger, 2016). Which in the context of training and maintaining EIBI proficiency, BST has been particularly successful in teaching individuals to implement DTT with fidelity even long after intervention (Crockett et al., 2007; Dib & Sturmey, 2007; Lafasakis & Sturmey, 2007; Sarakoff & Sturmey, 2004). Most notably, Sarakoff & Sturmey (2004) used BST to teach three naive teachers how to implement DTT with a child with autism. The teachers were first provided written instructions composed of a typed list of 10 component steps for delivering DTT. They were then asked to, “Do discrete trial teaching to the best of your ability” to begin their sessions in baseline that concluded after 10 discrete trials and lasted about 5 minutes. Following baseline, BST was provided in which the experimenters reviewed the instructions and each of the 10 steps outlined for DTT with each teacher. Next, teachers were provided a graph of their baseline performance as well as a copy of the previous session’s data sheet that the experimenter examined with them. For rehearsal, the teacher performed three discrete trials with the student without interruption. Afterwards the experimenter provided verbal feedback on the teacher’s rehearsal performance and then modeled three correct discrete trials with the student; specifically addressing components that the teacher previously demonstrated incorrectly (Sarakoff & Sturmey, 2004). Rehearsal and modeling continued as such for 10 minutes to complete training. Afterwards, in post-training sessions, teachers were presented with the same instruction and performed 10 discrete trials with the student.

Sarakoff & Sturmey’s (2004) results revealed rapid and substantial improvements from baseline in correctly implementing discrete trial teaching following BST. The
authors contribute the success of the intervention to their quick BST package, but admit uncertainty as to which component contributed most to the achieved improvement in discrete trial teaching proficiency.

In providing an answer, Ward-Horner & Sturmey (2012) conducted a component analysis to further examine the individual effects of each teaching method that comprises BST. In short, three direct-service staff members were taught how to conduct a Functional Analysis (FA) provided only individual conditions of instructions, modeling, rehearsal, or feedback to analyze their isolated as well as combined effects by presenting intermixed combinations of BST components in later phases. In the first phase of the component analysis by Ward-Horner & Sturmey (2012), the independent effects of BST components were examined then in the second and third phases, the effect of two or three components together, respectively, were analyzed. By employing an alternating treatments design across the training conditions of the experiment, essentially each FA condition was taught under separate training procedures (e.g., modeling, rehearsal, or feedback training), or in various combinations of training procedures (e.g., modeling + feedback).

Following the various intermixing of components of BST, results demonstrated that instructions alone were found to have minimal effects in improving performance and that rehearsal in isolation was never helpful (Ward-Horner & Sturmey, 2012). Modeling and feedback, however, were quite effective at improving FA accuracy. Overall, feedback was found to be most effective as it produced increases in FA fidelity to mastery criteria (90% correct or better) every time it was administered while modeling alone only achieved such effects 50% of the time (Ward-Horner & Sturmey, 2012).
As components within BST, the use modeling and feedback alone have produced substantial performance improvement outcomes as evidenced by a body of literature employing each independently for the purposes of training and maintaining behaviors. Feedback on its own has been examined in terms of Performance Feedback (Fleming & Sulzer-Azaroff, 1989; Arco, 2008) and video modeling has proven to be an efficient, highly cost-effective resource for training a variety skills across many populations with strong treatment integrity (Catania, Almeida, Liu-Constant, & Digennaro-Reed, 2009; Digennaro-Reed, Coddington, Catania, & Maguire, 2010; Vladescu, Carrol, Paden, & Kodak, 2012). Video modeling with voiceover instructions, in particular, has been especially effective in facilitating the learning of discrete trial teaching (Catania et al., 2009; Vladescu et al., 2012).

Video modeling training interventions typically consist of providing participants with instructions and/or other discrete trial materials like picture cards and datasheets in baseline. Then in intervention, participants are shown a video model and expected to imitate the modeled behavior within a short period of time (10-45 minutes) after watching the model (Catania et al., 2009; Vladescu et al., 2012). Participant target behaviors in session are then assessed by the experimenters for accuracy and additional viewings of a model are usually employed for the purposes of supportive and corrective feedback (Catania et al., 2009; Digennaro-Reed et al., 2010; Fazzio, Martin, Arnal, & Yu, 2009; Sarakoff & Sturmey, 2004; Vladescu et al., 2012). Oftentimes though, despite the success of video modeling alone, other measures are necessary for full fidelity. For example, Catania et al. (2009) found verbal, corrective feedback delivery to be vital for one participant that continuously made the same error in session. Similarly, Digennaro-
Reed et al. (2010) found variable performance integrity of DTT when only video modeling was employed, but observed increases to full accuracy once verbal Performance Feedback was provided.

Feedback as an essential piece in behavior change is quite common as it is usually regarded as a highly important variable in maintaining proficient performance after initial training concludes (Parsons & Reid, 1995). As such, it has been studied in its own right as Performance Feedback (Fleming & Sulzer-Azaroff, 1989). Performance Feedback has been especially effective in producing and maintaining behavior change across all kinds of individuals and a limitless variety of behaviors (Arco, 2008) by simply employing verbal and written feedback. In general, Performance Feedback has largely consisted of reviewing an individual’s data of past performance as written feedback while verbal feedback entails delivering supportive feedback for correct behaviors, corrective feedback as necessary per incorrect behaviors, and addressing participant question, comments, or concerns as well (Codding, et al., 2005; Fleming & Sulzer-Azaroff, 1989; Leblanc, Ricciardi, & Luiselli, 2005; Luke & Alavosius, 2011). Supportive feedback then typically consists of delivering labeled praise for specific behaviors such as, “You did very well at…” and then specifying the emitted behavior. In contrast, corrective feedback entails clarifying the context in which a deficit in performance was observed by instructing the correct behavior to perform such as, “Remember to remove materials if the student makes an error” (Leblanc et al., 2005). Altogether as well it is recommended that whenever providing feedback in general, it should be concise, frequent, relevant, direct and delivered immediately contingent upon target behavior (Codding et al., 2005; Green et al., 2002; Luke & Alavosius, 2011; Parsons & Reid, 1995; Miltenberger, 2016).
In terms of feedback’s utility as a singular training method in teaching and increasing the fidelity of DTT, Leblanc et al., (2005) employed an abbreviated Performance Feedback intervention to help three paraprofessional staff members learn to deliver DTT. Training was conducted at a private school for children with special needs in a therapy room that contained two chairs, a table, and discrete trial materials. A training session was approximately 10-15 minutes long and comprised by 10 trials of three programs. In baseline, participants received no training or feedback and were not shown any discrete trial materials, but had been taught the basic principles of behavior analysis as a feature of their preservice training. Immediately following intervention sessions, Performance Feedback was provided for each of the 10 discrete trial instructional steps outlined by the experimenter that participants viewed prior to their first session in intervention.

DTT items consistently demonstrated as proficient (100% correct) in session received supportive feedback in the form of approval and labeled praise that specified and encouraged the correctly demonstrated behavior (Leblanc et al., 2005). Whenever a skill was inconsistently performed or incorrectly emitted, corrective feedback was delivered which involved clarification and verbal direction (Leblanc et al., 2005), such as “Remember to…. next time.” Throughout the entirety of the intervention the trainer never modeled, role-played, or practiced the correct performance of skills for participants, only verbal supportive or corrective feedback was given. Training required approximately 8-10 minutes to implement across 17 sessions and was concluded once each participant demonstrated the discrete trial instruction skills correctly 90% of the time or greater during two sessions (Leblanc et al., 2005). Results revealed that
Performance Feedback alone was sufficiently effective in improving discrete trial fidelity as all three teachers showed rapid increases in accurate performance once they began intervention, judged training as highly acceptable, and maintained their instructional skills after up to 11 weeks without additional feedback (Leblanc et al., 2005).

Though feedback certainly appears a necessary component in training programs (Parsons & Reid, 1995), many studies employing its use have not sought to isolate or experiment with the exact parameters in which it can be delivered. While seemingly not a significant issue, perhaps there is more to learn about the utility of feedback alone particularly in regard to providing it immediately before target behaviors towards designing more adaptable, effective, efficient, and economical training interventions. Research on the parameters of feedback include examining the difference between written and verbal feedback (Sanetti, Luiselli, & Handler, 2007), frequency of feedback (Alavosius & Sulzer-Azaroff, 1990), sources of feedback (Fox & Sulzer-Azaroff, 1990), and other various forms of feedback (Arco, 2008; Arco, 1997; Green et al., 2002), but to the experimenter’s knowledge few studies (Fazzio et al., 2009; Krumhus & Mallot, 1980; Ryan & Hemmes, 2005; Sarakoff & Sturmey, 2004) have employed feedback before the emission of target behavior as an antecedent intervention. Doing so would defy the prototypical procedure of employing feedback usually as an immediate, consequential event following target behavior for the purposes of reinforcement (Krumhus & Malott, 1980), but as Mallot & Whaley (1976) have noted feedback may also have a more discriminative, rather than reinforcing, function.

To investigate, as well as examine verbal feedback alone, Krumhus & Malott (1980) assessed differences in student proficiency of providing social reinforcement
following the delivery of feedback either immediately after the occurrence of target behavior, or immediately before the next opportunity to emit the target behavior.

Sessions in the experiment occurred every day of the week except Friday and feedback was delivered in each. As such, feedback on student performance emitted in session was delayed by 24 hours for students that received feedback immediately before their next session. With such a small “delay to feedback” condition and other limitations of the study (Ward-Horner & Sturmey, 2012), no substantial differences in the temporal arrangement of feedback were observed (Krumhus & Malott, 1980).

Although, such minimal differences observed could suggest the proposition that feedback is best delivered immediately (Codd et al., 2005; Luke & Alavosius, 2011; Parsons & Reid, 1995; Miltenberger, 2016) after a target behavior may be misleading (Krumhus & Mallot, 1980; Ryan & Hemmes, 2005). While it may certainly not necessarily be more effective than delivering feedback as a consequence, the utility to provide feedback as an antecedent without any loss in effectiveness could enable the production of much more efficient, feasible, and flexible treatment packages for training.

