

**The Effectiveness of Direct Instruction in Teaching Students with  
Autism Spectrum Disorders to Answer “Wh-” Questions**

by

Jessica N. Cadette

A Dissertation Submitted to the Faculty of the

College of Education

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Education

Florida Atlantic University

Boca Raton, FL

May 2015

Copyright 2015 by Jessica N. Cadette

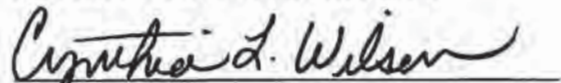
**The Effectiveness of Direct Instruction in Teaching Students with  
Autism Spectrum Disorders to Answer "Wh-" Questions**

by

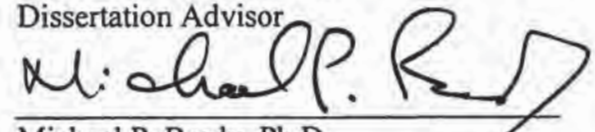
Jessica Cadette

This dissertation was prepared under the direction of the candidate's dissertation advisor, Dr. Cynthia L. Wilson, Department of Exceptional Student Education, and has been approved by the members of her supervisory committee. It was submitted to the faculty of the College of Education and was accepted in partial fulfillment of the requirements for the degree of Doctor of Education.

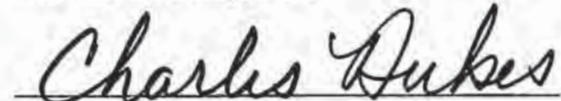
SUPERVISORY COMMITTEE:



Cynthia L. Wilson, Ph.D.  
Dissertation Advisor



Michael P. Brady, Ph.D.



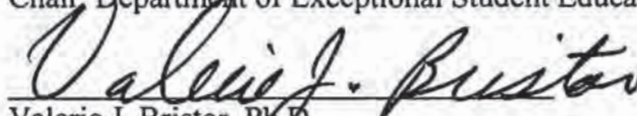
Charles Dukes, Ed.D.



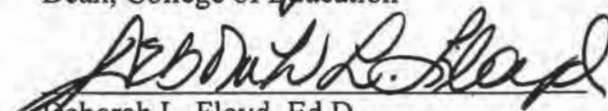
Kyle D. Bennett, Ed.D.



Michael P. Brady, Ph.D.  
Chair, Department of Exceptional Student Education



Valerie J. Bristol, Ph.D.  
Dean, College of Education



Deborah L. Floyd, Ed.D.  
Dean, Graduate College

3/27/15

Date

## **Acknowledgements**

I wish to express sincere gratitude to my committee members for their guidance and encouragement. I would like to thank my dissertation chair, Dr. Cynthia L. Wilson, for her unwavering commitment to helping me succeed. I would also like to thank Dr. Michael P. Brady for providing feedback on my methods and data collection throughout this project. In addition, I would like to thank Dr. Charles Dukes for taking me under his wing early in my doctoral studies, for his ongoing encouragement, and for his willingness to serve on my committee. Lastly, I would like to thank Dr. Kyle D. Bennett for introducing me to the field of Applied Behavior Analysis and for his willingness to serve on my committee.

I would also like to extend a special thanks to my research assistants, Christine Honsberger and Kathy Randolph, for their help with data collection and intervention implementation and for their moral support throughout the study.

This study was made possible through funding from the National Institute for Direct Instruction (NIFDI). I would like to thank the NIFDI for their monetary support, as well as their willingness to provide me with guidance on DI methods throughout my study.

Lastly, I would like to thank my family and loved ones who have supported and encouraged me tirelessly throughout my schooling career. Thank you, Mom, Poppy, Pierre, Amy, Rosie, Jonathan, and Chad for your relentless love, support, and encouragement.

## **Abstract**

Author: Jessica N. Cadette

Title: The Effectiveness of Direct Instruction in Teaching Students with Autism Spectrum Disorders to Answer “Wh-” Questions

Institution: Florida Atlantic University

Dissertation Advisor: Dr. Cynthia L. Wilson

Degree: Doctor of Education

Year: 2015

Teachers of students with autism spectrum disorders (ASD) often struggle to find effective instructional methods to use with their students on a daily basis. The characteristic verbal, social, and behavioral limitations of children with ASD make finding effective teaching methods difficult. Though some intensive intervention methods, such as discrete trial teaching (DTT), have numerous studies demonstrating their effectiveness with students with ASD, the required one-on-one format makes it impractical to use in a classroom setting on a regular basis. Direct Instruction (DI) appears in the literature as a promising intervention for students with developmental disabilities. One benefit of DI is that, unlike DTT and similar interventions, it can be implemented in a group format. This group format provides a practical alternative for classroom teachers to use with their students with ASD. This study utilized a multiple probe across behaviors design to further investigate the use of DI to teach high school

students with ASD how to answer “wh-” questions. The researcher used the Science Research Associates (SRA) *Reading Mastery* language program, which is a DI program designed to develop language skills. Three participants between the ages of 15 and 17 participated in 20-25 minute instructional sessions four times a week for eight weeks. Data were collected on each participant’s accuracy in answering “wh-” questions during baseline, acquisition (teaching), and maintenance conditions. The results indicate that DI was effective in helping participants acquire the language skills necessary to accurately respond to “what,” “where,” and “who” questions. Implications for small group language instruction for students with ASD and recommendations for future research are discussed.

*Keywords:* Direct Instruction, autism spectrum disorders, language acquisition

## **Dedication**

This manuscript is dedicated to the educators and caretakers who serve children and adults with special needs. Thank you for your hard work and dedication.

**The Effectiveness of Direct Instruction in Teaching Students with  
Autism Spectrum Disorders to Answer “Wh-” Questions**

List of Tables .....	xi
List of Figures .....	xii
Introduction.....	1
Difficulties in Language Acquisition .....	2
Language Skills and Question Answering .....	3
Statement of the Problem .....	4
Purpose .....	6
Research Questions .....	6
Definitions .....	7
Literature Review.....	9
Language Development in ASD .....	9
Effective Practices for Teaching Individuals with ASD .....	11
Direct Instruction (DI).....	13
Methods.....	22
Participants .....	22
Setting .....	25
Target Skills .....	25
Materials.....	26



The WH Comprehension Test .....	26
<i>Reading Mastery Signature Edition</i> Language Placement Test .....	27
The Direct Instruction Language Curriculum .....	27
Behavioral Measures .....	28
Procedures .....	28
Instructor Training .....	28
Lesson Modifications .....	28
Lesson Presentation .....	30
Data Collection .....	32
Instructional Phases .....	34
Pre-baseline .....	34
Baseline .....	34
Acquisition .....	35
Maintenance .....	37
Experimental Design .....	37
Treatment Integrity .....	37
Observer Training .....	37
Treatment Integrity Assessments .....	38
Interobserver Agreement (IOA) .....	39
Results .....	41
Effects of DI on Accuracy in Answering “Who” Questions .....	41
Effects of DI on Accuracy in Answering “Where” Questions .....	42
Effects of DI on Accuracy in Answering “What” Questions .....	44

Maintenance After Removal of the DI Intervention .....	45
Error Analysis of “Where” Questions for Jacob .....	50
Discussion.....	51
Effectiveness of DI for Teaching Students to Answer “Who” Questions.....	52
Effectiveness of DI for Teaching Students to Answer “Where” Questions.....	52
Effectiveness of DI for Teaching Students to Answer “What” Questions.....	53
Effectiveness of DI for Maintenance in Answering “Wh-” Questions .....	53
Summary of Findings .....	54
Implications of Findings .....	55
Limitations .....	56
Further Research .....	57
Appendices.....	59
Appendix A Data Collection Forms.....	60
Appendix B Treatment Fidelity Data Collection Forms .....	67
Appendix C IRB Approval Letter .....	73
References.....	76

## **List of Tables**

Table 1. Participant Characteristics .....	25
Table 2. Description of Target Skills .....	26
Table 3. Interobserver Agreement .....	40
Table 4. Post-hoc Error Analysis for Jacob .....	50

## List of Figures

<i>Figure 1.</i> Effects of DI on Jacob's performance.....	47
<i>Figure 2.</i> Effects of DI on Carl's performance.....	48
<i>Figure 3.</i> Effects of DI on Kevin's performance.....	49

## **Introduction**

Language and communication skills are necessary for surviving and navigating various social environments. Language systems provide a means for communication among a group of individuals. Merriam-Webster (2013) provides the following definition for language: “the words, their pronunciation, and the methods of combining them, used and understood by a community.” Most individuals use some form of language to communicate on a daily basis, whether it be written, spoken, or gestural. Underdeveloped language skills may hinder an individual’s ability to meet basic needs. Austrian-British philosopher, Ludwig Wittgenstein once said, “The limits of my language mean the limits of my world (Wittgenstein, 1922, section 5.6).” Wittgenstein’s quote summarizes the profound effect underdeveloped language skills can have on an individual’s life. Individuals with poorly developed language skills will likely have a diminished ability to obtain basic needs, acquire new skills, and develop and maintain social relationships (Whitehouse, Watt, Line, & Bishop, 2009).

Typically separated into two types, expressive and receptive, both areas of language are necessary to fully understand and interact with others. Expressive language refers to the expression of one’s own thoughts and feelings, while receptive language requires interpreting the language of others. These skills begin developing in infancy and typically require very little explicit instruction for development. By the time most children reach toddlerhood (around two years of age), they can communicate using

telegraphic speech (two-three word utterances) and can understand more language than they can express (Otto, 2006).

### **Difficulties in Language Acquisition**

In early childhood, the typically developing child acquires many of the aforementioned language skills through observation and imitation without much explicit instruction. Repeated exposure to people, events, and objects in the presence of language further solidifies and refines a child's language skills (Otto, 2006). Though most children acquire these essential language skills naturally, some children experience difficulties in acquiring language. These difficulties may affect their receptive language, expressive language, or both. Some common reasons for difficulty in language acquisition in childhood are developmental delay, hearing loss and deafness, medical issues (e. g., chronic ear infections), cognitive impairments, psychosocial factors (e. g., early deprivation of language interactions), major physical disabilities, and specific language disorder (Otto, 2006).

Individuals diagnosed with autism spectrum disorders (ASD) have impairments in language, communication, and socialization skills. In addition to these deficits, children with ASD often engage in restrictive and repetitive behaviors and have a tendency to perseverate on narrow interests (Boutot & Myles, 2011). Language impairments affect virtually all individuals with ASD. Though numbers vary, studies indicate that 25-50% of children with ASD may never acquire functional language (Eigsti, de Marchena, Schuh, & Kelley, 2011; Prizant, 1996). Furthermore, a delay in language acquisition is strongly correlated with future prognosis of ASD (Eigsti et al., 2011; Mayo, Chlebowski, Fein, & Eigsti, 2013).

## **Language Skills and Question Answering**

Question comprehension is an area of language that requires both expressive and receptive language skills. Questions, or interrogatives, are sentences used to gather information. There are three main types of questions: (a) polar (“yes-no”) questions, (b) alternative questions (e.g., multiple choice), and (c) “wh-” questions. “Wh-” questions are questions that begin with the words “who,” “what,” “when,” “where,” “which,” or “why”. Children are typically exposed to various question types early in their childhood through caregiver interaction and are often asked questions related to their needs. This exposure includes questions such as “What do you want to eat?” and “Where is your cup?” Research indicates that typically developing children begin to comprehend some “wh-” questions, usually beginning around age two (Goodwin, Fein, & Naigles, 2012; Seidl, Hollich, & Jusczyk, 2003). Furthermore, research suggests that the ability to comprehend these questions usually precedes the ability to formulate them (Goodwin et al., 2012; Seidle et. al., 2003). This finding is in line with other research that suggests that receptive language develops earlier than expressive language (Otto, 2006).

While answering questions may seem straightforward, accurately answering “wh-” questions requires several cognitive processes. Many linguists and psychologists have studied the cognitive processes involved in answering questions. Most agree that there are several steps involved in responding to questions. According to Singer (1986; 2003), the first step in accurately answering a question is encoding its meaning and identifying what the questioner wishes to know (e.g., identifying an agent/person, identifying a location). The individual answering the question, the answerer, must make a clear distinction between the given (presupposed) information and the new, or

requested, information (Singer, 1986; 2003). Next the answerer may categorize the question type; answering a yes-no question requires a different thought process than that of answering a “wh-” question. Singer (2003) asserts that categorizing questions directly affects the processes involved in retrieving the needed information from one’s memory. Next, the answerer must select a strategy to retrieve the required information to answer the question; the answerer will do this by either referring to a specific representation of knowledge (text or picture) or by referring to his/her own personal knowledge (Singer, 2003). Finally, the answerer will compare the retrieved answer to the question and then provide a response (Singer, 1986; 2003). As demonstrated, accurately answering “wh-” questions requires several cognitive processes. A dysfunction in one or more of these processes could affect an individual’s ability to accurately answer any of these question types.

### **Statement of the Problem**

The acquisition of language and the ability to understand and respond to questions are essential skills individuals need to understand and interact with others. Individuals who lack these skills may encounter problems navigating their environments unless an intervention is put into place to help remedy these deficits. One way to assist the development of these skills is to design instruction for those who cannot develop these language skills in a natural way. Teachers of students with disabilities often target skills in a classroom setting that may not have been acquired previously. Though special education teachers receive specialized training in effective instructional strategies for students with disabilities, there is no instructional method that is effective for every student. Thus, educators need a diverse repertoire of effective instructional strategies.



Students who have severe delays and deficits in cognitive processes, such as students with ASD, often do not receive the full benefit of instruction through traditional methods (such as whole group instruction); these individuals may benefit from more intensive instruction (Taylor, Smiley, & Richards, 2009). Due to the unique deficits in imitation and attention skills associated with ASD, few instructional methods have proven effective in teaching these students language. As a result, students with ASD often require one-on-one, intensive instruction to fully develop language. Some research has indicated that intensive one-on-one instruction can be effective in teaching students with developmental disabilities such as ASD basic skills including language and communication skills (Downs, Robyn, Johansen, & Fossum, 2007; Lovaas, 1987; Smith, 2001; Smith, Groen, & Wynn, 2000). The amount of resources needed to implement one-on-one instruction effectively makes it difficult to use in a classroom setting and leaves little recourse for special education teachers who want effective and practical instructional methods to teach their students with ASD. Due to this pitfall, more research is needed on effective methods of instruction for students with ASD that can be used in a small group or whole group classroom setting.

