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An Efficiency Tactic for Behavioral Skills Training

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An Efficiency Tactic for Behavioral Skills Training

by
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Approval Page

This applied dissertation was submitted by Brian Liu-Constant under the direction of the persons listed below. It was submitted to the Abraham S. Fischler College of Education and School of Criminal Justice and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova Southeastern University.

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Statement of Original Work

I declare the following:

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October 16, 2020

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Abstract

An Efficiency Tactic for Behavioral Skills Training. Brian Liu-Constant, 2020: Applied Dissertation, Nova Southeastern University, Abraham S. Fischler College of Education and School of Criminal Justice. Keywords: applied behavior analysis, efficiency, scripts, role playing.

This applied dissertation was designed to enhance the use of behavioral skills training to teach staff members a discrete trial training (DTT) procedure in a setting with a low trainer-to-staff ratio. Although effective, the rehearsal and feedback components of behavioral skills training can be time consuming and require more time with an expert trainer than the trainer has available.

For the behavioral skills training protocol, the researcher recorded and presented instructions and modeling on video and developed scripts that participants followed during rehearsal and feedback. Each participant was assigned to a group of three. Participants took turns in one of three roles (i.e., teacher-participant, student-participant, or observer-participant) and, when serving in the role of teacher-participant, practiced the DTT procedure with a student-participant while the observer-participant delivered performance feedback to the teacher-participant.

Results indicated that all participants were able to learn the DTT procedure when all feedback was provided by an observer-participant. The procedure was also efficient as evidenced by the expert trainer providing minimal feedback to observer-participants, and participants subsequent to the first participant of each group learning the DTT procedure in less time and with fewer sessions.

Table of Contents

Tables

Figure

Chapter 1: Introduction

Statement of the Problem

Since at least 1970 (McFall & Marston, 1970), the techniques that came to be known as Behavioral Skills Training (BST) resulted in convincing demonstrations of BST used effectively to teach a broad range of skills. However, despite several decades and dozens of studies supporting the efficacy of the training package, practitioners continue to use other less effective techniques such as lecture, likely due to the efficiency of lecture (Saville et al., 2006; Sawyer et al., 2017) as well as the relative inefficiency of BST (Jostad & Miltenberger, 2004; Pollard et al., 2014).

The BST package consists of four elements: instructions, modeling, rehearsal, and feedback (Koegel et al., 1977). Researchers conducting component analyses have evaluated the training elements of BST that are sufficient or necessary for research participants to achieve the mastery criteria of an intervention (LaBrot et al., 2017; Ward-Horner & Sturmey, 2012). The results of component analyses thus far suggest that feedback is the most effective component of BST, but sufficiency and necessity are conclusions best made relative to specific study participants (Geiger et al., 2018; LaBrot et al., 2017; McFall & Marston, 1970; Ward-Horner & Sturmey, 2012).

The feedback provided in BST research and applied work occurs relative to an individual's behavior or set of behaviors. As the number of individuals requiring training increases, the number of behaviors or sets of behaviors requiring feedback increases. As a result, the challenge for individuals with the expertise to supply the necessary feedback also increases (Pollard et al., 2014). In learning environments with few trainers and many participants, one problem is in finding a way to structure the training such that each participant may practice a new skill while receiving appropriate and timely feedback.

This circumstance appears common in professional-development seminars for school teachers (Kirkpatrick et al., 2019). Therefore, it is critical that professional-development trainers for teachers present both effectively and efficiently (Brock et al., 2017; Jostad & Miltenberger, 2004; Karsten et al., 2015; Sawyer et al., 2017).

The Research Problem

Although researchers identify BST as an effective training strategy, especially concerning consistent improvement in treatment fidelity (Brock et al., 2017), the upfront investment to prepare training materials and the training time required to teach all participants receiving this treatment package have made BST impractical or cost-prohibitive for some settings (Karsten et al., 2015; Pollard et al., 2014). One reason for the lengthy training time is that the identified, effective (and possibly necessary for some participants) components (i.e., feedback) of the package (Ward-Horner & Sturmey, 2012) are delivered to one participant at a time. As the number of participants increases, so does the duration of training time (Vanselow & Hanley, 2014). In settings with low trainer-to-staff ratios, or when operating under time-limited training arrangements, trainers have sometimes resorted to less effective or ineffective methods of staff training (Karsten et al., 2015).

Background and Justification

There are a variety of training settings or conditions, such as workshops (Kirkpatrick et al., 2019), institutions of higher learning (Kirkpatrick et al., 2019), and educational facilities with low trainer-to-staff ratios (Karsten et al., 2015), for which trainers describe BST use in simulation or in-situ as inefficient or costly. Effective procedures for training a new skill while decreasing the costs and training time may increase the use of BST (Geiger et al., 2018), especially over other less effective but

commonly used methods, such as lecture (Saville et al., 2006). Vanselow and Hanley (2014) developed a computer program designed to increase the efficiency of BST. In this study, there were three experiments where BST procedures were used with school children to teach them to respond appropriately to various dangerous situations (i.e., abduction, poison, lighter). The experimenters hypothesized that using a computer program would be a relatively easy way to provide instructions, modeling, and individual feedback to large numbers of participants and that one could forego the requirements of ensuring that a trainer could properly employ the BST methods.

Therefore, the program might provide opportunities for participants to emit appropriate responses to various dangers and potentially present a mechanism to overcome some of the efficiency issues inherent in teacher-implemented BST methods, especially regarding conditions when in-situ training was required to follow BST in order to achieve the criterion performance of the study (Vanselow & Hanley, 2014). The experimenters noted that a highly efficient demonstration of BST, as conducted by Carroll-Rowan and Miltenberger (1994), was used to successfully teach abduction prevention to 62 preschool children in 60 minutes. However, the researchers estimated that scaling the training to an average-sized primary school of 446 students for just the BST component, relative to one danger, would take 20 hours of instructional time (Vanselow & Hanley, 2014).

Furthermore, the preparation time and the training time required to learn how to use the Adobe Production Premium Software Suite and ActionScript 3 programming language were not known. The average training time per student participating in Computerized Behavioral Skills Training was less than 20 minutes in the first experiment. In that experiment, only one participant was able to perform the correct

danger responses with Computerized Behavioral Skills Training alone. The rest of the participants required in-situ training in addition to Computerized Behavioral Skills Training. A limitation in Experiment 1 was that the computer could not properly evaluate a child's response to running away from a danger to report to an adult. Therefore, Experiment 2 used human observers to collect those data. Participants in Experiment 2 completed the training in a mean of 20 minutes with minimal interaction required with the experimenter (Vanselow & Hanley, 2014).

Experiment 3 replicated the results of Experiments 1 and 2, and it evaluated the extent to which the protection response would generalize from responses to lighters and poisons to responses to strangers. As in the prior experiments, not all children were able to learn the target skills in the absence of IST, but training time with the experimenter was kept relatively brief. Despite trainers' arguments that BST is not efficient or feasible in specific environments (e.g., workshops), it has been an effective procedure. If it can be made more efficient, then it may be reasonable to adopt in contexts in which practitioners have sometimes opted for less effective procedures. Vanselow and Hanley (2014) demonstrated a viable way to deliver instruction efficiently, in conjunction with in-situ training, and in a way that was more efficient than BST with in-situ training.

Geiger et al. (2018) compared a BST model with a computer-based instruction model to evaluate the effects of the teaching procedures on undergraduates' accuracy implementing an auditory-visual, conditional discrimination, discrete-trial training protocol. The authors included a larger than average sample of 50 participants in their study. In a BST session, the experimenter followed a script to provide correct and incorrect responses to the research participant. The experimenter immediately corrected participant errors. During posttraining probes, experimenters provided participants

feedback if participant performance fell below 85% accuracy. The average participant time in the BST condition was 52 minutes; therefore, the average training time for the expert trainer was also 52 minutes.

In the computer-based instruction condition, where programmed procedures included the presentation of narration, on-screen text, pictures, animation, and some clicking and dragging features presented via computer, the training time was approximately 1 hour. However, the computer-based instruction condition did not effectively provide feedback for some steps performed (e.g., providing prompts, reinforcing correct responses), so it was unsurprising that there were some performance outcomes in favor of BST over computer-based instruction relative to the skills receiving feedback during BST (Geiger et al., 2018). Although computer-based instruction was an effective alternative to BST, to achieve criterion-level performance, participants required feedback from the experimenter during the postfeedback probe. At present, the programming skills and time involved in the development of a computer-based BST model are possible explanations for the relatively few examples of its use.

Deficiencies in the Evidence

Despite its widely recognized effectiveness, reviewers of BST identified critiques of the method, including that it is too time consuming for some settings or situations (Jostad & Miltenberger, 2004; Karsten et al., 2015; Parsons et al., 2013; Pollard et al., 2014); therefore, improving the efficiency of the BST model has been the focus of several studies. A noted limitation of BST research has been the length of time that some training may take. Karsten et al. (2015) evaluated a host of tactics (i.e., video modeling, video-based feedback, self-instruction, and distance training) designed to augment resource-intensive training packages such as BST. Several studies have evaluated novel

ways to deliver the components of BST more efficiently. Instructions have been presented vocally (Beaulieu et al., 2014), textually, or pictorially (Dart et al., 2017).

The method of instructional delivery has been in person (Gianoumis et al., 2012), via video (Lund & Ganz, 2011), or with the aid of computers (Palmen et al., 2010). Modeling of target responses has also been conducted in a manner consistent with instructions demonstrated in person (Parsons et al., 2013), via video (Speelman et al., 2015), or with computers (Pollard et al., 2014). Rehearsal has typically either been performed in an analog setting (Graudins et al., 2012), in situ (Lafasakis & Sturmey, 2007), or both (Johnson et al., 2005). Feedback has been provided in person or via a telehealth model (Sump et al., 2018) but always by an expert trainer or someone who has already demonstrated the skill of delivering the appropriate feedback prior to working with the target participant (Tarasenko et al., 2010).

In some cases, a concession with respect to tactics was made at the outset of the study. In one example, Burke et al. (2010) selected the performance cue system as a backup tactic to be used to train any participant who failed to acquire at least 50% of the required skills by the second session of BST, as the experimenters anticipated that BST could be potentially too time intensive for the needs of the recipients of the training. The performance cue system, which was a proprietary iPhone application arranged to deliver 63 textual cues (e.g., give high five), was required for two of the three participants.

Other research has investigated the use of peer models vis-à-vis pyramidal training. As a strategy to extend the reach of training conducted by an expert trainer, this tactic involves an expert trainer providing training to a subset of personnel within an agency who will, in turn, teach another subset of personnel, and so forth, until all target personnel demonstrated criterion performance (Parsons et al., 2013). Although this

training format might not reduce the total training time for the training participants, one advantage is that it can reduce the time for the senior trainer (Parsons et al., 2013).

However, a disadvantage is that one might not know if the peer trainers are using effective training procedures as the pyramidal training most commonly focusses on the trainer and second-tier staffs' use of the particular behavior-change skills that were the subject of the training (Parsons et al., 2013). In order to evaluate if BST could be used to train staff to use BST to teach other skills in a service agency for people with disabilities, Parsons et al. (2013) used a multiple probe design when evaluating the outcomes of teaching agency staff to use an eight-step BST procedure. All participants learned to use the BST procedures accurately. Additionally, all staff members improved their performance of the target skills that were the subject of the BST procedures.

In order to improve the efficiency of the instructions and modeling components of BST, some researchers have used video presentations for these components (Lund & Ganz, 2011; O'Neill & Rehfeldt, 2017; Roscoe et al., 2008; Speelman et al., 2015). Despite some of the efficiencies gained through the use of video, distance training (Sump et al., 2018), computer-based instruction (O'Neill & Rehfeldt, 2017), pyramidal training (Parsons et al., 2013), and other techniques, none of the BST studies reviewed by this researcher employed simultaneous practice and feedback for more participants than there were trainers. Hence, rehearsal and feedback to each participant added to the training time for whoever served as the trainer.

In other words, except for pyramidal training, each research participant performed a given skill for an expert trainer, who, as a function of how most BST studies were conducted, had to observe the performed skill of that individual and then deliver the appropriate performance feedback. Each participant repeated the rehearsal component,

and feedback repeated by each expert trainer until the criterion performance for a given study was achieved (Pollard et al., 2014). As the number of participants increased, or the number of rehearsal opportunities required to achieve the criterion performance increased, the amount of time committed by the expert trainer also increased, which experimenters and practitioners note as an obstacle to using BST in some settings (Karsten et al., 2015).

An additional obstacle for consideration is that the results of initially successful trainings do not always generalize across time. When, in some studies evaluating BST, the effects have not generalized across time, booster training sessions were occasionally scheduled for the participants (Miller et al., 2014; Ryan et al., 2017). These sessions were typically conducted as additional training time with an expert trainer who would reimplement the BST protocols (Dogan et al., 2017; Jostad & Miltenberger, 2004; Miller et al., 2014; Miltenberger et al., 2004; Ryan et al., 2017; Stocco et al., 2017; Sump et al., 2018). Gaps in the research remain for procedures that have been shown to improve the performances of trainees within a finite training period, which could be used, posttraining, under conditions absent the skilled trainer.

Audience

Trainers who need to teach skills to larger numbers of training participants, or to remediate the performance deficits of those participants, but who have limited time to meet the needs of each participant, may be interested in this line of research. Some of these trainers may be Behavior Analyst Certification Board Advanced Certificate Event providers, inservice training providers, undergraduate and graduate faculty, and others providing trainings on a limited time or training budget. Individuals attending workshops or other trainings, hopeful to gain new skills as a result of participating in the training,

may also benefit from the techniques used in a training with the features included in this study. Finally, students in need of instruction presented consistent with the techniques workshop attendees learn to implement with fidelity may be the ultimate beneficiaries of this study.

Setting of the Study

The setting for the study is a residential educational program for children with severe special needs between the ages of 6 and 21 years. The primary diagnosis of children attending the program is autism. The mean age of students is 15.5 years. The formal training experiences of direct care staff at the agency range from those who have received a high school diploma to those having obtained a graduate degree. The agency has a training department. One responsibility of the training department is to provide a series of workshops to preservice teachers during their orientation to the agency. The training time for orientation is finite (40 hours) and does not increase as the number of preservice teachers enrolled in orientation increases.

Therefore, it is important to ensure that the orientation experience does not degrade when the program enrolls larger groups of preservice teachers into its orientation. The training department also provides workshops to postorientation teachers who need to maintain hours of training compliance or perform a new skill relative to an agency training initiative. As with preservice teachers, full-service teachers will need to complete trainings in given periods of time due to budgetary considerations or due to the need to demonstrate competence relative to a given teaching procedure.

Researcher's Role

The author of the study is the Chief Clinical Officer of the program at which the study was held. The study author is the final authority for selecting topics trained, as well

as the manner with which they are taught. The training topic and methods chosen for this study have been authorized by the author.

Purpose of the Study

The purpose of this study was to evaluate a tactic designed to allow greater numbers of people to be trained using a BST model in a given time period by a small number of trainers. The study was arranged in a concurrent multiple probe design across participants and measured the impact of script use by preservice or full-service teachers on the accuracy of learning trials arranged within a simultaneous, matching-to-sample, discrete-trial training exercise. The method include preservice or full-service teachers following teacher, student, and trainer scripts in role-play scenarios. Scripts and role-plays have been used by research participants in several studies (Martocchio & Rosales, 2016; O'Neill & Rehfeldt, 2017; Palmen et al., 2010; Rosales et al., 2009).