Altogether, there exist a multitude of effective methods for training individuals to appropriately apply treatment (Arco, 2008; Matson & Smith, 2008; Thomson et al., 2009). In particular BST, video modeling, and Performance Feedback have been especially effective in improving treatment performance and as such have been employed most commonly. Nonetheless, the effectiveness of all teaching methods continues to be examined as well as the search for uniformity in simplistic, feasible, and efficient treatment training procedures.
Treatment Training Fidelity. Provided the numerous forms of training designed to teach individuals to deliver DTT as well as the variety at which the tasks that comprise DTT are selected, described, taught and given feedback, some form of consistency across the literature is warranted. In an effort to examine such consistencies towards constructing an agreeable DTT task analysis to deliver feedback upon, Thomson et al. (2009) performed a review of the literature in training packages available for teaching DTT. The inclusion criteria entailed that the intervention had to (a) examine the effects of a training package to teach DTT, (b) measure the participant’s ability to accurately deliver DTT before and after training, and (c) must be consistent with the behavioral dimension of ABA (Bear, Wolf, & Risley, 1968; Thomson et al., 2009) in which a literature search using university online library database resources returned a total of 17 publications. While various training packages in terms of self-instruction (Arnal, Fazzio, Martin, Yu, Kielback, & Starke, 2007; Fazzio et al., 2009; Thomson et al., 2012), video modeling (Ryan & Hemmes, 2005), self-monitoring (Belfiore, Fritts, & Herman, 2008), BST (Crockett et al., 2007; Dib & Sturmey, 2007; Lafasakis & Sturmey, 2007; Sarakoff & Sturmey, 2004), and Performance Feedback (Downs, Downs, & Rau, 2008; Leblanc et al., 2005) were all included and found to achieve strong effects, there were considerable discrepancies in the number and descriptions of tasks selected as components of DTT to be trained. A majority of studies employed 15 items or less (Crockett, et al., 2007; Dib & Sturmey, 2007; Lafasakis & Sturmey, 2007; Leblanc et al., 2005; Ryan & Hemmes, 2005; Sarakoff & Sturmey, 2004) while one choose upwards of 20 tasks (Downs et al., 2008) to examine, but all studies were found to have matching components with the Discrete Trials Teaching Evaluation Form (Thomson et al., 2009).
The Discrete Trials Teaching Evaluation Form (DTTEF) was constructed in an effort to standardize DTT fidelity and training after a similar search of the literature for uniformity in DTT task analysis (Babel, Martin, Fazzio, Arnal, & Thomson, 2008; Thomson et al., 2009). It is composed of a 21 component checklist of items (Appendix A) necessary to correctly deliver DTT and has been found to have high face validity, interobserver reliability, concurrent validity, discrimination of quality performance, and social acceptability (Babel et al., 2008; Jeanson et al., 2010; Thomson et al., 2009). Since its development, it has been used in numerous studies and found to be effective in evaluating DTT performance and teaching DTT to various individuals (Jeanson et al., 2010). In particular, employment of the DTTEF was effective in training university students to conduct discrete trials using a self-instruction training package (Arnal et al., 2007; Fazzio et al., 2009). Combined with the delivery of feedback and modeling of errored tasks, Fazzio et al. (2009) were successful in teaching five undergraduate psychology students to perform three DTT tasks (pointing to pictures, matching, and motor imitation) using the DTTEF to set a mastery criteria of 90% correct DTTEF steps with a confederate role-playing a child with autism.

In baseline of Fazzio et al. (2009), participants were given 10 minutes to read one page summaries of directions for teaching a child to perform a specified DTT task and were then asked to perform 12 teaching trials of the task with the confederate learner. Confederate behaviors were scripted and standardized across all sessions which concluded after the completion of 12 trials or 15 minutes of time (Fazzio et al., 2009). In intervention, subjects were asked to review a self-instruction manual built by the experimenters, study its questions, and master their answers. The content of the manual
examined various principles of ABA which was broken down by sections that need be mastered (100% correct) before advancing to another section (Fazzio et al., 2009). After mastering the manual, a participant was asked to deliver 12 discrete trials with a confederate learner again. Performance following the self-instruction manual alone resulted in small increases of correct implementation of DTT from baseline, but only the later phases of feedback and demonstration before a session produced mastery criteria delivery of DTT after an average of 30 minutes of training (Fazzio et al., 2009). In contrast, self-instruction training required an average of 2.2 hours of learning to which Fazzio et al. (2009) again stress the need for more productive, cost-effective training protocols for teaching instructors to apply DTT with proficiency.

In an effort to design more feasible and efficient training procedures, the present study sought to examine the utility of the DTTEF and Performance Feedback in BST by extending several lines of research (Fazzio et al., 2009; Krumhuis & Malott, 1980; Leblanc et al., 2005; Sarakoff & Sturmey, 2004). Most directly with Fazzio et al. (2009), undergraduate students were evaluated with the DTTEF and taught how to perform a DTT task of either pointing to pictures, matching, or motor imitation with confederates, but instead of training by means of self-instruction; BST was employed similar to Sarokoff & Sturmey (2004). In intervention Performance Feedback was provided in the same manner as Leblanc et al. (2005) to train a DTT task to mastery. Following mastery of the task and/or completing seven training sessions, untrained tasks were re-introduced to test for generalization in likeness to Fazzio et al. (2009). To broaden the research on feedback as well as its independent effect as a component of BST, the temporal contiguity of Performance Feedback was manipulated to be delivered either immediately
after a training session concluded, right before the next began, or both and after a session of DTT with the effects of student DTT performance defined and measured by the percentage of total correct DTTEF items demonstrated in session.

Provided the research on BST, modeling, feedback, and the DTTEF, students that received feedback after sessions were expected to learn DTT with efficiency, and that all students would display similar progress to proficiency in performing DTT regardless of the feedback delivery condition employed to train DTT to DTTEF mastery. Although research suggests that immediate feedback as a consequence after the emission of behavior facilitates most effective learning (Codding et al., 2005; Luke & Alavosius, 2011; Miltenberger, 2016), few studies have employed feedback as an antecedent (Krumhus & Malott, 1980; Ryan & Hemmes, 2005) and observed any adverse effects in producing rapid behavior change. As such, the present study attempted to further examine such findings and promote exploration of the discriminative function of feedback by delivering feedback after a substantial delay, but also immediately prior to the next emission of target behavior for select participants.

Method

Participants

The current study took place at James Madison University (JMU), a state university located in Harrisonburg, Virginia consisting of about 21,000 graduate and undergraduate students. Students in an undergraduate Psychology of Learning course at JMU were asked to participate and one graduate student in the Behavior Analysis program served as the confederate student throughout the entirety of the study. Interested students expressed their desire to participate to the lead experimenter by providing their
information to the experimenter. Six female students, ages 20 – 24 years, were selected to partake. Participants were then tentatively scheduled times that they could meet with the experimenter for about 30 minutes over the next couple weeks while the experiment was in progress.

**Materials & Setting**

Prior to beginning the study, interested participants were given a short intake form to complete (Appendix B). The intake form simply asked them for their name, age, gender, student email, their availability, and to rate their level of experience in DTT on a 1-5 likert scale with a score of 1 signifying no experience which increased by increments of 10 hours of experience as scores moved up in scale. Students with more than 30 hours of experience were (a score of 4 or higher) were not included in the current study.

All training was provided in a vacant office room within the Psychology Department at JMU. The room was approximately 6ft x 4ft x 10ft and contained one desk, two chairs, and various materials to teach tasks using DTT. Materials available to participants for performing DTT were six 3 x 3in picture cards (Appendix C) consisting of three matching pairs of images displaying either a dog, balloons, or banana (Fazzio et al., 2009), tokens and a token board for reinforcer delivery (Appendix C) all made with Boardmaker© software, data sheets (Appendix D, E) reproduced in likeness to Fazzio et al. (2009), and a pencil to record data across trials as participants performed DTT. Before performing DTT, participants were given similar instructions as Fazzio et al. (2009) for each of the three tasks (pointing, matching, and imitation; Appendix F, G, H) and the DTTEF decision tree (Appendix A).
Participants then watched a video model that exhibited the three DTT tasks and their corresponding DTTEF steps in several exemplars. The video model was 17:22 minutes in length and contained multiple modeled demonstrations with voiceover instructions (Catania et al., 2009; Vladescu et al, 2012) of how to perform each of the tasks (Appendix I). DTT tasks were modeled in a similar manner as Vladescu et al. (2012) in which each step of the DTTEF was performed once on its own then shown as a chain of responses chunked according to each section of the DTTEF (Appendix A) and ultimately presented all together across several total task exemplars. Examples of errored responses by confederates and the corresponding error correction procedures to employ as well as prompts to deliver and how to fade them across trials were also modeled in the same way. In an effort to produce a practical training video as well as attempt to implicitly train for generalization by demonstrating multiple exemplars (Stokes, 1977), all three DTT tasks to perform in the current study were interchangeably presented across all modeled DTTEF items and sections as well. The video model, as well as all sessions, were recorded using a Panasonic© SDR-H200 (1991) video camera.

At the conclusion of the study, an exit social validity survey (Appendix K) was administered to participants. The survey asked about their enjoyment in partaking in the experiment and the degree at which they felt they benefited from each component of BST according to a 1-5 likert scale with a designated space for participants to freely provide any additional comments. For all likert questions, a score of 1 designated a response of “not beneficial,” or “not enjoyable” for the probe on participant enjoyment, whereas scores above 1 described “minimally beneficial,” “somewhat beneficial,” “very beneficial,” and “most beneficial” or “enjoyable” respectively. Scores were then
assessed by the experimenter to determine the acceptability of intervention and which components participants self-reported as most helpful in learning DTT. Participant enjoyment self-reports of a score of 3 or higher were interpreted as the intervention being acceptable and all other self-report responses were collected by the experimenter then counted, grouped, averaged, and organized into a table (Table 1) across participants for analysis.

Data Collection & Analysis

Student DTT performance was evaluated using an experimenter data sheet (Appendix J) based of the DTTEF (Appendix A). The DTTEF is a 21 item checklist of reliable steps necessary in delivering effective DTT that has been shown to yield strong face validity, concurrent validity, interobserver reliability, measurement fidelity, and social acceptability (Babel et al., 2008; Jeanson et al., 2010; Thomson et al., 2009). The 21 tasks the DTTEF describes were determined after an extensive review of the literature in the various methods for training DTT found them to be most consistent across more than 15 studies (Babel et al., 2008; Thomson et al., 2009). The DTTEF provides a comprehensive task analysis for employing DTT by including components to be performed before (steps 1-5), during (steps 6-10), after a student’s response (steps 11-20) to DTT as well as other elements to include across all trials such as having brief inter-trial intervals (step 13) and fading prompts (step 21). Components are then categorized by specific step groupings to describe steps necessary in starting a task (steps 1-5), managing antecedents (steps 6-10), reinforcing correct responses (steps 11-12), correcting incorrect responses (steps 14-20), and steps to employ across all trials (step 13 & 21). Before beginning a teaching trial for example, some steps included are determining a task,
gathering materials, and selecting reinforcers. To manage antecedents, arranging teaching materials, securing the child’s attention, and presenting the correct instruction are a few provided steps. Correct response steps include praising and presenting a reinforcer whereas incorrect response steps entail a complete error correction procedure that offers blocking the response, removing materials, re-presenting them, prompting, and delivering praise only as steps amongst others like recording child responses.

