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Coaching In An Interactive Virtual Reality To Increase Fidelity Of Implementation Of Discrete Trial Teaching

Krista Vince Garland
University of Central Florida

COACHING IN AN INTERACTIVE VIRTUAL REALITY TO INCREASE FIDELITY OF IMPLEMENTATION OF DISCRETE TRIAL TEACHING

by

KRISTA VINCE GARLAND
B.S. University of Central Florida, 2005
M.A. University of Central Florida, 2008

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ABSTRACT

In teacher preparation, more effective pathways and practices are needed for preparing, placing, and supporting beginning teachers and principals (Darling-Hammond, 2010; U.S. Department of Education, 2009b). A common issue in the field of special education is the lack of skill transfer from one setting to another (Dieker, Hynes, Hughes, & Smith, 2008). It has been posited that "practicing up" is not ethical in that novice teachers must attempt to teach with a limited knowledge of appropriate pedagogy and skill (Dieker et al., 2008). The new challenge becomes finding an effective mechanism that provides essential learning experiences and opportunities to refine teaching techniques to the highest standards of fidelity in a safely controlled and coordinated environment (Odom, 2009).

Perhaps because of the ethical concerns in honing teacher skills on actual children, and despite the strong demand for professionals who are trained in discrete trial teaching (DTT), few studies have been published on training methodologies and fidelity of implementation (Fazzio, Martin, Arnal, & Yu, 2009). The training of teachers to implement evidence-based interventions such as DTT with fidelity while they are working with students with ASD cannot be over-emphasized in a teacher preparation program (Scheuermann, Webber, Boutot, & Goodwin, 2003; Simpson, 2004; 2005). The researcher utilized the TLE TeachLivE simulation classroom laboratory at the University of Central Florida as a mechanism to infuse cutting-edge technology and learning activities within program/project coursework. The TLE TeachLivE virtual classroom serves as a venue for pre-service and practicing teachers to safely gain proficiency and

enhance fidelity of implementation of evidence-based practices. Participants experienced an immersive, real-time environment that featured interactions with Austin, an avatar that portrayed a student with autism. A trained interactor remotely controlled the behavior and responses of the avatar with which teachers engaged for practice sessions consisting of ten discrete trials. Between sessions, participants received individualized clinical coaching (ICC) on their performance. Upon termination of the intervention, two generalization probes were conducted to measure retention of fidelity over time within actual classroom settings. Results indicated that all five participants strongly benefited from learning DTT with ICC in the TLE TeachLivE learning platform.

Across participants, the overall mean gain in fidelity from baseline phase (14%) to intervention phase (80%) was 66%. The fidelity means of participants in the generalization phase held to 90%, thus supporting the use of virtual environments for teacher preparation. Mean time among participants to attain higher than mastery level performance of 90% in intervention was 1.25 hours. This resulted in shorter training times than previously researched training programs (Arnal et al., 2007; Fazzio et al., 2009; Leblanc, & Luiselli, 2005; Thiessen et al., 2009). This investigation endeavored to reduce the potential of diminished pupil learning gains as a necessary consequence when honing skills in the appropriate delivery of instruction of discrete trial teaching.

To Dennis—

Because the road that we walk on

is paved in gold.

I love you.

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LIST OF ABBREVIATIONS

AAR	After-Action Review
ABA	Applied Behavioral Analysis
ADMMN	Autism and Developmental Disabilities Monitoring Network
APA	American Psychiatric Association
ASD	Autism Spectrum Disorders
AYP	Adequate Yearly Progress
BCBA	Board Certified Behavioral Analyst
CDC	Centers for Disease Control and Prevention
DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders- Text Revision
DSM-5	Diagnostic and Statistical Manual of Mental Disorders-5th edition
DTT	Discrete Trial Teaching
DTTER	Discrete Trial Teaching Evaluation Rubric
EBP	Evidence-Based Practice
ESE	Exceptional Student Education
ICC	Individualized Clinical Coaching
IDEA	Individuals with Disabilities Education Act
IOA	Inter-Observer Agreement
ITI	Inter-Trial Interval
LRE	Least Restrictive Environment
NCATE	National Council for Accreditation of Teacher Education
NCLB	No Child Left Behind

NPDC	National Professional Development Center for Autism Spectrum Disorders
NRC	National Research Council
ODW	Operational Definitions Worksheet
PDD-NOS	Pervasive Developmental Disorder- Not Otherwise Specified
PND	Percentage of Non-Overlapping Data
POD	Percentage of Overlapping Data
WWC	What Works Clearinghouse

CHAPTER ONE: INTRODUCTION

Chapter Overview

Chapter one describes a rationale for providing training to teachers of students with autism spectrum disorders (ASD) on discrete trial teaching (DTT) in an immersive virtual environment. The training had a positive effect on teachers' fidelity of implementation when delivering DTT in their classrooms. To begin, an overview of characteristics of students with ASD is presented, followed by current diagnostic criteria and statistical prevalence trends. Next, an impetus for change within the field of teachers who work with students with ASD is reviewed, followed by an explanation of applied behavioral analysis (ABA) and discrete trial teaching (DTT). The chapter continues with a call to effectively and ethically prepare teachers, and concludes with a description of the purpose, design, and limitations of the study.

Definition and Prevalence

Autism spectrum disorder is one of the most prevalently diagnosed developmental disorders in the world today. The Centers for Disease Control and Prevention (CDC, 2012) estimated a 23% increase in the prevalence of ASD when 2008 data were compared with the data for 2006. This increase equates to about 1 in every 88 children. ASDs are by their nature "spectrum disorders," which means ASDs affect each person in

various ways and symptomologies can range from very mild to severe. People with ASD are affected with symptoms that can include difficulties in language, communication, and social interactions (American Psychiatric Association, 2000).

Variations among individuals occur relative to age of symptomatic onset, severity of symptoms, and the exact nature of the symptoms. Diagnosing an individual as having an ASD can be difficult, since there are no currently accepted medical tests (e.g., laboratory blood panel work-ups) to diagnose the disorders. Doctors must instead look toward behavior and development to determine a diagnosis. ASD can sometimes be detected at 18 months or younger. By age two, a diagnosis from an experienced professional can be considered very reliable (Lord et al., 2006).

The term autism spectrum disorder (ASD) is often used interchangeably with the term Pervasive Developmental Disorder (PDD), although the former is the preferred term for this constellation of disorders because of its implication that the disruption in development occurs across multiple areas of functioning and implies a multidisciplinary approach to assessment and intervention (VanBergeijk, Klin, & Volkmar, 2008). One of the world's foremost authorities on developmental disorders, the American Psychiatric Association (APA, 2000) described the various characteristics of ASDs in the following way:

- Autistic Disorder (also called "classic" autism) is what most people think of when hearing the word "autism." Individuals with autistic disorder usually have significant language delays, social and communication

challenges, and unusual behaviors and interests. Many people with an autistic disorder also have an intellectual disability.

- Asperger's Disorder is usually described as milder symptoms of autistic disorder. Individuals with Asperger's Disorder might have social challenges and unusual behaviors and interests, but typically do not have problems with language or intellectual disability.
- Pervasive Developmental Disorder–Not Otherwise Specified (PDD-NOS; also called "atypical autism"). Many individuals who meet some of the criteria for autistic disorder or Asperger syndrome, but not all, may be diagnosed with PDD-NOS. People with PDD-NOS usually have fewer and milder symptoms than those with autistic disorder. The symptoms may present social and communication challenges, but no other difficulties in functioning

An Impetus for Change

The passing of the No Child Left Behind Act (NCLB, 2002) has dramatically increased the demand for knowledge on best practices to accommodate the diversity of student needs that teachers encounter within their classrooms (Boe, Shin, & Cook, 2007). With over 6,000,000 children receiving special education services across the country, the increased need for well-prepared teachers that accompanies such a number of students is critical (Cooper, Kurtts, Baber, & Vallecorsa, 2008). Simpson, McKee, Teeter, and

Beytien (2007) described best-practices for children and youth with ASD as educational interventions that have met rigorous peer review, and stated that when consistently and reliably used by qualified persons, such best practices have the capacity to yield positive results. Students on the autism spectrum require teachers who have strong knowledge of how to effectively implement research-based interventions within our school settings.

With the increase of prevalence of ASD displayed in America today, it is undeniable that this ripple effect reflects a dire need for colleges of education to prepare special education teachers to make instructional decisions that lead to effective student outcomes. Before teachers of students with ASD can effectively make such instructional decisions necessary to ensure student progress, they must be prepared with a mastery level of educational strategies and knowledge of how to organize and conduct instructional trials (Simpson et al., 2007). Brownell, Ross, Colon, and McCallum (2005) reported that studies demonstrated that teachers with pedagogical and content preparation are better able to engage students in the learning process. In a later publication, Brownell, Sindelar, and Kiely (2010) posited that to be effective, special education teachers must be knowledgeable of evidence-based intervention strategies and assessments that address disability-specific needs and be able to provide more intensive, explicit instruction within a broader curricular context.

Scheurmann, Webber, Boutot, and Goodwin (2003) reported that relatively few teachers are aware of strategies, and most have not mastered the ones that they are familiar with to a level that impacts student learning outcomes. Brownell et al. (2010) acknowledged that adequate yearly progress (AYP) and access to the general education

curriculum for many students with disabilities depend on the skill of their teachers, and that the future of the field of special education depends on the capacity to upgrade the quality of teacher education. Lerman, Vorndran, Addison, and Kuhn (2004) found that effective practice for teachers of students with autism was based on assessment of teacher skill, progress monitoring of student development, and ongoing feedback of teacher performance to ensure maintenance and generalization within educational settings. It becomes evident that teacher preparation programs should provide an effective platform for educators to perfect evidence-based practices (EBPs), in order to provide students with ASD the best possible learning outcomes (Simpson et al., 2007).

Applied Behavioral Analysis, One Component of Evidenced-Based Practice

One philosophy that is embedded within many EPBs is reflective of Applied Behavioral Analysis (ABA). The philosophies and methodologies of ABA are founded upon research-based principles of behavioral conditioning that can be transferred to learning (Siegal, 2003). Applied behavior analysis is a highly organized approach for planning, applying, and evaluating instruction within relevant settings for the learner (Alberto & Troutman, 2006; Lovaas, 1987; Skinner, 1968). In the late 1960s, a new method for teaching children with autism was introduced and researched by O. Ivar Lovaas. In his landmark study in 1987, Lovaas conducted a behavioral modification treatment program for children with autism. Lovaas reported that before treatment began, students in the experimental group constituted an "average or below average sample" of

children with autism (p. 5). Results from his study indicated that the experimental treatment group (n =19) reflected that "47% achieved normal intellectual and educational functioning, with normal-range IQ scores and successful performance in public schools" (p. 3). Since then, his original methodology has expanded, and today the behavioral principles of ABA are widely used within a variety of settings and populations (Dunlap, Kern, & Worcester, 2001; Heward, 2006). Dunlap et al. (2001) wrote that ABA's emphasis on individualization and direct observation of behaviors make the method a sensible match for most learning settings within special education. ABA complements and aligns itself with teacher accountability in learning and progress monitoring for students with ASDs (Alberto & Troutman, 2006; Dunlap et al., 2001; Heward, 2006; Simpson, 2005; Simpson et al., 2007).

Discrete Trial Teaching, One Practice within ABA

One particular EBP within ABA that is frequently used when teachers work with students with ASD is DTT. Discrete trial teaching has been recognized as an effective teaching methodology for children who are on the autism spectrum (Bogin, Sullivan, Rogers, Stabel, & Hatton, 2010; Dunlap et al., 2001; Leblanc & Luiselli, 2005; Lovaas, 1987; Odom, 2009; Simpson, 2005). DTT is based on the principles of ABA and emphasizes a highly systematic approach to learning where objectives are broken into smaller discrete components with positive reinforcement. As skills are acquired, new learning objectives can be added, building upon previous successes and eventually

incorporating them into more natural environments such as classroom and home settings. Specifically, DTT is described as a teaching method that is teacher centered and demonstrates a linear and specific fashion of instruction. Standard procedures within DTT involve the selection of reinforcers that are paired with clear contingencies and combined with repetition to teach new learning objectives (Ghezzi, 2007). Heward (2006) described four main components of DTT as being the instruction, the student response, the reinforcement or correction, and the data collection.

Many of today's educational settings incorporate DTT as a vital component of service delivery (Green, Brennan, & Fein, 2002; Leblanc & Luiselli, 2005; Maurice, Green, & Foxx, 2001). One of the most attractive attributes of DTT is that it subscribes to the concept of the three-term contingency, which relates to the concept of a stimulus, response, and reinforcer (Ghezzi, 2007; Lovaas, 1987; WWC, 2010). When teachers work with students who have developmental and/or behavioral difficulties, a highly contrived and controlled teaching environment may be most effective, especially when learners are in the early stage of learning acquisition (Siegel, 2003; Simpson, 2005; Simpson et al., 2007). DTT has been demonstrated to be extremely effective with learners, including those who have ASDs (Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993; Sheinkopf & Siegel, 1998), and it can be combined with other ABA methods (e.g., incidental teaching, pivotal response training) to generalize learning into more natural settings (Ghezzi, 2007). The training of teachers to implement evidence-based interventions such as DTT with fidelity while they are working with students with ASDs

cannot be over-emphasized in a teacher preparation program (Scheuermann, Webber, Boutot, & Goodwin, 2003; Simpson, 2004, 2005).

To Effectively and Ethically Teach the Teacher

The call for more effective pathways and practices has been heralded for preparing, placing, and supporting beginning teachers and principals (U.S. Department of Education, 2009a). To highlight an impetus for change, one common issue in the field of special education is the lack of skill transfer from one setting to another (Dieker, Hynes, Hughes, & Smith, 2008). Many specialized training programs and in-service professional development opportunities for teachers are limited in scope and content (Simpson, 2004), and it has been posited that "practicing up" is not ethical (Dieker et al., 2008). In many teacher preparation activities such as internships and field experiences, novice teachers must attempt to teach children with only a limited knowledge of appropriate pedagogy and skill (Dieker et al., 2008). In addition, institutes of higher education may have difficulty in providing field experiences that are consistent in quality, caliber, and diversity.

The new challenge becomes finding an effective mechanism that provides essential learning experiences and opportunities to refine teaching techniques to the highest standards of fidelity in a safely controlled and coordinated environment. In an effort to alleviate such concerns in field experiences, teacher educators are exploring the role that technology plays in supplementing traditional field experiences (Hixon & So,

2009). Field experiences that utilize a simulated environment have been termed "virtual practicums" and can play a part in meeting these needs, not as a replacement for real classroom experience but as a way to better educate and prepare people for their first encounters (Zibit & Gibson, 2005). Additionally, technology-based platforms provide a medium for instructors and supervisors to deliver feedback to learners (Scheeler, McKinnon, & Stout, 2012). Research on such platforms for teaching is of central importance, since teachers who work with students with ASD not only need a sound theoretical knowledge of EBPs, they also need to have practice incorporating learned skills into their teaching in order to deliver sound teaching practices with fidelity (Attwood, 2007; Odom, 2009).

The TLE TeachLivE virtual classroom laboratory is one such technology platform for teacher educators to investigate when considering more effective and ethical pathways for learning. TLE TeachLivE stands for Teaching Learning Environment: Teaching and Learning in an Interactive Virtual Environment. This learning lab was designed to provide educators with a realistic virtual setting avenue to practice teaching with avatars (virtual characters that are manipulated by human performers). Interactions are real-time and can either be scripted or spontaneous, depending upon the nature of the learning activity.

Purpose of the Study and Research Questions

The purpose of this study was to measure the efficacy of individualized clinical coaching (ICC) in a virtual reality learning modality (TLE TeachLivE) and the effect of this intervention on teachers' fidelity of implementation of DTT when working with students with ASD. Specifically, the study asked:

To what extent is the fidelity of implementation of DTT affected when teachers are prepared using individualized clinical coaching in the TLE TeachLivE virtual classroom laboratory?

To what extent did participants' preparation with individualized clinical coaching sessions delivered in TLE TeachLivE virtual classroom laboratory generalize when they administer DTT to students with ASD in a classroom setting?

To what extent did participants value their preparation of DTT with individualized clinical coaching while in the TLE TeachLivE virtual classroom laboratory?

Research Design

A modified multiple baseline design across five participants was used to evaluate the effects of ICC in the TLE TeachLivE virtual classroom on participants' performance when being trained to implement five components of a DTT procedure via coaching that utilizes feedback and demonstration. Baseline was collected concurrently, and treatment staggered across participants. If baseline data remained stable and DTT improved only

following intervention of coaching sessions, then the following conclusions were supported: (a) observed effects were likely due to the intervention and not due to an external variable, and (b) repeated exposure to baseline conditions did not affect performance (Gast, 2010).

Four baseline sessions were conducted concurrently with each of the participants at the beginning of the study. Based upon visual analysis of the sessions, the most stable participant was brought into the treatment phase and other participants were emailed dates for future probes as needed. When a participant in the treatment phase demonstrated 90% mastery of the DTT rubric for three consecutive sessions, the next participant received a baseline probe and was brought into the treatment phase. The investigator arranged to observe DTT generalization probes in teachers' classroom settings two weeks after respectively completing the treatment phase. The participants conducted two DTT sessions with a student who had been diagnosed with an ASD and who was receiving special education services. The investigator scored sessions within the classroom setting using the same DTT evaluation rubric that was used in the TLE TeachLivE virtual classroom laboratory during baseline and intervention phases.

Data Collection Procedures

Participants were scored in the lab setting and classroom setting with a teacher-evaluation rubric that was developed by the researcher to measure fidelity of implementation of discrete trial teaching. The Discrete Trial Teaching Evaluation Rubric

(DTTER) was developed through a review of literature on steps of implementation when administering DTT (Arnal et al., 2007; Bogin et al., 2010; Simpson, 2005) and validated in a previous pilot study investigating fidelity of DTT while in a virtual classroom setting (Vince Garland, Vasquez, & Pearl, in press). Sessions were live-scored, and written evaluations were kept in a three-ring binder. All sessions were video tape recorded for inter-observer agreement and review as needed. A field notebook was also kept to document any environmental occurrences that may have impacted the investigator's research.

Data Analysis

Data from the DTTER were visually analyzed, and percentages of correct responses per session on applicable components were calculated on a point-by-point basis to determine proficiency level of the DTT implementation (Gast, 2010). Components were grouped into five categories and each of these components was further sub-divided into subcomponents that equaled between 10 and 15 steps, depending on the avatar's response to the participant's request.

Limitations

This study was limited to investigating the effects that ICC in a virtual classroom setting had on teachers' fidelity of implementation of DTT when working with students with ASD. DTT is recognized as an EBP for students with ASD, and research has demonstrated that students can make strong gains when DTT is implemented with fidelity (Anderson et al., 1987; Birnbrauer & Leach, 1993; Lovaas, 1987; McEachin et al., 1993; Sheinkopf & Siegel, 1998). It is recognized that DTT is only one research-based intervention among many that teachers should receive in teacher preparation programs.

By the nature of single subject design, the small number of participants utilized within this investigation limits the applicability and generalizability of the results. Within the generalization phase, the student participants within teachers' classrooms displayed wide ranges of ability levels and behaviors, which are also noted as a limitation to the study. All participants were from the same graduate teacher preparation program, which may potentially limit diversity. The investigation was held to a pre-determined length of time (one school semester), which limited the number of generalization sessions that could be conducted and observed.