One-on-one instruction is not always necessary to teach children with ASD language skills (Flores & Ganz, 2007; 2009b; Flores et al., 2013); studies demonstrate that the use of Direct Instruction (DI) in a small group setting can be effective in teaching language skills to children with ASD. While previous studies (Lovaas, 1987; Smith, 2001; Smith et al., 2000) have suggested that individual instruction is required for children with ASD to develop language skills, later studies (e. g., Flores & Ganz, 2007; 2009b; Flores et al., 2013) maintain that children with ASD may benefit from small

group DI. This contradiction in the literature suggests that more must be learned about using DI to teach children with ASD language skills in a small group setting.

### **Purpose**

The purpose of this study was to determine the effectiveness of DI, specifically the Science Research Associates (SRA) *Reading Mastery* language program, in teaching high schools students with ASD, in a small group setting, to answer “wh-” questions. The researcher employed a multiple probe across behaviors design in which the behavioral conditions were responding to “who” questions, “where” questions, and “what” questions. Data were collected on each student’s accuracy in answering these questions during baseline, acquisition (teaching), and maintenance conditions.

### **Research Questions**

1. Is the DI curriculum effective for teaching students with ASD in a small group setting to acquire the language skills to answer “who” questions?
2. Is the DI curriculum effective for teaching students with ASD in a small group setting to acquire the language skills to answer “where” questions?
3. Is the DI curriculum effective for teaching students with ASD in a small group setting to acquire the language skills to answer “what” questions?
4. Will the language skills acquired using the DI curriculum maintain after instruction has ended?

## **Definitions**

Autism spectrum disorders (ASD) – a group of developmental disabilities characterized by delays or deficits in language, communication, socialization, and behavior. Cognitive characteristics (such as memory and IQ) vary among children with ASD.

Direct Instruction (DI) – a curriculum and method of instruction developed by Siegfried Engelmann that includes: (a) scripted lesson plans, (b) use of choral responding, (c) use of hand signals, (d) small group instructional format, (e) fast-paced instruction, (f) systematic monitoring and corrective feedback, and (g) ongoing assessment and evaluation.

Discrete Trial Teaching (DTT) – a specialized method of instruction that requires one-on-one instruction with five distinct parts: (a) cue or instruction, (b) prompt for correct response, (c) response, (d) consequence (praise or corrective), and (e) intertrial interval.

Echolalia – immediate or delayed repetition of speech spoken by another individual.

Joint Attention – the ability of one individual to acknowledge and engage in an experience with another individual.

Language – a systematic means of communicating ideas or feelings by the use of conventionalized signs, sounds, gestures, or marks having understood meanings.

Special Education – educational strategies and settings designed to meet the unique learning needs of students with disabilities in accordance with the Individuals with Disabilities Education Improvement Act (IDEIA 2004).

Students with ASD – students who have been diagnosed with autism spectrum disorders, currently have an individualized education program (IEP), and are receiving special education services.

Students with disabilities – students with a diagnosed or recognized cognitive, learning, affective, or physical disability or delay according to the Individuals with Disabilities Education Improvement Act (IDEIA 2004).

Typically developing children – children who are developing as expected cognitively, academically, affectively, and physically; students who have no known disabilities or developmental delays.

“Wh-” questions – Questions that begin with the words “what,” “who,” “where,” “when,” and “why”. These questions are often used to gather more information about topics being presented or discussed. For the purposes of this study, the focus was on questions that begin with the words “what,” “who,” and “where.”

## **Literature Review**

This chapter will review the literature that exists surrounding the topics under study. The first area of literature reviewed is that of language acquisition and language development in individuals with ASD. The second part of this chapter discusses common instructional practices for teaching language skills to individuals with ASD. The chapter concludes with a review of the literature on DI and its use with children with disabilities, including students with ASD.

### **Language Development in ASD**

It is well known that typically developing children acquire language naturally through interacting with and observing others in their environment. In addition to observing the pairing of words with objects and/or actions, young children often vocally imitate words that they hear. Research indicates that nonverbal skills such as imitation, gesturing, and joint attention are associated with language development in typically developing children (Luyster, Kadlec, Carter, & Tager-Flusberg, 2008). Language is such an integral part of child development that the timing of a child's first words can often provide early insight into his/her cognitive abilities. A delay in language development is often the first indication of an intellectual impairment and is a strong predictor of learning difficulties later in life (Mayo et al., 2013; Thal & Bates, 1989). Mayo and colleagues (2013) found that children who acquired their first words earlier demonstrated higher levels of adaptive skills and higher cognitive

ability in later childhood than their language delayed counterparts. Furthermore, a longitudinal study of adults who displayed developmental delays as children found that there was a statistically significant relationship between the age of speech development and cognitive functions (Murray, Jones, Kuh, & Richards, 2007). Murray and colleagues (2007) also found that individuals who were delayed in their speech development were less likely to move beyond basic education (e.g., attend a post-secondary institution). In addition, the findings of their study suggest that the timing of speech development as children has a strong effect on adult reading comprehension.

Autism spectrum disorders are neurological disorders characterized by deficits in verbal and nonverbal communication and in joint attention (Boutot & Myles, 2011). Among other things, children diagnosed with ASD often have difficulty with social interactions and with language and communication. Studies suggest that deficits in joint attention and imitation skills, characteristic of children with ASD, play a large role in these children's inability to acquire language through traditional, naturally-occurring ways (Toth, Munson, Meltzoff, & Dawson, 2006). In fact, many children who are later found to have ASD are initially identified for evaluation due to concerns about a delay in language development and/or missed language milestones (Eigsti et al., 2011).

In addition to experiencing delays in language development, individuals with ASD often acquire language in an atypical manner. For example, unlike their typically developing counterparts, individuals with ASD often show a greater impairment in comprehension of language (receptive language) than they do in expressive language; this anomalous difference in language ability can be attributed to the tendency of

individuals with ASD to emit rote responses and to display delayed echolalia (Boucher, 2003).

Due to the aforementioned language deficits, individuals with ASD typically show abnormalities in their abilities to answer “wh-” questions. Though research examining this phenomenon is scarce, one study (Vicker, 2004) found that children, aged 4-12 years-old, with ASD demonstrated lower performance than typically developing three-year-olds in answering “who,” “what,” “where,” “when,” and “why” questions. Vicker also discovered that while children with ASD acquired the ability to answer these types of questions at a later age than typically developing children, the order of acquisition of the “wh-” question categories remained the same, with “who,” “what,” and “where” questions being acquired before “when” and “why” (2004). Another finding from Vicker includes a discrepancy in the pattern of errors exhibited by children with ASD when answering these questions as compared to typically developing children. Specifically, Vicker found that the errors observed in typically developing children were due to vague and ambiguous responses, while children with ASD often erred in their ability to provide the correct response class for each type of “wh-” question (e.g., answering a “what” question with a “who” response, such as naming a person). Though very little is known about why these anomalous differences exist, a more pressing concern is how to address skill deficits in children with ASD so they improve their question-answering capacity.

### **Effective Practices for Teaching Individuals with ASD**

Due to the many unsubstantiated, and often controversial interventions that have emerged to treat the deficits experienced by individuals with ASD (e.g., facilitated

communication), a base of literature has emerged that focuses on identifying evidence-based practices (EBPs) for individuals with ASD. Independent researchers and public agencies have researched and identified practices that have consistently demonstrated effectiveness with individuals with ASD by examining the methods and outcomes of various group and single-subject studies. The National Autism Center created the National Standards Project (2009), which aimed to identify EBP that are established as effective for students with ASD. Many of the interventions identified by the National Standards Project as being EBPs are behavioral interventions that do not directly address language deficits in individuals with ASD. In addition, many of the interventions are intended to be implemented in an one-on-one format. Research on methods of instruction that are effective and practical to implement with children with ASD to address language skill development is extremely limited.

One EBP that has demonstrated efficacy with students in ASD is highly structured one-on-one instruction based on the principles of applied behavior analysis (ABA). One such method is discrete trial training (DTT). In a seminal study by Lovaas (1987), this method of instruction was found to be a highly effective intervention for students with ASD when implemented for 25-40 hours a week for approximately two years. A follow-up study on the same group of children used in the original Lovaas study showed that the effects of DTT maintained over time (McEachin, Smith, & Lovaas, 1993). Further studies have shown that DTT has been effective in teaching imitation skills, receptive language, expressive language, conversation, sentences, and grammar (Downs et al., 2007; Smith, 2001; Smith et al., 2000). Though the effectiveness of DTT in teaching students with ASD certain skills cannot be refuted empirically, this method often requires



25-40 hours of one-on-one instruction per week to be effective; this is its greatest limitation. The resources needed to provide each student this type of intensive intervention makes this method impractical to use in a typical special education classroom. More research is needed investigating other methods of instruction that are effective for children with ASD that do not require one-on-one instruction, thus providing a practical alternative for special education teachers to use in their classrooms.

### **Direct Instruction (DI)**

Though group instruction is common practice for many teachers, few methods of group instruction have strong empirical evidence demonstrating their effectiveness with struggling students. Introduced in the late 1960s, DI pervades the literature as an effective method of group instruction, especially for low-performing students, with numerous studies demonstrating its effectiveness since its introduction. DI, which was developed by Engelmann and his colleague, refers to a set of instructional principles (as well as a curriculum) that focuses on systematic, explicit instruction. DI was originally intended to teach and reinforce basic skills to disadvantaged, “at-risk” students and has been successful in improving scores in reading, math, and language for this group (Engelmann & Becker, 1976). Elements of DI include (a) highly regimented scripted lessons, (b) ability grouping of students, (c) repetition of content, (d) use of wait time, (e) use of signals, (f) choral responding, (g) fast pacing, and (h) mastery of preceding content before moving on to more difficult content.

In an effort by the United States’ federal government to improve educational outcomes for disadvantaged students, DI was selected, along with eight other educational interventions, to be tested in the largest educational experiment to date, known as *Project*

*Follow Through* (PFT). PFT was implemented between 1968 and 1978 and included over 75,000 students in 180 communities across the United States. Students were assigned to an intervention and received related instruction from kindergarten to grade three. Over 10,000 students were assessed annually throughout the course of PFT and data were collected on each intervention's effectiveness in the areas of basic skills, affective behavior, and cognitive behavior. The results of this unprecedented study indicated that students receiving the DI intervention significantly outscored students in all other treatment groups in all three areas that were measured (Engelmann & Becker, 1976). To date, no other group method of instruction has demonstrated widespread success of this magnitude with low-performing students.

Since PFT's end, several other studies have been published further solidifying DI's efficacy with low-performing students. To date, studies on DI have reported its effectiveness in improving reading outcomes (Fredrick, Keel, & Neel, 2002; Ryder, Burton, & Silberg, 2006; Shippen, Houchins, Steventon, & Sartor, 2005), improving math performance (Flores & Kaylor, 2007; Skarr et al., 2014; Wilson & Sindelar, 1991), and improving the overall performance of low-performing students at a struggling school in both math and reading (Grossen, 2010).

Due to the success experienced by at-risk, low-performing students who received DI, researchers have explored DI's effectiveness for individuals with disabilities. Several studies have been conducted to investigate the effectiveness of DI in comparison to other instructional programs and/or to generic classroom instruction (control conditions) for students with disabilities. These studies typically include students in preschool through middle school who have a learning disability, developmental disability, intellectual

disability, and/or language impairment. In one of the earliest published studies on DI and students with disabilities, Maggs and Morath (1976) sought to compare the DI language program, *Distar Language*, with another intervention, *Peabody Language Kit*, and found that the DI program was significantly more effective for participants between the ages of 6 and 14 years old and had moderate intellectual disability (IQ scores ranging from 20 – 45). Maggs and Morath's study spanned a two-year period, during which the DI group experienced a 22 ½ month growth in mental age; this growth was quite impressive when compared to the participants in the other treatment group, which experienced a 7 ½ month growth in mental age during that same time. O'Connor, Jenkins, Cole, and Mills (1993) also conducted a comparison study in which the effectiveness of the DI curriculum, *Corrective Reading*, was compared with another reading curriculum, *Superkids*, in a sample of students with various disabilities (e.g., language impairments, learning disabilities, Down syndrome, and other types of disabilities). O'Connor et al. (1993) found that though both curricula were effective in improving reading performance in the participants, students in the DI reading group who were more advanced showed larger gains in reading. In another comparison study, Waldron-Soler and colleagues (2002) compared the effects of DI language curriculum, *Language for Learning*, on the language skills of preschoolers with developmental disabilities to that of a control group. They found that the treatment group demonstrated more growth in receptive and expressive language than the control group. In addition, the treatment group in this study demonstrated a greater decrease in the occurrence of behavior problems than the control group (Waldron-Soler et al., 2002).

The aforementioned studies were all group studies that compared the effectiveness of DI with that of other methods. One other study that deserves mention is a single-subject study conducted by Hicks and colleagues (2011) which examined the effectiveness of DI to teach language skills to students with disabilities. Hicks et al., (2011) utilized a DI language program, *Language for Learning*, to teach prepositions to two middle-school students with intellectual disabilities and found that the program was effective in raising the number of cumulative correct responses across prepositions in daily probes.

Other variations of DI methodology have also documented success for students with disabilities. For example, DI flashcard programs have been used successfully with a variety of populations. Mangundayao and colleagues (2013) used DI flashcards to teach numerals, shapes, and colors to three preschool students with developmental delay. All three participants were able to identify colors and shapes during intervention at levels higher than their baseline; one participant was able to receive the intervention for numerals and consequently improved in that area as well (Mangundayao, McLaughlin, Williams, & Toone, 2013). Ruwe and colleagues (2011) investigated the effectiveness of a DI flashcard system in increasing sight word recognition in three middle school boys with intellectual disabilities. The DI flashcard system was found to be effective in improving the participants' ability to read the sight words correctly in isolation and also decreased their likelihood of inaccurately reading the selected sight words in text (Ruwe, McLaughlin, Derby, & Johnson, 2011).

In yet another study investigating the use of DI flashcards, Crowley and colleagues (2012) utilized DI flashcards in conjunction with a reading racetrack (a word

list arranged in the shape of a racetrack) to teach sight word acquisition to two elementary students with autism. The authors of this study found that DI flashcards with a reading racetrack and an AAC device as needed were effective in teaching sight words students with autism (Crowley, McLaughlin, & Kahn, 2012). Both the Ruwe et al. (2011) study and the Crowley et al. (2012) study required very little instructional time to effectively implement their interventions (approximately five minutes), yet the students made significant gains with very little overall instructional time. Though both of these aforementioned studies provide empirical support for the effectiveness of DI, the researchers implemented these programs in a one-on-one format and therefore did not provide insight into the effectiveness of DI programs in a group setting.