All data was entered into Microsoft Excel® (2010) in which each participant was organized by their own excel sheet of data. Analyses of participant responses across and within conditions as well as graphical displays of participant data across interventions were carried out using Excel tools. Specifically, the occurrence of correct DTTEF steps for all participants was assessed in terms of the total correct steps out of total DTTEF steps available in session across the phases of the experiment. To determine percentage of correct DTTEF steps emitted, the number of correct steps observed and recorded for a given trial or session was collected and divided against the total number of steps available in session then multiplied by 100%. All averages were achieved by selecting a given set of data (e.g. within a trial, session, condition or components of the DTTEF) and dividing that number across the number of variables selected to examine within the data set.

Individual participant data was displayed graphically using Excel® then inspected for variability, trends, changes in level, and stability of responses across and within conditions with visual analysis to discern intervention effects on participant behavior. Further computational analysis’ were also carried out to determine average measures of participant behavior across sessions and conditions as well as other average measures of DTT performance across conditions of the experiments.
All individual data was then grouped with the data of other participants assigned to similar conditions and compared across participants to assess the effects of the temporal displacement in feedback delivery in intervention (Table 2). Participants were grouped in two ways; by task trained or feedback condition. To analyze the different effects of feedback delivery, participants assigned to the same task were grouped together and compared across their varying feedback conditions. Similarly, participants that shared the same feedback conditions were also grouped to evaluate variance in task performance under similar feedback interventions. Previous measures of total and percent correct of DTTEF steps, were then compared and assessed across participants to examine average effects of feedback delivery across its varying temporal arrangements.

**Interobserver Reliability**

Before assessing IOA, the experimenter and second observer practiced scoring a given participant’s session until at least a 90% agreement was achieved (Fazzio et al., 2009). All sessions of the study were scored by the experimenter while at least 25% of sessions were independently evaluated by the other observer for IOA (Fazzio et al., 2009). Agreements were defined as both the experimenter and the observer scoring a component on the checklist the same way for any given trial, and disagreements were defined as both parties scoring a checklist item differently across trials. Total count IOA revealed that 95% (SD = 4.38) of items were scored as agreements across over 25% of the all the sessions in the current study. This was calculated by counting each observer’s total number of scored items for a given session and then dividing the smaller total number of scored items marked by the larger total number of scored items recorded by either observer.
Procedures

General procedure. DTT tasks to be taught were pointing to pictures, matching, and motor imitation (Fazzio et al., 2009) which were trained in accordance with the components of BST. First, participants were provided three one-page instructions (Fazzio et al., 2009) for each DTT task and watched the video model. Next, they rehearsed each task without any feedback in three baseline sessions with a confederate. Throughout intervention, participants were provided only Performance Feedback on their performance of the last task they rehearsed in baseline which was randomly assigned and counterbalanced across participants before beginning the study.

Performance Feedback was given for a total of four minutes and delivered either immediately after a session, immediately before the next session, or both in which two minutes of feedback was given immediately before and after a session. Following intervention, untrained tasks were re-introduced with the trained task to test for generalization (Fazzio et al., 2009) and maintenance of DTT performance without feedback. Therefore, a within-subject AB design followed by a maintenance & generalization phase was employed to evaluate the conditions in the current study.

Sessions. Across all conditions, sessions concluded after 12 trials or 15 minutes of time with confederate behavior scripted and standardized across participants (Fazzio et al., 2009). Sessions in intervention occurred approximately 56 hours (2.3 days, SD = 1.5) apart on average. Before every session as well, participants were provided a data sheet, a pencil, and other aforementioned DTT materials.

Confederate behavior. Confederates were instructed on which trials to emit correct, incorrect, or omitted responses prior to beginning a session. Similar to the
training provided by Vladescu et al. (2012), the confederate was randomly assigned trials to engage in four correct responses, four incorrect responses, and four non-responses after the instruction across the 12 trials in each session. For correct responses, the script entailed that confederates made no verbal responses and simply pointed to a correct picture, matched a correct item, or imitated the same behavior as the student. Errored responses also had no verbal property and consisted of either emitting a response opposite of the correct responses described (incorrect) or not engaging in a target response after the student’s instruction (non-response) by looking away from the task.

*Error Correction: Incorrect response.* Students were trained to perform the error correction procedure provided in steps 14-20 of the DTTEF from observing the video model. For step 18 (prompting correct response), students were trained follow a most to least errorless correction hierarchy across trials. On the first emitted error in session students to prompt the confederate using errorless learning prompts by re-presenting the materials, placing the correct picture to point to or match directly in front of the confederate, stating the image on the picture while tapping and looking at it, then deliver the instruction again. To prompt the second error in session, students were trained to re-present the materials with the correct picture directly in front of the confederate and to look at and tap it then give the direction. For the third emitted error in session, students were taught to re-present the materials with the target image in front of the confederate. On the fourth and final incorrect error in a session, students were trained simply re-present the materials without any prompts and give the appropriate direction as specified on the student’s datasheet.
Error Correction: Non-response. Whenever a confederate did not make a response after a student’s instruction, they were trained to follow a most to least prompting procedure in which they were to call the confederate’s name to secure their attention first, then physically prompt the student to engage in the task by gently guiding their arm towards the task. Students were to reduce prompts by substituting the full physical prompts into partial physical prompts, then just a tapping or point to the task, and simply representing materials over subsequent errors in a given session for fading.

Intake. Prior to beginning the study, participants were first read aloud the consent form for the current study by the experimenter. Once participants provided written consent to participate, they immediately began BST.

Baseline. All participants were provided with written instructions, the DTTEF decision tree, watched a video model, and then rehearsed DTT in three simulated sessions; one session per each task in the current study.

Instructions. Students were provided with the DTTEF decision tree, instructions for each task, and a data sheet (Appendix D, E). Students were given five minutes to review the instructions and then they were collected back by the experimenter.

Modeling. All participants watched the aforementioned video model consisting of multiple exemplars of the responses they would be expected to perform in session. Participants were allowed to keep the DTTEF decision tree and the datasheet of their first session while watching the video model in order to reference all 21 DTTEF steps as they were demonstrated in the video. After
watching the video model, the DTTEF decision tree was collected by the experimenter.

Rehearsal. Participants sat at a table with a confederate student sitting across from them. On the table were DTT task materials such as a datasheet, pencil, and tokens with a token board as reinforcers. Once the participant was seated, they were told by the experimenter to, “Do discrete trial teaching to the best of your ability” (Sarakoff & Sturmey, 2004) and a rehearsal session began.

Participants rehearsed each of three tasks in three separate rehearsal sessions with the option to take up to 5 minute breaks between them.

When a rehearsal session concluded the experimenter told the student, “Thank you. Nice work, that concludes this session.” If the student had only performed one or two of the tasks, they were given the option of a 5 minute break and then asked to perform another session with another task. At the conclusion of completing all three rehearsal sessions, students in the before condition were thanked for their time and told that they would receive feedback on their performance before the next session. Students in the after as well as before and after conditions, immediately received Performance Feedback for the task they performed in their last rehearsal session that was predetermined by the experimenter to receive feedback in intervention.

Intervention. Sessions in intervention were identical to rehearsal sessions in baseline with the exception that only one session was performed instead of the three in baseline. Performance Feedback was provided for a total of four minutes either before, after, or both before and after every DTT session according to the feedback condition that the participant was assigned. Duration of feedback was determined after trial testing the
length of time needed to provide feedback for all 21 DTTEF task items in which two minutes was found to be most appropriate which allowed for at least 5-7 seconds to provide Performance Feedback each DTTEF item. Since feedback was delivered twice during sessions for the before and after condition, all 21 DTTEF items were also reviewed twice during the four minutes that the only before or after only conditions received feedback. Also, on the very last session of intervention for participants that received feedback after sessions, no feedback was delivered immediately after to control for the number times feedback was delivered in intervention across participants.

Before. Performance Feedback was provided for four minutes prior to beginning a session once the participant was seated at the desk. Immediately after feedback was delivered, the participant was instructed to, “Do discrete trial teaching to the best of your ability” (Sarakoff & Sturmey, 2004) which started a session. Feedback on their performance was withheld until immediately prior to the occurrence of their next session.

After. Once a participant was seated, they were instructed to, “Do discrete trial teaching to the best of your ability” (Sarakoff & Sturmey, 2004) and a session began. Performance Feedback was provided immediately after a session concluded for four minutes. No feedback was provided before any sessions.

Before and After. Performance Feedback was provided for two minutes prior to beginning a session once the participant was seated. Immediately after a session concluded, the participant was instructed to, “Do discrete trial teaching to the best of your ability” (Sarakoff & Sturmey, 2004) which began a session. Immediately at the conclusion of a session, feedback was delivered again for two minutes.
Performance Feedback was provided by the experimenter by reviewing a graphical representation (Appendix J) of the correct DTTEF steps completed by the participant across the trials of a given session and delivering verbal supportive or corrective statements. DTTEF items demonstrated correctly 100% of the time (Leblanc et al., 2005) in session were given supportive comments such as, “When you ______, that was good,” “You were very proficient at________,” or “You’ve done a great job _________.” Whenever DTTEF items were performed at less than 100% accuracy throughout session, corrective phrases consisting of a clarification in deficient performance and a verbal direction (Leblanc et al., 2005) such as “Here we can work on ______,” “Try to work on “_______,” or “When the student makes that kind of error, do ______ next time” were provided. Feedback and graphical information was not provided for any other measures.

**Maintenance & Generalization.** Once students had either completed a total of seven sessions in intervention or reached a mastery criteria of three consecutive sessions at or above 90% correct (191 items) completion of steps in the DTTEF, tasks that were not trained in intervention were re-introduced with the trained task (Fazzio et al., 2009). In these sessions, the sequence of DTT tasks to perform in each session were counterbalanced across participants and participants were asked to perform each of the three tasks in three separate sessions without any feedback delivered; identical to rehearsal sessions in baseline. After three maintenance and generalization sessions (one per each task), the experiment was concluded.
Exit Survey. At the conclusion of the study participants were debriefed, asked to complete a brief exit social validity survey (Appendix K) and thanked for their participation.