Technology may also be considered a limitation within the study. In order to replicate the study, researchers must have access to a TLE TeachLivE virtual classroom laboratory or its equivalent. Particular components of technology in the lab also lend themselves to limitation. For example, the operating system is sensitive to severe weather conditions such as thunder storms. The system may not function as normal, resulting in dropped signal packets that delay avatar responses or create awkward

movements and positions. Avatars are also limited in their mobility. They are not able get up from their seats and are unable to interact physically. Because the avatar is a projected image and not an animate object, the participant cannot physically prompt or block the avatar within a DTT cycle.

CHAPTER TWO: LITERATURE REVIEW

Chapter Overview

This chapter's literature review provides an overview on prevalence and clinical description of Autism Spectrum Disorders, IDEA and least restrictive environment, the shortage of highly qualified teachers, and characteristics of highly qualified teachers for students with ASD. Turning from students to their teachers, the chapter includes current perspectives from within the field on the responsibility of special education teacher preparation programs to proficiently prepare their graduates with evidence-based practices that will enhance the lives of students with ASD. The chapter then turns to discuss a specific philosophy of behavior analysis, and reviews the highly prescribed EBP of DTT and its positive impact as a teaching tool. The next section describes Individualized Clinical Coaching (ICC) as a tool in teacher preparation. Following this discussion, the reader will examine the concept of preparing teachers within a digital world, and become familiar with the TLE TeachLivE Virtual Learning Classroom. Finally, the chapter concludes with a discussion on the need for research on teacher preparation that occurs while using the TLE TeachLivE lab; specifically using individualized clinical coaching to improve teacher fidelity when delivering DTT. Generalization of stimulated learning to real world performance is also discussed.

Autism Spectrum Disorders

Autism and its accompanying range of disorders is now recognized as the most prevalent diagnosis of developmental disorders within modern medicine today (Centers for Disease Control and Prevention, 2012; Moldin, & Rubenstein, 2006), and it is estimated that more than 1.5 million Americans live with some form of autism, including more than 100,000 children served under IDEA (U.S. Government Accountability Office, 2005). The Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring Network (ADMMN) estimated recently that approximately one in every 88 children has a form of autism. Specifically, it was reported that ASDs are almost five times more common among boys (1 in 54) than among girls (1 in 252). This finding displays a 23% increase from the 2006 report and a 78% increase in prevalence since the CDC's 2002 findings (Centers for Disease Control and Prevention, 2012).

Autism is a neurological disability that is presumed to be present from birth and is always apparent before the age of three. Although autism affects the functioning of the brain, the specific cause of autism is unknown (Dunlap & Bunton-Pierce, 1999). Progress within the community of medical research has revealed via recent neuroimaging studies that a contributing cause of autism may be abnormal brain development beginning in the first few months following an infant's birth, and mounting evidence from studies indicates that genetic factors play a prominent role in the causes for ASDs (National Institute of Mental Health, 2008).

According to the 2004 edition of the American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR), Autistic Disorder (299.0) is distinguished by:

> A qualitative impairment in social interaction, communication, and restricted repetitive and stereotyped patterns of behavior, interests and activities, and delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play. (p. 75)

The APA (2004) describes Asperger's Disorder as being categorized within the range of autism spectrum disorders. It is hallmarked by a clinically significant impairment in social, occupational, or other important areas of functioning. There are no clinically significant general delays in language, cognitive development, development of age-appropriate self-help skills, adaptive behavior (other than in social interaction), or curiosity about the environment in childhood when contrasting Asperger's Disorder to Autistic Disorder. A marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gesticulations to regulate social interaction, failure to develop peer relationships appropriate to developmental level, a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people, encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus, an inflexible adherence to specific, nonfunctional routines or rituals, stereotyped and repetitive motor mannerisms, and a persistent preoccupation with parts of objects are all diagnostic features that the APA (2004) describes as typical indicators for individuals with Asperger's Disorder (p. 84).

Proposed Diagnostic Criteria Changes in the DSM V

In 2012 the APA set forth a proposal for new diagnostic criteria for the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) for autism. A new category, titled autism spectrum disorder, would integrate previously separate diagnoses, to include autistic disorder, Asperger's disorder, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified. Rationale for this change was provided by the Neurodevelopmental Work Group, which asserted that the four disorders are not a separate diagnosis to a specific disorder but rather a range of mild to severe on a continuum and that the description assists in describing an individual's overall developmental status. The proposed criteria revisions will lead to a more accurate diagnosis by "recognizing the differences from person to person, rather than providing general labels that tend not to be consistently applied across different clinics and centers" ("DSM-5 Proposed Criteria," 2012). Publication of the DSM-5 will occur in 2013, concluding a 14-year revision process.

IDEA and the Least Restrictive Environment

In accordance with the Individuals with Disabilities Education Improvement Act (IDEA, 2004), special education teachers must meet the same highly qualified standards as general education teachers. The least restrictive environment (LRE) requirements within IDEA mandate that students with disabilities receive their education in the general

education classroom to the maximum extent appropriate, and that removal from the regular educational environment occur only when the severity of the disability prohibits satisfactorily education in regular classes (IDEA, 2004). Wolf, Risley, and Mees (1964) stated that learners with ASD can be notoriously difficult to teach, in that they do not usually display desirable behaviors to which reinforcers can be applied and engage instead in behaviors that interfere with teaching. Challenges such as these can contribute to frustrations within the learning environment for both the teacher and student if the educator is not adequately versed in how to implement individualized evidence-based interventions with a high level of fidelity and ultimately come with the cost of a more restrictive learning environment for the student (Simpson et al., 2007).

Shortage of Highly Qualified Teachers for Students with ASD

The U.S. Department of Education (2009a) reported that from 1990 to 2010 a total of 47 of the nation's states had or will have shortages in special education. These shortages may come as a result of a combination of key legislation pieces such as the NCLB (2002) and the reauthorization of IDEA (2004), which requires that teachers who work with students with disabilities be fully certified and highly qualified. The National Research Council (NRC, 2001) plainly described that shortages of highly qualified special educators prepared to work with students with ASD are even greater than the shortages that exist for special educators in general. Lang and Fox (2004) reported that meeting the critical shortage of qualified teachers of students with ASD is a particular

challenge, as these teachers must have very specialized expertise, and teacher preparation programs produce low numbers of educators who are prepared to teach students with ASD. To be considered highly qualified, a special education teacher for students with ASD must hold full state certification as a special education teacher, graduate with at least a bachelor's degree, and meet subject area certification requirements (Darling-Hammond, 2010; Florida Department of Education, 2012; National Comprehensive Center for Teacher Quality, 2009).

Characteristics of Highly Qualified Teachers for Students with ASD

An efficient special educator program will produce and support highly effective special educators who are not only well versed in fundamental knowledge needed to support learners of varying exceptionalities but also specially trained to be adept at working with the unique needs of students with autism (Simpson, 2004, 2005). Students with ASD experience a wide spectrum of challenges in functioning levels which vary from severely impaired to gifted (Baron-Cohen, 2002). Students with ASD must have the best teachers, those who know how to be intrusive, persistent, and careful about what and how they teach (Scheuermann et al., 2003). Simpson (2004) noted that because of the extreme range of variability within the realm of ASD, teachers who educate students with ASD not only need to be knowledgeable about general and special education but also need specialized skills in the area of autism.

A critical component that pre-service teachers of students with ASD must understand is that by virtue of the uniqueness within this particular exceptionality, the heterogeneity of autism limits the plausibility of applying optimal interventions that are applicable for all (National Research Council, 2001). There will always be individuals who are non-responders, which reemphasizes the need for individualization within interventional strategies (Dunlap, 2007). Teachers of students with ASDs must be prepared to work with students who will arrive at their classrooms with a variety of skill levels and deficits. The effective teacher will be able to assess the student's skill level, implement interventions, and provide accommodations as needed for the individual learner's needs, adjusting these as learning occurs or is demonstrated (Dunlap, 2007; Scheuermann et al., 2003; Simpson, 2004, 2005).

Special Education Teacher Preparation Programs

With the remarkable number of students on the autism spectrum who are in need of appropriate services within our school settings, there is a dire need for colleges of education to prepare future educators to effectively teach students on the autism spectrum (Attwood, 2007). Teachers must be supplied with the appropriate training and necessary resources in order to provide students with ASDs the services that they will need to be successful in life (Simpson, 2005). Bearing this in mind, teacher preparation programs should include specific intervention techniques that focus on completing assigned tasks, developing communication and socialization skills, working collaboratively, transitioning

between activities, utilizing technology, and adjusting sensory stimulation within the school environment (Attwood, 2007; Larkey, 2005).

Teachers who work with students with deficits in functional and learning skills should utilize specialized instructional techniques so that students will learn to the maximum extent possible, thereby decreasing the chance of regression in learning (Scheuermann et al., 2003). Interventions that are derived from educational and behavioral orientations (e.g., instructional techniques) have been shown to help students with autism by assisting in skill development that enables students to successfully function in home, school, work, and community interactions (Dunlap & Bunton-Pierce, 1999; Wehmeyer, Shogren, Zager, Smith, & Simpson, 2010). Despite the widespread acceptance of the importance of an infrastructure to support the service delivery system for the ever increasing population of students who have ASD, until recently relatively little has been written on the task of personnel preparation for providing interventions for children with ASD (National Research Council, 2001).

Evidence-Based Practices for Working with Students with ASD

The movement for EBPs in the field of education was introduced with the passage of NCLB 2002 and has been gaining a great deal of notoriety with respect to the treatment of autism (Mayton, Wheeler, Menendez, & Zhang, 2010). The 2010 Blueprint for Reform: The Reauthorization of the Elementary and Secondary Education Act. stated that: “an educational priority of the U.S. is to expand the implementation of, and

investment in, innovative and evidence-based practices, programs, and strategies that significantly improve student outcomes" (p. 27). To be considered an EBP for individuals with ASD, the National Professional Dissemination Center for Autism Spectrum Disorders (NPDC, 2009) reported that efficacy must be established through peer-reviewed research in scientific journals using:

> Two high quality experimental or quasi-experimental group design studies, five high quality single subject design studies, by three different investigators or research groups (maintaining experimental control for each study), or meet criteria of a combination of evidence across group and single subject design studies.

In 2009, Burns and Ysseldyke published a study on the reported prevalence of evidence-based instructional practices in special education. Seventy percent of the respondents indicated they used evidence-based practices that included components of ABA at least weekly. The training of teachers to implement evidence-based interventions with fidelity while they are working with students with ASDs cannot be overemphasized in a teacher preparation program (Dunlap, 2007; Scheuermann et al., 2003; Simpson, 2004, 2005). The No Child Left Behind Act of 2001 included over 100 references to the importance of practices driven by scientifically based research and defined such research as involving the application of rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to the education practices (NCLB, 2002; Simpson, 2005).

In preparing teachers to work with children or youth with disabilities, it is particularly important that teacher educators model strategies of proven effectiveness with special student populations, emphasizing the appropriate selection and

implementation of EBPs (Bullock, Gable, & Mohr, 2008; Horner et al., 2005). The importance of having an adept knowledge regarding the selection and implementation of EPBs for learners with ASD cannot be overstated, considering the prevalence, high-stakes nature of intervention outcomes, and the history of questionable treatments that have been marketed to children and families affected by autism (Mayton et al., 2010). Mastering multiple competencies such as the evidence-based and promising practices listed by Simpson (2005) and the NPDC (2009) will best prepare teachers for the various challenges involved in instructing students with ASD. It is important that teacher training programs provide teachers who work with students with ASDs a "tool box" full of many best-practice interventions from sound teaching philosophies (Scheuermann et al., 2003).

Applied Behavior Analysis

Applied Behavior Analysis (ABA) is a behavioral management philosophy that is based on the idea that social and behavioral skills can be taught, and treatment within ABA usually begins between the ages of two and eight (Lovaas, 1987). ABA has had a deep and widespread impact on education and been demonstrated to be effective in all educational arenas with a full range of student populations (Dunlap et al., 2001). ABA has been listed as one of the five scientifically based practices for ASD by Simpson (2005) and is versatile for use in a variety of academic settings and grade levels, ranging from self-contained to full inclusion. Simpson (2005) defined such scientifically based practices as having "significant and convincing empirical efficacy and support" (p.145),

and included ABA within this category. ABA offers the promise of theoretically-based, carefully researched principles that can be applied to almost any kind of learning (Howlin, Magiati, & Charman, 2009).

A premier cornerstone of ABA is its strong emphasis on individualization, as manifested in single-subject design research processes, and commitment to individual functional analysis. In 2003, Odom et al. conducted a meta-analysis of literature from 1990 to 2002 to examine the scientific evidence provided by single-subject design studies that supported effective intervention and educational practices for young children with autism. Results from this study demonstrated that two groups of intervention techniques met the criteria for a well-established level of effectiveness: adult prompting and differential reinforcement. Odom et al. (2003) regarded these two techniques as having decades of supporting research and as fundamental elements of DTT.

ABA is lock and key with special education's focus on individual learning characteristics and individual needs that is synthesized for individualized education plans (Dunlap et al., 2001). Direct observation is also a strong principle of ABA and meets the demands for accountability within educational practices (Dunlap et al., 2001). It is worth noting that several other effective educational intervention strategies have been derived from ABA. These interventions include (a) positive reinforcement (including point and token systems); (b) systematic task analyses for developing academic skills; and (c) generalized techniques for building new skill repertoires through operations such as prompting, shaping, chaining, and fading; and strategies of self-management (Dunlap et al., 2001).

A distinct advantage in the application of ABA within learning settings is the focus on antecedents when developing interventions (Odom et al., 2003). A supportive environment can be created to promote desirable responding, thereby decreasing or eliminating occurrences of challenging behavior. One of the cardinal requirements of ABA involves collecting data on the progress of the individual and then changing the treatment plan if progress is not occurring (Howlin et al., 2009). ABA's strongest contributions have been in special education, and have had especially strong impact with students who have developmental disabilities, including ASDs (Dunlap et al., 2001).

Discrete Trial Teaching

In 2010 What Works Clearinghouse (WWC) published a report entitled the "Early Childhood Education Interventions for Children with Disabilities" that described the Lovaas Model of Behavior Analysis and stated that this model was found to have "potentially positive effects on cognitive development for students with disabilities" (p. 2). The Lovaas Model was originally researched at the University of California- Los Angeles under the direction of O. Ivar Lovaas, Ph.D. As previously mentioned, one of the leading evidence-based methods by which student behavioral interactions within environments can be analyzed is DTT (NPDC, 2009; NRC, 2001; Odom, 2009; Simpson, 2005). DTT is one of the oldest and most widely known and practiced methods of teaching students with ASD and has proved to have positive effects on children's academic, cognitive, communication/language, social, and behavioral skills. It has been

used to teach attending, imitation, and symbolic play skills (Ghezzi, 2007; NPDC, 2009). DTT is derived from learning theory (Green, 2002; Lovaas, 1987; Sarokoff, & Sturmey, 2004) and serves to individualize and simplify teaching for children with developmental disabilities. This intervention focuses on skill acquisition by manipulating the sequence of antecedents and consequences. The main components of DTT include instruction, prompting, response, consequence, and intertrial interval (Bogin et al., 2010; Lovaas, 1987; NPDC, 2009; Texas Statewide Leadership for Autism, 2009). A strong benefit for learning how to adequately administer DTT is that this method of teaching can be used with all learners and is not limited to a specific age or level of development (Ghezzi, 2007).

Individualized Clinical Coaching

The process of supervisory coaching involves the prompting of teachers to implement a newly learned practice while receiving feedback, modeling, and reinforcement from the expert (Allen & LeBlanc, 2004; Joyce & Showers, 1995). Many teacher preparation programs wait to provide formal feedback on teaching skills until the preservice teacher is teaching students, a field experience that frequently takes place near the end of teacher preparation. These practices tend to incorporate feedback on a limited basis and primarily in a summative manner, with supervisors providing the only comments (Trautwein & Ammerman, 2010), thereby providing little opportunity to increase the fidelity of EBPs. Increasing the use of EBPs and improving the fidelity with

which teachers implement them is a critical variable for maximizing student achievement (Kretlow & Bartholomew, 2010). Conversely, Kretlow and Bartholomew (2010) noted that low or inconsistent levels of fidelity with teaching procedures have been shown to correlate with lower gains in student achievement.

One way of improving fidelity is providing teachers with individualized support after initial training (Kretlow & Bartholomew, 2010). Kretlow, Wood, and Cooke (2009) found that high and stable levels of accurate implementation of evidence-based practices did not occur until after practitioners received at least one individualized coaching session. Coaching is a particularly effective form of follow-up support with an expert, such as a skilled peer, lead teacher, or university professor (Filcheck, McNeil, Greco, & Bernard, 2004; Stitcher, Lewis, Richter, Johnson, & Bradley, 2006). Coaching serves the purpose of providing teachers with a "means of examining and reflecting on what they do in a psychologically safe environment where it is all right to experiment, fail, revise, and try again" (Raney & Robbins, 1989, p. 37). During formal observation, the coach records the presence or absence of particular instructional techniques that the teacher was instructed to use in an initial training. Afterward, the coach provides descriptive feedback to the teacher regarding strengths and opportunities for improvement (Kretlow & Bartholomew, 2010). The reinforcement of effectively implemented practices increases the likelihood that teachers will use them in their classrooms (Scheeler, Bruno, Grubb, & Seavey, 2009). Additionally, studies have shown that supervisory coaching after an initial training improves teaching accuracy (Fuchs, Fuchs, Hamlett, & Ferguson, 1992; Kohler et al., 1999).

Coaching engages adult learners in the learning process with content that is relevant to them while collaborating with the coach (Caffarella & Barnett, 1994; Merriam, 2001). Therefore, coaching is a form of professional development that allows teachers to practice their skills that address their needs while practicing self- reflection (Gordon, 2004.; Kretlow & Bartholomew, 2010). In a time when teacher accountability is under close scrutiny, the observable and positive changes of teachers' applied accuracy make individualized clinical coaching an important method in an attempt to improve student outcomes (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Desimone, Porter, Garet, Yoon, & Birman, 2002).

Teacher Preparation in Discrete Trial Teaching

As stated previously, DTT is an EBP that can be used as a highly effective teaching intervention when working with students who have ASD, when implemented with fidelity. It should be stressed that the contribution of DTT to the education of children is dependent largely on the teaching skills of practitioners (LeBlanc, Ricciardi, & Luiselli, 2005). Instruction of DTT and fidelity of implementation are the linkage between evidence-based research and positive student learning outcomes. Fidelity of implementation is not an automatic skill but one that must come through professional development and technical assistance (Odom, 2009). Although there is a strong demand for professionals to be trained in DTT, few studies are published on training methodologies (Fazzio, Martin, Arnal, & Yu, 2009). Even fewer studies have been

published that examine methods for training educators to implement DTT with high levels of fidelity (Fazzio et al., 2009; Thiessen et al., 2009).

Koegel, Glahn, and Nieminen (1978) published one of the earliest studies that assessed teachers' use of DTT, utilizing an intervention package that included a written manual, a videotape that demonstrated correct and incorrect procedures, performance feedback, and practice. Koegel et al. (1978) reported that training was terminated after 25 hours, and all participants achieved performance mastery. A similar study was conducted in 2005 by Ryan and Hemmes, who trained three special education teachers who worked with students with ASDs in the delivery of DTT using didactic and video instruction, modeling, performance feedback, and practice. Results from the treatment package were favorable, and a total of 30 hours was required to implement the treatment package. A limitation of both the Kogel et al. (1977) and Ryan and Hemmes (2005) studies was that they lacked procedural integrity checks, and procedures were only briefly described. Maintenance and generalization phases were not described.