While substantial literature exists on the use of DI with students with various disabilities, very little empirical literature exists that addresses specifically the effectiveness of DI with individuals with ASD. Shillingsburg, Bowen, Peterman, and Gayman (2014) investigated the effectiveness of the *DI Language for Learning* program for teaching language skills to 18 students with ASD between the ages of 4 and 12. They found that the *Language for Learning* program was effective in immediately increasing the language skills of the participants following the implementation of the intervention and the participants were able to maintain language scores that were higher than pre-intervention scores 6-8 months after the intervention was removed. Though this study provided strong evidence for the effectiveness of DI with students with ASD, they also implemented the curriculum in a one-on-one format, which resembles the more intensive, less practical interventions such as DTT (though according to the authors, the intervention required approximately five minutes of instructional time per student).

There is budding research on the use of DI with students with ASD in a group format. Thus far, the literature on the effectiveness of DI for teaching students with ASD is promising, yet very limited. To date, only five studies examined directly the use of DI for teaching students with ASD academic skills in a group format (Flores & Ganz, 2007; 2009a; 2009b; 2014; Flores et al., 2013). Of those studies, only three focus on teaching language skills to students with ASD (Flores & Ganz, 2009b; 2014; Flores et al., 2013). In the earliest published study investigating the effectiveness of DI with students with ASD in a group setting, Flores and Ganz (2007) used the DI curriculum, *Corrective Reading Thinking Basics*, with four elementary school students with disabilities (two of whom had autism) to teach reading comprehension. Flores and Ganz used a multiple probe across behaviors design (targeting statement inference, use of facts, and analogies) and found DI to be an effective intervention for improving the reading comprehension of the participants. In a later study, Flores and Ganz (2009a) were able to replicate these findings using the same curriculum to teach reading comprehension skills to four fifth and sixth graders with ASD. The researchers used a multiple probe across behaviors design to investigate the curriculum's effect on each student's performance in picture analogies, deductions (drawing a specific conclusion based on general examples), and inductions (making generalizations based on observation). The outcome of the study demonstrated a functional relationship between the intervention and improved reading comprehension behaviors in all four participants.

The preceding section discussed the effectiveness of DI in teaching students with ASD reading comprehensions skills. Though the information presented is valuable, it does not directly provide insight into the effectiveness of DI in teaching students with

ASD language skills. The next three studies in this review pertain specifically to the use of DI to teach students with ASD language. In the first study of its kind, Flores and Ganz (2009b) used a changing criterion design to test the effects of the DI language curriculum, *Language for Learning*, in teaching three elementary-age students with autism language (specifically, identifying materials). The researchers utilized the SRA *Language for Learning* curriculum to teach three elementary school students to vocally identify various materials such as wood, glass, plastic, paper, and cloth. A changing-criterion design was used by the authors. The results indicated that the intervention was highly effective as the percent of non-overlapping data was reported to be at least 90% for all participants in this study.

In a group study, Flores and colleagues (2013) utilized both a DI reading (*Corrective Reading*) curriculum and language curriculum (*Language for Learning*) without modification to teach multiple reading and language skills to elementary and middle school students with ASD and developmental disabilities. This study was unique from previous studies on the same topic in that the authors implemented the curriculum exactly as prescribed, whereas in previous studies the authors made modifications to the curriculum which excluded portions of the curriculum. The results of this study indicated that the DI interventions had a statistically significant positive effect on the students' learning (Flores et al., 2013).

Finally, in an unprecedented study, Flores and Ganz (2014) compared DI with the commonly used intensive intervention, DTT, to determine each intervention's effects on the language performance of students with ASD. Thirteen participants were included in this study that ranged in age from 4 through 10 years old. The DI group in this study

received group instruction as prescribed in the *Language for Learning* curriculum, while the DTT group received one-on-one instruction covering similar content as the DI group. Students were assessed using the mastery test that accompanied the *Language for Learning* curriculum. An independent t-test statistical procedure was used to determine the comparative effectiveness of each intervention. The results of the t-test demonstrated that the DI program was more effective than DTT with a moderate effect size (Cohen's *d*) of 0.62. It is important to note that there were no significant differences between the groups as determined by an independent t-test of students' initial skill levels (Flores & Ganz, 2014).

Though there is a paucity of research investigating the effectiveness of DI in teaching students with ASD language, the research that does exist suggests that DI may be a promising language intervention for students with ASD. The authors of the studies discussed in this literature review used sound methodology lending much-needed credibility and validity to this scarce research base. As promising as the literature appears thus far, there are still many gaps in the literature that need to be filled. One glaring gap in this literature base is the lack of independent researchers replicating the findings of these DI studies. All of the studies cited that have investigated the use of DI in a small group setting were conducted by the same research team. The lack of independent researchers investigating the efficacy of DI with students with ASD creates a barrier to DI meeting the high standards necessary to be considered as an EBP. According to Horner and Kratochwill (2012), in order for a method to be considered an EBP, it must have documented experimental control and have demonstrated efficacy by at least three different research groups. The requirement that independent researchers design and



conduct studies is a quality standard set forth by other researchers as well (Odom, Collet-Klingenberg, Rogers, & Hatton, 2010).

The scarcity of research on this topic calls for more studies to fill these gaps. This dissertation answers that call. This study is unique in that it sought to determine if DI would be effective in teaching language skills to older individuals with ASD (high school students ages 15-17), a group that has not been targeted in DI research thus far (the participants in this literature review ranged in age from 4 to 14 years old). There is little to no literature to date that targets DI with individuals with ASD in this age group. This study also addresses the need for independent researchers to replicate studies that investigate the use of DI with students with ASD. This study adds to the existing literature base on DI and extends the knowledge of how this intervention may affect other groups for which there is currently limited research.

## Methods

Chapter 3 describes the methods and procedures used in this study. It includes the following sections: participants, setting, target skills, materials, behavioral measures, procedures, experimental design, treatment integrity, and interobserver agreement.

### Participants

Participants were selected from a public charter high school exclusively for students with ASD. The school's principal, speech pathologist, and classroom teachers identified students for screening who had demonstrated deficits in answering "wh-" questions. The principal compiled a list of prospective participants by requesting names of students who might qualify for the study from the speech pathologist and the classroom teachers. All students who were identified were screened. Prospective participants were administered both *The WH Comprehension Test* (Vicker, 2004) and the *SRA Reading Mastery Signature Edition* placement test (Engelmann & Osborn, 2008). The first criterion for inclusion in this study was a score of less than 50% on *The WH Comprehension Test* on all three question types assessed. Second, participants were required to pass the first portion of the *SRA Reading Mastery Signature Edition* placement test to be included in the study. After screening was complete, four students met criteria for inclusion and were given parental consent forms (since all participants were under the age of 18). All four students returned their consent forms and verbally assented to participate in the study. Due to behavioral difficulties, one student was

excluded from the study before intervention began. The remaining three participants met the following criteria: (a) were receiving special education services for ASD as documented by their IEP, (b) had an existing verbal repertoire as demonstrated by passing the first part of the *Reading Mastery Signature Edition* placement test, (c) showed a deficiency in answering “wh-” questions as demonstrated by a score of 50% or less on the pre-baseline assessment, *The WH Question Comprehension Test* (Vicker, 2004), (d) returned signed consent forms granting them permission from their parents to participate in the study, and (e) verbally assented to participate in the study. Additional information about each student is provided below. Pseudonyms are used to protect the identity of the participants.

Jacob was a 10<sup>th</sup> grade student who, in addition to having a diagnosis of ASD, also received services for language impairment and speech impairment. He also received occupational therapy. At the beginning of the study, Jacob was able to answer yes/no questions and pose verbal requests to his teachers (e.g., asking to use the restroom). Jacob scored very low (0% on each question type assessed) on the *The WH Question Comprehension Test* with most of his responses being “yes” or simply echoing the question. According to his teacher, Jacob received a daily dose of an unknown sedative. This unknown medication may have affected Jacob’s participation on some days during the study. Most instructional days, the medication appeared to have had minimal effect (e.g., Jacob humming to himself) and is not believed to have affected Jacob’s performance during instruction in any meaningful way. But, on three days during the intervention phase of the study, Jacob appeared lethargic and inattentive (e.g., closing his eyes, falling asleep) which affected his performance during choral responding requiring

extra prompting from the researcher to participate in the choral responding. It should be noted that his state did not affect his participation in individual responding.

Carl was an 11<sup>th</sup> grade student with ASD and language impairment. Regarding communication, Carl was able to gain the attention of peers and adults by saying, “Excuse me,” but had difficulty initiating conversation thereafter. Carl was also able to answer yes/no questions, greet his peers, and engage in social niceties (e.g., saying “thank you”). In addition to his communication deficits, Carl often engaged in repetitive behaviors that involved clearing his throat, knocking on hard surfaces with his knuckles, and occasionally tapping his head on various surfaces (e.g., tables, walls). While these behaviors varied in severity and frequency, they had little impact on his participation in learning activities. For example, he participated fully during choral responding and answered all individual questions that were asked of him without extra prompting.

Kevin was a 10<sup>th</sup> grader with a diagnosis of ASD and language impairment. He was able to request wants and needs independently but required cues from adults to engage in social interactions and identify the thoughts and feelings of others. Kevin often echoed instructions from adults and required prompting to produce correct verbal responses. Additional information regarding the participants was obtained through school records and appears in Table 1.

Table 1

*Participant Characteristics*

Participant	Age and gender	Race/Ethnicity	Reading level	Verbal Score on <i>WH Comprehension Test</i>
Jacob	15 Male	Caucasian/White	3 <sup>rd</sup> grade	What = 0% Who = 0% Where = 0%
Carl	17 Male	African American/Black	2 <sup>nd</sup> grade	What = 30% Who = 20% Where = 20%
Kevin	16 Male	Asian	3 <sup>rd</sup> grade	What = 40% Who = 20% Where = 20%

**Setting**

The instructional sessions for this study took place in an unoccupied room on the campus of the charter high school where the participants attended. The room used in this study was utilized as a dining area, as well as an area to teach functional skills to students (e.g., making meals, doing laundry, washing dishes) and contained tables with benches, countertops, cabinets, microwaves, a washer, a dryer, and a sink. During the instructional sessions the room was occupied by the participants and the researcher, and on occasion, a research assistant.

**Target Skills**

The researcher sought to determine the effectiveness of the DI curriculum in teaching students with ASD language skills, and specifically, skills to answer “wh-” questions. The target “wh-” question types for this study were: “who,” “where,” and “what.” These targets were chosen because research has indicated that comprehension of “who,” “what,” and “where” questions emerge early in the question acquisition process

and thus, may be easier to acquire than other question types (Lee & Ashmore, 1983; Wootten, Merkin, Hood, & Bloom, 1979). Table 2 describes the typical manner in which the targeted “wh-” questions were presented in the curriculum and provides examples of the response criteria for each type.

Table 2

*Description of Target Skills*

Question Type	Examples	Response Criteria
“What”	“What is the girl eating?”	Naming an object – “ <i>An apple.</i> ”
	“What is the man doing?”	Naming an action – “ <i>Swimming.</i> ”
“Who”	“Who is eating an apple?”	Identifying a person using a descriptor – “ <i>The woman.</i> ”
		Identifying an animal – “ <i>The Cow.</i> ”
“Where”	“Where is the box?”	Describing relative location of the object using prepositions – “ <i>On the table.</i> ”

**Materials**

**The WH Comprehension Test.** The researcher utilized *The WH Question Comprehension Test* (Vicker, 2004) to aid in selecting participants for this study. This test includes items that pose open-ended questions that begin with “what,” “who,” “where,” “when,” “why,” and “how” based on everyday life experiences. There are 10 open-ended questions for each type, which can evoke several correct responses (e.g., “What makes music?”). For the purposes of this study, the researcher utilized the portion of the test that focuses on “who,” “where,” and “what” questions. Though the manual provides a detailed method of scoring with optional components, the researcher

used the simplest scoring method which entails placing a plus symbol (+) for reasonable responses and a minus symbol (-) for unreasonable, incorrect, or echolalic responses.

**Reading Mastery Signature Edition language placement test.** Prospective participants who scored within criterion on *The WH Comprehension Test* were administered the Science Research Associates (SRA) DI curriculum *Reading Mastery Signature Edition* language placement test (Engelmann & Osborn, 2008). The placement test allowed the researcher to ensure that prospective participants had the verbal repertoire and prerequisite skills necessary to actively and successfully engage in the DI lessons.

**The Direct Instruction language curriculum.** The curriculum used in this study was the *Reading Mastery Signature Education* language curriculum. According to the authors, Engelmann and Osborn (2008), this language curriculum was designed for kindergarten students and was meant to teach children “the words, concepts, and statements important to both oral and written language. The program emphasizes language as a means of describing the world and as a tool for thinking and solving problems” (p. 1). This program includes scripted lessons, presentation books with pictures to accompany lessons, and other supplemental materials (student workbooks, teacher’s guide, etc.). Each lesson consists of eight exercises that are intended to teach concepts that are organized into six groups: (a) basic actions, (b) description of objects, (c) information and background knowledge, (d) instructional words and problem-solving concepts, (e) classification, and (f) problem-solving strategies and applications. The target skills for this study are presented in the *instructional words and problem-solving concepts* section of the curriculum but appear in other lessons as well.

## **Behavioral Measures**

The dependent variable for this study was the number of correct responses on the *Reading Mastery* language skill assessment probes. Participants were presented with a verbal prompt, an accompanying picture, and a question. Data were collected on each participant's ability to respond accurately to each type of question. Data collection forms appear in Appendix A.

The independent variable in this study was the DI method and the *Reading Mastery* language curriculum. The three participants received instruction on how to answer each type of question using the scripted lesson plans and materials provided with the curriculum.

## **Procedures**

**Instructor training.** The researcher in this study was also the instructor responsible for program implementation for the participants. At the time of the study, the instructor had 10 years of experience as an elementary school classroom teacher. Prior to the implementation of this study, the instructor underwent several hours of training on the DI method through videos available on the National Institute for Direct Instruction (NIFDI) website ([www.nifdi.org](http://www.nifdi.org)) and also visited and observed teachers implementing DI programs in classroom settings.

