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Using Bug In Ear Feedback To Increase The Accuracy Of Discrete Trial Teaching Implementation

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USING BUG IN EAR FEEDBACK TO INCREASE THE ACCURACY OF DISCRETE TRIAL TEACHING IMPLEMENTATION

by

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ABSTRACT

Many professionals have successfully implemented discrete trial teaching in the past. However, there have not been extensive studies examining the accuracy of discrete trial teaching implementation. This study investigated the use of Bug in Ear feedback on the accuracy of discrete trial teaching implementation among two pre-service teachers majoring in elementary education and one pre-service teacher majoring in exceptional education. An adult confederate was used to receive discrete trial teaching. Implementing a multiple baseline across participants design, this study examined whether there was a functional relationship between receiving Bug in Ear feedback and the accuracy of discrete trial teaching implementation. The discrete trial teaching evaluation form was utilized to measure the accuracy of discrete trial teaching implementation. The findings demonstrated an increase in the discrete trial teaching implementation accuracy after Bug in Ear feedback was introduced. Participants agreed that using a self-instruction manual combined with receiving Bug in Ear feedback was beneficial in learning to implement discrete trial teaching.

To my children and my nieces and nephews; I love you all and dedicate this to each of you!
Always reach for the stars!!

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ABA – Applied Behavior Analysis

ASD – Autism Spectrum Disorders

BCBA – Board Certified Behavior Analysis

BIE – Bug in Ear

DSM – Diagnostic and Statistical Manual of Mental Disorders

DTT – Discrete Trial Teaching

DTTEF – Discrete Trial Teaching Evaluation Form

EF – Encouraging Feedback

IF – Instructional Feedback

IOA – Inter Observer Agreement

PND – Percent of Non-Overlapping Data Points

WWC – What Works Clearinghouse

CHAPTER ONE: INTRODUCTION

Discrete trial teaching (DTT) is a teaching strategy that has been successfully used for many years with students who have special needs including students with autism spectrum disorders (ASD) (LeBlanc, Ricciardi, & Luiselli, 2005; Lerman, Vorndran, Addison, & Contrucci Kuhn, 2004; Lovaas, 1987; Smith, 2001). During DTT skills are broken down into tiny steps and presented to students in a prescribed manner (Smith, 2001). Lovaas used DTT throughout much of his career working with students with autism. Wolf, Risely, and Mees (1964) used behavioral principals of Applied Behavior Analysis (ABA) similar to those used in DTT to teach a young boy several acquisition skills. Much earlier (in the late 1700s), Itard used principles which we can now see as precursors to DTT procedures while working with an individual named Victor.

In 1976, Lane wrote of Itard's Victor in The Wild Boy of Aveyron where he described the condition now known as autism. He also described the interactions and treatment strategies used with Victor. Victor was found in the Caune Woods of France in July 25, 1799. He was thought to have been in the woods alone since he was 4 years old. According to some (Bodea & Lubetsky, 2001; Frith, 2003), Victor had many characteristics that were congruent with typical characteristics of autism. His behaviors included a lack of oral communication, lack of social skills, insensitivity to extreme temperatures, insistence on sniffing items (even if they appeared to not have a smell), and elopement (Itard, 1962). Victor lived with a governess, Madame Guerin, who not only acted as a mother, but also aided in Victor's schooling, which included educational goals created by Itard. Over the course of five years Victor demonstrated progress in

emotional, intellectual, and adaptive skills. While he was unable to communicate verbally he did learn to write down many words to express his wants and needs.

Subsequent to Lane's account of Victor, Kanner was the first in America to write of individuals with characteristics similar to those of Victor and coined the term autism to describe them. In 1943, Kanner described the behaviors of 11 children with autism in great detail. He wrote that there is a set of unique characteristics, applicable to the children described, which had not yet been grouped together as a disability. Among these characteristics of autism, Kanner describes deficits in communication, unique cognitive abilities, obsessiveness, lack of social skills, insistence on repetitiveness, and lack of imaginative play (Kanner, 1943). Kanner's description is congruent with the definition in the most recent version of the Diagnostic and Statistical Manual of Mental Disorders (DSM), which states autism is a disorder that is affiliated with impaired communication, limited social skills, and restricted areas of interests (American Psychiatric Association [DSM-IV-TR], 2000). The current DSM goes on to list the following as common characteristics of individuals with autism: repetitive speech, abnormal language, insistence on routines, limited interests, and onset prior to age three. Kanner also discusses excellent rote memories and good intellectual potential of the 11 children in his study, but does not begin to prescribe specific intervention strategies.

While there is some continuity in Kanner's description and the current description, autism and its categorization have been part of an evolving journey. In the initial release of the DSM (1952), autism was only used as a characteristic description under the schizophrenic label (Grinker, 2007). There was not a separate category. The same held true for the 1962 edition of the DSM (Grinker, 2007). In the third edition of the DSM, released in 1980, autism was

grouped under Pervasive Developmental Disorders (Volkmar, Cicchetti, Bregman, & Cohen, 1992). As it stands, autism is one of the five disorders grouped under the Autism Spectrum Disorders category of the DSM IV-TR (released in 1994). However, the arrival of the highly anticipated revised DSM V (May, 2013) will likely offer a different division of subcategories (Rutter, 2011a; Rutter, 2011b).

Paralleling the evolution of the definition of autism is the increase in the diagnosis of autism as indicated by current research. In 2002, one out of every 150 children was diagnosed with autism; in 2004, one out of every 125; in 2006, one out of every 110. There was a 57% increase between 2002 and 2006 and according to the data by the Autism and Developmental Disabilities Monitoring Network which was collected in 2008 and reported in 2012, one out of every 88 children in America was diagnosed with autism.

As the incidence statistics rise, people are becoming more aware of the disorder and its characteristics (Fombonne, 2003). Consequently, parents are also becoming better informed on teaching strategies that are most beneficial to individuals with autism. The successful use of education interventions, based in ABA, by Lovaas and colleagues at UCLA, has drawn vast attention to their teaching strategies. The UCLA model focused on children diagnosed with autism prior to age five (Smith & Lovaas, 1998). Most participants were 3-years old and under when entering the program. The program generally included 40 hours per week of instruction for two to three years. Smith and Lovaas (1998) explained that the program used prompting and fading along with positive reinforcing items to shape behaviors meet to criteria. Once children learned some preschool skills in a one-on-one setting they were slowly introduced into the preschool setting with peers who did not have autism. Generally, this introduction to preschool

began with 30-minute sessions and gradually increased to a full 3-hour session (Smith & Lovaas, 1998). In 1987, Lovaas reported the findings of his study, which began in 1965 and included 20 students who received 40 hours of intervention across 2 years. When assessed, nine participants' IQ scores increased approximately 20 points after the intervention (Lovaas, 1987). A five-year follow up revealed that the IQ gains were maintained. More follow up assessments indicated that eight out of the nine students, whose IQ scores increased, could be labeled as typically developing (Lovaas, 1987). Additional researchers agree with Lovaas in their support of using components of ABA to teach individuals with ASD (Arnal et al., 2007; Salem et al., 2009; Smith, 2001; Steege, Mace, Perry, & Longnecker, 2007; Sturmey, 2008; Thiessen et al., 2009).

The National Research Council (2001) makes recommendations when it comes to educating individuals with autism. They suggest that individuals with autism receive early intensive intervention that is equivalent to a full school day. They propose using short increments of planned teaching opportunities, with sufficient amounts of one-on-one or small group instruction. The National Research Council does not recommend a specific intervention methodology. However, The State of New York Health Department (1999) and The United States Surgeon General support the use of ABA for students with autism. Several researchers have reported incorporating methods of ABA when teaching students with autism (Babel, Martin, Fazzio, Arnal, & Thomson, 2008; Fazzio, Martin, Arnal, & Yu, 2009; Salem et al., 2009; Thiessen et al., 2009) because these specific principles have been proven successful in instructing individuals with autism (Green, 1996; Lovaas, 1987; Smith, 2001).

Several instructional practices have also been developed using ABA principles. For example, discrete trial teaching (DTT) is a teaching strategy that uses principles from ABA

(Smith, 2001) and has been shown to be helpful in teaching skills to individuals with autism (LeBlanc et al., 2005; Lerman et al., 2004; Lovaas, 1987; Smith, 2001). Although several researchers agree DTT is effective for teaching students with autism, few pre-service teachers graduate with training on how to accurately implement DTT (Downs, Downs, & Rau, 2008). This lack of training is likely to pose a problem, as many parents are demanding those services for their children (Choutka, Doloughty, & Zirkel, 2004).

Discrete Trial Teaching and Feedback

Correct implementation of DTT is important to improve the skills of individuals receiving DTT. Relative to DTT processes, Kretlow and Bartholomew (2010) indicated "low or inconsistent levels of fidelity with teaching procedures correlated with lower gains in student achievement" (p. 279). Koegel, Russo, and Rincover also discovered that an increase of treatment fidelity increased student correct responding (1977). One way to increase the fidelity of implementation is to ensure adequate training of pre-service teachers in the delivery of DTT. In a 2008 study Downs, Downs, and Rau, reported that undergraduate psychology students participating in an 8 hour training including receiving oral and written feedback, demonstrated at least 90% accuracy in administering DTT. Kretlow, Wood, and Cooke (2011) discovered that, while rates of implementing new strategies did increase after training, implementation with high stability and accuracy was not present until a side-by-side feedback component was added during instruction.

When evaluating the importance of maintaining high levels of accuracy in implementation, feedback can take many forms and can be immediate or delayed. There is documented evidence suggesting the effectiveness of immediate feedback versus delayed

feedback (Coulter & Grossen, 1997; Goodman, Brady, Duffy, Scott, & Pollard, 2008; Scheeler & Lee, 2002; Scheeler, McAfee, Ruhl, & Lee, 2006). More scholars report, when comparing immediate feedback to delayed feedback (one-three days) that teachers learned and used effective teaching strategies faster and more accurately when immediate feedback was presented (Coulter & Grossen, 1997; O'Reilly et al., 1992, O'Reilly, Renzaglia, & Lee 1994). Delayed feedback provides opportunities for teachers to practice errors (Malott & Suarez, 2004; Scheeler et al., 2006; Scheeler, Ruhl, & McAfee, 2004). Such practice may lead to poor teaching habits that may, in turn, lead to poor student performance.

Bug in Ear

While some authors praise the effectiveness of immediate feedback, O'Reilly, Renzaglia, and Lee (1994) raise a concern regarding how disruptive this type of feedback could be in a classroom. Although DTT is typically administered in a one-on-one setting (Smith, 2001) where there is not a classroom to disturb, immediate feedback could likely be a distraction to an individual with autism and Patten and Watson (2011) note that in this setting some students with autism struggle to maintain attention. Scheeler, McAfee, Ruhl, and Lee (2006) and Scheeler and Lee (2002) report on an innovation in technology that allows for immediate feedback that does not interrupt instruction. This innovation, the Bug in Ear (BIE) is covert and is unlikely to be intrusive to students with autism. A study by Scheeler et al. (2006) points out the successes of using this technology to provide immediate feedback to pre-service teachers. Rock et al. (2009b) also write of the effective uses of BIE technology in the classroom. The researchers suggest that providing immediate feedback through BIE technology positively impacts teacher praise behavior and the use of advanced teaching strategies.

Discrete Trial Teaching Evaluation Form

When providing feedback through BIE regarding DTT implementation, it is important that the feedback be reliable (Babel et al., 2008). In 2006, a checklist called the Discrete Trial Teaching Evaluation Form (DTTEF) was created by Fazzio and Martin to assess the implementation of DTT. The DTTEF contains components that are important to evaluate during the DTT procedure as determined by nine experts over two studies (Babel et al., 2008; Jeanson et al., 2010). Jeanson et al. (2010) indicate that the live inter-observer agreement (IOA) of the DTTEF is above the recommended amount (80% agreement) and that the measure is capable of distinguishing between high quality and low quality DTT implementation. A social validity questionnaire completed by the parents revealed that they believe the DTTEF is socially important. Concurrent validity was demonstrated when comparing the scores of independent expert scorers not using the DTTEF as a guide to rate DTT implementation against those who were using the DTTEF to rate the implementation of DTT (Jeanson et al., 2010).

Statement of the Problem

Currently, the demand for effective treatment of individuals with autism is higher than the supply of trained and experienced implementers (Foxx, 2002). Individuals working with students with autism need special training that is effective in order to enhance the lives of those individuals (McGee & Morrier, 2005). Conversely, when the training of individuals who will be implementing interventions is inadequate the student achievement is negatively affected (Jahr, 1998). In teacher preparation programs, pre-service teachers are being trained and are presented with a tremendous amount of information regarding teaching students with autism including ABA, naturalistic learning, assistive technology, socialization, communication, inclusion

environmental adaptations, language interventions, assessments and data collection techniques (National Research Council, 2001).

Unfortunately, all of the valuable information and skills that are learned in the pre-service settings do not always generalize to the K-12 classrooms (Scheeler, 2008). Koegel et al. (1977) found after training 11 teachers on DTT instruction, the fidelity of treatment implementation increased as well as student correct responding. Witt, Noell, LaFleur, and Mortenson (1997) also reported successful increase of treatment fidelity after training (100% accuracy). However, after a period of time, the treatment fidelity decreased for all teachers; fortunately, adding a feedback component to the treatment increased the treatment fidelity. Bibby, Eikeseth, Martin, Mudford, and Reeves (2001) attempted to replicate the success of the Lovaas study reported in Smith and Lovaas in 1998. Bibby and colleagues (2001) share that the lack of treatment fidelity may have played a role in the low levels of success. Because providing feedback through BIE technology has increased treatment fidelity (Coulter & Grossen, 1997; O'Reilly et al., 1992, O'Reilly et al., 1994; Rock et al., 2009b; Scheeler et al., 2004), feedback through BIE may provide the missing ongoing support as teachers implement newly learned skills, such as administering DTT, in their own classrooms.

McIntyre, Gresham, DiGennaro, and Reed (2007) and Wheeler, Baggett, Fox, and Blevins (2006) reviewed the literature from The Journal of Applied Behavior Analysis's database and three search engines (PsyLit, ERIC, and InfoTrac) to reveal that research with detailed descriptions of treatment integrity is limited. Additionally, in 2004, Sarokoff and Sturmey attempted to locate methods used in training individuals to implement DTT. Their search yielded minimal results. Further, there is even less research examining the use of

synchronous feedback of DTT implementation through BIE. This study attempted to change those results and contribute to the literature by replicating portions of a 2007 dissertation by Daniela Fazzio. This study focused on two phases, baseline and treatment. The baseline phase was identical to Fazzio's baseline, in which the participants were provided time to read an abbreviated one-page self-instruction manual. Afterwards, they were asked to implement DTT with the confederate, who would receive DTT. During the treatment phase, the participants were asked to implement DTT to a confederate again, but this time, the current researcher introduced feedback (regarding accurate DTT implementation) through BIE technology, which was not used in Fazzio's work.

Purpose of the Study

The purpose of this study was to contribute to the literature regarding the fidelity of DTT implementation while receiving synchronous feedback through BIE. This study compared pre-service teachers' DTT implementation fidelity after reading three abbreviated one-page self-instruction manuals versus their DTT implementation fidelity after reading three abbreviated one-page self-instruction manuals and receiving feedback via BIE. The BIE feedback during DTT was a partial replication of the existing research of Fazzio (2007), with modifications.

Research Questions

This study will seek to answer the following questions:

1. How does Bug in Ear feedback impact implementation of discrete trial teaching procedures as measured by the Discrete Trial Teaching Evaluation Form for three undergraduate pre-service teachers in education?

2. How does participants' percent correct implementation of DTT procedures change from pre to post Bug In Ear feedback?
3. How does fidelity impact participants' rating of the acceptability of the goals, procedures, and outcomes as socially valid as measured by a social validity questionnaire?

Application to Practice

This study focused on the fidelity of DTT implementation with and without receiving feedback via BIE. Through feedback with BIE, the researcher hypothesized that pre-service teachers would internalize the skills necessary to implement DTT correctly and would take that knowledge into the classroom when working with students with autism. Research by Downs et al. (2008) indicated that correct implementation of DTT had a direct positive correlation to gains in student achievement.

Definitions of Terms

Abbreviated one-page self-instruction manuals – manual originally developed in 2006 by Fazzio and Martin, but revised most recently in 2009 to include topics such as recording data in addition to DTT implementation procedures (G. L. Martin, personal communication, July 6, 2011). The manual includes three abbreviated one-page self-instruction manuals which the current research revised for use in this study.

Bluetooth – method to share information through various means such as cellular phones, telephones, laptops, and personal computers (adapted from Wade, 2010).

Bug in Ear – wireless telecommunication earpiece device (i.e. Bluetooth)

Confederate – an individual using a script to portray an individual who needs to receive discrete trial teaching (Arnal et al., 2007).

Discrete trial teaching – Discrete trial teaching is a teaching method that has been proven to be helpful in teaching skills in individuals with autism (Smith, 2001). It consists of concepts or skills that are broken down into small pieces and typically taught in a one-on-one environment using a highly organized method (Smith, 2001; Tews, 2007).

Discrete Trial Teaching Evaluation Form (DTTEF) – an evaluation form that delineates 20 steps of the discrete trial teaching procedure that are necessary to accurately implement discrete trial teaching (Fazzio et al., 2009).

Fidelity – implementing the components of the DTTEF as designed (Belifore, Fritts, & Herman, 2008).

Instructional Feedback – immediate feedback delivered up to three seconds after the desired behavior was not observed (adapted from Scheeler et al., 2006; Wade, 2010).

Pre-service teachers – University students enrolled in the Education program (Scheeler et al., 2004).

