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# Improving Reading Comprehension of Children with ASD: Implication of Anaphoric Reference Support with Computer Programming

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Improving Reading Comprehension of Children with ASD: Implication of Anaphoric  
Reference Support with Computer Programming

by

Seda Karayazi Ozsayin

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy in Curriculum and Instruction  
with an emphasis in Special Education  
Department of Teaching and Learning  
College of Education  
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## **DEDICATION**

I would like to dedicate this dissertation to my family.

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## **ABSTRACT**

This study examined the effects of anaphoric pronouns presented via computer screen on the reading comprehension of four children with Autism Spectrum Disorder (ASD). Stories from the education.com website were used to collect data. The students' responses to reading comprehension questions during baseline, treatment, and follow-up sessions were analyzed. The perceptions of students regarding anaphoric pronouns were also analyzed. Initially, reading levels, fluency and comprehension rate, of the students with ASD were identified via the Gray Oral Reading Test, Fifth edition (GORT-5), Test of Narrative Language (TNL), and Test of Narrative Language, Second edition (TNL-2). A randomized multiple baseline (MBL) design with a follow-up extension across participants was implemented to determine the effects of anaphoric reference support using computer-based instruction on the students' reading comprehension skills. The analysis indicated a statistically significant increase in the reading comprehension skills. Positive student feedback about using anaphoric reference support with automated computer program supported the effect of the intervention on the reading comprehension of the students with ASD. The researcher presented recommendations for further research and studies.



## **CHAPTER ONE**

### **INTRODUCTION**

According to the Center for Disease Control and Prevention (CDC) (2014), the population of children diagnosed with Autism Spectrum Disorder (ASD) in the United States is consistently increasing. Recent reports reflect a considerable increase in the number of students who are diagnosed with ASD over the last 20 years (Wei, Christiano, Yu, Wagner, & Spiker, 2015, Zein, Solis, Vaughn, & McCulley, 2014). Approximately 673,000 American children aged 3-17 years have been identified with ASD (Zein et al., 2014). In 2014, the CDC reported, about 1 in 68 or 1.5% of children were diagnosed with ASD. Relatedly, around 336,000 individuals with ASD are currently receiving special education services from public and private schools in the United States (Armstrong, 2009, Wei et al., 2015). Schools face this growing number of students every day. Even though students with ASD have specific learning needs, they are often held to the same academic standards as their normally developing peers. Therefore, it is critically important to learn about their academic needs and provide effective instruction (Wei et al., 2015). Further, the use of research-based instructional practice to meet the educational needs of children with ASD in school environments was mandated by the No Child Left Behind (NCLB, 2002) Act and the Individuals with Disabilities Education Act (IDEA, 2004) (Accardo, 2015). Thus, even though some strategies have been identified, research-based and evidence-based

instructional practices are still needed for teachers and professionals who work with children with ASD.

Although the individuals with Disabilities Act (IDEA, 2004) specifies that all students with disabilities have access to the general curriculum and receive appropriate accommodations and modifications to improve their academic performance (Armstrong, 2009), a review of the literature reveals that there is still concern regarding the use of research-based practices in our classrooms. Students with ASD usually have difficulties academically and socially in their classrooms. However, although many studies focus on communication and social skills of students with ASD, they often do not concentrate on the academic achievement of the students with ASD in the classrooms (Wei et al., 2015). Since academic expectations have only recently been tracked for children with ASD, a research gap exists in the literature related to interventions in academic areas such as reading comprehension (Accardo, 2015). Utilizing appropriate strategies in academic areas such as reading comprehension is significantly important to meet the needs of children with ASD in school environments (Wei et al., 2015; Zein et al., 2014).

### **Background and Need**

Autism Spectrum Disorder (ASD), characterized by restricted activity and interests, and disabilities in social interaction and communication skills, is one of the more severe types of disabilities in pervasive development disorders (Hillman, 2011). ASD is known as a spectrum disorder because of the range of severity observed across the disorder. For example, one individual with ASD may need very little support to function independently, which means less severe signs and symptoms while another individual with ASD may need almost consistent support to function in daily life which means more severe signs and symptoms (Gira, 2010).

According to IDEA (2004), “autism is described as a developmental disability significantly affecting verbal and nonverbal communication and social interaction that adversely affects a child's educational performance. Evidence of the disability is generally observed before the age of three.”

While many individuals with ASD, score within the normal range on intellectual testing, social communication and independent functioning may remain as substantial challenges (Allen, Wallace, Greene, Bowen, & Burke, 2010). Historically, children with ASD have been struggling with reading comprehension (Randi, Newman, & Grigorenko, 2011). Kanner was the first researcher who reported reading deficits in children with ASD. In his description, he said children with ASD read tediously and they focus on unrelated portions of stories rather than on the coherent totality (Nation, Clarke, Wright, & Williams, 2006). Additionally, children with ASD struggle with understanding the rules of reading and grammar, lack motivation, and lack attention span (Gira, 2010). As a result, many students with ASD have challenges in reading that impact their academic performance.

In the early stages of reading development, to be able to learn how to read, children should be prepared with the required skills to identify words and decode. To reach this aim, readers should not only comprehend what has been read, but should isolate words during reading. There is a process to be able to comprehend texts. First of all, readers may understand the texts by identifying the words. Then, they need to correlate the meaning of the words with their background knowledge (Nation & Angell, 2006). Improvement in word recognition skills is the most significant issue because this skill enables learners to read words and link texts accurately and fluently. In addition, when a child improves his or her reading skills, he or she

will also develop skills in understanding the meaning of the context. Thus, oral language skills form the basis of successful reading comprehension (Ricketts, Jones, Happe, & Charman, 2012).

Furthermore, for successful reading comprehension, readers should have adequate reading accuracy, and also be able to connect words into messages. Without these two processes, they will fail in reading comprehension (Nation et al., 2006).

For many individuals with ASD, reading comprehension is one of the most difficult areas, although students with ASD often show deficits in word recognition as well. For example, poor oral language skills are one of the features of reading in children with ASD. These skills make them unsuccessful in literacy because individuals with ASD have deficits in oral language development resulting in causes challenges in learning to read (Nation et al., 2006).

Even though students with ASD often have deficits in reading comprehension, they may learn how to read and improve their reading comprehension (Frith & Snowling, 1983). Little research exists regarding how individuals with developmental disabilities such as ASD, learn to read. Knowledge about reading development of individuals with ASD is critical because many studies imply that children with ASD can improve reading comprehension and decoding skills when appropriate approaches or strategies are applied (Davidson & Weismer, 2014). Therefore, reading comprehension is an important area to target in efforts to help children with ASD achieve academically (Ricketts et al., 2012).

Some strategies such as direct instruction, peer tutoring, graphic organizers, and explicit instruction have been shown to be effective in improving reading comprehension skills of children with ASD (Finnegan & Mazin, 2016). However, a review of literature indicates a need for additional research to identify effective practices specific to improving reading comprehension for these individuals (Accardo, 2015). One of the biggest challenges for trainers

and educators is the lack of agreement on appropriate training to improve reading comprehension skills in individuals with ASD (Allen et al., 2010). This study contributed to the field by identifying an effective instructional practice for improving reading comprehension of children with ASD.

### **Statement of the Problem**

Interest in the identification of evidence-based practices for children with ASD has been increased. This may be due to the increase in the number of children diagnosed as having ASD and requiring special education services. This creates a need for school districts, teachers, and families to identify scientifically based educational practices (Armstrong, 2009). Additionally, the field of education is now placing a greater emphasis on identifying practices that demonstrate scientific evidence for their effectiveness (Armstrong, 2009). Research based reading comprehension strategies are of particular importance because of the challenges children with ASD have in this area and the importance of reading comprehension to academic success. Research in regard to reading comprehension and individuals with ASD is an issue of concern because it is well known that individuals with ASD have deficits with comprehension (Accardo, 2015). Despite the importance, a review of literature demonstrates that there is little research guidance to identify effective practice specific to improving reading comprehension for children with ASD (Accardo, 2015).

This study advanced our understanding of the use of anaphoric reference pronouns with an automated computer program, indicated by O'Connor and Klein (2004), to fill the gap in the literature. It was the first study to examine anaphoric reference by using computer-based instruction to improve reading comprehension skills of children with ASD.

## **Purpose of the Study**

This study investigated the use of anaphoric reference support using computer-based instruction to improve reading comprehension for students with ASD. Participants were in 3<sup>rd</sup> through 5<sup>th</sup> grade level.

## **Rationale for the Study**

One strategy that was identified early in the research showing promise for improving reading comprehension for students with ASD was anaphoric referencing (Charles, 2016). However, there have been no follow-up studies to investigate this further. The use of computers have been shown to be motivating for students with ASD and effective in supporting their reading comprehension (Williams, Wright, Callaghan, & Coughlan, 2002). However, no studies to date have examined the combination of anaphoric referencing with computer assisted instruction to improve reading comprehension among students with ASD. Therefore, this study explored anaphoric reference support with computer programming as a potential means of improving reading comprehension among students with ASD.

## **Research Questions**

The following research questions were addressed in this study:

1. What is the effect of anaphoric support via computer-based instruction on overall reading comprehension of students with ASD?
2. What is the effect of using and then removing anaphoric support via computer-based instruction on the overall reading comprehension of students with ASD?

## **Limitations and Delimitations**

Although a single-case experiment has many advantages, the design also has weaknesses. Generalization is the primary weakness. The number of children participating in the study did

not represent the entire population. In addition, the participants were not selected randomly from the entire population because of the small population. In this specific study, the impact of reader's background knowledge, nature of the text, and text difficulty may have been limitations. With regard to the reader, skill, accuracy, and fluency of the participants may have also affected the results. For example, a child who has good vocabulary knowledge may have high scores from the tests (Carnahan & Williamson, 2011). Structure of the text such as predictable structure, is another important factor affecting the results of the comprehension. In addition, text difficulty could be a factor affecting outcomes.

For the purpose of delimitation, the researcher used several inclusion and exclusion criteria to draw boundaries of the study. The participants were those identified as having ASD by the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) criteria by a psychologist or physician. The researcher also considered results of the intelligence tests demonstrated total IQ scores (WISC III or IV, Stanford Binet III, IV, or V, Woodcock Johnson III). Because children with ASD who speak second languages would demonstrate compounding linguistic variability and they may exhibit speech disorders or delays (Armstrong, 2009), the researcher only included children who were monolingual with their primary language being English. Names of the children were changed to protect their privacy. Before starting the research, the researcher obtained informed consent from the parents and also assent from the children.

### **Definition of Terms**

1. Central Coherence - ability to shape significant issues across stimuli and generalize the information of contexts (Diehl, 2015).
2. Executive Function - directing, monitoring, and regulating our thoughts, attention, and behavior in many different situations (Carnahan & Williamson, 2010).

3.Theory of Mind - the capability to connect mental conditions to others and to oneself (Begeer, Gevers, Clifford, Verhoeve, Kat, Hoddenbach & Boer, 2011).

4.Reading Comprehension - recall, understanding, and integrating of information stated in or cognizable from specific text passages (Carnahan & Williamson, 2010).

5.Anaphoric Cuing - a specific procedural facilitator that helps the reader identify the correct pronoun referent in a group of sentences (Campbell, 2010).

### **Summary**

In this chapter, definition of the terms, research questions, purpose of the study, and need for the study were discussed. The information in this chapter indicates that there is a need to study reading comprehension for children with ASD to better meet their needs. In the following chapter, a review of related literature is addressed. Existing research related to reading comprehension and students with ASD are reviewed. Research regarding interventions utilizing anaphoric reference support with students who have ASD is reviewed to affirm that this study contributed to the knowledge base regarding reading comprehension for students with ASD and anaphoric reference strategy.



## **CHAPTER TWO**

### **LITERATURE REVIEW**

Reading comprehension has been described as the recall, understanding, and integrating of information stated in or cognizable from specific text passages. The ultimate goal of reading instruction is silent reading with comprehension. Decoding, sight word knowledge, text structure awareness, word knowledge, and reading fluency are other reading abilities and skills. These are also significant components of the ability to understand texts (Carnahan & Williamson, 2010). Reading comprehension depends on students' knowledge and language, and their ability to apply that knowledge to understanding, interpreting, and applying information in written texts (Carnahan & Williamson, 2010). Children with ASD often present an inability to interpret and comprehend information. They have difficulties with comprehension when they attempt to interpret verbal, nonverbal, and social communication. They also face challenges when working with written language (Armstrong, 2009).