Independent Variables and Procedural Integrity

Experimenter feedback & procedures. Checklists containing scripts (Appendix L) were prepared by the experimenter that outlined the tasks to be completed across all sessions of each phase of the experiment. Approximately 90% of all sessions were evaluated (Fazzio et al., 2009) by an observer that monitored the experimenter’s behavior in session with the checklist. Tasks consisted of objectives such as having materials ready for a participant before a session, delivering feedback for the designated time as well as using corrective and supportive statements. The percentage of tasks correctly completed served out of the total number of tasks necessary to perform served as a procedural integrity score for that session. Procedural integrity for the experimenter procedures yielded an average of 97% (SD = 8.1) correctly completed tasks across over 90% of all sessions in the current study.

Confederate Script Behavior. Confederate script evaluation checklists (Appendix M) were created and used to assess the confederate’s adherence in emission of aforementioned script behaviors given their corresponding context for each trial of a session in approximately 30% of sessions for all participants (Fazzio et al, 2009). The percentage of correct confederate responses for a session served as a procedural integrity score. This was calculated by counting the total number of correct confederate behaviors in a given session and dividing it by the total number of trials in session. Confederate script following averaged 98% (SD = 3.46) across over 30% of all sessions.
Dependent Variables and Measurement of DTT Performance

The dependent variables of the current study all assessed the fidelity of student’s DTT performance across sessions under different feedback interventions by examining the total number and percent of correct DTTEF steps implemented per trial of each session across all participants and conditions of the experiment. This was determined in every session by marking a “✓” anytime a DTTEF component was correctly demonstrated based on its description across trials. The average occurrence and average percent of correct DTTEF items across sessions of the experiment were also assessed and examined between and across conditions, feedback interventions, and participants. Other individual measures evaluated consisted of trial pace, acquisition to mastery criteria, prompt fading, mastered DTTEF items and the duration of sessions. Participant changes in level, trend, and variability across trials or sessions were analyzed using Microsoft Excel and visual analysis. Procedural integrity was also assessed with experimenter procedures, confederate script behavior, and interobserver agreement.

Results

Results of the current study (Figure 1) demonstrate that the Behavior Skills Training intervention employed in the current study was highly successful and efficient in teaching university students to perform discrete trial teaching with a confederate student regardless of when they received feedback on their performance in sessions. Across baseline sessions of both tasks, all participants demonstrated an average of 76% ($SD = 9.02$) correct DTTEF items with participants trained on the imitation task performing an average of 72% ($SD = 10.5$) correct DTTEF items and participants trained on pointing performing 81% ($SD = 4.25$) correct DTTEF items on average. Following baseline, all
participants showed rapid increases in proficiency of delivering DTT with a confederate student, many achieving mastery almost immediately, with an average of 93% ($SD = 9.30$) correct DTTEF items across both tasks and all sessions of intervention for all participants.

Participants trained to proficiency on the imitation task emitted 93% correct ($SD = 12.38$) DTTEF items on average across all intervention sessions while participants trained to perform the pointing task demonstrated an average of 94% ($SD = 5.4$) correct. Finally, when feedback was withdrawn to test for maintenance of behaviors after training, all participants performed an average of 96% ($SD = 2.78$) correct DTTEF items as the other tasks from baseline were reintroduced in separate sessions to measure maintenance of DTT proficiency and generalization to untrained DTT tasks. In the final condition, participants trained to teach the pointing task demonstrated 97% ($SD = 1.45$) correct DTTEF items on average while participants that learned to deliver the imitation task achieved an average of 95% ($SD = 3.48$) accuracy in DTTEF steps performed across maintenance sessions.

When examining the average percentage of correct DTTEF items demonstrated in correlation to the type of confederate behavior emitted during trials across sessions in Figure 2, similar results described above are apparent as well. For both tasks, correct confederate responses were demonstrated at a higher overall proficiency across all conditions in comparison to omitted or incorrect confederate responses. When delivering trials that resulted in correct confederate responses, participants assigned to perform the imitation task achieved 93% ($SD = 9.11$) correct DTTEF items on average across all sessions of the experiment in contrast to incorrect or omitted imitative responses which
reached averages of 86% ($SD = 14.88$) and 85% ($SD = 15.88$) correct DTTEF items respectively. With regards to DTTEF task items to perform per the occurrence of each type confederate response though, correct responses required less items to fulfill (errored responses necessitated about 10 more items) which plausibly suggests that trials correlated with confederate correct responses were easier for participants to learn, master, and maintain overtime.

Subsequently, and similar to the imitation results, participants that were trained to deliver pointing DTT tasks implemented an average of 93% ($SD = 4.31$) correct DTTEF items when the confederate emitted correct responses across all sessions whereas incorrect confederate responses resulted in 89% ($SD = 10.12$) correct DTTEF items and 91% ($SD = 9.66$) for omitted responses on average across all sessions. Following baseline sessions, however, all participants performed 94% ($SD = 9.00$) and 94% ($SD = 8.08$) correct DTTEF items for incorrect and omitted confederate responses with 95% ($SD = 6.08$) correct DTTEF items demonstrated when confederate responses were correct across intervention and generalization sessions.

DTTEF components demonstrated at 100% accuracy per presented opportunities by participants within a given session are represented in Figures 3-8 for each participant. In comparing all DTTEF sections and task items against another, again it appears that teaching trials that resulted in correct confederate responses were acquired quickly and maintained with proficiency across all sessions of the study irrespective of when feedback delivery occurred. Specifically, DTTEF task list item 11, “Recording the correct response” of the section, “Providing S’s” was consistently mastered best by all participants across all sessions. In contrast the error correction items, and especially items
of the “Across all trials” section, of the DTTEF appeared to be most challenging for participants to implement reliably with task item 13, “Have brief inter-trial interval (3-5 secs)” least demonstrated at 100% correct over all sessions in particular.

After nearly a single delivery of Performance Feedback alone though, once more similar substantial rapid increases in DTT proficiency are observed in terms of the number of items mastered at 100% accuracy throughout the entirety of a DTT session overtime. During baseline sessions, an average of 13 ($SD = 2.74$) DTTEF tasks items were demonstrated at 100% for all participants of both tasks in any feedback condition. Then while receiving training in intervention, participants increased mastered task items to an average of 18 ($SD = 2.56$) items followed by an average of 19 ($SD = 1.91$) mastered DTTEF items when untrained tasks were reintroduced during maintenance and generalization.

An especially notable outcome of the current study is that no substantial difference in participant DTT behaviors were observed across all sessions on average regardless of which task was trained or whether Performance Feedback was delivered immediately after a session, immediately before a later session, or both. Table 2 provides information pertaining to the average effects of the current study’s training intervention across all feedback conditions to show that minimal differences in learning DTT were observed across participants. Finally, Table 1 presents information regarding the acceptability and social validity of the experiment as well as the approximate durations of time between sessions that occurred for each participant as well.

Results of the current study collectively indicate the Behavior Skills Training invention employed was successful and efficient in effectively teaching undergraduate
students to perform DTT with proficiency. All participants showed similar patterns in behavior towards proficiently delivering DTT across all sessions, tasks, and confederate behaviors, with the exception of participants C-10 and C-20. C-20 consistently performed error corrections the study did not instruct and did not utilize the datasheet to provide or fade the prompts specified. As such, her ability to fade prompts over trials was hampered. After directing her to attend more to the prompts on the datasheet with feedback only proved insufficient in correcting her behavior over several sessions, the experimenter modeled how to deliver and fade prompts as the study intended immediately after her second to last session in intervention. Then, before the following session the experimenter provided only feedback and she perfectly performed prompts as described which maintained across all remaining sessions of the study.

C-10’s first session in intervention is also aberrant in comparison to all other participants. Though this session was approximately 26 hours later and the participant received Performance Feedback immediately before beginning as well as immediately after their last session in baseline, the participant inconsistently utilized the instructor datasheet to present and record trials during baseline sessions which was maintained throughout their first session of intervention. Without properly administering trials as described on the instructor datasheet, trials were presented out of their designated order, error corrections were skipped, and prompts had little systematic qualities. For C-10’s fourth session in particular, a lack of employing error-corrections correctly, sometimes not at all, especially impaired the total of correct DTTEF items that were demonstrated along with the participant re-presenting the same trial over five consecutive times as well as also presenting tasks using an incorrect instruction. Following the delivery of
feedback both immediately after that session and before their next one with specific encouragement to slow down and utilize the datasheet as well, however, participant C-10 showed an exceedingly rapid increase in mastering DTTEF items which was maintained for all remaining sessions.

Limitations. The results of the current study are susceptible to numerous limitations. A significant obstacle that could not be overcome was in controlling for the scheduling of sessions so that they would occur approximately 24 hours apart from each other on average. Combined with the availability of the experimenter, the confederate, and all participants, such control was simply unfeasible. As such, unfortunately only a select few of sessions for some participants ever occurred after 24 hours of time with most sessions occurring approximately 2.3 ($SD = 1.5$) days apart from each other on average across all participants. While a lack of explicit control is undesirable in terms of drawing confident conclusions, such a lengthy average duration of time between sessions appeared to have little effect on every participant’s ability to learn DTT to proficiency which may provide useful information for future research or extensions of the current study.

In terms of experimental control as well, several participants’ sessions in the current study were not highly comparable with the same sessions for other participants. When developing this study, all sessions were controlled so that all trials in a given a session would result in the same confederate responses for all participants across all tasks and feedback conditions. Unfortunately though, the confederate student did not always engage in the appropriate scripted behaviors and participants that did not appropriately utilize the datasheet in DTT sessions were highly susceptible to present trials out of
order, skip over trials, miss error corrections or continuously re-present the same trial, all of which made it difficult to compare them with other participants that presented trails as intended for the study.