CHAPTER TWO: LITERATURE REVIEW

Bug-In-Ear (BIE) has been helpful in the past in increasing the accuracy of various practices (Rock et al., 2009b; Scheeler & Lee, 2002; Scheeler et al., 2004; Scheeler et al., 2006) and could be useful in increasing the accuracy of implementing discrete trial teaching (DTT). This literature review will trace the connections between autism and applied behavior analysis (ABA) examining the specific practice of DTT. Next, the role of feedback and observations in DTT will be discussed and the use of BIE technology for feedback in DTT will be explored. Finally, this chapter culminates with a systematic examination of the research related to DTT as supported by BIE technology.

Autism and Applied Behavior Analysis

Autism is a developmental disorder that effects communication and social interactions (American Psychiatric Association, 2000). Individuals with autism typically struggle to learn information through incidental or informal teaching (Smith, 2001). This difficulty acquiring educational information haphazardly from the environment can lead to irritation and undesirable behaviors. Typically, individuals with autism function better with a more direct learning approach. Applied Behavior Analysis (ABA) is one such approach. ABA is an evidenced based methodology (Green, 1996) with strategies that can be used to teach individuals with Autism Spectrum Disorders (ASD) (Arnal et al., 2007; Salem et al., 2009; Smith, 2001; Steege et al., 2007; Sturmey, 2008; Thiessen et al., 2009).

Many years of research were examined to develop the philosophy of science called ABA (Hayward, Gale, & Eikeseth, 2009). ABA is dedicated to the comprehension and advancement of human behavior (Heward & Cooper, 1987) and combines principles from the work of many

notable individuals. Watson's belief that psychology should be based on observable behavior rather than mental processes or states of mind was a major contribution (1913). Skinner further studied behavior and added that the consequences of behaviors influence whether or not the behavior was replicated (1953). In an attempt to replicate and increase compliant behavior, Wolf et al. (1964) were the first group to use behavior modification with a child with autism. Their primary goal was training the child to wear eye glasses, but they also addressed tantrumming behavior, appropriate eating skills, and language acquisition. Baer, Wolf, and Risely felt that experimental control was important in ABA (1968). These researchers thought it was imperative to determine if applying principals of behaviors would result in any changes (1968). Bijou asserted that applied research should be implemented to better the education of students and to generalize that information to other environments (1970).

More recently, researchers have used applied research with students with autism and indicate that ABA principles (e.g., reinforcement, shaping, error correction, etc.) have demonstrated empirical evidence of improvements in these individuals (Green, 1996; Lovaas, 1987; Smith, 2001). ABA entails addressing socially relevant behavior using a scientific framework (Hayward et al., 2009). Programs based on ABA should be systematic and contain replicable programs that have measurable results. An efficient ABA program is implemented in the student's natural environment, includes intensive comprehensive instruction involving parents, is based on research, and is supervised by a qualified individual (Hayward et al., 2009).

Discrete Trial Training

Lovaas combined elements from various researchers with his own ideas for his research. He built on what Hayward described as an efficient ABA program. Lovaas borrowed ABA

elements from many research pioneers to develop DTT. From Risley, Wolf, and Mees (1964), he imitated the highly structured one-on-one instruction method. Baer and Bijou inspired Lovaas to code direct observations (as cited in Smith & Eikeseth, 2011). Lovaas' investigations of antecedents and consequences were influenced by Allyon and Goldiamond. Allyon and Roberts, decreased inappropriate behaviors by increasing skill acquisition (1974). Goldiamond wrote of the experimental control of reinforcement (1961; 1976). Lovaas built on much of this work to implement subsequent studies, which closely match modern DTT.

DTT is one instructional method that falls in the ABA category (LeBlanc et al., 2005; Steege et al., 2007; Tews, 2007). DTT has proven to be helpful in teaching skills to individuals with autism (LeBlanc et al., 2005; Lerman et al., 2004; Lovaas, 1987; Smith, 2001). DTT consists of skills that are broken down into minute steps and is typically taught in a one-on-one environment using a highly organized method (Smith, 2001; Tews, 2007). The one-on-one format also contributes to the students' increased learning as it allows instruction to be individually designed for each student. DTT is made up of many short teaching cycles, which means the information can be presented frequently and learning opportunities are increased. The teaching cycle is very predictable to the child because it follows the same basic format (Smith, 2001) and consists of several parts. Smith (2001) focuses on five distinct parts, whereas, Babel, Martin, Fazzio, Arnal, and Thomson (2008) deconstruct the teaching cycle down even further into 20 parts. The 20 components have been identified by experts in the field as integral parts of DTT (Babel et al., 2008; Jeanson et al., 2010).

Early intervention DTT is typically delivered in the student's home or childcare setting (Hayward et al., 2009). Frequently, DTT materials and instruction are contained to one room in

that setting. However, students are given the opportunity to explore their environments to increase the chances of incidental teaching opportunities and generalizing skills throughout the home. Moving throughout environments also provides the family members with the chance to learn more about teaching and generalization strategies. DTT also extends outside of the student's home to incorporate important places in the student's neighborhood such as parks, restaurants, and stores (Hayward et al., 2009). Downs, Downs, Johansen, and Fossum (2007) demonstrate a functional relationship for DTT intervention effects based on the fact that their successful training of pre-service teachers to implement DTT has been shown to demonstrate positive results in the academic gains of students. As a result of these effects, many parents are demanding that this specific method be used when teaching their children with autism as evidenced by Choutka, Doloughty, and Zirkel (2004).

As parents become more interested in DTT for their children, it is important the individuals administering DTT have proper training (Ingersoll & Smith, 2003). Most teachers do not graduate with extensive experience in DTT implementation (Downs et al., 2008) and some teachers feel as though they have been thrown in the classroom without enough support.

Several researchers have examined the effectiveness of preparing individuals to implement DTT using various treatment packages. A number of these articles are displayed in Table 1 and a more detailed description follows.

Table 1: Summary of DTT Implementation Treatment Packages

Discrete Trial Teaching		
Summary	Author	Date
Video clips, practice, and feedback.	Koegel	1977
Quizzes and scored DTT video. Received feedback on scores.	Arnal et al.	2007
Quizzes and scored DTT video. Received feedback on scores and self practice.	Salem et al.	2009
Quizzes and self practice.	Thiessen et al.	2009
Quizzes and feedback plus demo 1 and 2.	Fazzio	2009
Video instruction and modeling and feedback.	Severtsen	2011

In 1977, Koegel et al. conducted a study that required the in-service teachers to read a self-instruction manual and watch video clips demonstrating correct and incorrect implementations of DTT. Next, the participants implemented DTT with a child with autism. Corrective and supportive feedback was provided every 5 minutes and descriptive feedback was provided every hour. The total training took about 25 hours to complete. The training was effective in improving fidelity of implementation and improving student responses. Results generalized to new targets and new students. Ten years later, Gilligan, (2007) focused on 10

components of DTT during their investigation of effective DTT training. During the collection of baseline data the participants (paraprofessionals) were given 1 hour to look over the directions for DTT implementation. The training took 15 minutes to review implementation procedures with the participants. Participants were allowed to ask questions and were provided a hard copy of directions. The participants then implemented DTT with students with developmental disabilities. During the intervention phase the participants implemented DTT and were given verbal feedback regarding their implementation, which lasted up to 8 minutes. DTT implementation improved with treatment and maintained at high levels 3 months afterward.

Also in 2007, Arnal and colleagues conducted two experiments related to teaching undergraduate students taking courses in psychology to implement DTT. In study 1, the participants examined a one page summary then implemented DTT to a confederate during the baseline condition. During the treatment condition, they read and mastered a self-instruction manual before implementing DTT. During this implementation, the participants were allowed to use a 1-page summary as a guide. The accuracy of DTT implementation increased after the treatment condition. During the second experiment, the participants watched a video of someone implementing DTT and then each participant used the Discrete Trial Teaching Evaluation Form (DTTEF) to score the DTT implementation on the video (see Appendix E). Their scores were praised if correct and corrected if incorrect. Next, the participants implemented DTT and their implementation accuracy increased again.

In 2009, there were three similar studies (Fazzio, 2009; Salem et al., 2009; Thiessen et al., 2009), all examining training individuals (undergraduates enrolled in psychology or behavior modification courses) to implement DTT using a self-instruction manual. During baseline, each

of the studies provided the participants 10 minutes to study a 1-page summary of how to implement DTT. The participants were then instructed to implement DTT to a confederate. The treatment phases varied slightly among the three studies. Each researcher provided the participants unlimited time to study a self-instruction manual (developed by Fazzio & Martin, 2006). However, Salem et al. (2009), included two additional components: watching a videotape of correct DTT implementation and practicing implementing DTT alone. Fazzio, 2009, administered quizzes as the participants studied the self-instruction manual. Participants were required to reach 100% accuracy on each of the chapters' quizzes to move on to the next phase. At the end of this phase each of the three studies (Fazzio, 2009; Salem et al., 2009; Thiessen et al., 2009) instructed the participants to deliver DTT to a confederate again. During this administration of DTT to a confederate, Thiessen et al. and Salem et al. allowed their participants to use a 2-page self-instruction manual while Fazzio did not. Next, the participants in all of the studies moved on to a generalization phase, where DTT was implemented to an individual with autism.

Thiessen et al and Salem et al concluded their studies at that point, but Fazzio continued by providing 3 additional phases for participants who had not reached master criteria of 90% or above (in DTT implementation). Phase 3 included feedback plus demonstration, where the participants received specific feedback on correct and incorrect aspects of their own DTT implementation. The participants also watched a demonstration on correct DTT implementation with a confederate. Next, the participants were asked to implement DTT to a confederate again. Fazzio went on to add an additional phase in which the participants were asked to generalize implementing DTT to a task in which they did not receive training. In a final phase the

participants were asked to implement DTT to a child with autism. Fazzio went on to include a second experiment that attempted to use the same methods as used above and generalize them to parents of students with autism and individuals who worked with students with autism. Accuracy of DTT implementation increased with the treatment package in each of the three studies described above.

Also in 2009, Thomson Martin, Arnal, Fazzio, and Yu conducted a literature review and found 17 articles that discussed/evaluated treatment packages for DTT training; had a measurement to determine how effective the training package actually was; and documented acceptable rates of IOA. The authors found it difficult to compare the various training methods because the studies varied in many aspects. First, their participants had different amounts of experience in DTT. Second, the amount of time instructing participants in DTT implementation varied across studies. Lastly, although each of the studies had an evaluation component, they did not measure the same number of DTT procedures.

A dissertation by Severtson (2011) is the most recent study examining the effects of a self-instruction manual on the accurate implementation of DTT. The author compared a self-instruction manual, video based instruction and modeling, and performance feedback when training participants to implement DTT to confederates. The self-instruction manual by Fazzio and Martin (2006) was modified and used. Participants included paraprofessionals and newly hired employees of an in-home autism program. During baseline the participants were provided up to 10 minutes to study a 1-page instruction sheet. The participants were then provided teaching material and instructed to implement DTT to a confederate. The DTT session lasted until the 12 trials were complete or up to 10 minutes in length. No feedback was delivered

during baseline. During the self-instruction phase, participants were provided up to 2 hours to review the self-instruction manual. After 2 hours or when participants indicated they were finished, they were given a quiz on the material in the manual, which took approximately 20-30 minutes for most participants. The researcher graded the quizzes and went over the results with the participants, but no questions were answered and the participants were not permitted to review the manual. The participants were instructed to implement DTT again to the confederate. If they reached the mastery criteria, they moved into the generalization phase of the study. If the participants did not reach the mastery criteria, they moved into the video instruction and modeling phase.

During the video instruction and modeling phase, the participants watched a video depicting correct and incorrect DTT implementation. The video featured narration, outlining which steps had been implemented accurately and which steps had not been implemented inaccurately. This provided the participants examples of both accurate and inaccurate DTT implementation. Next, the participants implemented DTT to the confederate again. If the participants reached mastery, they moved into the generalization phase of the study. If they did not reach mastery, they moved into the performance feedback phase.

During the performance feedback phase, the researcher reviewed the most common errors committed by the participants during the previous intervention session. The researcher answered any of the participants' questions relating to DTT implementation. The participant then implemented DTT to the confederate and received immediate verbal feedback from the researcher during implementation until 100% accuracy over all 12 trials was achieved. The

participants repeated the implementation of DTT to the confederate again, but without feedback. Once participants reached mastery during this phase they moved into the generalization phase.

During the generalization phase, participants attempted to generalize their skills to a new program. The participants were provided a 1-page instruction sheet and materials for implementing a new task that they had not received any training on. Participants were given up to 10 minutes to review the instruction sheet. During DTT implementation, the participants were not provided any feedback. One follow up probe was conducted 3-5 days following mastery. The researcher found that half of the participants reached the mastery criteria using only the self-instruction manual as a guide. The other participants needed to complete all of the intervention phases to reach the mastery criteria.

While training to teach individuals to implement DTT accurately seems scarce, some researchers have highlighted their successes. Some researchers used self-instruction manuals to successfully prepare individuals to accurately implement DTT (Arnal et al., 2007; Fazzio, 2009; Salem et al., 2009; Severtson, 2011; Thiessen et al., 2009; Thomson et al., 2009). Several groups of researchers utilized a multi-component treatment package with diverse groups of participants. Bolton and Mayer (2008), O'Guin (2011), and Dib and Sturmey (2007) successfully used a multi component treatment package to prepare paraprofessionals to accurately implement DTT. Downs et al. (2008) also utilized a multi-component treatment package, but to prepare research associates to implement DTT correctly. Crockett, Fleming, Doepke, and Stevens (2007) used a multi-component with parents and Koegel et al. (1977) used a multi-component treatment package with teachers to ensure accurate DTT implementation. Some researchers used video modeling alone to prepare individuals to implement DTT (Cantania, Almeida, Liu-Constant, &

Digennaro Reed, 2009) while other researchers used video modeling in conjunction with performance feedback to insure fidelity of DTT implementation (Leblanc et al., 2005; Gilligan, 2007). Sarakoff (2008), Sarokoff and Sturmey (2004), and Lafasakis and Sturmey (2007) all used a behavior skills training package to increase the fidelity among DTT implementation.

While success has been demonstrated in the past, the need for further supervision and feedback during DTT implementation still exists. Kretlow, Cooke, and Cooke (2011) found that while rates of implementing new strategies did increase after training, implementation with high stability and accuracy was not present until a feedback component was added.

Feedback and Observations

In a recent study evaluating feedback to improve the fidelity of evidence-based practices, Kretlow and Bartholomew (2010) discovered a correlation between low student achievement and implementing teaching procedures inaccurately. To increase the fidelity of evidence-based practices, McLeskey and Billingsly (2008) suggested looking to the training of pre-service and in-service teachers. Often times when pre-service teachers are introduced to evidence-based practices for the classroom there is minimal follow-up once teachers return to their classrooms (Scheeler et al., 2009) as evidenced from the following studies. After a training, Koegel et al. discovered an increase in the fidelity of treatment implementation as well as in student correct responding (1977). An increase in treatment fidelity also was reported by Witt et al. (1997). However, the gains in treatment fidelity decreased when generalized to the classroom until a feedback component was added. In 2001, Bibby et al. (2001) conducted a replication of the UCLA Early Intervention Project described by Lovaas, Koegel, Simmons, and Long (1973). In this study, Lovaas et al. addressed inappropriate behaviors and language deficits. Each

participant in the study made some gains during treatment. Follow up studies highlighted that the children receiving treatment made more progress than those who were institutionalized. Bibby et al. (2001) announced that the lack of treatment fidelity in their study may have been detrimental as they attempted to replicate Lovaas' work.

While treatment fidelity is important, teachers typically receive trainings through a one-day training (Kretlow & Bartholomew, 2010). Kretlow et al. (2011) add that this type of training is effective initially, but these successes do not sustain without at least one individualized feedback session. Kretlow and Bartholomew (2010) reviewed 13 studies where feedback was used. Their review revealed improvement in teaching accuracy in all cases. When looking at social validity, they found that teachers rated the feedback experience positively and would have liked to have had more feedback sessions. When examining student outcomes as a result of feedback, there was an increase in academic engagement or on-task behavior. According to Kretlow and Bartholomew (2010), there is "strong evidence for the effectiveness of coaching in promoting the fidelity of evidence-based practices" (p. 292).

Researchers further specified that the type of feedback is important and found immediate feedback to be superior to delayed feedback (Coulter & Grossen, 1997; Sheeler et al., 2006; Scheeler & Lee, 2002). Studies indicated that when comparing immediate feedback to delayed feedback (one to three days) teachers comprehended strategies quicker and implemented them with more fidelity when they received immediate feedback (Coulter & Grossen, 1997; O'Reilly et al., 1992, and O'Reilly et al., 1994). According to Scheeler et al. (2006) Malott and Suarez (2004) and Heward (1994), opportunities to practice errors increased with delayed feedback and could lead to poor teaching habits.

The effectiveness of immediate feedback has been supported by many researchers, but O'Reilly et al. (1994) raised a concern regarding the disruption immediate feedback could cause in a classroom. However, Scheeler and Lee (2002) indicated that technology has evolved and now presents opportunities for covert immediate feedback that does not interrupt instruction.

Bug-In-Ear Feedback

BIE feedback is one option that can be tied to preparations for a more effective feedback component. However, before BIE and other alternatives for covert immediate feedback came into existence, feedback was generally delivered in an immediate or delayed face-to-face format. Several of the major articles in the field of BIE feedback are listed in Table 2.