McBride and Schwartz (2003) conducted a study that evaluated the effects of a teacher-training package that included sequential components and blended DTT with activity-based intervention (ABI) and investigated the combination of the two methods on rate of instructional opportunities presented to young children with disabilities. Substantial increases in the children's rates of independent correct responses to target learning objectives in the ABI condition were observed after teachers were trained to implement DTT within classroom activities, demonstrating a relationship between fidelity of DTT and correct student response rates (McBride & Schwartz, 2003). Similar

to the McBride and Schwartz study, maintenance and generalization phases were not measured.

In 2004, Sarokoff and Sturmey evaluated the effectiveness of a behavioral skills training package to train teachers to correctly implement DTT. The training package utilized in this study consisted of instructions, feedback, rehearsal, and modeling. Results indicated that participants demonstrated rapid and large improvements in implementation after receiving the intervention package, but limitations included a lack of clarity as to which specific components were necessary to effectively train staff and did not address generalization of performance to actual children or maintenance across time.

Leblanc, Ricciardi, and Luiselli (2005) selected performance feedback as a primary training procedure for improving the fidelity of DTT, positing that it was a successful approach toward personnel management that could be adapted in a variety of applied settings. Researchers demonstrated that this style of performance feedback was effective in this case for improving paraprofessionals' skill in DTT. Study participants were able to make criterion for mastery in five sessions or less and maintained levels between 90% and100% for up to eleven weeks during the post-intervention phase. Limitations for this study included the possibility that paraprofessionals may have had prior knowledge of discrete trial instruction before training occurred and that the study lacked formally exploring factors responsible for the study's outcome (LeBlanc et al., 2005).

In 2007, Gilligan published a study that described a multiple baseline across participant intervention to teach DTT to three staff members who worked with students

with developmental delays. The treatment package comprised written learning objectives, feedback and observation, positive reinforcement, and practice. All three participants achieved nearly 100% accuracy by the end of the study. This study scored participants during training sessions, and the process of the discrete trial was analyzed in five components, similar to the NPDC (2009) procedural implementation checklist. Participants in this study did practice with students, but it was noted that assignment was not exclusive, meaning that some students were giving instruction by more than one participant during the study.

Arnal et al. (2007) conducted research that explored the effectiveness of training university students to implement DTT via a self-instructional manual. Participants were evaluated on their level of fidelity when attempting to teach tasks to confederates who portrayed children with ASD. A second leg of the experiment paired the self-instructional manual with a video-scoring component. Participants evaluated the taped performance of a professional conducting a DTT session with a confederate who portrayed a student with an ASD. In both the first and second experiment, one participant achieved mastery (greater than 90%) of DTT. Six out of seven participants demonstrated considerable improvement in administering or correctly scoring teacher fidelity of DTT. A strength of this study is that participants demonstrated high scores after limited exposure to the treatment packages (less than four hours). A limitation of the study was a lack of generalizability to actual students with autism.

Building upon the Arnal et al. (2007) study, Fazzio et al. (2009) evaluated performances of five university students' implementation of DTT procedures after they

received training that utilized a curriculum package that included a self-instructional manual and feedback plus demonstration. Participants were trained using a 19-step procedural checklist. A confederate who played a student with autism was again utilized in the experiment's baseline and intervention phases. A particular strength of this study was that in the generalization phase, participants' fidelity levels were measured while working with actual students.

In the baseline phase, participants were provided with one page lesson summaries and materials for teaching the confederate a skill via DTT and asked to teach the skills to the best of their ability. In the treatment phase of the study, participants studied a self-instructional manual and successfully completed skill check questions. Study times for each section of the manual were held constant across participants, but unlimited time was provided when completing the assessment test for each section. Criterion mastery for each section of the manual was 100%. After each participant achieved mastery, a simulated DTT session was conducted with a confederate. Participants were permitted to use a one page table similar to the summary sheet used in baseline during the session. Participants who earned scores less than 90% mastery within the confederate training session received a feedback plus demonstration session. One out of the five participants met mastery in the first DTT session after completing the self-instructional manual. Three participants required one session of demonstration and feedback, and one participant required a total of three sessions before reaching mastery with the confederate. Mastery criterion during the feedback plus demonstration session

was set at 80%. The last phase of the study attempted to generalize participants' levels of fidelity when conducting a DTT session with a child with autism.

Overall mean baseline for participants within the Fazzio et al. (2009) study was 34% (range of 45% to 97%), and participants required an average of 2.6 hours to master the self-instructional manual. After meeting with 100% proficiency in the manual, participants' average fidelity of implementation of DTT rose to 66% (range of 82% to 100%). A 26% improvement was demonstrated on average after participants received demonstration and feedback sessions, and generalization to a child with autism averaged a 91% mean accuracy (range of 81%–99%). Social validity was assessed via a five-point likert scale survey, and responses from participants who returned the survey (80%) were in agreement with positive statements for the merit of the intervention package (198/200 agreement score).

In a separate study, also published in 2009, Thiessen et al. evaluated the revised self-instructional manual from the Fazzio et al. (2009) study. A modified multiple baseline across four participants was conducted. In this study the instructional manual was modified slightly. The baseline for the Thiessen et al. (2009) study duplicated Fazzio et al.'s study, in that a confederate who portrayed a student with autism was employed to perform learning tasks within the session. In this study, a script was developed and utilized to maintain consistency across participants and sessions. Phases two and three of this study were also replicated from the Fazzio et al. (2009) investigation. Researchers determined that the manual was an effective way to train undergraduate students to implement DTT when teaching children with autism. All four

participants' scores improved immediately and abruptly from baseline, and training time was averaged at four hours and 34 minutes. Participant fidelity scores in the generalization phase averaged 77% (range 71%–83%) when working with a student rather than a confederate

While previous literature within the field of educator preparation and staff development has demonstrated the effectiveness of various packages for improving fidelity of DTT when working with students who have developmental disabilities, a limited amount of information was presented from the research demonstrating the transference of skill acquisition when actually working with students in an applied setting. Previous research presented was also limited in researchers' use of twenty-first century technology–based approaches, relying on television and video for instances of review and evaluation within experiments. The following sections of the literature review describe the need for institutes of higher education to prepare future teachers by harnessing innovative technological approaches to learning.

Teacher Preparation in a Digital World

Teachers who work with students with ASD need a sound theoretical knowledge of interventions and assessments and must have practice incorporating these skills into their teachings (Attwood, 2007). Colleges of education have a responsibility to prepare future teachers in effectively collecting and analyzing student data in a meaningful way so as to ensure that they can provide meaningful and effective instruction. One of our

nation's greatest failures in the educational system is the inability to prepare today's educators utilizing new technologies (Prensky, 2001). Teachers have a need to practice interventions and assessments in a well-supervised environment, and technology can assist in providing such a venue to maximize learning potential in an efficient manner.

Teaching skills are developed over time and must be practiced in order to be perfected (Yell, Drasgow, & Lowery, 2005). In 2001 the National Research Council (NRC) released the landmark report, Educating Children with Autism, which stated that teachers must be familiar with theory and research concerning best practices for children with autistic spectrum disorders, including methods of applied behavior analysis. Also included in this publication, the NRC (2001) reported that there is a need for personnel preparation to produce qualified teachers and support staff and to provide technical assistance to answer problems faced by local practitioners, as well as to generate research, enhance communication, and support demonstration projects. A priority for technology has been addressed in the 2010 publication of A Blueprint for Reform: The Reauthorization of the Elementary and Secondary Education Act, stating: "technology, effectively and thoughtfully deployed, can improve how schools work, how teachers teach, and how students learn" (p. 45).

Similar thoughts were expressed in Andreasen and Haciomeroglu's (2009) publication, Teacher Training in Virtual Environments. Researchers stated that new platforms of technology, such as simulated classroom environments, are integral components of teacher preparation programs and will provide learning experiences that are steeped in best-practices and are commensurate with the dynamic culture of digital

native learners. Andreasen and Haciomeroglu further posited that the realistic aspects of the virtual classroom environment can enhance and enrich teacher preparation and provide multiple experiences that can focus on both mastery of content and its delivery, which can be effective in schools.

TLE TeachLivE Virtual Learning Classroom

One such viable platform for enhancing teacher preparation through technology is the TLE TeachLivE classroom simulation laboratory. This virtual classroom setting offers real time, unscripted interactions that assist in providing authentic "hands on" opportunities for pre-service and practicing teachers to safely gain proficiency and enhance fidelity of DTT. Integrating the TLE TeachLivE virtual classroom setting into learning activities for DTT within teacher preparation coursework could serve to diminish the potential for loss of learning time when student teachers are honing their skills and replace this lost time with something more instructive that does not come at the cost of reducing learning gains for an actual student (Andreasen & Haciomeroglu, 2009). By implementing teacher training via TLE TeachLivE virtual instruction, students' exposure to under-prepared, ineffective teachers may be reduced, which would, in turn, assist in improving teacher practice that may eventually lead to improved student learning within the classroom setting (Dieker, Hynes, Stapteton, & Hughes, 2007; Dieker et al., 2008).

Need for Research on Individualized Clinical Coaching of Discrete Trial Teaching in the TLE TeachLivE™ Virtual Classroom Environment

The NRC stated very clearly in 2001 that multiple exposures, opportunities for hands-on practice, and active involvement are essential principles in learning both for the student as well as the teacher, and that ongoing consultation, technical assistance, and opportunities to engage with models of working classrooms and effective teachers are therefore crucial when acquiring experience with children with ASD. Practicum sites provide extremely valuable opportunities for students to work with children with ASD. Quality training of these sites should be highly organized within a program that focuses on ASD.

The NRC (2001) also stated that teacher preparation may include incorporating treatment manuals, instructions, and procedures in print, videotape, and audiotape media to improve the education of young children with ASD. Most recently, the National Council for Accreditation of Teacher Education (NCATE, 2010) reported technology must be utilized to share best practices across partnerships and facilitate on-going professional learning. The TLE TeachLivE virtual classroom is consistent with NCATE's position and provides the perfect platform to facilitate best practices for teachers who work with students with ASD by providing experiences such as those in this study for individualized clinical coaching in DTT.

Generalization of Simulated Learning to Real World Performance

To effectively deliver evidence-based instruction, practitioners who teach children with ASDs must be prepared to deliver instruction properly and demonstrate a high fidelity of implementation (Bullock et al., 2008; Kretlow & Bartholomew, 2010; Simpson, 2004, 2005). Fidelity of implementation is affected by a number of items, including the development of models and coaching support, professional development and assistance, web-based instruction and posting of modules, interactive communication, the use of technology, and a virtual community of learners (Odom, Boyd, & Hall, 2010). Literature on the generalization of educational teaching skills acquired within a simulated environment to a classroom setting is virtually non-existent. This lack of inquiry and research evidence demonstrates a clear need for exploration and study that may yield evidence toward a valuable teaching intervention and learning platform that may assist in impacting the lives of students with disabilities and in this particular study, the lives of students who have ASDs.

CHAPTER THREE: METHODOLOGY AND PROCEDURES

Chapter Overview

This research study measures the impact of utilizing a virtual reality learning modality (TLE TeachLivE) with individualized clinical coaching and measures the effects on teachers' fidelity of implementation of discrete trial teaching. Furthermore, the study investigates the level of transference and generalization within an actual classroom setting. The Institutional Review Board of the University of Central Florida granted permission for this study, which has been assigned number SBE-11-07469 (Appendix A). Described in this chapter are the research design, methodology, and procedures for the study. Research questions are posed at the beginning of the chapter, followed by an overview of the investigation. The solicitation of participants is described, and setting information is presented, along with materials and necessary instrumentation needed to carry out the study. Dependent measures, experimental procedures, and study design are explained, and the chapter concludes with a description of validity and reliability checks for each instrument of the investigation. Treatment integrity and social validity measures are also illustrated.

Research Design

A modified multiple baseline design across five participants was used to evaluate the effects of individualized clinical coaching (ICC) of discrete trial teaching (DTT) in the TLE TeachLivE virtual classroom. Kazdin (1982) wrote that one of the great strengths of the multiple baseline design is its ability to display the effect of the intervention as it is applied.

Participants' performances were measured using an Operational Definitions Worksheet (ODW) and Discrete Trial Teaching Evaluation Rubric (DTTER) that was designed from current literature, reviewed by a panel of experts in the field, and piloted in a previous study (Vince Garland et al., in press). Participants were trained to implement the five components of the DTT procedure as described by Bogin et al. (2010), the National Professional Development Center for Autism Spectrum Disorders (NPDC, 2009), and Simpson (2005) using the ICC intervention which utilized feedback and demonstration. Baseline data were collected concurrently, and treatment was staggered across participants. No more than two sessions per participant occurred on one calendar date. It was established that if baseline data remained stable and DTT improved only following intervention of coaching sessions, then the following conclusions would be supported:

(a) Observed effects were likely due to the intervention and not due to an external variable that may have occurred, and

(b) Repeated exposure to baseline conditions did not affect performance (Gast, 2010).

Four probe sessions were conducted concurrently with each of the participants at the beginning of the study. Based upon visual analysis of participants' baseline sessions for trends in stability levels, the most stable participant received a final session and began the treatment phase. Other participants were emailed a date for an additional baseline session probe. When a participant in the intervention phase demonstrated proficiency in learning to 90%, the next participant entered the treatment phase. Treatment was terminated after the participant demonstrated mastery of delivering DTT at 90% or above on the DTTER for three sessions in a row, or a total of seven treatment sessions had occurred.

Research Questions

1. To what extent is the fidelity of implementation of DTT affected when teachers are prepared using individualized clinical coaching in the TLE TeachLivE virtual classroom laboratory?
2. To what extent will participants' preparation with individualized clinical coaching sessions delivered in TLE TeachLivE virtual classroom laboratory generalize when they administer DTT to students with ASD in a classroom setting?
3. To what extent did participants value their preparation of DTT with individualized clinical coaching while in the TLE TeachLivE virtual classroom laboratory?

Participants

A convenience sample was assembled for the purpose of this study, and five participants were recruited from the College of Education at the University of Central Florida. Potential participants were selected from a federally funded project that serves to prepare educators to work with students with ASD. An email introducing the opportunity to participate was sent to grant recipients who were currently taking graduate-level classes toward a master's degree in Exceptional Education. Recruitment also occurred during the fall semester project meetings.

A participant inventory assessment (Appendix B) was distributed at the first baseline probe session to assess participants' prior level of knowledge regarding DTT. Selected participants received course credit for taking part in the research project. Participation in this study was voluntary. All participants had completed at least one full year of course work toward their degree and worked with students who had been diagnosed with ASD. Participants ranged in age from 27 to 38, and all were female. Two participants were Asian American, and three were Caucasian.

Participant One, Allie

Allie was employed as a self-contained middle school teacher at a public school in central Florida. She worked full time with students with ASDs and had been teaching for five years. She is a Caucasian female and was 28 years old at the time of the study.

Participant one taught a total of 14 students with ASD and described them as follows: seven of her students stayed with her in a self-contained setting, and seven of her students spent a majority of their time in mainstreamed classes. Specific needs for her students included needing a Dynovox, Talk 20, hand-over-hand, file folder manipulatives, talking calculators, Alpha Smarts, token economy, and picture schedules. She described her daily schedule as including classes for higher-level language arts, geography, lower level language arts, physical education, lower-level social studies, and vocational/cooking class. Allie reported using interventions that included "least to most, reinforcements on an individualized basis, pictures and labels, communication, manipulatives, and picture schedules."

Participant Two, Betty

During the course of the research investigation, Betty was transitioning from her graduate teaching internship at a K-third grade charter school in central Florida to a lead teaching position at the same school. Betty is a Caucasian female who was 38 years old at the time of the investigation. She described her students as being in the second and third grades, having varying degrees of learning disabilities, ASDs, cerebral palsy, and other disorders. Betty reported that she had approximately 20 students in her class and described the specific needs of her students as unique and widely variable, reporting that one student needed one-to-one supervision. She described using small groups a great deal to provide attention and educational needs to students based on their learning levels.

Her daily schedule was described as beginning at 8:00 a.m. when students arrived to put their items away and practice writing in their journals. Reading and spelling occurred in the morning, and the students rotated around computer centers, allowing the class to engage in small group work with the teacher. A snack time broke up this session and was followed by story read-alouds, math, and language arts. Lunch occurred at about noon. Handwriting, science, and social studies took up the afternoon, and at 2:00 recess/pick-up wrapped up the day. When asked about what best-practices she used in her classroom, she reported that since she was not teaching but doing practicum in another class she always tried to follow the lead teacher's lesson plans. She said that she had a lot to learn and hoped to use best-practice interventions taught to her by the lead teacher during the semester.

Participant Three, Cassie

Cassie is a Caucasian female, who was 27 years old and had been in the teaching field for three years at the time of the investigation. She worked full time at a public elementary school in central Florida as a teacher of students with ASD and reported having nine male students in her self-contained classroom, all diagnosed with ASD. She described her students as receiving occupational therapy, as well as speech-language therapy. Cassie described her students as having behavioral issues, and she used incentives such as break time and tangibles as reinforcers for positive behaviors within her classroom. Her daily schedule included announcements, breakfast, and reading

essentials in the morning, math, followed by lunch, and then story time. In the afternoon students worked on social skills and received a snack. Science and pack-up time concluded the daily routine. She described her classroom arrangement as having independent work stations, a group table, and another small group table for direct instruction, computer stations, a listening station, and break area. Cassie described best practices used within her classroom in the following way:

> I use the ABA interventions with all of my students in some sort of way. Most of them use a picture schedule, and two students have a paper written schedule. Most students have a "first-then" chart. Two of my students work, then immediately get a break as a reinforcer. I use mostly direct instruction for reading and have seen that a few of my kids respond very well to PCI. I use the TEACCH model for all of my students. They are all very successful when they have a clear understanding of expectations and duration of activities.

Participant Four, Denise

Denise was a 36-year-old Asian American female who had been teaching for seven years and was employed at a residential behavioral clinic in central Florida at the time of the investigation. She described her students as being eight males at the middle and high school levels who were diagnosed with ASDs and Asperger's disease (for her hospital-homebound rotation) and 20 students with behavioral issues and psychological diagnoses. Specific needs of her students included requiring support when transitioning during sudden changes in routine and schedule, staying on task, and remaining focused during instruction. She described her classroom as small and narrow, with a teacher's desk, bookshelf, and TV on the righthand side; sink, counter, and cabinets along the

widest wall; and desks in rows. There was a window on the righthand side of the room. Denise described her uses of best-practice in the following way: "I use a stress ball, time out, frequent breaks (using a clock as a timer), first-then statements, visual examples, reinforcers (e.g., school store, resident of the week), positive praise and encouragement." It is important to note that participant four conducted her generalization sessions in participant five's classroom, as her own students were not available for assessment.

Participant Five, Elle

Elle had been teaching for one year and was 28 years old at the time of the investigation. She is of Asian American descent. She worked as a public school teacher in a self-contained developmentally delayed setting at an elementary school. She described her students as having the following disabilities: developmentally delayed, Down syndrome, and ASD. She taught a number of grade levels from kindergarten to third grade, and one of her students was mainstreamed a majority of the time. She described her daily schedule as beginning at 7:30 a.m. and reported that she began her mornings with a pull-out student with ASDs, followed by working with whole-group activities and academic rotations. Her students attended lunch and recess with general education students. While her students were at lunch and specials, she worked with a pre-k ASD unit. In the afternoon she worked with more academic rotations and planned to start social skills lessons with students who had been mainstreamed and had higher functioning ASD. Elle ended her days by completing parent communication folders. She

reported that her classroom was arranged based on the TEACCH structure (i.e., visual schedule, independent work stations, and one-to-one work stations). Elle reported utilizing the following as best practice interventions within her classroom: incidental teaching, video modeling, social stories, PECs, errorless learning, verbal behavior, and TEACCH.