However, in all previous cases (with the exception of pyramidal training after the initial phase of training), it was a skilled trainer that provided the approving or corrective feedback (i.e., reinforcement or punishment) to the target participants. This study was designed so that each participant played each role (i.e., teacher, student, and trainer) in turn. The observer-trainer script was used to prompt the participant to deliver feedback to the participant playing the role of the teacher. The feedback was approving or corrective depending on the responses of the person playing the role of teacher. The teacher-participant needed to adjust feedback responses to the person playing the role of student (i.e., student-participant) who also followed a carefully prepared script for the role-play. Video-recorded instructions and models by this author attempted to further limit the amount of time a skilled trainer (e.g., the experimenter) needed to spend within or across groups of training participants.

Definition of Terms

Researchers (DiGennaro Reed et al., 2018; Leaf et al., 2015; Love et al., 2013) have categorized the common features of the treatment package known as BST and have highly consistent agreement that the components of the package are instructions, modeling, rehearsal, and feedback. A set of guidelines on the use of BST, developed by DiGennaro Reed et al. (2018), included definitions for instructions, modeling, rehearsal, and feedback. Instructions are descriptions of the target behaviors that the trainee would be expected to perform and the conditions under which the responses would be expected. Instructions are most commonly delivered vocally or textually. Modeling involves a demonstration, by a competent performer, of the skills to be learned by the training participant.

Rehearsal is the performance, by the training participant, of the skill that has been described and modeled. Feedback is the delivery of information regarding the earlier rehearsed performance, which is designed to select and promote the target performance (DiGennaro Reed et al., 2018). A more technical description of feedback is the "presentation of and exteroceptive stimulus whose parameters vary as a function of parameters of antecedent responding" (Mangiapanello & Hemmes, 2015, p. 54) and has been suggested for use to aid in developing a better understanding of the conceptual framework that could explain the operant functions of the stimulus conditions. Discrete-trial training (DTT), which also referred to as discrete trial teaching or discrete trial instruction, is a teaching technique involving a stimulus presentation, a learner response, a consequence, and a short intertrial interval (Geiger et al., 2018; Maffei-Almodovar et al., 2017), which is the period between the ending of one learning trial and the start of the next (Geiger et al., 2018; Maffei-Almodovar et al., 2017).

Chapter 2: Literature Review

Behavioral Skills Training

Behavior analysts produced decades of inductive studies resulting in a corpus of work detailing many principles of behavior (Cooper et al., 2007) from which useable behavior change tactics emerged. The BST approach is one such tactic (Raymond, 2000). This type of training is a highly effective treatment package with four components: instructions, modeling, rehearsal, and feedback (DiGennaro Reed et al., 2018; LaBrot et al., 2017; Raymond, 2000). The BST treatment package, as the word package implies, uses a combination of behavior change components that have been studied in isolation and in different combinations. Researchers have discussed the function of the BST components, their sufficiency, and their necessity since early in this line of research, (McFall & Marston, 1970; Ward-Horner & Sturmey, 2012). Each component of BST may vary along different modalities, and across the literature, and each component has had several variations, with the BST package having been used successfully across a wide range of topics and populations.

Research has evaluated the use of different BST tactics for primary recipients of treatment, and in some cases, secondary recipients (i.e., the effects of the primary research participant's tactic-use on the skill development of a secondary, or ultimate, research participant). Researchers used BST effectively across a broad range of populations and as an effective method to teach procedures across a broad range of topics or domains. Researchers have applied BST to several topics, including safety skills (Miltenberger et al., 1999), communication skills (Roscoe et al., 2008), social skills (Hollandsworth et al., 1977), various strategies and tactics relative to applied behavior analysis (Koegel et al., 1977), and DTT (Sarokoff & Sturmey, 2004).

Safety Skills

Regarding addressing various safety skills for children, learning to move away from a source of danger and then reporting that danger to an adult were primary dependent measures across several studies. Research participants learned how to behave in the presence of devices that could start a fire (Houvouras & Harvey, 2014; Vanselow & Hanley, 2014), how to behave in the presence of firearms (Himle & Miltenberger, 2004; Jostad & Miltenberger, 2004; Miltenberger et al., 2004, 2009), and how to react safely to abduction lures (Gunby & Rapp, 2014; Johnson et al., 2005; Ledbetter-Cho et al., 2016; Miltenberger et al., 1999; Tarasenko et al., 2010; Vanselow & Hanley, 2014).

In investigations evaluating teaching children how to behave when lost, Pan-Skadden et al. (2009) taught children between the ages of 4 and 6 years to look left and right. If, after failing to locate a known adult, children in the study then learned to walk quietly to the front of the store and solicit assistance from the cashier, giving the cashier their name as well as the caregiver's name. Initial BST sessions occurred in the children's homes for up to 20 minutes per session. If the child performed the skill correctly in the home, then the caregiver brought the child to a store within a 30-minute drive from the house and conducted an in-situ assessment. If, when alone, the child failed to begin walking toward the cashier within 20 seconds of looking left and right during the in-situ assessment, then the experimenter was called into the store by an assistant. The experimenter then conducted an in-situ training with the child. The training protocol involved using an incentive when BST and in-situ training failed to produce the criterion performance for two of the three participants. After the introduction of the incentive, the participant quickly achieved criterion performance.

Tai and Miltenberger (2017) used BST to teach pee wee football players to avoid

helmet-to-helmet contact while practicing tackling. Investigators enrolled six defensive players from a local Pop Warner football team in a study to teach them a 10-step process of preparing for player-to-player contact, engaging the other player, and completing a tackle that did not include helmet-to-helmet contact. The rehearsal component of the BST sessions involved the use of a tackling dummy. Evaluation of players' performances occurred after 100% of the steps were completed accurately in simulation. All participants substantially decreased tackles with helmet-to-helmet contact (Tai & Miltenberger, 2017).

Behavioral researchers have addressed issues relevant to society-at-large and which are representative of the issues of the times. Between the years of 2000 and 2010, 39% of 84 active shooters entered school buildings (Dickson & Vargo, 2017). Dickson and Vargo (2017) recommended practicing regular lockdown drills to aid in a quick and safe response in the event of an actual emergency with an active shooter (Dickson & Vargo, 2017). In their study, Dickson and Vargo taught 32 kindergarten-aged children with little to no experience with lockdown drills how to stop what they were doing, go quickly to a concealed area, remain quiet, sit in the target location cross-legged, and remain quietly in that location for 5 minutes. The experimenter conducted the BST procedures with the children as a group, across three groups. The experimenter read the directions and, due to the lack of developed literacy skills with this age group, showed pictures representing each of the steps. After rehearsal, the experimenter provided praise or corrective feedback to the group. All three groups showed substantial improvements demonstrating steps of the lockdown procedures. However, making noises that could potentially be detected by an active shooter still occurred above the targeted criterion level.

Himle and Wright (2014) taught adults to safely install different types of passenger safety devices (i.e., front-facing or rear-facing passenger restraint systems) for young children. Accurate completion of the task was arranged as 10 separate steps. Prior to the start of the training, participants received the manufacturer's instruction manual, and evaluation occurred relative to participants' accuracy in completing the installation task. None of the participants were able to install the seat according to the safety specifications used in the study. Additionally, the study used trainers certified as Child Passenger Safety Restraint technicians to conduct the BST training phase. After the BST phase, which used modeling, rehearsal, and feedback, all participants installed the devices without errors.

Finally, Nabeyama and Sturmey (2010) taught staff members six posture and guarding responses to safely support children with various physical impairments that resulted in ambulation issues. With the use of instructions, modeling, guided rehearsal, a checklist for self-recording, and feedback provided by the experimenter, all staff met the criterion performance for correct guarding responses and all the secondary, or ultimate, targets of the intervention, and increased their distance of ambulation up to 10 meters (Nabeyama & Sturmey, 2010).

Communication Skills

Researchers investigating the use of BST to teach communication skills successfully taught a variety of communication skills across different modes of communication. Bingham et al. (2007) taught paraeducators to support students with disabilities to use an assistive and augmentative communication device. The experimenters explained the importance of communication to the participant paraeducators, the relationship between problem behaviors and their communicative

functions, the use of the specific devices, a way in which to prompt students to use the devices, how and when it would be appropriate to evoke a communicative response, and how to self-evaluate their implementation of the protocols. Participants received a treatment package that included a summary of intervention research, a rationale for the importance of communication, and information concerning the use and functions of different alternative and augmentative communication devices.

Also included in the training were modeling and role-play in which participants prompted students. The training length was 3 hours. Finally, participants evaluated video recordings of themselves teaching students to use alternative and augmentative communication devices and scored their own use of the prompting procedures. The participants' scores were compared to those of the experimenter. The criterion for the study was 100% accuracy. Sessions repeated until reaching the criterion performance, which occurred within 1 hour for each participant. All primary participants (i.e., paraeducators) increased prompted responses to alternative and augmentative communication devices from a range of zero to two prompted responses to a mean of nine times per session.

Additionally, the secondary targets of behavior change (i.e., children with autism) had mixed results across the two dependent measures evaluated. Regarding increasing alternative and augmentative communication device use, two of the secondary targets had some increases in use, but one participant did not. Regarding targeted problem behavior, all three participants experienced decreases throughout the study. However, the context for judging decreases was unclear as none of the visual displays provided information regarding the period represented by the sessions. The baseline procedures indicated that the data were collected for 3 hours, across 3 days, for each participant (Bingham et al.,

2007). Therefore, it remains unclear how many hours, in total, were needed to train all three participants in order to meet the criterion performance, and if the performance changes between baseline and treatment represent equivalent units of time. Hence, making judgments about the feasibility of using these BST techniques, with video recordings of staff performance and self-evaluation in training environments with more significant numbers of staff, is difficult.

Special education teachers and speech-language pathologists learned to help students with special needs vocally specify their reinforcers (Nigro-Bruzzi & Sturmey, 2010), and young adults with developmental disabilities were taught vocal and nonvocal conversational skills (Beaulieu et al., 2014; Nuernberger et al., 2013; Ryan et al., 2017). Several studies focused on teaching research participants to use a picture-based system of communication. Lund and Ganz (2011) taught college students, and Roscoe et al. (2008) and Homlitas et al. (2014) taught teachers of children with autism how to implement different preference assessment protocols as well as protocols from the Picture Exchange Communication System curriculum. Studies addressing the first phase of the Picture Exchange Communication System curriculum entailed teaching the staff (i.e., a communicative partner) how to set the occasion for a communication attempt, how a second staff would prompt a communicative response (i.e., release a picture icon into the communicative partner's hand), and how to fade the prompts provided (Homlitas et al., 2014; Rosales et al., 2009).

The second phase involved staff learning to support a student who was learning to walk further distances to the communicative partner as well as increasing distances to the student's communication books (Homlitas et al., 2014; Lund & Ganz, 2011; Martocchio & Rosales, 2016). In Part A of Phase III of the Picture Exchange Communication

System, the staff learned to place two cards in front of a student. One card represented a desired item and the other an undesirable one. The staff demonstrated having the corresponding items present and then providing, to the child, the item that matched whichever picture was handed to the communication partner. A rejection of the item offered by the communication partner resulted in the use of a four-step error correction procedure (Rosales et al., 2009).

Researchers taught staff to accurately implement a natural language paradigm to help children with autism learn to accurately reproduce vocal syllables. Each vocal response contained three syllables (e.g., bubbles, please). Seiverling et al. (2010) taught staff a four-step process for preparing the learning environment as well as a 24-step process for using the natural language paradigm procedure. Rehearsal, feedback, and modeling sequences between the staff and the experimenter occurred in 20-minute sessions. After 20 minutes, the staff conducted a 10-trial assessment with the experimenter playing the role of the child. The training criterion for the study was 90% of natural language paradigm steps implemented correctly for 75% of four assessments. The study demonstrated that natural language paradigm with general case programming was effective for training natural language paradigm and response chaining (Seiverling et al., 2010).

Gianoumis et al. (2012) instructed teachers to implement natural language paradigm protocols with three preschool children diagnosed with autism. The teachers were required to use a multicomponent set of procedures involving conducting a stimulus preference assessment followed by a 14-step task analysis for prompting and shaping appropriate vocalizations while extinguishing inappropriate behavior (Gianoumis et al., 2012). The BST package was efficacious for improving the teachers' use of natural

language paradigm for target students and in the generalization condition. Additionally, four of six children demonstrated improvements in target vocalizations as well as decreases in maladaptive behavior (Gianoumis et al., 2012). The studies above demonstrate BST to be sufficient to develop a communication response in one of the various response modes that had either been nonexistent or been previously insufficiently developed. Additionally, BST has been used to improve not only what to communicate, but under what conditions to use the communication skills across social skills contexts.

Social Skills

Several studies using BST helped individuals to improve communication to suit particular contexts better. Hollandsworth et al. (1977) taught college seniors, in the context of interviews, how to make appropriate eye contact, use appropriate body expression, use good voice volume and speech fluency, as well as express themselves appropriately in an interview. Other researchers used a lag reinforcement schedule, which provided reinforcement contingent upon novel responses, in addition to BST, to promote better responding to interview questions (O'Neill & Rehfeldt, 2017). When the BST sessions alone were insufficient to develop all components addressed in the interview training fully, Stocco et al. (2017) added booster training to address a lack of generalization across time.

Additionally, a reflection component was used as part of the training, and for one participant, self-management was added for smiling while interviewing. The authors noted that adjustment of teaching tactics for specific behaviors and for specific participants within a study is a testament to the power of single-subject analyses within behavior analytic research (Stocco et al., 2017). Other contexts for communication improvements include on-the-job skill development (Burke et al., 2010).

A third context for communication improvement was teaching individuals to relate better to others in one's social peer group. For some individuals, their voice volume, the timing of communication relative to other speakers, movement of facial muscles, imitation of others, proximity to others, and topics of conversation (e.g., sexual explicitness) interfered with successfully forming a social group (Raymond, 2000). Researchers used BST as a model for addressing these types of social behaviors (Hollandsworth et al., 1977).

The fourth context for communication development was in assertiveness training. In an early study that evaluated the effects of different components of BST, McFall and Marston (1970) approached the question by using what they termed a constructive strategy—one in which they selected the most theoretically significant treatment component and then added to it. Prior research on the power of rehearsal and feedback led McFall and Marston to investigate whether rehearsal alone would yield the desired changes in problem behavior and to evaluate the therapeutic importance of feedback. In the study, feedback referred to audio recordings of participant responses played for participants in order to compare their performance to an outline provided. The more common use of the term feedback refers to the supportive or corrective stimulus presentations from an expert trainer that occur between participant performances (Parsons et al., 2013). The automated feedback procedure did not result in statistically significant improvements over the behavioral rehearsal alone condition.

However, due to the behavioral rehearsal with automated feedback condition yielding subject performance that was greater in absolute value as compared to behavioral rehearsal alone, the authors did not make the active claim that feedback did not add additional value (McFall & Marston, 1970). Furthermore, as the study employed

a group design, which necessarily obscures individual performances, the degree to which any single participant's performance improved in any of the conditions is not known.