Therefore, in order to better measure and compare such situations, DTTEF items were scored out of the percent of opportunities that were present in a session which was completely dependent upon how participants presented trials and the corresponding confederate behaviors that were emitted. The limitation of deriving challenging comparisons caused by participants inconsistently utilizing the datasheet is particularly prominent during baseline sessions for several participants (see Figures 3-8 for “Determining teach task” item). In baseline, participants were especially likely to repeatedly engage in “pro-forma” errors by consistently missing specific DTTEF task items in the same manner over baseline trials as a result of no supportive or corrective feedback especially, being provided. After providing almost only a single session of Performance Feedback though, most participants were successful in discriminating more available opportunities to complete DTTEF items which was evidenced by increases in appropriate datasheet use during sessions and well-represented in the data which consistently shows near immediate effects in DTT proficiency that were maintained throughout the entirety of the study.

The topography in which feedback was delivered during each session it occurred for, however, was somewhat difficult to compare as well during several participant’s first two sessions of intervention. While feedback delivery itself, in terms of reviewing all 21 items of the DTTEF and providing supportive or corrective feedback contingent on participant performance, varied slightly by the length of time used to review each item of
the DTTEF and all 21 items in total combined with minute inconsistencies in the experimenter’s tone, affect, interactions with participants and comments employed to describe rationale or how to correctly perform DTTEF items, spontaneous questions asked by participants were much more difficult to control. Most frequently, participants asked for added clarification about using the datasheet more effectively to correctly present trials as intended for the study or would ask the experimenter to elaborate on how to employ prompts and fade them over trials, but the manner and duration in which these events occurred were inconsistent across participants.

Participants A-10, B-20 and C-20 did not ask any questions, but participants B-10, B-20, and C-10 asked approximately 2 questions in their first two sessions of intervention which were answered by the experimenter within about 1-2 minutes of time. With participant B-10 specifically though, the experimenter spent about 4 minutes of time answering several questions before their first session of intervention. As such, it is unclear whether Performance Feedback or answering the participant’s questions contributed most to their increase in correctly performing DTT as the study intended. Answering trainee questions may be a vital, natural component for effective training interventions, but more research is necessary to determine the effects of answering questions alone in producing behavior change as well as in combination with Performance Feedback. With regard to the present study specifically, future research could reduce the likelihood of questions being presented by participants if sessions are prefaced with a disclaimer that questions will not be answered while feedback is delivered.
In order to control participant responses in terms of providing prompts, the current study instructed participants to present prompts only after errored confederate responses. In this regard, each teaching trial of a session could be understood as a novel “probe” trial in which confederates were always given the opportunity to independently engage in a correct response. If the confederate was unsuccessful in making a correct independent response, participants were then supposed to engage in DTTEF items 14-20 of the “Consequences for Incorrect Responses” section which requires the presentation of prompts to guarantee a correct response. Though a “probe-error-error correction” control procedure as such appeared desirable while designing this study, when actually enacted with participants it revealed a rather awkward, time consuming, and impractical form of discrete trial teaching.

Combined with participants not abiding by the protocol to control for the trials presented in every session, this “probe” procedure as well produced potential measurement artifacts. In short, participants were scored incorrect for items 14-20 in the “Consequences for correct responses” of the DTTEF if prompts were delivered outside of the error correction procedure (because no expected error correction took place). While fairly cumbersome, this protocol ensured more orderly occurrences and measures of error corrections during sessions, therefore the measurement criteria remained in effect for the entirety of the study in order to allow for more comparable information. This is reflected in that data of Figures 1 and 2, but is not represented in Figures 3-8 as that information describes tasks performed 100% correctly per the opportunities presented by participants. Perhaps most importantly in keeping the criteria, is that participants were consistently instructed to perform prompts across trials in such a manner beginning with the
descriptions in the instructions, the behaviors model in video, and while receiving feedback throughout intervention especially.

Four of the six participants actually began by presenting prompts *before* the confederate student could even engage in an errored response when initially attempting DTT. Some did so spontaneously while others learned to expect incorrect responses as a result of consistent confederate errors and would occasionally present prompts before the confederate emitted an error as well, which from a practical standpoint likely represents more relevant and effective teaching procedures for delivering DTT. Instructors that increase a learner’s rate of success by reducing their likelihood of failure are arguably engaging in more effective teaching, therefore mastery criteria could be set so that proficiency in delivering DTT is measured in terms of the least number of error corrections that participants perform in session. Future research can explore other various methods for assessing DTT proficiency that reinforce instructors for “knowing their learner” by employing prompts before a student has an opportunity to engage in a predicted errored response to create training models that better represent especially relevant contexts and teaching conditions.

It is worth noting that this study also instructed participants to perform two separate prompt hierarchies for each type of confederate error. All omitted responses across all three discrete trial tasks employed were meant to follow a most to least physical prompt hierarchy (see Appendix D, E) whereas incorrect confederate responses were supposed to undergo a most to least errorless correction prompt hierarchy across trials of a session. The errorless prompt hierarchy, specifically, entailed several more prompt steps that were presented all at once then faded over trials. In contrast, the
omitted prompt hierarchy was considerably easier to perform as it involved one-step physical prompt directions and simply required an easy motor action of participation. As a result, the errorless prompt hierarchy was considerably harder for participants to perform at mastery. This is also supported by the data from participants that were trained the imitation task throughout intervention.

The imitation task itself has a considerable advantage in ease of application over the other two tasks employed in this study since it required no materials and consisted primarily of basic gross motor behaviors. The matching task in particular involved the most moving parts which also made it much more challenging to deliver trials with brief inter-response time if at all. Given such variance in the difficulty of each task, there may be less confidence that solely the training intervention contributed to any substantial differences observed in DTT performance across the tasks and participants. Furthermore, as most all imitative responses involved basic gross motor movements for both participants and confederates, physical prompts were employed for omitted and incorrect confederate errored responses which also likely adds to the ease in correctly performing DTTEF items for the imitation task across all confederate responses. In contrast, the difficulty in demonstrating the pointing and matching tasks is revealed again in the data for participants trained only on imitation as they generalized back to the untrained tasks of matching and pointing. During these sessions, the errorless prompt hierarchy was never performed entirely correctly or faded properly for all participants trained to perform the imitation task.

As a result, the difficulty involved in performing the errorless prompt hierarchy can also account for the slightly slower progress towards proficiency in correctly
performing and fading prompts as evidenced by the data for participants trained on the pointing task (Figures 6, 7, 8). A typical “error” that most participants across both tasks engaged in when rehearsing the errorless prompt hierarchy was employing both errorless and physical prompts. The most common example involved participants placing a correct item in immediate proximity to the student as an errorless prompt which was then combined with them physically guiding the confederates hand to perform a correct response as well.

Since the study had hoped to control for participants’ prompting so that they would employ explicit prompts specific to each type of confederate error because they were described in the instructions, provided on the datasheet, modeled in video, and were encouraged to be performed as such by the experimenter whenever corrective feedback was delivered, the quality of prompt employment was meant to be measured in terms of the occurrence of corresponding confederate specific prompts across trials. Provided the aforementioned limitations in experimental control as well as the occurrence of participants mixing prompts hierarchies oftentimes across confederate responses, this measurement criteria seemed inappropriate and too strict to measure participant proficiency in DTT. Instead, as long as any form of prompting occurred during an error correction the DTTEF item 10 “present prompts” was scored as “correct” with item 21 of “fading prompts across trials” scored as “correct” as well if the participant faded their level of prompting across trials in a way that was discrete and measurably different than a previous prompt employed for the same type of confederate error. It should be mentioned though, that participants did progressively present prompts as the study originally intended concurrent with delivery of corrective feedback, suggesting at least
that participants will follow corrective directions, potentially independent of what the
direction actually entails so long as performing that direction ultimately results in greater
reinforcement.

Another limitation, or potential strength as well, can be examined in terms of the
total duration of time necessary to complete the study. Overall, the course of the study
required an average of 4:22 minutes (SD = 1:18) of time to complete for all participants
(Table 1). Although this is not necessarily an excessive length of time for the typical
training intervention, many components in the methodology of the current study could
easily be abbreviated and improved in various ways for better efficiency and efficacy.
Outside of baseline and maintenance conditions, which both required a substantial
consecutive duration of time to complete, the video model in particular occupied
approximately 17 minutes of the average total time that was necessary for participants to
finish the study.

While the model was reportedly beneficial in training DTT as indicated by
participant responses on their exit surveys (Table 1) as well as their performance during
baseline sessions, it was questionably repetitive, tedious, and dull. Moreover, after A-10
watched the model, it was revised to include more emphasis on exactly how to correctly
utilize the datasheet in session since A-10 did not immediately do so during baseline
sessions. As a result of the revision, all other participants thereafter demonstrated more
appropriate use of the datasheet in terms of presenting teaching trials with the exception
of C-10 only, which may suggest an issue in their individual attending to video rather
than the quality of descriptions or models provided within the video itself. Nonetheless,
the video model could still benefit from further revision to trim its total duration, reduce
redundant information, and make it more appealing or engaging to better facilitate attending from participants.

Finally, though the results of the current study suggest feedback to be the most prominent factor in producing the observed participant changes in behavior towards DTT proficiency, it is unknown what effects would have been achieved from the use of instructions or modeling alone. The rapid effects and near immediate changes in target behaviors which resulted from the delivery of feedback in this study are bound to the context of a Behavior Skills Training paradigm. The efficacy of feedback delivery to produce behavior change without employing instructions or modeling prior cannot be determined from the methodology of this study; the effects of instructions or modeling alone were not experimentally controlled to make comparisons about their effectiveness. More research on the efficacy of only the delivery of feedback outside of the context of BST is warranted to determine the full utility of feedback and precisely identify how its function serves to contribute to such substantial changes in trained behaviors. Future research should also consider performing parametric analysis’ of BST to gather more evidence for which components are most effective in training target behaviors to continue to pursue the development of more efficient, feasible, and productive training interventions.

**Discussion**

A conclusion that can certainly be drawn from this study is that it further provides evidence for the significance of feedback in its utility to effectively produce rapid behavior change. Of particular interest though, is that the results of this study reveal that feedback itself may primarily serve a more discriminative, rather than reinforcing,
function. Feedback is often encouraged as best delivered immediately after the occurrence of target behavior (Codding et al., 2005; Green et al., 2002; Luke & Alavosius, 2011; Parsons & Reid, 1995; Miltenberger, 2016) in an effort to reinforce target behaviors. In this study however, with little to no difference observed in each participant’s ability to acquire, maintain, and master discrete trial teaching regardless of whether feedback was delivered before, after, or both before and after a session of rehearsing DTT in this study, the data suggest that feedback reinforces target behavior by allowing individuals to better discriminate stimuli, available opportunities, and their own behaviors throughout as well which result in greater reinforcement.