Secondary Population for the Study

The secondary population for this study consisted of students with special needs who have been diagnosed as having an ASD (according to teacher report) and who were receiving educational services in special education. All students within this population were at the elementary school level and received educational services within a self-contained classroom setting. Permission to participate was received from parents by the teachers prior to evaluation measurements in the generalization phase.

The Interactors

Dieker et al. (2008) described an interactor as "a person trained in acting, improvisation, and human psychology; renaissance artists who develop live, human-to-human, interactive experiences by developing a character then playing out that character's behaviors" (p. 11). In TLE TeachLivE virtual classroom laboratory the interactor

provides human, interpersonal behavior characteristics that artificial intelligence is still unable to create.. Each time the student works with a different avatar, the interactor "jumps into the skin" and plays the nuances of that character, giving it life and personality. This use of an interactor is vital for participants to engage in the simulated environment, to ensure that the experience is authentic and engaging. In order to define and maintain the integrity of the virtual classroom setting and experience participants had when working with the avatar, interactors in the study utilized an Interactor Response Fidelity Worksheet (Appendix G).

Austin, the Avatar

A participant by way of digital animation and interactor skill was the avatar, Austin. Austin portrayed a nonverbal male student who had ASD. While a particular grade level was not assigned to Austin, for the purposes of this investigation it was assumed that he was in an upper-grade at an elementary school setting. Austin did not demonstrate challenging behaviors other than inattention and occasional rocking, and he demonstrated preference and choice selections via pointing. Austin was able to make eye contact with participants and hold sustained eye gaze for extended lengths of time. He also demonstrated the ability to smile and could look down or away. Although Austin had the ability to engage in behaviors such as moaning, agitated rocking, flapping, and ignoring, he did not engage in these mannerisms during the study.

Settings

Primary Setting

The TLE TeachLivE virtual classroom laboratory at the University of Central Florida served as the platform for teachers to receive training in DTT in a real-time virtual-reality setting. Teachers experienced multiple learning opportunities that assisted in the acquisition of knowledge in the research-based practice of DTT. Participants rehearsed implementation of DTT and refined teaching sessions through integrative training within the TLE TeachLivE virtual classroom. A trained interactor was in control of the behavior of the avatar that teachers engaged with for training, and operated the avatar from a setting that was remote from the virtual classroom lab. Classrooms of the participants served as the setting for participants to attempt transference and generalization of DTT skills acquired in the TLE TeachLivE virtual classroom laboratory.

The virtual classroom space was a windowless room with three beige colored walls and one green wall. A large projection screen was located slightly left of the center of the room, roughly twelve feet from the entryway. A 70-inch high-definition flat-screen television that was suspended approximately three feet from the floor was placed in front of this screen for use in the study. (See Figure 1.) A screened space adjoined the projection screen on the lefthand side and provided a divider for an on-site TLE TeachLivE technician to assist in program operations. A Logistics webcam was mounted

on the top of the projection screen to allow the interactor to view the participant during sessions. Several microphones were mounted on the ceiling perimeter of the laboratory, enabling the interactor to hear what the participant was saying during sessions. Although the avatar that participants were working with in this study was non-verbal, a speaker allowed participants to hear other activities and avatars within the virtual classroom. Real time communications occurred via Skype, which allowed the participant and interactor to respond immediately to one another.

Figure 1: Researcher speaking to class of avatars in the virtual classroom laboratory

Generalization Settings

The generalization settings for this research were participants' classrooms. Participants' classrooms were located in Central Florida and were in either public or charter schools. A quiet area to conduct the DTT session was required. Necessary furniture for sessions within the generalization phases included a table and two chairs, student reinforcers, and a data-collection sheet, as used in the TLE TeachLivE setting. The investigator conducted generalization sessions with the same teaching evaluation rubric that was used in baseline probe and treatment phases of the study (the DTTER).

Allie's Classroom

Allie's classroom was arranged with a sensory area, computer area, four desks in front of the chalkboard, two tables behind the four desks, and a teacher's desk to the front left side of the classroom. Her classroom included a washer and dryer and cooking area. A reading/relaxing nook was located to the front righthand side of the room, and it was noted that there was a large use of labeling with pictures and words to assist students in language and communication. Windows lined the rear wall of the classroom. Allie conducted her generalization sessions at a worktable near the front of the chalk board. Allie arranged her table so that a chair was placed on each side of a student desk. Her materials for the session were placed to her lefthand side, and she arranged them as necessary before calling her student over to her.

Betty's Classroom

Betty's charter school combined grades two and three, and they are referred to as a "neighborhood." The neighborhood comprised three classrooms among which students rotated throughout the day. Betty had an office space separate from the classrooms where teacher desks were located. One of the neighborhood classrooms was a computer lab; the other two were more traditional in nature to academic classrooms. Student desks were clustered into small groups in the center of the rooms. Each room had a very large flat-screen TV mounted to the wall. The screens displayed activity timers and a schedule

for the day. There were low-pile carpets in one corner of each of the rooms and cubbies near the doors for student belongings. The rooms were clean and brightly lit, with a wall of windows on the lefthand side that overlooked the school yard. Each room had a sink at student level and a side door for passage from one room to the other. All three rooms had numerous pictures and labels to identify items. Many pictures were PECS symbols or photographs.

Betty's DTT worktable was arranged near the front entrance of her classroom. The table was kidney-shaped and had a chair on each side. Betty had all materials needed for the sessions on her righthand side. The table sat directly in front of a hallway window, with the student's chair facing the window.

Cassie's Classroom

Researcher observations for Cassie's classroom were limited to a video tape that was provided by the participant. From this video tape, it appeared that Cassie's classroom had independent work stations, a group table, small group table for direct instruction, computer stations, a listening station, and break area. Her sessions occurred while no other students were in the classroom. The DTT work table for generalization sessions was a student desk with a chair set up on each side. The work table appeared to be located at the back left corner of the classroom. Cassie sat opposite from her student, with her materials directly in front of her for the lesson. The student had his back to the camera.

Denise's Classroom

Denise was not able to conduct generalizations at her own work setting, so she traveled to Elle's classroom instead. The DTT work table was set up within a partitioned area in front of the teacher's desk. The student sat at a desk that faced the wall, to the right of the classroom door. The instructor sat in a chair to the right side of the student, situating herself between the teacher's desk and the work table. Her materials were placed to her righthand side. A screen partition blocked the student's view to the left, prohibiting the student from seeing the classroom door.

Elle's Classroom

Elle's classroom was in a portable that was close to the main buildings of a public elementary school. Her room was brightly lit, with windows along the rear wall of the classroom. A large Smartboard was centered in the middle of the front wall of the classroom that displayed the time, schedule of activities for the day, and an activity timer. Elle's room was sectioned into several zones, including a cubby area near the door for students' belongings, a kitchen area, reading area, occupational therapy/physical therapy area, and one-to-one learning area. Several desks were clustered together in the center of the room in small groupings. Elle's desk was located in the upper left corner of the room. Pictures and labels were placed throughout the room for student identification of objects.

Elle used the same DTT work table as Cassie (see description of Cassie's classroom above), which was set up within a partitioned area in front of Elle's desk.

Materials

A one-page abbreviated lesson plan for the task (i.e., audio-visual discrimination of pictures) and accompanying data sheet (see Appendixes E and F, respectively) were provided to the participants during the first baseline session. Teaching materials that the participants utilized across all sessions included a data sheet, pencil, choice of two reinforcers (motion activated squeeze ball or animated plush dog), an unlaminated green 8.5" x11" "walk" sign, and an unlaminated red 8.5"x11" "don't walk" sign. These materials were placed on the upper lefthand corner of a table with a chair, located approximately four feet from the flat-screen television screen that displayed the student avatar. Sessions throughout each phase of the investigation were videotaped using a web camera from a Sony Vaio laptop computer. Software for the webcam was WebCam Companion 3. All sessions were recorded and were available for later review.

Other materials used in this study included Operational Definition Worksheets (ODW, Appendix C) that were utilized for the coaching intervention and investigator fidelity level checks, and the Discrete Trial Teaching Evaluation Rubric (DTTER, Appendix D). The Abbreviated Lesson Plan (Appendix E) was provided only during the first baseline session. Trained interactors controlled the behavior of the avatar that teachers engaged with during training. Materials used for measuring treatment fidelity of

the interactor included the Interactor Response Fidelity Worksheet (Appendix G). Finally, the research investigator's fidelity was evaluated using the Investigator Protocol Fidelity Worksheet (Appendix H). These worksheets were developed after a similar pilot study was conducted (Vince Garland et al., in press) and approved by a panel of experts within the field of exceptional education.

Target Behaviors and Data Collection

The dependent variable in this study was the performance of participants on the implementation of the DTT procedure while teaching one task per session as measured by the DTTER. The DTTER was developed based on a review and adaption of steps 5 and 6 of the NPDC's Autism Spectrum Disorders Discrete Trial Training Implementation Checklist (Bogin et al., 2010) and components 10 through 21 of the Discrete Trials Teaching Evaluation Form (Arnal et al., 2007). Correct implementation of DTT steps was operationally defined and proceduralized based on a review of published research on DTT (Arnal et al., 2007; Belfiore, Fritts, & Herman, 2008; Koegel et al., 1978; Koegel, Russo, & Rincover, 1977; Leblanc & Luiselli, 2005; NPDC, 2009; Ryan & Hemmes, 2005; Sarokoff & Sturmey, 2004; Simpson, 2005; Smith, 2001). Discrete trial components or steps were grouped into five categories: (1) management of antecedents; (2) management of discriminative stimuli; (3) management of consequences for a correct response; (4) management of consequences for an incorrect response; and (5) management of the inter-trial interval (ITI).

Each component was sub-divided into subcomponents that totaled between ten and thirteen steps, dependent upon Austin's response to the trial. Percentages of correct responses per session on applicable components were calculated on a point-by-point basis to determine proficiency level of the DTT implementation (Gast, 2010). A total of 72 points could be earned on the DTTER, and points were converted to a scale of 100%.

Responses of a participant were recorded on the DTTER by coding (+) for each component correctly demonstrated and (-) for each component incorrectly demonstrated. The DTTER was designed to collect data for a session with ten consecutive trials.

Practitioner behaviors for the DTT cycle were operationally defined and an Operational Definitions Worksheet ODW (Appendix C) was utilized by the investigator to define correct procedural guidelines within the DTT cycle. The ODW was formatted to align with the five sections and subsequent subsections of the DTTER and served as a visual guide for the participant. During the intervention phase of the investigation, the investigator evaluated the participant's performance using the DTTER and then transferred results to the ODW for feedback and review with the participant during the ICC session. On the ODW, a star was placed to the left of the definition if the step within the sub-component was performed accurately. If the step was performed incorrectly, a Δ was placed to the left of the definition.

Baseline/Probe Phase

Participants met with the investigator in a group setting and were introduced to the study. Participants signed all necessary release forms during the meeting and were advised not to speak to each other or anyone else about the research. Participants were also advised that no assistance would be provided during the baseline phase and that the investigator would not be able to provide any type of feedback until the intervention phase began. Participant order was chosen via random number selection. A research assistant remained in the common seating area to ensure that participants did not discuss topics involving the research study.

In session one, the participant was guided to a computer station with headphones. At this station, the participant watched a recorded video that described the protocols of the study. A written script of the recorded video is included in Appendix I. Upon completion of the video component, the participant was provided with an abbreviated lesson plan and given ten minutes to read and review the abbreviated lesson plan (Appendix E). After the elapse of ten minutes, the abbreviated lesson plan was collected and the participant transitioned from the common seating area to the virtual classroom setting.

Once in the lab, the participant was asked to perform ten teaching trials with "Austin" (an avatar that portrays a student with autism) to the best of her ability. The participant was asked to inform the experimenter when she had completed her lesson with Austin. A script for this information was developed so that each participant was given the same directions (Appendix J). When the participant completed the task or

fifteen minutes elapsed (which ever occurred first), the session concluded and the participant was thanked for her time. This procedure was repeated for each participant for the remaining sessions in the baseline phase, with the exception that the abbreviated lesson plan was not redistributed after the first session.

The task delivered in the sessions was the same throughout the study. Austin was asked to complete an auditory-visual discrimination task, where the correct mand by the participant was a request such as "point to the don't walk sign." As a part of this task, the participant held two 8.5 x 11-inch cards (a green colored "walk" sign and a red colored "don't walk" sign) in front of Austin, at shoulder-height. Austin indicated his response for each trial by pointing to a picture held by the participant. After each session, the participant completed a one minute written AAR as a protocol of participation within the TLE TeachLivE lab (Appendix L).

Visual analyses of baseline performances were conducted. After reviewing data to calculate level stability (i.e., the amount of variability within the data series), the most stable participant was brought into the treatment phase first. The median level was calculated by arranging data points in each participant's data set from low to high. Since there was a total of five data points in the baseline setting, the middle point within this set was considered the median, and a parallel stability envelope with 80%–20% criteria was placed around the median line. Using this criterion, a participant's performance was considered stable if 80% of the data points fell on or within 20% of the median value (Gast, 2010).

Additional participants were introduced into the treatment phase one at a time, when the previous participant reached 90% mastery of criterion for three consecutive sessions, or six sessions from the previous participant had occurred. Probes were conducted for participants two, three, four, and five before they were brought into the treatment phase.

Treatment Phase

While in the treatment phase, the investigator recited a script to each participant that described protocols and directions for the session (Appendix K). The investigator was assessed on accuracy of script delivery via review of videotaped sessions using the Investigator Protocol Fidelity Worksheet (Appendix H). Each participant attempted to instruct Austin utilizing DTT to the best of her ability. The participants conducted one session (ten trials) of DTT and ended the session with Austin. The experimenter reviewed the participant's performance, as measured by the DTTER, for the ten trial session. The participant was given a copy of the ODW. Each of the components within the five categories was reviewed step by step, and the experimenter provided verbal and written feedback of the participant's previous DTT session. Written feedback was provided to the participant on the ODW. If the component was performed accurately, a star was placed to the left of the definition and verbal praise was given. If the component was performed incorrectly, a Δ was placed to the left of the definition and error correction occurred by reviewing the operational definition of the step, modeling the step

to the participant, and instructing the participant to practice the step back to the participant, asking questions as needed.

Verbal feedback included praise of participant's performance on components performed correctly and instructional feedback on components performed incorrectly. Each DTT step performed incorrectly by the participant was defined and correctly modeled by the experimenter as the ODW was reviewed. For example, if the participant incorrectly performed a step within the management of incorrect response subsection, that step was marked with a delta on the ODW. As the investigator and participant reviewed the ODW and arrived at this particular step, the definition would be read aloud by the investigator and correctly modeled to the participant. The participant then practiced the step with the investigator until she performed it correctly. The participant was allowed to ask questions to clarify the correct implementation of each component, but questions were not prompted.

After all steps on the ODW were reviewed, a rehearsal and modeling was repeated. The investigator called Austin forward to the teaching table, and together the investigator and Austin fluidly demonstrated three trials in a row (a correct trial, an incorrect trial, and a correct trial again). It should be noted that during each of the demonstration trials per component, other components were indirectly demonstrated, by virtue of a discrete-trial. Following each training session, the participant performed ten uninterrupted discrete trials with Austin (i.e., completed a new session). All sessions were videotaped for inter-observer agreement and further coding review as necessary.

Post-Intervention/Generalization Phase

When the participant reached criterion level of mastery (i.e., 90% mastery for three data points in a row), or seven sessions occurred, treatment for that participant terminated. Generalization probes were conducted to investigate the level of impact that the DTT coaching treatments had within an applied setting such as a classroom. The researcher observed each participant in a special education classroom two weeks after the intervention phase terminated. Each participant conducted two sessions of DTT in a classroom with a student who was receiving services in special education and who had, according to teacher reports, been diagnosed with ASD. In an effort to account for potential variance in behaviors between Austin and an actual student, the investigator conducted an environmental evaluation that included scans of behaviors occurring during the times when the DTT sessions occurred and interviewed teachers to get background information on the student they were teaching. The investigator observed four participants in the classroom setting and video recorded each DTT session. The investigator was accompanied by a trained inter-rater who also scored sessions on site. This inter-rater was a second year doctoral student in exceptional education. One participant was not permitted to demonstrate generalization within her classroom setting and so traveled to another participant's classroom to conduct her sessions there. Another participant faced a similar situation and as a solution, video recorded the session in her classroom. The investigator and inter-rater scored her performance from the recorded video. Mean scores of post-interventions were totaled to investigate generalization over

time and served to collect information on the continued impact of the intervention for each of the participants.

Post-Treatment Assessment

Evaluation of data included visual analysis in the form of a graphical representation of data points (via an Excel spreadsheet) for each participant that was collected throughout each phase (i.e., probes, treatment, maintenance, and generalization). Assessment of results included identifying changes in trend direction, analyzing change between adjacent conditions, and calculating percentage of non-overlapping data (PND). All formulas for calculating results described below are referenced from the Single Subject Research Methodology in Behavioral Sciences text by David Gast (2010).

Change in Trend Direction

The first visual analysis that was conducted was to determine the change in trend direction. This served to determine the reliability of effect that the change in conditions had on the dependent variable.

Percent of Non-Overlapping Data (PND)

In an attempt to quantify effect, percent of non-overlapping data was calculated to measure treatment outcomes. PND assisted in determining the impact that the treatment package (individualized clinical coaching in the TLE TeachLivE lab) had on the target behavior (correct implementation of DTT by participants). PND was calculated by (a) determining the range of data-point values of the baseline condition; (b) counting the number of data points plotted in the treatment phase; (c) counting the number of data points within the treatment condition that fell outside the range of the baseline condition; and (d) dividing the number of data points that fell outside the range of the baseline condition by the number of data points on the treatment condition and multiplying this number by 100. Generally, the higher the PND, the greater the impact the intervention had on the target behavior.

Percentage of Overlapping Data (POD)

As an alternative to calculating PND, a Percentage of Overlapping Data (POD) was also conducted. The POD was calculated by (a) determining the range and data point valued of the baseline conditions; (b) counting the number of data points plotted in the treatment phase; (c) counting the numbers of data points in the treatment condition that fall within the range of data-point values of the first condition, and (d) dividing the number of data points of the first condition by the total number of data points that occur

within the treatment condition and multiplying this number by 100 (Gast, 2010). The total percent provided from this algorithm reflects the percentage of overlap between the two conditions. As a guide, Gast (2010) reported that the lower the percentage of overlap, the greater the impact the intervention has had on the target behavior. Percent of data exceeding the median of baseline was also calculated for each participant and was used to demonstrate a mean effect size.

Validity and Reliability

Interobserver Agreement (IOA)

The investigator and second observer practiced data collection using the DTTER while observing both live and taped baseline performance of a volunteer who was not used in study. The observers practiced until 90% agreement was reached. Agreement was calculated point-by-point on the DTT teacher worksheet by dividing the number of agreements by the number of agreements plus disagreements for the session, and multiplying by 100% (Gast, 2010). A disagreement was documented if there was a discrepancy between observers. Interobserver agreement (IOA) checks occurred across at least 30% of each phase of the study for each participant.

Treatment Integrity

Interactor

Training with the interactor occurred in both face-to-face and virtual settings. A one-hour face-to-face training session occurred first, followed by a separate one-hour training session with the investigator in the virtual classroom setting and the interactor present in the remote command center of the lab. An interactor response protocol was followed that scripted for seven correct responses that were interspersed with three incorrect responses. Avatar behaviors were also scripted and held constant across phases and participants (e.g., look-away behaviors, eye gaze, lack of escalation behaviors). Response protocols were assessed for at least 30% of each phase for each participant to assess treatment fidelity (Appendix G).