Various Behavior Analytic Strategies and Tactics

Teaching descriptive antecedent-behavior consequence data collection, teaching the identification of behavioral function from functional assessment, behavior intervention plan, visual analyses, or answering research questions (more sophisticated skill) are skills successfully taught across studies. In another study involving nonbehaviorally trained individuals, researchers evaluated BST as a tactic to teach three oral care providers a set of behavior analytic strategies they could use to increase compliance with the dental procedures, and reduce the need for restraint techniques for their patients with autism (Graudins et al., 2012). Eight children with autism served as the secondary participants, and three oral care providers were the primary participants.

The oral care providers learned a series of behaviors that corresponded to a provided checklist. Participants first reviewed steps in a 45-minute PowerPoint presentation. Additional instruction was given regarding basic behavior analytic techniques used in the study (e.g., positive and negative reinforcement, escape extinction), followed by a 20-minute video depicting the accurate implementation of the oral care checklist, as well as managing problem behavior, followed by role-playing, and finally, feedback concerning the steps correctly or incorrectly performed (Graudins et al., 2012).

After a total training time between 3.5 and 4 hours, all oral care providers were able to accurately use differential reinforcement, escape extinction, and visual prompting techniques. Outcomes for patients with autism were limited, as not all of the children received all of the dental procedures. However, there were some reductions in problem

behavior, as well as gains made in the dental procedures to which the children were exposed and completed (Graudins et al., 2012).

Dogan et al. (2017) taught four parents with no prior formal training in applied behavior analysis to use the BST model to teach their children improved social skills. The experimenter began by telling the parent participants that they were going to learn BST techniques and that they would participate in role-play scenarios for which the experimenter would begin in the role of the teacher and the parent in the role of the child, followed by a role reversal. Parents received a handout on BST steps, and the principal investigator instructed the parents on the correct use of the handout for each of the social skills that were targets of change. In the modeling phase, the principal investigator and two graduate students role-played a training vignette, with the BST steps demonstrated for the parent. The principal investigator then modeled the entire BST sequence for the parent who role-played as the child. Once this was complete, the principal investigator and parent switched roles; the parent was provided novel vignettes and scored on accuracy following the target teaching steps (Dogan et al., 2017).

After the parent met or exceeded 80% proficiency with the teaching steps on three consecutive trials, posttraining began with the target child (Dogan et al., 2017). Training booster sessions (i.e., BST role-plays with the parent as a teacher and primary investigator as a child) would occur if the parent were unable to achieve at least 80% accuracy with the BST steps while working with their child (Dogan et al., 2017). Parents whose performance did not maintain over time despite booster training sessions received another condition involving self-monitoring. In self-monitoring, parents learned to place a checkmark in a corresponding box of the checklist at the point that they correctly completed a given step (Dogan et al., 2017). All participants were able to improve their

performance of using the BST skills shown from a baseline range of 0% to 13% to a mean performance of 84% to 100% across the three participants. The parent requiring the most prolonged training period was able to meet the mastery criteria after three 2-hour training sessions (Dogan et al., 2017).

In evaluating a strategy to help parents address noncompliance in their children, parents learned a 10-step technique for improving compliance. The steps used in the study were to get eye contact with the child before the instruction, say the child's name, provide just one instruction, use clear articulation, use correct phrasing, refrain from instructional repetition, give the child 10 seconds to respond, praise correct performance or correct incorrect performance with a specific prompting strategy, record data, and then wait a minimum period before delivering the next instruction. The experimenters used a training package based on BST, which involved written instructions describing the 10 target components of the procedure, a review of the graphed baseline performance of the parents, in situ rehearsal of the guided compliance procedure for three uninterrupted consecutive trials, and feedback from the experimenter that included praise for correct performance and modeling with emphasis for incorrectly performed steps. The mean duration of training sessions was just under 1 hour across participants. Posttraining completion criteria were set at 100% correct for three consecutive five-trial sessions. All participants met the training criteria (Miles & Wilder, 2009).

Generalization of BST

Despite BST protocols resulting in research participants achieving the target criterion in a given study, the mastery criterion may have been insufficient to produce lasting change (i.e., generalization across time), and the BST protocol needed to be reimplemented to remediate the performance deficits of the training participants (Dogan

et al., 2017; Jostad & Miltenberger, 2004; Miller et al., 2014; Miltenberger et al., 2004; Ryan et al., 2017; Stocco et al., 2017; Sump et al., 2018). In a study conducted to extend previous research on the use of booster training, three female teachers received training within 12 months prior to the testing of skills to check for maintenance also received booster training. The skills evaluated for this study were packaged into a program titled "Tools for Positive Behavior Change" (Miller et al., 2014) and involved five skills based on basic skills of applied behavior analysis. The skills of the program included staying close to the child, using reinforcement, pivoting, redirecting student behavior before using reinforcement, and ignoring behavior that was undesirable, but not harmful. Eight teachers received initial training during 15 hours of training and assessment that occurred across five 3-hour sessions in a week.

The only difference between booster training and prebooster BST was the focus of the training. Specifically, booster training focused on those steps on which a particular participant made errors (Miller et al., 2014). The results of the study, evaluated across both simulated BST and in situ conditions, showed that all three participants were able to again achieve the criterion performance of the study with booster sessions, except for one participant in the simulated BST condition (Miller et al., 2014).

In an evaluation of simulated and in-situ training with adults on the autism spectrum in the workplace, staff members learned specific job-training skills in the context of behavioral skills training. Staff received a 2-hour group training followed by six individual 10-minute feedback sessions for each skill taught (Palmen et al., 2010). Task analyses that described the target skills expected of the adults with autism were reviewed, and staff members stated examples of target behavior criteria. Staff then watched videos of confederate staff and adults with autism and were asked to evaluate the

videos using a provided checklist. Following the video models, staff engaged in role plays in which two staff alternated between the roles of staff and adults receiving support services.

As the role-plays progressed, the experimenter provided feedback to the person in the staff role. If there were any errors, then the experimenter modeled the correct behavior and had the two staff members repeat the role-play scenario (Palmen et al., 2010). Low to moderate improvements were achieved on the three dependent measures of providing reinforcement, providing error corrections, and staff initiation. There remained many missed opportunities to deliver reinforcement, and none of the staff met the performance criteria of the study. The authors speculated that some of the staffs' beliefs about what they called the artificial nature of delivering reinforcement might have acted as a setting condition that worked against the training (Palmen et al., 2010). Secondary target individuals (i.e., adults on the autism spectrum) showed some improvement in asking questions.

In a study composed of two experiments analyzing components of BST to determine components most closely associated with behavior change, LaBrot et al. (2017) taught eight pairs (i.e., parents and children) of participants to use Effective Instructional Delivery. In the study, expert trainers implemented a BST package of instructions, modeling, rehearsal, and feedback, to novice participants (i.e., parents) in order to teach them to effectively and accurately gain eye contact before delivering instructions, provide praise for eye contact, phrase instructions as statements, deliver instructions in close proximity to the target child, use descriptive instructions, and give an appropriate latency period (i.e., 5 to 10 seconds) prior to delivering feedback (LaBrot et al., 2017).

The study employed a component analysis to attempt to determine sufficient or necessary components of the BST package. The authors used a non-concurrent multiple baseline design across participants, and the conditions were randomly introduced in additive fashion (LaBrot et al., 2017). The specific design used was an A / B / B + C / B + C + D / B + C + D + E, for which A was baseline and B, C, D, and E were different components of behavioral skills training (LaBrot et al., 2017). The instructions phase for this study involved providing a brief rationale for using EID, listing the seven components with examples, and two examples of correct use of the technique (LaBrot et al., 2017).

In the rehearsal phase, parents delivered two commands to an experimenter. In the modeling phase, the experimenter modeled Effective Instructional Delivery with a child. The feedback component involved the experimenter asking the parents to deliver instruction to their child, provide praise for each element of Effective Instructional Delivery performed correctly, and a description of the incorrect performance, followed by repeating the rationale for the importance of using the component. The BST components for Participants 1 and 5 were sequenced in the order of instruction, rehearsal, feedback, and modeling; for Participants 2 and 6, it was modeling, feedback, instruction, and rehearsal; for Participants 3 and 7, it was modeling, instruction, rehearsal, and feedback; for Participants 4 and 8, it was feedback, rehearsal, modeling, and instruction.

Although all participants in Experiment 1 improved after baseline, five of the eight participants had the most significant mean increase in performance when exposed to the feedback phase (LaBrot et al., 2017). However, it was not until participants (seven of eight) entered the final condition, regardless of the order of conditions, that participant performances reached their most accurate and stable levels. As there were additional

improvements as conditions continued, performance changes may also be a function of the cumulative effects of the entire treatment package. Thus, a second experiment evaluated the extent to which instructions, modeling, and rehearsal contributed to the noted outcomes (LaBrot et al., 2017).

In the second experiment, researchers introduced the final phase such that irrespective of the sequencing of the prior three phases, Phase 4 was the feedback component. Three parents, and three children without a clinical diagnosis, served as participants for the study. A concurrent multiple baseline design was used with the conditions of baseline, instruction, rehearsal, modeling, and feedback arranged in random order, but always with baseline first and feedback last. All other procedures were identical to those used in the first experiment. The results of the second experiment more clearly demonstrated the necessity of feedback for some participants, as well as its sufficiency for other participants with respect to achieving the criterion performance of the study (LaBrot et al., 2017).

Discrete Trial Training and BST

The DTT approach has been a targeted technique of at least 12 studies using BST. In one study with three teachers and one 3-year-old child with autism, Sarokoff and Sturmey (2004) used BST in a multiple baseline across participants design to evaluate teachers' performance on the correct use of 10 components of a DTT procedure. Sessions were 10 trials and lasted approximately 5 minutes each. The BST procedures entailed a review of a written copy of the teaching procedures, and a review of baseline performance displayed graphically. Rehearsal involved the teacher performing three uninterrupted trials and receiving feedback following the performance. For the three learning trials, the experimenter modeled correct performance for the student. The

teacher and the experimenter each alternated three learning trials with the student until 10 minutes had elapsed. All three teachers were able to perform the 10 components of the DTT procedure with a high degree of accuracy after BST delivered by the experimenter (Sarokoff & Sturmey, 2004).

Lafasakis and Sturmey (2007) evaluated a protocol to train three parents to teach their children gross motor imitation and vocal imitation. The parents successfully learned a discrete trial training format taught in the context of BST. Posttraining sessions were approximately 5 minutes per session, and graphic displays illustrated that, across the three participants, there were 24 posttraining sessions (i.e., 2 hours).

In an experiment that investigated teaching five staff members to implement a matching-to-sample arrangement of a discrete trial training task comprised of 10 components, conditions were arranged in a multiple baseline across participants (Sarokoff & Sturmey, 2008). However, the training data were reported as probes. The procedures used were the same as Sarokoff and Sturmey (2004). All staffs were able to accurately teach the target skill as well as a similar generalization skill. In addition to the students learning the targeted relations of the discrete trial training program, their problem behaviors also improved (Sarokoff & Sturmey, 2008).

Downs et al. (2008) evaluated BST in the context of what they termed a typical inservice training. The training spanned 8 hours and covered the topic of DTT. Six undergraduate students served as participants. The conditions of the experiment were arranged in a multiple-baseline-across-participants design. The training entailed a didactic component, live demonstrations of correct and incorrect performances, and rehearsal opportunities with corrective feedback. During the 8-hour training, each participant received two 30-minute opportunities to run complete DTT sessions. The

results of the 8-hour training were teaching performances that ranged between 60% and 80% across the six participants. When oral corrective and reinforcing feedback was provided during the DTT sessions, as well as summary feedback and ratings provided at the end of a work shift, all participants' performances rose above the 90% performance criterion for the study (Downs et al., 2008).

In an evaluation of BST procedures and general case programming, researchers were able to teach parents to correctly implement 10 components of DTT while exposing the parents to a range of possible child responses that were likely to occur during DTT sessions (Ward-Horner & Sturmey, 2008). This study delivered the training package as conducted in Sarokoff and Sturmey (2004), except for modeling and rehearsal. The experimenter provided positive or corrective feedback for the performances that occurred on three rehearsal trials. The experimenter also modeled the correct implementation of any components performed incorrectly by the parent by having the parent simulate the child's behavior that should have been responded to differently (Ward-Horner & Sturmey, 2008).

The performances of all three participants improved in the training and generalization conditions within four sessions for each participant. However, at about the 63rd session (composed of baseline, training, and posttraining), retraining was applied to one participant whose performance in posttraining was on a decreasing trend. There was an immediate level increase in performance that maintained after re-training sessions ended. Additional dependent measures in the study were children's number of correct responses per session and the percentage of intervals of maladaptive behavior. Only one of three children showed a performance change in either of those measures (Ward-Horner & Sturmey, 2008).

Due to the time-intensive nature of some BST research, a comparison study evaluated computer-based BST and noncomputer-based BST with six direct care staff for adults attending a day program. The participants were randomly assigned to the two simulated conditions, resulting in three participants in each (Nosik et al., 2013). The dependent measures were accuracy with the discrete trial training steps with a research assistant in a simulated environment and with a client in the natural environment (Nosik et al., 2013). The computer-based training package included the BST elements of instructions, modeling, and feedback, but instead of rehearsal opportunities, there were knowledge comprehension measures. It was a self-paced condition that took the participants between 34 and 42 minutes to complete. In the BST training condition, participants were exposed to instructions, modeling, rehearsal, and general feedback in the form of merely reading the checklist items that were performed incorrectly.

To meet the criterion of 90% or better during rehearsal on three consecutive performances, it took participants between 68 and 92 minutes in the BST condition. Both conditions led to participants running the DTT procedures accurately. The computer-based condition took a third of the time of the BST condition. Treatment integrity for both the BST and computer-based condition had an initial decrease in the natural environment, before reaching the performance criterion of the study. Researchers could not evaluate the treatment integrity effects on the secondary target (i.e., a student with autism) as one of the limitations of the study was that there were no performance data reported for the condition involving the individual with autism (Nosik et al., 2013).

In a study with three experiments, one of which investigated BST to teach DTT skills to bachelor's level instructors, Fetherston and Sturmey (2014) introduced the independent variables in a multiple probe design across participants and evaluated their

effects on three dependent measures: percentage correct use of teaching components by instructors, percentage of correct responses by learners, and percentage of intervals scored for disruptive behavior by learners. Criterion performance for the instructors was set at 90% accuracy for three consecutive sessions. All participants met the performance criterion after the introduction of the BST protocol. Two participants' training time was 30 minutes each, and the training time of two other participants was 40 minutes each, for a total of 2 hours and 20 minutes to train all four participants (Fetherston & Sturmey, 2014). In the experimenter's agency, with over 200 staff employed, a similar training rate to that of Fetherston and Sturmey would take an estimated 133 hours (i.e., 3-1/3 work weeks) to train the staff, similarly.

In another effort to increase the efficiency and reduce the training time required when using BST, an interactive computer training program was evaluated using a concurrent multiple baseline design across participants in order to teach four undergraduate students to accurately implement a DTT protocol (Pollard et al., 2014). Before assessing the skill of children with autism, the experimenters assessed the skill in role-play scenarios with an adult. The experimenter created an interactive computer program using Adobe Captiva 5.5 and then converted the program to a Shock Wave flash video format before being loaded onto an online course-management system called Instructure Canvas (Pollard et al., 2014). An element of the computer program included self-guided practice, in which, prior to the start of a training module, participants were prompted to engage in perceptual behavior (Catania, 1998) of imagining teaching a student, managing materials, delivering instructions, and collecting data (Pollard et al., 2014).