The role of feedback serving a more discriminative function in terms of producing behavior change is demonstrated best by participants in the conditions that received feedback only before DTT sessions in intervention. In these conditions, the strength for feedback to serve its most reinforcing function was unavailable as no feedback was delivered immediately after the occurrence of target behaviors. Instead, when a session of DTT concluded, participants were simply thanked for their participation and were not given any feedback on their performance in that session until immediately before their next DTT session, usually days later. As all participants in this condition displayed improvements in delivering discrete trial teaching with proficiency similar to the participants in the other conditions of this study, combined with the fact that feedback was never delivered immediately after the occurrence of target behaviors, there is evidence that the recommendation of feedback being most effective when delivered immediately after emission of target behavior (Codding et al., 2005; Green et al., 2002; Luke & Alavosius, 2011; Parsons & Reid, 1995; Miltenberger, 2016) may in fact be
misleading. The results of this study suggest instead, that feedback may be best delivered
before the next opportunity to engage in the target behavior.

By delivering feedback on prior performance immediately before giving the
learner an opportunity to rehearse target behaviors, the learner will be more likely to
better discriminate stimuli, opportunities for improvement, and their own behaviors
throughout which ultimately reinforces the occurrence of their desired target behaviors.
This discriminative mechanism of feedback in producing behavior change is especially
evident in attempting to explain the highly successful effects of coaching. In coaching,
feedback is frequent and generally delivered between the emissions of desired target
behaviors. Therefore, feedback is not only provided immediately after the emission of
target behaviors, but perhaps more importantly is delivered immediately before the
learner further engages in the target behaviors. Considering coaching literature, as well
as the already well-established efficacy of delivering feedback after target behaviors
observed in this study and many, the findings of the current study are not to suggest that
feedback ever only be delivered before the occurrence of target behavior, unless perhaps
when employing corrective feedback specifically.

Frequent, contingent, and direct Performance Feedback is a long withstanding
protocol for reinforcing the occurrence of desired learner behaviors which the results of
this study can support, though they better suggest that simply the topography of feedback
delivery may benefit from a bit of refinement. In regards to corrective feedback
especially, there is growing evidence in the literature of Performance Management, to
support that it is best delivered when the learner is provided an opportunity to act upon
the corrective feedback and change their behavior. Therefore by providing corrective
feedback immediately before the learner is given an opportunity to engage in the desired behaviors, it is more likely that the learner will change their behavior which may also further support a discriminative role of feedback. Combined with the results of the current study then, one could hypothesize that the most effective way to deliver feedback would be to provide supportive feedback immediately after the occurrence of target behaviors and primarily only ever deliver corrective feedback immediately before the learner’s next opportunity to engage in the desired behaviors. In doing so, both the discriminative and reinforcing functions of Performance Feedback would be placed in what presumably seems would be their most effective points of delivery.

More research is necessary to confirm such a hypothesis and establish exactly when the delivery of corrective or supportive feedback is most effective per the occurrence of target behaviors. Research on the effectiveness of supportive feedback alone in producing behavior change when delivered either before or after the emission of target behaviors would also further provide evidence for the primary function of feedback within its respective topographies as well. This could even be attempted with interventions such as video modeling since it is especially interesting that modeling specifically addressing missed tasks (Sarakoff & Sturmey, 2004) appeared essential for one participant to master prompt fading, similar to Catania et al. (2009) finding it necessary to provide feedback to a participant in their video modeling intervention.

Sessions in the current study were also 2.3 ($SD = 1.5$) days apart on average, and while no substantial differences were observed in participants’ ability to perform DTT with proficiency, assumedly after certain durations of time, there must exist an indifference point in the efficacy of delivering feedback either immediately after target
behaviors or before the next opportunity to engage in them. Future research could explore this to determine the exact length or point(s) in time that would be more advantageous for a trainer to not give any feedback at all after the emission of target behaviors and wait to only deliver feedback entirely during the next chance to emit them. The results of the current study as well, require further replication across participants and other discrete trial teaching tasks before such strong conclusions and extensions can be drawn.

Though the current study exhibits results of a successful training intervention, aside from aforementioned experimental limitations, there exist many other ways to improve upon the current training model it towards developing more effective trainings interventions. Most notably, discrete trial teaching was demonstrated relatively well by all participants after simply watching the video model. More importantly, the delivery of feedback generally produced near immediate increases to mastery criteria of target behaviors. Taken together, the length of sessions in terms of the number of trials to be presented in each could likely be shortened. This would prove especially beneficial in baseline as participants generally repeatedly performed the same errors since feedback was not provided. Reducing the number of trials to present in every session would not only shorten the total duration of time required to partake in the study, but also eliminate opportunities for excessive failures for participants. To further trim the time necessary for this training as well, perhaps participants need only perform a maximum of four to five sessions of training altogether to then generalize back to the other tasks since many participants in the current study achieved mastery criteria within their first three sessions.
Ultimately, the understanding that feedback may primarily serve a more discriminative role when training target behaviors is likely the most beneficial information to apply towards developing more effective training interventions. In this way, training interventions can be designed in ways that more effectively help learners discriminate available opportunities and their behaviors by enhancing their ability to attend to especially relevant environmental stimuli. Trainer’s should certainly make best efforts to clearly describe and rehearse such relevant stimuli in detail, but in terms of simply providing feedback on desired target behaviors specifically, the results of the current study suggest that feedback is best delivered whenever it would most likely enhance a learner’s ability to discriminate relevant stimuli that will result in reinforcement. While feedback can be delivered in many forms under a variety of methods and although the results of the current study require replication, altogether the information collected suggests that within the context of training behaviors specifically, the delivery of contingent Performance Feedback may generally serve a more discriminative function. It is hypothesized that this function enables highly effective attending to relevant stimuli for a learner to then engage in target behaviors that ultimately result in greater rates of reinforcement, which could be determined from further feedback research revealing similar results in an effort to establish and confirm the primary function of feedback’s utility to produce strong changes in behavior towards developing more efficient and effective training interventions.
Table 1. Information regarding the social validity, efficiency, and experimental control of the study is presented across participants. Social validity measures are displayed above, experimental control in terms of the average time between sessions in represented in the middle, and the average durations of intervention are provided below. Averages all information are presented in the column on the farthest to right. Numerical values in parenthesis specify standard deviations for each average measure provided.

<table>
<thead>
<tr>
<th></th>
<th>A-10</th>
<th>B-10</th>
<th>C-10</th>
<th>A-20</th>
<th>B-20</th>
<th>C-20</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4.0</td>
</tr>
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<td>Instructions</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3.3</td>
</tr>
<tr>
<td>Modeling</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4.7</td>
</tr>
<tr>
<td>Rehearsal</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4.3</td>
</tr>
<tr>
<td>Feedback</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4.7</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Average Days</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Sessions</td>
<td>2.3</td>
<td>1.5</td>
<td>2.2</td>
<td>2.2</td>
<td>2.9</td>
<td>2.8</td>
<td>2.3</td>
</tr>
<tr>
<td>Std. Dev</td>
<td>(2.45)</td>
<td>(0.99)</td>
<td>(1.30)</td>
<td>(1.30)</td>
<td>(1.70)</td>
<td>(1.60)</td>
<td>(1.50)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Session</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Duration (mins)</td>
<td>4:36</td>
<td>3:18</td>
<td>3:30</td>
<td>5:06</td>
<td>5:06</td>
<td>4:36</td>
<td>4:22</td>
</tr>
<tr>
<td>Std. Dev</td>
<td>(1.06)</td>
<td>(0.50)</td>
<td>(1.30)</td>
<td>(1.03)</td>
<td>(1.12)</td>
<td>(0.54)</td>
<td>(1.18)</td>
</tr>
</tbody>
</table>