Table 2: Summary of BIE Articles

Bug In Ear Literature		
Summary	Author	Date
Used BIE in counseling	Korner and Brown	1952
Behavior Modification	Bowles and Nelson	1976
Three term contingencies	Scheeler and Lee	2002
Added Skype™ and increased mobility	Rock et al.	2009
Co-teaching	Scheeler et al.	2010

In 1952, Korner and Brown reported on a technology known as the "mechanical third ear." It was made of two main components: an FM system and a transmitter. Essentially, this BIE technology is a radio system where the teacher wears a 'bug' (transmitter) in the ear and the

coach is able to deliver immediate feedback through a radio system (Goodman et al., 2008). Many researchers have used this BIE technology for various studies (Baum, 1976; Bowles & Nelson, 1976; Giebelhaus, 1994; Giebelhaus & Cruz, 1995; Hunt, 1980; Kahan, 2002; Rock et al., 2009b; Scheeler & Lee, 2002; Scheeler et al., 2004; Scheeler et al., 2006; Thomson, Holmberg, Baer, Hodges, & Moore, 1978).

In 1976, Bowles and Nelson conducted a study evaluating the impact of in-service training. Phase one of the treatment condition consisted of only in-service training. BIE feedback was delivered during phase two. In phase two of the treatment condition, the six remaining participants were divided. BIE feedback was delivered to four participants, while the other two participants, along with the control group, received nothing. Results were measured through four observations (two pretests and two posttests during each phase) in which different components of teacher behavior were measured (such as praise and verbalization). The researcher found that none of the information or strategies demonstrated during the in-service training generalized into the classroom until BIE feedback was added.

Much later, in 1994, Giebelhaus, conducted the first BIE study in teacher education using a true experimental design. The study included 22 elementary education students whose cooperating teachers provided BIE feedback on 14 discrete teacher clarity behaviors. The researcher determined that student teachers and supervising teachers enjoyed using BIE. BIE was an effective and appropriate tools to deliver feedback to student teachers, student teachers were able to handle input from 2 verbal stimuli (BIE and classroom happenings) and student teachers adjusted their behaviors based on the BIE feedback. In 1995, Giebelhaus joined with Cruz and continued this line of research. The researchers enlisted 25 elementary education pre-

service teachers as participants. Their cooperating teachers or their university coordinators provided BIE feedback on eight discrete teacher clarity behaviors. Participants who received BIE prompts acted on those prompts immediately and later when there were no prompts. Participants noted that BIE reminded them to focus on what they were doing during the observation as well as during the post conference time. Participants were able to function with the classroom stimuli and the stimuli from BIE feedback. Participants noted that BIE promoted a sense of confidence.

In 2002, Scheeler and Lee began examining the effect BIE corrective feedback had on three term contingency completion. Delayed feedback was presented during the baseline phase and immediate feedback was presented during the treatment phase. Immediate feedback resulted in more three term contingency completions. Moreover, when teachers implemented three term contingencies correctly, student responses increased in accuracy. Scheeler et al. (2006) went on to contribute to the field by discussing the advantages and disadvantages of delayed feedback versus immediate feedback. The researchers proclaimed that delayed feedback does not disrupt flow, but allows for ineffective procedures to continue, which could have a negative effect on student learning. Further, deferring feedback could give the appearance that there are no highlights of the teaching because all of the negative aspects are addressed at one time. Immediate feedback reduces the chances of teachers practicing ineffective strategies, but does so by interrupting the flow of the classroom. BIE feedback could solve the problem of interruptions.

In 2009, Goodman, Brady, Duffy, Scott, and Pollard extended the work of Scheeler et al. Goodman et al. used BIE to provide feedback on learn unit accuracy and delivery rates. Both

increased with use of BIE feedback. In 2009, Rock et al. utilized the practice of providing BIE for feedback to increase the rate that teachers delivered praise statements, to increase the rate that teachers used effective practices, and to increase the amount of student on-task behavior. Teachers felt BIE feedback was effective, but required patience and determination from participants and trainers. Most recently, in 2010, Scheeler et al. examined using BIE feedback in co-taught inclusive classrooms. The co-teachers were split up and provided feedback to their partners on three term contingency completion. With BIE feedback, three term contingency completions increased. Once BIE feedback was removed, three term contingency completions were generalized to different settings.

Baum (1976) described the use of BIE feedback to assist in training graduate students to implement intelligence assessments. The students reported that BIE feedback decreased their levels of anxiety regarding implementing the assessments. The students also shared that BIE feedback increased their awareness of administration skills that needed improvement. An additional study by Bowles in 1976 evaluated the impact of in-service training. Upon completion of the study, the researcher noted the lack of generalization of the information demonstrated during the in-service training into the classroom until BIE feedback was added. Thomson et al. (1978) built on the previous research, examining the variety of ways feedback is delivered to current preschool teachers and future preschool teachers. In this investigation, self-counting and BIE feedback were identified as the most effective methods. Hunt (1980) used BIE feedback to assist medical students in acquiring interview skills. Upon completion, most of the medical students reported feeling anxious prior to interviewing their first patient, but the anxiety subsided as the interview began. Only a small percentage of medical students reported continued

anxiety throughout their interviews. A vast majority of the medical students appreciated the BIE feedback.

In 1994, Giebelhaus continued exploring the effects of BIE while boasting of conducting the first BIE study in teacher education using a true experimental design. The researcher reported successful use of BIE feedback. In 1995, Giebelhaus joined with Cruz and extended this line of research. Participants noted that BIE was not disruptive, but was instead helpful. In 2002, Kahan enlisted two participants to extend the literature examining the use of BIE feedback and think-out-loud methods during supervisory feedback. The researcher examined the characteristics of intralesson dyadic communication, the effects of using a two-way communication device on participants' role satisfaction, and participants' attitudes toward using the device. The researchers discovered that the BIE feedback did not alter the dyad's communication patterns. One participant indicated more satisfaction with the two-way communication device than the other and both participants shared that they were more comfortable communicating without the BIE equipment. Despite these results, research concerning BIE continues. In 2002, Scheeler and Lee began examining the relationship between BIE corrective feedback and three-term contingency completion. Researchers found that BIE feedback increased three term contingency completions. Scheeler and Lee (2002) indicated that the most practical feedback for teachers as they are going through their training program is immediate and corrective.

Scheeler, Ruhl, and McAfee (2004), went on to substantiate the effectiveness of BIE feedback as they conducted a literature review examining characteristics of effective feedback. During their review they used three databases (ERIC, dissertation abstracts, and Psych Info)

from 1970-2003. Three specific categories were analyzed: who delivers feedback, nature of feedback (content of feedback and how it was delivered), and temporal dimensions of feedback (timing and frequency of feedback). Results yielded 10 empirical studies and indicated that immediate feedback was the only attribute that proved to be effective. In 2006, Scheeler et al. took these literature review results, indicating immediate feedback to be effective, and extended them by comparing immediate feedback and delayed feedback. The researchers found that while delayed feedback does not disrupt instructional flow, it also does not intercept ineffective teaching procedures. Addressing the concern of disrupting instruction flow, Scheeler et al., (2006) suggested that immediate feedback be implemented through BIE to maintain instructional momentum. Additionally, Scheeler et al. (2006) found that BIE feedback could also increase three term contingency completion and student responding.

In 2009, Rock et al. contributed to the existing support of BIE in the literature by successfully using BIE feedback to increase the teachers' use of research based teaching practices and increase the teachers and students behaviors. The researchers brought BIE feedback to a more mobile platform with the addition of Skype to the BIE feedback package. Prior to Rock et al. BIE feedback was delivered in close proximity to the recipient (e.g., Baum, 1976; Bowles & Nelson, 1976; Giebelhaus, 1994; Giebelhaus & Cruz, 1995; Hunt, 1980; Scheeler & Lee, 2002; Scheeler et al., 2006). With the use of Skype, BIE feedback can be delivered without any limitations resulting from distance.

Other studies have focused their work on adding BIE feedback in an attempt to increase treatment fidelity and decrease situations similar to those Bibby et al. described. Many researchers have found success at increasing treatment fidelity by providing feedback through

BIE (Coulter & Grossen, 1997; O'Reilly et al., 1992; O'Reilly et al., 1994; Rock et al., 2009; Scheeler et al., 2004;). Thus, feedback through BIE may help support teachers as they implement newly learned skills, such as DTT, in their own classrooms.

The demand for adequate treatment of individuals with autism remains higher than the pool of experienced implementers (Foxx, 2002) as the implementers need to possess specific skills to better serve individuals with autism (McGee & Morrier, 2005). Researchers have found a correlation between implementer training and student achievement (Jahr, 1998). Teacher preparation programs are introducing pre-service teachers to a variety of teaching strategies and skills related to teaching students with autism (National Research Council, 2001). However, not all of the strategies and skills that are learned in teacher preparation programs generalize to the K-12 classrooms (Scheeler, 2008). DTT is a practice for students with autism that is supported by research literature, and BIE may provide a technology platform that would enable improvements in current practice. In the following paragraphs, the research literature is systematically explored, to examine how DTT and BIE are currently used in conjunction.

Systematic Literature Review

Research containing detailed descriptions of treatment integrity is limited even though some researchers find value in it. Wheeler et al. (2006) reviewed 60 articles from nine recognized behavioral journals between 1993 and 2003 in search of articles that disclosed the treatment integrity of their studies. The researchers reported that 11 of the 60 articles evaluated and described treatment integrity data. McIntyre et al. (2007) also conducted a literature review. The researchers reviewed 142 articles published in Journal of Applied Behavior Analysis between 1991 and 2005. McIntyre et al. (2007) determined that 45% of the articles reviewed

were likely to have a high risk of implementing treatments inaccurately. In addition to less than desirable reports of treatment integrity, minimal research exists on the methods used in preparing individuals to implement DTT (Sarokoff & Sturmey, 2004). Even less research exists examining the use of BIE feedback on DTT implementation. As a result, the purpose of this systematic literature review is to search the current research base for connections between BIE and DTT. This systematic literature review attempts to answer the following question:

1. Does the empirical literature in special education examine the use of Bug in Ear feedback with DTT instruction?

Article Selection

This review contains articles selected from a search for literature pertaining to training individuals to implement DTT with high levels of fidelity to students with autism and synchronous feedback through BIE. A search was conducted using ERIC, Medline, PsychInfo, PsycARTICLES, MAS Ultra - School Edition, Middle Search Plus, Primary Search, Professional Development Collection, SPORTDiscus, and Academic Search Premier using the following key words: bug in the ear; bug in ear; bug-in-ear; bug-in-the-ear; BIE; auditory feedback; preservice teacher education; preservice teachers; student teachers; student teaching; teacher education; discrete trial teaching; discrete trial training; discrete-trial; mechanical 3rd ear; mechanical equipment; audio equipment; educational technology; radio; immediate feedback; autism; special education; pervasive developmental disorders and Asperger's syndrome.

Methods

Inclusion criteria. Articles were included if they involved feedback using BIE to improve parent behaviors toward their children; feedback through BIE to improve teachers' skills; feedback using BIE to improve professionals' behaviors in their fields other than education or training in the implementation of DTT.

Exclusion criteria. Articles were excluded if they used discrete trial to mean a small time period and did not delve into any other aspects of DTT. Other articles were excluded if they completed a comparison of DTT and another method of instruction, as this was not within the realm of this study. Additional articles were excluded if they used DTT within animal experimentation or other studies that did not pertain to the fidelity of DTT implementation. Articles were eliminated if they only discussed the effects of reinforcement on the rate of DTT implementation or the student outcomes. More articles were excluded if they only provided an overview of autism or DTT. Lastly, articles were excluded if the term BIE referred to the author's name, or any other acronym that was not discrete trial teaching/training.

Results

Researchers have suggested that DTT is an effective strategy when teaching skills to individuals with autism (LeBlanc et al., 2005; Lerman et al., 2004; Lovaas, 1987; Smith, 2001). However, pre-service teachers are not always instructed on this particular strategy in their university programs (Downs et al., 2008) even though there is extensive research highlighting the successes of training on the fidelity of DTT implementation (Arnal et al., 2007; Bolton & Mayer, 2008; Cantania et al., 2009; Crockett, 2007; Dib & Sturmey, 2007; Downs et al., 2008; Fazzio, 2009; Gilligan, 2007; Koegel, Russo, Rincover, 1977; Lafasakis, 2007; Leblanc et al.,

2005; O'Guin, 2011; Salem et al., 2009; Sarakoff, 2008; Sarokoff & Sturmey, 2004; Severtson, 2011; Thiessen et al., 2009; Thomson et al., 2009). While there is substantial support for training on the fidelity of DTT implementation, this review of literature did not locate any articles combining BIE feedback with training individuals to implement DTT.

Instead, 40 articles were found (see Table 3), with only eight articles identified that discussed BIE feedback in the field of education and eight articles were located that discussed training individuals to implement DTT. These articles are summarized below as they contribute significantly to the field.

Table 3: Categorization of Relevant Literature

Category	Number of articles	Percentage
Feedback using BIE to improve parent behaviors toward child	1	3%
Feedback using BIE to improve professionals' behaviors in their fields other than education	5	13%
Feedback through BIE to improve teachers skills	11	27%
Training individuals to implement DTT	23	57%
BIE and DTT	0	0%

As research developed in the area of BIE, literature was also growing in regards to using self-instruction manuals to prepare individuals to implement DTT. From the initial 372 articles, 142 were excluded because they discussed autism spectrum disorders and/or DTT, but not necessarily in the contexts needed for this study. Another 53 articles were excluded as they met the search criteria because some aspect of the article was contained the search term, BIE. This included articles whose author's names were "Bie" or contained bie as well as various acronyms (e.g., Bureau of Indian Education). Of the remaining 177 articles, 137 were excluded as they used discrete training to mean a short time frame and/or conducted research on animals. The remaining 40 articles were classified in four categories and displayed in Table 3.

Of the 40 articles, six articles were excluded as they described using BIE feedback for educational purposes, but not for DTT implementation. Three additional articles were excluded. Rock, Gregg, Gable, and Zigmond (2009) and Rock et al., 2009a were excluded because the focus was on describing specific projects and discussing tactics for recruitment and retention. Scheeler et al. (2004) was excluded because it was a literature review examining characteristics of effective feedback.

Of the 31 remaining articles, 15 were excluded as they used techniques other than BIE feedback or self-instruction techniques (see Appendix N for Article Exclusion Criteria). The remaining 16 articles were discussed in the previous paragraphs. Eight articles highlighted the use of BIE feedback to improve teaching skills and eight discussed using self-instruction techniques to instruct DTT implementation.

The systematic review of literate failed to identify any articles that combined BIE feedback to enhance DTT implementation. However, there were several studies describing the successful use of a self-instruction manual when teaching psychology majors (or students enrolled in psychology courses) to implement DTT (Arnal, 2007; Fazzio, 2007; Salem, 2009; Thiessen, 2009). The mean duration of time reported to master the self-instruction manual of DTT was 3 hours and 45 minutes. Arnal et al. (2007) reported that 2 hours and 49 minutes were needed for participants to reach mastery levels. Fazzio, 2007 indicated that mastery took 3 hours and 40 minutes. Salem et al. (2009) shared that it took participants 4 hours 47 minutes to master the self-instruction manual. In Thiessen et al. (2009) participants required 4 hours and 34 minutes to master the self-instruction manual. Previous research involving the use of self-instruction manuals for teaching DTT implementation has been limited to psychology majors or

students enrolled in psychology courses whereas the current study utilized pre-service teachers. This dissertation will extend the literature by utilizing a condensed self-instruction manual of DTT procedures with BIE feedback in an effort to demonstrate increased efficiency of training and skill acquisition for pre-service teachers.

CHAPTER THREE: METHODOLOGY

The purpose of this study was to examine the fidelity of discrete trial teaching (DTT) implementation and extend the literature by utilizing Bug in Ear (BIE) to provide immediate feedback for pre-service teachers teaching students in need of DTT.

Research Questions

The research questions were as follows:

1. How does Bug in Ear feedback impact implementation of discrete trial teaching procedures as measured by the Discrete Trial Teaching Evaluation Form for three undergraduate pre-service teachers in education?
2. How does participants' percent correct implementation of DTT procedures change from pre to post Bug In Ear feedback?
3. How does fidelity impact participants' rating of the acceptability of the goals, procedures, and outcomes as socially valid as measured by a social validity questionnaire?

Participants and Setting

This study began with five undergraduate pre-service teachers with no experience administering DTT procedures. However, two participants were lost to attrition. Consequently, the study included three undergraduate pre-service teachers with no experience delivering DTT procedures. To be included in this study, pre-service teachers were recruited from undergraduate students in the Education program at a large University in the Southeast United States, who self-reported that they had no experience with DTT and BIE feedback. A pre-assessment screen was

used to identify pre-service teachers who scored below 70% correct in the initial baseline implementation of DTT, as measured by the Discrete Trial Teaching Evaluation Form (DTTEF). Students who scored below 70% on the DTTEF (Appendix E) were included in this study. Participants were three full time female students ages 23, 26, and 40. Annette, Participant 1, was a senior in the Exceptional Education program. Mary, Participant 2, was a junior majoring in Elementary Education with a minor in Exceptional Education, who disclosed having a reading disability after the completion of the study. She shared that reading written instructions took her longer to comprehend. She went on to reveal that reading instructions and implementing DTT tasks during this study was difficult for her and that it would have been easier if she had access to video examples of DTT implementation or other visual aids. Phoebe, Participant 3, was a junior in the Elementary Education major.

Additionally, the study included one female student who acted as a confederate for each of the participants. The confederate received DTT during training sessions and experimental sessions. She was a senior recruited from undergraduate students in the Psychology program at the same University. The confederate used a script, which led the responses, when reacting to DTT to balance the responses the pre-service teachers experienced. The script also helped to ensure the confederate's responses were not contaminated due to continuous exposure to the treatment.

The study took place in a research laboratory housed at the University, specifically, in a 12ft x 11ft room with a one-way mirror and a video recording system. The room was equipped with a table and two chairs.