No feedback or other contingencies were in place for this perceptual task. Each

module had pretests and posttests comprised of 10 questions. During role-plays, one experimenter played the role of the student and followed a script that had, across 20 trials, 13 planned correct responses, five planned incorrect responses, and two planned no responses. The role-plays were evaluative, except for one 10-minute session with one participant whose performance did not maintain. The four modules of the computer program: data collection and program overview, managing antecedents, prompting strategies, and managing consequences, took an average of 115 minutes to complete (Pollard et al., 2014). One participant withdrew from the study during baseline due to the time commitment of three to five times per week for 4 to 6 weeks (Pollard et al., 2014). While the performances of all participants increased after interactive computerized training commenced, it is unclear to what extent the role-plays with adults may have contributed to the overall performance with the students (Pollard et al., 2014).

In an evaluation of didactic versus BST with high school students, Dart et al. (2017) sought to train the high school students to be peer-interventionists for their classmates with autism, by teaching them to implement a discrete trial training protocol. The procedures were evaluated within a concurrent multiple baseline across participants design and took two 30-minute sessions over 2 days to complete. The DTT protocol consisted of nine steps, which included clearing extraneous materials, keeping reinforcers out of reach of the target student, attempting to gain the student's attention, presenting the target stimuli and instruction, providing a verbal prompt if the student did not respond, using a model or gestural prompt if the verbal prompt was insufficient in evoking a response, providing a hand-over-hand prompt if the modeling prompt was insufficient, providing the prescribed consequence, and recording data and providing 3 to 5 seconds before delivering the next instruction. After achieving the established criterion level in

the BST sessions, the study participant worked with their target student, though the experimenters did not report those data. Before BST implementation and exposure only to the didactic condition, no participants met the criterion performance. After BST implementation, all participants met the target criterion of executing a correct component for 80% of opportunities (Dart et al., 2017).

Through videoconferencing, specialists can provide training, consultation, and other services to clients at a distance and in real-time (Fischer et al., 2016), which may open up some efficiencies in training. In a study evaluating the efficacy and efficiency of telehealth and in-person training of discrete trial training, seven undergraduate students were exposed to study conditions arranged as a "multiple baseline across skills with elements of a multiple probe and delayed multiple baseline combined with an alternating treatments design" (Sump et al., 2018, p. 466). The BST package was evaluated in teaching participants to implement a multiple stimulus without replacement preference assessment, arranging an instructional context, implementing antecedent prompts, delivering consequences for both accurate and inaccurate responding. Training and booster training conditions lasted a maximum of 30 minutes or until the participant implemented a target skill with 100% accuracy across three consecutive trials within a session. Booster training was identical to the BST condition, and was only conducted if a participant's performance fell below 90% on any given target during the posttraining and maintenance phases. Both conditions were nearly equally effective and efficient across dependent measures, which may allow for a telehealth model having advantages for some situations (Sump et al., 2018).

In a comparison study evaluating the efficacy and efficiency of computer-based instruction and BST, experimenters randomly assigned 50 participants to one of the two

conditions. They were instructed on how to perform an auditory-visual conditional discrimination training (Geiger et al., 2018). The computer-based instruction condition included instructions, modeling, rehearsal for some lessons, and quizzes that required 100% accuracy for continuation with new lessons. If the participant scored less than 100%, then they were required to view the lesson again before retaking the quiz. At the program's conclusion, there was a cumulative quiz with a requirement of 90% accuracy for completion of the condition. In the BST condition, the experimenter delivered live, interactive, and individual sessions. Each session of DTT lasted for 12 trials. If an error occurred, then the experimenter immediately interrupted the trial with feedback before allowing the participant to continue. The preparation time for the computer-based instruction condition was 142 hours.

The mean duration of learner time in the computer-based instruction condition was 59.32 minutes. The preparation time for the BST condition was 89 hours. The mean duration of learner time in the BST condition was 51.8 minutes. The performance of the BST group was better than the performance of the computer-based instruction group. The study authors attributed the performance outcomes to differences in the lack of rehearsal of some components in the computer-based instruction condition (Geiger et al., 2018). The performances of participants in the computer-based instruction group reached the criterion level after receiving experimenter feedback during the postfeedback probe. This outcome suggests the possible necessity of rehearsal with feedback (Geiger et al., 2018). While not reported, the mean learner time in BST of 51.8 minutes for 25 participants is approximately 21.5 hours of training with a skilled trainer.

In a study that evaluated a BST protocol concerning three paraprofessionals' acquisition of a 10-step DTT sequence, the experimenters arranged conditions in a

nonconcurrent multiple-baseline-across-subjects design. Participants received a graph of their prior performances, a list of the 10 components of the DTT protocol, five discrete trials with a student modeled by the experimenter, five rehearsal opportunities, and feedback provided immediately after the five trials were complete (Clayton & Headley, 2019). While training data were not reported, posttraining data indicated that all participants met the study criterion of three consecutive sessions at 90% accuracy and that the 1-month probe after posttraining was also at 90% or better for all three participants (Clayton & Headley, 2019).

Theoretical Framework

Fundamentally, the current study and its components were premised on a theory of learning related to operant behavior and its conditioning. Learning is a change in behavior due to experience (Chance, 1988). Ontogenetic mechanisms, in relation to phylogenetic mechanisms, have given rise to a well-studied learning process within the field of Applied Behavior Analysis known as operant conditioning (Cooper et al., 2007). The concepts and principles of Applied Behavior Analysis arose out of findings vis-à-vis inductive research (Chiesa, 1994).

Findings included that some stimulus conditions arranged as consequences (i.e., events that follow) to behavior have selective effects relative to future behavior (Austin & Carr, 2000). Other stimulus conditions (e.g., discriminative stimuli) have evocative effects. The inductive methodology of behavior analytic science evaluates stimulus conditions relative to behavior, gives prominence to data rather than to theory, and reasons from specific instances to general laws (Chiesa, 1994).

State of Knowledge

Researchers have addressed at least 25 different teaching practices with BST

(Brock et al., 2017). Studies have demonstrated the efficacy of BST across a vast population (e.g., preservice teachers, special education teachers, paraprofessionals) of research participants (Brock et al., 2017; Karsten et al., 2015; Kirkpatrick et al., 2019). The studies have included both primary (Beaulieu et al., 2014) and secondary targets (Graudins et al., 2012) of behavior change. Although independent evaluation of the elements of the treatment package has occurred across a limited number of studies, the data suggest that some elements (e.g., instructions), on their own, are insufficient in bringing behavior change to significant levels (LaBrot et al., 2017). Modeling appears to be an active component of the BST treatment package, but some studies did not establish its sufficiency for some participants (Ward-Horner & Sturmey, 2012). Feedback, however, is considered by some to possibly be a critical component (LaBrot et al., 2017; Roscoe et al., 2008). In studies examining BST, feedback occurs relative to the rehearsal of the procedure that is the target of a given training.

For school personnel, training topics typically involve specific content or subject matter. Training is often provided in large group instructional seminars (Kirkpatrick et al., 2019). The format for many of these trainings is didactic. While a didactic seminar may be sufficient to disseminate information to large groups of people, it often is insufficient to bring about the appropriate application of skills, or retention of those skills (Kirkpatrick et al., 2019). As lectures alone have primarily been insufficient to bring about desired behavior change, recommendations for instructional practices have consistently emphasized active responding models, BST being one of those models.

Given that the majority of BST studies conducted applied the treatment components to just one participant at a time in research (Clayton & Headley, 2019; Dart et al., 2017; Downs et al., 2008; Fetherston & Sturmey, 2014; Lafasakis & Sturmey,

2007; Sarokoff & Sturmey, 2004, 2008; Sump et al., 2018) and in practice (Karsten et al., 2015), the approach has exceeded the resource needs of many trainers (Parsons et al., 2013). Some studies used two or more trainers for the modeling component (Nuernberger et al., 2013). In order to address some of the time constraints of the BST model, researchers have assessed the efficiency of delivering different BST components using different presentation modes for a given component or components (e.g., video versus live, computer versus in-situ, telehealth versus in-person).

Extending the Research

Research practitioners have examined viable ways to deliver BST to attendees of workshops or other types of inservice training such that the participants perform the trained skill in a manner consistent with its possible implementation with the ultimate target of behavior change (e.g., students with autism). Except for studies that evaluated a computer-based model of teaching (Geiger et al., 2018; Nosik et al., 2013; Pollard et al., 2014), all other research conducted using BST to teach DTT introduced the independent variables to the participants one participant at a time. Other studies that addressed procedures other than DTT taught more than one participant at a time, but the instruction was conducted serially (Parsons et al., 2013).

Despite examples of efficiencies gained through various stimulus presentation tactics, the format of instructional delivery with feedback to one participant at a time would exceed the time allotted for training in some contexts (Vanselow & Hanley, 2014). The feedback component, identified as the most effective component (Johnson, 2013; LaBrot et al., 2017; Ward-Horner & Sturmey, 2012), has most often been delivered by an expert trainer (Geiger et al., 2018). The current study used the research participants, themselves, as the ones serving the function of feedback providers. Although not

designed to answer the question as to how feedback functioned relative to any changes in participant behavior noted, another feature of the feedback in this study, which was different from other studies reviewed, involved the timing of the feedback relative to the behaviors emitted by participants in the role of teacher.

Specifically, feedback was provided multiple times within each trial. Feedback provided after varying numbers of participant responses defined the term *immediate* across the research literature (Lafasakis & Sturmey, 2007). Furthermore, in almost all cases in behavioral skills training research, the skilled trainer was a member of an external research team (Brock et al., 2017). Although studies requiring follow-up sessions did so with the experimenter, the standard training for inservice teachers consists of stand-alone workshops without follow-up training (Brock et al., 2017). If research practitioners could deliver an effective and active component in the absence of a skilled trainer, then it might be reasonable to speculate that the method would also be available for use under conditions of future performance decline.

Shortcomings and Strengths of Prior Research

An apparent strength of BST research has been its noted efficacy concerning practitioners' proper use of a technique or set of techniques after BST training (Beaulieu et al., 2014; Bingham et al., 2007; Brock et al., 2017; Clayton & Headley, 2019; Gianoumis et al., 2012; Hahs & Jarynowski, 2018; Hogan et al., 2014; Homlitas et al., 2014; Love et al., 2013; Maffei-Almodovar et al., 2017; Miller et al., 2014; Nabeyama & Sturmey, 2010; Nosik et al., 2013; Parsons et al., 2013; Roscoe et al., 2008; Sarokoff & Sturmey, 2004). The effects of practitioner implementation on the performance outcomes of people with disabilities have been effective to a lesser extent (Brock et al., 2017; Sawyer et al., 2015; Seiverling et al., 2010). Additionally, BST research has a fair amount

of flexibility in stimulus arrangements of its components, as evidenced by the aforementioned manipulations.

Instructions have been presented orally, in writing, in video, and graphic form (Dickson & Vargo, 2017; Ryan et al., 2017; Speelman et al., 2015). Modeling has involved live models, puppets, and video (Dogan et al., 2017; Hahs & Jarynowski, 2018; Rosales et al., 2009). Rehearsal has occurred in both simulation and in-situ conditions and with both confederate and target populations (Homlitas et al., 2014; Martocchio & Rosales, 2016). Feedback has been provided through self-monitoring, via an experimenter, via a peer trainer, via expert trainer in a remote location, immediately after rehearsal, and delayed in time after rehearsal (Dogan et al., 2017; Krumhus & Malott, 1980; LaBrot et al., 2017; Parsons et al., 2013; Stocco et al., 2017).

Determining the feasibility of using procedures in applied settings, as arranged in reported research has been a shortcoming noted in the BST literature (Brock et al., 2017; Miltenberger et al., 2009; Parsons et al., 2013). Repeated one-to-one training may be cost and time prohibitive in many applied settings. There also are features of the way that BST research has been conducted (e.g., using external trainers) that, when compared to more typical inservice training arrangements (e.g., stand-alone nature of inservice training), call into question whether BST procedures could be implemented in time-limited situations and within a group format (Brock et al., 2017). These types of group formats are traditionally conducted with school-based or residential practitioners. Despite some innovation achieving a more efficient way to implement training, there still can remain a substantial up-front investment. Trainers, for example, interested in creating video models will need to secure all the needed equipment, as well as to schedule the time to create, and possibly edit, the footage captured (Karsten et al., 2015).

Methodological Criticisms

Reviews of BST research have identified some limitations. Many articles used imprecise descriptions of variables (Brock et al., 2017; Tarasenko et al., 2010), which interfered with making accurate interpretations of study conditions (i.e., length of time participants received BST, specifics relative to feedback provided to participants). Additionally, in the Brock et al. (2017) review of BST research, they determined that 10% of studies reported interobserver agreement measures below 80%, the generally accepted criterion for establishing confidence in the reported measures. A substandard interobserver agreement may indicate that, for data with less than 80% agreement, a higher degree of skepticism should be used in the evaluation of the study's results, as the lack of agreement may be an indication that the findings were attributable to something other than the independent variable (Brock et al., 2017).

Research Questions

The contexts of research studies may be substantially different from those to which the findings of the research are applied. In research-practitioner settings with low trainer-to-staff ratios, it is paramount to identify efficient and effective practices (Karsten et al., 2015). If training tactics involving the use of unskilled participants to deliver feedback to others are efficacious, then the tactic might be used with practitioners not involved in the study but who also need to access the active components used in the study.

The field of applied behavior analysis has a set of expectations, among which, is that individuals participating in continuing education activities are involved in activities that go beyond basic skills, that the objectives can be accomplished within the timeframe of the event, and that the objectives are written in terms that specify what the participant

will be doing as the activity is conducted. Additionally, participants should know the learning outcomes of the training event (Association for Behavior Analysis International, n.d.). Within the context of inservice training, and with participants arranged in triads (i.e., teacher, student, and observer-feedback provider roles), this study sought to contribute to and extend the line of research on efficient methods of using behavioral skills training by establishing the following research questions:

1. How will participants' accuracy performing the steps of discrete trial training in a simultaneous match-to-sample arrangement be affected by rehearsal and consequences delivered by a peer, preservice direct-care staff?

2. Will participants achieve the mastery criterion for the study if only other untrained staff provide scripted performance feedback?

3. How long will it take to train triad members who begin in the student or feedback roles relative to the person who begins in the teacher role?

4. How many training sessions will triad members who begin in the student or feedback roles require to reach the study's criterion performance, relative to the sessions required for the person who begins in the teacher role?

Chapter 3: Methodology

Participants

The direct-care staff of children with an intellectual disability who would benefit from instruction presented in discrete trial format served as the target population. Six direct-care staff who worked at a private residential education program were the participants for this study. On average, agency employees were 27 years old and had, on average, 2.5 years of experience teaching children (typically-developing or special needs). They ranged in age between 21 and 54 years old. The experimenter randomly assigned six participants with scores below 90% in baseline probe sessions to one of two groups of three participants. The participants of each subgroup were selected by first alphabetizing their last names and arbitrarily assigning each participant a number based on the letter of their last name from A to Z. The experimenter used a random number generator from random.org. The range entered into the number generator was the number of participants (i.e., six). The numbers generated were assigned, serially, to the alphabetized list. For example, given six participants, the first, second, and third participants on the alphabetized list could have been randomly assigned the numbers 4, 2, and 5, respectively. The participants with randomly assigned numbers 1 to 3 and 4 to 6 formed the first and second groups, respectively.