| Total Duration (mins) | 66 | 55 | 60 | 71 | 71 | 76 | 66.5   |
Table 2. Average intervention effects across participants. Participants trained on the imitation task are represented above and data for pointing participants are below. The feedback condition of each participant is provided in the middle. Numerical values in parenthesis specify standard deviations for each average measure provided.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Feedback Condition</th>
<th>Average DTTEF Completion</th>
<th>Per Confederate Behaviors</th>
<th>Average Proficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Items</td>
<td>Percent Correct</td>
<td>Correct Responses</td>
</tr>
<tr>
<td>Imitation</td>
<td>After</td>
<td>Before</td>
<td>Before &amp; After</td>
<td></td>
</tr>
<tr>
<td>Average DTTEF Completion</td>
<td>184 [4.36]</td>
<td>184 [3.61]</td>
<td>168 [35.20]</td>
<td>96% (2.31)</td>
</tr>
<tr>
<td>Per Confederate Behaviors</td>
<td></td>
<td></td>
<td></td>
<td>96% (2.73)</td>
</tr>
<tr>
<td>Average Proficiency</td>
<td></td>
<td></td>
<td></td>
<td>95% (3.46)</td>
</tr>
<tr>
<td>DTTEF Items Mastered</td>
<td>19 (1.00)</td>
<td>19 [0.58]</td>
<td>17 (5.85)</td>
<td></td>
</tr>
<tr>
<td>DTTEF Sections Mastered</td>
<td>3 (1.00)</td>
<td>3 [3.33]</td>
<td>3 (2.00)</td>
<td></td>
</tr>
<tr>
<td>(3-5 sec) Inter-trial Intervals</td>
<td>10 (1.00)</td>
<td>10 [0.58]</td>
<td>11 (1.26)</td>
<td></td>
</tr>
<tr>
<td>Painting</td>
<td>After</td>
<td>Before</td>
<td>Before &amp; After</td>
<td></td>
</tr>
<tr>
<td>Average DTTEF Completion</td>
<td>183 (2.65)</td>
<td>179 [5.86]</td>
<td>174 (16.10)</td>
<td>96% (1.53)</td>
</tr>
<tr>
<td>Per Confederate Behaviors</td>
<td></td>
<td></td>
<td></td>
<td>94% (1.15)</td>
</tr>
<tr>
<td>Average Proficiency</td>
<td></td>
<td></td>
<td></td>
<td>95% (3.51)</td>
</tr>
<tr>
<td>DTTEF Items Mastered</td>
<td>19 (1.00)</td>
<td>19 [0.58]</td>
<td>19 (0.96)</td>
<td></td>
</tr>
<tr>
<td>DTTEF Sections Mastered</td>
<td>4 [0.58]</td>
<td>4 [0.58]</td>
<td>4 (0.58)</td>
<td></td>
</tr>
<tr>
<td>(3-5 sec) Inter-trial Intervals</td>
<td>5 (1.16)</td>
<td>3 [1.16]</td>
<td>5 (2.50)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1. Percentage of total correct DTTEF items over sessions of time for participants that only received feedback delivery before, after, or before and after rehearsing DTT. Closed circles represent when feedback was delivered. Gray shaded circles denote that feedback was delivered only immediately before a session. Data point shapes signify the teaching tasks presented in session. Circles represent pointing sessions, triangles symbolize matching sessions, and squares signify imitation sessions.
Figure 2. Percentage of correct DTTEF items over sessions of time as they correspond to confederate script behaviors emitted in session. Different data paths represent whether a confederate emitted an incorrect response, a non-response, or a correct response.
Figure 3. DTTEF components correctly demonstrated during 100% of presented opportunities in session over time for participant A-10. Shaded cells denote DTTEF item correctly implemented during all 12 trials within a session. Unshaded cells signify DTTEF items not demonstrated at 100%. A graph displaying the percentage of correct DTTEF items implemented over sessions of time by A-10 is overlaid as well.
Figure 4. DTTEF components correctly demonstrated during 100% of presented opportunities in session over time for participant B-10. Shaded cells denote DTTEF items correctly implemented during all 12 trials within a session. Unshaded cells signify DTTEF items not demonstrated at 100%. A graph displaying the percentage of correct DTTEF items implemented over sessions of time by B-10 is overlaid as well.
Figure 5. DTTEF components correctly demonstrated during 100% of presented opportunities in session over time for participant C-10. Shaded cells denote DTTEF items correctly implemented during all 12 trials within a session. Unshaded cells signify DTTEF items not demonstrated at 100%. A graph displaying the percentage of correct DTTEF items implemented over sessions of time by C-10 is overlaid as well.
Figure 6. DTTEF components correctly demonstrated during 100% of presented opportunities in session over time for participant A-20. Shaded cells denote DTTEF items correctly implemented during all 12 trials within a session. Unshaded cells signify DTTEF items not demonstrated at 100%. A graph displaying the percentage of correct DTTEF items implemented over sessions of time by A-20 is overlaid as well.
Figure 7. DTTEF components correctly demonstrated during 100% of presented opportunities in session over time for participant B-20. Shaded cells denote DTTEF items correctly implemented during all 12 trials within a session. Unshaded cells signify DTTEF items not demonstrated at 100%. A graph displaying the percentage of correct DTTEF items implemented over sessions of time by B-20 is overlaid as well.
**Figure 8.** DTTEF components correctly demonstrated during 100% of presented opportunities in session over time for participant C-20. Shaded cells denote DTTEF items correctly implemented during all 12 trials within a session. Unshaded cells signify DTTEF items not demonstrated at 100%. A graph displaying the percentage of correct DTTEF items implemented over sessions of time by C-20 is overlaid as well.
Appendix A
Appendix B

Intake Questionnaire

Name: ________________  Age: ___  Gender: M / F  Student ID: ___________@dukes.jmu.edu

Participant #: _______

Availability:

Please provide any times before 8pm that you can be available for about 30 minutes.

Su: ______________________________________
M: ______________________________________
T: ______________________________________
W: ______________________________________
Th: _____________________________________
F: ______________________________________
Sa: _____________________________________

Level of Experience in delivering discrete-trial teaching (DTT):

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>10 hours</td>
<td>20 hours</td>
<td>30 hours</td>
<td>40 hours</td>
</tr>
</tbody>
</table>
Appendix C

banana

dog

balloons

Done!  Done!  Done!  Done!  Done!  Done!  Done!  Done!

Done!  Done!  Done!  Done!  Done!  Done!  Done!  Done!
Appendix D

Record ✓ in the appropriate column for each trial

<table>
<thead>
<tr>
<th>Trials</th>
<th>Correct Independent</th>
<th>Error</th>
<th>Correct On Error Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Waving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Waving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Touching Nose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Waving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Clapping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Touching Nose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Clapping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Waving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Clapping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Touching Nose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Touching Nose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Clapping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Across trials, try to teach the "child" to perform all 3 gross motor behaviors when presented the $S^0$, "do this" followed by your modeling of the target behavior.

Prompt Hierarchy for imitation

<table>
<thead>
<tr>
<th>For incorrect responses....</th>
<th>For non-responses....</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Use full physical prompting.</td>
<td>1. Use full physical prompting.</td>
</tr>
<tr>
<td>2. Use partial physical prompting.</td>
<td>2. Use partial physical prompting.</td>
</tr>
<tr>
<td>3. Tap / point to student's hand.</td>
<td>3. Tap / point to student's hand.</td>
</tr>
<tr>
<td>4. Re-present instruction.</td>
<td>4. Re-present $S^0$s.</td>
</tr>
</tbody>
</table>
## Appendix E

Record ✓ in the appropriate column for each trial

<table>
<thead>
<tr>
<th>Trials</th>
<th>Correct Independent</th>
<th>Error</th>
<th>Correct On Error Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Banana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Dog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Dog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Banana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Balloons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Banana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Dog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Balloons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Balloons</td>
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<tr>
<td>10</td>
<td>Balloons</td>
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<td></td>
</tr>
<tr>
<td>11</td>
<td>Banana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Dog</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Across trials, try to teach the "child" to match all 3 pairs of pictures when given a sample picture and the S°, "match."

<table>
<thead>
<tr>
<th>Prompt Hierarchy for Pointing / Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For incorrect responses...</strong></td>
</tr>
<tr>
<td>1. Place the correct picture in front of student, state the image of correct picture, tap and look at the picture, re-present instruction.</td>
</tr>
<tr>
<td>2. Place the correct picture in front of student, tap and look at the picture, re-present instruction.</td>
</tr>
<tr>
<td>3. Place the correct picture in front of student, re-present instruction.</td>
</tr>
<tr>
<td>4. Re-present instruction.</td>
</tr>
</tbody>
</table>
Appendix F

Instructions for Teaching Motor Imitation

- For this task you will role-play a tutor who is attempting to teach a child with autism who has minimal receptive language skills. Do your best at providing what you think would be appropriate instructions, prompts or cues, and consequences while attempting to teach the “child,” based on the guidelines below.

- The objective is to teach this person (who will be role-playing a child with autism) to imitate three distinct motor behaviors. The actions to teach them are:
  - clapping their hands
  - touching their nose
  - waving

- Across trials, try to teach the “child” to perform all three motor actions when presented the $S^D$, “do this” followed by your modeling of the target behavior.

- After each response by the “child,” record on the attached Data Sheet if the “child” responded correctly independently, responded correctly with prompts or cues, or made an error. Place a checkmark like this ✓ in the appropriate column.

Summary of Steps

1. Arrange necessary materials.
2. Decide what you will use as consequences for correct and incorrect responses.
3. On each trial:
   a. Secure the child’s attention.
   b. Present the correct materials.
   c. Present the correct instruction ($S^D$).
   d. Provide whatever extra help (i.e., prompts or cues) you think are necessary for the child to respond correctly.
   e. Once the “child” responds, provide what you consider to be an appropriate feedback or reward for a correct response, or provide an appropriate reaction for an error.
   f. Across trials gradually provide less and less prompts or cues (i.e., fade out the extra prompts).
      i. For incorrect responses...
         1. Use full physical prompting.
         2. Use partial physical prompting.
         3. Tap student’s hand.
         4. Re-present instruction.
      ii. For non-responses...
         1. Use physical guidance.
         2. Tap student’s arm.
         3. Point to task.
         4. Re-present.
   g. Record the results on the data sheet.
Appendix G

Instructions for Teaching Pointing to Pictures

- For this task you will role-play a tutor who is attempting to teach a child with autism who has minimal receptive language skills. Do your best at providing what you think would be appropriate instructions, prompts or cues, and consequences while attempting to teach the “child,” based on the guidelines below.

- There will be three pictures. The objective is to teach this person (who will be role-playing a child with autism) to point to the correct picture after you place the three pictures on the table and ask them to point to one of them. Across trials, try to teach the “child” to point to all 3 pictures when presented the \( S^0 \), “point to...” followed by stating the target picture.

- After each response by the “child,” record on the attached Data Sheet if the “child” responded correctly independently, responded correctly with prompts or cues, or made an error. Place a checkmark like this \( \checkmark \) in the appropriate column.

Summary of Steps

1. Arrange necessary materials.
2. Decide what you will use as consequences for correct and incorrect responses.
3. On each trial:
   a. Secure the child’s attention.
   b. Present the correct materials.
   c. Present the correct instruction (\( S^0 \)).
   d. Provide whatever extra help (i.e., prompts or cues) you think are necessary for the child to respond correctly.
   e. Once the “child” responds, provide what you consider to be an appropriate feedback or reward for a correct response, or provide an appropriate reaction for an error.
   f. Across trials gradually provide less and less prompts or cues (i.e., fade out the extra prompts).
   i. For incorrect responses...
      1. Place the correct picture in front of student, state the image, tap and look at the picture, re-present instruction.
      2. Place the correct picture in front of student, tap and look at the picture, re-present instruction.
      3. Place the correct picture in front of student, look at the picture, re-present instruction.
      4. Place the correct picture in front of student, re-present instruction.
      5. Re-present instruction.
   ii. For non-responses...
      1. Use physical guidance.
      2. Tap student’s arm.
      3. Point to task.
      4. Re-present.
   g. Record the results on the data sheet.
Appendix H

Instructions for Teaching Matching Pictures

- For this task you will role-play a tutor who is attempting to teach a child with autism who has minimal receptive language skills. Do your best at providing what you think would be appropriate instructions, prompts or cues, and consequences while attempting to teach the “child,” based on the guidelines below.

- There will be six pictures with three matching pairs. The objective is to teach this person (who will be role-playing a child with autism) to match one picture with its identical counterpart presented within an array of the three separate pictures on the table. Across trials, try to teach the “child” to match all three pairs of pictures given a sample picture and the S0, “match.”

- After each response by the “child,” record on the attached Data Sheet if the “child” responded correctly independently, responded correctly with prompts or cues, or made an error. Place a checkmark like this ✓ in the appropriate column.