The following section reviews the relevant literature on ASD and highlights the research gap in the literature in regard to reading comprehension interventions for students with ASD. The review is divided into three parts. First, cognitive theories relating to reading comprehension skills of students with ASD are reviewed. In the second part, the reading comprehension skills of children with ASD are discussed, and in third part, reading comprehension strategies and rationales for using anaphoric reference support are explained in detail.

The works reviewed here are gathered from articles, books, and dissertations using Academic Research Premier, Google Scholar, the Education Resources Information Center (ERIC), JSTOR Education, PsycINFO, and ProQuest.

### **Cognitive Theories on Reading Abilities of Individuals with ASD**

Many cognitive concepts and theories have been invoked as relevant to understanding the reading comprehension of students with ASD, including Theory of Mind (ToM), executive functioning, central coherence, and the Simple View of Reading (Carnahan & Williamson, 2010).

#### **Theory of Mind**

The Theory of Mind (ToM) was first defined by Premack and Woodruff in 1978 (Westby & Robinson, 2014) in their research on chimpanzee behavior (Premack & Woodruff, 1978). They described ToM as the ability to identify the mental states of others. There are two abilities considered to be part of ToM: (a) the ability to identify the beliefs, thoughts, and intentions of other people, and (b) the use of this ability to predict the behavior of others (Carnahan & Williamson, 2010). ToM in the context of ASD was first discussed by Baron-Cohen, Leslie, and Frith in 1985. Understanding other people's beliefs, thoughts, and emotions, and predicting the behaviors of others are often challenging to individuals who have ASD because of their social-communication differences. These difficulties impact their pragmatic language use and language comprehension (Carnahan & Williamson, 2010). By the late 1980s and the 1990s, ToM was seen to be deficient in individuals who have ASD. These deficits and delays in the development of ToM were not limited to young children, adult, or adolescents with ASDs, but were seen in individuals with language impairments, attention-deficit/hyperactivity disorder, deafness, and traumatic brain injury. In regard to the cognitive style of individuals with ASD, ToM is a known

factor affecting their reading comprehension skills, because deficits in ToM hinder an understanding of the mental states of story characters and how these internal states motivate character behavior in the stories (Lucas & Norbury, 2014). Effective and appropriate social communication and pragmatic language skills require that an individual have a well-functioning ToM (Westby & Robinson, 2014).

Understanding and predicting other people's behaviors, thoughts, and interests improves the perspective-taking abilities of individuals with ASD. In a literacy context, perspective taking is crucial to grasping the actions of characters in a story while reading and listening. To comprehend a text, individuals with ASD need to understand how and why a character behaves a certain way and need to use different perspective while they read. Furthermore, sometimes individuals with ASD have a difficult time understanding another person's figurative language and engaging in shared experiences (Carnahan & Williamson, 2010). For example, when a teacher or supervisor says "get moving" during a seated activity, an individual with ASD may hear it as "stand up and move around." These deficits may negatively impact the ability to make predictive and causal inferences. Thus, individuals with ASD might have difficulty building a situation model consistent with a text (Carnahan & Williamson, 2010). In addition, ToM provides latent explication abilities that do not necessitate advanced verbal skills or concepts (Begeer, Malle, Nieuwland, & Keysar, 2010). ToM is usually used with tasks that concentrate on emotion recognition (Begeer et al., 2011).

### **Executive Function**

Executive function is set of abilities or skills that enables us to sustain a mentally specific goal and then apply this goal in many different situations (Carnahan & Williamson, 2010). It is a broad ability that enables us to monitor, organize, and direct our attention, thoughts, and

behaviors in the face of distracting alternatives (Carnahan & Williamson, 2010). Executive function includes working memory, fluency, cognitive flexibility, planning and initiation, and inhibition skills (Carnahan & Williamson, 2010).

Individuals with ASD have been shown to have challenges with executive function in several areas, such as transitioning. These may cause a person to struggle in various areas (i.e., moving from one activity to another, completing complex tasks, integrating new experiences into background knowledge, or self-monitoring behavior) (Carnahan & Williamson, 2010).

In addition to social-behavioral effects on individuals with ASD, executive function also impacts the reading abilities of individuals with ASD. Reading is a complicated process. For instance, while we read, we monitor our comprehension and self-correct as needed, with attention to details. To be able to understand a text correctly, monitoring and self-correcting are required (Carnahan & Williamson, 2010). However, individuals with ASD have difficulties with attention and memory in regard to organizing and planning. Therefore, differences in executive function impact their reading comprehension skills (Carnahan & Williamson, 2010).

### **Central Coherence**

Children with ASD have difficulty combining information from different sources to reach holistic meaning. This deficit was termed “central weak coherence” (Lucas & Norbury, 2014) by Frith in 1989, who defined it as a cognitive style of individuals with ASD that makes them focus more locally than globally on textual information. Making inferences is known to be confusing for people with developmental disorders, and central weak coherence has a great impact on the making inference ability of individuals with ASD (Norbury & Bishop, 2002) who are unable to comprehend texts (Norbury & Bishop, 2002). They may focus on details and parts of texts, like sentence comprehension, rather than on general features (Diehl, 2015), and they may have

challenges in processing information at the paragraph and overall text levels, and in making connections among sentences and paragraphs (Carnahan & Williamson, 2010).

### **Simple View of Reading**

The Simple View of Reading is a reading development theory that holds that reading comprehension is fundamental to good reading skills. In addition, decoding and listening comprehension are also considered essential skills for good reading comprehension (Davidson & Weismer, 2014). The Simple View of Reading theory proposes that receptive language abilities are considered a predictor of reading ability. According to Lucas and Norbury (2014), the Simple View of Reading asserts that reading comprehension comprises decoding skill and oral language comprehension. The cognitive, linguistic, and reading profiles of children with ASD range from low to high levels on standardized measures. However, the reading comprehension profiles of many children with ASD are poor, which means their comprehension falls behind the appropriate age development and reading accuracy. Davidson and Weismer (2014) observed that decoding is recognized as involving word-recognition skills, phonological awareness, and orthographic coding. However, listening comprehension is identified as the comprehending of oral linguistic information, and it also involves morphosyntax, vocabulary, and pragmatics. Reading is not easy for individuals; it requires comprehensive skills.

Reading comprehension also requires the use of ToM skills, executive function, and central coherence skills (Agbeyewa, 2010). This study addresses the effectiveness of direct instruction in the form of anaphoric reference support, via computer programming, to improve the reading comprehension skills of children with ASD. Few studies have examined ways to improve the reading comprehension of individuals with ASD (Cotter, 2011). In those that have

been done, researchers have used different interventions, such as social stories. However, very few studies have considered anaphoric reference for improving reading comprehension skills.

### **Types of Reading Disorders**

Reading disorders are classified based on problems with reading comprehension and decoding skills. The cause of reading comprehension disorder has not been established. However, studies show that poor oral language abilities are seen more in poor comprehenders. For example, in a study by Davidson and Weismer (2014), individuals with specific language impairments demonstrated problems in phonological processing issues and oral language abilities.

Phonological processing issues are usually seen individuals with dyslexia, who are also known to be poor decoders. As well, other, non-linguistic factors influence reading comprehension skills. For instance, background knowledge, motivation, and working memory affect the reading comprehension skills of individuals. These factors are found to influence individuals who are poor comprehenders or individuals who have specific reading comprehension disorders. Individuals with ASD are usually known as poor comprehenders (Davidson & Weismer, 2014).

### **Cognitive Profiles of Individuals with ASD in Regard to Reading Comprehension**

It is worth noting the history of reading instruction for children with specific educational needs before considering the reading ability of individuals with ASD. In the past, records indicate that individuals with ASD did not take reading instruction, which required basic skills such as knowing all of the sound-letter correspondences. According to emergent literacy views, individuals with developmental disabilities should be taught how to read (Davidson & Weismer, 2014). Children with ASD have many disadvantages in communication, social, and academic

areas, and reading comprehension is an area of struggle for them. Many children with ASD are at risk for reading impairment because they have disorders that affect pragmatic processes, cognitive abilities, and oral language (Arciuli, Trembath, & Simpson, 2013).

Individuals with ASD usually focus on detailed parts of reading passages more than on general features. According to research findings, students with ASD are good at word recognition but have weaknesses in reading comprehension (Davidson & Weismer, 2014; Finnegan & Mazin, 2016; Randi et al., 2010).

The cognitive profiles of the students with ASD may explain why individuals on the spectrum have these differences. According to Randi et al. (2010), students with ASD use more visual imagery to make sense of sentences because of a deficiency of connectivity between the frontal and parietal regions of their brains. In other words, by thinking in pictures to understand sentences, students with ASD try to adjust the under-connectivity among those regions that causes reading comprehension deficits at the discourse or text levels. To be able to understand long passages or construct a global understanding—in other words, to “comprehend a reading”—students with ASD should use their memory to form an organizational structure and schema to facilitate memory (Randi et al., 2010). However, they have memory deficits and cannot use organizational structures to help with memory. In addition to these deficits, focusing on details in the passages contributes to reading comprehension deficits because, for readers on the spectrum, it leads to difficulties in connecting parts of texts into a coherent whole (Randi et al., 2010). These deficiencies may also contribute to reading comprehension deficits.

Even though students with ASD have difficulty with reading comprehension because of these deficiencies, studies have shown that they may improve their reading comprehension skills

when intervention or instruction is provided in keeping with their demands and needs (Randi et al., 2010).

### **Theoretical Framework of the Present Study**

According to constructionist theory, readers may comprehend a text when they make inferences based on the global message (Charles, 2016). Although children with ASD have adequate language ability, they might not use the words correctly or utilize the words to describe emotional or mental states. They often engage in one-sided interactions with other people, and they are usually non-reciprocal. One of the common deficits in the language of individuals with ASD is pronoun reversal errors (Campbell, 2010)—that is, they usually are unable to identify pronouns in texts. This deficit is related to joint attention interactions of individuals with ASD. They have difficulty with shifting references between the speaker and listener. For instance, calling a person by name, like “Mike,” is comprehensible for them because they do not care whether the person is listener or speaker; however, using a pronoun to call a person “I” or “you” is a problem, because they might not be able to tell from the pronoun who is the speaker and who is the listener (Campbell, 2010).

This current study is based on the theorem that students with ASD have challenges identifying references in a text and constructing a mental representation. This may cause difficulty with pronoun mastery for students with ASD (Charles, 2016).

### **Reading Skills of Individuals with ASD**

There are crucial skills and functions for all individuals, such as communication, critical thinking, academic involvement, independence, and lifelong learning. Literacy skills enable a student to improve and establish a foundation for developing quality of life without consideration of the student’s ability or functioning level (Carnahan & Williamson, 2010). Decoding and



comprehension are considered the two bases of reading ability. Children with ASD usually exhibit differences in speech and language skills (Arciuli, Trembath, & Simpson, 2013; Campbell, 2010); however, many of them have disabilities that affect these skills (Arciuli et al., 2013).

Most children with ASD demonstrate language delays before the age of three. *Echolalia* is a common impairment in the verbal language of children with ASD; it consists of the exact repetition of words or phrases that have been said by someone. Children with ASD usually exhibit communication deficits in different ways. For example, they might have difficulty responding to verbal information or they might have problems understanding complex commands. Thus, children with ASD usually need to have verbal information repeated (Campbell, 2010).

The word-reading abilities of students with ASD often develop at an early age; in contrast, their decoding and reading comprehension skills are not usually as well developed (Norbury & Nation, 2011). According to Norbury and Nation (2011), almost 65% of students with ASD show difficulties in reading comprehension.

In addition, most students with poor reading comprehension demonstrate poor word-level reading. Studies show that there are variations in the reading development of students with ASD, which may be due to differences in oral language skills (phonology, syntax, and semantics). Some individuals with ASD may demonstrate difficulties with verbal language. However, some may use grammatically accurate speech and be verbally fluent (Norbury & Nation, 2011). Oral language competence may cause variations in language development of the students with ASD, and deficits in this area may lead to difficulties in word-level reading and reading comprehension (Norbury & Nation, 2011). Although literacy skills are very important for all people, individuals

with ASD may have difficulty accessing literacy instruction that would improve their literacy skills. This is because they have challenges in social communication and cognitive processing. Therefore, educators should actively engage students with ASD in meaningful literacy experiences to improve their literacy skills (Carnahan & Williamson, 2010).