Independent Variable

The independent variable was BIE feedback on accurate administration of DTT for undergraduate pre-service teachers. Instructional feedback (IF) and encouraging feedback (EF), using BIE, was based on a script to ensure that the pre-service teachers received balanced feedback (see Appendix F). Both scripts were based on 20 items from the DTTEF (see Appendix E). Each of the 20 components on the DTTEF was adapted to create a statement providing instructional feedback as well as an encouraging feedback statement. These adaptations comprised the IF and EF scripts.

Steps needed to deliver the independent variable

1. The BIE coach used a cellular phone to call the participant, who was fitted with a BIE device.

2. The BIE coach watched the participant conduct DTT sessions

2. The BIE coach used DTTEF as guideline for accurate DTT implementation

3. If the participant deviated from procedures delineated by the DTTEF, the BIE coach provided instructional feedback through BIE using a script. If the participant followed the procedures delineated by the DTTEF the BIE coach provided encouraging feedback through BIE using a script.

Table 4: Material Needed for Study

Materials for Lead Researcher	Materials for Participants	Materials for Confederate
Script (Appendix F)	Three one-page abbreviated manuals (Appendix A)	Script (Appendix G)
BIE enabled cellular phone	Pictures for pointing task (Appendix B)	Tabletop Easel
	Pictures for matching task (Appendix C)	
	Data collection sheets (Appendix D)	
	Writing utensil	
	Tangible reinforcers	
	BIE device	
	BIE enabled cellular phone	

Several materials were needed to deliver and assess the outcomes of the independent variable on participant delivery of DTT procedures included in Table 4. First, three abbreviated one-page self-instruction manuals detailing three specific DTT tasks (pointing to named pictures, visual matching, and motor imitation) were used by the participants (Appendix A). Second, the participants used three pictures for 'pointing to named pictures' task (e.g., pictures of a dog, balloons, bananas see Appendix B) and one set of matching pictures for 'visual matching' task (Appendix C). Third, the participants used data sheets (Appendix D) for recording correct and incorrect responses. Fourth, scripts for the BIE coach and the confederate were used

(Appendices F and G). Fifth, a tabletop easel for the confederate to place the scripts to keep them out of the participants' line of vision was used. Sixth, a writing utensil, tangible reinforcers, BIE device, and two cellular phones were required.

This study utilized Plantronics M50 Bluetooth earpieces. The earpieces were wireless and fit in the participants' ears with an ear loop fitting around the back of the ear lobe. The participants used cellular phones with Bluetooth capability to wirelessly connect to the BIE device and communicate with the researcher.

Training to Deliver Independent Variable

This study required a three-person research team to accurately measure the effectiveness of BIE feedback on DTT delivery for pre-service teachers. The three individuals included a lead researcher, a secondary independent data collector, and a confederate. The lead researcher ran session procedures and attended to experimental conditions, monitored fidelity of implementation and inter-observer agreement procedures, and delivered BIE feedback (BIE coach). The secondary independent data collector was needed for inter-observer agreement and assistance in running experimental procedures. The confederate simulated a student in need of DTT instruction and used a script to help control for variability in responses.

Lead Researcher

The lead researcher provided BIE feedback (BIE coaching) to pre-service teachers. The lead researcher was a Board Certified Behavior Analyst (BCBA) with over 10 years of experience in delivering DTT to individuals with autism. The lead researcher used the DTTEF, which detailed exactly how to deliver DTT procedures, to determine whether the mock participant was implementing DTT accurately. If the mock participant deviated from accurately

implementing DTT, the lead researcher provided IF using a script. If the mock participant implemented DTT accurately, the lead researcher provided EF using a script. These scripts were aligned directly to the 20 steps of the DTTEF. Additionally, these scripts were used during training and experimental sessions and remained the same throughout the study. The researcher had access to all scripts used in the study (Appendices F and G), which provided the researcher with all steps and procedures for implementing DTT and delivering feedback.

Training sessions were videotaped and sent to two expert BCBAs, with over 10 years of experience working with DTT, to code for validity. During training, the researcher watched the DTT session with the mock participant and the confederate. The researcher used the script to intervene; briefly explaining what should be done if an error was committed. For example, if the mock participant started to deliver DTT to the confederate without gaining the confederate's attention, the researcher used BIE to provide a reminder to gain attention before beginning DTT administration. Once each training session was complete, the video recording was sent to the experts. The experts watched the video recording and determined whether the researcher provided accurate prompts at appropriate times according to the DTTEF. The researcher then completed the aforementioned procedure again of watching a DTT session and using a script to provide feedback. Next, this video recording was sent to the experts to rate. Upon viewing and rating the video recordings, the experts indicated whether the researcher provided accurate prompts at appropriate times according to the DTTEF. This cycle continued until 100% accuracy over 3 out of 4 sessions was reached as determined by the two experts. Similar procedures were followed to train the independent data collectors.

Independent Data Collectors

Two independent data collectors, a secondary data collector, and a supplemental data collector, were part of the data collection team. The secondary data collector gathered data across all training and experimental conditions. The supplemental data collector was available to provide inter observer agreement (IOA) during the experimental sessions. Both data collectors were doctoral students with experience in data collection. They used the DTTEF as a guideline. The data collectors watched the mock participant deliver DTT to the confederate. The data collectors used the DTTEF to score the accuracy in which DTT was delivered. The lead researcher also scored these training sessions using the DTTEF. The data collectors' scores were compared to the researcher's scores. The data collectors continued training until proficiency was reached. The data collectors were deemed proficient at scoring when there was a 90% match between their scores and the lead researcher's scores over 3 out of 4 sessions. These sessions were videotaped so each data collector could score identical sessions.

Confederate

The final individual needed to implement the independent variable was the confederate, who simulated someone in need of DTT. The confederate also required training. In this study a confederate referred to a university student portraying an individual who received DTT. The confederate was given a script for the training (Appendix G). The script indicated the responses the confederate should display each time a demand was placed. The researcher delivered DTT to the confederate until reaching at least 80% accuracy (of following the script) over three consecutive sessions.

Assessment of Treatment Integrity

To ensure procedural integrity of the study, a procedural integrity checklist was used, similar to that used by Salem et al. (2009), (Appendix H). The procedural integrity checklist contained each of the steps of the study, including the scripts that the confederate and researcher used. The procedural integrity checklist also indicated which steps were optional (i.e., providing prompts if the confederate responds correctly). Procedural integrity checks were preformed across 20% of all conditions. An independent observer, a recent graduate of the doctoral program, with experience in data collection, and a supplemental data collector used the procedural integrity checklist to assess whether or not the study was being implemented as designed. They also assessed whether the confederate and researcher were following the scripts.

Data collectors also measured the degree to which the confederate was following the script accurately during mock DTT sessions as well as the DTT sessions during the experimental conditions. During the mock DTT sessions, the confederate was considered proficient once 80% accuracy of following the script was reached. The data collectors watched 20% of the experimental DTT sessions and used an identical copy of the script to measure the accuracy of the confederate's use of the script (Appendix G). During the study, an 80% agreement was required between the two data collectors. An agreement was defined as two data collectors scoring an item the same. Disagreement was defined as two data collectors scoring an item differently.

Dependent Variable

The primary dependent variable was pre-service teachers' correct implementation of DTT procedures established by Fazzio (2007). Correct implementation of DTT procedures was

measured using the DTTEF. Correct implementation of DTT procedures was defined as following the components of the DTTEF with at least 90% accuracy. The DTTEF has previously been validated with high rates of concurrent validity and high rates of social validity (Babel et al., 2008; Jeanson et al., 2001). A second dependent variable was pre-service teachers' perceptions of the BIE coaching, experimental procedures, goals, and outcomes, which served as a measure of social validity. The dependent measure was a questionnaire delivered to the participants at the conclusion of the study (Appendix J).

Inter-observer Agreement

It is important that data collectors in a study be adept in collecting data to help maintain the validity of the study (Ayres & Gast, 2010). Inaccurate data collection could result in misleading study results. To ensure data collectors were skilled at scoring DTT sessions accurately, the data collectors and the researcher used the DTTEF and scored videotapes of DTT implementers conducting DTT sessions until IOA was 90% or higher. An agreement was defined as two data collectors scoring an item the same using a point-by-point agreement (Koegel et al., 1977). Disagreement was defined as two data collectors scoring an item differently using a point-by-point disagreement.

$$\textbf{Interobserver Agreement} = \frac{\textbf{Agreements}}{\textbf{Agreements} + \textbf{Disagreements}} \textbf{X100}$$

Figure 1. Formula for Point-by-Point Method for Calculating Inter-observer Agreements

IOA was calculated by dividing the number of trials with agreement by the total number of trials with agreement and disagreement and multiplying by 100 (Figure 1). IOA was collected during 20% of each phase.

Experimental Design, Procedures, and Conditions

The primary research question: (How does Bug in Ear feedback impact implementation of discrete trial teaching procedures as measured by the Discrete Trial Teaching Evaluation Form for three undergraduate pre-service teachers in education?) was addressed with a multiple baseline across participants design. The design was the most appropriate for this study as it lent itself to participant led programming – the participants' responses led the researcher's behaviors (Horner et al., 2005; Kratochwill et al., 2010). For example, the researcher moved the participants into the treatment phase as the participants' data became stable as opposed to using pre-determined criteria. A multiple baseline design across participants allowed for the measurement of program efficacy and with the detailed procedures supplied the program could be replicated by clinicians. Another advantage of this design was that there was not a withdrawal of the intervention, which was beneficial in this study because once the participants were taught procedures of implementing DTT they could not be untaught. Experimental control was established through inter-group direct replication across participants and a clear change in both slope and trend from the baseline to the treatment condition was observed (Gast & Ledford, 2010).

What Works Clearinghouse (WWC) set forth clear standards in identifying research as meeting evidence based standards as well as standards to determine evidence of a causal relationship (Kratochwill et al., 2010). This research implemented a multiple baseline design across participants. The accuracy of pre-service teachers' implementation of DTT was measured by more than one data collector over time as suggested by WWC. Inter-observer agreement data was collected by trained data collectors over 20% of all phases, meeting WWC's criteria of

evidence based standards. This research collected a minimum of five data points during baseline and treatment phases across two phases among three participants to meet the standards according to WWC of attempting to demonstrate an effect. Replication across six phases with a minimum of five data points per phase helps demonstrate experimental control (Kratochwill et al., 2010). Appendix K presents a detailed comparison of WWC standards and the proposed study.

The current research follows the quality indicators of Single Subject research set forth by Horner et al. (2005). First, the current research describes the participants, participant selection, setting, dependent and independent variables, and the baseline and treatment conditions in enough detail to promote replication. Also, the dependent variable is operationally defined, quantifiable, and has been validated and measured repeatedly. To further adhere to Horner's guidelines, the researcher systematically manipulated the independent variable during the study and fidelity was collected on the implementation of the independent variable. Additionally, the baseline condition consisted of repeated measurement of the dependent variable. Experimental control was established as this study collected three demonstrations of an experimental effect at three different points in time across three participants. Threats to external validity were addressed as Horner suggested and the results documented a pattern. In addition, the social validity of the study was examined using a social validity questionnaire which deemed the study and its results to be socially important. In observing Horner's final tenement, the implementation of the independent variable was practical and cost effective.

The quality indicators of Single Subject Research were demonstrated across the six stages of this research. A synopsis of each stage is provided in Table 5 and a more detailed description follows.

Table 5: Clarification of Stages of Study

Stages	Activities	Measured by
Stage I Introduction to study	Summarize study verbally Present written synopsis of study Obtain consent	N/A
Stage 2 Pre-test	Participants will instruct a confederate on one task using DTT	DTTEF
Stage 3 Baseline	Participants will study an abbreviated one-page self-instruction manual. Participants will instruct confederate on three tasks using DTT	DTTEF
Stage 4 Treatment	Participants will instruct confederate on tasks using DTT while receiving BIE feedback	DTTEF
Stage 5 Maintenance without feedback	Participants will instruct a confederate on three tasks using DTT	DTTEF
Stage 6 Post-test	Participants will instruct a confederate on one task using DTT	DTTEF

Initial Participant Assessment and Training

Three participants participated in a pre-test to measure their DTT implementation skills prior to moving into the baseline phase. The pre-test consisted of the participants administering one task, using DTT, to a confederate. Accuracy rates were measured using the DTTEF. If the

participant implemented DTT with an accuracy rate below 70% they were included in the study. As part of the study, the participant received a brief training session consisting of how to place the BIE device in their ear and how to turn it on and off. The researcher left the room and conversed with the participant using the BIE device until the participant self-reported a comfort level had been reached in receiving feedback through the BIE device. The confederate was not present for this portion of the training.

The researcher greeted the participants and attempted to develop a positive rapport by asking questions about their experiences with students with autism. Next, the researcher provided a verbal synopsis of the project, after which, the participants were provided a written description of the project and time to read it and ask questions. Participants were then asked to indicate whether they agreed to participate in the study. Prior to baseline, each participant was asked to participate in a pre-test DTT session.

The pre-test DTT sessions, the baseline DTT sessions, the treatment DTT sessions, and the post-test DTT sessions each consisted of 12 trials per task. The tasks were identical to the tasks used in several previous studies (Arnal et al., 2007; Fazzio et al., 2009; Salem et al., Thiessen et al., 2009). Each task took place at a table with the participant sitting next to the confederate. Materials were placed on the table in front of the participant and out of the confederate's reach. The three tasks included pointing to named pictures, visual matching, and motor imitation (Appendix A). In the pointing to named pictures tasks, the participant placed three pictures on the table in front of the confederate (Appendix B). Next, the participant instructed the confederate to touch one of the pictures (e.g., Touch the picture of the dog). In the visual matching task, the participant placed three pictures on the table in front of the confederate

(Appendix C). Next, the participant gave the confederate one picture that matched one of the pictures on the table and instructed the confederate to place the picture on top of the identical one on the table. In the motor imitation task, the confederate was asked to imitate simple motor movements made by the participant, such as touching their nose. There were three different stimuli included in each task and each of those stimuli was presented four times. For example, while working on the pointing to named pictures tasks, the confederate was asked to point to three different pictures four times to make up the 12 trials (Appendix D). The confederate used a script to ensure each participant experienced the same responses (Appendix G).

Experimental Conditions

In addition to utilizing pre-service teachers as participants, the researcher also enlisted the participation of data collectors and a confederate portraying a student in need of DTT. The confederate was a university student. The confederate used a script that described when specific responses should be displayed (Appendix G). The confederate did not display any physical aggression, self-stimulatory behavior, verbal deficiencies, or any other undesirable behaviors as the focus of this study was the accurate implementation of DTT procedures by the participants. The confederate's responses to each discrete trial task were predetermined and only related directly to DTT. For example, after being asked to match the pictures (during the 3rd trial), the confederate matched them correctly, but during the 7th matching trial the confederate did not match them correctly. This procedure allowed for each participant to experience the same responses and for more experimental control during the study. As described previously, the data collectors were university students, who had experience in data collection methodologies.

Baseline (Phase 1)

During baseline, the participants were provided three abbreviated one-page self-instruction manuals that described how to administer the DTT tasks they were asked to deliver. The participants were given 10 minutes to study each abbreviated one-page self-instruction manual. Next, the participants conducted another DTT session covering the three previously mentioned tasks with a confederate who received DTT. This session was scored using the DTTEF, and the participants' scores were compared to the initial DTTEF scores to determine if there was any growth as a result of the abbreviated one-page self-instruction manuals. The participants moved into the treatment phase after they completed at least five DTT sessions in the baseline phase as suggested by WWC and Kratochwill et al. 2010. If more than one participant completed the baseline phase at the same time, the participants moved into the treatment phase based on their scores (percentage correct of DTT steps implemented according to the DTTEF). The individual who scored the lowest percentage, (as measured by the DTTEF in the form of a percentage, i.e., 7 out of 20 steps correct), indicating they were least proficient at administering DTT, began first. The second participant moved into treatment when the 1st participant reached a 70% proficiency level. The third participant moved into treatment when the second participant reached a 70% proficiency level.

Treatment (Phase 2)

During the treatment phase, the participants administered DTT (three tasks, which had 12 trials each) to a confederate while receiving feedback through a BIE device. The feedback was in the form of either praise (encouraging feedback – EF) for following the steps of the DTT accurately or instructive (instructive feedback – IF) if the steps were not being implemented

accurately. The individual providing the feedback (the researcher) used a script to help ensure each participant received similar feedback on the same items. For example, if several participants implemented step 5 incorrectly, they all received the same feedback on how it should be implemented as opposed to them all receiving varied instructions. The treatment phase was completed once the participant reached 90% accuracy of implementation over three out of four consecutive DTT sessions without receiving any instructional feedback via BIE, as measured by the DTTEF. While the criteria of mastery was over three out of four sessions, each participant required at least five sessions of DTT prior to reaching the mastery criteria, which meets the standards of WWC and Kratochwill et al. 2010. The treatment phase was concluded after 10 sessions of if a participant did not reach the mastery criteria. If the participant reached mastery criteria within 10 sessions of intervention, maintenance without feedback was implemented, where the participants implemented three additional DTT tasks without utilizing the BIE device to receive feedback.

Phase change rules

Phase change rules referred to predetermined guidelines the researcher followed during this study as they related to moving between phases. Prior to the beginning of the study, phase change rules were developed by the researcher (Appendix I). Before implementing BIE feedback to participant one, the researcher and advisor visually inspected the baseline trends for the primary dependent measure for all participants and determined if data were stable and predictable. In general, a stable and predictable data trend is established when 80% of the data points reside on or within the stability envelope (Gast & Spriggs, 2010). The stability envelope was created by drawing two parallel lines: one above and one below the median line. However,

changes in (a) mean level, (b) trend slopes, and (c) variability or data "bounce" were considered. If more than one participant had stable data at the same time, the participant with the lowest percentage of correct DTT implementation scores, as measured by the DTTEF, entered the treatment phase first. The mastery criteria for the treatment phase was met when the participants implemented DTT with 90% accuracy (as measured by the DTTEF) three out of four consecutive days. After the mastery criteria was met, the feedback via BIE was faded out. The participants were instructed to implement three DTT tasks to a confederate without using the BIE device. Once complete, the treatment phase was concluded for each participant. If a participant did not reach the mastery criteria after 10 sessions of intervention, the treatment phase was terminated for that participant and that participant did not move to maintenance without receiving BIE phase.