Investigator

Fidelity checks on the investigator's fidelity of coaching were conducted by a second independent observer for at least 30% of each participant's sessions in each phase (specifically when modeling correct and incorrect trials), using the ODW and DTTER (Appendixes C & D respectively). The observer was trained utilizing taped participant performances until 90% accuracy was reached.

Validity of Instruments, Scripts, and Protocols

In an effort to achieve a strong level of validity within the study, a panel of experts was asked in a previous pilot study to review and provide feedback on the ODW, DTTER, and abbreviated lesson plan (Vince Garland et al., in press). This panel included four individuals who hold PhDs. in Exceptional Education, a parent of a child with autism, teacher of students with ASD, and a board certified behavioral analyst (BCBA) practitioner. All experts concluded that the instruments were sound for the purposes of the study being conducted. Scripts were developed as a result of the pilot study, reviewed and approved by the panel, and utilized in the dissertation research study (Appendixes I, J, & K).

After Action Review (AAR)

AAR is a continuous improvement tool and resource for promising strategies in classrooms, laboratories, and field experiences within the lab. The premise of the AAR is not to judge success or failure but to discover why events unfolded in a particular manner (Clark, 2009; Parry, Pires, Sparkes-Guber, 2007; USAID, 2006). Dieker et al. (2008) referred to the AAR process as "reviewing an experience from multiple points of view and at multiple levels of detail" (p. 13). An established protocol for conducting a research session within the TLE TeachLivE virtual classroom laboratory is an after action review (AAR). Within the parameters of this study, the AAR consisted of two writing

prompts: (1) List one thing that went well with the task/goal/project and (2) list one thing that needs improvement (if any) (Peterson, 2010; Appendix L).

After participants completed their DTT session with Austin, they were given a sheet of paper with the two prompts. Participants had one minute to respond to the prompts. Written responses were collected in baseline and intervention phases of the study but were not analyzed, as the researcher did not want to influence the pre-established coaching procedure. The individualized clinical coaching with feedback and demonstration align with the intended purpose of the AAR protocol for the TLE TeachLivE virtual classroom laboratory.

Social Validity

The researcher attempted to evaluate Wolf's third dimension of social validity (1978)—the social importance of the effects of behavioral treatment. In an attempt to assess the social validity for this investigation, a participant survey was distributed electronically via Google Forms at the conclusion of the study. The survey comprised eight scaled statements regarding the perceived value and benefit of EBPs, usefulness of DTT when working with students with ASD, effectiveness of the TLE TeachLivE lab, effectiveness of the ICC method, and comfort levels in the lab setting. Two open-ended questions were provided for participants to discuss suggestions for change and to comment on individual experiences regarding the study (Appendix L).

CHAPTER FOUR: RESULTS

Chapter Overview

The chapter presents an overview of the data collection, inter-rater reliability, fidelity of treatment, treatment outcomes, and participant demographics followed by a presentation of treatment outcomes. Social validity measures of the intervention are also discussed. The study sought to measure the impact of implementing a virtual reality learning modality (TLE TeachLivE) with individualized clinical coaching (with practice, feedback, and demonstration) and the effect such clinical coaching had on teachers' fidelity of implementation of DTT. Finally, this study investigated the level of transference and generalization within an actual classroom setting. Specifically, the following questions were addressed:

1. To what extent is the fidelity of implementation of DTT impacted when teachers are prepared using individualized clinical coaching (with practice, feedback, and demonstration) in the TLE TeachLivE virtual classroom laboratory?
2. To what extent will participants prepared with individualized clinical coaching sessions delivered in TLE TeachLivE virtual classroom laboratory generalize when they administer DTT to students with ASDs in a classroom setting?

3. To what extent did participants value their preparation of DTT with individualized clinical coaching (with practice, feedback, and demonstration) while in the TLE TeachLivE virtual classroom laboratory?

In response to the above research questions, a multiple baseline across participants design was used to identify whether a functional relationship existed between the independent variable and the dependent measures. For the purpose of confidentiality, pseudonyms are used throughout the text.

Inter-rater Reliability

The observers for this investigation were the primary investigator and a second-year doctoral student. Prior to data collection, both observers met and reviewed operational definitions, investigator protocols for each phase of the investigation, percentage of accuracy analysis, specified observational procedures utilizing the DTTER, and standards for data collection. The researchers met for two 1-hour sessions. The first session was held in the virtual classroom setting, and the second was held in a meeting room on the university campus. During the first meeting, the observers worked with the interactor to review protocol procedures and to rehearse the role of the avatar. At the second meeting observers practiced using the written protocols and procedures as well as the observation and recording instruments by scoring videotaped sessions of participants who were carrying out DTT in the virtual classroom from a previously piloted study. As established in Chapter 3, the inter-rater observed the participants for 36% of the total

observations within both the baseline and treatment phases (eight sessions in each phase, 16 sessions total). Inter-rater observance occurred 100% of the time in the generalization phase.

The investigator and inter-rater were required to have a 90% rate of agreement using point-by-point analysis. Agreement for investigator and inter-rater in the baseline phase averaged 99% (range of 98%-100%). The range in the intervention phase was 77% to 100%, with a mean of 96%. A retraining was conducted after an inter-observer drift occurred (77% agreement). After retraining, inter-rater agreement achieved levels of 100% of 100% from that point on in intervention. The range of agreement in the generalization phase was 93%-100%, with a mean of 98%. Table 1 provides mean and range IOA values for the DTTER in the generalization phase. The range of agreement in the generalization phase was 93%–100%, with a mean of 98%.

Table 1: Mean and Range of Interobserver Agreement (IOA) Across Phases

Measure	Mean	Range
DTTER- Baseline Phase	99	98–100
DTTER- Intervention Phase	96	77–100
DTTER- Generalization Phase	98	93–100

Procedural Fidelity of Investigator

Procedural fidelity for the investigator's delivery of scripted instructions (e.g., introduction to the lab setting, instructions for the learning session) was assessed across 36% of sessions for each participant by the inter-rater. Evaluations were conducted by comparing the video recording of the investigator's instructions to written, scripted protocols on a step-by-step basis using the Investigator Protocol Fidelity Worksheet (Appendix H). Reliability for instructions within the baseline phase ranged from 98% to 100%, with a mean of 99%. Investigator's accuracy when providing demonstrations was systematically evaluated by an inter-rater during the intervention phase of each participant, using the DTTER. Reliability measured 100% across all participants during baseline and intervention phases.

Procedural Fidelity of Interactors

Fidelity of the interactors' performances was evaluated to ensure that each participant received the same quality of response for correct and incorrect answers from Austin. Austin was scripted to reply to participants' mands with a total of seven correct responses and three incorrect responses during every session. Austin was not to respond with more than two incorrect responses in a row and had to respond correctly on the tenth response. Fidelity during baseline was measured using the Interactor Response Fidelity Worksheet (Appendix G), and observations for fidelity were conducted in 36% of

baseline sessions (seven sessions). Interactor performances met with 100% fidelity during the baseline phase. Similarly, when observed for 36% of sessions (seven sessions) in the treatment phase, interactor performance fidelity maintained a mean of 100% when assessed using the Interactor Response Fidelity Worksheet (Appendix G).

Modified Multiple Baseline Across Participants

The Discrete Trial Teaching Evaluation (DTTER) was used as the evaluation instrument within all phases of the study. Percentages of correct responses per session on applicable components were calculated on a point-by-point basis to determine the proficiency level of the practitioner's DTT implementation. A total of 72 points could be earned on the DTTER, and points were converted to a scale of 100%.

Research Question One

The first research question addressed in the investigation posed the query: to what extent is the fidelity of implementation of DTT impacted when teachers are prepared using individualized clinical coaching (with practice, feedback, and demonstration) in the TLE TeachLivE virtual classroom laboratory? All five participants showed increases in the fidelity of implementation of DTT after being exposed to the intervention of individualized clinical coaching (with practice, feedback, and demonstration) while in the

virtual classroom. Visual analysis of the data indicated that all participants demonstrated increases in the accuracy and fidelity of implementation of DTT over time, with a maintained fidelity when evaluated in the generalization phase of participants' classrooms. A graph of overall performance is presented in Figure 2 for visual examination over the course of the investigation.

Allie

Allie consistently scored low in baseline sessions, displaying a zero-accelerating trend. Visual analysis of data indicated that Allie displayed the most stable scores among the participants. A baseline probe was taken one week after the last baseline session and confirmed that little improvement in performance was occurring. Allie participated in a total of six intervention sessions. She scored 27% higher on the DTTER after the first intervention session compared to the last baseline session (3%) and rapidly gained proficiency in the fidelity of implementation of DTT over the first three intervention sessions (30%, 42%, and 56% respectively). A 93% fidelity score was recorded on the fourth session. Scores for the remaining two sessions were nearly perfect, at 99% each time (see Figure 2).

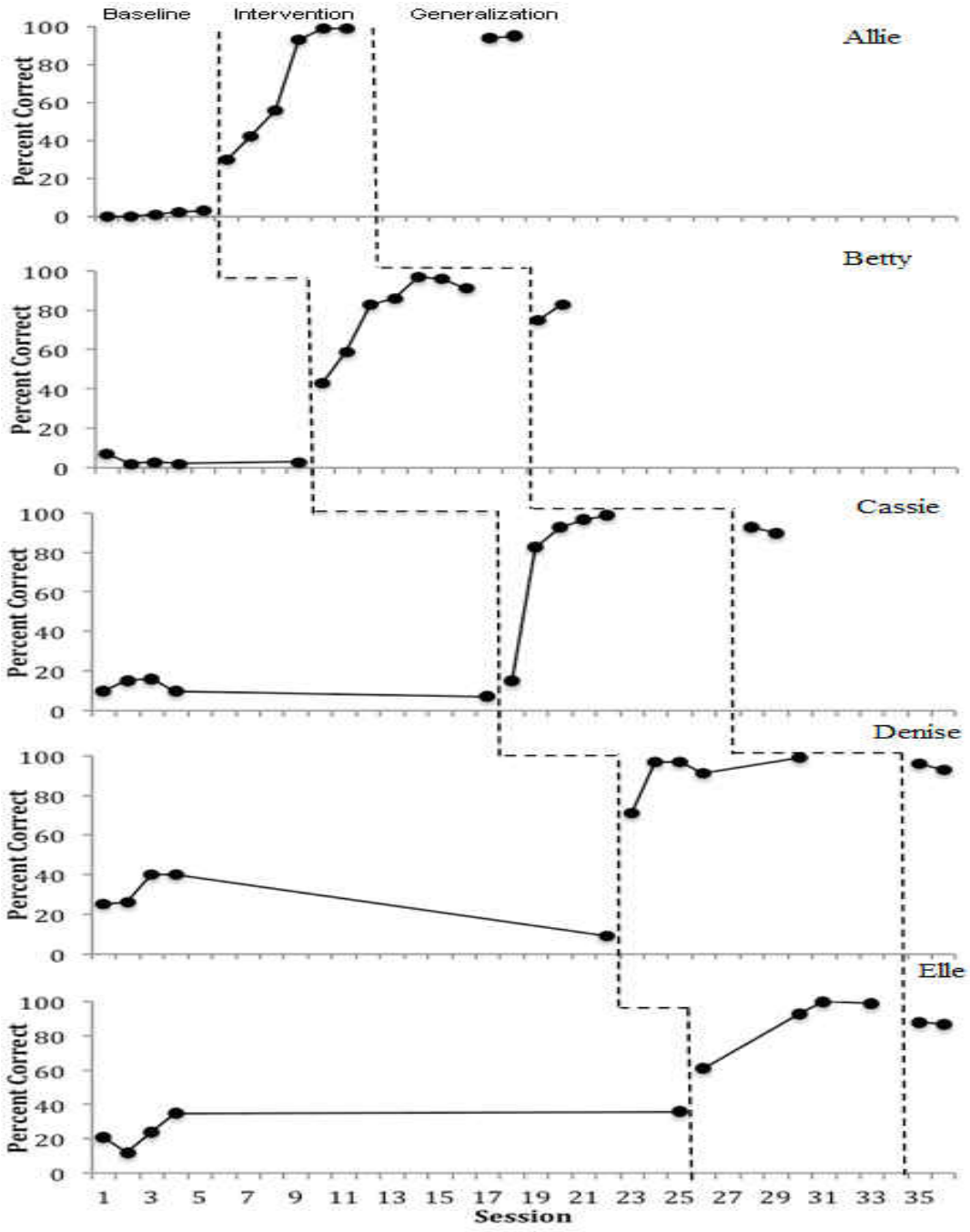

Figure 2: Modified Multiple Baseline for Primary Participants Across All Phases

Betty

Similar results were found when reviewing scores from Betty. Average baseline proficiency was 3% (with a range of 2% to 7%). A baseline probe was taken three weeks after initial baseline testing and revealed a score of 3%, displaying no effects of practice or outside learning. As displayed in Figure 2, a strong increasing trend can be observed graphically after the participant entered the treatment condition of individualized clinical coaching (with practice, feedback, and demonstration) in the TeachLivE lab. A 40% increase was observed from the baseline probe session (3%) to the first treatment session (43%). Betty participated in a total of seven treatment sessions, and while results were not as immediate as observed for other participants, strong improvement can clearly be seen in her results. Betty reached criterion for mastery (90%) on her fifth session, scoring 97% and maintained her level of fidelity for the remaining two treatment sessions after that, scoring 96% and 91%, respectively. Betty's mean score in treatment raised to 80% (range of 43%–97%), resulting in a 77% improvement on fidelity of implementation of DTT.

Cassie

Baseline average for Cassie was 12% (range 10% –16%). A baseline probe was taken five weeks after baseline assessment and proficiency was recorded to be 10%. After one session of individualized clinical coaching (with practice, feedback, and

demonstration), Cassie's score stayed within range of previous baseline sessions at 15 %. Researcher field notes and video for the first intervention session were reviewed and did not provide information on any unusual circumstances that may have inhibited learning gains. An immediate improvement in Cassie's performance was noted after her second intervention session, resulting in a 72% gain from intervention session one to intervention session two. Cassie received a total of five treatment sessions, and scored above mastery level on sessions three, four and five (93%, 97%, and 99% respectively).

Denise

Baseline average for Denise was 28% (range 9%–40%). A baseline probe taken seven weeks after baseline assessment and proficiency was recorded to be 9%. Denise also had a lower baseline probe score compared to her four previous scores in baseline (See Figure 2). After one session of individualized clinical coaching (with practice, feedback, and demonstration), Denise's score was raised 62% climbing from 9% on baseline probe to 71%. Denise received a total of four treatment sessions and scored above mastery level on sessions two, three, and four (97%, 97%, and 91% respectively).

Elle

The mean value for Elle's baseline was 26% (range 21%–36%). A baseline probe taken seven weeks after baseline assessment and proficiency was documented to be 36%. This score was one point higher than her last baseline score of 35% and demonstrated that no increase in skill occurred outside of the TeachLivE virtual classroom. After the first session in the intervention phase, Elle's score increased to 61%, a 25% gain in proficiency from the baseline probe. Participant five exceeded the mastery level of 90% on her remaining three sessions, earning 93% on her second session, 100% on her third session, and 99% on her fourth session. Intervention sessions averaged 89% across four sessions. It is important to note that the Thanksgiving break occurred between treatment sessions one and two, allowing for an extra week between treatments. This break did not appear to adversely affect performance.

Summary for Research Question One

The objective in this research question was to determine the effect that individualized clinical coaching (with practice, feedback, and demonstration) had on the fidelity of implementation of DTT when teachers were prepared in the TeachLivE virtual classroom. The only variable that changed between conditions was the addition of coaching with feedback and demonstration. A positive change in trend direction was noted across all five participants when moving from baseline to treatment conditions, and

change was observed to be directly relative to the coaching intervention. This finding is evidenced by a zero-accelerating trend in Allie, decelerating-deteriorating trends in baselines across participants Betty, Cassie, and a variable decelerating trend by participants Denise and Elle. An analysis of change across similar conditions indicated that across participants, baseline levels were maintained until individualized clinical coaching (with practice, feedback, and demonstration) was introduced, causing accelerating-improving levels and trends in each of the participants' data. Participants' fidelity while implementing DTT improved abruptly and immediately after the introduction of the coaching intervention in the TeachLivE virtual classroom. Across participants, the overall mean gain in fidelity from baseline phase (14%) to intervention phase (80%) was 66%. All participants successfully met criteria for termination of intervention (i.e., 90% mastery for three data points in a row). Percentage of non-overlapping data (PND) for all participants was 100%. Likewise, the percentage of overlapping data for all participants was zero. To calculate PND, the percentage of data points during intervention that surpassed the extreme values in pretreatment or baseline was calculated. PND is a widely used non-regression approach. Scruggs and Mastropieri (2001) describe PND as a "meaningful index of treatment effectives" (p. 241). (See Table 2.)

Table 2: Mean Scores of Participants Across Phases

Participant	Baseline	Intervention	Generalization
Allie	1% (0%-3%) 5 Sessions	70% (30%-99%) 6 Sessions	95% (94%-95%) 2 Sessions
Betty	3% (2%-7%) 5 Sessions	80% (43%-97%) 7 Sessions	79% (75%-83%) 2 Sessions
Cassie	12% (10%-16%) 5 Sessions	77% (15%-99%) 5 Sessions	92% (90%-93%) 2 Sessions
Denise	28% (9%-40%) 5 Sessions	91% (71%-99%) 5 Sessions	95% (93%-96%) 2 Sessions
Elle	26% (21%-36%) 5 Sessions	89% (61%-100%) 4 Sessions	88% (87%-88%) 2 Sessions
Average Across Participants	14% (0%-40%) 25 Total sessions 5 Sessions per participant	80% (15%-100%) 27 Total sessions Median of 5 sessions (range 4-7)	90% (75%-96%) 10 Total sessions 2 Sessions per participant

Research Question Two

The second research question investigated the level of fidelity that would be attained when participants took the skills honed in the TeachLivE lab and applied them using DTT when in classrooms. The research question asked specifically: to what extent will participants' preparation with individualized clinical coaching (with practice, feedback, and demonstration) sessions delivered in TLE TeachLivE virtual classroom laboratory generalize when they administer DTT to students with ASDs in a classroom

setting? To attempt to answer this question appropriately, a variety of considerations had to be addressed. To account for variances of behaviors between the avatar and the actual student, the investigator observed the student in the classroom setting prior to DTT sessions. Field notes were compiled to document behaviors exhibited by the student and responses (if any) delivered by the teacher. Participants also gave written descriptions of the student they worked with for the generalization phase.

For each participant, two weeks after intervention two separate sessions were evaluated, and each session was scored by both the researcher and inter-rater. Sessions were held in a quiet area of a classroom or occurred in a separate room. Allie, Denise, and Elle were relieved of additional classroom supervision duties during generalization probes by scheduling the DTT sessions to occur when other students were at lunch or specials (e.g., P.E., art, or music). Betty had additional staff support in her class and was able to conduct the DTT sessions in a vacant adjacent room. Unfortunately, the researcher was not able to gain permission from school administration to observe Cassie in her classroom during the generalization phase. Her principal did agree to allow Cassie to videotape the DTT sessions on a CD and mail them to the researcher for review. In this circumstance, behaviors were reviewed during the taped sessions and documented for review.

Allie

Allie conducted her generalization sessions in her classroom while her other students were at lunch and worked with "Nick" who was nine years old at the time of his observations. He was able to verbally communicate simple sentences and would frequently giggle and flap his hands when he was excited. Nick was eager to please his teacher and slightly rocked back and forth during the sessions when listening to the teacher explain the task. Participant one chose to conduct a discrimination task in her generalization sessions that was similar to the ones she practiced with while working with Austin in the lab. She stated that Nick was not familiar with crossing signs and this would be a novel task for him. Analysis of the first generalization session revealed that Allie showed a slight regression in session scores but still performed well above the 90% criterion score required for mastery of fidelity of implementing DTT.