**Lesson modifications.** To meet the unique learning needs of the participants, the researcher made four modifications to delivery of the *Reading Mastery Signature Edition* program, none of which affected the lesson sequence of each target or the scripted delivery of instruction (which are major components of DI). The first modification was to reduce the number of “wh-” question types presented during instruction. The *Reading*



*Mastery Signature Edition* curriculum provides lessons for teaching children how to answer “who,” “what,” “where,” and “when” questions. However, the research on the acquisition of “wh-” question suggests that “who,” “what,” and “where” require less conceptual knowledge and thus are easier to learn than “how,” “why,” and “when” (Bloom, Merkin, & Wootten, 1982). Therefore, this study focused on teaching “who,” “what,” and “where” questions.

The second modification was teaching each question type in isolation. Isolating the question types required teaching one type of question (e.g., “who”) to mastery before introducing the next question type (e.g., “where”). The *Reading Mastery Signature Edition* curriculum presents and teaches all question types simultaneously. Though this format may be beneficial for typically developing children, it may hinder the learning process for the study participants since students with ASD often have difficulty discriminating between similar concepts (Boutot & Myles, 2011). By teaching these skills in isolation, it is less likely that the participants in this study would focus on unimportant information (e.g., the other question types) as is common for students with ASD.

The third modification made to the program was teaching the question types in a different order than they appeared in the curriculum. To ensure that any change in performance by the students would have a functional relation to the intervention, the researcher began instruction with the question type in which the students first demonstrated stability of performance during baseline (i.e., data path showing no evidence of upward or downward trend). In this study, participants demonstrated stability in answering “who” questions first, therefore that question type was taught

before the others. Though “what” questions appeared earlier in the curriculum, student performance with this question type was unstable (one participant showing a slight increase in performance during baseline), therefore, beginning with the question types in sequence as they appeared in the curriculum risked confounding the study.

The fourth modification made during this study was presenting the lessons using the pictures from the presentation book without allowing the participants to view the teacher script portion. Prior to each lesson, the researcher created a color photocopy of the picture(s) that were to be used in the upcoming lesson. During the lesson, the students viewed the picture in isolation without the accompanying script. This modification was made to ensure that the participants (all of whom could read at a second grade level or higher) could not read the teacher script and would not be distracted by the text.

A final modification to this curriculum was excluding the use of the student workbooks that accompanied the curriculum. The workbook activities were not utilized throughout the study because they were not age-appropriate for high school students (e.g., requiring coloring), did not contain many activities directly related to the skills under study, and did not focus on improving the vocal responses of the participants.

**Lesson presentation.** Each exercise was taught using a presentation book that accompanied the curriculum. The presentation book contains pictures pertaining to the target skills (which occupies approximately 2/3 of each page), a teacher script, and expected student responses (which occupies approximately 1/3 of each page).

In preparation for instruction, the instructor was seated directly across from the three participants with a table between the instructor and the participants. The instructor

was seated approximately one meter away from the participants and faced them during instruction. During a typical exercise presentation, the instructor held the presentation book within sight of all students and (a) provided a verbal prompt, (b) made a reference to the picture, (c) asked a question relating to the target skill, and (d) gave a hand signal to prompt for student response. The students were taught to respond to the questions in a choral fashion. The instructor provided immediate feedback after each response. If responses were firm (i.e., students responded simultaneously and correctly), the instructor began the exercise again and called on individual students for responses. Correct responses received verbal praise and other forms of reinforcement (e.g., edibles). If students responded incorrectly, the instructor implemented the correction procedure as prescribed in the curriculum. The instructor followed this sequence several times for the exercise until all students responded simultaneously and correctly. The correction procedure consisted of four parts:

1. *The model:* The instructor said, “My turn, listen...” and modeled the correct statement.
2. *The lead:* The instructor said, “Let’s say it together...” The instructor and students said the correct statement together. The instructor continued to lead until the student produced the statement firmly and correctly.
3. *The test:* The instructor said, “Your turn.” If the child responded correctly, the instructor moved on to the next step, *retest*. If the student responded incorrectly, the instructor repeated the *model* and *lead* steps until the student responded correctly.

4. *The Retest:* The instructor repeated the entire exercise sequence from the beginning.

**Data collection.** The researcher created and administered daily assessment probes modeled after the SRA DI *Reading Mastery Signature Edition* lessons. The researcher used a data collection sheet to record each participant's verbatim responses to each "wh-" question. Assessment questions were administered to all participants, individually, at the end of each session. During each assessment, the researcher presented the participant with a picture from an unseen lesson in isolation (accompanying script and other text were excluded). The researcher created assessment questions by selecting and copying pictures and accompanying questions directly from the *Reading Mastery* curriculum. In addition, the researcher created additional "who," "where," and "what" questions based on the pictures provided in the curriculum, which were modeled after pre-existing questions of these types. Questions that were used during probes were not used again to subsequent probes unless it was a question answered incorrectly by all participants. Each assessment lasted approximately 3 to 15 minutes; the length of each assessment was dependent on whether it was an assessment of a single target (which consisted of four questions) or a probe of all question types (which consisted of 12 questions, four of each type of "wh-" question under study).

Each participant was assessed individually out of audible range of the other participants. At the end of each instructional session, one participant was assessed while the other two were seated in the back of the room where the study was conducted, or outside of the room in a covered patio area until it was their turn to answer assessment

questions. The order in which students were assessed was informally randomized and therefore varied throughout the study. The assessment procedure consisted of four steps:

1. The researcher presented a printed picture, in color, to the participant by placing it on the table in front of him.
2. The researcher pointed to part of the picture, or sometimes, the entire picture, and posed a “wh-” question that could be answered based on the picture.
3. The participant responded orally to the assessment questions.
4. The researcher recorded the verbatim responses given by the participants on the corresponding data sheet (see Appendix A) without providing indication as to whether the response was correct.

Based on the expected student responses provided in the curriculum (which allows for reasonable answers to be accepted), the researcher marked each question as correct (1), incorrect (0), or nonresponse or “I don’t know” (0). The researcher recorded the number of questions each participant answered correctly and recorded this value on a data collection sheet.

If participants provided unclear responses, the researcher provided clarifying questions or statements to better understand each participant’s response. For example, for incomprehensible responses (inaudible or mumbled responses), the researcher would first repeat the question. If the given oral response was still unclear, the researcher asked, “Can you say that again?” or repeated part of the participant’s response in an effort to evoke a clearer response. After attempting to evoke a response, the researcher would mark a “0” for a nonresponse or a “1” for a correct response.

**Instructional phases.** This study was carried out in four phases: *pre-baseline*, *baseline*, *acquisition*, and *maintenance*.

***Pre-baseline.*** The *pre-baseline phase* entailed participant assessment and selection. An initial assessment, *The WH Question Comprehension Test* (Vicker, 2004) was administered to prospective participants to determine their preexisting ability to answer the target question types. If a participant met the selection criteria for the study (answering less than 50% of each question type correctly), the researcher administered the *Reading Mastery Signature Edition* Placement Test as prescribed in the teacher's edition. The placement test was administered to participants individually. The exercises in this test required participants to point to common body parts, name common items and actions, describe the location of objects using prepositions, and describe the relative size of objects. The purpose of the *Reading Mastery Signature Edition* placement test was to ensure that the participants had mastered the necessary prerequisite skills needed to proceed with instruction. Students who met selection criteria were included in the study.

***Baseline.*** During baseline, data were collected on all three participants' preexisting ability to answer the target "wh-" questions using the assessments described in the *Assessment* section. Data were collected until data points remained stable or showed a decreasing trend across three sessions before the intervention for the first skill was implemented. In addition to collecting baseline data, each session in this condition consisted of rapport building and instruction on the DI response criteria. The instructor introduced and practiced the hand signals used to indicate when the participants should respond during lessons. The instructor also taught a transition lesson to the participants which was designed to help learners who did not begin the program at Lesson 1 ease into

the DI program. The authors of the DI curriculum recommend that all children who do not begin on Lesson 1 go through the transition lesson.

*Acquisition.* During *acquisition*, the researcher implemented the curriculum for approximately 25 minutes, 4 times a week for 8 weeks. Each target was taught until every participant demonstrated mastery by answering 100% of assessment questions correctly across three consecutive sessions. The target skills were taught in the following order: “who,” “where,” and “what”.

*First target – “who.”* Due to the participants’ performance in baseline, the first skill that was introduced was responding to “who” questions. During this phase of instruction, the researcher followed the sequence of exercises as prescribed in the curriculum beginning with the first exercise that taught “who” questions. Instruction focused solely on presenting the parts of the lessons that teach how to respond to “who” questions, and any information pertaining to other question types in the lesson were not presented. During this instructional period, an assessment probe consisting of four “who” questions was administered to each participant at the end of each session to assess their knowledge in answering “who” questions. Once all three participants scored 100% on three consecutive probes, the instructor administered probes on the remaining two skills (answering “where” and “what” questions) during the subsequent two sessions before beginning instruction on the next skill.

*Second target – “where.”* Instruction for the second target closely resembled that of the first target. The instructor provided daily instruction on answering “where” questions while also maintaining the previously learned skill by including at least one “who” question throughout the instructional sequence. The instructor ended each

instructional session with an assessment of accuracy to responding to “where” questions only. Though mastery criteria initially required that all three participants score 100% across three consecutive sessions to move to the next target, the instructor made instructional decisions based on actual performance.

While two of the participants (Carl and Kevin) met mastery criteria, Jacob did not reach mastery on “where” questions. The instructor continued to provide instruction on “where” questions while introducing the final target, “what,” to all participants. Data collection for Jacob on “where” questions continued to measure any improvement in performance. After variability in Jacob’s performance on “where” questions occurred for several sessions after the other participants had mastered answering “where” questions, the instructor discontinued instruction for two sessions to determine whether a “break” from instruction would affect Jacob’s performance. After these sessions, instruction was reintroduced to determine further effects. The results of these actions appear in the Chapter 4. After two of three participants met the mastery criteria for “where” questions, the researcher administered a probe assessment for the third skill (answering “what” questions) and the mastered skill (answering “who” questions) during the subsequent two sessions.

*Third target – “what.”* Instruction for the third target entailed daily instruction on “what” questions, with instruction on “who” and “where” questions once per session. Each session ended with an assessment of “what” questions for all participants, and an assessment of “where” questions for Jacob. Once mastery was established for all participants for “what” questions, the instructor ended all instruction and gave two assessments that probed all three targets over the subsequent two sessions.



**Maintenance.** In the *maintenance phase*, the researcher reassessed target skills after instruction was discontinued. Follow-up data were collected at two weeks and four weeks post instruction. Data from maintenance sessions were recorded and graphed with other instructional session data.

### **Experimental Design**

A single-subject, multiple-probe across behaviors design was used to demonstrate the effects of DI on each of the selected target question types. This design was chosen in lieu of a continuous multiple baseline design because, in this case, the researcher could assume that the baselines would remain stable over time. This assumption can be made because the academic behaviors being assessed typically only improve with training (Horner & Baer, 1978). This design is beneficial when collecting continuous data is impractical (for example, providing full-length assessments on all targets skills to the participants after each instructional session is time-consuming). In addition, frequent exposure to these questions types may inadvertently affect participant performance in answering each question type. Furthermore, the design lessens the risk of baseline data collection affecting student performance once intervention had begun due to the deleterious effects known to occur when students practice academic errors.

### **Treatment Integrity**

With few modifications, the researcher delivered instruction exactly as prescribed in the *Reading Mastery Signature Edition* curriculum. A task analysis checklist, which includes each step of the DI lesson, was developed for each observed lesson.

**Observer training.** Two research assistants assisted throughout the study to facilitate the assessment of treatment fidelity. To this end, the researcher trained the

research assistants to use a task analysis checklist to score the teacher behaviors in the DI instructional videos. The videos were taken from the NIFDI website and also from a social media video website. The videos depicted various instructors implementing DI curricula with their students. Before training, the researcher acquired the needed curriculum materials and selected two brief videos (one from each website) from which a task analysis checklist was created based on the lesson components found in the accompanying curriculum. The task analysis checklist was developed by creating a document on which the lesson steps were listed (e.g., teaching script and signals), as well as the steps in the correction procedure. Two columns, labeled “yes” and “no,” were drawn beside the listed steps, which allowed the research assistants to note when the teacher performed the step correctly (by placing a check mark in the “yes” column) and when the teacher skipped a step or performed the step incorrectly (by placing a check mark in the “no” column). During training, the researcher reviewed the task analysis checklist with the research assistants and then reviewed two video lessons during which individual components of instruction (e.g., signals, verbal prompts) were identified. After two training videos, the researcher and research assistants watched and independently scored, on the task analysis checklist, two additional video clips of instructors implementing DI with students. The researcher and observer compared scores to ensure treatment integrity during training. A mean of 90% agreement across two video clips was required to successfully complete training. Both researchers met criteria in scoring the videos.

**Treatment integrity assessments.** The researcher was observed implementing lessons during 20% of the sessions and data were collected on the percentage of steps

performed accurately using this task analysis checklist developed by the researcher. Overall, five out of the 25 instructional lessons were observed. The data demonstrated that the researcher implemented the observed lessons with an average 98% accuracy with a range of 95-100%. The data collection forms for treatment integrity can be found in Appendix B.

### **Interobserver Agreement (IOA)**

Data for IOA were collected for 44% of sessions. For data collection purposes, a research assistant observed 14 out of 32 data collection sessions during which she sat within listening distance of the students and the researcher during assessments, while remaining unobtrusive. During the assessment, the researcher verbally asked each participant questions relating to the lessons as described in the *Data Collection* section of this paper. Both the researcher and observer recorded the verbatim responses to each question. The researcher and observer scored each participant's responses as either correct (1), incorrect (0), or nonresponse or "I don't know" (0).

After assessment ended for all participants, the researcher calculated IOA based on the data collected during the assessments. IOA was calculated as the total number of agreements divided by the total number of disagreements and agreements, multiplied by 100. IOA exceeded 90% for all question types. The data for IOA for all questions, and by question type are presented in Table 3.

Table 3

*Interobserver Agreement*

Question Type	Agreement	Range
“Who”	98%	91.7% to 100%
“Where”	98.8%	91.7% to 100%
“What”	100%	--
Overall	98.8%	91.7% to 100%

## **Results**

The results of the DI intervention are presented individually for each participant in Figures 1, 2, and 3. These figures show both the training effects, as well as any maintenance effects observed after training was removed.

### **Effects of DI on Accuracy in Answering “Who” Questions**

The effects of the DI intervention on Jacob’s accuracy in answering “who” questions are found in the top graph of Figure 1. Over the course of the three baseline sessions, Jacob answered one question correctly in the first session before dropping to zero correct in the two sessions that followed. Once the intervention was implemented, Jacob continued a zero trend for the first three days. After four days of instruction (day 8), Jacob began to show a strong, steady increase in his accuracy in answering “who” questions. After 10 days of instruction, Jacob met mastery criteria for “who” questions by answering 100% of questions correctly for three consecutive sessions. During two subsequent instructional probes (days 23 and 30), Jacob continued to answer 4 out of 4 “who” questions correctly.