Word identification and text comprehension are the basis of reading skills. The literature indicates that individuals with ASD may have great skill in decoding and word calling; however, they usually have challenges in reading comprehension (Carnahan & Williamson, 2010; Arciuli et al., 2013), even though they demonstrate acceptable letter/word recognition skills and average word reading accuracy. Good readers are capable of integrating information in a text by making inferences about the referents of pronouns, the states of characters in a passage, and the meanings of words. Poor comprehenders have deficits in making inferences when they read or listen because of their poor comprehension ability (Campbell, 2010). The literature indicates that children with ASD have difficulty making inferences about reading passages (Campbell, 2010); they also have difficulties with prior knowledge and with switching attention from the local to the global level (Arciuli et al., 2013).

### **Reading Comprehension in ASD**

Reading comprehension has been described as the recall, understanding, and integration of information stated in, or cognizable from, specific text passages. It is a complex task and requires active reader engagement to be able to gain meaning from print. Readers should use high-level cognitive functions to understand a task. Reading comprehension is significant in the development of literacy skills (Finnegan & Mazin, 2016). The ultimate goal of reading instruction is silent reading with comprehension. Decoding, sight word knowledge, text structure

awareness, word knowledge, and reading fluency are other reading abilities and skills that are also crucial to understanding texts (Carnahan & Williamson, 2010).

Reading comprehension depends on a student's knowledge and language skills, and on the ability to use them to understand, interpret, and apply information in written texts (Carnahan & Williamson, 2010). Children with ASD often present an inability to interpret and comprehend information (Armstrong, 2009). They have difficulties in comprehension when they attempt to interpret verbal, nonverbal, and social communication. They also face challenges in writing language that inhibit the development of their reading comprehension (Armstrong, 2009). Studies show that students with ASD demonstrate low levels of reading comprehension, even though they can match their peers in reading accuracy and IQ. Researchers have found that performance in reading comprehension is related to the verbal ability of students, and that there are specific factors related to reading comprehension in individuals with ASD (Finnegan & Mazin, 2016).

*Hyperlexia*. On the other hand, children with ASD might have good academic achievements in certain areas, such as reading, word recognition, and math. Having a good achievement in word recognition, first defined by Silderberg and Silderbeg in 1967 (Arciuli et al., 2013), is called *hyperlexia* (Wei et al., 2015). Hyperlexia means that children with ASD have superior skills in word recognition; however, they may not exhibit them for reading comprehension (Wei et al., 2015). It is not certain, but 5% to 10% children with ASD could have hyperlexia. When reading comprehension is poorer than reading accuracy in an individual with ASD, it is considered possible that this person might have *hyperlexia* (Arciuli et al., 2013).

It should be said that the concept of hyperlexia is a matter of debate; some researchers argue that it exists, while others reject the idea. Among those who recognize its existence, some

debate how it should be defined. This is noteworthy because many individuals with ASD are said to have hyperlexia based on the results of the research (Davidson & Weismer, 2014).

The literature shows students with ASD score the same on reading-related tasks as their normally developing peers, although they demonstrate difficulties in reading comprehension. According to one study (Grigorenko, Klin, & Pauls, 2002), 20.7% of students with ASD presented variations in hyperlexia (Wei et al., 2015).

Hyperlexia and a lack of prior background knowledge may cause impairments in the reading comprehension of individuals with ASD (Gira, 2010). A profile of well-developed word recognition with less-developed reading comprehension skills is associated with ASD (Randi et al., 2010). Hyperlexia involves impairments in reading comprehension; children with hyperlexia develop good reading accuracy, but their reading comprehension is impaired because of their linguistic deficits (Gira, 2010). This situation has a neural basis. fMRI scans of brain activity show that when students with hyperlexia read, they synchronically use their left hemisphere's phonological system and their right hemisphere's visual processing system. This complication causes to have deficits in reading comprehension (Randi et al., 2010).

The majority of children who have ASD demonstrate poor reading comprehension, although they achieved adequate levels of reading accuracy. Thus, poor reading comprehension is an indicator of hyperlexia, which is associated with ASD (Gira, 2010). There is also a correlation between semantic knowledge and reading comprehension. Individuals with ASD may have difficulty with semantic knowledge, which might affect their reading comprehension skills. In addition, they may have trouble when they are required to combine specific knowledge with the global comprehension of a text (Finnegan & Mazin, 2016). This causes them to have poor

reading comprehension. Each individual has cognitive differences which might also influence reading comprehension skills.

Theory of Mind (ToM), executive function, and weak central coherence can help to explain the cognitive differences of individuals with ASD (Finnegan & Mazin, 2016). The important component of reading comprehension is the ability to access prior knowledge. Studies have shown that children with ASD are generally unable to do this when they read (Gira, 2010). *Inference-Making*. Anaphoric expressions are significant for sustaining cohesion within and between sentences. Pronouns, substitutions, and ellipses are anaphoric expressions. They may help integrate a text for comprehension. Studies have shown that children with ASD display low performance in their comprehension of anaphoric expressions. In a study by Yuill and Oakhill, children with poor comprehension skills had trouble understanding one type of anaphor, such as pronouns, in the text. In addition, they had more difficulty when they were required to use complex anaphoric references to resolve pronouns. These findings indicate that poor reading comprehension may be related to a lack of skill in identifying anaphors in a text (Yuill & Oakhill, 1988).

### **Strategies for Improving the Reading Comprehension of Individuals with ASD**

Reading is a very important skill. Reading ability provides individuals with the means to improve their communication and learning opportunities (Nation & Norbury, 2005). Academic achievement, specifically reading achievement, is significant for all students, including those with ASD. The level of students' reading and understanding of written materials affects their academic success. Through written materials, they may gain self-sufficiency skills, knowledge, and personal enjoyment. When they become literate, they may also learn independently (Campbell, 2010). Therefore, designing instruction and creating interventions to improve reading

comprehension skills is critical not only for students with ASD, but also for students with other developmental disorders (Randi et al., 2010).

Although students with ASD have difficulties with reading comprehension because of these deficiencies, studies show that they may improve their comprehension when intervention or instruction is provided based on their demands and needs (Randi et al., 2010).

Armstrong and Hughes (2012) examined the impact of two repeated reading interventions (computer and storybook) on the comprehension of five high-functioning children with ASD. They used comprehension questions and story retellings to collect the data, and applied a single-subject design with randomization. Three students with ASD increased their performance on reading comprehension during the intervention sessions. However, two children with ASD did not improve their performance as much as had been expected. The overall results show that the children with ASD were successful when repeatedly reading along with either by a storybook or a computer.

Carnahan and Williamson (2013) designed a study to examine the effects of a compare-contrast text structure on the comprehension of a science text for three middle-school students with ASD who were in low reading levels. They also included a classroom teacher to implement treatment fidelity. The students were required to read passages and then compare and contrast key words from handouts. After reviewing the key words and concepts, the students were directed to a Venn diagram, which showed the accuracy of the content and the number of propositions recorded by the students. The comprehension scores indicated that the students took more than 90% in PND evaluation. One of the students had a PND of 100%. These results demonstrate that systematic and explicit instruction was effective in improving the ability of students with lower reading levels to attend to academic content.

Flores and Ganz (2007) noted that there had been limited research on the reading comprehension ability of individuals with developmental delays, including those with ASD and that there had been no research on any direct instruction reading comprehension program for individuals with ASD. Their study was the first research to evaluate a direct instruction strategy for students with ASD. They designed their study to evaluate the effectiveness of a direct instruction reading comprehension program with regard to reading comprehension skills, with specific reference to students' progress in statement reference, utilizing facts and analogies. In this study, the researchers used multiple-probes across a behavior design to assess the effectiveness of the intervention. Four elementary school students participated. The results show that the direct instruction reading comprehension program was effective for students with developmental delays; they needed no additional instructions during the study. (However, the researchers used some visual cues for one student.)

Knight, Wood, Spooner, Browder, and O'Brien (2015) observed that computer-based instruction was useful for students with ASD in reading, specifically in regard to sentence construction, decoding and word identification, and basic reading skills. The researchers piloted a study to assess the impact of Book Builder™ (BB) on measures of vocabulary, literal comprehension, and application questions. The participants were four middle-school students with ASD. BB was found to be helpful for increasing the students' science knowledge and was beneficial. The students preferred eText books more than traditional books; they also indicated their satisfaction at using eText books at the end of the study.

*Anaphoric Reference:* Anaphora is an element in a text that refers back to a previous element or elements. Anaphoric devices use two different signals that provide information to readers and listeners on where to locate the referent. One is the zero anaphora signal. With this signal, the

referent is currently the focus of attention (O'Connor & Klein, 2004). For example, "Lisa came in and sat down." In this sentence, "she" is the missing term. It should be "Lisa came in and (she) sat down. However, in this sentence "she" is not indicated, so "sat" is considered as the zero anaphor, the null element. In other words, zero anaphor is the absence of a linguistic item (Colle, Baron-Cohen, Wheelwright, & Van Der Lely, 2008).

On the other hand, with a pronoun anaphora signal, the referent is already discussed and stocked in memory, yet it is not currently the focus of attention (O'Connor & Klein, 2004). For instance, "I asked Johnny to come with me, and he came." In this sentence, "he" is a pronoun anaphor (Colle et al., 2008). Pronoun anaphora is the most common form of anaphora (O'Connor & Klein, 2004). Educators may utilize verbs or whole sentences as pronoun anaphora (Colle et al., 2008). According to Yuill and Oakhill (1988), anaphoric expressions refer to an element recommended by the text, and they meld into the reader's model of the text.

Students with ASD have difficulties integrating their prior knowledge in order to understand a text. Moreover, they do not relate pronouns to prior nouns. The results of study showed that individuals with ASD read texts quickly and pass over anaphora without pausing, even if they are not familiar with the topic (O'Connor & Klein, 2004).

Norbury and Bishop (2002) assessed the story comprehension skills of children with pragmatic language impairments, specific language impairment, and high-functioning autism. Sixteen children with specific language impairment, 24 children with pragmatic language impairment, and 10 children with high-functioning autism, all of whom ranged in age from 6 to 10 years were recruited in the study. In addition to these specific groups, 18 typically developing children were recruited as the control group. The researchers administered many assessments to measure the children's reading and language ability. They found that children with high-



functioning autism had the lowest scores on the inferencing questions; however, there were no significant differences among the children in the clinical groups and the children with pragmatic and specific language impairments.

O'Connor and Klein (2004) hypothesized that procedural facilitation, anaphoric cuing, cloze sentences, and pre-reading questions would make a great impact on the comprehension skills of children with ASD reading text passages. The researchers utilized five adapted stories for 25 participants who had moderate to high levels of decoding and lower levels of reading comprehension. The participants all had ASD; their mean age was 15.11. The researchers requested that they read five stories aloud, after which, they were required to answer pre-reading questions, complete cloze sentences, and dissolve anaphora by determining the referents. A within-subject design was used, and the questions were administered via post-hoc contrast tests to indicate the effectiveness of the three interventions on the dependent variable. The results show that the procedural facilitation variable was statistically significant for the reading comprehension of the children with ASD. Specifically, anaphoric cuing made the greatest impact on the improving the comprehension; the other two interventions made a small impact. The researchers suggested that parents, teachers, and educational assistants should promote the students with ASD to use the antecedent pronouns while they read. In addition, they recommended that future studies use computer software as the means of facilitation. This study was the first experimental study to measure the impact of facilitation strategies on the reading comprehension of students with ASD.

In another study, Oakhill and Yuill (1986) tested the ability of skilled and less-skilled comprehenders to understand pronouns. The researchers applied two different memory conditions with 24 participants. The subjects were grouped based on matching tests for word

recognition and reading vocabulary; however, they differed in their performance on reading comprehension. Thus, according to this criteria, 12 participants were selected as skilled comprehenders, and 12 participants were chosen as less-skilled ones. Thirty-two sentences were utilized to measure understanding of the pronouns used in the sentences. The independent variable in the study was a gender cue, and dependent variable was pronominal reference. The study found that skilled comprehenders usually made fewer errors than less-skilled comprehenders at assigning antecedents to pronouns. The researchers emphasized that this occurred because less-skilled comprehenders had difficulty integrating their previous knowledge and using their memory to assign antecedents to pronouns. The researchers suggested that different representations of the pronouns would be helpful for the less-skilled comprehenders.

Nation and Norbury (2005) examined the reading comprehension skills of children with ASD, specific language impairment, and specific impairments in reading comprehension in a study entitled “Why Reading Comprehension Fails.” The researchers indicated that reading comprehension deficits are not common. Many children are able to read the written word effectively by mid-childhood; however, some children may have deficits in understanding what they read. This is because these children might have oral language deficits. Via this study, the researchers applied a framework to understand variations in the reading comprehension skills of the subjects, and they provided appropriate interventions to improve the participants’ comprehension of the texts. In this framework, there was a quadrant tool called the Simple View of Reading, which demonstrated the interaction of language domains. For example, in the tool, quadrant A showed dyslexia, quadrant B showed no impairment, quadrant C showed generally poor readers, and quadrant D showed poor comprehenders. Via this tool, educators could identify the children’s needs and challenges. The results showed that phonological skills

were important to the ability to decode text, but non-phonological language skills, syntax, semantics, morphology, and pragmatics contributed to text comprehension. The researchers recommended that educators try to identify which aspects of the reading comprehension process are disabled in children with poor comprehension.