Summary of Steps

1. Arrange necessary materials.
2. Decide what you will use as consequences for correct and incorrect responses.
3. On each trial:
   a. Secure the child’s attention.
   b. Present the correct materials.
   c. Present the correct instruction (S0).
   d. Provide whatever extra help (i.e., prompts or cues) you think are necessary for the child to respond correctly.
   e. Once the “child” responds, provide what you consider to be an appropriate feedback or reward for a correct response, or provide an appropriate reaction for an error.
   f. Across trials gradually provide less and less prompts or cues (i.e., fade out the extra prompts).
   i. For incorrect responses...
      1. Place the correct picture in front of student, state the image, tap and look at the picture, re-present instruction.
      2. Place the correct picture in front of student, tap and look at the picture, re-present instruction.
      3. Place the correct picture in front of student, look at the picture, re-present instruction.
      4. Place the correct picture in front of student, re-present instruction.
      5. Re-present instruction.
   ii. For non-responses...
      1. Use physical guidance.
      2. Tap student’s arm.
      3. Point to task.
      4. Re-present.
   g. Record the results on the data sheet.
Appendix I

Before Starting a Teaching Task

1. Determine teaching task.
   To begin a trial, first the instructor reviews the datasheet to determine which task to present.

2. Gather materials.
   Next, the instructor selects the necessary materials to present for the task.

3. Select effective reinforcer(s).
   Third, the instructor also selects a reinforcer to be readily available for delivery.

4. Determine prompt fading procedure and initial fading step.
   The instructor determines the appropriate prompt fading procedure and initial fading step by reviewing the datasheet which describes prompts to employ and fade over trials.
   Instructors determine the prompts to deliver by recording the prompts they have provided throughout a given session on the designated spot on the datasheet.
   The actual prompts to use as well as fading them across trials will be shown later.

5. Develop rapport/positive mood.
   Throughout every DTT session, the instructor should maintain an enthusiastic tone of voice and demeanor that encourages the learner to succeed to develop rapport.
   Enthusiasm is evidenced by the instructors affect through their facial expressions and vocalizations.
   Smiling and delivering praise with fluctuations in tonation, for example, shows an enthusiastic affect to satisfy maintaining a positive mood/developing rapport in session.

Before Starting a Teaching Task (chunk)

In the next video, all tasks previously described and modeled will demonstrated from start to finish. You may notice that individually DTTEF items do not necessarily occur in consecutive order, though the respective parts of the DTTEF occur sequentially.
During Teaching Trials

6. **Arrange teaching materials.**
   After the instructor has prepared for instruction, the instructor arranges any necessary materials to be readily available for the DTT task they will teach.
   - For Pointing, necessary pictures should be in close proximity to the instructor.
   - For Matching, the three separate pictures, and a matching or "sample" picture, should be in close proximity to the instructor.
   - For Imitation, the instructor should have their hands ready on the desk to quickly perform motor behaviors.

7. **Secure child’s attention.**
   The instructor calls the student’s name, "Tyler or Amanda," to establish ready behavior and secure the child’s attention.
   Ready behavior includes hands on lap or table, looking at the teacher, and shoulders facing the teacher.

8. **Present teaching materials.**
9. **Present correct instruction.**
   After securing the child’s attention, the experimenter presents the learner teaching materials then delivers the correct instruction or "S0." The instructor presents the S0 exactly as stated in the instructions, modeled in video, and provided on the datasheet.
   - For Pointing, the three separate pictures should be presented in front of the learner.
     Then, the instructor presents the S0, "point to..." followed by stating the target picture.
   - For Matching, the three separate pictures should be presented in an array in front of the learner.
     Then, the instructor presents them with the sample picture to match beneath the array and deliver the S0, "match."
   - For Imitation, the instructor should have their hands on the table then present the S0, "do this" and model the target behavior to imitate.

10. **Present prompts.**
    Due to the nature of this study employing a confederate learner with scripted responses, the instructor will only present prompts for incorrect responses that will modeled in later sections.
    However, it is important to note that every trial to present within this study is a "probe."
    This means that prompts are only provided after errored responses.
    For example....

During Teaching Trials (chunk)

In the next video, all tasks previously described and modeled will be demonstrated from start to finish. You may notice that individually DTT items do not necessarily occur in consecutive order, though the respective parts of the DTTF occur sequentially.
Correct Responses

11. **Praise & present additional reinforcer.**
Correct responses will consist of matching or pointing to a correct picture or the learner imitating the behavior modeled. Whenever a correct response occurs, the instructor should provide praise and a token on the student’s token board as an additional reinforcer.

12. **Record correct response.**
*Note after a correct response, the instructor records it by marking a check in the corresponding spot on the data sheet as they occur throughout session.*

Correct Response (chunk)

*In the next video, all tasks previously described and modeled will demonstrated from start to finish. You may notice that individually DTTEF items do not necessarily occur in consecutive order, though the respective parts of the DTTEF occur sequentially.*
Incorrect Responses

There will be two types of incorrect responses that may occur.

Error Responses, consist of matching or pointing to an incorrect picture.
And Omitted Responses, consist of the learner simply looking away from the task.

For any incorrect response, a consistent error correction procedure is employed. Beginning with...

14. Block gently, remove materials, look down (2-3 secs)
Whenever an incorrect response occurs, the instructor attempts to block the learner's error so then removes the materials presented and looks down for about 2-3 seconds.
If the confederate emits no response, however, the instructor should simply remove the materials and look down.
An example of each type response is shown.
Note that for omitted imitations, no materials are removed.
For errored imitations, however, all components of step 14 are demonstrated.

15. Record incorrect response.
Again note, after an incorrect response as well, the instructor records it by marking a check in the corresponding spot on the data sheet as they occur throughout session.

16. Secure child’s attention.
17. Re-present materials.
After recording an errored response by the learner, the instructor calls the student's name to secure their attention and re-presents the same teaching materials of that trial then delivers the correct instruction, or "S^0." Materials should be presented for their corresponding task as they were previously modeled.

18. Re-present instruction & prompts to guarantee correct response.
Specific prompts and how to fade them over trials will be demonstrated later, but examples employing a prompt to guarantee a correct response will be shown.
It is important to note that matching or pointing errors receive errorless prompts and
That all omitted matching or point errors receive physical prompts.
Both types of incorrect imitative responses receive physical prompts as well.
Again, S^0's should be presented as they were previously modeled for their corresponding task.

19. Give praise only.
20. Record error correction.
Whenever an incorrect response is emitted, the instructor only delivers labeled praise as reinforcement and records that an error correction resulted in a correct response by marking a check in the corresponding spot on the data sheet as they occur throughout session.

Incorrect Responses (chunk)

The following video demonstrates only all steps in the incorrect response part of the DTTEF as all items occurring before a response have already been modeled.
Across All Trials

21. **Fade prompts across trials.**

   Across all trials, it is important to fade prompts. In the following videos, error responses are not demonstrated and only prompts are delivered but remember, prompts are only delivered after a probe trial results in an errored response.
   
   - For your reference as well, prompts and their hierarchies are provided on the data sheet.
   - For matching and pointing errors, the error correction follows an errorless learning procedure in which verbal and gestural prompts are removed across trials.
   - Matching and pointing omitted responses are to be physically prompted and the level of physical prompt is reduced over trials to a gestural prompt and re-presentation.
   - For omitted imitative responses, the same physical prompt hierarchy and fading procedure is employed.
   - Similarly, errored imitative responses are also physically prompted in the same manner.

13. **Have brief inter-trial interval (3-5 secs.)**

   To show brief inter-trial interval an example three trials demonstrating all DTTEF items to administer for correct confederate responses is provided.

   The last videos will demonstrate two trial examples of all DTTEF items to administer for each type of incorrect response.

   In sessions, however, trials will presented in a random order.
### Appendix J

#### Before Starting a Teaching Task

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<td>3. Select effective reinforcer(s)</td>
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<td>5. Develop rapport/positive mood</td>
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<td>10. Present prompts</td>
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#### Provide Consequence for Correct Response

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<tr>
<td>11. Praise &amp; present additional reinforcer</td>
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<td>12. Record correct response</td>
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#### Provide Consequence for Incorrect Response

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<td>14. Block gently, remove materials, look down (2-3 secs.)</td>
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<td>18. Re-present instruction &amp; prompts to guarantee correct response</td>
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<td>19. Give praise only</td>
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#### Across All Trials

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<td>21. Fade prompts across trials</td>
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Appendix K

Exit Survey

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Please rate how much you feel you benefitted from each component of training by the following scale:

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<td>Extremely beneficial</td>
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Instructions: 1 2 3 4 5

Modeling: 1 2 3 4 5

Rehearsal: 1 2 3 4 5

Feedback: 1 2 3 4 5

Additional Comments:

_________________________________________________________________
_________________________________________________________________
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Appendix L

Experimenter Script Checklist  Experimenter: ___________  Participant #: _______  Session: _______

____  Materials ready before session.
    ____  Token Board & Tokens
    ____  Instructor Data sheet & Pencil
    ____  Pictures (only for pointing & matching tasks)

Feedback delivered for:
    ____  4 minutes (after or before session)
    ____  2 minutes (before and after session)

____  “Do discrete-trial teaching to the best of your ability”

____  Written and verbal performance feedback was provided.
____  Experimenter used only supportive and corrective statements for feedback.
    ____  Supportive feedback delivered for DTTEF items demonstrated at 100% in session.
    ____  Corrective feedback delivered for DTTEF items demonstrated at less 100% in session.

Supportive Feedback
  • Used labeled praise (specified correct DTTEF item demonstrated)
    • “Very good, you made sure to __________________ across trials”
    • “When you __________________, that was really good”
    • “You were very proficient at __________________”
    • “You’ve done a great job __________________”

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Corrective Feedback
  • Clarified DTTEF item not demonstrated at 100%
  • Provided direction of correct behavior to engage in.
    • “Make sure you __________________ when __________________”
    • “As you can see, you can improve ______________ by ______________”
    • “Try to work on ______________ if ______________”
    • “Remember to ______________ next time”

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Appendix M

Confederate Evaluation Checklist

Confederate: ________________  Participant #: _____  Session: _____

Indicate confederate responses by denoting the trial that they occurred within provided boxes.

For example, a mark of “4” within any box under the non-responses heading would designate the occurrence of a confederate non-response during the 4th trial in session.

Incorrect responses

- No verbal response
- Emitted response opposite of the correct response.
  - Pointed to incorrect picture, selected incorrect item for match, or engaged in different behavior than student modeled.

Non-responses

- No verbal response
- No emission of target response after the student’s instruction
  - Looked away from the task.

Correct response

- No verbal responses
- Emitted correct behavior
  - Pointed to correct picture, matched correct item, or imitated the same behavior as the student.
References


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