Scoring

Scoring was recorded on the DTTEF (Appendix E). A different DTTEF was used for each DTT session. Each component of the DTTEF was coded with a checkmark, IF, or EF. The checkmark indicated that component of the DTTEF had been performed correctly, but EF was not provided. Participants periodically received encouraging feedback after accurately implementing specific components of the DTTEF, which was coded as EF. An example of encouraging feedback can be seen in Appendix F. All EF, in addition to steps implemented accurately and coded with a checkmark were counted as correct. However, each step implemented accurately did not receive EF as it may have been too distracting. If participants made an error regarding implementation of a specific component of the DTTEF and required instructive feedback, instructional feedback was provided. It was then coded as instructive

feedback (IF) and counted as incorrect. For example, if participants did not provide appropriate reinforcement to the confederate, the researcher provided instructional feedback and it was coded as IF see (Appendix F). This study used the IF scores to examine the accuracy of DTT implementation and the frequency of IF over the feedback sessions. At the conclusion of each DTT session all IF scores were combined for a total IF score. Participants who received less IF as the study progressed were thought to have increased in implementation accuracy.

To assist in scoring, a video recording system was used. The video recording system allowed real-time data collection as well as delayed data collection. The videotapes were available to be viewed for more detailed data collection or for scoring of the IOA. The DTTEF was used for scoring the recording sessions and the scoring procedure was identical to the scoring procedure of the real-time DTT sessions. The video recording also provided a means of obtaining the amount of time spent studying the abbreviated one-page self-instruction manuals.

Data Analysis Procedures

Visual analysis is commonly used among researchers in the field of single subject research (Gast & Spriggs, 2010; Tankersly, Harjusola-Webb, & Landrum, 2008). Visual analysis examines trends, levels, and data variability among baseline and treatment conditions (Horner et al., 2005). Trends refer to the directional path of the data and level refers to the change in data points once the intervention has been implemented (Kratochwill et al., 2010; Tankersly et al., 2008). Kratochwill et al. (2010) describe variability as the "fluctuation of the data around the mean" (p. 5). Tankersly, Harjusola-Webb, and Landrum (2008) discuss the mean as the average of each phase. Further, visual analysis calls for frequent analysis of data, which assists in making data driven decisions during a study (Gast & Spriggs, 2010). When data

were graphed in an Excel spreadsheet and analyzed for each participant, the risks of overestimation and underestimation were reduced.

Visual analysis was used in this study to determine when participants moved between phases (see Phase Change Rules, Appendix I). During the baseline phase, a participant moved into the treatment phase when 80% of that participant's baseline data fell within a 20% range of the baseline mean. Visual analysis was also used in this study to compare the data between baseline and treatment phases and in determining if there was a functional relationship between the two phases (Tankersly et al., 2008). A functional relationship was demonstrated if data displayed stable trends, levels, and variability in each condition (Kratochwill et al., 2010). Evidence of an immediate distinct change of levels between baseline and treatment phases and the amount of overlapping data points also worked together to demonstrate a functional relationship.

Percentage of Non-Overlapping Data Points

Scruggs, Mastropieri, and Casto (1987) used the percent of non-overlapping data points (PND) to determine a functional relationship between the baseline and treatment phases. Further, PND can be used as a measure of effect size that can be easily computed using the overlapping data points between the baseline phase and subsequent treatment phase. Scruggs et al. (1987) indicated PND could be calculated by dividing the number of data points that fall above the highest baseline data point by the total number of data points in the treatment phase and multiplying by 100 (see Figure 1). The fewer data points that overlap between baseline and treatment, the more confidence held in the effectiveness of the intervention (Kazdin, 1978; Kratochwill et al., 2010).

Analysis of Pre- Post-test Data

Visual analysis was used to analyze the pre- and post-test data. Visual analysis was also used to analyze treatment data. PND was calculated to assess the effectiveness of the BIE feedback on the accuracy of DTT implementation between pre- and post-test data and between baseline and treatment conditions.

Social Validity

Social validity measures social relevance (Horner et al., 2005; Wolf, 1978). Wolf (1978) shares that social validity can be assessed on three levels: social significance of the goals, social appropriateness of the procedures, and social importance of the effects. In this study, social validity was assessed, as described previously, using a short questionnaire about the experiment's goals, procedures, and effects. The questionnaire (Appendix J) was similar to that used in a 2009 dissertation by Fazzio. The questionnaire was presented at the end of the study and asked participants to rate their feelings regarding the importance of the study's goals (i.e., I think the goal of the study; to teach pre-service teachers to accurately implement DTT is important), procedures (i.e., The abbreviated one-page self-instruction manual to teach pre-service teachers to accurately implement DTT was effective) and of the effectiveness of the training procedures (i.e., I have learned how to accurately implement DTT). Additionally, an expert watched video clips of DTT implementation by one participant during baseline and treatment. The expert coded both video clips using the DTTEF to determine which DTT implementation was more accurate.

CHAPTER FOUR: RESULTS

The purpose of the study was to replicate and extend the literature as it relates to accurate discrete trial teaching (DTT) implementation with bug-in-ear (BIE) feedback. This study utilized a multiple baseline design to investigate if a functional relationship between BIE feedback and the accuracy of DTT implementation existed. Specifically, the researcher replicated and extended the research of Fazzio (2007) by using an abbreviated self-instruction manual combined with BIE feedback to instruct pre-service teachers on accurate DTT implementation. A total of three participants were used to demonstrate the effects of BIE feedback.

Inter-Observer Agreement and Procedural Integrity

The primary investigator and two doctoral students collected inter-observer agreement (IOA) and procedural integrity. Prior to data collection, the research team met and reviewed operational definitions, protocols for each phase of the study and standards for data collection. The training consisted of using the Discrete Trial Teaching Evaluation Form (DTTEF) to score videotapes of DTT implementation. The researcher shared with the inter-observers a video clip of an individual implementing DTT to a young child that was already scored by the researcher using the DTTEF. Then the two doctoral students were instructed to watch the same video clips of DTT implementation and score them using the DTTEF. The inter-observers were allowed to pause the videos and review the clips as many times as necessary. After scoring one video, the two inter-observers shared their ratings on the DTTEFs with the researcher. These scores were compared using a point-by-point analysis (Koegel et al., 1977) to code for IOA. Next, the inter-observers were instructed to code a second video. Upon completion of coding the second video,

the researcher again compared the DTTEF scores using a point-by-point analysis. This cycle continued until 90% agreement was met by the researcher and the two inter-observers. Once a level of agreement was reached at 90%, the same observers were asked to code video clips for IOA throughout the study for 23% of all sessions. Table 6 provides the means and range of IOA across each phase of the study.

Table 6: Mean and Range of Inter-Observer Agreement

Condition	Mean	Range
Multiple Baseline	87%	81% - 92%
Non-Experimental Pre- Post-Test	90%	83% - 97%
Social Validity	100%	100% - 100%

The Mean IOA across all multiple baseline sessions (i.e., baseline, treatment, and maintenance) was 90% (range 81% to 100%), which exceeded minimal standards set forth by Horner (2005). IOA also was collected across 100% of the non-experimental pre- and post-tests as well as three social validity questionnaires.

Procedural Integrity

Confederates have been used in previous research related to improving DTT implementation (Arnal et al., 2007; Fazzio et al., 2009; Salem et al., 2009; Thiessen et al., 2009). A confederate, who portrayed an individual requiring DTT, also was utilized during this study. The confederate used a script to ensure each participant received balanced responses (Appendix G). The confederate was instructed to follow the script without deviation during baseline. However during treatment, some variances were allowed as they had been explained to the

confederate prior to data collection. Below is an example of an acceptable deviation from the script:

1. The participant instructed the confederate to tap the table.
2. Instead the confederate moved her hand in an attempt to touch her nose.
3. The participant quickly noticed this action and blocked the confederate's attempt to touch her nose.
4. The confederate responded to the blocking action by tapping the table.

The confederate's fidelity was measured using an identical script and recorded on the Procedural Integrity checklist (Appendix H). The procedural integrity checklist contained only three broad area items. For example, one item addressed the confederate's fidelity of following the script during the DTT sessions. This required the confederate to accurately follow the script in responding to 12 trials of DTT in order for that one item to be coded as correct on the Procedural Integrity checklist. Procedural integrity was calculated for 20% of all sessions. The mean percentage of procedural integrity was 90% of all sessions (range 66% to 100%). During one session two out of three items was coded as occurring, which brought the procedural integrity score to 66% for that session. A decision was made that retraining was not necessary since only one component from the procedural integrity checklist was missed and remaining observation sessions were maintained at 100% correct procedural integrity.

Multiple Baseline Across Participants

Research question one (How does BIE feedback impact or affect implementation of discrete trial teaching procedures as measured by the DTTEF for three undergraduate pre-service teachers in education?) was analyzed using a multiple baseline across participants. Each participant's percent of accurate DTT implementation per session is presented in Figure 1 on the x-axis. The baseline and treatment means are depicted with an orange line. The mean has been described as the average of the data points in each phase (Tankersly et al., 2008). The PND are represented by the red lines. The PND was utilized to help ascertain if a functional relationship existed between the baseline and treatment phases. PND was calculated by dividing the number of data points that fall above the highest baseline data point was by the total number of data points in the treatment phase then divided by 100 (Scruggs, Mastropieri, & Casto, 1987). The blue lines represent the projected baseline slopes, which assisted in accounting for trends in the baseline (Vasquez, 2009). To obtain the projected baseline slope PND, the projected trend line of the baseline phase was examined and the number of data points in the treatment phase that surpassed the projected trend line of the baseline phase was noted and divided by 100. Visual analysis of the multiple baseline demonstrated the effects of BIE feedback on accurate administration of DTT for each participant within the treatment phase. Kratchowill et al. (2010) described four steps in conducting visual analyses. The first step includes documenting a predictable baseline data path. The second step includes finding the within-phase patterns among each phase. A comparison among adjacent phases for demonstrated effects is the third step. The final step in visual analysis is an overall analysis of the study in search of at least three illustrations of an effect.

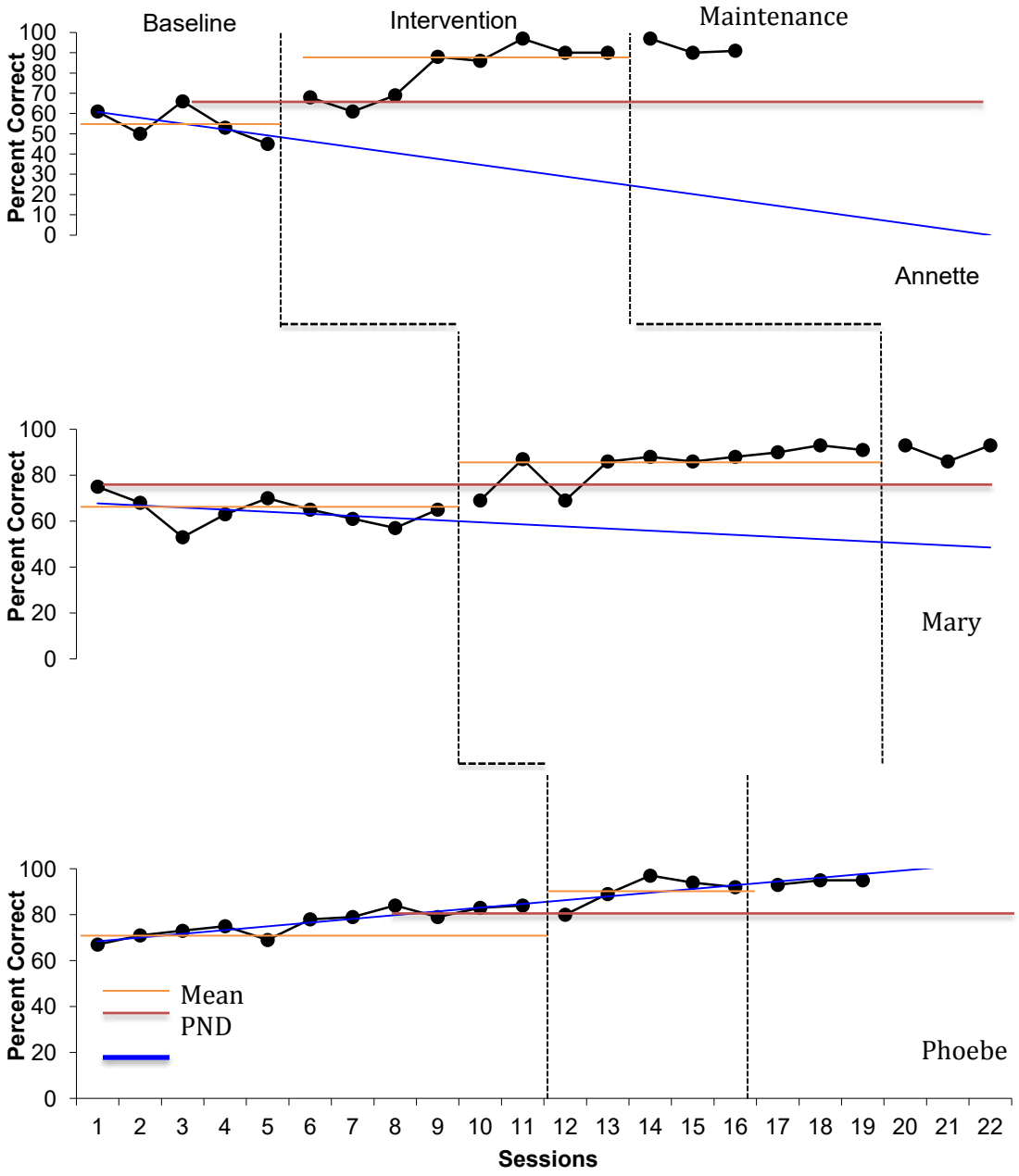

Baseline
Intervention
Maintenance
Percent Correct
Annette
Mary
Phoebe
Mean
PND
Sessions

Figure 2. Results by Participants

Participant One, Annette

Annette's data is displayed in the first leg of the multiple baseline. From visual analysis, Annette demonstrated a somewhat predictable baseline data pattern. The data was slightly variable and displayed a decelerating slope in the baseline condition across five consecutive sessions. While evaluating the level, trend, and variability between adjacent phases, there is noted difference between the level and trend in the baseline phase compared to the treatment phase. However, there was little observable difference between the variability in the two phases. To strengthen the visual analysis, two methods of Percent of Non-overlapping Data Points (PND) were used to address effect size. The first method was the traditional PND where the highest score in baseline was used to plot a horizontal line across the phases. The PND between baseline and intervention was 86%. The second method was a projected baseline slope PND, where a projected baseline trend line was plotted and the number of data points in the treatment phase that exceeded that trend line was calculated and multiplied by 100 (Vasquez, 2009). The projected baseline slope PND was 100%. The immediacy of the effect was noticeable between the last three data points in the baseline phase and the first three data points in the intervention phase. An overall analysis across two phases of the study demonstrated a stable baseline and marked change in level and trend with a large portion of non-overlapping data points.

During baseline, Annette had a mean of 55% for accurate DTT implementation ranging from 45% to 66%. Given the decreasing trend in baseline and consistent performance for the other participants, a phase change was applied on session six and Annette moved into the treatment phase where the independent variable was implemented. At that time a clear change in

both slope and level across eight sessions was demonstrated on Annette's percent correct DTT implementation. During the intervention phase, Annette had a mean of 81% correct implementation with an increasing trend and a range of scores from 61% to 97%. Once Annette met the exit criteria (i.e., three out of four sessions with at least 90% accuracy) she was moved into the maintenance phase, where she demonstrated consistently high correct implementation of DTT procedures without BIE feedback given three follow-up sessions. Annette's mean percent correct performance was 93% (range 90% to 97%) during the maintenance phase.

Participant Two, Mary

While Annette's scores increased, both Mary and Phoebe demonstrated a stable and predictable trend leading to experimental control (Figure 2). The second leg of the multiple baseline reflects Mary's data path, in which there was a predictable baseline phase with slight variability and a decelerating slope across 9 consecutive sessions. After a within-phase analysis of level, trend, and variability a noticeable difference was detected between the baseline and treatment phases. Visual analysis of the data after the intervention phase indicated comparable changes in both slope and level when compared to Annette. Similar to Annette, both the traditional PND and projected slope PND were used to demonstrate effect size. The traditional PND between baseline and treatment was 80% demonstrating a moderate effect. The projected baseline slope PND was 100%. There was a visible difference between the last three data points in the baseline phase and the first three data points in the treatment phase. A noticeable change was noted between the level and trend of the baseline and treatment phases, after an overall analysis of the two phases. Additionally, there was a large amount of non-overlapping data points between the two phases.

A mean of 64% correct implementation of DTT (range of 53% to 75%) was revealed during the baseline condition. Given a predictable performance for both Mary and Phoebe, the researcher used decision rules (Appendix I) to implement another phase change, the intervention phase. Mary's mean performance for percent correct DTT implementation was 85% with a range of 69% to 93% with an increasing slope trajectory. Once Mary reached the exit criteria (i.e., three out of four sessions with at least 90% accuracy of DTT implementation), she entered into the next phase, maintenance. Mary's mean percent correct performance was 91% with a range from 86% to 93%.