Campbell (2010) investigated how direct instruction, with prompting in the form of anaphoric cues, might improve the reading comprehension skills of 21 children with ASD. The researcher used direct instruction in the form of discrete trial instruction. The Letter-Word Identification and Passage Comprehension subtests of the Woodcock Johnson III Tests of Achievement Form A and the Listening and Grammar Comprehension subtests of the Test of Language Development (TOLD), Primary (IV) and Intermediate (III) were administered to the children with ASD to produce low passage comprehension and high word identification word scores. The researcher utilized the school district's different reading series at each session. The children with ASD answered *wh*- questions, who, what, when, where, and why, after the reading activity. Then the researcher presented three pronoun referents to the intervention group; these included two appropriate words and one inappropriate word. The researcher selected and presented reading passages, *wh*- questions, and pronoun referents randomly for each session. At the end of the study, the researcher found that direct instruction on the identification of pronouns improved the passage comprehension scores of children with ASD but did not enhance their ability to define pronouns. The researcher suggested that the reading skills of children with ASD vary. Thus, researchers should investigate different types of reading instruction for students with ASD. In addition, the researcher emphasized that, in future ASD studies, anaphoric cues with a programmed computerized reading series could benefit the reading comprehension skills of children.

Colle, Baron-Cohen, Wheelwright, and Van der Lely (2008) examined pragmatic skills in individuals with high functioning autism (HFA) and Asperger syndrome (AS) using referential expressions (temporal expressions and anaphoric pronouns) during a story-telling task. Twelve adults with HFA and AS and 12 matched controls were participants. The famous wordless picture book *Frog, Where Are You?* was presented to the participants. The researchers used a coding scheme to analyze length and episode referential expressions, temporal expressions, and mental state expressions. The study found that adults with AS showed less skill in using personal pronouns, temporal expressions, and referential expressions compared to the other group. The researcher emphasized that Theory of Mind abilities were needed to improve these abilities.

Van Riper (2010) researched the effects of the directed-thinking activity on the reading comprehension skills of three middle-school students with ASD. In this study, the researcher utilized information from the National Institute of Child Health and Human Development (NICHD) which was reported in 2000. In this report, some strategies for increasing the reading comprehension skills of individuals with ASD were recommended. The strategies were: making predictions, activating prior knowledge, using visual prompts, organizing information with graphic organizers, making connections with the text, and eliciting group discussion. An adapted book was used to measure the reading comprehension skills of the three participants. To gather the data, the researcher included pre- and post-tests consisting of 10 multiple-choice questions following each book chapter. An ABAB reversal design was used. According to the results, middle-school children with ASD improved their reading comprehension skills thanks to the directed reading-activity strategy.

Weissinger (2013) contributed to the field with her dissertation study. In this research, the examiner explored how executive function in normally developing students and students with

ASD affected the children's reading comprehension abilities. Eleven students with ASD and 37 typically developing students who were in the fourth through eighth grade participated. The Peabody Picture Vocabulary Test, the Comprehension subtest of the Stanford Diagnostic Reading Test – Fourth Edition, Happé's Strange Stories Test, and the Tower Test of the Delis-Kaplan Executive Function System were administered to measure receptive vocabulary, reading comprehension level, Theory of Mind, and the executive functioning skills of the students in the study. The examiner collected the data over two sessions. In Session 1, fluency, executive functioning, and word recognition tests were administered. In Session 2, a reading comprehension test was given. Standard deviation, means, and group differences were analyzed. The results show that word recognition, reading fluency, and receptive vocabulary were significantly correlated with reading comprehension abilities in both groups.

According to results of the studies, anaphoric reference has a significant positive effect on the reading comprehension skills of children with ASD. In this current study, the researcher investigates whether pronoun anaphora using with automated computer software can improve the reading comprehension skills of children with ASD.

## **Summary**

In this chapter, theoretical concepts regarding reading comprehension in individuals with ASD, the reading comprehension skills of individuals with ASD, and strategies for improving the reading comprehension skills of these individuals were discussed. The review of the literature indicates that improving the reading comprehension skills of individuals with ASD is needed for their success in school environments. However, there is limited research on the effects of pronoun anaphors on the reading comprehension of children with ASD. This study aims to fill

this gap and provide the results of experimental research on the effects of pronoun anaphors on children who have ASD.

## **CHAPTER THREE**

### **METHODS**

The research questions for this project were developed based upon a thorough review of the literature and are the foundation for the study. They provide the anchor for the theoretical and conceptual framework, the methodology, and the research protocol. In the following section, the research procedures, the single-case design, the data analysis, and research implications are discussed.

#### **Research Questions**

The following research questions guided this study:

1. What is the effect of anaphoric support via computer-based instruction on the overall reading comprehension of students with ASD?
2. What is the effect of using and then removing anaphoric support via computer-based instruction on the overall reading comprehension of students with ASD?

#### **Population Characteristics**

The population of the study consisted of students in grades three through five identified with ASD. Five such students participated in the study.

#### **Sampling Procedure**

##### **Sampling Administration**

The purpose of the study was to examine the effects of pronoun anaphora on the reading comprehension skills of students with ASD. Because students with ASD are a low-incidence

population (Armstrong, 2009), the researcher was not interested in achieving population validity (Griess, 2010). Purposeful sampling and voluntary participation were utilized.

The research was conducted at the participants' homes and at a public library, at times convenient for the participants. Three participants requested to work at their houses. One participant preferred to work at a public library in a study room that was free of, or had few, distractions. The room contained three chairs, one rectangular table, and a trash receptacle. All baseline, intervention, and follow-up sessions were conducted in the preferred settings. During the baseline session, the participants were required to read the stories and answer the *wh*-questions. For the intervention session, the participants were required to read stories using the computer program, indicate the anaphoric pronouns, and then answer the *wh*- questions about the stories. For example, the participant was required to make a mouse click to see the pronouns in parentheses on the computer screen. The researcher asked the participant, "What does this pronoun stand for?" If the participant answered correctly, he/she continued to read the story. If the participant did not respond, the researcher helped him or her to answer.

All stories were selected based on the participants' grade levels. The sessions were conducted at least two days a week, based on the participants' availability. Each passage and break during the sessions took approximately 10 minutes. A complete session lasted about 20 minutes for each participant. The researcher utilized responses to the questions about the story as data. For the intervention session, the researcher asked the participants to read the questions again and try to remember when he or she made a mistake. If the participant still did not remember or give the right response, the researcher showed the correct answer to the participant. The intervention session was completed when the participant gave verbal confirmation of having



understood the task. For each time, when the participant responded the questions correctly, the researcher rewarded the participant verbally, such as “Good job!”

### **Consent**

IRB approval was received through the Institutional Review Board at the researcher’s institution. Written consent to participate in the study was obtained from the participants’ parents or legal guardians, and written consent was obtained from all of the participants to ensure confidentiality and protect them. In addition, the names of the participants were changed to protect their privacy. The protocol for the study was offered to the parents/legal guardians of the participants and the directors of the autism center and the public charter school (See Appendix 1).

### **Participants**

To recruit the participants, the researcher first contacted a center for autism and related disabilities in the southeastern United States and requested permission to post a recruitment flyer for potential participants through their social media outlets and asked the personnel at the center to share the flyer with staff who consulted with families that met the inclusion criteria. The researcher also contacted a public charter school serving students with ASD and obtained permission to post the flyer for families who might be interested in the study. Parents who responded to the request for participants were contacted by the researcher, and a mutually convenient time and place were chosen for a meeting. Informed consent was obtained from the parents/guardians of five participants who met the inclusion criteria, and the participants formally assented to participate.

The researcher applied the following selection criteria: (a) the participants should be in the 3<sup>rd</sup> to 5<sup>th</sup> grade, (b) should be able to identify *he/she/it* pronouns with 80% accuracy, (c)

should be diagnosed by a psychologist or physician as having ASD according to the *Diagnostic and Statistical Manual of Mental Disorders (DSM-V)* criteria, (d) should have a demonstrated total IQ score of average or above average, as measured on intelligence tests (the WISC III or IV, the Stanford Binet III, IV, or V, or the Woodcock Johnson III), and (e) should be monolingual English speakers. Students with ASD often exhibit speech disorders and delays; therefore, students with ASD who speak second languages could demonstrate confounding linguistic variability (Armstrong, 2009).

Five students with ASD—one female and four males—agreed to participate in the study. Three of the participants (Melisa, Mike, and Eric) were in the 4<sup>th</sup> grade; one (Noah) was in the 5<sup>th</sup> grade, and one (James) was in the 3<sup>rd</sup> grade. Although five participants began the study, one—Eric—did not complete it. After three sessions, he said he did not want to continue because he was required to attend another program. The study was completed with the four remaining students. One of the students was African-American, two were Hispanic, and one was Indian. However, all of the participants spoke only English at home and in school.

Mike was 10 years old and in the 4<sup>th</sup> grade. He scored in the average range in cognitive abilities, based on the Kaufman Assessment Battery for Children, Second Edition (KABC-II) Model: Nonverbal. He had been receiving exceptional education services (ESE) support in the areas of reading and writing. Based on his most recent evaluation results (the Developmental Reading Assessment [DRA]), when he was in the 3<sup>rd</sup> grade, he tested in the 42<sup>nd</sup> percentile (expected 50) for reading comprehension. The results of the DRA demonstrated that he was at a 2.5 age equivalency level for reading comprehension. According to his IEP record, Mike attempted to read fluently and was able to make a simple summary of just a few sentences;

however, he needed reminders to go back into the text to look for support. The outcome of the test and his IEP record demonstrated that he was behind his peers in reading comprehension.

Melisa was 11 years old and in 4<sup>th</sup> grade. She had been receiving special services under the categories of Autism Spectrum Disorder and Language-Impaired. She had had direct instruction in a setting with a reduced teacher-to-pupil ratio for all academics. According to her last report, cognitive assessment of Melisa with the Stanford-Binet Intelligence Scales, Fifth Edition (SBIS-5) showed that she was in the average range for skills overall, with above-average strength in fluid reasoning skills. In terms of her academic skills, her scores fell within the average range in a number of word identification and reading fluency areas, but also showed some specific academic areas where she would likely benefit from additional intervention services (reading comprehension, spelling). Based on the i-Ready Diagnostic Assessment results, Melisa's overall score was at a 3<sup>rd</sup> grade level when she was in 4<sup>th</sup> grade. She was able to understand the organization and basic features of print and decode regularly spelled words with one or more syllables. Her reading comprehension had been improving with below-level texts in skills such as comparing and contrasting, inferencing, sequencing, and recognizing cause and effect. Although she was able to understand key details and ideas, find word meanings, and retell plot events, she had difficulty understanding the author's point of view.

James was 10 years old and in 3<sup>rd</sup> grade. He had been attending an early exceptional program (EELP). He was diagnosed with ASD and language impairment by a psychologist. The results of the Battelle Developmental Inventory, Second Edition indicated that he had average levels of cognitive abilities. According to his most recent report, he had difficulty answering questions about a story after reading it. He did well on concrete/detail questions but required

more prompting when open-ended questions were asked. As stated in his report, he had problems understanding and using language effectively.

Noah was 12 years old and in 5<sup>th</sup> grade. He had received a medical diagnosis of ASD. According to the results of the Florida Comprehensive Achievement Test and the Florida Alternate Assessment, he scored in the 7<sup>th</sup> percentile in English language arts (ELA), and he improved his scores in Quarters 2 and 3. As stated in his last report, Noah was below grade level in reading. He was reading at the “white” level of the Independent Reading Assessment Framework (IRLA), which equated to a mid-third-grade reading level. It was stated that due to his disability, he had had reading comprehension difficulties with synthesizing and integrating information in grade-level texts.

Table 1 shows the characteristics of the participants.