Within each group, participants served one of three roles: observer-participant, teacher-participant, student-participant. Each teacher-participant implemented the discrete trial lesson to an individual in the student role (i.e., experimental assistant or student-participant). The observer-participant provided the scripted feedback to the teacher-participant based on the teacher's discrete trial teaching performance. The student-participant followed a script that simulated student responses encountered by

teachers when conducting discrete trial teaching with students. The experimental phase (i.e., baseline-experimental or BST-experimental) determined when the student-participant would be involved. The student-participant and observer-participant were present only in the BST-experimental condition.

Instruments

Discrete Trial Teaching Instrument

Observer-participants used the DTT instrument (see Appendix A) to measure the teacher-participant's performance implementing the discrete trial training protocol. Experimenters used the instrument to evaluate the observer-participant's accuracy of feedback relative to the teacher-participant's performance. The Sarokoff and Sturmey (2004) procedures informed the use of this instrument. The teaching procedure involved instructing the student to look at the teacher, deliver the matching, programmed instruction one time, implement the pre-determined correction procedure, provide immediate praise for correct responses, and record data following each trial.

Observer-Participant Instrument

Feedback by the observer-participant relative to the teacher-participant (using the DTT instrument) was scored as accurate if provided after the start of a trial, but before the beginning of the next trial, and if the affirmative statements provided matched the teacher participant's accuracy of implementing the discrete trials. Experimenters recorded a negative score if feedback was absent before the start of the subsequent trial or inconsistent with the teacher-participant's accuracy (e.g., the observer-participant informed the teacher-participant that "good" was said to the student participant when it had not been stated).

Social Acceptance Questionnaire

Three doctoral-level Board Certified Behavior Analysts reviewed an eight-question questionnaire (see Appendix B) that, after the experiment, asked background questions about the participants, as well as acceptance of the training format of the study. The reviewers edited word usage of the questionnaire for three of the questions. They also combined the social acceptance questionnaire with the demographic and experience questionnaire, which was intended for administration during the study's pre-experimental phase. The result was that two questions addressed whether participants had prior exposure to the discrete trial training procedures used in the experiment by asking if participants used either the position-controlled datasheet or the specific DTT techniques prior to the study. Two questions established the number of years working with children and the number of formal study years after high school each participant completed. The remaining four questions used a 5-point Likert-type scale rating (Fetherston & Sturmey, 2014). The extent to which participants were satisfied with the DTT procedures (Thiessen et al., 2009), as well as the extent to which participants felt that they received a sufficient level of practice.

Procedures

Design

The effects of BST on the acquisition of DTT were evaluated within a multiple-probe across participants design (Horner & Baer, 1978). The multiple-probe is a single-subject research design that relies on repeated measures of each participant's responses conducted in such a way as to make the discovered patterns in results less plausibly related to extraneous factors (Kazdin, 2011). Various behavioral studies evaluating BST used this design (Fetherston & Sturmey, 2014; Hassan et al., 2018; Rosales et al., 2009;

Roscoe et al., 2008). In a review of 114 BST research articles published in peer-reviewed journals, 83% of the studies employed a multiple baseline or multiple probe across participants design (Brock et al., 2017).

The multiple-probe design involved replicating training across two groups of three participants. Accordingly, the multiple probe design included two legs, with the two groups of participants assigned to each leg. During the baseline phase, each participant's discrete trial teaching performance was evaluated during probe sessions in which an experimenter simulated student behavior while the participants conducted DTT. The participant with the lowest discrete trial teaching performance underwent training first and was assigned the teacher-participant role. The other two participants within each group were given the role of student-participant (i.e., simulated student) and observer-participant (i.e., observer providing feedback to the teacher-participant) during training sessions.

Once the first participant assigned to the teacher-participant role met the mastery criterion, an experimenter conducted probe sessions with the group's remaining participants. The remaining participants within each group yet to serve the role of teacher-participant and whose performance was below the mastery criterion were assigned to the teacher-participant role and began training. Thus, training was conducted sequentially for participants within each group. The experiment started with a baseline probe of discrete trial teaching performance of nine teaching trials, performed with a confederate student who followed the script that student-participants would use in the BST-experimental condition.

Across both groups of three participants, as participants met the study's training criterion (i.e., two sessions at 90% or higher accuracy), all participants underwent a probe

session as described earlier. The probe sessions conducted just before exposure to the treatment condition help evaluate the extent to which vicarious learning (Chance, 1988) within a subgroup may have taken place. Baseline probes conducted within a group of three participants, as well as across participants in the second group who had not yet received treatment, may adequately address threats to internal validity when changes in performance reach the criterion level only after the introduction of the independent variable. Repeating the independent variable's effects on the dependent measure with each participant, across groups, and within groups, would strengthen the evidence for the study's external validity.

Independent and Dependent Variables

This study's independent variable was the BST training package consisting of instructions, modeling, rehearsal, and feedback. The experimenter presented instructions and modeling via video. Rehearsal and feedback was live, and with another participant (observer-participant) following a prepared script to deliver these components of the independent variable. Relative to this study's research questions, the dependent variables were the percentage accuracy with which each teacher-participant performs a nine-trial discrete trial training session in baseline and treatment, the number of minutes in treatment each participant took to reach the performance criterion of the study, and the number of sessions needed to attain the performance criterion. Fewer minutes receiving treatment or fewer trials required to achieve the criterion performance could be attributable to vicarious learning. Additionally, the study reported the fidelity with which each participant-observer delivered feedback to the participant in the teacher role.

Setting and Materials

A staff training room, partitioned with a floor to ceiling curtain, served as the

study's location. Each side of the room was equipped with a table, a free-standing sneeze-guard with an opening at the bottom center through which training materials were presented, three chairs, and a video camera. Three 3-inch by 5-inch index cards were affixed to the table in each room and indicated where each of the participants was situated when playing a particular role within the experiment. A Sony Handycam HDR-CX405 video camera was placed next to the teacher-participant and angled down to have all materials used in the discrete trial procedure within view.

The materials used in this study included a lesson plan for the baseline phase, a lesson plan for the intervention phase, a position-controlled datasheet, three geometric shapes (triangle, circle, and square), a video depicting the use of the position-controlled datasheet, and the implementation of the discrete trial procedure (i.e., instructional video), laminated student scripts, two MacBook Air laptops, dry erase markers, red pens, and a video depicting the use of the feedback procedures in the context of discrete trials (i.e., training video).

In the baseline phase, the teacher-participant was provided a lesson plan with three columns. Teacher instructions appeared in the first column. Possible student behaviors were in the second column. Teacher responses to the potential student responses appeared in the third column. The teacher-participant was provided a position-controlled data sheet (see Appendix C) in both the study's baseline and BST conditions. This datasheet contained scoring codes: a plus symbol for correct student responding and a minus symbol for incorrect student responding. Three letters (i.e., A, B, C) represented the locations that the comparison stimuli (i.e., geometric shapes) were to be placed relative to the participant in the teacher role (i.e., teacher-participant).

The positional order in which the comparison stimuli were listed, as well as the

target spoken sample stimulus (e.g., “touch triangle”), were randomly determined. Although the comparison stimuli were in a different position from one trial to the next, the sample stimulus was the ‘A’ stimulus in three of nine trials, the ‘B’ stimulus in three of nine trials, and the ‘C’ stimulus in three of nine trials. Each stimulus appeared on the left, in the middle, and on the right three times across the nine trials. Shading, italicization, and bolding were used to increase the target sample stimulus’s salience on each trial. Representations of the geometric shapes were included in the key for each letter. The randomly assigned designations across all sessions were that the ‘A’ stimulus was the square, the ‘B’ stimulus was the circle, and the ‘C’ stimulus was the triangle.

At the bottom of the datasheet, a row was included for writing the ratio of correct responses for each session grouping. The datasheet also had a calculation tool for determining the percent accuracy for any ratio between one out of nine to eight out of nine. A 3-inch by 3-inch triangle, square, and circle, individually laminated, were used as the comparison stimuli during the DTT lessons. In the study’s baseline phase, two 13-inch MacBook Air laptops were used to display the introductory 5-minute video to all research participants. In the treatment phase, two same MacBook Air laptops were used to display the rationale, instructions, and modeling of rehearsal and feedback procedure. Additionally, the same DTT lesson plan (see Appendix D) was used in the BST-experimental condition as was used in the baseline-experimental condition, but with three added rows shaded black, and with a white textual prompt in each row that reads, “Do not proceed without feedback.” All other materials were the same as those used in the baseline condition (see Appendix E).

In the intervention phase, an observer-participant feedback form was used in addition to all materials used during the baseline phase. The observer-participant

feedback form (i.e., DTT instrument) included instructions on its use. Instructions to circle a “y” or “n” in each box containing those letters appeared above the scoring area and were highlighted in yellow. The first column illustrated the geometric shapes arranged from left to right according to the teacher’s perspective. Shading was added to rows in which a scripted student error was to occur. There were 49 opportunities (boxes) in a nine-trial session that a “yes” or “no” decision could be made about the teacher’s performance. The observer-participant read praise-specific statements for each correct response by the teacher-participant and read correction-specific statements for each teacher-participant error.

Preexperimental Procedure

Prior to the study’s start, the experimenter described the study conditions to the participants and followed a checklist of items to complete as the different phases of the experiment progressed.

Baseline-Experimental Procedure

In two groups of three, participants viewed a 5-minute video about the discrete trial training procedure that was the subject of the training. In the first 2 minutes, 30 seconds of the video, the study author provided a rationale for using discrete trial training and provided instructions with illustration regarding the use of a three-stimulus position-controlled datasheet. The video modeled the correct movement of comparison stimuli across teaching trials. The video also illustrated which sample stimulus was the target for any given trial. Following the introduction of the datasheet, the next 2 minutes, 30 seconds of the video showed two experimental assistants, one in the teacher role and the other in the student role, demonstrating how to conduct nine discrete trials.

The experimenter in the teacher role demonstrated accurately moving the

comparison stimuli, gaining the confederate student's eye contact, and stating the appropriate spoken sample stimulus. The confederate student then performed either one of five correct responses or one of four incorrect, randomly arranged, responses, as written in a student script. The teacher said, "Good" in response to correct student responses or covered the comparison stimuli for 1 second before re-presenting the comparison stimuli and instruction with a gesture (correction) prompt. The confederate student's responses to corrections received no feedback. Finally, the teacher wrote the appropriate scoring code on the datasheet after gaining a correct student response.

After the video, the participants conducted nine discrete trials with an experimenter playing the role of the student. No other participants were present during the baseline-experimental condition. All sessions of nine trials were video recorded. Before starting each session, the participant was provided the lesson plan, datasheet, and comparison stimuli shown in the video. All participants were provided up to 5 minutes to review the lesson plan before conducting the first session. After the participant reviewed the lesson plan, the participant was directed to the datasheet section to use and told to do their best to follow the procedures outlined in the lesson plan. The experimenter then instructed the participant to conduct discrete trial teaching while another experimenter served the role of the student.

No feedback relative to participant performance conducting discrete trials was provided. The experimenter directed any questions the participant asked regarding the teaching procedures by stating to the participant to refer to the materials provided and do the best they could. Two experimenters collected procedural integrity data during each session. Once a session was complete, the experimenter thanked the study participant, had the participant wait in a separate area, and then repeated the process with each

participant in the group until each member conducted a session of nine trials. The participant with the lowest baseline score across groups was the first to receive treatment while in the teacher-role. The second group members had one more baseline probe collected on each member before selecting the lowest scoring participant to begin in the teacher-role. If more than one participant had the lowest mean, then the participant starting in the teacher-role would have been randomly determined.

BST-Experimental Procedure

The BST consisted of the following components: instructions, modeling, rehearsal, and feedback. Instructions were presented via video and included a rationale for rehearsal and feedback. The video depicted the use of the observer-participant's datasheet. The video also showed experimenters in each of the three roles (i.e., student, teacher, and observer). The observer provided specific praise or corrective feedback at three distinct points of each trial.

In each of the two groups of three participants, the experimenter showed a training video displayed on a MacBook Air. The video illustrated how an observer-participant would provide feedback to a teacher-participant throughout a nine-trial teaching session. The video described how to use the DTT instrument and illustrated its features at the video's start. After review of the instrument, the video showed three experimenters role-play the DTT lesson taught in baseline, but with an observer-role (i.e., BST feedback provider) present and delivering feedback at three different points during the lesson. The lesson plan and DTT instrument contained intended prompts for feedback. The points for feedback were after the stimuli were laid out for the student, after the point at which a consequence should be delivered, and after the point when a scoring code should be entered onto the datasheet.

After watching the video model highlighting the use of the DTT instrument, the three participants were assigned to the roles of student-participant, teacher-participant, and observer-participant. As in baseline, the teacher-participant was given a position-controlled datasheet and oriented to the section to use at the start of the session. The teaching stimuli and lesson plan were the same as was used in the baseline phase. However, the lesson plan contained instructions in three different areas to stop and wait for feedback (from the observer-participant).

The student-participant received a laminated card with instructions for how to respond to teacher instructions across trials. These were the same laminated cards that were used in the baseline phase. Across a session, the student-participant was to touch the named stimulus on a total of five trials and was to commit different errors on four trials according to the randomly ordered scripts provided. The student-participant was also provided with a dry-erase marker to keep track of the trials completed.

The experimenter provided the observer-participant with the DTT instrument and gave praise for delivering the scripted feedback at the designated time immediately after the observer-participant's feedback. If the observer-participant did not provide the specified feedback or deliver it at a time not indicated on the DTT instrument, then an experimenter immediately directed the observer-participant to the area of the instrument in need of correction, stated what the teacher-participant's response was, and then directed the observer-participant to deliver the feedback that corresponded to the response emitted by the teacher-participant.

After three trials of feedback from the experimenter to the observer-participant, the experimenter withheld further feedback unless two consecutive errors occurred (e.g., observer-participant informs teacher-participant that the comparison stimuli are arranged

correctly for a trial, but they are not). If two consecutive errors in providing feedback occurred, then the experimenter provided feedback for an additional two trials. If, after two BST sessions, an observer-participant continued to commit errors, the experimenter used instruction and modeling to deliver feedback to the teacher-participant for three discrete trials. After the three modeled trials, the observer-participant delivered feedback to the teacher-participant while also receiving feedback from the experimenter.

The observer-participant training of the teacher-participant continued until the teacher-participant achieved two consecutive sessions of 90% or greater accuracy. Once the accuracy criterion was achieved, all other participants received a probe session conducted as described for the baseline phase. If a participant achieved 90% or greater in the probe session, the participant was asked to complete a second session with the experimenter. If the participant achieved 90% or greater in the second session, then no further training was required. If the participant failed to achieve the criterion performance in the probe session, then the participant continued in the BST phase with another participant serving the observer-role and delivering feedback until the criterion performance was achieved.

Data-Collection Procedures

Two experimenters recorded teacher-participant accuracy using the DTT instrument for both groups of three participants. The experimenters collecting data were Board Certified Behavior Analysts at the master's, specialist, and doctoral levels. The experimenters from each group independently evaluated the 49 responses contained within a nine-trial teaching session. Interobserver agreement data were calculated between the primary and secondary experimenter in each group using a trial-by-trial calculation that obtained a sum of the number of items in agreement, divided by the total

number of items available, and multiplied by 100 (Cooper et al., 2007) A primary experimenter for each group was designated in advance of the study, and the primary experimenter's score regarding teacher-participant performance was reported for analysis. In the baseline condition, interobserver agreement was calculated for 100% of each participant's sessions in the teacher role. The calculation was conducted at the time of the performance; however, should either experimenter have had fewer than 49 responses recorded, then interobserver agreement would have been independently calculated from the session's video recording.