The overall score for percent correct declined from 99% in the last intervention session to 94% in the first generalization session and a score of 95% in the second generalization session (see Figure 2). All steps within these sessions of DTT were delivered with nearly perfect fidelity. A component analysis of subsections on the DTTER for generalization sessions was conducted and revealed a drop through the third subsection in the first session (71% correct). Allie moved through the second session at a somewhat more rapid pace, and this was reflected in her shortened inter-trial interval (ITI) times. A 95% overall correct score for the second session was totaled, which is well above the 90% criterion for mastery of fidelity. The remaining four subsections of the DTTER were performed with 100% fidelity.

Betty

Betty had recently transitioned into a lead teaching position at a central Florida K-third grade charter school. Betty worked with Amy, a Hispanic girl who was eight years old at the time sessions occurred. Amy was a very thin, quiet young lady who wore glasses. She was in second grade but academically working on the first grade level. Amy appeared to be very willing to work with her teacher and immediately sat down to the table upon being summoned by Betty. She remained focused on the DTT sessions for their entirety, but would wiggle in response to praise from Betty, and occasionally flap her fingers (holding her elbows close to her sides) when she was waiting for the next trial to occur (during ITIs). Betty selected a shape discrimination task for the DTT sessions.

During the generalization sessions, Betty made overall scores of 75% for the first session and 83% for the second session. This was a regression from her final intervention session (IV 7) which totaled 91%. In reviewing subsection scores for the two generalization sessions, the lowest area of fidelity occurred in subsection three, when the participant was managing consequences for correct responses. Total percent correct in this area was 43% for the first generalization session and 0% for the second session. This subsection was not met with fidelity. While Betty did deliver praise, it was general in nature and did not include all three specific points required to meet the operational definition of providing specific verbal praise (i.e., must state student's name, praise statement, and statement of action that was performed by student). All other subsections within the sessions either nearly met or exceeded necessary criteria for mastery of fidelity.

Cassie

The investigator was not permitted access by Cassie's school principal to observe and evaluate her in the classroom. Permission was granted for Cassie to videotape her classroom, student, and generalization sessions. The school media specialist filmed Cassie's sessions and mailed a CD to the researcher for scoring. Cassie worked with Ronald. Ronald was in Kindergarten and was five years old at the time data were collected. Cassie reported that Ronald was diagnosed as having ASD under the category of "Other Health Impaired." Ronald was served full time in a self-contained special education classroom and was also receiving additional services for his language impairment. A number of behaviors were exhibited including defiance and manipulation of other students. Ronald needed supervision at all times and was able to stay on task only for up to five minutes. Preferred reinforcers included bubbles, computer time, balls, and candy.

Cassie also chose to deliver DTT sessions that asked the student to discriminate between crossing signs (specifically, walk and don't walk). She reported that Ronald was not familiar with the crossing signs and they had not been discussed in class. Her camera was set up so that she was facing the camera and the student sat with his back to the viewer. Cassie did comment that she believed that Ronald's performance was affected by the camera, noting that he seemed more distracted than usual and tried to touch the camera several times during taping. He was observed to engage in echolalia throughout the sessions.

The overall percent score of fidelity of implementation of DTT in a classroom setting for Cassie in the first generalization session was 93%. A slight decrease in score did occur in the two-week time period that occurred between termination of treatment and taping of generalization sessions (final score for intervention session five was 99%); however, it should be recognized that this score was still above the 90% criterion mastery level required to show proficiency. Subcomponent scores on the DTTER demonstrated that four out of five areas met with 100% proficiency. The fifth subsection (Management of Inter-Trial Interval) was the only area in which Cassie did not score perfectly. Anecdotal notes from the evaluation explain that Cassie did not allow for enough time to pass from one trial to the next.

Cassie scored a 90% on her second generalization session. This score was still considered a high ranking score and met with criterion for mastery in fidelity of implementation. Like her first generalization session, Cassie's fifth subsection (i.e., Management of the Inter Trial Interval) was an area where she scored lower on the overall assessment, but there was 21% improvement from the first generalization session, moving her score in this subsection from 74% (in the first generalization session) to 95% (in the second generalization phase). Subsections one, three, and four were perfectly executed (100%). Subsection two (Management of Discriminative Stimuli) dipped to 80% in the second session. Anecdotal notes attributed the decrease in score of the second subsection to an incomplete explanation of the learning task when presenting initial instruction to the student. It should be noted that no observers from the study were present to ensure integrity of these sessions.

Denise

Denise was not able to demonstrate generalization at her current place of employment. During the course of the investigation, she took a new teaching position at a residential behavioral clinic, which did not permit observers or visitors unaffiliated with their company. She was able to perform two generalization sessions with a student in another participant's classroom (Elle's). Denise worked with Rick, a six-year-old in a public school Kindergarten, who had a diagnosis of ASD.

Rick was also in the school's exceptional student education (ESE) program for speech/language. He displayed immediate and delayed echolalia and had difficulty with attention (his teacher reported that Rick had been diagnosed with a severe Attention Deficit Disorder and also reported that he was not taking any medication as the child's father was against the idea). Rick spent about 90 minutes a day with Kindergarten general education peers (i.e., recess, specials, and play centers). Rick was cooperative during the DTT sessions but moved in his seat frequently and constantly looked around for attention from others. He was very curious to know why the researcher was observing him and demonstrated this by repeatedly asking questions inquiring about who was visiting and why visitors would be watching him. Denise delivered two DTT sessions that required the student to discriminate between the crossing signs, walk and don't walk. Rick's teacher stated that she had not taught these signs in her classroom before so they should have been novel to his learning.

Denise was still able to deliver DTT with high fidelity two weeks after the intervention phase had been terminated. The overall score for the first generalization

session was 96%. This score was just a few percentage points lower than on her last intervention session, which was 99%. Fidelity of DTT was maintained to a very high standard, with every subcategory meeting or exceeding the 90% criteria for mastery. Save for subcategory two (Management of Discriminative Stimuli), which was scored at 90%, all other categories were executed perfectly.

Generalization session two also met with strong success. Denise earned a total of 95% as her overall average measured by the DTTER. Subsections one and four were demonstrated 100% correctly, subsection two scored out at 93%, and subsection five scored at 95%. Anecdotal notes indicated that subsection two was abbreviated, possibly due to Rick's eagerness to get started, and subsection five included shortened ITI times. Although the second generalization session score was slightly lower than the first generalization session, both were well above the criterion standard for demonstrating fidelity of implementation of DTT.

Elle

Elle worked with a boy named Shin. Shin was five years old at the time the study took place and had been diagnosed with ASD. Shin was being served in a public Kindergarten ESE program for Speech/Language and occupational therapy and spent the remaining time in a self-contained ASD classroom. He was able to use 1-2 word utterances but his speech was sometimes unintelligible. According to his teacher, Shin spent about 120 minutes a day with general education peers (e.g., circle, recess, specials,

and play centers). Shin appeared cooperative during the generalization sessions but was very distracted when any conversation occurred around him. He required a short pause (three minutes) midway through the first generalization session but was refocused with the promise of a favorite reinforcer (gummy bears). Elle reported that Shin did not have any prior knowledge regarding crossing signs, so she chose to use walk and don't walk images for the identification and discrimination tasks.

Elle was close to delivering DTT with high fidelity two weeks after the intervention phase ended in the TLE TeachLivE virtual classroom laboratory. The overall score on the DTTER for her first generalization session was 88%, a nine point decrease from her final intervention score of 99%. Visual analysis of the DTTER subcategories revealed a score of 78% for the fifth subcategory (Management of Inter-Trial Interval). Anecdotal notes explained that Shin appeared to be very anxious to move through the session, and this may have impacted the score. All four of the other subsections received scores between 97% and 100%. A similar score was produced in the second generalization session, totaling 87%. As with the first generalization session, Shin needed to constantly be reminded that he was working for gummy bears. He did not appear to be interested in participating in the DTT session. As with the first generalization session, all other subsections exceeded the 90% mastery criterion level.

This question sought to measure the level of fidelity that would be attained when participants took the skills learned in the TeachLivE lab and utilized them when applying DTT in classrooms with actual students. Participants were probed two weeks after the intervention phase was terminated. Four out of five participants were able to conduct

DTT with a student that they taught on a daily basis, the exception being with Denise, who worked with a student in another participant's (Elle's) classroom. All teachers reported that they worked with a student who had been diagnosed with ASD. Four out of five teachers chose to use walk and don't walk signs as a discrimination task for their generalization sessions. The fifth teacher used a set of basic geometric shapes as the discrimination task for the DTT sessions (e.g., the pupil was asked to discriminate between a circle and a square). This teacher scored the lowest in generalization sessions.

Although some regression was noted for participants, generalization scores still indicated that overall, teachers were able to correctly demonstrate steps within DTT trials with fidelity. Analysis of participants' performance revealed that the most difficult area for teachers to employ within the DTT cycle was the fifth subsection, "Management of Consequences for an Inter-Trial Interval." This subsection was one of the lowest subsections across all participants and was noted as being the lowest area of fidelity in six out of the ten generalization sessions. Two participants had difficulty executing the third subsection, "Management of Consequences for an Incorrect Response," as this was scored as the lowest area in two of the ten sessions.

Research Question Three

The third and final research question queried: to what extent did participants value their preparation of DTT with individualized clinical coaching (with practice, feedback, and demonstration) while in the TLE TeachLivE virtual classroom laboratory?

Participants were sent an email inviting them to complete a brief anonymous online survey via Google Forms. Table 3 displays ratings of the online survey, reflecting participants' views regarding their experiences and perceived value of the intervention.

Table 3: Social Validity Outcomes for Participants

Statement	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
I have used DTT in my classroom since my learning experience in the TeachLivE ™ lab.	80%	20%			
I plan to use the DTT strategy that I learned in the TeachLivE lab when appropriate, to work with my students.	80%	20%			
I feel very prepared to implement DTT with fidelity when working with my students.	80%	20%			
The instruction that I received in the TLE TeachLivE virtual classroom had a greater impact on learning to deliver DTT with fidelity than had I received it in traditional course activities.	80%	20%			
The effect of coaching I received was positively enhanced by the technology presented in the TLE TeachLivE lab.	100%				

Statement	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
I was completely comfortable working in the TLE TeachLivE lab during baseline (before coaching).			20%	20%	60%
I was completely comfortable working within the TLE TeachLivE lab after the intervention (coaching) began.	80%	20%			
Delivering evidence-based practices with fidelity in my classroom is extremely important.	100%				
What are points that you would like to suggest for change?	The only change I would suggest is to gain permission from the school at the beginning of the semester to ensure the rules of entering the school to observe the generalization. Everyone in the teaching program should have a class like this one. No changes. Well done. It would be great to learn about other evidence-based practices in this setting. I had no idea that this technology even existed on our campus! No changes				

Statement	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
Please share comments about your experiences while in the TeachLivE lab.	I feel that I learned how to successfully implement DTT in my classroom after the TeachLivE lab and coaching sessions. Krista was a very good coach and made the whole process very comfortable. After receiving coaching, I realized that every time I taught using DTT I did it incorrectly. The TeachLivE lab overall was a great experience! This was a great class. I learned so much with the hands on experience. The instructor was absolutely terrific. Great class and I learned so much from the hands on approach. Krista did an awesome job with coaching and explaining exactly what needed to be corrected. Awesome job Krista. I thought that this was one of the best learning experiences I've had while in the Master's program. I was able to practice until meeting proficiency, rather than being forced to read about it and then be forced to practice right away on one of my students. More courses need to use the lab for teaching. I really enjoyed my time on this project. Krista was able to analyze my performance in a very detailed way so that we focused on targeted areas in need of improvement. I felt like this really helped to speed me along. I really liked working with Austin—it was easy to imagine him as a "real" student.				

All participants (100%) wrote that they had favorable experiences while in the TLE TeachLivE laboratory and assigned a high value to the way that they learned to deliver DTT. Specifically, all (100%) teachers stated that they had used DTT in their classrooms since their learning experiences in the TeachLivE ^{TM} lab, that they planned to use the DTT strategy that was learned in the lab (when appropriate) to work with students, and that they felt very prepared to implement DTT with fidelity when working with their students.

Likewise, 100% of the participants agreed that the effect of coaching received was positively enhanced by the technology presented in the TLE TeachLivE lab. Participants unanimously responded with strong agreement when answering questions regarding the strategy instruction that they received in the TLE TeachLivE virtual classroom. All (100%) strongly agreed that they felt that receiving individualized clinical coaching (with practice, feedback, and demonstration) in the TLE TeachLivE ™ lab had a greater impact on their learning to deliver DTT with fidelity compared to receiving preparation via traditional course activities (e.g., referencing textbooks, receiving information via traditional lecture format). The participants also all rated the importance of having evidence-based practices in their classrooms as being extremely important.

In an online survey emailed at the conclusion of the study, the participants answered questions to ascertain the social validity of the research (Wolf, 1978). When asked about the level of comfort experienced while in the TLE TeachLivE ™ lab (see Table 3), an obvious difference was apparent regarding experiences between baseline and intervention phases. When participants were surveyed about comfort levels in baseline phase, three teachers (80%) responded that they did not feel comfortable working in the TLE TeachLivE ™ lab during baseline (before coaching). The remaining participant responded that she was neutral and did not feel strongly one way or the other. When the next statement was posited: "I was completely comfortable working within the TLE TeachLivE ™ lab after the intervention (coaching) began," four participants (80%) responded that they strongly agreed with this statement. One participant (20%) answered that she agreed with the statement.

Two open-ended questions were posed in the survey, asking participants to describe points for change and to share comments about their experiences while learning DTT with fidelity in the TeachLivE ™ lab. Two participants responded that they would not change anything. One participant added "well done." A third participant wrote that the only change she would suggest would be to work to gain permission from administration of the school where generalization would occur before the study began. A fourth participant wrote that "everyone in the teaching program should have a class like this one." The fifth respondent to the survey stated that "It would be great to learn about other evidence-based practices in this setting. I had no idea that this technology even existed on our campus." Finally, the last survey item asked the participants to share comments about their experiences while learning DTT with fidelity in the TeachLivE ™ lab. Overall, participants wrote that they had positive experiences with both the coaching intervention and the TeachLivE ™ lab. Complete responses can be viewed in Table 3.

Responses from the survey indicated participants strongly agreed that delivering evidence-based practices with fidelity in their classrooms was extremely important. Participants stated that they had subsequently used DTT in their classrooms and planned to use the strategy whenever appropriate. Furthermore, all participants felt very prepared to implement DTT with fidelity. Participants expressed a strong belief in the value of the strategy instruction they received in the TLE TeachLivE and responded that this instruction had a greater impact on learning to deliver DTT with fidelity compared to learning DTT via traditional course activities.

All teachers stated that the effect of coaching was positively enhanced by the technology presented in the TLE TeachLivE lab. Responses to the open-ended question "what are points that you would like to suggest for change?" were largely positive in nature. One participant stated that "everyone in the teaching program should have a class like this one" and that the procedure was "Well done. It would be great to learn about other evidence-based practices in this setting." Another participant replied that she "had no idea that this technology even existed on our campus!" and not to make any changes. A statement encouraging change was also noted, regarding permissions for the researcher to observe the participant in the classroom setting. Specifically, the participant wrote that "the only change I would suggest is to gain permission from the school at the beginning of the semester to ensure the rules of entering the school to observe generalization."

The last open-ended question asked participants to share comments about their experiences while learning DTT with fidelity in the TLE TeachLivE lab. Feedback from this question was extensive. All participants wrote favorably about their time in the lab learning DTT and practicing with Austin. The investigator received several compliments regarding the detailed level of instruction. Participants reflected on the level of specificity involved in the ICC intervention and responded: "Krista was able to analyze my performance in a very detailed way so that we focused on targeted areas in need of improvement. I felt like this really helped to speed me along." One participant remarked that after completing the intervention, she realized that every time she taught using DTT she did it incorrectly. A final participant expressed that she thought that her experience in the lab receiving ICC with practice, feedback, and demonstration was one of the most

positive she had experienced while in the master's program. She further wrote that she was allowed to practice until meeting proficiency, rather than being forced to read about it and forced to read about it and immediately use one of her students for practice. It was also suggested that more courses need to use the lab for teaching and that Austin was enjoyable to work with and could easily be imagined as a "real" student.

CHAPTER FIVE: SUMMARY AND DISCUSSION

Chapter Overview

The present chapter restates the purpose and procedures and research questions for the current study, summarizes results for each question, and provides implications for findings. Discussion regarding overall intervention effects is addressed and related to prior research. Study limitations are reviewed. The chapter concludes with recommendations for future practice, implications for future study, and teacher preparation. A conclusion of the study is also included.

Purpose of the Study

As stated previously in chapters one and two, ASD is one of the most pervasive developmental disorders in the world today. The Centers for Disease Control and Prevention (2012) estimated that approximately one in every 88 children is affected by ASD, reflecting an increase of 23% from their previously published report. This increase of prevalence can only exacerbate the shortage of highly qualified special educators prepared to work with students with ASD that continues to exist. In order to provide the best possible learning outcomes for students with ASD, teacher preparation programs must provide avenues for teachers to efficiently and effectively practice evidence-based

interventions (LeBlanc, Ricciardi, & Luiselli, 2005; Lerman, Vorndran, Addison, & Kuhn, 2004; Odom, 2009; Simpson et al., 2007).

One such evidence-based practice that is often employed as an intervention for students with developmental delays such as ASD is DTT, a learning strategy that can be implemented in a variety of settings and populations (Dunlap et al., 2001; Heward, 2006). This intervention is based on the principles of ABA, a very structured approach to learning that focuses on skill acquisition. Discrete trial instruction can be used with a wide range of ages and levels of student development (Ghezzi, 2007). McBride and Schwartz (2003) reported that training in evidence-based practices such as DTT should be considered essential in all teacher preparation programs.

Scheeler et al. (2009) reported an increase in the likelihood that teachers would use EBPs in their classrooms when reinforcement of effectively implemented practices occurred through formal review methodologies such as coaching. Andreasen and Haciomeroglu (2009) stated that new platforms of technology such as simulated classroom environments align with the dynamic culture of digital native learners and are integral components of teacher preparation programs. Furthermore, a call for the implementation of technology in learning has been addressed in the 2010 publication of A Blueprint for Reform: The Reauthorization of the Elementary and Secondary Education Act, which states "technology, when effectively and thoughtfully deployed, can improve how schools work, how teachers teach, and how students learn" (USDOE, 2010). Therefore, in an effort to effectively increase teachers' fidelity of DTT when working with students with ASD, a research investigation on the method of ICC was

conducted within the TLE TeachLivE live virtual reality classroom laboratory at the University of Central Florida.

This study attempted to answer three questions: To what extent is the fidelity of implementation of DTT affected when teachers are prepared using individualized clinical coaching in the TLE TeachLivE virtual classroom laboratory? To what extent will participants' preparation with ICC sessions delivered in TLE TeachLivE virtual classroom laboratory generalize when they administer discrete trials to students with ASD in a classroom setting? To what extent did participants value their preparation of discrete trial teaching with individualized clinical coaching while in the TLE TeachLivE virtual classroom laboratory?

The study included five University of Central Florida graduate students who reported that they had no formal training on DTT or previous experiences within the TLE TeachLivE virtual classroom laboratory. All five participants were currently teaching or working with students who they reported had been diagnosed with ASD. The secondary population in the study comprised five elementary level students who participated in generalization sessions at the school sites.

Procedures

A single subject, modified multiple baseline across participants design was used. The dependent variable of this research was participants' performance on the implementation of DTT while teaching one task per session, as measured by the DTTER.