**Table 1.** Characteristics of the Participants

Participants	Age	Grade Level	Gender	Ethnicity	Classification
Melisa	11	4 <sup>th</sup>	Female	African-American	Autism
James	10	3 <sup>rd</sup>	Male	Caucasian	Autism
Mike	10	4 <sup>th</sup>	Male	Indian	Autism
Noah	12	5 <sup>th</sup>	Male	Hispanic	Autism

## Materials

The materials used in the study consisted of 58 narrative print stories written at the third, fourth, and fifth grade levels, as identified on the website [www.education.com](http://www.education.com). Only fictional reading comprehension stories, as opposed to nonfiction passages, were used. Fiction comprehension was selected in order to measure the comprehension of more inferential and

higher-level questions, versus mere detail. The researcher selected the stories randomly for each participant. For each session (baseline, treatment, and follow-up sessions), the participants read different stories based on their grade levels. An automated computer-based software program, indicated by O'Connor and Klein (2004), was utilized during the intervention session. In this program, pronouns were highlighted on the screen. The participants were required to “mouse-click” on the antecedent referent before proceeding to the next paragraph (O'Connor & Klein, 2004). In addition, to measure the reading levels of the participants, the researcher utilized the Gray Oral Reading Test, Fifth Edition (GOR-5) before the baseline session and after the follow-up session for each participant. In addition, the researcher issued the Test of Narrative Language (TNL) to the 3<sup>rd</sup> and 4<sup>th</sup> graders and the Test of Narrative Language, Second Edition (TNL-2) to the 5<sup>th</sup> grader before the baseline session (See Appendix 4, 5, 6, and 7 for copyright permission).

## **Design**

### **Single-Subject Design**

The purpose of a single-case experiment is to treat one individual or a single group intensely. It might be applied in the contexts of classroom management, the training of individuals with disabilities, and skill development (Gall, Gall, & Borg, 2007). In addition, in its review of reading interventions, the National Reading Panel (2000) utilized single-case research for individual with disabilities (Kratochwill & Levin, 2014). Researchers who have used single-case research have contributed knowledge about practices for children with ASD (Armstrong, 2009). Single-case design logic dictates the measurement of each participant's performance before, during, and after an intervention. The goal is to depict the process of change as well as the level of change (Levin, Ferron, & Kratochwill, 2012). All single-case designs are expected to measure the dependent variable with reliability and validity, and operationally define and

measure the fidelity with which the independent variable is implemented. The single-case research design of a study is organized to (a) document a pattern of responding that is in need of change, (b) demonstrate “basic effects” through change in the dependent variable when the independent variable is manipulated, and (c) demonstrate experimental control via the documentation of at least three basic effects, each occurring at a different point in time (Levin et al., 2012).

In the literature on educational practices for individuals with ASD, single-case research has been used to determine the effectiveness of individual practices. Moreover, if researchers interested in low-incidence populations want to look at treatment development or individual treatment effects, or both, single-case research is the best option (Armstrong, 2009). Multiple baseline design (MBD) is an outgrowth of the simple AB design, in which the repeated measurement of a variable at the baseline is used to document a basic effect following the introduction of the intervention (independent variable) in the B condition. Experimental research designs are constructed to enable both the demonstration of change, and the inference that it is unlikely that anything other than the independent variable was responsible for the observed change in the dependent variable (Kratochwill & Levin, 2014). MBDs achieve this goal by (a) ensuring that manipulation of the independent variable is “active” rather than “passive,” (b) incorporating replication of at least three basic effects, and (c) staggering the onset of the independent variable across at least three different points in time (length of baseline). These three specifics of single-case design are called MBL designs across participants, settings, and behavior (Kratochwill & Levin, 2014).

In this study, a randomized multiple baseline (MBL) design with follow-up across participants was utilized because a randomized, multiple-baseline design (across units, setting, or

behaviors) is the domain of combined-series, single-case intervention designs, and it is the strongest application of the design from the perspective of internal validity (Kratochwill & Levin, 2014).

In MBLs across participants, the researcher hopes that the effect of the intervention will be replicated in each series, and therefore it can be thought to generalize across recipients/units. The extent to which the intervention effect is similar across recipients helps to enhance the external validity of the findings (Kratochwill & Levin, 2014).

A key internal validity requirement of the MBD is the intervention's demonstration of a selective effect, namely, the demonstration of an effect only when the intervention is applied to a recipient/unit during its personally targeted time period or start point in the MBD across participants. The extent to which the intervention effect is similar for participants with differently staggered intervention start points helps to establish the external validity of the intervention's ecological and referential generality. The extent to which an intervention produces similar effects across outcome measures helps to establish the external validity of the generality of the referent and convergent validity of the intervention (Kratochwill & Levin, 2014).

This study was conducted over a six-week period, beginning in May and ending in July 2017, which included a one-week break. The duration of each of the three phases (baseline A, intervention B, and follow-up C) took two to three weeks from the starting date of each phase. The study was conducted in 31 sessions overall. The participants attended the sessions at least two days a week during this period. The selection of the order in which the participants would start the intervention phase (B) was conducted randomly. For this purpose, the researcher wrote each of the participants' names on a different piece of paper, and then randomly selected one for the first intervention session.

Each reading section took approximately 20 minutes, depending upon the participants' reading rate. In the baseline phase (A), the participants read the stories aloud and answered the *wh*- questions. In the intervention phase (B), anaphoric pronouns via computer-based instruction were introduced. The participants read the stories aloud, using computer program. In this session, the researcher asked, "what does the specific pronoun stand for?" When the participants finished reading the stories, they were required to answer the *wh*- questions about the stories. Before beginning the follow-up session (C), the participants took a one-week break and were required to read the stories with the program and answer the questions by themselves. The participants read different stories each time. The researcher used a total of 58 stories for all the sessions. The stories were selected based on a participant's grade level.

### **Intervention**

The research was conducted at the participants' homes or in the public library at a time convenient for the participants. Pronoun anaphors were utilized as an intervention. First, an instruction from Yuill and Oakhill (1986) was given to the participants:

When you say things or read them, sometimes there are short ways of saying them.

Sometimes a person called "Robert" is called "Rob" for short. "Rob" stands for "Robert."

Sometimes in a story there are short ways of saying things. These shortcuts point back to something else in the story that has been said before. I am going to ask you about some of these shortcuts. I will ask you to tell me what they stand for. The shortcut words are underlined. I want you to circle one of the words underneath that you could put instead of the shortcut, to say it the long way.

The researcher asked each participant to read a story aloud. Then the researcher asked him/her to answer the *wh*- questions, which were prepared by the researcher about the story if the



story did not include *wh-* questions on the website. The purpose of the questions about the stories was to determine whether or not the participant understood the main ideas or details of the characters, the setting and time of the story, and the main characters' appearance.

After the instructions were given, the researcher demonstrated an example of the program and asked the participants to practice. The stories were selected based on the participant's grade level. Each passage and break took approximately 10 minutes. A complete session lasted about 20 minutes for each participant. Responses to the questions about the story were used as data for the intervention and baseline phases. During this process, when the participant made a mistake, the researcher asked him or her to read the question again and try to remember. When the participant still did not give a right answer, the researcher showed the participant the correct answer for the question.

When the participant provided verbal confirmation of having understood the task, the training session was completed. Each time the participant answered a question correctly, the researcher rewarded the participant verbally, such as remarking "Good job!"

### **Independent Variable (Pronoun Anaphors)**

This study is a follow-up to O'Connor and Klein's 2004 study. In the current study, pronoun anaphora was the independent variable, and it was systemically manipulated during the intervention period. One doctoral student evaluated the quality of the pronoun anaphora in the passages. At the end, the overall mean rating by an external reviewer was measured to increase inter-rater reliability.

### **Social Validity**

Wolf (1978) indicated that there are several kinds of social validity based on the ethics, cost, practicality, or importance of a study. He also observes that social validity has a social

impact on the effects of treatments. For example, using social validity tools, a researcher might learn whether or not consumers are satisfied with the results of programs or treatments intended to help them (Wolf, 1978). In light of this information, the researcher in the current study employed a Likert-scale checklist to measure social validity. The checklist consisted of negative and positive statements to ascertain whether or not the participants with ASD were satisfied with the use of anaphoric support via computer-based instruction to apprehend the main ideas in the stories. The checklist was created by the researcher (see Appendix 2).

### **Procedure**

The instruments used in the study were administered in a well-organized and detailed manner so that they could be followed up to ensure that the research questions had been addressed correctly (Griess, 2010).

### **Initial Assessment**

First of all, the researcher obtained written consent forms from the participants and their families and examined the qualifications of the participants for this study using the Narrative Language Test, Second Edition, and the Gray Oral Reading Test, Fifth Edition. In addition to administering these tests, the researcher looked at whether the participants could identify pronouns with 80% accuracy. The researcher gave the participants different pictures to sort under *he*, *she*, *they*, and *it* pronouns. Melisa, James, Mike, and Noah showed 90%, 92%, 87%, and 92% pronoun accuracy, respectively. In addition, the researcher interviewed the participants' parents to ascertain whether the participants were fluent in English. The IEP forms of the participants were reviewed to get information about their reading levels, disability categories, and learning needs in reading areas.

The Gray Oral Reading Test, Fifth Edition was used to measure the comprehension skills of the participants. This assessment was administered before the baseline and after the follow-up sessions as a pre-test and post-test. Wiederholt and Bryant (2012) note that the Gray Oral Reading Test is an individually administered, norm-referenced measure of oral reading ability intended for individuals of 6 years, 0 months through 23 years, 11 months of age. The test consists of two parallel forms (A and B), each of which has 16 separate stories, with five comprehension questions following each story. It typically can be administered in 15-45 minutes. The GORT-5 serves multiple purposes, including (a) making classification decisions (identifying the severity of reading problems and making placement decisions for interventions), (b) informing instructional decisions (determining strengths and weaknesses between rates of accuracy or fluency and comprehension, to guide intervention strategies), (c) evaluating student progress or intervention effectiveness (by making use of the two parallel forms of the test), and (d) conducting research (with a range of options using scaled scores as well as miscue analyses of oral reading). The GORT-5 can be scored for rate of accuracy, fluency, and comprehension.

The protocol for applying the Gray Oral Reading Test, Fifth Edition is as follows. A participant is given a reading passage based on his or her grade level and is instructed to read it orally. While the participant is reading the story, the researcher looks at the rate, accuracy, fluency, and comprehension scores during the oral reading. The rate score is based on the amount of time in seconds it takes the participant to read the story aloud. The accuracy score indicates the number of words the participant pronounces correctly. The fluency score is a combination of the rate and accuracy scores of the participant. The comprehension score registers the number of questions about the story the participant answers correctly (Wiederholt & Bryant, 2012).

In this test, there are basal and ceiling scores for fluency. The student’s basal fluency score is a score of 9 or 10 points on two consecutive stories. The ceiling score is given when the participant’s fluency score is 2 or less for two consecutive stories. For comprehension, the basal and ceiling scores are not applied. To produce the total raw score for comprehension, the researcher sums the item scores for the applied comprehension items and adds 5 points for each unapplied story, before the entry story, below the fluency entry point or the basal score. All comprehension items above the fluency score get zero points (Wiederholt & Bryant, 2012). The Gray Oral Reading Test, Fifth Edition consists of two forms, A form and B form. A form was applied before baseline phase, and B form was administered after follow-up phase for the each of the participant. Tables 2, 3, 4, and 5 show a summary of the performance results for each participant on the Gray-Oral Reading Test, Fifth Edition.