Participant Three, Phoebe

As Annette and Mary's percent correct DTT implementation increased, Phoebe's baseline data path (represented by leg three of the multiple baseline) displayed a predictable slightly increasing slope over 11 consecutive sessions. Given this minor increase in baseline performance, there was a slight loss of experimental control. Phoebe was moved into the treatment phase last due to this limitation. The researcher attempted to postpone Phoebe's entry, anticipating the data path leveling out but, it continued to increase. Phoebe remained in the treatment phase for the shortest amount of time among the three participants. After a within-phase analysis, high levels of DTT implementation were evident in both the baseline and treatment phases. However, the trends remained similar, with a dramatic increase after treatment. During the treatment phase, Phoebe displayed a slightly variable data path which was accelerating more than in the baseline phase. A moderate to low effect was demonstrated by the traditional PND of 80% between baseline and intervention of 80%. The projected baseline slope PND was 40%. The immediacy of the effect was seen between the last three data points in the

baseline phase and the first three data points in the intervention phase as there was a marked sharper increasing trend. While an overall analysis across two phases of the study demonstrated a predictable baseline data path with similar levels between the baseline phase and the treatment phase, there was a marked change in trend with a small portion of non-overlapping data points.

Phoebe demonstrated high rates of accurate DTT implementation, with a baseline mean of 75% correct DTT implementation and a range of scores from 67% to 84%. Her treatment data increased to a mean of 90% and a range of scores from 80% to 97%. Upon reaching the exit criteria (i.e., three out of four sessions with at least 90% accuracy of DTT implementation), she moved into the maintenance phase. After the maintenance phase, Phoebe's scores remained above the mastery criteria (range of scores from 93% to 95% with a mean of 94%). Phoebe's data should be cautiously interpreted as her baseline data displayed an increasing trend.

Summary

Mixed conclusions can be drawn from the results of the multiple baseline. Overall, from the visual analysis each of the participants displayed increased scores from baseline to intervention. Moreover, these results were present in the maintenance phase for all participants. While there were not three demonstrations of effect per participant, there were three demonstrations of effect across the three participants. Importantly, a slight loss of experimental control was exhibited in the final leg of the multiple baseline causing the researcher to interpret the results with caution. The overall effect size for both traditional PND and projected PND was low to moderate.

Non-experimental Pre- and Post-Test

Non-experimental pre- and post-tests were implemented before and after the primary research design to address the second research question (How does participants' percent correct implementation of DTT procedures change from pre to post Bug In Ear feedback?). The pre-test was administered to help determine the amount of proficiency each participant displayed in accurate DTT implementation prior to intervention. The post-test was delivered to ascertain the proficiency levels of accurate DTT implementation upon completing the intervention and maintenance phases. There was at least a 45% increase in each of the participants' pre and post-test scores (range of 45% to 91%). Table 7 displays the results.

Table 7: Pre- Post-Test Percent Correct of Implementing DTT Procedures

	Pre-Test	Post-Test	Difference
Annette	65%	98%	+51%
Mary	47%	90%	+91%
Phoebe	62%	90%	+45%

Pre-test scores for all three participants were 65%, 47%, and 62% for Annette, Mary, and Phoebe respectively. Upon completing the treatment phase, each of the three participants maintained mastery level performance on the post-test. Annette scored 98%, while both Mary and Phoebe obtained a score of 90%.

BIE feedback during the treatment sessions was successful in increasing the accurate implementation of DTT as evidenced by the increased data for each participant. Each participant's scores increased at least 45% (Table 7). More specifically, Annette's scores increased 51%. The difference between Mary's pre-test and post-test scores was 91%. There

was a 45% increase between Phoebe's pre-test and post-test scores as shown. The pre- and post-tests revealed increased scores by all participants. On average there was a 62% increase in the amount of proficiency in accurate DTT implementation from pre-test to post-test among participants.

Abbreviated One-Page Self-Instruction Manuals

Each participant studied three abbreviated one page self-instruction manuals prior to entering the baseline phase. Participant 1 studied the three abbreviated one-page self-instruction manuals for a total of 6.5 minutes broken down as follows: Matching for 4 minutes, Imitating Simple Actions for 1.5 minutes, and Pointing to Named Items for 1 minute.

Participant 2 spent a total of 5.5 minutes reviewing the three abbreviated one-page self-instruction manuals: Matching for 3 minutes, Imitating Simple Actions for 1.5 minutes, and Pointing to Named Items for 1 minute.

It took Participant 3 a total of 5 minutes to examine the three abbreviated one-page self-instruction manuals: Matching for 2 minutes, Imitating Simple Actions for 2.5 minutes, and Pointing to Named Items for 30 seconds.

Social Validity

A social validity questionnaire to address the social validity of the study question three (How does fidelity impact participants' rating of the acceptability of the goals, procedures, and outcomes as socially valid as measured by a social validity questionnaire?) was proposed. The results are displayed in Table 8.

Table 8: Social Validity Questionnaire Results

Measure	Responses				
Goals	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree
I think that the goal of the study; to teach students to accurately implement discrete trial teaching is important	100%	0%	0%	0%	0%
I think that the goal of teaching students to reinforce and correct errors made while implementing discrete trial teaching with children receiving discrete trial teaching is important	100%	0%	0%	0%	0%
Procedures					
The abbreviated one-page self-instruction manuals were effective	33%	33%	0%	33%	0%
The Bug in Ear feedback added to the abbreviated one-page self-instruction manuals were effective	100%	0%	0%	0%	0%
Effects					
I have learned to conduct discrete trial teaching of three skills	100%	0%	0%	0%	0%
I think that what I have learned can help me to teach a child with autism	100%	0%	0%	0%	0%
I have learned a new important skill by participating in this study	100%	0%	0%	0%	0%
I would recommend this training opportunity to other students	100%	0%	0%	0%	0%

The social validity questionnaire was administered to the students at the end of the study. Items on the questionnaire were measured on a Likert Scale (1="Disagree", 2 = "Somewhat Disagree", 3 = "Neutral", 4 = "Somewhat Agree", and 5 = "Agree"). Participant responses to the questionnaire across the three domains established by Wolf (1978) can be found in Table 8. Generally speaking, the participants felt the goals of the study were important and that they learned an important skill that could be used to work with students with autism. However, some discrepancy in the beliefs of the effectiveness of the procedures did exist. Nevertheless, each participant indicated that they would recommend this training to other students.

Specifically, each participant indicated that teaching pre-service teachers to accurately implement DTT was important. Further, each of the participants reported that teaching pre-service teachers to reinforce positive practices and correct errors made during DTT was important. Annette agreed that the self-instruction manuals were effective. Mary agreed to some degree that the self-instruction manuals were effective, while Phoebe indicated that she somewhat disagreed that the self-instruction manuals were effective. All of the participants agreed that the BIE feedback added to the self-instruction manual was effective. Each of the participants agreed that they learned how to implement DTT over three tasks and that what they learned would help them teach a child with autism. All participants agreed they learned a new skill by participating in this study and shared that they would recommend this training opportunity to other students.

Summary

Three participants were trained to implement three DTT instructional procedures given the independent variable of BIE feedback on the fidelity of implementation. The results of the

multiple baseline and pre-post data reveal a high level of accurate DTT implementation among all participants. Additionally, participants rated the goals, procedures, and outcomes of this study as favorable, according to the social validity questionnaire. While a slight loss of experimental control was demonstrated within the multiple baseline, additional analysis and data suggest that BIE feedback is an effective and efficient method for training pre-service teachers to deliver DTT procedures.

CHAPTER FIVE: DISCUSSION

This study examined the relationship between bug-in-ear (BIE) feedback and accurate discrete trial teaching (DTT) implementation. Feedback and coaching using BIE has been used over a number of years to increase various desired skills (Bowles & Nelson, 1976; Rock et al., 2009; Scheeler & Lee, 2002; Scheeler et al., 2006). In addition, DTT has a history of effective results as it relates to individuals with disabilities, including autism (LeBlanc et al., 2005; Lerman et al., 2004; Lovaas, 1987; Smith, 2001). This study replicated and extended Fazzio's research (2007) by incorporating an immediate feedback component using a BIE device.

A multiple baseline design was used with pre-service participants to help determine if a functional relationship between BIE feedback and the accurate implementation of DTT existed. While two of the three participants displayed a clear change in performance between baseline and treatment, one participant displayed a slightly increasing trend in baseline (Figure 2). Though this increase during baseline adversely affects the experimental control of this study, it could also be explained by a practice effect. A practice effect can occur when there are repeated opportunities to practice a strategy or skill (Heward & Cooper, 1987) and practice, was a component of this study.

Despite the results of the practice effect, the findings of this study are promising, given that as a whole there appears to be a functional relationship between the percent of accurate DTT implementation and BIE feedback as suggested by the 31% mean increase between baseline and treatment scores (65% and 85% respectively). To assist in analyzing these data traditional percent of nonoverlapping data (PND) effect sizes were used across all participants and revealed moderate effect size and a mean of 82% (with a range of 80% to 86%) between baseline and

treatment. The projected baseline slope PND was also used to analyze the data. Participants' projected use of DTT in the baseline phase revealed a mean score of 80% with a range of 40% to 100%.

Similar to the multiple baseline results, analysis of pre- and post-tests revealed increased percentages in accurate DTT implementation (mean pretest was 58% and mean post-test, 93%). This increase supports the multiple baseline results. While there was a 60% mean increase between pre-and post-test, it is interesting to note that two of the three participants entered the study with pre-test scores indicating over 50% accuracy in DTT implementation, although all of the participants self-reported no previous experience in administering DTT.

One of the key reasons to conduct single subject research is to look at practices that have strong social relevance (Horner et al., 2005; Wolf, 1978). When questioned about the importance of the current research, each of the participants in this study agreed that the goals of this study were important, which enhances the social validity of the goals (Horner et al., 2005). Further, participants reported a gained understanding of how to implement DTT consistently. All participants agreed BIE feedback coupled with the traditional self-instruction manual was effective. However, variance on the effectiveness of using only the self-instruction manual was reported by the participants (Table 8). Participants' ratings were dispersed among agree, somewhat agree, and neutral responses. This division is important as it implies pre-service teachers may desire more than self-instruction manuals when learning new procedures. Nevertheless, each of the participants pronounced that they would recommend this type of training to other students. Similar questions were posed to participants in previous studies and comparable results were obtained (Fazzio, 2007; Salem et al., 2009; Thiessen et al., 2009).

Results from the current study are comparable to previous research with similar methodologies and data outcomes. The unique component of this study was the BIE feedback added to a self-instruction manual to comprise the treatment package. When the current treatment package was compared to previous treatment packages in the literature less time was necessary to study the self-instruction manuals for participants to reach the mastery criteria when there was a BIE feedback component present (Arnal et al., 2007; Fazzio, 2007; Salem et al., 2009; Thiessen et al., 2009). On average, previous participants studied the self-instruction manuals for 3 hours and 45 minutes whereas participants in the current research spent 6 minutes studying the self-instruction manuals. This could be important if individuals need to be trained effectively in a short timeframe.

Treatment Fidelity

Important to the study was the need to address treatment fidelity. Two experts in DTT implementation viewed an initial baseline session video and a video of the final treatment session to determine if DTT implementation accuracy increased from the baseline phase to the treatment phase. Both experts used the Discrete Trial Teaching Evaluation Form (DTTEF) to score the accuracy of DTT implementation and agreed that the implementation during the treatment session was more accurate than the implementation during the initial baseline session (20% increase from baseline to treatment). Experts in DTT agreed that the accuracy in DTT implementation increased from baseline to treatment. This finding lends support to the functional relationship between accurate DTT implementation and BIE feedback. This finding expands past research by supporting the successes of self-instruction manuals as well as the effectiveness of providing immediate feedback via BIE.

To help preserve treatment fidelity a confederate was used to receive DTT instruction. In this study and in previous studies, the use of the confederate also was helpful in maintaining experimental control to help ensure each of the participants received balanced responses from the confederate (Arnal et al., 2007; Fazzio, 2007; Salem et al., 2009; Thiessen et al., 2009). These balanced responses allowed the participants to have very similar opportunities to exhibit specific components of DTT (i.e., providing reinforcers and blocking) versus a model where Participant One only experiences opportunities to provide reinforcers and Participant Two only experiences opportunities to block attempts to respond incorrectly.

Relationship to Prior Research

The current research has many similarities and differences from the previous research. One similarity is the amount of sessions required to reach mastery using a self-instruction manual to teach individuals to implement DTT. Previous researchers spent an average of nine sessions using various treatment packages to instruct individuals to accurately implement DTT (Arnal et al., 2007; Fazzio, 2007; Gilligan, 2007; Koegel et al., 1977; Salem et al., 2009; Sarakoff, 2008; Severtson, 2011; Thiessen et al., 2009). On average, participants in the current research required eight sessions to reach the mastery criteria.

While the number of sessions needed to reach mastery criteria is similar between the current study and previous studies there is a difference relating to the amount of time spent studying the self-instruction manuals. Participants in the current study reached mastery criteria after an average of six minutes studying the one-page self-instruction manuals whereas it took participants in previous studies an average of 3 hours and 45 minutes to study the self-instruction manual (Arnal et al., 2007; Fazzio, 2007; Salem et al., 2009; Thiessen et al., 2009). Given the

efficiency of BIE coaching on DTT instruction, researchers and practitioners may want to utilize this combined method to train service personnel to deliver instruction.

Another similarity between the current research and existing research is the use of a self-instruction manual combined with other components to teach individuals to accurately implement DTT. However there is some variation in the components that make up the previous treatment packages and the components of the current treatment package. Previous treatment packages combined the self-instruction manual with other components such as video modeling, demonstrations, and practice sessions (Arnal et al., 2007; Fazzio, 2007; Salem et al., 2009; Thiessen et al., 2009). The current research utilized a treatment package consisting of a one-page self-instruction manual and BIE feedback.

Another difference between the current study and the previous research is the participants' backgrounds. Researchers from the University of Manitoba utilized students majoring in psychology as their participants (Arnal et al., 2007; Fazzio, 2007; Salem et al., 2009; Thiessen et al., 2009). The current study used pre-service teachers as participants yet this alteration did not negatively impact the end results thus demonstrating that self-instruction treatment packages can be modified and generalized to individuals outside of the field of psychology to obtain favorable results. This generalization to other individuals could be beneficial as DTT has been suggested as an effective strategy for working with children with autism (LeBlanc et al., 2005; Lerman et al., 2004; Lovaas, 1987; Smith, 2001) and the diagnosis of autism increases (Autism and Developmental Disabilities Monitoring Network, 2012).

While there was a difference among the participants' backgrounds between previous studies and the current study, the use of a confederate is a similarity (Arnal et al., 2007; Fazzio,

2007; Salem et al., 2009; Thiessen et al., 2009). A confederate was used in each of the studies to portray an individual in need of receiving DTT. In each case, the confederate followed a script and did not display any aggressive or self-injurious behaviors. This continued protocol also included a confederate who utilized a script. The use of a confederate and a script allowed the researcher to focus on preparing individuals to accurately implement DTT implementation without the distractions of competing behaviors. An additional component to the current treatment package was the inclusion of BIE feedback.

Using BIE feedback is both a similarity and difference in that it has been used before, but there has not been previous research examining the use of BIE feedback in the area of DTT implementation among pre-service teachers. In 1976, Bowles and Nelson investigated the effects of BIE feedback on teachers' behavior management skills. Thomson et al. (1978) searched for effective ways to provide feedback to preschool teachers. The increase of using teacher clarity behaviors was examined in two studies in 1994 and 1995 (Giebelhaus, 1994; Giebelhaus & Cruz, 1995). Several studies focused on increasing the completion of three term contingencies (Scheeler & Lee, 2002; Scheeler et al., 2004; Scheeler et al., 2006). Rock and colleagues in 2009 investigated using BIE feedback to increase praise statements delivered by teachers, to increase teachers' use of effective practices, and to increase student on task behaviors.

The current study utilized BIE feedback and combined it with a one-page self-instruction manual (adapted from Fazzio, 2007) to explore the relationship between accurate DTT implementation and BIE feedback. This use was a unique combination to impact the practice of pre-service teachers. The current treatment package of BIE feedback and a self-instruction

manual to learn to implement DTT could help move the field forward by providing feedback in a more efficient manner. Further this new combination intervention package could allow for more opportunities for pre-service and in-service teachers to receive feedback, thereby creating a positive effect on student achievement (Koegel et al., 1977; Kretlow & Bartholomew, 2010), which is the ultimate outcome for all research on teacher practice.

Limitations

This study is not without limitations. The primary researcher delivered the BIE feedback, which could be perceived as researcher bias. Researcher bias may include the researcher's beliefs and self-motivated interests related to the research (Creswell, 2009). To reduce the risk of researcher bias and strengthen experimental control, the researcher provided BIE feedback using a script and in a consistent manner as delineated in the fidelity of treatment section.

A second limitation of this study was the use of a confederate as opposed to an individual with autism or other exceptionalities. In an attempt to achieve experimental control within the study, the investigator and confederate utilized an extensive amount of scripting and protocols. In addition, given this study was a replication, similar procedures were previously employed enhancing experimental control.

The focus of this analysis was on the implementation of DTT. There was no measurement of the behaviors or skill acquisition of the individual receiving DTT. Therefore, it was determined that the use of a confederate as opposed to an individual who would benefit from receiving DTT would be the most efficient method to demonstrate the outcomes of BIE feedback.

Another limitation of this study was conducting the research in a clinical setting, rather than a natural setting. The use of DTT is frequently administered in a one-on-one environment. Consequently, this study setting was authentic to the strategy of one-on-one administration; however, outcomes may vary if these procedures were implemented in classrooms with differing configurations.

A fourth limitation of this study is the slight loss of experimental control as a result of the third participant's increasing baseline trend. This increase can possibly be explained by a practice effect. The design of the study did not allow for teasing out this variable but this limitation should be further investigated in the future.