The effects of the DI intervention on Carl’s accuracy in answering “who” questions are found in the top graph of Figure 2. Like Jacob, Carl’s three baseline sessions began with one question answered correctly on the first day, followed by two days with zero correct responses. When the DI intervention was implemented, Carl did not answer any questions correctly on the first day but answered one question correctly

on each of the four subsequent instructional days. On the sixth day of instruction, Carl began to show a rapid and steady increase in accuracy. Carl reached mastery criteria after 11 days of instruction. During two subsequent instructional probes (days 23 and 30) Carl continued to answer 4 out of 4 “who” questions correctly.

The effects of the DI intervention on Kevin’s accuracy in answering “who” questions are found in the top graph of Figure 3. During the initial three baseline sessions, Kevin answered just two questions correctly before demonstrating a steady decline in accuracy. Kevin answered one question correctly on the second baseline day, and zero questions correctly on the third baseline day. Once the intervention began, Kevin continued a zero trend for the first day of instruction, quickly spiked to two questions correct on day 2 of instruction, only to decline once more in his accuracy on the third and fourth days of instruction during which he answered zero questions correctly. Beginning with day 8, Kevin began to show a steep and steady increase in the accuracy of answering “who” questions. After 8 days of instruction, Kevin met mastery criteria for answering “who” questions and continued this trend for three additional instructional days. During two subsequent instructional probes (days 23 and 30) Kevin continued to answer 4 out of 4 “who” questions correctly.

### **Effects of DI on Accuracy in Answering “Where” Questions**

The effects of the DI intervention on Jacob’s accuracy in answering “where” questions are found in the middle graph of Figure 1. During baseline probes of “where,” Jacob had zero accuracy in answering “where” questions correctly. Consistent with the multiple probe design, baseline probe data for “where” were collected during the initial three days of the study (before the introduction of any intervention) with a follow-up

probe administered immediately prior to beginning instruction of “where” questions (day 14). The first nine days of instruction were characterized by inconsistent performance by Jacob with scores ranging from zero to three questions answered correctly. There was no visible trend. Due to this inconsistency, instruction was removed for two days to observe removal effects. Jacob answered two questions correctly on the first day without instruction (day 24) but then dropped to zero on the second day (day 25). Once instruction was reintroduced on day 26 Jacob’s accuracy increased to two correct answers for each of the subsequent five days. Jacob never met mastery criteria for answering “where” questions.

The effects of the DI intervention on Carl’s accuracy in answering “where” questions are found in the middle graph of Figure 2. During baseline probes of “where,” Carl never answered more than one “where” question correctly. Consistent with the multiple probe design, baseline probes were delivered during the first three sessions preceding instruction for the first target, with a follow-up probe immediately prior to beginning instruction for the next target, “where” questions (day 14). During the first three days of intervention, Carl’s accuracy increased from answering one question correctly to answering two questions correctly. On the fourth day of instruction on “where” questions (day 18), Carl answered all 4 questions correctly and continued with this trend for five consecutive days, as well as during an instructional probe seven days later.

The effects of the DI intervention on Kevin’s accuracy in answering “where” questions are found in the middle graph of Figure 3. During baseline probes of “where,” questions, Kevin answered two questions correctly on the first day, but his accuracy

declined rapidly as he answered zero questions correctly on the subsequent three baseline probes. Consistent with the multiple probe design, baseline probes were delivered during the first three sessions preceding instruction for the first target, with a follow-up probe immediately prior to beginning instruction for the next target, “where” questions (day 14). Kevin’s accuracy increased immediately and steadily after the introduction of instruction. On the fourth day of instruction on “where” questions (day 18), Kevin answered all 4 questions correctly and continued this trend for five additional consecutive days, as well as during an instructional probe 7 days later (day 30).

### **Effects of DI on Accuracy in Answering “What” Questions**

The effects of the DI intervention on Jacob’s accuracy in answering “what” questions are found in the bottom graph of Figure 1. Consistent with the multiple probe design, baseline probes were delivered during the first three sessions, with two subsequent probes administered immediately before beginning instruction for subsequent instructional targets. Baseline data on “what” questions were collected on days 1, 2, 3, 14, and 23. During these baseline sessions, Jacob answered one question correctly on 4 of the days, and answered zero correctly on one day. Once the instruction on “what” questions began, Jacob showed an immediate increase in his accuracy in answering “what” questions and was able to answer all four questions correctly by the third day of instruction. Jacob met mastery criteria for answering “what” questions after five days of instruction (day 28).

The effects of the DI intervention on Carl’s accuracy in answering “what” questions are found in the bottom graph of Figure 2. Consistent with the multiple probe design, baseline probes were delivered during the first three sessions, with two



subsequent probes administered immediately before beginning instruction for subsequent instructional targets. Baseline data on “what” questions were collected on days 1, 2, 3, 14, and 23. During these baseline sessions, Carl’s accuracy in answering “what” questions fluctuated with scores ranging from zero correct (on days 1 and 2) to two correct (day 14) and one correct (days 3 and 23). Carl showed some variability in his accuracy once instruction began with a score of two correct on the first day of instruction and one correct on the second day before abruptly increasing to four questions correct on the third day of instruction. Carl met mastery criteria after five instructional days and continued with this level of performance for an additional two days.

The effects of the DI intervention on Kevin’s accuracy in answering “what” questions can be found in the bottom graph of Figure 3. Baseline data on “what” questions were collected on days 1, 2, 3, 14, and 23. During baseline, Kevin answered one question correctly on all five baseline days. Once instruction began, Kevin showed an immediate increase in his accuracy and met mastery criteria after five days of instruction. Kevin continued with this level of performance for two additional days after meeting mastery criteria.

### **Maintenance After Removal of the DI Intervention**

Maintenance data for all three students can be found in the last condition on Figures 1, 2, and 3. The data points represent the student’s performance on follow-up probes administered at two and four weeks after the DI intervention was removed. These data demonstrate each student’s level of maintenance for each type of “wh-” question. For “who” and “what” questions, all three students maintained their high levels of

accuracy by answer answering all four questions correctly at two weeks and four weeks post instruction.

Carl was the only participant who maintained mastery levels on “where” questions at both the two-week and four-week follow-up probes. During the two-week follow-up, Kevin demonstrated a maintenance of mastery by answering all four “where” questions correctly. However, Kevin’s accuracy at the four-week follow-up showed a decrease in accuracy as he answered 3 out of 4 questions correctly.

Jacob never met mastery criteria for “where” questions during instruction and his follow-up probes further demonstrate this lack of mastery. At the two-week follow-up, Jacob’s score matched his scores during the last portion of the intervention (2 out of 4 questions answered correctly). However, at the four-week follow-up, Jacob’s score fell to 1 out of 4 correct responses, which is lower accuracy than what he demonstrated during the end of instruction.