**Table 2.** Performance Summary of Melisa – A Form of Gray Oral Reading Test, Fifth Edition

	Raw Total	Age Equivalent	Grade Equivalent	%ile Rank	Scaled Score	SEM	Descriptive Term
Rate	20	8 – 0	2,4	5	5	1	Poor
Accuracy	19	7 – 6	2,2	9	6	1	Below Average
Fluency	39	7 – 9	2,2	5	5	1	Poor
Comprehension	19	7 – 3	2,0	2	4	1	Poor

Sum of Scaled Scores                      9

Sum of Scaled Scores	Oral Reading %ile Rank	Oral Reading Index (ORI)	SEM	Descriptive Term
9	2	70	3	Poor

**Table 3.** Performance Summary of James - A Form of Gray Oral Reading Test, Fifth Edition

	Raw Total	Age Equivalent	Grade Equivalent	%ile Rank	Scaled Score	SEM	Descriptive Term
Rate	10	6 – 9	1,2	1	3	1	Very Poor
Accuracy	10	6 – 6	1,2	2	4	1	Poor
Fluency	20	6 – 9	1,2	1	3	1	Very Poor
Comprehension	8	6 – 0	<1.0	<1	1	1	Very Poor

Sum of Scaled Scores                      4

Sum of Scaled Scores	Oral Reading %ile Rank	Oral Reading Index (ORI)	SEM	Descriptive Term
4	<1	57	3	Very Poor

**Table 4.** Performance Summary of Mike - A Form of Gray Oral Reading Test, Fifth Edition

	Raw Total	Age Equivalent	Grade Equivalent	%ile Rank	Scaled Score	SEM	Descriptive Term
Rate	15	7 – 3	1,7	5	5	1	Poor
Accuracy	15	7 – 0	1,7	5	5	1	Poor
Fluency	30	7 – 3	1,7	2	4	1	Poor
Comprehension	14	6 – 9	1,4	1	3	1	Very Poor

Sum of Scaled Scores                      7

Sum of Scaled Scores	Oral Reading %ile Rank	Oral Reading Index (ORI)	SEM	Descriptive Term
7	1	65	3	Very Poor

**Table 5.** Performance Summary of Noah - A Form of Gray Oral Reading Test, Fifth Edition

	Raw Total	Age Equivalent	Grade Equivalent	%ile Rank	Scaled Score	SEM	Descriptive Term
Rate	15	7 – 3	1,7	2	4	1	Poor
Accuracy	15	7 – 0	1,7	5	5	1	Poor
Fluency	30	7 – 3	1,7	2	4	1	Poor
Comprehension	13	6 – 6	1,2	1	3	1	Very Poor

Sum of Scaled Scores                      7

Sum of Scaled Scores	Oral Reading %ile Rank	Oral Reading Index (ORI)	SEM	Descriptive Term
7	1	65	3	Very Poor

Based on these criteria, the participants’ reading comprehension and fluency scores were poor. However, their comprehension scores were lower than their fluency scores. Thus, the participants were competent in reading accuracy, although they did not understand what they were reading. Based on observations during the administration of the test, the researcher realized that all of the participants focused only on accuracy rather than on the meaning of the stories. This resulted in lower scores in comprehension.

The Narrative Language Test (TNL) and the Narrative Language Test, Second Edition (TNL-2) measure the performance of the affiliated speech used to tell stories and express comprehension. The TNL is for individuals aged 5 through 11 years. The TNL-2 is for individuals who are 5 to 15 years old. The researcher collected the data in three formats: (a) with no picture cues, (b) with five sequenced pictures, and (c) with a single picture (Gilliam & Pearson, 2004). The results are shown in Tables 6, 7, 8, and 9.

**Table 6.** Summary of Melisa’s Performance on the TNL

	Narrative Comprehension	Oral Narration	
Total Raw Score	31	59	
Age Equivalent	9 – 3	12 – 3	
Percentile Rank	37	50	
Standard Score	9	10	
Sum of Standard Scores	19		
Narrative Language Ability Index	97	41	Average
	Index	Percentile Rank	Description

**Table 7.** Summary of James’s Performance on the TNL

	Narrative Comprehension	Oral Narration	
Total Raw Score	12	25	
Age Equivalent	4 – 7	4 – 7	
Percentile Rank	<1	2	
Standard Score	1	4	
Sum of Standard Scores	5		
Narrative Language Ability Index	55	<1	Very Poor
	Index	Percentile Rank	Description

**Table 8.** Summary of Mike’s Performance on the TNL

	Narrative Comprehension	Oral Narration	
Total Raw Score	30	43	
Age Equivalent	8 – 3	7 – 7	
Percentile Rank	37	16	
Standard Score	9	7	
Sum of Standard Scores	16		
Narrative Language Ability Index	88	21	Below Average
	Index	Percentile Rank	Description

**Table 9.**  
Summary of Noah's Performance on the TNL

	Narrative Comprehension	Oral Narration	
Total Raw Score	30	34	
Age Equivalent	8 – 1	6 – 11	
Percentile Rank	16	2	
Standard Score	7	4	
Sum of Standard Scores		11	
Narrative Language Ability Index	75	5	
	Index	Percentile Rank	Poor Description

According to the results of the test, Melisa scored at an average level and Mike scored at a below-average level in reading comprehension. However, James and Noah presented poor performance in reading comprehension.

### Pre-Treatment Session

Once the participant finished the Gray Oral Reading Test, Fifth Edition, and the TNL or the TNL-2, and identified *he/she/it/they* pronouns with 80% accuracy, the baseline session was begun. For this session, the researcher and participant were seated in chairs next to each other. The researcher provided the participants with a laptop to read the stories. To ensure treatment integrity, the researcher utilized a self-monitoring method for each phase and each treatment session to see to what extent the protocol of the study was followed by the researcher (see Appendix 3). Prior to the session, the researcher asked the families if any external factors or personal circumstances could affect the participant's learning.

During the baseline session, the participants read stories that were selected based upon



their grade level, and answered *wh*- questions. Each time, the participants read different stories. The researcher then asked five questions, which were scored between 0-10 points. If the participant gave an incorrect response or gave no response to the questions, the participant got 0 points for the assessment. If the participant completed any questions successfully, 2 points were awarded. At the end of each session, the researcher encouraged the students using descriptive praise, such as “good job” or “you worked hard today.” The conditions for the baseline observations were maintained until at least five data points were received for each participant. This was necessary to meet the criteria of the *What Works Clearinghouse* (WWC) (Kratochwill, Hitchcock, Horner, Levin, Odom, Rindskopf, & Shadish, 2010).

Moreover, at least five data points are required to be able to start the intervention phase for successive cases and achieve baseline stability for a single-case research design. In the baseline phase, when the researcher had collected at least five data points for each individual, stability was calculated. To do this, the researcher followed the criteria stated by Neuman, McCormick, and the International Reading Association (1995), that is, 80%-90% of the data points in any phase should be within a 15% range of the mean of all the data points in that phase. Given these baseline stability criteria, the baseline of only one participant, Melisa, was stable. For her, 100% of the data points in the baseline phase were within a 15% range of the mean of all the data points in that phase. The other three participants’ baseline phases did not meet the criteria. Logan, Hickman, Harris, and Heriza (2008), Byiers, Reichle, and Symons (2012), and Kratochwill, Hitchcock, Horner, Levin, Odom, Rindskopf, and Shadish (2010) indicate that if the baseline has at least three data points, if the variability is not high, and if the trend in the baseline is descending, the intervention might start without a stability criterion being met. James’s, Mike’s, and Noah’s baseline sessions showed a downward trend line, low variability, and

consistent data. In addition, the baseline phase had more than three data points. Therefore, the researcher intervened with those participants.

To increase inter-rater reliability, a doctoral student scored the students' responses on the assessments besides the researcher.

### **Treatment Phase**

For the treatment phase, the researcher randomly selected the order in which the participants would receive the intervention. For this purpose, she wrote each of the participant's names on a different piece of paper, and then randomly selected one for the first intervention session. For example, Joe was the first participant selected. When Joe had at least three data points in the intervention phase and when there was a notable change in his performance (Ferron & Scot, 2005), the researcher selected another participant for the intervention period, using the same random selection process. This continued until all of the students had received the intervention. When the children finished the intervention phase, they had one break before the maintenance assessment began.

During the intervention session, the researcher introduced anaphoric pronouns to the participants via using computer program. Then, the researcher gave the instructions from Yuill and Oakhill (1986) to the participants. The participants read the stories aloud, and the researcher asked about the pronouns while they were reading the stories. For example, the researcher would ask the participant, "What does *he* stand for in the story?" After reading a story, the participant answer *wh*- questions about it. The participants' responses were used as data points for the baseline, intervention, and follow-up sessions.

### **The Follow-Up (Maintenance) Session**

Once each participant finished the intervention phase, a follow-up phase was conducted in the same setting after a one-week break. In this phase, the researcher collected at least three data points for follow-up phase. During this maintenance phase, the researcher assessed whether the participants continued to use anaphoric reference over time. This session was conducted like the baseline session. The participants read the stories aloud without using anaphoric reference and the computer program, and then they answered the *wh*- questions. The researcher did not reinforce the participants when they gave an incorrect response. At the end of the session, the researcher administered the social validity checklist (Appendix 2) to explore the students' perceptions of anaphoric reference and the computer program.

### **Analysis**

The analysis of the data consisted of masked visual analysis, the calculation of effect sizes utilizing the percent of non-overlapping data (PND), the percent of all non-overlapping data (PAND), and the percent exceeding median data (PEM), and multilevel modeling. For the purpose of data analysis, in addition to the researcher, two graduate students, who had taken a course on single-case analysis, completed a masked visual analysis (reference) to determine the order of the participants. Then, they conducted a visual analysis of the graphs, which were developed using the SAS program. The graduate students examined six features to determine the effects of the intervention. These features included the level, the trend, variability, the immediate effect of the intervention, overlapping data points, and the consistency of data patterns within and between phases (Kratochwill & Levin, 2014).

After completing the visual analysis, the researcher determined whether there were at least three indications of an effect at different points in time. Three indications of an effect are

the accepted standard for determining whether an intervention results in an experimental effect on the dependent variable (Kratochwill & Levin, 2014).

Besides the visual analysis, the researcher determined the PND, which is commonly used by researchers to calculate the effect sizes of studies in which a single-subject design is used (Scruggs & Mastropieri, 1998). In addition, the PAND and PEM were used to determine the effect size (Ferron, 2015).

After the visual analysis and the calculation of the PND, PAND, and PEM, the data were analyzed using a multilevel model for multiple-baseline designs (a hierarchical liner model). Specifically, the model used was:

$$Y_{it} = \beta_0 + \beta_1 Treat + \beta_2 Follow + e_{it}$$

$$\beta_0 = \gamma_{00} + r_0$$

$$\beta_1 = \gamma_{10} + r_1$$

$$\beta_2 = \gamma_{20} + r_2$$

where *Treat* was coded 1 for observations in the treatment phase and 0 for all other observations, and *Follow* was coded 1 for observations in the follow-up phase and 0 for all other observation, the level-2 errors were assumed normal and uncorrelated, and the level-1 errors were assumed to be homoscedastic and follow a first-order autoregressive model.

To estimate and make inferences from the multilevel model, restricted maximum likelihood estimation was coupled with the Kenward Roger method for estimating standard errors and degrees of freedom. Ferron, Bell, Rendina-Gobioff, and Hibbard (2009) found that because of the small sample sizes in multiple baseline designs that the Kenward Roger adjustment was needed to obtain accurate inferences about the average treatment effects.

## **Summary**

In this chapter, the design of the study, the sample selection, the study's reliability and validity, and data collection procedures were explained in detail. In the next chapter, the findings of this study are explained.

## CHAPTER FOUR

### RESULTS

This study was designed to explore the effects of anaphoric pronouns presented via computer screen on the reading comprehension of children with ASD. Stories from the education.com website were used to collect data. The students' responses to reading comprehension questions during baseline, treatment, and follow-up sessions were analyzed. The perceptions of students regarding anaphoric pronouns were also analyzed.

#### **Visual Analysis**

Masked visual analysis was utilized to control the Type I error rate when conducting the visual analysis for this single-case study. The researcher worked with two doctoral students who had taken a doctoral-level, single-case research course.

There are specific steps to conducting a masked visual analysis. First of all, the two groups involved, a research team and an analysis team, were separated for the analysis. The research team planned the study and made random assignments. However, they did not reveal these to the analysis team at this point. Then, the research team conducted the study and created a masked graph, which the analysis team analyzed in the final phase (Ferron & Jones, 2006). In their first specifications, the analysis team determined the correct order of the randomly selected participants.

The  $p$ -value was computed as:

$$p = \frac{\text{\#specifications}}{\text{\#possible assignments}}$$

$$\text{\#possible assignments} = 4*3*2*1 = 24$$

$$p = 1/24 = .0417.$$

The  $p$ -value obtained was less than .05, which indicates that the treatment had an effect.

In addition to the masked visual analysis, the researcher and doctoral students analyzed the graphs, using six features of visual analysis to meet the standards of the WWC. First of all, the researcher and the students looked at the consistency of levels, variability, and trends within each phase for all of the participants. According to Kratochwill et al., (2010), the level indicates the mean score for the data within a phase. Based on this information, the team computed mean scores for all four participants. The baseline mean scores of Melisa, James, Mike, and Noah were 3.2, 0, 4.92, and 2.25, respectively, and their intervention mean scores were 8, 8.85, 8, and 7.25. For the follow-up, the means scores were 9, 5, 5, and 2.66. When considering the mean scores, the team decided that there was a change in levels within the phases and that improvement had taken place, which was what was expected by the team.