The independent variable was the administration of ICC for mastering the procedures of DTT while in the TLE TeachLivE virtual classroom laboratory. Levels of fidelity involving the inter-rater, investigator, and interactors were all monitored and assessed across at least 30% of all sessions, phases, and participants using point-by-point analysis described in chapter three.

The investigator and inter-rater were required to have a 90% rate of agreement. Their agreement in baseline phase averaged 99% (range of 98%–100), and a mean of 96% was reported in the intervention phase (range of 77%–100%). Range of agreement in the generalization phase was 93%–100%, with a mean of 98%. Procedural fidelity for the investigator's delivery of scripted instructions was also assessed to be strong. Reliability for investigator's instructions within the baseline phase ranged from 98% to 100%, with a mean of 99%. Investigator's accuracy when providing demonstrations was systematically evaluated by the inter-rater during the intervention phase of each participant, using the DTTER. Reliability measured at 100% across all participants, in both baseline and intervention phases. Fidelity of interactor performances also met with 100% treatment fidelity in the baseline and treatment phases.

Data Analysis

Data from the DTTER were visually analyzed, and a percentage of correct responses per session on applicable components was calculated on a point-by-point basis to determine proficiency level of the DTT implementation (Gast, 2010; Kazdin, 1982).

Analysis in the form of a graphical representation of data points (via an Excel spreadsheet) for each participant was performed throughout each phase, and assessment of results included identifying changes in trend direction, change between adjacent conditions, and percentage of non-overlapping data (PND) (Gast, 2010; Kazdin, 1982).

Research Question One

To what extent is the fidelity of implementation of DTT affected when teachers are prepared using individualized clinical coaching in the TLE TeachLivE virtual classroom laboratory?

Summary

The only variable that changed between conditions was the addition of coaching with feedback and demonstration. A positive change in trend direction was noted across all five participants when moving from baseline to treatment conditions, and the change was directly relative to the coaching intervention. This is evidenced by a zero-accelerating trend in Allie, decelerating-deteriorating trends in baselines across participants Betty and Cassie, and a variable decelerating trend by participants Denise and Elle. An analysis of change across similar conditions indicates that across participants, baseline levels were maintained until individualized clinical coaching was

introduced, causing accelerating-improving levels and trends in each of the participants' data. Participants' fidelity when implementing DTT improved after the introduction of the coaching intervention in the TeachLivE virtual classroom. Across participants, the overall mean gain in fidelity from baseline phase (14%) to intervention phase (80%) was 66%. All participants successfully met criteria for termination of intervention (i.e., 90% mastery for 3 data points in a row). Percentage of non-overlapping data for all participants was 100%. Likewise, the percent of overlapping data for all participants was zero.

Implications

Results from this research question would suggest that the participants from the study benefited from learning in a highly interactive and highly contrived environment. Results will assist in adding to the body of research from previously published literature on teacher preparation and professional development of DTT. This study had the fortune of taking place at the home institution of the TeachLivE virtual classroom at the University of Central Florida. It should be noted that lab costs incurred by this study were generously funded through a Workforce Central Florida grant.

Visual displays of participants' performances clearly display a strong, rapidly ascending trend as the intervention was implemented and carried through to success. All participants advanced to mastery in adequate time, some progressing faster than originally hypothesized. The total amount of baseline time in the lab for each participant

was one hour and fifteen minutes. The median number of treatment sessions required for participants to demonstrate mastery was five, indicating that participant time in the lab was around two hours and thirty minutes. This finding is noteworthy when taking preparation cost into consideration. For the purpose of this research, this study was held to a pre-determined number of baseline sessions and maintained a high level of scripting by the researcher when engaging with students. The indication that baseline results remained largely unchanged after several weeks is favorable evidence that the intervention was effectively taught to fidelity. This implication could lead future researchers and practitioners to explore implementing the ICC method of teaching DTT with a reduced number of baseline sessions, thereby reducing the amount of baseline time in the lab. Future researchers may wish to consider teaching the concept in a small group setting and include training as an evaluator.

Research Question Two

To what extent will participants' preparation with individualized clinical coaching sessions delivered in TLE TeachLivE virtual classroom laboratory generalize when they administer DTT to students with ASD in a classroom setting?

Summary

Participants were probed two weeks after the intervention phase was terminated. Four out of five participants were able to conduct DTT with a student that they taught on a daily basis, the exception being with Denise, who worked with a student in another participant's (Elle's) classroom. All teachers worked with a student who was diagnosed with ASD. Four out of five teachers chose to use walk and don't walk signs for their generalization sessions. The fifth teacher used a set of basic geometric shapes. It is interesting to note that the teacher who chose to use geometric shapes scored lowest in the generalization sessions, leading the researcher to query whether the teachers' familiarity of discrimination cards may have played into performance.

Mean scores in generalization indicated that overall, teachers were able to correctly demonstrate steps within DTT trials with fidelity after treatment terminated and time without coaching had elapsed. The most difficult area for teachers to employ within the DTT cycle was the ITI. When observed in classrooms, participants did not wait the total required amount of time (three to five seconds) before moving on to the next trial. Two participants had difficulty correctly executing an error correction in the DTT cycle, as anecdotal notes indicated that they tended not to eliminate eye contact before representing the prompt, and did not offer correct specific verbal praise. Three out of five of the teachers still performed above the mastery level of 90%, and all teachers maintained levels of at least 75% or higher.

Implications

It is not surprising that some regression occurred when participants transitioned from treatment to the generalization phase. Two weeks elapsed from the final session in the lab to the first generalization session. It is possible that results were lower due to the termination of treatment or because an additional week had elapsed between assessments on fidelity. A strong and notable difference that may have contributed to the change in generalization scores is that unlike Austin (who was highly controlled via scripted behaviors and responses), the students who participated in generalization DTT sessions were actual students. While these students shared the diagnosis of being an individual with ASD, every child was unique and had unique behaviors, interests, and personalities. All five students involved in the study appeared to enjoy participating in the DTT sessions, but they still engaged in behaviors such as inattention and distractibility. For example, Allie's student Nick was very interested in what the researchers were doing while the sessions were occurring and would frequently look over. It is possible that teachers had to make slight compromises to fidelity in order to continue a student's progress in learning. Elle's student, Shin, needed to take a three-minute pause during the middle of the first generalization session and was very distracted when any type of conversation occurred around him. Implications from the results of research question two indicate that most teachers were able to maintain fidelity when implementing DTT in their classrooms while teaching students with ASD. It is acknowledged by the researcher that the generalization phase was abbreviated and that a definitive conclusion to the question would require several more evaluated sessions.

Research Question Three

To what extent did participants value their preparation of DTT with individualized clinical coaching while in the TLE TeachLivE virtual classroom laboratory?

Summary

The final research question investigated the perceived value of learning DTT in an interactive virtual reality setting. Did teachers value what they learned? More specifically, did teachers feel that the experience of receiving ICC in the TLE TeachLivE was valuable? Did they value their time more in the lab compared to the opportunity to learn the same concept in a traditional university course? Were they comfortable learning via the TLE TeachLivE? What would they change about their experience?

The teachers in the study responded with overwhelmingly positive feedback about their experiences in the TLE TeachLivE lab. All participants reported that they held EBPs in high regard when working with their students and that they have and would continue to use DTT as an intervention with their students in the future when appropriate. Participants wrote that they were not particularly comfortable in the TLE TeachLivE lab during baseline but became comfortable with the technology setting after the intervention phase was initiated. Teachers who practiced DTT in the TLE TeachLivE lab expressed a preference for learning the concept via the technology platform of the lab, rather than

through a more traditional course approach. Save for one comment regarding school visitation permissions of the researcher, all open-ended responses were positive and encouraging of continued research for teacher preparation within the TLE TeachLivE lab setting.

Implications

Positive implications can be drawn from results of this research question. Bearing in mind the limited size of this convenience sample of participants, it can still be determined that this study held strong social importance to participants on the effects of behavioral treatment, which is one type of social validity described by Wolf (1978). Teachers within this study reported that they preferred the technology and interactive method of learning compared to traditional methods of learning. As institutes of higher education work toward preparing students utilizing twenty-first-century technologies, it is important to take into consideration student preference and efficiency in learning. Teachers may be more engaged and involved when learning EBPs in an interactive setting such as the TLE TeachLivE lab, which may lead to stronger fidelity of implementation of such practices.

Overall Intervention Effects

Overall intervention effects of the study were positive and lasted to a high degree for at least a short time after the study ended. Participants in the study made strong immediate gains in DTT fidelity as a result of the ICC intervention and enjoyed the time spent within the TLE TeachLivE lab. A preference to learn in the lab setting was strongly voiced, and participants believed that there was an inherent value to their learning that their own students benefited from, as participants felt that they received more intensive and individualized coaching that they would be able to take back to their classrooms and utilize with their own students. Research results from all questions posed within the study indicate that the intervention and technology platform for learning was of strong benefit to teachers and positively impacted students within their classrooms. These findings suggest that if fidelity were to be maintained over time, a large number of students with ASD would benefit from teachers who are taught DTT via ICC while in the TeachLivE lab.

Relationship to Prior Research

Results of this study were compared to current peer-reviewed literature. Findings from research question one were consistent with results from previously published research that investigated the effect that interventions involving coaching, feedback, and demonstration had on the fidelity of implementation of DTT. As in Sarokoff and

Sturmey (2004), Leblanc, Ricciardi, and Luiselli (2005), and Gilligan (2007), various behavioral skills training packages were assessed that consisted of instructions, feedback, rehearsal, and modeling. Results from the current research align with previously listed studies in that participants from all studies demonstrated immediate improvements in DTT fidelity after receiving prescribed intervention packages.

The closest relationship that the present research presented in this study to previously published literature has been investigations by Arnal et al. (2007), Fazzio et al. (2009), and Thiessen et al. (2009) involving the use of confederates to train university students to implement DTT. These studies also integrated an instructional manual. Studies by Fazzio et al. (2009) and Thiessen et al. (2009) featured various levels of scripting in their interventions and generalization phases that included assessment of participants when working with actual students, which is similar to research conducted in the present study. Although researchers from the two previous studies (Fazzio et al., 2009; Thiessen et al., 2009) employed the use of an instructional manual (which was not included in the present investigation), both studies included coaching components that were similar to the ICC intervention used in this research. Researchers determined that the intervention packages used were effective in training participants to implement DTT when teaching children with autism.

Results from the present study parallel the gains in participant learning for the previous studies that employed confederates within their intervention phases and generalized those skills into a setting when working with actual students with ASD. A difference to be noted between the present research described in the current study and the

previously mentioned studies is that Fazzio et al. (2009) and Thiessen et al. (2009) did not report any findings that the perceived impact of scripting had on fidelity levels. It is posited that within the current study the high level of scripting and protocols contributed to participants' proficient gain in fidelity for delivering DTT to students who were diagnosed with ASD. To date, there have been no studies that evaluate the use of avatars when preparing professionals to deliver DTT with fidelity when working with students who have ASD.

The most unique aspect of this research, which sets it apart from other studies concerning the coaching of DTT procedures, is the TeachLivE lab setting where the training took place. The TeachLivE lab environment is highly controlled so that interactions with the avatar are deliberate and rich in context. Because Austin was a persona rather than a human, engagement with him could be paused, resumed, and advanced much in the same manner as a recorded audio or video track and yet be reflexive enough to instantly change behavior when an appropriate antecedent occurred. This characteristic was conducive to concentrated learning and performance gains in a reduced amount of time. In fact, the mean time among participants to attain higher than mastery level performance of 90% (98% in this study) was 1.25 hours. By comparison, the Arnal et al. (2007) study reported that mastery among participants took three hours and twenty minutes, the Fazzio et al. (2009) study took three hours and ten minutes, and the Thiessen et al. (2009) study took a mean of four hours and thirty-four minutes for participants to attain mastery levels of proficiency.

Limitations and Challenges

Single Subject Design

Single subject design research methodology carries with it specific threats to internal validity that include threats related to prolonged baselines such as boredom, and the small sample size inherent in single subject research studies limits the external validity of the investigation (Kazdin, 1982). Additionally, according to teacher report, the five secondary participants carried diagnoses of ASD. Due to the variations in behaviors of individuals on the autism spectrum, results from this study should be approached with caution, as it is not assured that findings could be replicated with individuals with differential diagnoses of ASD.

Selection Difficulty

The nature of a convenience sample restricts generalizability, as the pool of potential participants who volunteered to participate in the present study was taken from a graduate level course in a master's degree program at the University of Central Florida. The homogeneity of the sample limits the applicability of findings. When moving to the post-intervention phase, it is acknowledged that actual students will have a wide range of behaviors that may limit generalization. Another unforeseen challenge occurred when a school administration refused to allow the investigator to observe participants in their

classrooms. This presented difficulty in the generalization phase, as the researcher was limited to analyzing video footage that was filmed by an outside party.

Time Constraints

Time constraints of the study were sometimes a challenge. Participants were enrolled in a course that was mixed-mode, meaning that there was a reduced amount of time required on campus. This reduced time on campus translated into a limited number of times that the investigator could require participants to travel to campus for sessions. Time limitations within the TLE TeachLivE lab were also a challenge, when combined with technical difficulties that occasionally occurred during scheduled training times. Generalization was also limited, as participants were obliged to participate in the study for the length of only one semester. It should be noted that all participants and interactors were very generous with their time, staying late and making arrangements to accommodate unforeseen events such as computer shut-down and technical difficulties. The TLE TeachLivE lab was very sensitive to weather conditions and became difficult to operate when thunderstorms occurred. Calibration of the avatars was also difficult at times and was resolved by shutting the entire system down and rebooting again.

Prolonged Baselines

The current study was conducted over the course of fourteen weeks. A modified multiple baseline across subjects experiment requires the withholding of the independent variable from the first participant until baseline stability occurs (Gast, 2010; Kazdin, 1982). Following the intervention for the first person, subsequent interventions are withheld from the next participant until data are found to be stable from the prior participant that received the intervention. This continues until the intervention has been presented to all participants. By this design, baselines extended for several weeks before all subjects received the treatment package. The current study experienced a prolonged baseline that delayed the opportunity to conduct more sessions while in the generalization phase.

Scripting and Protocols

In an attempt to achieve and maintain treatment fidelity within the study, an extensive amount of scripting and protocols was necessary by the investigator and interactor. This proved to be a challenge at times, as the investigator was held to scripts that at times conveyed a sterile approach to learning, especially while in the baseline phase. Predetermined protocols in the coaching intervention (e.g., procedure for reviewing the DTT session such as reading the definition verbatim from the ODW) also became redundant. Interactors were also held to scripted behaviors that may or may not

be realistic in classrooms. Although the scripts and protocols were cumbersome at times, it should be noted that they assisted in maintaining consistency and treatment integrity within the study and resulted in high levels of fidelity; for this reason this section is considered a challenge but not a limitation of the study. Three different interactors were able to successfully portray Austin with no noticeable recognition by participants and no fluctuation on rates of treatment integrity.

Technical Difficulties

As with any technology, the TLE TeachLivE lab was not immune to technical difficulties and system interruptions. Although sporadic, such interruptions caused delays in session start times and occasionally resulted in the termination of a session. Specific technology components utilized within the system were sensitive to weather interference and became difficult to work with when strong weather was in the local area. At times Austin appeared to be very jumpy. During these instances he seemed to twitch, and his arms would arc into unnatural positions. There were also times that he was not able to make intended eye contact with the participant (according to scripted behavioral protocols), or would become frozen for several seconds. When these unintended behaviors would occur infrequently or at a low rate, they were largely ignored by the participants and investigator. A common explanation offered by the investigator was that Austin may have eaten too much sugar at lunch or drunk a Mountain Dew before he got to school. When glitches occurred at higher rates, the participant was escorted out of the

lab, the system was rebooted, and the participant was called back in to start a new session. Anecdotal notes were kept by the researcher to record such instances. Upon review and comparison of notes to session scores on the DTTER, the researcher determined that the technical difficulties experienced during sessions did not negatively impact participants' performance.

Implications for Future Study

Implementing EPBs with fidelity is predicted to result in improved outcomes for learners and is essential when planning educational interventions when working with students with ASD (Nosik, & Williams, 2011; Odom, 2009; Odom, Collet-Klingenberg, Rogers, & Hatton, 2010). Today's special education teachers must enter their classrooms fully prepared to effectively administer a variety of EBPs to assist their learners in maximizing outcomes (Simpson, 2005). Future research in providing effective teaching packages for preparing teachers and professional staff to implement DTT with high fidelity is essential for all stakeholders. Prospective researchers should consider exploring other simulated virtual learning platforms such as Second Life and SimSchool, as learning via these modalities has the potential benefit of allowing learners to proceed through learning sessions without having to travel to a main campus, provided that learners have internet access. Adobe Connect, Saba, and Elluminate are all web conferencing platforms to be considered in future studies. One possibility for study

would include having all parties on video chat. The facilitator could portray an individual with ASD, thereby dismissing the need for an avatar or confederate.

Future research should also consider participants' knowledge and comfort of utilizing technology in a virtual setting. Researchers could familiarize participants with the virtual setting by facilitating an experience whereby participants interact with avatars in a manner that is benign to the study. Other considerations for future studies include determining if fidelity of implementation of DTT can be maintained over time and generalized across settings. Field testing the DTTER may lend strength to future teacher preparation. Future research should explore the impact and efficacy that the TeachLivE virtual classroom may have on levels of fidelity for other EBPs.

Future research could also investigate how the layering of various avatar behaviors affects teacher performance. For example, participants could utilize the lab to become familiar with an EBP and work with an avatar that displays a minimized amount of behaviors. As the participant becomes more adept at delivering this EBP, behaviors can be added to simulate working with a student who has more complexities. The participant would again train up to proficiency with the avatar. This scenario could be repeated until mastery of the EBP occurs. The complexity of the EBP intervention could also be expanded upon as lessons within the lab are designed and delivered. For example, a token board could be added to a lesson, which would assist the participant in learning how to utilize such a reinforcer in a classroom setting.

Implications for Teacher Preparation

Benefits to teachers who participated in training via ICC in the TeachLivE lab were numerous, and results indicated that all participants demonstrated strong levels of improved performance in fidelity when delivering DTT to students with ASD. After receiving a relatively small number of coaching sessions, participants' fidelity was greatly increased, and teachers reported that they had and would continue to utilize DTT in their classrooms when working with students who have ASD in their classrooms. Because Austin's behaviors were tightly scripted to remain passive and compliant, teachers were able to attend to improving the fidelity of DTT. Using an avatar enabled the instructor and participant to focus on a specific section, subsection, or step of the DTT cycle and provided the participant with the opportunity to hone skills without adversely impacting the learning of an actual student.

The nature of the ICC intervention also provided the opportunity for training to be focused to specifically targeted areas in need of improvement unique to each teacher. Having the ability to diagnostically assess teachers' strengths and weaknesses for fidelity when implementing DTT by utilizing the DTTER, and the option to review recorded sessions either on demand or at a later time for further analysis if needed is also a unique aspect of the TeachLivE lab that could prove valuable for future research projects.

Institutes of higher education may wish to consider developing semester-long methods coursework that utilizes the TeachLivE virtual classroom. Students within such a course could become familiar with the lab setting and avatar and basic principles of particular EBPs, perhaps selecting a few EPS in particular to master. As the semester

progresses, the student could practice working within the virtual classroom, gaining proficiency in delivering the EPBs with fidelity. As the student gains proficiency, avatars can increase their range of behaviors and behavior intensity levels to provide a stronger level of difficulty for the student, rendering a more authentic scenario to that of a real classroom.