In the BST experimental condition, two independent experimenters randomly selected 43% of recorded sessions. They scored the accuracy with which the participant in the observer role delivered accurate feedback to the participant in the teacher role. These data were independently scored on the DTT datasheets used by a participant in the observer-role, but with an additional row for summarizing each column's score. Additionally, a calculation tool was added to quickly summarize the total level of accuracy concerning the percent correct performance of 49 possible responses within a nine-trial session.

Procedural integrity of observer-role and student-role participants was conducted. Observer-role participants had 49 possible responses per nine-trial session, which two independent experimenters scored from video recordings using the datasheet as did the participant in the observer-role. Procedural integrity of participants as students was also recorded in a manner similar to that for participants in the observer role and was addressed as a discussion point as student's responses occasionally deviated from the script such that the teacher-participant's or observer-participant's scripts no longer matched the responses made. The number of BST sessions for each participant was

counted and then analyzed for potential patterns relative to learning efficiency. The total time spent in training was calculated from the sum of all durations of each participant's BST sessions.

Data Reliability

Interobserver agreement data were collected in vivo on teacher-participants' accuracy in implementing the DTT protocol, and by video for observer-participants' accuracy in delivering scripted feedback. From the video record, the observer-participant's fidelity of feedback was evaluated by two board-certified experimenters scoring a modified version of the DTT instrument. Interobserver agreement for this measure was calculated in the same manner as it was for the teacher-participants.

An interobserver agreement measure of the teacher's performance's fidelity was calculated using a point-by-point method (Cooper et al., 2007). The experimenter and an experimental assistant recorded teacher-participant performance across 100% of nine-trial sessions during study phases. In the baseline phase, agreement between two experimental assistants was calculated relative to teacher-participant performance teaching discrete trials to a confederate student. In the BST phase, agreement between two experimental assistants was calculated relative to teacher-participant performance conducting discrete trials with a student-participant. Agreement was calculated at the conclusion of the study.

Data-Analysis Procedures

The results from this study were evaluated via visual inspection of equal-interval line graphs. Visual inspection is the recommended method by which the significance of behavior change procedures are to be judged and interpreted in behavior analytic research (Cooper et al., 2020). Each participant's performance was represented with a data series. The series for each participant included baseline and intervention performances. Each

phase was separated with phase lines marking the sessions on which any given participant was introduced to the intervention condition. Effect size, vis-à-vis level changes was evaluated using the percentage of nonoverlapping data (PND) calculations (Alresheed et al., 2013).

Specifically, for each participant, the number of intervention data points that exceeded the highest data point in the baseline phase was divided by the total number of data points in the intervention phase. The quotient was then multiplied by 100 (Alresheed et al., 2013). A variant of PND, the percentage of data exceeding the median (PEM), was also used to facilitate interpretation of the experimental outcomes. The researcher calculated PEM by determining the median value of baseline-experimental data, counting the number of BST-experimental data points above the median line, dividing that number by all the BST-experimental data points, and then multiplying the quotient by 100 (Alresheed et al., 2013).

Chapter 4: Results

Introduction

This study evaluated a low-tech strategy to teach a DTT protocol to preservice teachers using a novel BST package. The BST package arranged for the research participants to provide the rehearsal and feedback components to one another in a setting with a low number of expert trainers relative to the number of individuals requiring training. The research participants provided the feedback by following scripts that prompted what to say to the teacher-participant and when to say it. The study also addressed these conditions in a fixed period (i.e., 3-hour orientation workshop). The research questions addressed in this study were as follows:

1. How will participants' accuracy performing the steps of discrete trial training in a simultaneous match-to-sample arrangement be affected by rehearsal and consequences delivered by a peer, preservice direct-care staff?

2. Will participants achieve the mastery criterion for the study if only untrained staff provide scripted performance feedback?

3. How long will it take to train triad members who begin in the student or feedback roles relative to the person who starts in the teacher role?

4. How many training sessions will triad members who start in the student or feedback roles require to reach the study's criterion performance, relative to the sessions needed for the person who begins in the teacher role?

Demographic Characteristics

There were four male and two female participants in this study. The average number of years that study participants worked professionally with children with special needs was 2.5. The range in years working with children with special needs was 0 to 11.

The average number of years of school completed after high school was 3, ranging from 0 to 6 years. No participants reported using the DTT protocol used in the study. Only one participant reported having used the position-controlled datasheet before the training.

Data Analysis

The researcher used visual analysis of line graphs to assess level changes between baseline and BST-experimental conditions across all six participants. Percentage of nonoverlapping data, and a variant of PND, the percentage of data exceeding the median (PEM), were used to facilitate interpretation of the experimental outcomes. The PND was calculated by counting the number of data points in the BST-experimental condition that exceeded the highest data point of the baseline-experimental condition, dividing that number by the total number of data points in the BST-experimental condition, and then multiplying the quotient by 100 (Alresheed et al., 2013). The researcher calculated PEM by determining the median value of baseline-experimental data, counting the number of BST-experimental data points above the median line, dividing that number by all the BST-experimental data points, and then multiplying the quotient by 100 (Alresheed et al., 2013).

Research Question 1

The first question in this study asked how participants' accuracy performing the steps of DTT in a simultaneous match-to-sample arrangement might be affected by rehearsal and consequences delivered by a peer, preservice, direct-care staff. Five of the six study participants demonstrated level increases in performance from the baseline-experimental condition to the BST-experimental condition. One study participant met the criterion performance (i.e., 90% or higher accuracy across two consecutive sessions) prior to the BST-experimental condition (see Appendix F).

As shown in Appendix F, Panel 1 displays performance for Participants 1, 2, and 3 of Group 1, and Panel 2 displays performance for Participants 4, 5, and 6 of Group 2. Closed symbols represent performance during baseline probe sessions with an experimenter roleplaying as a student. Open symbols represent performance during BST-experimental sessions with participants in the roles of teacher, student, and observer. Percentage accuracy out of nine trials is reported. The PND was 100% for the first participant from each group (i.e., P1 from Group 1 and P6 from Group 2) to enter the BST-experimental condition. The PND was 0% or 50% for the remaining participants. The PEM was 100% for the five participants who entered the BST-experimental condition (see Table 1).

Table 1

Percentage of Nonoverlapping Data and Percentage of Data Exceeding the Median

	Group 1			Group 2		
Item	P1	P2	P3	P4	P5	P6
Training order	1	2	3	3	2	1
PND	100	0	0	n/a	50	100
PEM	100	100	100	n/a	100	100

Note. PND = Percentage of nonoverlapping data. PEM = Percentage of data exceeding the median. The order that participants were in the teacher's role, the percentage of nonoverlapping data between baseline and BST-experimental phases, and the percentage of data exceeding the mean. One participant from Group 2 met the criterion performance of the study and therefore PND and PEM were not calculated.

Experimenters collected interobserver agreement data for 100% of baseline-experimental and probe sessions for Group 1. The mean agreement was 98.2%, with a range of 90% to 100%. The mean agreement for BST-experimental sessions for Group 1

was 99.4%, with a range of 98% to 100%. Experimenters collected interobserver agreement data for 95% of baseline-experimental and probe sessions for Group 2. The mean agreement was 98.4%, with a range of 86% to 100%. The mean agreement for BST-experimental sessions for Group 2 was 98.6%, with a range of 96% to 100% (see Table 2). Procedural fidelity data were collected for 43% of BST-experimental sessions in both groups (see Table 3).

Table 2

Interobserver Agreement

	Group 1			Group 2		
Item	% sessions	Mean %	Range	% sessions	Mean %	Range
Baseline	100	98.2	90-100	95	98.4	86-100
BST	100	99.4	98-100	100	98.6	96-100

Note. BST = Behavioral skills training. The percentage of sessions in which interobserver agreement data were collected, the mean of point-by-point calculations, and the range for both baseline-experimental and BST-experimental conditions.

Table 3

Procedural Integrity for Behavioral Skills Training

Group	% sessions	Mean %	Range
1	43	94	92-98
2	43	97	92-100

Note. The percentage of sessions in which procedural integrity data were collected relative to the accuracy of feedback to the teacher-participant. The mean and range are reported for 43% of sessions.

Research Question 2

The second research question asked if research participants would achieve the

study's performance criterion if only untrained staff provided scripted performance feedback. All six participants met the training criterion. One participant met the criterion before entering the BST-experimental condition, but did receive one booster session due to a probe performance falling below this study's criterion level. The remaining five participants only received feedback from other untrained staff who followed scripts. In one of the baseline probes, the participant that achieved the criterion performance prior to treatment, performed below the criterion performance (i.e., 84%), received one booster training session with another study participant providing scripted feedback, and the participant's performance returned to 100% accuracy.

Research Question 3

The third research question asked how long it would take to train triad members who started the BST-experimental condition in the student or feedback roles compared to starting in the teacher role. The training was the longest for the first participant in the teacher role of each three-member group. In Group 1, the total training time of the second participant (i.e., P2) was 73% (i.e., 30.36 min) faster than it was for the entire training time of the first participant (i.e., P1). It was 58% (i.e., 24.21 min) faster for the third participant (i.e., P3) of Group 1, as compared to P1. In Group 2, the total training time for the second participant (i.e., P5) was 54% (i.e., 18.21 min) faster than it was for the total training time of the first participant (i.e., P6). The third participant of Group 2 received one booster session that totaled 6.91 minutes, which was 80% of the training time of P6 (see Table 4).

In Group 1, the experimenter provided 14.5 minutes of instruction and feedback training to observer-participant (P3), 7 minutes of instruction and feedback training to observer-participant (P1), and 2 minutes of instruction and feedback training to observer-

participant (P2) for a total of 23.5 minutes across 12 learning trials. The experimenter provided no feedback training time to any teacher-participant in Group 1. The study participants in Group 1 delivered a combined 70.56 minutes of training to each other across seven BST-experimental sessions. Therefore, study participants in group one provided 47.06 minutes of training time in the absence of an expert trainer.

Table 4

Training Time of Teacher Participants Conducted by Observer Participants

	Group 1			Group 2		
Item	P1	P2	P3	P4	P5	P6
Training order	1	2	3	4	5	6
Training time	41.7	11.4	17.5	6.9*	15.7	33.9
Comparative difference in training time	n/a	73	58	80*	54	n/a

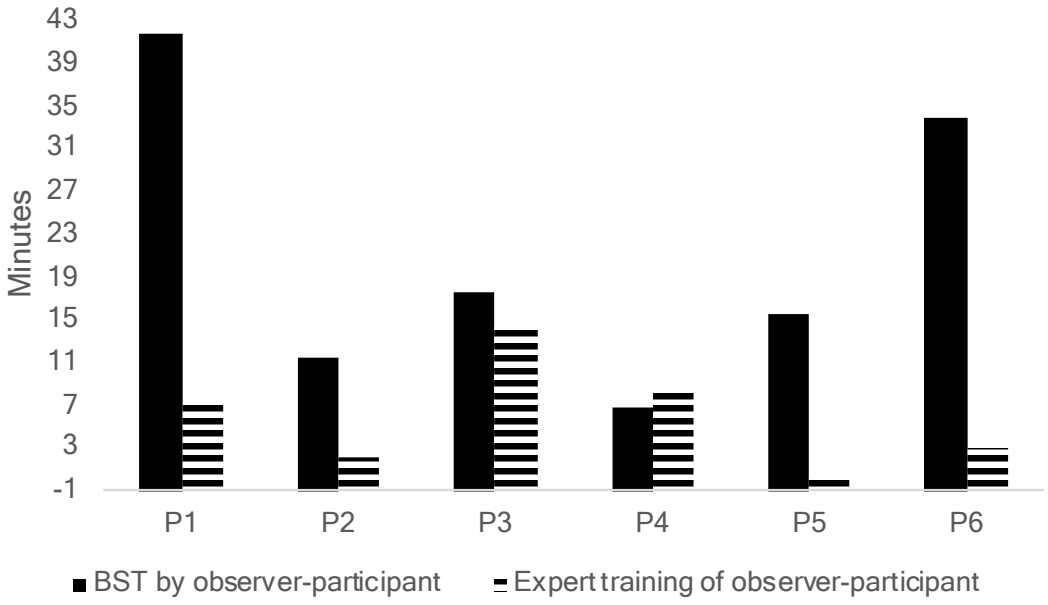
Note. The table shows the training time in minutes of participants in the teacher role as conducted by observer-participants. The first participant in each group (number 1 in the training order) spent the longest time in training. The second teacher-participant in Group 1 completed training 73% faster than the first teacher-participant. The second teacher-participant in Group 2 completed training 54% faster than the first teacher-participant in that group.
*P4 underwent booster training only.

In Group 2, the experimenter provided 8.5 minutes of instruction and feedback to observer-participant (P4), 3 minutes of instruction and feedback to observer-participant (P6), and 0 minutes of instruction and feedback to observer-participant (P5) for a total of 11.5 minutes across 11 learning trials. The experimenter provided no instruction or feedback training time to any teacher-participant in Group 2. The study participants in Group 2 delivered a combined 56.76 minutes of training to each other across seven BST-

experimental sessions. Therefore, study participants in Group 2 provided 45.26 minutes of training time in the absence of an expert trainer. In total, six participants were trained with 35 minutes of expert trainer time, while the participants, across groups, provided 92.32 training minutes, collectively, in shortly over 1 hour (see Figure).

Figure

Training Time Conducted by and for the Observer-Participant



Note. Solid bars represent the time in minutes that observer-participants provided training to teacher-participants. Hashed bars represent the time in minutes that the experimenter provided training to the observer-participant. The bottom of the y-axis is the zero line. In order to show a score of zero, the scale extends from below the zero line (i.e., -1) to 43.

Research Question 4

The fourth research question asked how many training sessions triad members who began the BST-experimental condition in the student or feedback roles would require to reach the study's criterion performance, relative to the sessions needed for the person who started the condition in the teacher role. Three study participants who followed the first participant (across groups) in the teacher-role required fewer training

sessions. Additionally, in Group 1, the first teacher-participant (P6) required two booster sessions, and P4 required just one booster session (see Table 5). Booster sessions represent training activity that might occur after the workshop has concluded, but participants' performances fell below the desired criterion level.

Table 5

Number of Sessions

	Group 1			Group 2		
Item	P1	P2	P3	P4	P5	P6
Training order	1	2	3	3	2	1
No. BST sessions	3	2	2	0	2	2
No. booster sessions	0	0	0	1	0	2

Note. BST = Behavior skills training. In Group 1, the second and third participants required fewer sessions than the first participant. In Group 2, the second participant (P5) required the same number of sessions as the first participant (P6), and the third participant (P4) required no training sessions. Two participants received booster sessions.

Study participants also completed acceptability ratings of the training. A 5-point Likert-type rating was used. The scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). The mean rating for the questions related to confidence using the datasheet or the DTT practice was 4.8. The mean rating for the questions pertaining to liking the training format and satisfaction with the amount of practice provided was 4.7. Overall, participants indicated high social acceptance for procedures used and their effects.