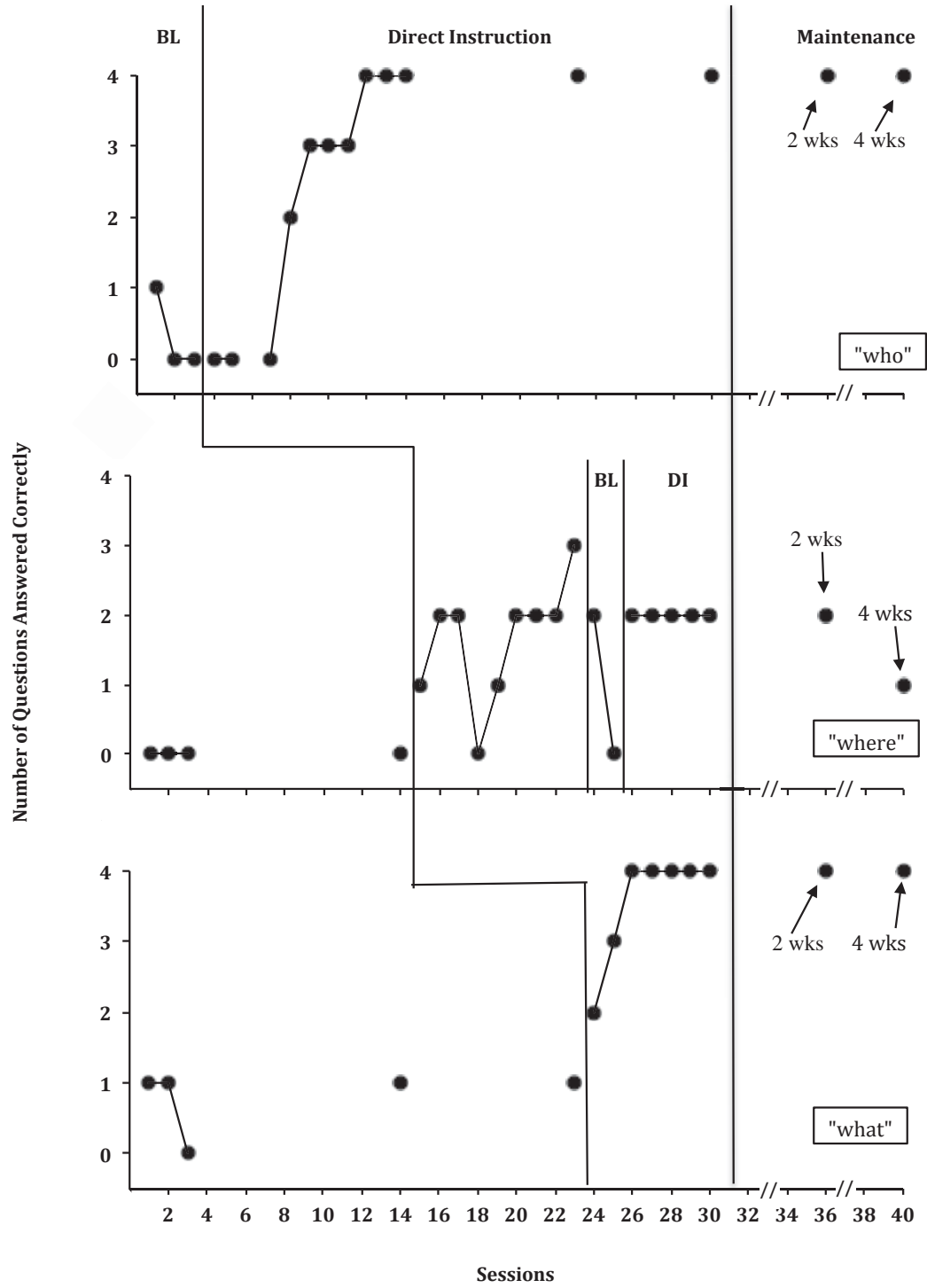


Figure 1 Effects of DI on Jacob's performance

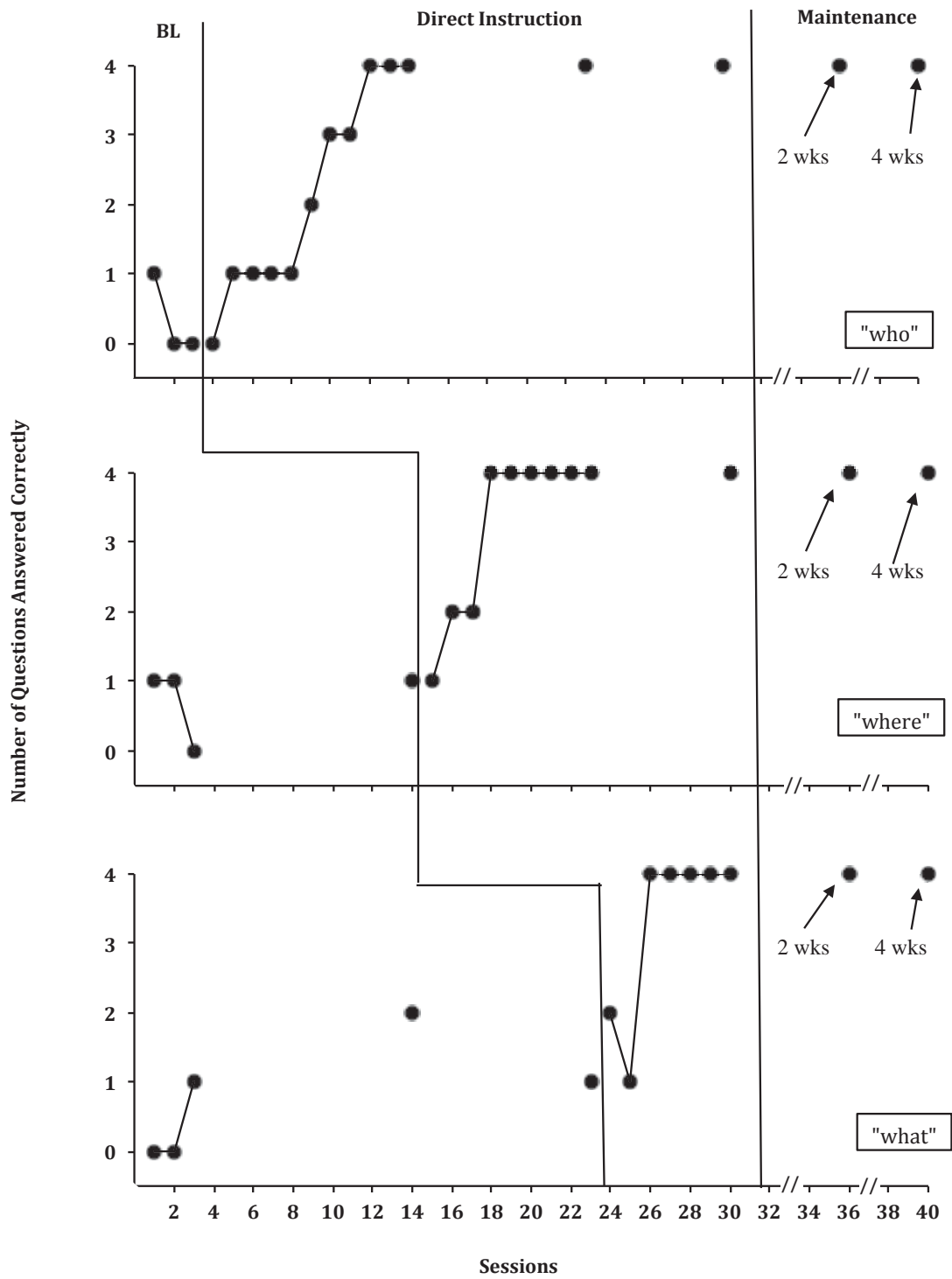


Figure 2 Effects of DI on Carl's performance

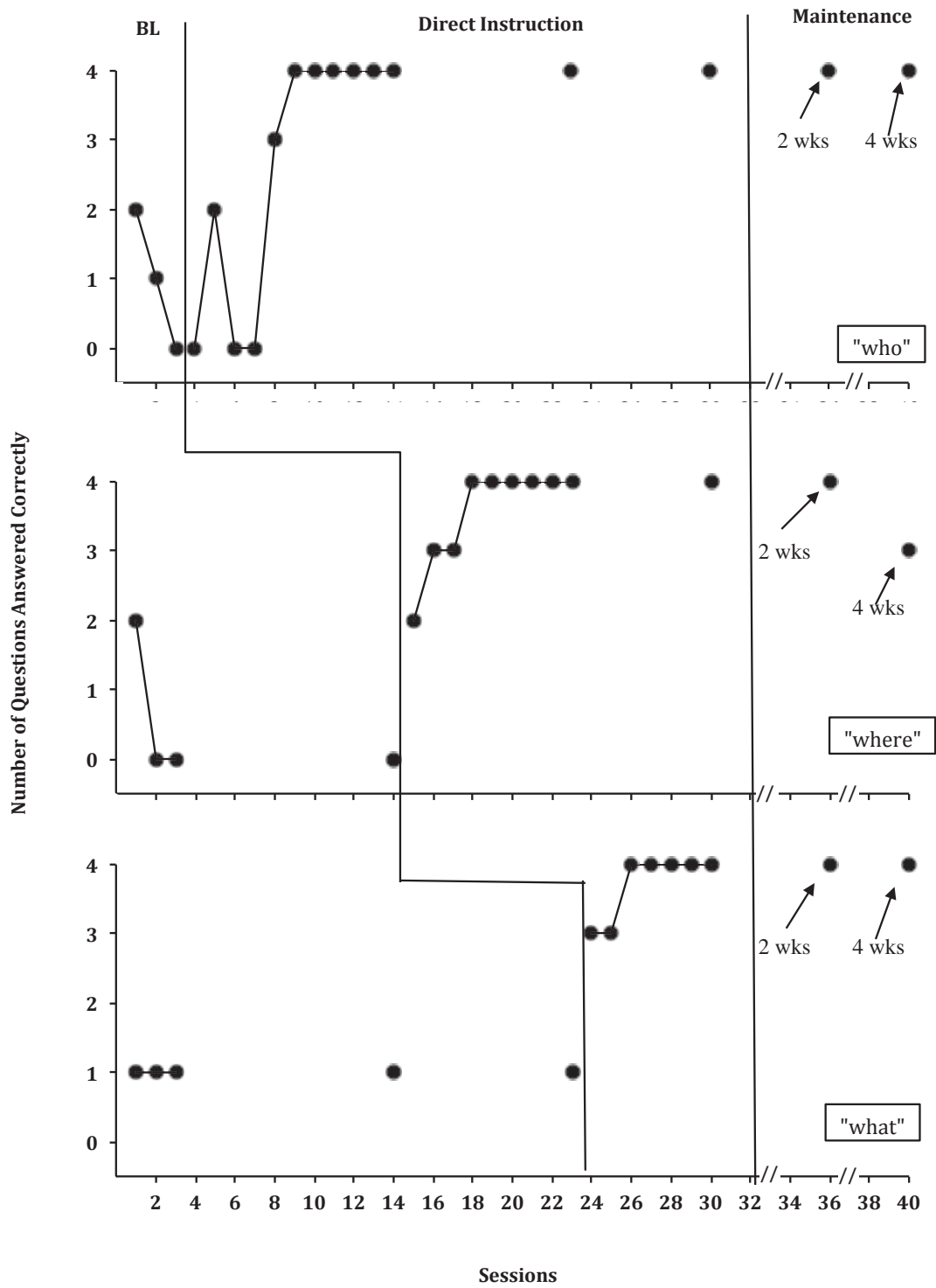


Figure 3 Effects of DI on Kevin's performance

## Error Analysis of “Where” Questions for Jacob

Due to Jacob’s difficulty with “where” questions, the form of these items was subjected to a post-hoc analysis to identify any possible patterns in these errors. The researcher reviewed Jacob’s data collection sheets and identified the types of “where” questions that were asked of Jacob and the responses he provided to these questions throughout the study. The researcher categorized the types of “where” questions by preposition types (*in, on, in front of, and over*) in order to analyze if the DI had any effects on Jacob’s responding to any of these types of questions. The post-hoc analysis revealed that the intervention resulted in a substantial increase in Jacob’s accuracy in answering “where” questions that required the use of the preposition “on.” Jacob also demonstrated a slight improvement in his ability to answer “where” questions which required the use of the preposition “in.” Minimal impact was demonstrated on Jacob’s accuracy in answering “where” question that required prepositions “in front of” and “over.” The results of this analysis are displayed in Table 4.

Table 4

### *Post-hoc Error Analysis for Jacob*

“Where” question: Preposition type	Percent correct during baseline probes	Percent correct during intervention	Percent correct after intervention
“on”	0%	89%	100%
“in”	0%	54%	50%
“in front of”	0%	14%	0%
“over”	0%	14%	0%

## Discussion

The purpose of this study was to determine the effectiveness of DI, and specifically the *SRA Reading Mastery Signature Edition* language program, in teaching high school students with ASD in a small group setting to answer “who,” “where,” and “what” questions. In addition, this study sought to determine if any effects demonstrated during the intervention would maintain after instruction ceased. The results indicated that the DI curriculum was effective in teaching all students to answer “who” and “what” questions to mastery. In addition, the data revealed that the students maintained these improvements at both the two-week and four-week post-intervention follow-up assessments.

The data demonstrated less impressive results for the effects of the intervention on teaching students to answer “where” questions. While two out of three students reached mastery during the instructional phase of the study, only one of those students, Carl, continued to demonstrate this level of mastery at both the two-week and four-week post intervention assessments. Kevin, who reached mastery criteria during intervention, maintained mastery level at the two-week mark, but fell to 3 out of 4 questions correct at the four-week follow-up. Jacob demonstrated a slight improvement in his ability to answer some types of “where” questions, but ultimately was never able to reach mastery for this skill.

### **Effectiveness of DI for Teaching Students to Answer “Who” Questions**

Prior to the implementation of the intervention, all participants demonstrated minimal accuracy in answering “who” questions. After several days of instruction, all three participants showed an increase in their abilities to accurately answer “who” questions and all participants demonstrated mastery in answering “who” questions after 11 days of instruction. The results of this experiment demonstrate that DI was effective in teaching all participants to accurately answer “who” questions.

### **Effectiveness of DI for Teaching Students to Answer “Where” Questions**

The outcome of the study revealed mixed results regarding the effectiveness of DI for teaching the participants to answer “where” questions. The data indicate that two out of three participants met mastery criteria in answering “where” questions during intervention. One participant, Jacob, never met mastery criteria.

Based on the participants’ data on answering “where” questions, it appears that this question type may be the most difficult of the three to acquire. This question type appeared to be more complex in that it required direct knowledge of prepositions. Though Hicks and colleagues (2011) found DI to be effective in teaching prepositions to two middle school students with intellectual disabilities, their procedures differed in that they taught each preposition in isolation. In addition, the study utilized objects to demonstrate the various positions of prepositions. Unlike the Hicks et al. study, the researcher in the current study presented the preposition lessons as they appeared in the *Reading Mastery Signature Edition* curriculum, which meant that the prepositions (“on,” “in,” “over,” and “in front of”) were presented in a two-dimensional format and were often presented simultaneously. For example, the first picture-based preposition exercise



in the curriculum (lesson 31, exercise 5) teaches both “on” and “over” (Engelmann & Osborn, 2008). Based on the findings by Hicks and colleagues, the participants in the current study may have benefitted if the prepositions were taught with objects and taught in isolation. Further research may be needed in this area.

Though Jacob never met criteria in answering “where” questions, it is important to note that a post-hoc error analysis of Jacob’s responses to “where” questions demonstrated that he did show a substantial improvement in his ability to answer “where” questions, particularly those that required the use of the preposition “on” (see the post-hoc analysis results presented in Chapter 4). He also showed a modest improvement in his ability to answer “where” questions that required the use of the preposition “in.” Though DI, as implemented in this study, was not effective in teaching Jacob to mastery in answering all types of “where” questions, it did improve his accuracy in answering certain types of “where” questions.

### **Effectiveness of DI for Teaching Students to Answer “What” Questions**

The results of this study demonstrated that DI was effective in teaching all participants to reach mastery in answering “what” questions. The participants were able to meet mastery within six sessions of the start of the intervention. Participants reached mastery criteria with “what” questions more quickly than with the other two types of “wh-” questions targeted in this study.

### **Effectiveness of DI for Maintenance in Answering “Wh-” Questions**

The follow-up data gave insight into the effectiveness of DI in providing sustainable change in each participant’s ability to answer the target “who,” “where,” and “what” questions. The data indicate that all three participants maintained 100% accuracy

in answering “who” and “what” questions at both the two-week and four-week follow-up probes.

The follow-up data for “where” questions show inconsistent sustainability. Only one participant, Carl, maintained the highest level of performance at both maintenance checks. Kevin demonstrated stable performance at the two-week post intervention follow-up, answering 100% of “where” questions correctly. Jacob also demonstrated stability in his performance by answering 50% of the “where” questions correctly. At the four-week post intervention follow-up, both Kevin and Jacob decreased their performance by one question. These maintenance data differ from the data for the other question types and warrants further inquiry. It is possible that this difference in sustainability may indicate that DI was less effective in providing sustainable effects for “where” questions. Another possibility is that, due to the complex nature of the prepositional knowledge needed to be successful in answering “where” questions, the participants required additional instruction or instruction that isolated each preposition type (consistent with Hicks et. al., 2011) to fully master the material.

### **Summary of Findings**

Overall, these findings suggest that DI implemented in a small group setting could be an effective intervention for individuals with ASD who possess specific prerequisite language skills. Specifically, DI was highly effective in teaching the participants how to answer “who” and “what” questions. It was moderately effective in teaching the participants to answer “where” questions. Though the sample size is small, which is inherent to single-subject research designs, the effects of the intervention were demonstrated across question types and therefore provide strength to the findings and

provide some evidence of generalizability. These findings are consistent with previous studies that demonstrated that DI in a small group setting was effective in teaching students with ASD (Flores & Ganz, 2007; 2009a; 2009b; 2014; Flores et al., 2013).

The results of this study add to and extend the literature in several ways. First, it adds to the scarce literature that exists on the effectiveness of DI with students with ASD and provides further empirical support demonstrating the effectiveness of this method. Second, the results demonstrated that DI was effective in a small group setting, which is complementary to the aforementioned studies, which also demonstrated that small group instruction was effective in teaching students with ASD language skills. This finding is especially important because it contradicts studies that suggest that one-on-one instruction is necessary for students with autism to acquire skills (Lovaas, 1987; Smith, 2001; Smith et al., 2000). Finally, this study includes older participants than those who have previously appeared in published studies on this topic. This extends the literature by demonstrating that DI is effective in teaching older students with ASD language skills.

### **Implications of Findings**

Limited research on effective instructional strategies for individuals with ASD has long been an issue for special education teachers. Many instructional strategies either require exorbitant resources (e.g., discrete trial teaching) or have limited empirical support and are considered emerging interventions, which is the case with programs such as PECS and TEACCH (National Autism Center, 2009; Simpson, 2005). This study adds empirical support to a method of instruction that is practical and effective for students with ASD. DI can be implemented in a small group setting and provides a predictable

and structured format of instruction. Due to the small group format, special educators may find that DI is a practical alternative to one-on-one instruction.

Furthermore, these findings suggest that DI may be effective for teaching high school students with ASD. Though all previous studies on this topic employed younger students, this study demonstrated the efficacy of DI with older students. This finding also suggests that older students who struggled acquiring language skills earlier in their childhood (which is often the case with individuals with ASD) may still be able to acquire these skills at an older age when exposed to systematic instruction, such as DI.

### **Limitations**

One limitation of this study was the lesson modifications. DI requires that skills be taught successively and systematically until mastered, and thus the DI curriculum under study was developed to be implemented from start to finish, in lesson order with little deviation. This study allowed for lesson modifications in which individual components under study were extracted and implemented in isolation and, at times, in a different order than prescribed. Though most aspects of this curriculum remained intact (teacher scripts, choral responses, correction procedures, etc.), the unprescribed manner in which the exercises were presented may have had an impact on the study outcomes.

Another limitation to this study was the selection of participants. Participants in this study were limited to students who resided within a small geographic area and attended the same charter school. Individuals who did not attend the school at which the study was conducted, were not considered for this study.

Finally, the study focused on teaching students to answer “who,” “where,” and “what” questions, and other “wh-” question types were not considered for inclusion. It is unknown if the intervention would have the same impact on other question types.

### **Further Research**

This study focused on increasing a particular language skill, answering “who,” “where,” and “what” questions, for high school students with ASD using a small group instruction format. The results also demonstrated that these skills can be taught to older children with ASD. Additional research should focus on examining further the effectiveness of DI with individuals with ASD for language development. Specifically, researchers may seek to investigate:

1. The effectiveness of this DI curriculum in a group setting to teach language to high school students with ASD (replication of the current study).
2. The effectiveness of the DI curriculum in a small group setting, as designed in the curriculum. As discussed previously in the Methods section, the DI curriculum components were extracted and implemented in a manner that would allow the researcher to answer directly the posed research questions. It may be helpful to study and measure learning with the curriculum as prescribed – that is, without the modifications implemented in the current study.
3. The effectiveness of DI in teaching other language skills (such as answering other types of “wh-” questions) to individuals with ASD in a group setting.
4. The effectiveness of DI when compared with other common practices for individuals with ASD such as the comparison to DTT conducted in the Flores and Ganz study (2014).

5. The effectiveness of DI curriculum to teach skills as prescribed compared to its effectiveness when using the DI curriculum to teach skills in isolation.
6. The effectiveness of the DI curriculum in teaching students to generalize responses within each question types (e.g., learning if learning one type of response to “what” questions would lead to improved performance in a different type of “what” question).

This study provides additional support to the budding literature on the effectiveness of DI in teaching students with ASD various skills. It provides further evidence that the use of DI instruction can be effective for individuals with ASD in a small group setting and that one-on-one instruction is not always necessary to teach students with ASD effectively. This finding is especially helpful for special education teachers who may be seeking more efficient ways to teach their students with ASD but do not have the resources to provide one-on-one instruction.