The final limitation of this study relates to participant selection and attrition. This study began with five pre-service teachers as participants. However, two were lost due to attrition. One never attended any of the sessions and the other individual only participated in one day of sessions because of scheduling differences. There were three participants who took part in the study in its entirety. The attrition of participants can be interpreted as a limitation as it affects the frequency of replication across participants and limits the generalizability of the study.

The remaining participants majored in either exceptional education or elementary education. The variance in the education programs may have led to a minor loss of experimental control as their educational backgrounds are likely to have been somewhat varied. For example, participants who majored in exceptional education are likely to have had more than one class discussing topics related to DTT, data collection, or behavior management whereas participants who majored in elementary education are not as likely to have had extensive preparation on those topics. However, pre-tests revealed at least 50% accuracy in DTT implementing although

each participant self-reported not having experience in implementing DTT. The results of the pre-tests were likely related to the participants' education. Many of the steps of the DTTEF are procedures that most pre-service teachers learn in their beginning curriculum (i.e., gather teaching materials, arrange teaching setting, gain students' attention, provide instruction). As a result of the mastery of these and other similar skills, the pre-test scores appear high.

Technical Considerations for Replication

This study utilized an observation room with a built in recording system, which required training on how to accurately record the DTT implementation sessions. The researcher had experience using the system in the past and as a result there were no complications related to the recording and play back of the DTT implementation sessions. Individuals who are interested in replicating this study should be fully knowledgeable about using recording systems to ensure proper video recording that can later be used for more in depth data review. The BIE required pairing in order to connect to the cellular phones. The researcher had already spent time exploring the pairing procedures thus the pairing did not pose any obstacles.

Of the 23 sessions using the BIE devices, there was only one dropped call. In that instance, the participant paused the DTT session and the researcher called the participant again and the session continued. There was also a single instance of a different participant losing audibility with the researcher. Again, in this instance, the session was paused until a clearer connection was established. These are issues that may happen when using BIE technology and there should be established procedures to address these issues if they occur.

Implications

The outcome of this study has several implications related to preparing teachers to implement DTT through feedback using BIE. First, the outcomes present potential benefits for schools, agencies, DTT trainers, and observers. Specifically, these stakeholders can utilize these procedures to instruct individuals designated to deliver DTT. Observers can use these procedures to provide feedback to help increase DTT implementation accuracy. Researchers have suggested that when procedures are implemented with high rates of fidelity, students' academic achievement increases (Koegel et al., 1977; Kretlow & Bartholomew, 2010). The procedures in the current study can be replicated to prepare individuals, including pre-service and in-service teachers, to accurately implement DTT in a relatively quick timeframe and for minimal funding (approximately $30 for a BIE device) which is an added benefit would be beneficial in today's economy. However, the ultimate outcome that should be measured in future research is the impact of this intervention package on student learning in the classroom setting.

As this treatment package is replicated in other settings there are also implications as it relates to generalizing the results to other participants. This study used pre-service teachers with backgrounds in both exceptional education and elementary education. These diverse backgrounds can be beneficial when attempting to implement this study to other pre-service or in-service teachers, as the generalizability will be greater than if the participants were from only one major.

Generalizing these results to other pre-service and in-service teachers would be helpful, as previous researchers have revealed the successes of DTT (LeBlanc et al., 2005; Lerman et al.,

2004; Lovaas, 1987; Smith, 2001). However, even with the documented positive results of DTT, other researchers have shared that there is a low likelihood of pre-service teachers graduating with experience in implementing DTT (Downs et al., 2008). The current study provides individuals with an alternative method to become more familiar with implementing DTT.

A final implication of this study is related to individuals with ASD (Autism Spectrum Disorders). Researchers have discovered that students with ASD are more successful when instruction is more direct and less incidental (Smith, 2001). DTT is an intervention that fits that description. Following these procedures to learn how to accurately implement DTT could mean that more pre-service and in-service teachers could be educated in correct DTT implementation and in turn, more students with ASD would receive proper DTT instruction. This implementation is important as the Autism and Developmental Disabilities Monitoring Network recently reported the rate of prevalence for children born with Autism has risen to 1 out of every 88 children (2012). Therefore an effective treatment package to prepare pre-service and in-service teachers to accurately implement DTT would be of great benefit.

When examining the results of this study, one can assume that pre-service teachers with no experience implementing DTT can likely be trained to implement DTT in an average of eight sessions with each session lasting approximately five minutes as this was the case in the current study. Given the outcomes of this study, participants of future replications are likely to maintain the acquired skills without feedback. Additionally, these findings support future treatment packages that combine self-instruction manuals and BIE feedback to train individuals to implement DTT.

Generalizability

This procedures are likely generalizable to various audiences and agencies as they could be replicated with little complication and the materials are easily accessible. The generalizability across three variables is delineated in Table 9.

Table 9: Generalizability of Results

Variable	High	Medium	Low
Technology	Bluetooth enabled smartphones iPod iPad Bluetooth enabled computer with webcam	Telephones with headphone adaptors	Telephones without Bluetooth capabilities or headphone adaptors
Population	Elementary education pre-service teachers Exceptional education pre-service teachers Individuals comfortable receiving BIE feedback	Parents	Peer tutors Individuals uncomfortable receiving BIE feedback
Settings	Clinical settings	Classrooms & Homes	Community

The results of this study are most likely to be generalized when technology is used that is similar to what was used in the current study. Generalizability is also highly likely among individuals who have similar backgrounds as the participants in this study. Specifically, individuals with the following characteristics are likely to elicit the same or similar results as discussed in this study: college students who range in age from 23 to 40; who are majoring in

Education; who have no experience in DTT; and who are comfortable receiving BIE feedback. This study is highly generalizable to other clinical settings.

Medium generalizability may occur when parents using telephones with headphone adaptors instead of Bluetooth devices attempt to implement these procedures. Implementing these procedures in a classroom or home setting may also have medium generalizability, but more research should be conducted to ensure each of these claims is accurate.

Low generalizability may be possible when telephones without Bluetooth capability or headphone adaptors are used. These procedures have a low likelihood of generalizing to peer tutors or individuals who are not comfortable receiving BIE feedback. Low generalizability may exist in community settings, where DTT is periodically implemented to generalize skills to natural environments.

Future Research

Based on the aforementioned limitations there are many opportunities for future research. First, this study should be replicated replacing the researcher as the BIE coach with an independent BIE coach to completely eliminate the chances of researcher bias. The results should then be compared to this study to determine if there is congruency. Also, to increase the rigor of the current study it should be replicated with more alignment to the standards of single-case designs by What Works Clearinghouse (Kratochwill, et al., 2010). More attention should be paid to creating a study that will meet evidence based standards.

Second, researchers should extend the current research by generalizing BIE feedback across participants and to other settings. This researcher demonstrated success in teaching participants to implement DTT to a confederate, but this study should be altered to include an

individual with autism, as past researchers have reported DTT effectiveness in working with students with autism (LeBlanc et al., 2005; Lerman et al., 2004; Lovaas, 1987; Smith, 2001). Further, future researchers should seek to replicate these results with parents who are interested in implementing DTT with their children and therapists/tutors who work with students with autism. Replications of this study should seek to take advantage of the flexibility of this mobile BIE model, as it is not tied to one particular location and can be used in various settings. These replications will help to determine the efficacy of the BIE feedback across settings. Possible settings could include individual homes and educational settings such as public or private schools. Additional research could address the effects of the combination of BIE feedback and DTT on students' academic achievements.

A component analysis could also be completed to determine which individual skills of the DTT administration process participants have the most difficulty with and which skills are the most simplistic to master. Details from that information would be helpful in making treatment packages more effective as more time could be focused on areas that are more likely to be deficit areas.

Another area researchers could further examine is the use of BIE feedback with DTT. While the current study demonstrates success in the instruction of DTT, replication would assist in solidifying this treatment package as effective. Additionally, BIE feedback and training has a history of success in various treatment packages (Baum, 1976; Bowles & Nelson, 1976; Giebelhaus, 1994; Giebelhaus & Cruz, 1995; Hunt, 1980; Kahan, 2002; Rock et al., 2009; Scheeler & Lee, 2002; Scheeler et al., 2004; Scheeler et al., 2006; Thomson, Holmberg, Baer, Hodges, & Moore, 1978). While the current researcher demonstrated successful use of BIE

feedback on the accurate implementation of DTT using only an abbreviated one-page self-instruction manual, future research should also examine the effects of adding a modeling component to the treatment package.

Finally, researchers have discovered that students with ASD are more successful when instruction is more direct and less incidental (Smith, 2001). DTT is an intervention that fits that description. Following these procedures to learn how to accurately implement DTT could mean that more pre-service and in-service teachers could be educated in correct DTT implementation and in turn, more students with ASD would receive proper DTT instruction. As discussed earlier, the implementation of an effective treatment package to prepare pre-service and in-service teachers to accurately implement DTT would be of great benefit as the rate of children born with Autism increases.

Conclusion

This study extends the literature and supports previous research demonstrating the effectiveness of instruction on accurate DTT implementation for individuals who primarily work with students who have autism (Downs et al., 2008; LeBlanc et al., 2005; Lerman et al., 2004). The current study resulted in successful implementation of an effective treatment package to increase the accuracy of DTT implementation with the aid of BIE feedback and an abbreviated self-instruction manual for pre-service teachers. Participants displayed a significant increase between non-experimental pre- and post-test scores. These results are indicative of the likely effectiveness of the current treatment package. On the social validity questionnaire, participants reported feeling that this study and its procedures were important and would merit a recommendation to other students. While this study yielded promising results, more research

should be conducted to strengthen the findings by replicating the procedures in various settings and among participants with varied educational backgrounds.

APPENDIX A:
ABBREVIATED INSTRUCTIONS

Abbreviated Instructions
Teaching Individuals to Point to Pictures When Named Using Discrete-Trials Teaching

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

- Here are three pictures. Your task is to teach this individual to point to the correct picture after you place the three pictures on the table and name one of them. Across trials, try to teach the individual to point to all 3 pictures when they are named.

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

Summary of Steps
1. Arrange necessary materials.
2. Decide what you will use as consequences for correct responses and consequences for incorrect responses
3. On each trial:
    a. Secure the individual's attention.
    b. Present the correct materials and instruction as stated on data sheet
    c. Provide whatever extra help (i.e., prompts or cues) you think are necessary for the individual to respond correctly.
    d. Once the individual responds, provide what you consider to be an appropriate feedback or reward for a correct response, or provide an appropriate reaction for an error (prompt)
        For Incorrect Responses
        1. Block gently, remove the items and look down for 2-3 seconds
        2. Record response
        3. Wait 3-5 seconds before gaining individuals attention and re-presenting materials, instruction, and prompts
        4. Provide praise and record response.
    e. Across trials gradually provide less prompts or cues (i.e., fade out the extra prompts)
        i. By prompting less
        ii. By delaying your prompts
            Prompt Fading Steps:
            1. Full prompt (F): Full physical guidance
            2. Partial prompt 1 (P1): Light physical guidance and pointing to correct picture
            3. Partial prompt 2 (P2): Gestural prompt, pointing to correct picture only
            4. No prompt (NP)
            Fading Rules on Standard Trials:
            Following 3 consecutive correct responses at Steps 1-3, proceed to the next step

Following 2 consecutive errors at Steps 2-4, return to the previous fading step

f. Continue in this manner until you have conducted 12 teaching trials. Record the results on data collection sheets provided to you.

Adapted from Fazzio (2009).

Abbreviated Instructions

Teaching Individuals to Match Pictures Using Discrete Trials Teaching

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

- Here are three pictures. Your task is to teach this person to place a card on top of the identical card presented on the table when you say "Match" and give her one picture at a time. Across trials, try to teach the individual to match the three pictures.

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

Summary of Steps

1. Arrange necessary materials.
2. Decide what you will use as consequences for correct responses and consequences for incorrect responses
3. On each trial:
    a. Secure the individual's attention.
    b. Present the correct materials and instruction as stated on data sheet
    c. Provide whatever extra help (i.e., prompts or cues) you think are necessary for the individual to respond correctly.
    d. Once the individual responds, provide what you consider to be an appropriate feedback or reward for a correct response, or provide an appropriate reaction for an error (prompt)
        For Incorrect Responses
        1. Block gently, remove the items and look down for 2-3 seconds
        2. Record response
        3. Wait 3-5 seconds before gaining individuals attention and re-presenting materials, instruction, and prompts
        4. Provide praise and record response.
    e. Across trials gradually provide less prompts or cues (i.e., fade out the extra prompts)
        i. By prompting less
        ii. By delaying your prompts
            Prompt Fading Steps:
            5. Full prompt (F): Full physical guidance
            6. Partial prompt 1 (P1): Light physical guidance and pointing to correct picture
            7. Partial prompt 2 (P2): Gestural prompt, pointing to correct picture only
            8. No prompt (NP)

            Fading Rules on Standard Trials:

            Following 3 consecutive correct responses at Steps 1, 2, and 3, proceed to the

next step
Following 2 consecutive errors at Steps 2, 3, and 4, return to the previous fading step

f. Continue in this manner until you have conducted 12 teaching trials. Record the results on data collection sheets provided to you.

Adapted from Fazzio (2009)

Abbreviated Instructions

Teaching Individuals to Imitate Simple Actions Using Discrete-Trials Teaching

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

- Your task is to teach this person to imitate some actions you will present using your arms and hands, immediately after you present the action. The actions are: tapping table, touching shoulders, and touching nose. Across trials, try to teach the individual to imitate the three actions.

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

Summary of Steps

1. Arrange necessary materials.
2. Decide what you will use as consequences for correct responses and consequences for incorrect responses
3. On each trial:
    a. Secure the individual's attention.
    b. Present the correct materials and instruction as stated on data sheet
    c. Provide whatever extra help (i.e., prompts or cues) you think are necessary for the individual to respond correctly.
    d. Once the individual responds, provide what you consider to be an appropriate feedback or reward for a correct response, or provide an appropriate reaction for an error (prompt)
    e. Across trials gradually provide less prompts or cues (i.e., fade out the extra prompts)
        i. By prompting less
        ii. By delaying your prompts

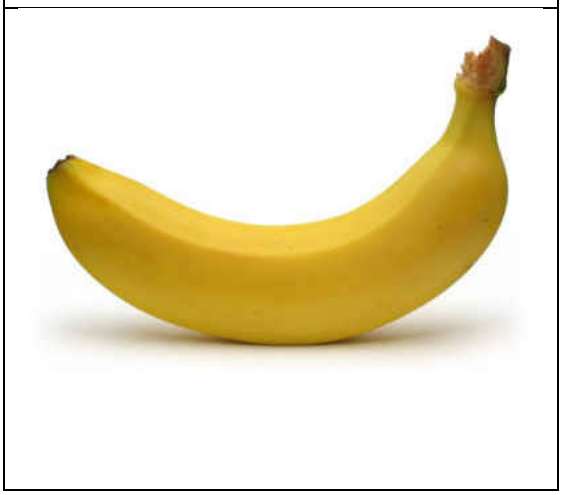
        Prompt Fading Steps:
        1. Full prompt (F): Full physical guidance
        2. Partial prompt 1 (P1): Light physical guidance and pointing to correct picture
        3. Partial prompt 2 (P2): Gestural prompt, pointing to correct picture only
        4. No prompt (NP)

        Fading Rules on Standard Trials:
        Following 3 consecutive correct responses at Steps 1-3, proceed to the next step
        Following 2 consecutive errors at Steps 2-4, return to the previous fading step
    f. Continue in this manner until you have conducted 12 teaching trials. Record the results on data collection sheets provided to you.

Adapted from Fazzio (2009).