Kratochwill et al. (2010) stated that a trend is indicated by the slope of the best-fitting straight line for the data within each phase, and variability is represented by the range or standard deviation of data about the best-fitting straight line. When examining trends, the team found a slope for each participant. For Melisa, there is a downward trend in the baseline, however; there is an upward trend line in the intervention phase. In the follow-up, she shows a zero trend. For James, there is a downward trend in the baseline; in his intervention and in the follow-up there is an ascending trend line. For Mike, the baseline phase has a descending trend, but the intervention and follow-up sessions have an ascending trend. For Noah, there is a downward trend in the baseline; however, there is an upward trend in the intervention phase. In the follow-up session, he shows a zero trend. The team noted that all four participants with ASD exhibited an ascending

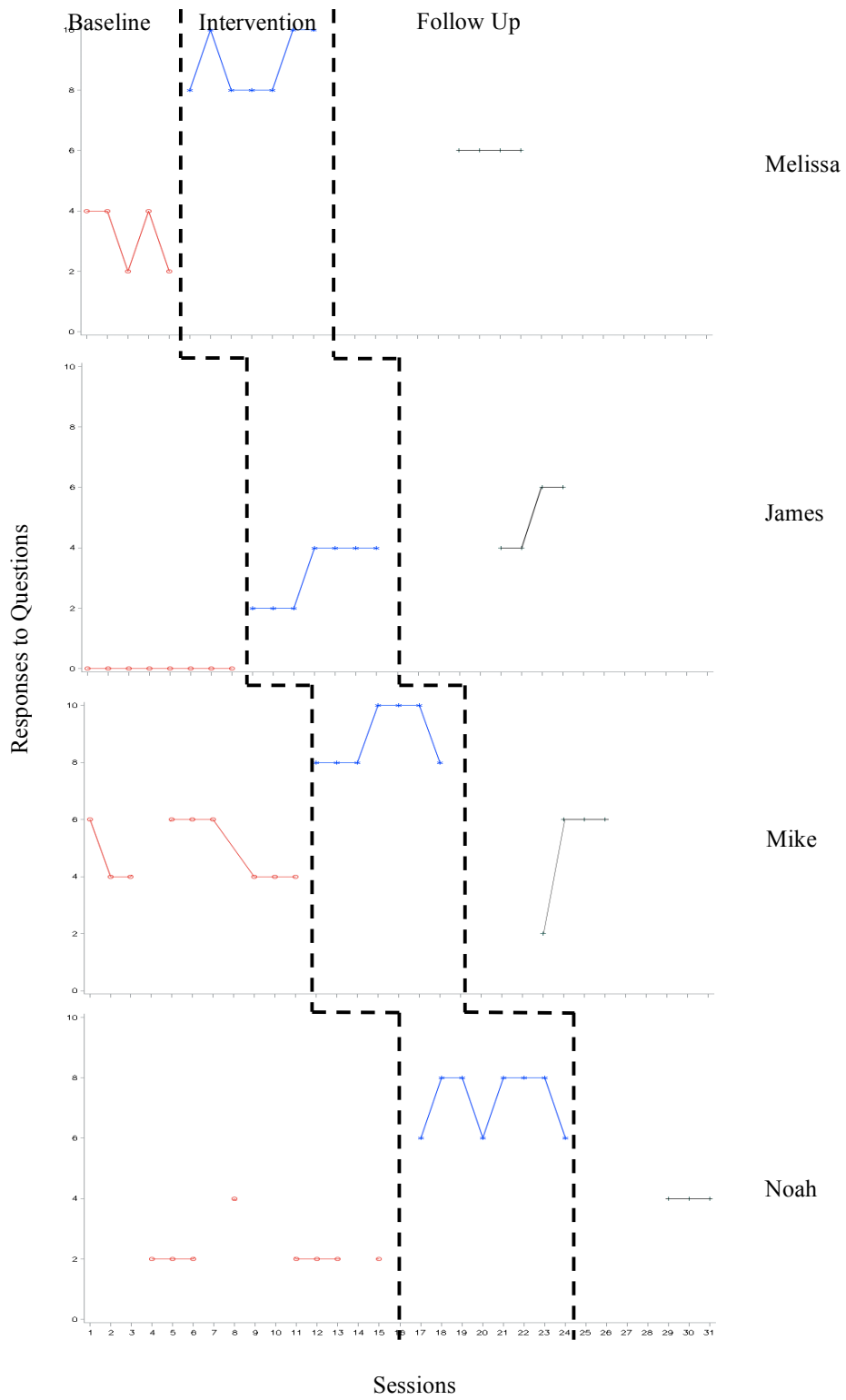
trend line in the intervention phase. For the follow-up session, two participants, Melisa and Noah, displayed zero trend lines. More data points were needed for follow-up sessions, because two participants displayed an upward trend and two showed a zero trend. To get an accurate reading, more data points are needed.

When looking for variability within the phases for all four participants, the team members indicated that there was none.

In addition to levels, trends, and variability within phases, the team members examined data patterns across phases, looking at overlaps, immediacy effects, and the consistency of data across similar phases (Kratochwill et al., 2010). To gauge the immediacy effect, the team members considered changes in levels between the last three data points of one phase and the first three data points of the next. With respect to this information, the team members stated that there was an immediate effect at the intervention phase for all the participants. This makes “more convincing the inference that change in the outcome measure was due to manipulation of the independent variable” (Kratochwill et al., 2010). There were overlapping data points for James and Mike when the baseline compared to follow-up phases. Melisa and Noah did not have overlapping data points in the phases.

As for the consistency of the data, the team members and researcher concluded that the data patterns were consistent across the phases (see Figure 1).





**Figure 1.** Number for correct responses of the participants

## Effect-Size Estimates

Researchers should consider effect sizes when examining research questions (Kratochwill et al., 2010). Various issues arise when making effect-size estimations. One is how to measure the size of an effect, such as quantifying the effect for a single case, or quantifying it across several single-case studies, or across a group of cases within one study. The researcher should decide on the method before calculating the effect size.

### Percent of Non-Overlapping Data (PND)

Based on the information about how to calculate the effect size, the researcher computed the PND by determining the highest data point in the baseline phase (A phase), and then, if an increase was expected between the phases, finding the percentage of intervention phase (B phase) or follow-up phase (C phase) data points that exceeded it. Also, the researcher computed the PND by determining the lowest data point in the baseline phase (A phase), and then if a decrease was expected between the phases, finding the percentage of B phase or C phase. According to Scruggs and Mastropieri (1998), if the effect size is >70, it is considered effective; if the effect size is 50-70, the effect is considered questionable, and if the effect size is <50, the researcher should note that there is no observed effect.

When comparing the intervention to the baseline phases, an increase in reading comprehension was observed for all four participants.

$$PND = \frac{n_{Bnooverlap A}}{n_B} * 100$$

**Table 10.** The PND and Effect Size Scores

	A to B Phase	Effect Size	A to C Phase	Effect Size
Melisa	100 (7/7*100)	Highly Effective	100 (4/4*100)	Highly Effective
James	100 (7/7*100)	Highly Effective	100 (4/4*100)	Highly Effective
Mike	100 (7/7*100)	Highly Effective	0 (0/4*100)	No Observed Effect
Noah	100 (8/8*100)	Highly Effective	0 (0/3*100)	No Observed Effect

When comparing the follow-up to the baseline phases, an increase in reading comprehension was observed for two participants, Melisa and James although no observed effect was seen for other two participants, Mike and Noah.

### Percent Exceeding Median Data (PEM)

To obtain the PEM score for each participant, the researcher found the median of the baseline phase (A phase), then, if an increase was noted, determined the percentage of intervention phase (B phase) or follow-up phase (C phase) data points that exceeded it. If a decrease was observed, the researcher found the median of the A phase, and then determined the percentage of B phase or C phase data points that exceeded it.

$$PEM = \frac{n_{B>Md}}{n_B} * 100$$

**Table 11.** The PEM and Effect Size Scores

	A to B Phase	Effect Size	A to C Phase	Effect Size
Melisa	100 (7/7*100)	Highly Effective	100 (4/4*100)	Highly Effective
James	100 (7/7*100)	Highly Effective	100 (4/4*100)	Highly Effective
Mike	100 (7/7*100)	Highly Effective	75 (3/4*100)	Effective
Noah	100 (8/8*100)	Highly Effective	100 (3/3*100)	Highly Effective

The results of the PEM scores for all participants showed an increasing reading comprehension was observed.

**Percent of All Non-Overlapping Data (PAND)**

The data points that overlapped in either phase were removed, and the percentage that remained was counted as the PAND score.

$$PAND = \frac{n_{remaining}}{n} * 100$$

**Table 12.** The PAND and Effect Size Scores

	A to B Phase	Effect Size	A to C Phase	Effect Size
Melisa	100 (12/12*100)	Highly Effective	100 (9/9*100)	Highly Effective
James	100 (15/15*100)	Highly Effective	100 (12/12*100)	Highly Effective
Mike	100 (16/16*100)	Highly Effective	77 (10/13*100)	Highly Effective
Noah	100 (16/16*100)	Highly Effective	91 (10/11*100)	Highly Effective

When considering PAND scores for all participants, the results indicated that it is highly effective in both phases, B phases and C phases when it is compared to A phases.

**Multilevel Modeling**

In single-case design, some researchers use only visual analysis for the statistical analysis. However, that is not enough to quantify the effects of a treatment (Shadish, Kyse, & Rindskopf, 2013). Multilevel modeling provides a broader scale for answering research questions. It enables researchers to see average treatment effects and how they effect changes over time (Rindskopf & Ferron, 2014). Thus, in this study, the researcher utilized multilevel modeling to analyze the data, using the SAS program to estimate the confidence interval, standard errors, and degrees of freedom.

**Table 13.** The Fixed Effects with Standard Errors

<u>Solution for Fixed Effects</u>								
Effect	Estimate	Standard Error	DF	t Value	Pr >  t	Alpha	Lower	Upper
Intercept	2.7099	1.0071	3	2.69	0.0744	0.05	-0.4963	5.9161
Treat	4.2844	0.6552	2.79	6.54	0.0090	0.05	2.1088	6.4599
Follow	2.2305	1.0442	3.08	2.14	0.1200	0.05	-1.0461	5.5070

**Table 14.** Covariance Parameter Estimates

<u>Covariance Parameter Estimates</u>					
Cov Parm	Subject	Estimate	Standard Error	Z Value	Pr Z
Intercept	Person	3.7719	3.3334	1.13	0.1289
Treat	Person	1.1347	1.3919	0.82	0.2075
Follow	Person	3.5442	3.5798	0.99	0.1611
AR(1)	Person	0.4189	0.1667	2.51	0.0120
Residual	Person	1.1878	0.3250	3.65	0.0001

In Table 14, the estimate shows average effects. For example, Estimate score (4.28) of treatment demonstrates shift between levels. The estimated average baseline level is 2.71 and the estimated average treatment effect is 4.28. The 95% confidence interval indicates that the actual treatment effect is between a 2.11- and a 6.46-point increase in reading comprehension. In addition to the average effect, the *p* value for the treatment effect is .0090, which shows that the

treatment effect, averaged across all the participants, is statistically significant. However, when considering average follow-up effect, reading comprehension is 2.23 greater than the average baseline level, but this difference is not statistically significant ( $p > .05$ ). Residual variance is the variability within persons. In this study, it is 1.1878 and it is significant. The first-order auto-regression estimate is 0.4189.

In light of this information, we can conclude that the use of anaphoric pronouns in computer-based instruction was highly effective for improving the reading comprehension skills of the participants-students with ASD.

### **Testing Research Questions**

#### **Research Question 1**

1. What is the effect of anaphoric support via computer-based instruction on the overall reading comprehension of students with ASD?

According to results of the visual analysis, the statistical analysis, the effect size calculations, and the PND, PEM, and PAND scores, all the participants with ASD improved their reading comprehension by using anaphoric support via computer-based instruction. In the visual analysis, it is apparent that there was a change in levels within phases, an upward trend from the baseline to the intervention phase, an immediate effect across participants, and consistency among the data in the phases. In addition, there was no high variability across the phases. Kratochwill (2010) indicated that there should be at least three indications of whether a treatment is effective or not. The results of the visual analysis in this study show that there are more than three indications of the effectiveness of the intervention.

In addition to visual analysis, the PND, PEM, and PAND scores indicate the effectiveness of the intervention. The result of the PND, PEM, and PAND scores was 100 for

every participant. Scruggs and Mastropieri (1998) indicated that if the effect size is  $>70$ , the treatment can be considered effective; if the effect size is 50-70, the effect is questionable, and if the effect size is  $<50$ , the researcher should note that there is no observed effect. In light of this, the treatment can be considered to have been highly effective for all four participants in this study.