## **Appendices**

**Appendix A**  
**Data Collection Forms**



**Probe Data Collection Sheet**

Date \_\_\_\_/\_\_\_\_/\_\_\_\_ Session # \_\_\_\_ Question Type: what where when all Phase: baseline acquisition maintenance

Question	Participant Response	Score			Question Type		
		C	I	NR	What	Who	Where
1. <i>Point to picture. Who is wearing a hat?</i> (A194)		C	I	NR			
2. <i>Point to picture. What is the man doing?</i> (A194)		C	I	NR			
3. <i>Point to picture. Where is the dog?</i> (A194)		C	I	NR			
4. <i>Point to picture. Where is the cat?</i> (A235)		C	I	NR			
5. <i>Point to picture. What is the woman feeding?</i> (A235)		C	I	NR			
6. <i>Point to picture. Who is jumping the fence?</i> (A235)		C	I	NR			
7. <i>Point to picture. Where is cat?</i> (A236)		C	I	NR			
8. <i>Point to picture. What is the bird doing?</i> (A236)		C	I	NR			
9. <i>Point to picture. Who is eating an apple?</i> (A236)		C	I	NR			
10. <i>Point to picture. What is the man doing?</i> (D247)		C	I	NR			
11. <i>Point to picture. Where is the boy?</i> (D247)		C	I	NR			
12. <i>Point to picture. Who is playing baseball?</i> (D247)		C	I	NR			
		<b>Total Correct</b>					

C-Correct (1), I-Incorrect (0), NR-No Response or "I don't know" (0)

**Probe Data Collection Sheet**

Date \_\_\_\_/\_\_\_\_/\_\_\_\_ Session # \_\_\_\_ Question Type: what where when all Phase: baseline acquisition maintenance

Question	Participant Response	Score			Question Type		
		C	I	NR	What	Who	Where
1. <i>Point to picture. Who is flying a kite that looks like an elephant?</i> (A244)		C	I	NR			
2. <i>Point to picture. What is the monkey doing?</i> (A244)		C	I	NR			
3. <i>Point to picture. Where is the red kite?</i> (A244)		C	I	NR			
4. <i>Point to picture. What is the dog on the house doing?</i> (B15)		C	I	NR			
5. <i>Point to picture. Who is sitting?</i> (B15)		C	I	NR			
6. <i>Point to picture. Where is the dog that is sleeping?</i> (B15)		C	I	NR			
7. <i>Point to picture. What is the boy doing?</i> (B84)		C	I	NR			
8. <i>Point to picture. Where is the kite?</i> (B84)		C	I	NR			
9. <i>Point to picture. Who is flying the kite?</i> (B84)		C	I	NR			
10. <i>Point to picture. Where is the dog?</i> (A236)		C	I	NR			
11. <i>Point to picture. What is the boy doing?</i> (A236)		C	I	NR			
12. <i>Point to picture. Who is standing by the table?</i> (A236)		C	I	NR			
		Total Correct					

C-Correct (1), I-Incorrect (0), NR-No Response or "I don't know" (0)

Probe Data Collection Sheet

Date \_\_\_/\_\_\_/\_\_\_ Session # \_\_\_ Question Type: what where when all Phase: baseline acquisition maintenance

Question	Participant Response	Score		Question Type		
		C	I	What	Who	Where
1. <i>Point to B. What is the firefighter doing?</i> (D117)		C	I			
2. <i>Point to picture. Where is the boy?</i> (D259)		C	I			
3. <i>Point to picture. Who is riding a horse?</i> (D259)		C	I			
4. <i>Point to picture. Where is the bird?</i> (D228)		C	I			
5. <i>Point to picture. Who picked up the rabbits?</i> (D228)		C	I			
6. <i>Point to picture. What is the baby holding?</i> (D228)		C	I			
7. <i>Point to B. Who jumped in the water?</i> (D94)		C	I			
8. <i>Point to A. What did the frog sit on?</i> (D94)		C	I			
9. <i>Point to C. Where is the rabbit?</i> (B240)		C	I			
10. <i>Point to picture. Where is the flower?</i> (D300)		C	I			
11. <i>Point to picture. What is the frog doing?</i> (D300)		C	I			
12. <i>Point to picture. Who is sitting?</i> (D300)		C	I			
		Total Correct				

C-Correct (1), I-Incorrect (0), NR-No Response or "I don't know" (0)

**Probe Data Collection Sheet**

Date \_\_\_\_/\_\_\_\_/\_\_\_\_ Session # \_\_\_\_ Question Type: what who where all Phase: baseline acquisition maintenance

Question	Participant Response	Score		Ques. Type		
		C	I	What	Who	Where
1. <i>Point to picture. Who is chopping down a tree?</i> (A194)		C	I	NR		
2. <i>Point to picture. Who is feeding the ducks?</i> (A235)		C	I	NR		
3. <i>Point to picture. Who is fishing?</i> (D247)		C	I	NR		
4. <i>Point to picture. Who is swimming?</i> (D247)		C	I	NR		
		Total Correct				

Date \_\_\_\_/\_\_\_\_/\_\_\_\_ Session # \_\_\_\_ Question Type: what who where all Phase: baseline acquisition maintenance

Question	Participant Response	Score		Ques. Type		
		C	I	What	Who	Where
1. <i>Point to picture. Who is flying the red kite?</i> (A244)		C	I	NR		
2. <i>Point to picture. Who is eating an apple?</i> (A236)		C	I	NR		
3. <i>Point to picture. Who is painting the fence?</i> (C271)		C	I	NR		
4. <i>Point to picture. Who is painting the sidewalk?</i> (C271)		C	I	NR		
		Total Correct				

C-Correct (1), I-Incorrect (0), NR-No Response or "I don't know" (0)

**Probe Data Collection Sheet**

Date \_\_\_/\_\_\_/\_\_\_ Session # \_\_\_ Question Type: what who where all Phase: baseline acquisition maintenance

Question	Participant Response	Score		Ques. Type		
		C	I NR	What	Who	Where
1. <i>Point to C. Where is this dog?</i> (A327)		C	I NR			
2. <i>Point to D. Where is this dog?</i> (A327)		C	I NR			
3. <i>Point to B. Where is this girl?</i> (A273)		C	I NR			
4. <i>Point to C. Where is this girl?</i> (A273)		C	I NR			
		Total Correct				

Date \_\_\_/\_\_\_/\_\_\_ Session # \_\_\_ Question Type: what who where all Phase: baseline acquisition maintenance

Question	Participant Response	Score		Ques. Type		
		C	I NR	What	Who	Where
1. <i>Point to B. Where is this dog?</i> (A327)		C	I NR			
2. <i>Point to A. Where is this girl?</i> (A273)		C	I NR			
3. <i>Point to B. Where is this frog?</i> (A289)		C	I NR			
4. <i>Point to C. Where is this frog?</i> (A289)		C	I NR			
		Total Correct				

C-Correct (1), I-Incorrect (0), NR-No Response or "I don't know" (0)

**Probe Data Collection Sheet**

Date \_\_\_\_/\_\_\_\_/\_\_\_\_ Session # \_\_\_\_ Question Type: what who where all Phase: baseline acquisition maintenance

Question	Participant Response	Score		Ques. Type			
		What	Who	Where	What	Who	Where
1. <i>Point to B. What is the mouse doing?</i> (D127)		C	I	NR			
2. <i>Point to B. What are the boys doing?</i> (D145)		C	I	NR			
3. <i>Point to B. What did the boys sleep in?</i> (D145)		C	I	NR			
4. <i>Point to B. What did the baby sit on?</i> (D192)		C	I	NR			
Total Correct							

Date \_\_\_\_/\_\_\_\_/\_\_\_\_ Session # \_\_\_\_ Question Type: what who where all Phase: baseline acquisition maintenance

Question	Participant Response	Score		Ques. Type			
		What	Who	Where	What	Who	Where
1. <i>Point to A. What did the firefighter climb?</i> (D229)		C	I	NR			
2. <i>Point to B. What is the firefighter doing?</i> (D229)		C	I	NR			
3. <i>Point to A. What is the police officer doing?</i> (D288)		C	I	NR			
4. <i>Point to B. What is the woman doing?</i> (D311)		C	I	NR			
Total Correct							

C-Correct (1), I-Incorrect (0), NR-No Response or "I don't know" (0)

## **Appendix B**

### **Treatment Fidelity Data Collection Forms**

**Language for Learning—Treatment Fidelity Checklist**

Date		Time	Target skill:	
		<b>Lesson 17, Page A90, Exercise 7</b>	<b>Completed?</b>	
			<b>Yes</b>	<b>No</b>
1.	Instructor says: <i>"We're going to talk about some actions."</i>			
a.	Instructor points to the girl.			
	Instructor says, <i>"Everybody, what is this?"</i>			
	Instructor signals students to respond.			
	Instructor says, <i>"Say the whole thing."</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
b.	Instructor says, <i>"Listen. What is this girl doing?"</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
c.	Instructor says, <i>"Let's say the whole thing about what this girl is doing?"</i>			
	Instructor signals students to respond.			
	Instructor responds with students, <i>"This girl is standing."</i>			
	Instructor provides feedback (corrective or praise)			
d.	Instructor says <i>"Again."</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
e.	Instructor says, <i>"All by yourselves. Say the whole thing about what the girl is doing."</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
2.	Instructor says, <i>"Now we'll talk about some more actions."</i>			
a.	Instructor points to the dog.			
	Instructor says, <i>"Everybody, what is this?"</i>			
	Instructor signals students to respond.			
	Instructor says, <i>"Say the whole thing."</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
b.	Instructor says, <i>"What is this dog doing?"</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
c.	Instructor says, <i>"Say the whole thing about what this girl is doing?"</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
d.	Instructor says <i>"Again."</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
1.	Instructor says: <i>"We're going to talk about some actions."</i>			
a.	Instructor points to the cat.			
	Instructor says, <i>"Everybody, what is this?"</i>			
	Instructor signals students to respond.			
	Instructor says, <i>"Say the whole thing."</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
b.	Instructor says, <i>"What is this dog doing?"</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
c.	Instructor says, <i>"Say the whole thing about what this cat is doing?"</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			
d.	Instructor says <i>"Again."</i>			
	Instructor signals students to respond.			
	Instructor provides feedback (corrective or praise)			



Statement Correct Procedure

Steps		Completed?	
1.	<i>The model:</i> Instructor says, " <b>My turn listen...</b> " and models the correct statement		
2.	<i>The lead:</i> the instructor says, " <b>Let's say it together...</b> " The instructor and students say the correct statement together		
2b.	The instructor continues to lead until the student can produce the statement firmly and correctly.		
3.	<i>The test:</i> the instructor says, " <b>Your turn.</b> " If the child responds correctly, the instructor will move on to the next step, <i>retest</i> .		
3b.	If the student responds incorrectly, the instructor will repeat the <i>model</i> and <i>lead</i> steps until the student responds correctly.		
4.	<i>The Retest:</i> the instructor repeats the entire exercise sequence from the beginning		

SRA Reading Master Language – Treatment Fidelity Checklist

Date \_\_\_\_\_ Time \_\_\_\_\_ Target skill: \_\_\_\_\_

Lesson 40, Page D249, Exercise 5		Completed?	
		Yes	No
1.	Instructor says: <b><i>“One of these frogs is in front of the dog. One of these frogs is on the dog. One of these frogs is jumping over the dog. Get ready to tell me where each frog is.”</i></b>		
	Instructor points to A.		
	Instructor asks, <b><i>“Everybody, where is this frog?”</i></b>		
	Instructor signals (touch) for students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor points to B.		
	Instructor asks, <b><i>“Everybody, where is this frog?”</i></b>		
	Instructor signals (touch) for students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor points to C.		
	Instructor asks, <b><i>“Everybody, where is this frog?”</i></b>		
	Instructor signals (touch) for students to respond.		
	Instructor provides feedback (corrective or praise)		
2.	Instructor repeats part 1 until responses are firm.		
3.	Instructor says, <b><i>“We’re going to talk about one of the frogs.”</i></b>		
	Instructor points to C.		
	Instructor asks, <b><i>“Where is this frog?”</i></b>		
	Instructor signals (touch) students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor says, <b><i>“Say the whole thing about where this frog is.”</i></b>		
	Instructor signals (touch) students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor asks, <b><i>“Is this frog in front of the dog?”</i></b>		
	Instructor signals (touch) students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor says, <b><i>“Say the whole thing.”</i></b>		
	Instructor signals (touch) students to respond.		
Instructor provides feedback (corrective or praise)			
4.	Instructor says, <b><i>“Now we’ll talk about the other frogs.”</i></b>		
	Instructor points to A.		
	Instructor asks, <b><i>“Where is this frog?”</i></b>		
	Instructor signals (touch) students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor says, <b><i>“Say the whole thing about where this frog is.”</i></b>		
	Instructor signals (touch) students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor asks, <b><i>“Is this frog on the dog?”</i></b>		
	Instructor signals (touch) students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor says, <b><i>“Say the whole thing.”</i></b>		
	Instructor signals (touch) students to respond.		
Instructor provides feedback (corrective or praise)			

Statement Correct Procedure

Steps		Completed?	
1.	<i>The model:</i> Instructor says, " <b>My turn listen...</b> " and models the correct statement		
2.	<i>The lead:</i> the instructor says, " <b>Let's say it together...</b> " The instructor and students say the correct statement together		
2b.	The instructor continues to lead until the student can produce the statement firmly and correctly.		
3.	<i>The test:</i> the instructor says, " <b>Your turn.</b> " If the child responds correctly, the instructor will move on to the next step, <i>retest</i> .		
3b.	If the student responds incorrectly, the instructor will repeat the <i>model</i> and <i>lead</i> steps until the student responds correctly.		
4.	<i>The Retest:</i> the instructor repeats the entire exercise sequence from the beginning		

SRA Reading Master Language – Treatment Fidelity Checklist

Date \_\_\_\_\_ Time \_\_\_\_\_ Target skill: \_\_\_\_\_

Lesson 128, Page D84, Exercise 11		Completed?	
		Yes	No
1.	Instructor says: <i>"These pictures tell a story about what a boy did."</i>		
	Instructor points A (top picture).		
	Instructor says, <i>"The boy went to his room in the afternoon. Say that."</i>		
	Instructor signals for students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor says, <i>"He had to clean his room. Who had to clean his room?"</i>		
	Instructor signals (touch) for students to respond.		
2.	Instructor says: <i>"Look at this picture."</i>		
	Instructor points to B (bottom picture).		
	Instructor says: <i>"The boy ran outside after he cleaned his room. Say that."</i>		
	Instructor signals for students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor asks, <i>"Who ran outside?"</i>		
	Instructor signals (touch) for students to respond.		
3.	Instructor says, <i>"Let's do some of those questions again. This time I won't point to the pictures."</i>		
	Instructor asks, <i>"Who had to clean his room?"</i>		
	Instructor signals (touch) students to respond.		
	Instructor provides feedback (corrective or praise)		
	Instructor asks, <i>"Who looks happy?"</i>		
	Instructor signals students to respond.		
4.	Instructor repeats exercises until response are firm.		