Conclusion

There is an inherent value in equipping educators who work with students with ASD with a strong skill set of EBPs (Scheuermann et al., 2003; Simpson, 2004). The intent of this study was to investigate the efficacy of ICC in a virtual reality learning modality (e.g. the TLE TeachLivE virtual classroom setting) and the effect that the intervention had on teachers' fidelity of implementation of DTT when working with students with ASD. Results from this research study indicate that across all five participants, performance improved from a mean accuracy of 14% in baseline to 80% after receiving the ICC intervention in the TeachLivE lab. A stable baseline and baseline probes indicated that immediate improved performance was evidenced through visual analysis after the first intervention session occurred. Results of the intervention were significant across all participants, and strong experimental control was maintained throughout the study. Two generalization sessions were assessed in teachers' classrooms, and results indicated that participants continued to implement DTT with fidelity and effectively utilize this EBP when working with a student who had ASD. Results indicate

that teachers' improvements in fidelity of implementation of DTT could be attributed to ICC received in the TeachLivE virtual classroom.

The researcher acknowledges that there may be limited generalization from the TeachLivE lab to actual classrooms without the ability to account for rudiments such as student behaviors. Adding such layers into TeachLivE sessions may lend legitimacy to the intervention and provide a higher level of generalization when working with students with behavioral complexities. Fortunately, such gradations can be controlled so that participants are able to focus on learning objectives. As teachers become more adept in delivering a strategy, more complexities may be integrated within sessions, thereby providing a more realistic experience for teachers.

APPENDIX A: IRB APPROVAL LETTER

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Krista M. Vince Garland** and Co-PI: **Cynthia Pearl**

Date: **February 21, 2011**

Dear Researcher:

On 2/21/2011, the IRB approved the following human participant research until 2/20/2012 inclusive:

Type of Review:	UCF Initial Review Submission Form
Project Title:	Measuring the Efficacy of Coaching in TeachME Virtual Classroom for Increasing Fidelity of Discrete Trial Training.
Investigator:	Krista M Vince Garland
IRB Number:	SBE-11-07469
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 https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 2/20/2012, 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 Joseph Bielitzki, DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 02/21/2011 11:03:35 AM EST

IRB Coordinator

APPENDIX B: PARTICIPANT INVENTORY ASSESSMENT

Student Name:

Who are your students?

What are the specific needs of your students?

What evidence-based practices do you implement in your classroom?

What is your daily schedule?

How is your classroom arranged?

How do you address the following domains in the Matrix of Services?

Curriculum and Learning Environment

Social/emotional Behavior

Independent Functioning

Health Care

Communication

APPENDIX C: OPERATIONAL DEFINITION WORKSHEET

APPENDIX C. OPERATIONAL DEFINITION WORKSHEET

Management of Antecedents	
1. Arranges necessary materials	Selects teaching materials that are appropriate to lesson (e.g. pictures, data sheets, pens/pencils, tangible reinforcers) and places them within easy reach for instructional session. Must do this before inviting student to the table.
Invite learner to the table	Requests learner to table for learning opportunity.
2. Develop rapport/positive mood.	Smiles, makes a friendly inquiry, or makes a positive comment to the learner. Examples might be "You look ready to go today!" or "It's great to see you again!" Directions for the task or reinforcer selection are not acceptable for this component. Must be done before task is introduced.
3. Introduce the task.	Explains to the learner what he will be learning in the session. Tells learner that when he completes the task, he will be rewarded with the selected reinforcer for 10 minutes of free time. May do after component 4.
4. Provide opportunity for the learner to choose a reinforcer.	Holds up two items, one in each hand, one to the right and one to the left at almost arm's length, and at shoulder height, and asks learner to point to the item that he would like to earn for completing the task. May do before component 3.
Management of Discriminative Stimuli	
5. Secure learner's attention.	Ensures that learner is attending to the instruction. This can be done by requesting the learner to "look at me". Does not go to component 6 until learner is oriented towards the task and looking directly at the instructor.
6. Present the correct materials.	Holds up the two signs, one in each hand, (one to the right and one to the left, at almost arm's length, and at shoulder height). Placement should be varied at least once for every three consecutive trials. Must be up when delivering instruction
7. Present the correct instruction.	Delivers concise instruction once, with clear articulation, using minimal words or gestures (no more than 6 words). Examples might be "Show me Don't Walk." or "Point to Don't Walk." Waits 2-3 seconds for a response. Must consistently use the same direction for all 10 trials. May be delivered simultaneously with holding up the signs.
Management of Consequences for a Correct Response	

8. Provide specific verbal praise. Name Action Praise (In any order)	Delivers immediate positive feedback to learner (within 2s). Examples might be "That's correct, great job pointing Austin!" or "You got it right! Good job Austin!" Praise should be enthusiastic in tone. Must be specific praise. Generic praise such as "Good job!" or "That's right!" is not acceptable for this component.
9. Remove materials.	Removes materials from the learner's view by placing sign cards face-down on table.
Management of Consequences for an Incorrect Response	
8. Remove materials	Calmly and quietly remove materials from the learner's view by placing sign cards face-down on the table. Looks down without talking or otherwise interacting with the learner for 2-3 sec.
9. Re-present material with a prompt.	Presents only correct picture for request. Points to the sign and says, "This is don't walk' while pointing to the picture with free hand as a model prompt.
10. Re-present correct instruction.	Delivers concise instruction once, with clear articulation, using minimal words or gestures. Examples might be "Show me don't walk." or "Point to don't walk." Waits 2-3 seconds for a response. Must consistently use the same direction for all 10 trials.
11. Affirm correct response. Name Action Praise (In any order)	Delivers immediate feedback to learner (within 2s) affirming a correct response. Examples might be "That's correct Austin, that is don't walk" or "yes, Austin that's don't walk". Feedback is delivered in a neutral tone. There should be a clear difference between this feedback and the verbal praise provided for an unprompted correct response.
Management of the Intertrial Interval	
12./13. Provides a break between instructional trials.	Places materials face-down on the table. Does not interact with learner for 3-5 seconds.
14./15. Records Data	Correctly records learner response onto data sheet as either a Correct (+) or Prompted (-) response. Must do this during the intertribal interval. Cannot go back and fill in for previous trial.

APPENDIX D: DISCRETE TRIAL TEACHING EVALUATION RUBRIC

Discrete Trials Teaching Evaluation

Name: _____ **Date:** _____

Video Start time: _____ **Video Stop time:** _____

Management of Antecedents

Components	
1. Arrange materials.	
2. Develop rapport/positive mood	
3. Introduce task	
4. Provide opportunity for the learner to choose a reinforcer.	

Yes	+
No	-

Management of Discriminative Stimuli

Components	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
5. Secure learner's attention										
6. Present correct teaching materials										
(Right or Left hand)										
7. Present correct instruction										
SD:										

Management of Consequences for Correct Response

Components	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
8. Provide specific verbal praise										

Management of Consequences for Incorrect Response

Components	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
8. Remove materials, look down (2-3 secs.)										

Components	1	2	3	4	5	6	7	8	9	10
9. Re-present materials (with prompt)										
10. Re-present instruction & prompt to ensure correct response										
11. Affirm correct response										

Management of the Inter-Trial Interval

Components	1	2	3	4	5	6	7	8	9	10
9/12. Provides a break between instructional trials (3-5 secs.)										
10/13. Record data										

Totals

DTT Steps	Points Possible	Points Earned
Management of Antecedents (Steps 1-4)	4	
Management of Discriminative Stimuli (Steps 5-7)	30	
Management of Consequences for Correct Response (Step 8)	7	
Management of Consequences for Incorrect Response (Alt. Steps 8-11)	12	
Management of Inter-trial Interval (Steps 9-10/ Alt Steps 12-13)	19	
Totals	72	

APPENDIX E: ABBREVIATED LESSON PLAN

Discrete Trial Training Instructions

In this session you will attempt to implement the Discrete Trial Training strategy with Austin, a child with an autism spectrum disorder. Austin is nonverbal and has fine motor difficulties. However, he can discriminate by pointing to items that are held at least two feet apart, at shoulder height.
Given your present knowledge, you will deliver a lesson using the procedure listed below. You will record data on the datasheet provided. The lesson will take between 10-15 minutes to complete. Please let me know when you have finished.

Lesson Objective:
When presented with two sign cards and asked to point to "Don't Walk", Austin will point to "Don't Walk" for 10 out of 10 trials over three consecutive sessions.

Lesson Procedures

1. Gather Materials
- a. Having the necessary materials readily available will make your session easier and more productive. Items you may want to consider using:
  - i. Data collection sheet
  - ii. Pen
  - iii. Selection of tangible items
  - iv. Instructional materials

2. Prepare for the Lesson
- a. Invite Austin to the teaching table.
- b. Introduce the task.
- c. Have him choose the tangible he would like to earn for completing the task.

3. Begin Trials
- a. Secure Austin's attention.
- b. Present the correct materials.
- c. Present the correct instruction.
- d. If Austin responds correctly, provide verbal praise.
- e. If Austin responds incorrectly, provide whatever prompt you think is necessary to ensure a correct response.
- f. Break for the *Inter-trial Interval* and record results on the data sheet.
- g. Repeat steps 1-3 for 10 trials.

4. **End the Lesson**
- a. Provide tangible item that Austin chose as a reward for doing his work.
- b. End session.

APPENDIX F: PARTICIPATE DATA SHEET

APPENDIX F: PARTICIPATE DATA SHEET

Name: _____
Date: _____

S^D	Response	Reinforcers	Materials

Mark each trial with + for correct, unprompted, - for prompted

Trial	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Response	+	+	+	+	+	+	+	+	+	+
	-	-	-	-	-	-	-	-	-	-

Trial	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Response	+	+	+	+	+	+	+	+	+	+
	-	-	-	-	-	-	-	-	-	-

APPENDIX G: INTERACTOR RESPONSE FIDELITY WORKSHEET

APPENDIX G: INTERACTOR RESPONSE FIDELITY WORKSHEET-

Date/# of Session: _____

Participant: _____

Inter-rater:_____

Response Management		
A total of ten trials were performed.	Yes	No
A total of seven correct responses occurred.	Yes	No
A total of three incorrect responses occurred.	Yes	No
Austin responded correctly on the last trial.	Yes	No
Management of Antecedents		
Attending behavior was executed correctly.	Yes	No
Look-away behavior was executed correctly.	Yes	No
Non-attending behavior was executed correctly.	Yes	No
Grabbing behavior was executed correctly (if applicable).	Yes	No
Management of Discriminative Stimuli		
Attending behavior was executed correctly.	Yes	No

Look-away behavior was executed correctly.	Yes No
Non-attending behavior was executed correctly.	Yes No
Management of Consequences for a Correct Response	
Attending behavior was executed correctly.	1 2 3 4 5 6 7
Look-away behavior was executed correctly.	1 2 3 4 5 6 7
Management of Consequences for an Incorrect Response	
Attending behavior was executed correctly.	1 2 3
Look-away behavior was executed correctly.	1 2 3
Non-attending behavior was executed correctly.	1 2 3
Management of the Intertrial Interval	
Attending behavior was executed correctly.	1 2 3 4 5 6 7 8 9
Look-away behavior was executed correctly.	1 2 3 4 5 6 7 8 9
Non-attending behavior was executed correctly.	1 2 3 4 5 6 7 8 9
Grabbing behavior was executed correctly (if applicable).	Yes No

APPENDIX H: INVESTIGATOR PROTOCOL FIDELITY WORKSHEET

APPENDIX H: INVESTIGATOR PROTOCOL FIDELITY WORKSHEET

Date:_____ **Total Score:**_____

Step		Description	Completed	Not Completed
1	**Introduction to Setting**	Investigator orients participant to lab	Completed	Not Completed
		Investigator facilitates a greeting with avatars	Completed	Not Completed
2	**Instructions for Beginning Session**	Investigator explains session objective	Completed	Not Completed
		Investigator points out teaching materials on table	Completed	Not Completed
3	**Instructions for Technical Difficulties**	Investigator explains protocol for exiting and reentering lab should technical difficulties arise	Completed	Not Completed
4	**Instructions for Ending Session**	Investigator asks participant to indicate when the instructional session has ended	Completed	Not Completed
5	**Instructions for After-Action Review**	Investigator presents After-Action Review worksheet	Completed	Not Completed
		Encourages open and honest answers	Completed	Not Completed
		Iterates that the AR worksheet will not be scored	Completed	Not Completed
		Announces the two minute time parameter	Completed	Not Completed
		Provides stop indicator after two minutes have elapsed	Completed	Not Completed
6	**Session Conclusion**	Investigator concludes session and escorts participant out of lab	Completed	Not Completed

APPENDIX I: SCRIPT FOR RECORDED VIDEO INTRODUCTION

APPENDIX I. INVESTIGATOR SCRIPT OF RECORDED VIDEO

Greetings! I'd like to take a moment to thank you for volunteering to participate in my study. It means a lot to me and my department that you are willing to work with us. Before you get started I wanted to let you know about some very important information.

First- Please do your best to relax and have fun in the lab. You are not expected to come into the lab and be experts! It may take you a few minutes to get used to the technology of the lab. This is normal. If you ever feel like you need a break, just let me know and we will stop the session. People usually do not have any discomfort when working in the lab and acclimate to the virtual setting very quickly.

Second- You will be learning about a specific evidence-based practice that many educators and leaders in the field utilize when working with students with ASDs. You will receive an instructional sheet that will provide you with a "lesson plan" for you to work with your student. You will have 10 minutes to review this plan. After 10 minutes have elapsed, the lesson plan will be collected and you will be guided into the virtual classroom. No further instructions regarding the instructional lesson will be provided to you at this time, but I will be able to introduce you to the classroom. Again- the most important thing for you to remember is to relax and do your best!

Third- While you are in the "baseline" phase, I will not be able to provide you with any type of feedback. In order to maintain the integrity of the study, I will not be able to provide you with any verbal or non-verbal feedback whatsoever. This is the hardest part of the study for me, and I appreciate your understanding that my lack of response is only a part of the process of research.

Fourth- When you are finished with your instructional session, please turn to me and let me know you have completed your session. At that time we will proceed to the next step within the research protocol.

Fifth- After all participants have been initially evaluated a schedule for upcoming dates of attendance will be provided. This will not occur on the first few days of the study. I am mindful of the importance and need for planning and will let you know as soon as possible what your scheduled dates will be.

Finally- You are the most important part of my research and I could not do this without you. Many thanks again for your willingness to participate. You will now be given the lesson plan and 10 minutes to review for your lab experience. I look forward to seeing you shortly!

APPENDIX J: INVESTIGATOR BASELINE SCRIPT

APPENDIX J: INVESTIGATOR BASELINE SCRIPT

1. Introduction to setting:

I would like to welcome you back to the virtual classroom. As you remember, the students you see before you are typical of students that you may have in your own class. Each of them has individual characteristics and abilities. Class, please say hello! *Class responds to introduction with short, unscripted greetings. This should take no longer than one minute to complete.*

You will be working with Austin again today. *Screen pans to Austin, then pans back to front of class.*

2. Instructions for beginning and ending session:

Given your present knowledge, deliver a lesson to the best of your teaching ability. Here is the teaching table with all of the materials that you need for the lesson. When you are finished with your instructional session, please turn to me and let me know that you have completed your session. If technical difficulties occur, I will ask that we take a break and escort you out of the virtual classroom. The session will not be evaluated, and we will begin with an entirely new session when I escort you back into the classroom. When you are ready, you may call Austin to the table and begin your lesson.

Participant will proceed through the instructional session. When the participant indicates that the lesson has been completed, the camera will pan out from Austin, returning to a shot from the front of the room, and will continue to pan out until the screen is gray.

3. Instructions for After Action Review:

After the session hand the participant the AR worksheet. The participant will remain seated at the table and will have one minute to complete the AR worksheet. This should be timed by the investigator. Please write your answers to the questions on this worksheet. I encourage you to provide open and honest responses. This worksheet will not be scored in any way and will not count toward or against your performance. I will let you know when to stop writing.

Investigator signals to begin writing and allows two minutes to elapse.

Investigator signals to stop writing after the elapse of two minutes.

This concludes your session. At this time I will escort you out of the lab. You will not receive any feedback during this phase of the study. Thank you again for your participation!

Investigator escorts participant out of lab.

APPENDIX K: INVESTIGATOR TREATMENT SCRIPT

APPENDIX K: INVESTIGATOR TREATMENT SCRIPT

1. Introduction to setting:

I'd like to welcome you back to the virtual classroom. As you remember, the students you see before you are typical of students that you may have in your own class. Each of them has individual characteristics and abilities. Please say hello class! *Class responds to introduction with short, unscripted greetings. This should take no longer than one minute to complete.*

You will be working with Austin today. *Screen pans to Austin, then pans back to front of class.*

2. Instructions for beginning and ending session:

Given your present knowledge, deliver a lesson to the best of your teaching ability. This is the teaching table with all of the materials that you need for the lesson. If technical difficulties occur, I'll ask that we take a break and escort you out of the virtual classroom. The session won't be evaluated, and we'll begin with an entirely new session when I escort you back into the classroom. When you are ready, you may call Austin to the table and begin your lesson. When you're finished with your instructional session, please turn to me and let me know that you have finished.

Participant will proceed through the instructional session. When the participant indicates that the lesson has been completed, the camera will pan out from Austin, returning to a shot from the front of the room, and will continue to pan out until the screen is gray.

3. Instructions for After Action Review:

After the session hand the participant the AR worksheet. The participant will remain seated at the table and will have one minute to complete the AR worksheet. This should be timed by the investigator. Please write your answers to the questions on this worksheet. I encourage you to provide open and honest responses. This worksheet won't be scored in any way and will not

count toward or against your performance. You will have two minutes and I'll let you know when to stop writing.

Investigator signals to stop writing after the elapse of two minutes.

4. Feedback and Demonstration:

Now we're going to take a few moments to review your session using a sheet of operational definitions to guide us. An operational definition identifies one or more specific observable events and serves to provide meaning to the item or event. The operational definitions worksheet that we'll be using will include five subsections, with a varying number of steps within each of the subsections. Each step that you performed correctly has been marked with a *. Each step that you performed incorrectly has been marked with a Δ. I'll give you your total score, and we'll review your session step by step, through each of the subsections. I'll read the definition for each step and demonstrate it for you if you've performed it incorrectly. When we're finished with each subsection, I'll model it correctly for you, and then you'll model it back to me.

Investigator proceeds through each of the steps using the following statements to guide correct and incorrect responses.

> Correct Step: *Read operational definition.* You performed this step correctly! I really liked the way that you *(insert positive feedback regarding step)*.
>
> Incorrect Step: *Investigator reads operational definition.* You performed this step incorrectly. I'll model the step for you.

Investigator models step.

Now you try it.

Participant models step.

If the participant demonstrates the step correctly the investigator will respond: "That is correct (positive praise statement)!"

If the participant demonstrates the step incorrectly the investigator will respond: "Watch me again" *and model the step again. This correction cycle will continue until the participant performs the step correctly.*

Feedback, demonstration, modeling, and practice will continue to the completion of each subsection and step within the operational definition worksheet.

Now that we've reviewed each of the steps, I'll model three trials for you with Austin. You'll see Austin respond correctly, then incorrectly, then correctly again.

Investigator calls Austin back to the table and proceeds to demonstrate three trials.

Investigator models three trials.

After three trials are performed, the investigator thanks Austin for his help and tells him that he can go back to his desk. The screen will pan away from Austin to the front of the class, and then pan out to a gray screen.

This concludes our session. I'd like to thank you again for all of your help. I look forward to seeing you again!

Investigator escorts participant out of the lab.

APPENDIX L: AFTER ACTION REVIEW

Name:_____

Date:_____

Session:_____

1. **Describe one thing that went well with the task/goal/project.**

2. **Describe one thing that needs improvement (if any).**

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