Chapter 5: Discussion

Introduction

The study's purpose was to evaluate if participants could learn a discrete trial training protocol presented using a novel, low-tech BST protocol. The study demonstrated the instruction and modeling components via video. The rehearsal and feedback components were conducted entirely by other research participants who were also preservice teachers attending their employment orientation at the study location. The study used a video to describe the DTT procedure. Additionally, this study presented research participants with a video, training stimuli, written instructions (i.e., lesson plan), and a datasheet. Participants performed the DTT protocol with another participant who role-played as the student and who followed a script. Participants were then randomly assigned to one of two groups and asked to practice the DTT procedure that was the study's subject. Participants took turns playing one of three roles: teacher, student, or provider of feedback (i.e., observer-participant). The student and observer-feedback used scripts to guide their performances on each of nine learning trials. The researcher provided the teacher-participant with a lesson plan, datasheet, and training stimuli.

This study addressed whether participants would perform the DTT procedure and use the accompanying position-controlled datasheet correctly if the feedback relative to rehearsal was provided entirely by other preservice teachers. The study also addressed whether, by being exposed to additional modeling by the participants in the different roles, there would be evidence of more efficient learning (i.e., vicarious learning) for participants who followed the first participant in the teacher-role.

Summary of Findings

This study demonstrated that the experimental tactic used was both effective and efficient. All study participants performed the DTT protocol presented at or above the target criterion level. The DTT protocol involved a simultaneous, match-to-sample stimulus arrangement. The comparison stimuli were three pictures of shapes, and the spoken name of each shape served as the sample stimulus across trials. The study participants performed targeted skills with limited expert trainer (i.e., experimenter) support. Study participants subsequent to the initial participant entering the BST-experimental condition in the teacher-role also performed more efficiently with respect to training time and the number of sessions to criterion. While initial instruction, modeling, baseline-experimental sessions, and baseline probes took approximately 100 minutes, all six study participants met the study criterion in a period with fewer than 71 minutes of training. The experimenter (i.e., expert trainer) provided feedback to all participants across both groups in less than half the time (i.e., 35 minutes) of the observer-participants' feedback sessions.

Interpretation of Findings

This study's findings demonstrate that preservice teachers can learn an unfamiliar procedure in a finite period when BST components are presented on video when scripts guide rehearsal with feedback, and other novices provide feedback to the individual learning a procedure. Two groups of participants received treatment concurrently, but in different locations. Though the groups were physically isolated, the replication of results within and across groups further suggests good internal validity and limited external validity.

Experimental Control and Effect Size

Visual analysis suggests experimental control across Group 1 and two of three participants in Group 2. Additionally, the first participant of Group 2 did not achieve any sessions at the criterion performance level until after treatment began for the first participant in Group 1. Although PND did not yield results consistent with effectiveness beyond each group's first participant, the PEM did suggest effectiveness for the five participants exposed to the treatment. Beyond effect size, there was evidence of efficiency.

Efficiency

Time spent by the experimenter providing feedback to the observer-participant relative to the period of training time that the observer-participant provided feedback to the teacher-participant (i.e., the individual performing the procedure that was the subject of the BST training) served as a measure of efficiency. For Group 1, the experimenter's total training time was 23.5 minutes, and the total training time conducted by observer-participants was 70.56 minutes. Additionally, the second and third participants required less training time by the other observer-participants than the first participant required. The second participant's time in training was 73% shorter than the first participant's. For Group 2, there were similar results as compared to Group 1. The experimenter's total training time was 11.5 minutes, and the total training time conducted across observer-participants was 56.76 minutes. Therefore, the experimenter spent 66% and 80% less time, respectively, providing training to the participants compared to the amount of time that research participants spent giving feedback to each other.

Context of Findings

This research study adds to several studies regarding the use of BST to teach DTT

(Downs et al., 2008; Fetherston & Sturmey, 2014; Gannon et al., 2018; Lafasakis & Sturmey, 2007; Nosik et al., 2013; Pollard et al., 2014; Sarokoff & Sturmey, 2004, 2008; Sump et al., 2018; Ward-Horner & Sturmey, 2008). Several BST studies (Geiger et al., 2018; Karsten et al., 2015; Pollard et al., 2014) evaluated ways to increase the efficiency of training techniques given the commonality of many work settings having low trainer-to-staff ratios (Karsten et al., 2015), and given that the available expert trainer resources (Pollard et al., 2014) may be too limited to provide the level of feedback needed to bring about socially significant behavior change using BST at scale (Brock et al., 2017).

This research also emphasized reducing expert trainer training time to address a common obstacle of insufficient trainer resources when using BST more widely in some settings and contexts. Although some researchers used high-tech solutions such as computer-based instruction to address efficiency issues (Geiger et al., 2018; Nosik et al., 2013; Pollard et al., 2014), the current study employed a low-tech solution that used printed copies of lesson plans, datasheets, scripts, and similar materials to what might be used with students who could serve as the ultimate beneficiaries of the practice taught.

Efficiency Tactics

As Karsten et al. (2015) recommended, this experiment used strategies to streamline the conditions under which the expert trainer provided direct involvement to participants receiving training. Specifically, video models, including instructions for how to implement the teaching procedure, were used. The video was 5 minutes in length, shorter than the video used in some studies that used video modeling alone (Catania et al., 2009). However, whereas the video modeling procedure in Catania et al. (2009) repeated the presentation of the video model followed by rehearsal sessions with participants until the procedure was learned, participants in this study were exposed to

repeated live models with variation in performance throughout the rehearsal and feedback sessions of the BST-experimental phase.

Conditional Discriminations

Although the modeling of performances of the student-participant and teacher-participant varied, this study presented a limited set of techniques in using DTT and did not address any errorless teaching strategies (Geiger et al., 2018). Despite the limited range of DTT techniques, as other researchers have noted, the protocol used in this study included several of the recommended features for teaching conditional discriminations (Geiger et al., 2018). Specifically, the sample stimulus changed across learning trials. The comparison stimuli positions varied unsystematically across learning trials (Geiger et al., 2018), and the sample and comparison stimuli were presented equally often in each session (Green, 2001).

Types of Error

Given research demonstrating treatment fidelity errors by omission or commission degrading student performance (DiGennaro Reed et al., 2011), the role-plays included observer-participants' feedback to teacher-participants commenting on their errors of commission (e.g., "You asked for the wrong picture") or omission (e.g., "You forgot to say, 'Look at me'") emitted on the part of the teacher-participant. Additionally, simulated students emitted both errors of commission (e.g., touching an unnamed stimulus) and omission (e.g., failure to emit a response within 4 seconds), with precisely four simulated errors per nine-trial session.

Feedback

The type and timing of feedback used in this study were consistent with recommendations to use immediate verbal feedback that is descriptive of the errors

(DiGennaro Reed et al., 2018). However, different researchers using BST to teach a DTT protocol have conceptualized ‘immediate’ differently. Some researchers described immediate feedback as occurring after a block of 10 trials (Clayton & Headley, 2019), after five trials (Clayton & Headley, 2019), after three trials (Lafasakis & Sturmey, 2007; Sarokoff & Sturmey, 2004, 2008; Ward-Horner & Sturmey, 2008), after each trial with a critical error (Nosik et al., 2013), or generally, immediately following the performance (Sump et al., 2018).

Some research described the feedback as occurring ‘as needed’ without respect to the latency after performance (Dart et al., 2017). This study provided feedback at three points during each trial. The first point of feedback occurred after the comparison stimuli were presented to the student-participant, but before the teacher-participant called for eye contact. The second point of immediate feedback occurred after the instruction for eye contact and teacher-participant consequence to student-participant performance. The last point of immediate feedback occurred after the teacher-participant wrote the code representing student performance on the datasheet. These three feedback points per trial occurred across all nine-trials of each session for which the observer-participant was present.

Implications of Findings

Practice implications of this study include that trainers may be able to extend the effects of the performance feedback of BST packages, increasing the amount of rehearsal and feedback opportunities for individuals learning a new teaching practice, and at levels that an expert trainer, alone, would not be able to provide given certain attendance sizes or time-periods for the learning event. Extending the active components hypothesized to be the effective and possibly necessary components of BST (Ward-Horner & Sturmey,

2012) beyond that which a given setting's trainer-resources permit could be of great practical benefit. Workshops, trainings, and classes are possible settings that could make use of these practices.

Given that this study employed a low-tech tactic, compared to studies that evaluated high-tech solutions, it may be more accessible to a greater number of people looking to assess or use this tactic. Despite the many advantages of computer-based instruction, researchers have reported that there can be significant up-front costs with respect to time and money (Geiger et al., 2018), but there may also exist additional obstacles such as having to learn how to program software to perform the functions that would relate to the parameters of one's research or teaching protocol. An additional consideration is the extent to which any training procedure can bring about behavior that will generalize from the training environment to other or all relevant settings and conditions. Some researchers found that their study participants would require in-situ training in addition to computer-based training to see generalization of skills taught to other conditions (Vanselow & Hanley, 2014). In some cases, the lack of generalization was related to a lack of corresponding active responses with feedback for every step of the computer-trained procedure (Geiger et al., 2018).

Researchers have investigated the use of non-experts to train others in the context of pyramidal training (i.e., peer training). Pyramidal training typically involves an expert trainer who teaches a small group of less proficient individuals who then train others (Parsons et al., 2013). The current study shares some of the features of the Parsons et al. (2013) study. First, this study used staff to train other staff. Second, this study had participants use the active components of BST to then train other participants. Third, this study investigated participants' use of BST to teach another behavior change procedure.

Fourth, the participant trainer maintained a record of the trainee's performance during the training.

The Parsons et al. (2013) study also differed from this study in fundamental ways. First, pyramidal training arranges training-groups, serially, whereas this study arranged them concurrently. Second, this study did not have the participants use all of the components of BST, as Parsons et al. did. Under conditions for which training needs to occur in a given period (e.g., orientation training for a new job), this study contributes to the existing literature. For individuals conducting time-limited trainings, these tactics may be preferable to those used in pyramidal training arrangements.

Individuals receiving training may also find the tactics used in this study preferable. As study participants indicated vis-à-vis social acceptability measures, there was a strong preference for the format of the training. Participant responses indicated that, on average, respondents strongly agreed with statements about liking the format of the training, feeling confident in the use of the procedures and datasheet, and feeling satisfied with the amount of practice; all practice having been guided by scripts.

As was the case in several studies, researchers prepared student scripts to guide the responses of confederate students (Burke et al., 2010; Geiger et al., 2018; Martocchio & Rosales, 2016; Pollard et al., 2014; Seiverling et al., 2010), or feedback scripts to guide statements made by supervisors to staff (Palmen et al., 2010), but this study appears to be the first to make simultaneous use of both student and feedback scripts. At times, some vocal responses emitted by observer-participants may have come under the sole control of the nonauditory stimuli (i.e., text) before them. Pure textual control (Palmer, 2017) of the scripts might have led to support of the null-hypothesis had there not been sufficiently accurate feedback to teacher-participants.

Despite occurrences of stimulus overselectivity that may have occurred with the observer-participant scripts, it appeared as though observer-participants could respond sufficiently well to the compound stimulus arrangements (Rieth et al., 2015) of the textual prompts, the vocalizations and motor movements emitted by teacher-participants, making the desired discriminations of observer-participants' responses in the context of those compound stimuli. The experimenters' prompts to recall what the observer-participant saw and heard the student-participant do, with direction to the relevant portion of the feedback form, was sufficient to evoke the appropriate feedback in the limited number of occasions for which errors by the student-participant occurred.

How the feedback stimuli functioned was not a conceptual focus of this study, and conclusive statements beyond speculation cannot be made. This study specified the temporal movement of feedback stimuli closer, in time, to the behaviors they followed. This is contrasted with those studies that specified feedback following blocks of 10 trials (Clayton & Headley, 2019), five trials (Clayton & Headley, 2019), three trials (Lafasakis & Sturmey, 2007; Sarokoff & Sturmey, 2004, 2008; Ward-Horner & Sturmey, 2008), or after trials with critical errors (Nosik et al., 2013). Despite the temporal movement of the feedback stimuli, this study did not evaluate the relative effects of the discriminative or reinforcing properties that feedback had on teacher-participant responses (Roscoe et al., 2006).

Limitations of the Study

There were several limitations to this study. Statements regarding experimental effects are limited mainly due to the experimental design. A multiple-probe design was selected partly as a matter of convenience and logistics. Study participants were preservice teachers attending orientation at their agency of hire. The time available for

data collection was limited to the DTT training module's length in the orientation period. Therefore, the experimenter arranged experimental conditions to leave enough time to ensure that participants would achieve the desired training outcomes before the end of their orientation period. If time had permitted for baseline conditions to be extended until steady-state responding occurred, then it may have been possible to make stronger statements about the contributions of the independent variable (Cooper et al., 2020). Despite that the baseline performances for five of the six participants did not meet the criterion level until the participant entered the BST-experimental condition, two of the participants from Group 1 demonstrated performance above the criterion level on one probe session prior to treatment, and one participant from Group 2 demonstrated performance at the criterion level before entering the treatment phase. The performance improvements may have resulted from additional modeling to which participants were exposed in the BST-experimental condition, or the performance may have been due to practice effects (Cooper et al., 2020).

External validity statements are extremely limited because the range of participants, behaviors, and conditions to which the procedure was applied was small. The study size was very small ($N = 6$). Replication of effects occurred under conditions that remain unproven to generalize to the population at large. The participant who took the longest time in training (P1) spoke English as a second language. Although this participant eventually discriminated aspects of the role-plays well enough to deliver the corresponding feedback statements, the errors that did occur (e.g., not substituting the parenthetical word *picture* with the name of the shape used on a given trial) might point to additional considerations that a research-practitioner should make if pursuing this tactic. Furthermore, as there were no generalization probes conducted with actual

students, it is unknown if the performances would occur under conditions where they would be most meaningful (i.e., with the students targeted as the ultimate beneficiaries of the procedure learned).

Another limitation was that rehearsal and feedback was not provided for all the roles in the BST-experimental condition. The student role was guided by scripts, each containing instructions for correctly performing five responses and incorrectly performing four responses. The order and type of error varied unsystematically across sessions. The training video illustrated a confederate student performing one of the nine scripts. The one script modeled in the video did not demonstrate the range of responses a student in training would make. If a student-participant demonstrated inaccurate performance of the designed response, then the teacher-participant, observer-participant, or both, might need to deviate from their instructions in order to emit desired responses. There were occasions that a student-participant responded slower than instructed, continued to follow an earlier part of a script after the teacher-participant moved on, or performed the targeted response incorrectly in some other way. Student-participant performance was not measured, so the effects of student-participants' errors on the performance of the teacher-participant or observer-participant cannot be made with precision. Although the experimenter detected some errors made on the part of different student-participants, the errors were estimated to be acceptable at the time of the study.

Another limitation related to error was structural. The number of errors that could occur on a given component of the DTT activity, but the study participant still meet the study criterion, was five. There were 49 components evaluated across nine trials. A participant, therefore, could have committed five errors and receive a score of 90%. Given that there were five scripted opportunities per nine-trial session to say, "Good" to a

student-participant, a teacher-participant might have omitted every opportunity to provide the praise statement after the student-participant's correct responding, and still met the targeted criterion.