Statement Correct Procedure

Steps		Completed?	
1.	<i>The model:</i> Instructor says, <i>"My turn listen..."</i> and models the correct statement		
2.	<i>The lead:</i> the instructor says, <i>"Let's say it together..."</i> The instructor and students say the correct statement together		
2b.	The instructor continues to lead until the student can produce the statement firmly and correctly.		
3.	<i>The test:</i> the instructor says, <i>"Your turn."</i> If the child responds correctly, the instructor will move on to the next step, <i>retest</i> .		
3b.	If the student responds incorrectly, the instructor will repeat the <i>model</i> and <i>lead</i> steps until the student responds correctly.		
4.	<i>The Retest:</i> the instructor repeats the entire exercise sequence from the beginning		

**Appendix C**  
**IRB Approval Letter**



**Institutional Review Board**

*Mailing Address:*

Division of Research  
777 Glades Rd., Bldg. 80, Rm. 106  
Boca Raton, FL 33431

Tel: 561.297.0777 Fax: 561.297.2573

<http://www.fau.edu/research/researchint>

Michael Whitehurst, Ed.D., Chair

DATE: May 6, 2014

TO: Cynthia L. Wilson, Jessica Cadette

FROM: Florida Atlantic University Social, Behavioral and Educational Research IRB

IRBNET ID #: 582736-2

PROTOCOL TITLE: [582736-2] The Effectiveness of Direct Instruction in Teaching Children with Autism Spectrum Disorders to Answer "Wh-" Questions

PROJECT TYPE: *New Project*

ACTION: APPROVED

APPROVAL DATE: May 6, 2014

EXPIRATION DATE: May 5, 2015

REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # B7

Thank you for your submission of Response/Follow-Up materials for this research study. The Florida Atlantic University Social, Behavioral and Educational Research IRB has APPROVED your *New Project*. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

- This study is approved for a maximum of **4** subjects.
- It is important that you use the approved, stamped consent documents or procedures included with this letter.
- **\*\*Please note that any revision to previously approved materials or procedures, including modifications to numbers of subjects, must be approved by the IRB before it is initiated.** Please use the amendment form to request IRB approval of a proposed revision.
- All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All regulatory and sponsor reporting requirements should also be followed, if applicable.
- Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.
- Please note that all research records must be retained for a minimum of three years.
- **This approval is valid for one year.** A Continuing Review form will be required prior to the expiration date if this project will continue beyond one year.

If you have any questions or comments about this correspondence, please contact Angela Clear at:

Institutional Review Board

Research Integrity/Division of Research  
Florida Atlantic University  
Bldg. 80, Rm. 106  
Boca Raton, FL 33431  
Phone: 561-297-0777

\* Please include your protocol number and title in all correspondence with this office.

**This letter has been electronically signed in accordance with all applicable regulations,  
and a copy is retained within our records.**

## References

- Bloom, L., Merkin, S., & Wootten, J. (1982). Wh- questions: Linguistic factors that contribute to the sequence of acquisition. *Child Development, 53*, 1084–1092.
- Boutot, A.E., & Myles, B.S. (2011). *Autism spectrum disorders: Foundations, characteristics, and effective strategies*. Upper Saddle River, NJ: Pearson Education.
- Boucher, J. (2003). Language development in autism. *International Journal of Pediatric Otorhinolaryngology, 67*(S1), S159-S163.
- Crowley, K., McLaughlin, T., & Kahn, R. (2012). Using Direct Instruction flashcards and reading racetracks to improve sight word recognition in two elementary students with autism. *Journal of Developmental and Physical Disabilities, 25*(3), 297-311.
- Downs, A., Robyn, C. D., Johansen, M., & Fossum, M. (2007). Using discrete trial teaching within a public preschool program to facilitate skill development in students with developmental disabilities. *Education & Treatment of Children, 30*(3), 1-27.
- Eigsti, I., de Marchena, A. B., Schuh, J. M., & Kelley, E. (2011). Language acquisition in autism spectrum disorders: A developmental review. *Research in Autism Spectrum Disorders, 5*, 681-691.



- Engelmann, S., & Becker, W. C. (1976). Analysis of achievement data on six cohorts of low-income children from 20 school districts in the University of Oregon Direct Instruction follow through model. Retrieved from [www.eric.ed.gov](http://www.eric.ed.gov) on June 22, 2011.
- Engelmann, S., & Osborn, J. (2008). *Reading Mastery Language Arts Strand, Level K* (Signature Edition, Grade K) (Teacher's Presentation Book, Student Material, Literature Guide, and Teacher's Guide). Columbus, OH: SRA/McGraw-Hill.
- Flores, M.M., & Ganz, J. B. (2007). Effectiveness of Direct Instruction for teaching statement inferences, use of facts, and analogies to students with developmental disabilities and reading delays. *Focus on Autism and Other Developmental Disabilities, 22*, 244-251.
- Flores, M.M., & Ganz, J. B. (2009a). Effects of Direct Instruction on the reading comprehension of students with autism and developmental disabilities. *Education and Training in Developmental Disabilities, 44*(1), 39-53.
- Flores, M. M. & Ganz, J. B. (2009b). The effectiveness of Direct Instruction for teaching language to children with autism spectrum disorders: Identifying materials. *Journal for Autism and Developmental Disorders, 39*, 75–83.
- Flores, M.M., & Ganz, J. B. (2014). Comparison of Direct Instruction and discrete trial teaching on the curriculum-based assessment of language performance of students with autism. *Exceptionality: A Special Education Journal, 22*(4), 191-204.
- Flores, M. M., & Kaylor, M. (2007). The effects of a Direct Instruction program on the fraction performance of middle school students at-risk for failure in mathematics. *Journal of Instructional Psychology, 34*(2), 84-94.

- Flores, M.M., Nelson, C., Hinton, V., Franklin, T.M., Strozier, S.D., Terry, L., & Franklin, S. (2013). Teaching reading comprehension and language skills to students with autism spectrum disorders and developmental disabilities using direct instruction. *Education and Training in Autism and Developmental Disabilities, 48*(1), 41-48.
- Fredrick, L. D., Keel, M. C., & Neel, J. H. (2002). Making the most of instructional time: Teaching reading at an accelerated rate to students at risk. *Journal of Direct Instruction, 2*, 57-62.
- Goodwin, A., Fein, D., & Naigles, L. R. (2012). Comprehension of wh- questions precedes their production in typical development and autism spectrum disorders. *Autism Research, 5*(2), 109-123.
- Grossen, B. (2010). Success of a Direct Instruction model at a secondary level school with high-risk students. *Reading and Writing Quarterly: Overcoming Learning Difficulties, 20*(2), 161-178.
- Hicks, S. C., Bethune, K. S., Wood, C. L., Cooke, N. L., & Mims, P. J. (2011). Effects of Direct Instruction on the acquisition of prepositions by students with intellectual disabilities. *Journal of Applied Behavior Analysis, 44*, 675-679.
- Horner, R. D., & Baer, D. M. (1978). Multiple-probe technique: A variation of multiple baseline. *Journal of Applied Behavior Analysis, 11*(1), 189-196.
- Horner, R. D., & Kratochwill, T. R. (2012). Synthesizing single-case research to identify evidence-based practices: Some brief reflections. *Journal of Behavioral Education, 21*, 266-272.

- Language. (n.d.). Retrieved February 1, 2014, from <http://www.merriam-webster.com/dictionary/language>
- Lee, R. F., & Ashmore, L. L. (1983). Receptive and expressive wh- question performance by language-delayed children. *Journal of Communication Disorders, 16*, 99-109.
- Lovaas, O.I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55(1)*, 3-9.
- Luyster, R. J., Kadlec, M. B., Carter, A., & Tager-Flusberg, H. (2008). Language assessment and development in toddlers with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 38(8)*, 1426-38.
- Maggs, A., & Morath, P. (1976). Effects of direct verbal instruction on intellectual development of institutionalized moderately retarded children: A 2-year study. *Journal of Special Education, 10*, 357-364.
- Mangundayao, J., McLaughlin, T. F., Williams, R. L., & Toone, E. (2013). An evaluation of Direct Instruction flashcard system on the acquisition and generalization of numerals, shapes, and colors for preschool-aged students with developmental delays. *Journal of Developmental and Physical Disabilities, 25(4)*, 461-473.
- Mayo, J., Chlebowski, C., Fein, D. A., & Eigsti, I. M. (2013). Age of first words predicts cognitive ability and adaptive skills in children with ASD. *Journal of Autism and Developmental Disorders, 43*, 253-264.
- McEachin, J. J., Smith, T., & Lovaas, O. I. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal on Mental Retardation, 97*, 359-372.

- Murray, G. K., Jones, P. B., Kuh, D., & Richards, M. (2007). Infant developmental milestones and subsequent cognitive function. *Annals of Neurology*, *62*, 128–136.
- National Autism Center (2009). *National Standards Project-Addressing the need for evidence-based practice guidelines for autism spectrum disorders*. Randolph, MA: National Autism Center.
- O'Connor, R. E., Jenkins, J. R., Cole, K. N., & Mills, P. E. (1993). Two approaches to reading instruction with children with disabilities: Does program design make a difference? *Exceptional Children*, *59*(4), 312-323.
- Odom, S. L., Collet-Klingenberg, L., Rogers, S. J., & Hatton, D. D. (2010). Evidence-based practices in interventions for children and youth with autism spectrum disorders. *Preventing School Failure*, *54*, 275-282.
- Otto, B. (2006). *Language development in early childhood* (2nd ed.). Upper Saddle River, NJ: Pearson Prentice Hall.
- Prizant, B. M. (1996). Brief report: Communication, language, social, and emotional development. *Journal of Autism and Developmental Disorders*, *26*, 173–178.
- Ruwe, K., McLaughlin, T. F., Derby, M. K., & Johnson, J. (2010). The multiple effects of Direct Instruction flashcards on sight word acquisition, passage reading, and error for three middle school students with intellectual disabilities. *Journal of Developmental and Physical Disabilities*, *23*(3), 241-255.
- Ryder, R. J., Burton, J. L., & Silberg, A. (2006). Longitudinal study of Direct Instruction effects from first through third grades. *Journal of Educational Research*, *99*(3), 179-191.

- Seidl, A., Hollich, G., & Jusczyk, P.W. (2003). Early understanding of subject and object wh- questions. *Infancy*, 4(3), 423–436.
- Shillingsburg, M. A., Bowen, C. N., Peterman, R. K., & Gayman, M. D. (2015). Effectiveness of the Direct Instruction Language for Learning curriculum among children diagnosed with autism spectrum disorder. *Focus on Autism and Other Developmental Disabilities*, 30(1), 44-56.
- Shippen, M. E., Houchins, D. E., Steventon, C., & Sartor, D. (2005). A comparison of two Direct Instruction reading programs for urban middle school students. *Remedial & Special Education*, 26(3), 175-182.
- Singer, M. (1986). Answering wh- questions about sentences and text. *Journal of Memory and Language*, 25(2), 238-254.
- Singer, M. (2003). Processes of question answering. In G. Rickheit, T. Herrmann, & W. Deutsch (Eds.), *Psycholinguistik- Psycholinguistics* (pp. 422-431). Berlin: Walter de Gruyter.
- Simpson, R. (2005). Evidence-based practices and students with autism spectrum disorders. *Focus on Autism and Other Development Disabilities*, 20(3), 140-149.
- Skarr, A., Zielinski, K., Ruwe, K., Sharp, H., Williams, R. L., & McLaughlin, T. F. (2014). The effects of direct instruction flashcard and math racetrack procedures on mastery of basic multiplication facts by three elementary school students. *Education & Treatment of Children*, 37(1), 77-93.
- Smith, T. (2001). Discrete trial training in the treatment of autism. *Focus on Autism and Other Disabilities*, 16(2), 86-92.

- Smith, T., Groen, A. D., & Wynn, J. W. (2000). Randomized trial of intensive early intervention for children with pervasive developmental disorder. *American Journal Of Mental Retardation*, 105(4), 269-285.
- Taylor, R., Smiley, L., & Richards, S. (2009). *Exceptional students: Preparing teachers for the 21<sup>st</sup> century*. Boston: McGraw-Hill.
- Thal, D., & Bates, E. (1989). Language and communication in early childhood. *Pediatric Annals*, 18(5), 299-300,302-305.
- Toth, K., Munson, J., Meltzoff, A. N., & Dawson, G. (2006). Early predictors of communication development in young children with autism spectrum disorder: Joint attention, imitation, and toy play. *Journal of Autism and Developmental Disorders*, 36, 993-1005.
- Vicker, B. A. (2004). *The WH Question Comprehension Test: Exploring the world of WH question comprehension for students with an autism spectrum disorder*. Bloomington, Ind.: Indiana University, Indiana Institute on Disability and Community.
- Waldron-Soler, K. M., Martella, R. C., Marchand-Martella, N. E., Tso, M. E., Warner, D. A., & Miller, D. E. (2002). Effects of a 15-week Language for Learning implementation with children in an integrated preschool. *Journal of Direct Instruction*, 2, 75–86.
- Whitehouse, A. J. O., Watt, H. J., Line, E. A., & Bishop, D. V. M. (2009). Adult psychosocial outcomes of children with specific language impairment, pragmatic language impairment and autism. *International Journal of Language & Communication Disorders*, 44(4), 511-528.

- Wilson, C. L., & Sindelar, P. T. (1991). Direct instruction in math word problems: Students with learning disabilities. *Exceptional Children*, 57(6), 512.
- Wittgenstein, L. (1922). *Tractatus logico-philosophicus*. London: Routledge & Kegan Paul.
- Wooten, J., Merkin, S., Hood, L., & Bloom, L. (1979). "Wh-" questions: Linguistic Evidence to explain the sequence of acquisition. Paper presented at the Biennial Meeting of the Society for Research in Child Development, San Francisco, California.