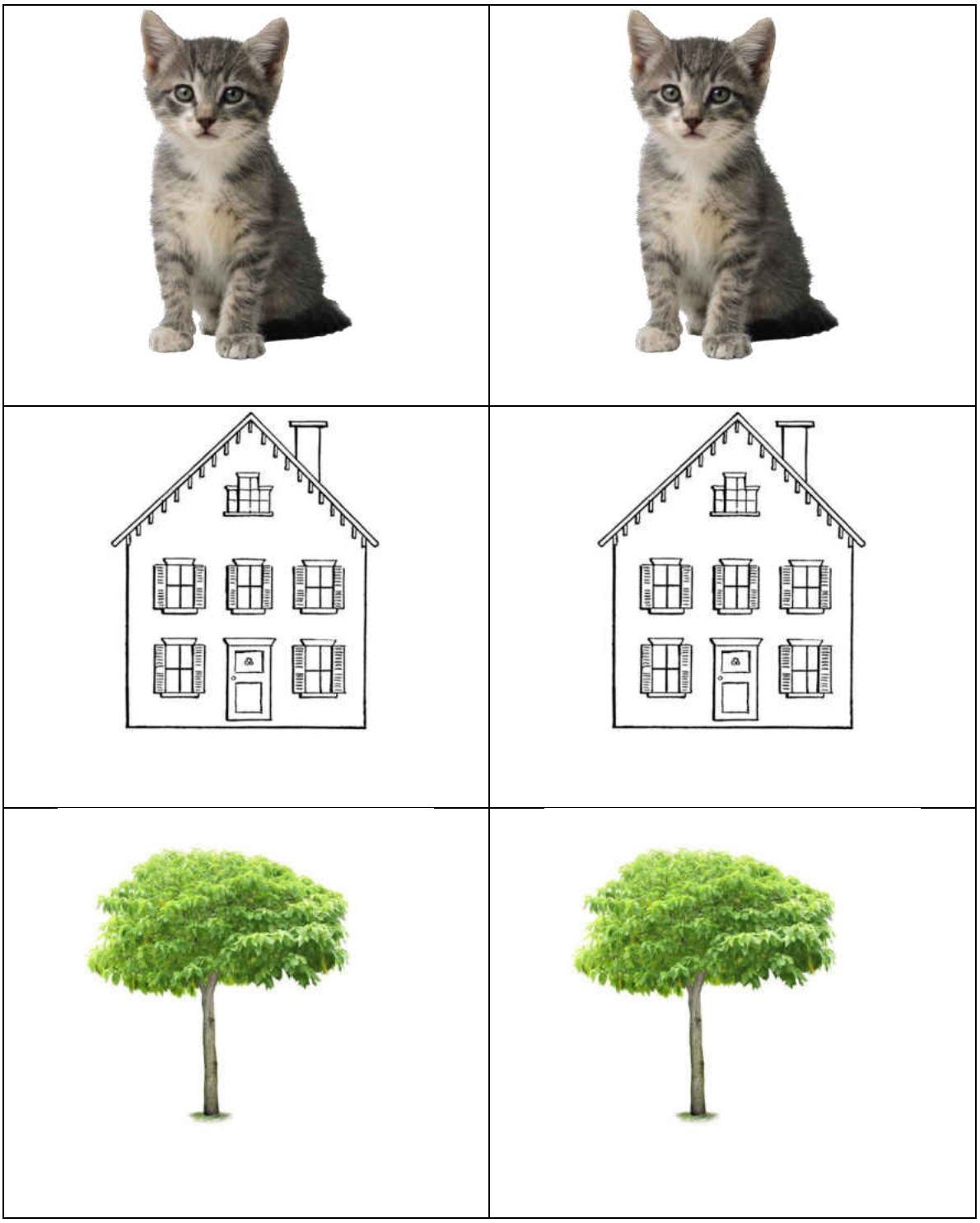
APPENDIX B:
PICTURES FOR POINTING TO NAMED TASKS

Pictures for Pointing to Named Tasks



APPENDIX C:
PICTURES FOR MATCHING TASK

Pictures for Matching Task



APPENDIX D:
DATA SHEETS

Data Sheet for Matching

Materials Required:
Double pictures of a cat, a house, and a tree

Individual's Response of Each Trial:
Accept picture from teacher and place it on top of corresponding picture on table

Set-Up for Each Trial:
A row of three pictures on the table in front of the individual

Instructions at start of each trial:
Say "Match"

Most-to-Least Prompt Fading Steps:

5. Full prompt (F): Full physical guidance
6. Partial prompt 1 (P1): Light physical guidance and pointing to correct picture
7. Partial prompt 2 (P2): Gestural prompt-pointing to correct picture only
8. No prompt (NP)

Fading Rules on Standard Trials:
Following 3 consecutive correct responses at Steps 1, 2, and 3, proceed to the next step
Following 2 consecutive errors at Steps 2, 3, and 4, return to the previous fading step

Mastery Criterion:
3 consecutive correct, independent responses (no prompts) on standard trials

On each trial, record individual's response as correct (✓) or error (x) or no response (NR) in the appropriate column, and indicate prompting level.

Trials	Position of Pictures on Table			Picture to Give to Individual	Standard Trials		Error Correction Trials	
	Cat	House	Tree		Correct	Error	Correct	Error
1	R	M	L	Cat				
2	L	R	M	House				
3	M	L	R	Tree				
4	R	M	L	House				
5	L	R	M	Tree				
6	M	L	R	Cat				
7	R	M	L	Cat				
8	L	R	M	Tree				
9	M	L	R	Cat				
10	R	M	L	House				
11	L	R	M	Cat				
12	M	L	R	House				

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Data Sheet for Pointing to Named Items

Materials Required:	**Individual's Response of Each Trial:**
Pictures of a banana, a dog, and balloons	Point to the picture the instructor named
Set-Up for Each Trial:	**Instructions at start of each trial:**
A row of three pictures on the table in front of the individual	Say touch "_____" (banana, dog, or balloons)

Most-to-Least Prompt Fading Steps:

1. Full prompt (F): Full physical guidance
2. Partial prompt 1 (P1): Light physical guidance and pointing to correct picture
3. Partial prompt 2 (P2): Gestural prompt, pointing to correct picture only
4. No prompt (NP)

Fading Rules on Standard Trials:

Following 3 consecutive correct responses at Steps 1, 2, and 3, proceed to the next step

Following 2 consecutive errors at Steps 2, 3, and 4, return to the previous fading step

Mastery Criterion:

3 consecutive correct, independent responses (no prompts) on standard trials

On each trial, record child's response as correct (✓) or error (x) or no response (NR) in the appropriate column, and indicate prompting level (F, P1, P2, or NP)

Trials	**Position of Pictures on Table**			**Picture to Give to Individual**	**Standard Trials**		**Error Correction Trials**	
	Banana	**Balloons**	**Dog**		**Correct**	**Error**	**Correct**	**Error**
1	R	M	L	Banana				
2	L	R	M	Dog				
3	M	L	R	Balloons				
4	R	M	L	Dog				
5	L	R	M	Balloons				
6	M	L	R	Banana				
7	R	M	L	Banana				
8	L	R	M	Balloons				
9	M	L	R	Banana				
10	R	M	L	Dog				
11	L	R	M	Dog				
12	M	L	R	Balloons				

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Data Sheet for Imitating Simple Actions

Materials Required:	**Individual's Response of Each Trial:**
None	Imitates modeled action
Set-Up for Each Trial:	**Instructions at start of each trial:**
Teacher models an action	Say "Do this" and model an action (Tap table, Touch nose, or Touch shoulders)

Most-to-Least Prompt Fading Steps:

1. Full prompt (F): Full physical guidance
2. Partial prompt 1 (P1): Light physical guidance and pointing to correct picture
3. Partial prompt 2 (P2): Gestural prompt, pointing to correct picture only
4. No prompt (NP)

Fading Rules on Standard Trials:

Following 3 consecutive correct responses at Steps 1, 2, and 3, proceed to the next step

Following 2 consecutive errors at Steps 2, 3, and 4, return to the previous fading step

Mastery Criterion:

3 consecutive correct, independent responses (no prompts) on standard trials

On each trial, record child's response as correct (✓) or error (x) or no response (NR) in the appropriate column, and indicate prompting level (F, P1, P2, or NP)

Trials	**Action to be Modeled**	**Standard Trials**		**Error Correction Trials**	
		Correct	**Error**	**Correct**	**Error**
1	Tap Table				
2	Touch Nose				
3	Touch Shoulders				
4	Tap Table				
5	Touch Shoulders				
6	Touch Nose				
7	Touch Nose				
8	Touch Shoulders				
9	Tap Table				
10	Touch Shoulders				
11	Touch Table				
12	Touch Shoulders				

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APPENDIX E:
DISCRETE TRIAL TEACHING EVALUATION FORM (DTTEF)

DTTEF

Prepare to Conduct a Teaching Session

Components	
1. Determine teaching task	
2. Gather teaching materials	
3. Select at least 3 reinforcers	
4. Arrange the teaching setting	
5. Determine prompt fading proc. and initial fading step	
6. Invite child to the table & give a reinforcer choice	

During Teaching Trials

Manage Antecedents

	Trials				
Components	1	2	3	4	5
7. Check data sheet for trial information					
8. Secure child's attention					
9. Present teaching materials or model response					
10. Present correct instruction					
11.Present correct prompts					

Manage Consequences

Correct Response

	Trials				
Components	1	2	3	4	5
12. Praise & present additional reinforcer					
14. Record response					

Incorrect Response

	Trials				
Components	1	2	3	4	5
13. Block gently, remove materials, look down (2-3 secs.)					
14. Record response					
15. Allow brief inter-trial interval (3-5 secs.)					
16. Secure child's attention					
17. Re-present materials					
18. Re-present instruction & prompts to guarantee correct response					
19. Give praise only					
14b. Record error correction					

	Trials				
Components	1	2	3	4	5
15. Allow brief inter-trial interval (3-5 secs.)					

Across All Trials

Component	
20. Fade prompts across trials	

APPENDIX F:
BIE FEEDBACK SCRIPT

BIE Feedback Script

DTTEF Step	**Instructional Feedback**
1. Determine teaching task	Decide which task you'll teach
2. Gather teaching materials	Get your materials together
3. Select at least 3 reinforcers	Choose 3 reinforcers
4. Arrange the teaching setting	Arrange your table
5. Determine prompt fading proc. and initial fading step	Use most to least/least to most here
6. Invite child to the table & give a reinforcer choice	Invite to table and let him choose a reinforcer
7. Check data sheet for trial information	Look at data sheet for information
8. Secure child's attention	Get his attention
9. Present teaching materials or model response	Present teaching material/model response
10. Present correct instruction	Provide correct Sd
11.Present correct prompts	Provide higher/lower prompting level
12. Praise & present additional reinforcer	Praise and provide reinforcer
13. Block gently, remove materials, and look down (2-3 secs.)	Block, remove materials, and look down for 2-3 seconds
14. Record response	Record response
14b. Record error correction	Record error correction
15. Allow brief inter-trial interval (3-5 secs.)	Wait 3-5 seconds
16. Secure child's attention	Get his attention
17. Re-present materials	Present materials again
18. Re-present instruction & prompts to guarantee correct response	Present instruction again
19. Give praise only	Only give praise
20. Fade prompts across trials	Fade prompts

Encouraging Feedback Sample Statements
Nice work securing attention!
Good job presenting correct instruction!
Way to praise!
Wonderful inter-trial interval!
Amazing _____
I like the way you_____
Fantastic
Awesome
Excellent
Marvelous
Super
Great
Fabulous
Fantabulous
Outstanding
Superb
Beautiful job
Unbelievable work
Brilliant
Magnificent
Lovely

APPENDIX G:
SAMPLE CONFEDERATE SCRIPT

Sample Confederate Script
Imitating Simple Motor Actions

Task	**Confederate Response**
1. Tap Table	Correct
2. Touch Nose	Incorrect
3. Touch Shoulders	Incorrect
4. Tap Table	Incorrect
5. Touch Shoulders	Correct
6. Touch Nose	Correct
7. Touch Nose	Correct
8. Touch Shoulders	Incorrect
9. Tap Table	Correct
10. Touch Shoulders	Correct
11. Touch Table	Incorrect
12. Touch Shoulders	Correct

APPENDIX H:
PROCEDURAL CHECKLIST DATA SHEET

Procedural Checklist Data Sheet

Participant	
Date	
By	

Record if the study followed this script

+ indicates YES	**- indicates NO**	**/ indicates not applicable**

Orientation	
Researcher provides written synopsis of study	
Researchers explains study verbally	
Researcher obtains consent	
Pretest	
Administered Pretest (DTT before receiving one-page self-instruction manuals)	
Confederate followed script during DTT	
Baseline	
Participants studied one-page self-instruction manuals	
Participants instructed confederate on three tasks using DTT	
Confederate followed script during DTT	
Treatment	
Participants instructed confederate on tasks using DTT while receiving BIE feedback	
Confederate followed script during DTT	
Researcher followed script regarding encouraging feedback and instructional feedback	

APPENDIX I:
PHASE CHANGE GUIDELINES

Phase Change Guidelines

Condition	Transition	Decision Rule
Baseline	Baseline to Treatment	Moves into treatment once 80% of the data points reside on or within the stability envelope
Treatment	Treatment to Completion	Participants will exit the study when they implement DTT with 90% accuracy (as measured by the DTTEF) 3 out of 4 consecutive days or when they have received 10 sessions of treatment

APPENDIX J:
SOCIAL VALIDITY QUESTIONNAIRE

Social Validity Questionnaire

Please complete this questionnaire to assist the researcher in evaluating the social importance of the conducted research. It is anonymous. Mark the number according to how much you agree or disagree with each statement. 5 indicates that you completely agree, 1 indicates that you completely disagree, 3 indicates that you are neutral, or do not agree nor disagree.

	1 Disagree	2 Somewhat Disagree	3 Neutral	4 Somewhat Agree	5 Agree
I am a university student					
Goals					
1. I think that the goal of the study; to teach students to accurately implement discrete trial teaching is important.					
2. I think that the goal of teaching students to reinforce and correct errors made during implementing discrete trial teaching with children receiving discrete trial teaching is important.					
Procedures					
3. The abbreviated one-page self-instruction manuals were effective					
4. The Bug in Ear feedback added to the abbreviated one-page self-instruction manuals was effective					
Effects					
5. I have learned to conduct discrete trial teaching of three skills					
6. I think that what I have learned can help me to teach a child with autism					
7. I have learned a new important skill by participating in this study					
8. I would recommend this training opportunity to other students					

APPENDIX K:
WHAT WORKS CLEARINGHOUSE STANDARDS

What Works Clearinghouse Standards

WWC criteria to meet evidence based standards	Alignment of current study
The independent variable must be systematically manipulated, with the researcher determining when and how the independent variable conditions change.	The research will monitor the data. When the independent variable is implemented and the data reach 70% accuracy the next participant in baseline will move into treatment. When the independent variable data reaches 90% accuracy the intervention will be complete for that participant.
Each outcome variable must be measured systematically over time by more than one assessor, and the researcher needs to collect inter-assessor agreement in each phase and on at least twenty percent of the data points in each condition and the inter-assessor agreement must meet minimal thresholds.	Inter-assessor/inter-observer agreement will be collected using a percentage agreement for 20% of the baseline condition and 20% of the treatment condition.
The study must include at least three attempts to demonstrate an intervention effect at three different points in time or with three different phase repetitions.	This study will include 3 participants, each with their own baseline and treatment phases.
For a phase to qualify as an attempt to demonstrate an effect, the phase must have a minimum of three data points. *To Meet Standards a multiple baseline design must have a minimum of six phases with at least 5 data points per phase.*	This study will include 3 participants, each with their own baselines and treatment phases. The baseline phases will have a minimum of 5 data points per participant and the treatment phases will also have at least 5 data points per participant.

Adapted from Kratochwill et al., 2010

APPENDIX L:
IRB APPROVAL

[redacted] [redacted]

Approval of Human Research

From: [redacted] Institutional Review Board #1
[redacted]

To: **Tracy McKinney**

Date: **April 13, 2012**

Dear Researcher:

On 4/13/2012, the IRB approved the following human participant research until 4/12/2013 inclusive:

Type of Review:	[redacted] Initial Review Submission Form
Project Title:	Using Bug In Ear Feedback to Increase DTT Fidelity Implementation
Investigator:	Tracy McKinney
IRB Number:	SBE-12-08368
Funding Agency:	
Grant Title:	
Research ID:	N/A

The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at [redacted].

If continuing review approval is not granted before the expiration date of 4/12/2013, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of [redacted] Ph.D., L.C.S.W., CF IRB Chair, this letter is signed by:

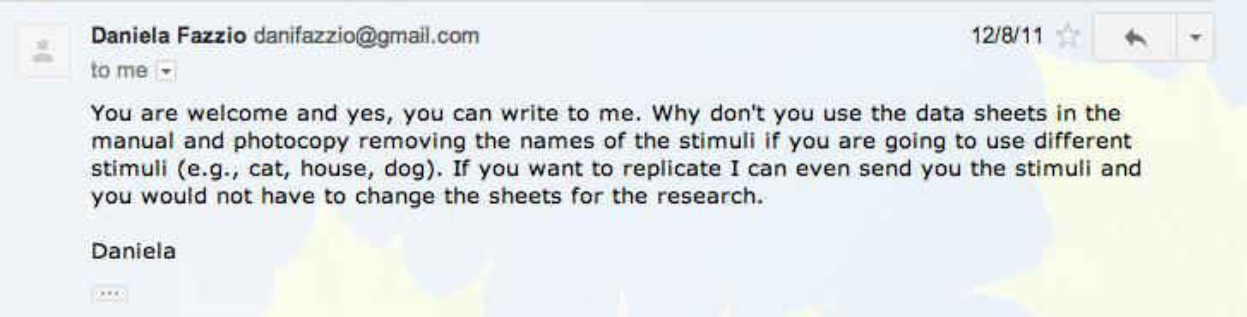
Signature applied by [redacted] on 04/13/2012 03:21:19 PM EDT

[redacted]

IRB Coordinator

APPENDIX M:
PERMISSION TO REPLICATE FORM

Permission to Replicate



Daniela Fazzio danifazzio@gmail.com 12/8/11

to me

You are welcome and yes, you can write to me. Why don't you use the data sheets in the manual and photocopy removing the names of the stimuli if you are going to use different stimuli (e.g., cat, house, dog). If you want to replicate I can even send you the stimuli and you would not have to change the sheets for the research.

Daniela

APPENDIX N:
ARTICLE EXCLUSION CRITERIA

Article Exclusion Criteria

Date	Author	Reason for exclusion
2011	May	Extended DTT skills that therapists already possessed using a prompting board
2011	Nosik	Advocated eliminating human trainers and substituting computer based trainings
2011	O'Guin	Implemented didactic instruction, modeling, role play, Q & A, and practice with verbal feedback
2010	Weinkauf	Administered verbal Description of skills, rationale, examples, modeling, and practice with praise or corrective feedback
2009	Cantania et al.	Used video modeling
2008	Downs, Downs, and Fossum	Examined the difference in using two different implementation models for DTT and the effects on student skill acquisition
2008	Sarakoff	Implemented the use of written instructions, rehearsal, feedback and modeling
2008	Bolton and Mayer	Delivered didactic instruction, modeling, general case instruction, and practice with specific performance feedback

Article Exclusion Criteria

Date	Author	Reason for exclusion
2008	Downs et al.	Utilized didactics, live modeling of correct and incorrect implementation, practice and corrective feedback
2007	Crockett	Provided lecture, demonstration video, role play with verbal feedback
2007	Dib and Sturmey	Administered instructions, feedback, modeling and rehearsal
2007	Lafasakis and Sturmey	Administered written instructions, verbal explanations, Q & A, modeling, rehearsal with verbal feedback
2005	Leblanc, Ricciardi, and Luiselli	Used instruction and performance feedback
2004	Sarokoff	Delivered written instructions, feedback and modeling
1978	Koegel, Glahn, and Nieminen	Used demonstration, lecture, video

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