Statements about internal and external validity are limited. Though most participants met the study's performance criterion only after introducing the independent variable, there were performance improvements for all participants in the baseline-experimental condition. Therefore, the data in this study do not rule out the possibility that study participants could have met the performance criterion with additional practice opportunities prior to the introduction of the BST-experimental condition. The first participant of the second group (P6) also did not meet the criterion-performance before the first participant of the first group (P1) was introduced to the BST-experimental condition, but P6's second session performance was better than the first session. It is possible that an extended baseline could have revealed continued performance improvement, leaving both internal and external validity on tenuous ground.

Future Research Directions

To enhance the demonstration of control over the dependent measure, repeating the experiment with a stronger experimental design is recommended. A multiple baseline design with baselines of varying lengths could address the question more convincingly of whether participants would have met the study conditions with nothing more than additional practice. The performance criterion should also take into consideration the types of errors that occur and the number of errors of a given type. If an error of a particular type persists, then bringing in other components of the BST package may be required. Perhaps instructions and videos could be presented as video clips as opposed to one continuous sequence. A repeated error on a given component (e.g., failure to deliver

the praise statement following a correct response) despite receiving feedback, might be supplemented with a video clip modeling how to deliver the praise contingent on correct student performance.

Future studies should evaluate whether study participants are able to use the target skill with the intended ultimate beneficiaries of the procedure being learned. Probes of participant performance conducting discrete trials with students at different points of a study could demonstrate how learning a simulated arrangement procedure might generalize to an in vivo arrangement.

This study was a good proof-of-concept. However, the results should be replicated across a much broader range of variations on techniques and procedures. The procedure taught in this study introduced a position-controlled datasheet and a simple differential response to student response type (i.e., correct or incorrect). The teacher-participant learned to provide one type of response contingent upon a student's correct response or to provide a correction, followed by social extinction, after an incorrect response. This procedure could be extended to various errorless teaching tactics (e.g., progressive time delay, spatial fading) as well as to other procedures (e.g., PECS phases).

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Appendix A

Discrete Trial Teaching Instrument

Discrete Trial Teaching Instrument

Feedback Instructions
Session **1** Trials

1. Quietly Read entire page and keep from view of teacher.
2. Make sure everyone is using the same session number before starting. Take new feedback page after 9 trials below are completed. Repeat session numbers if all were used.
3. Stand slightly behind and to the side of the "teacher" so you can see the teacher's data sheet and materials.
4. EVERY box with a Y or N must be circled. **Stop** the teacher when there is a black box for feedback delivery and immediately tell the person in the teacher role what was scored **and why** (N's are helpful to the learning process so make sure to tell the teacher when it was an 'N')

CIRCLE EITHER Y OR N ACROSS AN ENTIRE ROW. PICK THE RIGHT QUOTE TO READ FOR EACH ONE

	Layout			Eyes	Instruction		Good	Correction	*No Good*		Data		
Trial #	**Teacher's left** ↓ L M R	**Y** = "Your pictures are in the correct order. Go ahead" **N** = "Wait, fix your pictures"	STOP TEACHER & DELIVER FEEDBACK	**Y** = "Good saying, 'Look at me' before the instruction" **N** = "You forgot to say, 'Look at me'"	**Y** = "You correctly said touch (picture)" **N** = "You asked for the wrong picture"		**Y** = "You correctly said 'good'" **N** = You forgot to say, 'good' or, "I couldn't hear you"	**Y** = "You covered the materials for a second, said the instruction again, and touched the picture" **N** = "You didn't follow the correction procedure on your lesson plan"	**Y** = "You correctly didn't say good after the correction" **N** = "You shouldn't have said good after the correction"	STOP TEACHER & DELIVER FEEDBACK	**Y** = "You scored correctly" **N** = "You used the wrong symbol on the data sheet"		STOP TEACHER & DELIVER FEEDBACK
1.	■ ● ▲	Y N		Y N	●	Y N	Y N				+	Y N	
2.	▲ ■ ●	Y N		Y N	▲	Y N		Y N	Y N		-	Y N	
3.	● ▲ ■	Y N		Y N	■	Y N	Y N				+	Y N	
4.	■ ● ▲	Y N		Y N	▲	Y N		Y N	Y N		-	Y N	
5.	▲ ■ ●	Y N		Y N	■	Y N	Y N				+	Y N	
6.	● ▲ ■	Y N		Y N	●	Y N	Y N				+	Y N	
7.	■ ● ▲	Y N		Y N	■	Y N		Y N	Y N		-	Y N	
8.	▲ ■ ●	Y N		Y N	●	Y N	Y N				+	Y N	
9.	● ▲ ■	Y N		Y N	▲	Y N		Y N	Y N		-	Y N	

Your Name: _____
Teacher's Name: _____

Appendix B

Social Acceptance Questionnaire

Social Acceptance Questionnaire

The information below informs the study author about the value you found by participating in this study. All information provided will be kept confidential.

1. Had you previously used the discrete trial data sheet used today when teaching the student? Y N

2. Had you previous used, with children, the teaching techniques practiced today? Y N

3. How many years have you worked with children with special needs?

0	1	2	3	4	5	6	7	8	9	10	#
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	_____

4. How many years of school have you completed after receiving your high school diploma?

0	1	2	3	4	5	6	7	8	9	10	#
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	_____

5. I feel confident in using the data sheet used in the teacher role of this study

Strongly disagree		Neutral		Strongly agree
1	2	3	4	5
❍	❍	❍	❍	❍

6. I feel confident running the discrete trial training procedures taught today

Strongly disagree		Neutral		Strongly agree
1	2	3	4	5
❍	❍	❍	❍	❍

7. I liked the format for this training

Strongly disagree		Neutral		Strongly agree
1	2	3	4	5
❍	❍	❍	❍	❍

8. I am satisfied with the amount of practice I received with the discrete trial procedures taught today

Strongly disagree		Neutral		Strongly agree
1	2	3	4	5
❍	❍	❍	❍	❍

Your Name: _____

Please print legibly

Appendix C

Position-Controlled Data Sheet

Position-Controlled Data Sheet

Name: _____

Scoring: + = Only touch the named picture prior to your feedback to the student
— = Did not touch (or only touch) the named picture within 4-seconds

Session 1

A= ■ Square B= ● Circle C= ▲ Triangle

trial	*target picture highlighted*			**+ or -**
1	A	***B***	C	
2	***C***	A	B	
3	B	C	***A***	
4	A	B	***C***	
5	C	***A***	B	
6	***B***	C	A	
7	***A***	B	C	
8	C	A	***B***	
9	B	***C***	A	
Total:		/9 =		%

Session 2

A= ■ B= ● C= ▲

trial	*target picture highlighted*			**+ or -**
1	A	B	***C***	
2	C	***A***	B	
3	***B***	C	A	
4	***A***	B	C	
5	C	A	***B***	
6	B	***C***	A	
7	A	***B***	C	
8	***C***	A	B	
9	B	C	***A***	
Total:		/9 =		%

Session 3

A= ■ B= ● C= ▲

trial	*target picture highlighted*			**+ or -**
1	***A***	B	C	
2	C	A	***B***	
3	B	***C***	A	
4	A	***B***	C	
5	***C***	A	B	
6	B	C	***A***	
7	A	B	***C***	
8	C	***A***	B	
9	***B***	C	A	
Total:		/9 =		%

Session 4

A= □ B= □ C= □

trial	*target picture highlighted*			**+ or -**
1	A	***B***	C	
2	C	***A***	B	
3	B	C	***A***	
4	A	B	***C***	
5	***C***	A	B	
6	***B***	C	A	
7	***A***	B	C	
8	C	A	***B***	
9	B	***C***	A	
Total:		/9 =		%

Session 5

A= □ B= □ C= □

trial	*target picture highlighted*			**+ or -**
1	A	B	***C***	
2	***C***	A	B	
3	B	***C***	A	
4	A	***B***	C	
5	C	A	***B***	
6	B	C	***A***	
7	***A***	B	C	
8	C	***A***	B	
9	***B***	C	A	
Total:		/9 =		%

Session 6

A= □ B= □ C= □

trial	*target picture highlighted*			**+ or -**
1	***A***	B	C	
2	C	A	***B***	
3	***B***	C	A	
4	A	B	***C***	
5	C	***A***	B	
6	B	C	***A***	
7	A	***B***	C	
8	***C***	A	B	
9	B	***C***	A	
Total:		/9 =		%

Session 7

trial	*target picture highlighted*			**+ or -**
1	***A***	B	C	
2	C	A	***B***	
3	B	***C***	A	
4	A	***B***	C	

Session 8

trial	*target picture highlighted*			**+ or -**
1	A	***B***	C	
2	C	***A***	B	
3	***B***	C	A	
4	***A***	B	C	

Session 9

trial	*target picture highlighted*			**+ or -**
1	A	***B***	C	
2	***C***	A	B	
3	B	C	***A***	
4	A	B	***C***	

5	C	***A***	B	
6	***B***	C	A	
7	A	B	***C***	
8	***C***	A	B	
9	B	C	***A***	
Total:		/9 =		%

5	C	A	***B***	
6	B	C	***A***	
7	A	B	***C***	
8	***C***	A	B	
9	B	***C***	A	
Total:		/9 =		%

5	C	***A***	B	
6	***B***	C	A	
7	A	***B***	C	
8	***C***	A	B	
9	B	C	***A***	
Total:		/9 =		%

Calculation tool: 8/9 = 89% 7/9 = 78% 6/9 = 67% 5/9 = 56% 4/9 = 44% 3/9 = 33% 2/9 = 22% 1/9 = 11 %

Appendix D

Lesson Plan for BST Condition

Lesson Plan for BST Condition

Teacher Instructions
TRAINING

1. **Only** follow the instructions below in the left and right columns ('what teacher does')
2. Say quotes exactly as they are written
3. Work one row at a time
4. Wait for feedback from the person in the "trainer" role for each blocked section below

What teacher does	What student does	What teacher does
1. Set up the materials according to the data sheet (from your left to your right)	1. Waits without touching 2. Isn't looking at teacher	
DO NOT PROCEED WITHOUT FEEDBACK		
2. Before every trial get eye contact by saying, "Look at me"	2a. Looks at teacher	
3. Say, "Touch 'picture'" Expect that the student makes the response within 4 seconds (count to yourself: "one-one thousand, two-one thousand, etc…")	3a. Touches named picture in 4 or fewer seconds 3b. Touches something else or doesn't touch what was named by the silent count of 'four one-thousand'	3a. Say, "Good" immediately, then mark data sheet 3b. Cover the materials for one second, uncover them, repeat the instruction, and immediately touch the named item, Say NOTHING after the correction,
DO NOT PROCEED WITHOUT FEEDBACK		
		then mark data sheet and conduct the next trial until all trials are complete.
DO NOT PROCEED WITHOUT FEEDBACK		
4. Go back to step 1		

Appendix E

Lesson Plan for Baseline Condition

Lesson Plan for Baseline Condition

Teacher Instructions
TESTING

1. **Only** follow the instructions below in the left and right columns ('what teacher does')
2. Say quotes exactly as they are written
3. Work one row at a time

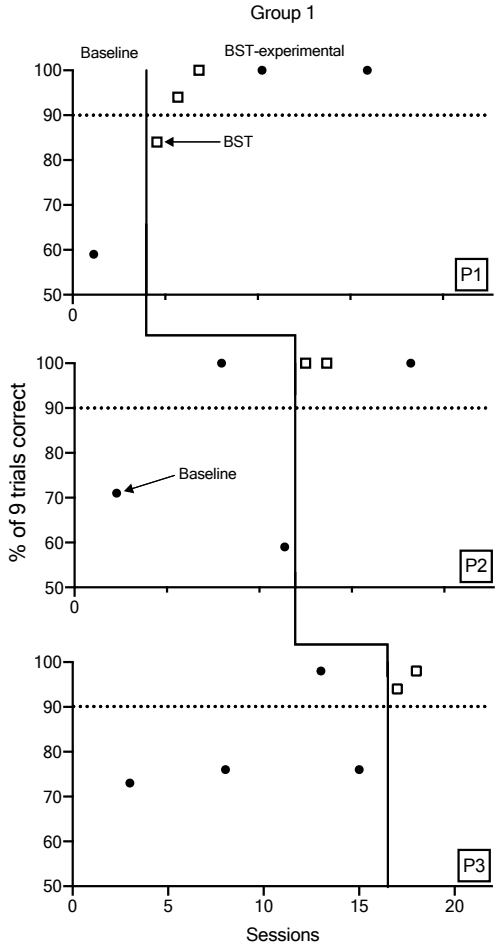
What teacher does	What student does	What teacher does
1. Set up the materials according to the data sheet (from your left to your right)	1. Waits without touching 2. Isn't looking at teacher	
2. Before every trial get eye contact by saying, "Look at me"	2a. Looks at teacher	
3. Say, "Touch 'picture'" Expect that the student makes the response within 4 seconds (count to yourself: "one-one thousand, two-one thousand, etc…")	3a. Touches named picture in 4 or fewer seconds 3b. Touches something else or doesn't touch what was named by the silent count of 'four one-thousand'	3a. Say, "Good" immediately, then mark data sheet 3b. Cover the materials for one second, uncover them, repeat the instruction, and immediately touch the named item, Say NOTHING after the correction, then mark data sheet and conduct the next trial until all trials are complete.
4. Go back to step 1		

Appendix F

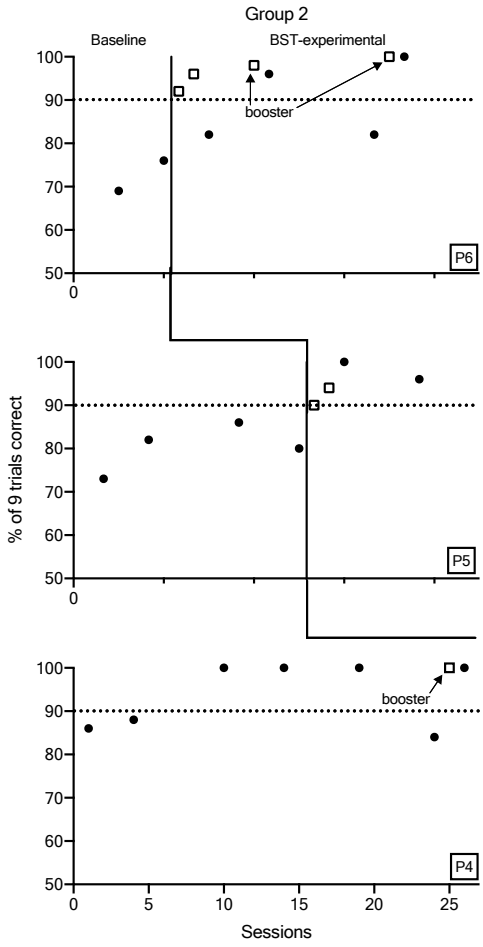
Teacher-Participants' Performance in Baseline and BST-Experimental Conditions

Teacher-Participants' Performance in Baseline and BST-Experimental Conditions

Panel 1



Panel 2



Note. Teacher-participant performances conducting DTT in groups 1 and 2 across baseline-experimental and BST-experimental conditions. Panel 1 displays performance for participants 1, 2, & 3 of Group 1, and Panel 2 displays performance for participants 4, 5, & 6 of Group 2. Closed symbols represent performance during baseline probe sessions with an experimenter roleplaying as a student. Open symbols represent performance during BST-experimental sessions with participants in the roles of teacher, student and observer. Percent accuracy out of nine trials is reported.