The effect size calculation and statistical analysis also demonstrated that all four participants with ASD increased their reading comprehension between the baseline and intervention phases. The effect size in the baseline phase was 2.7099, and it showed an increase of 4.28 in the treatment phase. Thus, the participants with ASD improved their mean score by 4.28. Additionally, the  $p$  value for the treatment effect was  $<.0001$ . In consequence, based on the visual analysis, the statistical analysis, the PAND, PEM, and PND scores, and the effect size calculation, anaphoric support via computer-based instruction proved to be effective for improving the reading comprehension skills of the participants.

### **Research Question 2**

2. What is the effect of using and then removing anaphoric support via computer-based instruction on the overall reading comprehension of students with ASD?

When considering the visual analysis, the doctoral students and researcher determined that there was a change in levels within phases for all four participants. There was an upward trend from baseline to the follow-up phases for Melisa, James, and Mike although zero trend was seen in Noah. There was no high variability in the phases. To calculate immediacy effect, the researcher and doctoral students looked at the last three data points of one phase, and first three data points next phase. When considering the immediacy effect for each participant, there was an increase in data points between baseline and follow-up phases. In addition, there was consistency

among the data in the phases for all participants. According to the results of the visual analysis, the doctoral students and researcher determined that there are more than three indications of the effectiveness of the maintenance phase.

An inferential statistical analysis showed when considering average follow-up effect, reading comprehension is 2.23 greater than the average baseline level, but this difference is not statistically significant ( $p > .05$ ). Therefore, there was a decrease in effect size in the follow-up phase for all four participants. In addition to average effect size, PND scores of Mike and Noah showed there was no observed effect in follow-up phases even though Melisa and James' PND scores indicated it as highly effective. Mike and Noah had overlapping data when comparing baseline to follow-up phases. In addition, Noah had some missing data in baseline phase.

Even though visual analysis showed there was an increasing in reading comprehension, inferential statistical analysis and PND, PEM, and PAND indicated that there was a decrease in reading comprehension in follow-up phases.

Therefore, based on the information from the statistical and visual analyses, the team members and researcher concluded that more data for the follow-up session was needed.

### **Findings from the Gray Oral Reading Test, Fifth Edition, B Form**

After the follow-up sessions, Gray Oral Reading Test, Fifth Edition was administered to all four participants to measure their reading comprehension levels. According to the results of the test, Melisa increased her Oral Reading Index score from 70 to 84 points. She demonstrated poor performance on Form A; however, after the treatment session, she improved her score to 84 on Form B. James did not change his score on Form B, but scored the same, a 57, which means a very poor performance. Even though Mike displayed very poor performance, a 65 score on Form A, he increased his score to 102 on Form B and showed an average reading level on the Oral



Reading Index. Similarly, Noah presented a very poor performance, yet he improved his ability to reach a 102-point score, considered average on the Oral Reading Index.

**Table 15.** Performance Summary of Melisa – B Form

	Raw Total	Age Equivalent	Grade Equivalent	%ile Rank	Scaled Score	SEM
Rate	24	8 – 6	3,0	16	7	1
Accuracy	22	8 – 0	2,4	9	6	1
Fluency	46	8 – 3	2,7	9	6	1
Comprehension	30	9 – 6	7,7	25	8	1

Sum of Scaled Scores                      14

Sum of Scaled Scores	Oral Reading %ile Rank	Oral Reading Index (ORI)	SEM	Descriptive Term
14	14	84	3	Below Average

**Table 16.** Performance Summary of James - B Form

	Raw Total	Age Equivalent	Grade Equivalent	%ile Rank	Scaled Score	SEM
Rate	10	6 – 6	1,2	1	3	1
Accuracy	10	6 – 6	1,0	1	3	1
Fluency	20	6 – 3	1,2	1	3	1
Comprehension	4	<6 – 0	1.0	<1	1	1

Sum of Scaled Scores                      4

Sum of Scaled Scores	Oral Reading %ile Rank	Oral Reading Index (ORI)	SEM	Descriptive Term
4	<1	57	3	Very Poor

**Table 17.** Performance Summary of Mike - B Form

	Raw Total	Age Equivalent	Grade Equivalent	%ile Rank	Scaled Score	SEM
Rate	30	9 – 9	4,2	37	9	1
Accuracy	32	10 – 3	4,7	50	10	1
Fluency	62	9 – 9	4,4	50	10	1
Comprehensio	35	10 – 3	5,7	63	11	1

Sum of Scaled Scores                      21

Sum of Scaled Scores	Oral Reading %ile Rank	Oral Reading Index (ORI)	SEM	Descriptive Term
21	55	102	3	Average

**Table 18.** Performance Summary of Noah - B Form

	Raw Total	Age Equivalent	Grade Equivalent	%ile Rank	Scaled Score	SEM
Rate	36	11 – 3	5,4	37	9	1
Accuracy	27	9 – 0	3,4	16	7	1
Fluency	63	9 – 9	4,4	25	8	1
Comprehension	8	7 – 3	2,0	5	5	1

Sum of Scaled Scores                      13

Sum of Scaled Scores	Oral Reading %ile Rank	Oral Reading Index (ORI)	SEM	Descriptive Term
13	10	81	3	Below Average

**Findings from Inter-Rater Agreement**

A doctoral student was trained to check the data on the number of correct responses by the participants to the questions about the stories. In addition, the student evaluated the quality of pronoun anaphora to increase inter-rater reliability. The percentage of inter-rater agreement was

calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100%. For Melisa, the mean percentage of inter-rater agreement across all phases of the study was 94 % (range = 85%-100%). For James, it was 95% (range = 86%-100%), for Mike 95% (range = 86%-100%), and for Noah 94 % (range=85%-100%). The researcher and the doctoral student independently checked inter-rater agreement across all phases of the study. There is no difference found for the quality of pronouns.

### **Results for Social Validity**

As the conclusion of the study, the researcher administered a social validity questionnaire consisting of negative and positive statements to ascertain the participants' thoughts about anaphoric reference. The researcher applied the self-monitoring method to analyze the responses of the participants. The researcher rated the statements of the participants and his peers using a four-point Likert-type scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). Table 6 displays the means of the participants' statements. All four participants agreed that anaphoric reference helped them to find the main concept of the stories. The mean score for the first statement is 4.75. As shown by the inferential statistical analysis, the treatment (anaphoric reference) was effective for all the participants; thus, the statements of the participants corroborated the statistical analysis.

While three of the participants indicated that they liked to use anaphoric reference with computer-based instruction, one participant, Melisa, stated that she did not. The mean score for the second statement is 4.25. Melisa's graph shows an upward trend in the intervention phase; however, she did not demonstrate this trend in the follow-up session. In response to statement three, all of the participants said they were comfortable when they used anaphoric reference. The mean score is 5. Only one participant, Melisa, reflected that she was not sure whether or not she

was boring when she used anaphoric reference. She rated the fourth statement as neutral. The mean score for the fourth statement is 2. Three of the participants specified that anaphoric reference is easy to use, but Melisa strongly disagreed with that statement. The mean score for statement four is 4.

**Table 19.** Means of the Participants’ Responses to the Social Validity Tool

	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5
Melisa	5	2	5	3	1
James	4	5	5	2	5
Mike	5	5	5	2	5
Noah	5	5	5	1	5
Means	4.75 (19/4)	4.25 (17/4)	5 (20/4)	2 (8/4)	4 (16/4)

In conclusion, all of the participants gave positive responses about computer-based instruction for anaphoric reference, which indicates that it was effective for reading comprehension for these participants with ASD.

## **CHAPTER FIVE**

### **DISCUSSION**

The primary purpose of this study was to examine the effects of support for anaphoric reference using computer-based instruction to improve the reading comprehension of students with ASD. This discussion provides the main findings of the study. First, the findings relating to the research questions and the theoretical framework of the study are discussed. Second, the findings relating to previous research are discussed. Finally, the study's limitations and suggestions for future research are outlined.

#### **Summary Findings Related to the Research Questions and Theories**

Based on the visual analysis and statistically significant data results, participants with ASD showed an increase in reading comprehensions skills during the intervention phase when using anaphoric pronoun support with computer-based instruction.

O'Connor and Klein (2004) examined three different strategies for improving the reading comprehension skills of high-functioning students with ASD. Anaphoric cuing, one of the strategies in the study, was effective at increasing the reading comprehension skills of such students. In addition, the O'Connor and Klein study suggested that if computer-based instruction is used for anaphoric cuing with students with ASD, it can be more effective at improving their reading comprehension. Based on their suggestions, this study was a follow-up to O'Connor and Klein's (2004) study (O'Connor and Klein, 2004).

The results of this study are mixed. Although anaphoric pronoun support via computer-based instruction was effective during the intervention phase, it did not fall within statistical significance for improving the reading comprehension of the children with ASD during the follow-up phase. Nevertheless, consistent with O'Connor and Klein (2004), during the intervention phase, it demonstrated that anaphoric reference support was effective.

There are three cognitive theories related to the reading capabilities of individuals with ASD: executive function, Theory of Mind, and central coherence theory. Carnahan and Williamson (2010) state that individuals with ASD have difficulties with executive function in several areas. For instance, they struggle with transitioning. Moving from one activity to another and integrating new experiences with background knowledge are difficult tasks for individuals with ASD. The results of this study are consistent with this theory because the participants with ASD could not apply their new knowledge to novel tasks. They did not show an increase in performance during the follow-up phase.

In addition to difficulties with executive function, individuals with ASD have deficits in Theory of Mind (ToM) development. In this study, the Gray Oral Reading Test, Fifth Edition was utilized as a pre- and post-test to measure the reading comprehension levels of the participants. The test includes five comprehension questions for each story, some of which ask about the thoughts, feelings, and emotions of the characters in the stories. All four of the participants did not give correct responses to some of the questions related to the thoughts, feelings, and emotions. This relates to the notion of a ToM deficit, which results in individuals with ASD not understanding the mental states of characters in stories and how these internal states motivate the characters' behaviors (Lucas & Norbury, 2014).

With regard to central coherence, consistent with findings from earlier studies (Charles, 2016; Frith & Happe, 1994; Happe & Booth, 2008; Norbury & Bishop, 2002), the participants showed weakness in inferencing. None of the four participants could answer the question “What is the main idea of the story?” during the baseline, intervention, and follow-up phases, suggesting that they had difficulties in this area.

Other factors, as well, can affect the comprehension of a text. For example, Perfetti, Landi, and Oakhill (2005) and Charles (2016) imply that individuals with ASD have difficulty with reading comprehension because they have a limited memory capacity, which hinders them from recalling parts of the text. In addition, Frith (1989) observes that individuals with ASD concentrate on the parts and details of a text more than on the global meaning. This also results in poor comprehension. Another consideration might be not understanding the referentiality of pronouns.

Based on the results of the study, the participants who scored lower at identifying pronoun references showed poor performance in reading comprehension. According to Charles (2016), “the children [in the study] with ASD who had poor use of pronouns may not have been able to deepen their understanding of the topic due to their inability to construct a mental representation of the text.” Therefore, lack of knowledge about pronouns might have affected the reading comprehension of the participants in this study. In addition to knowledge of pronouns, the Gray Oral Reading Test, Fifth Edition requires good vocabulary knowledge if readers are to understand the text. The participants with smaller vocabularies did not perform well on the reading comprehension questions.

As a consequence, the participants performed well during the intervention phase; however, they performed poorly in the follow-up phase because, due to a lack of the above skills, they might have had difficulty using an understanding of context to make valid inferences.

### **Implications of the Study**

The results of the study were consistent with earlier research (O'Connor & Klein, 2004), showing that anaphoric pronoun support was effective for improving the reading comprehension skills of individuals with ASD. The findings suggest that the use of anaphoric pronouns was the factor with the most impact on reading comprehension in this study.

In addition, vocabulary knowledge, computer-based instruction, and pronoun knowledge are other variables that might affect the reading comprehension skills of the students with ASD. Educators may also need to look at other variables, such as paying attention, bilingual backgrounds, perspective taking, and inferencing, which can affect the understanding of anaphoric reference, and, in turn, the reading comprehension of individuals with ASD.

The participants in this study indicated that they were satisfied with the use of computer-based instruction. Tjus, Heimann, and Nelson (1998) found that individuals with ASD learned textual material and improved their reading and phonological awareness when computer-based instruction was used. Therefore, teachers may consider using computer-based instruction to help students with ASD improve their reading comprehension.

Finally, even though all of the participants spoke in English, their families spoke other languages, such as Spanish and Hindi, at home, and this could have affected the vocabulary and pronoun knowledge of the participants. Their families might have limited English vocabularies, and they might use pronouns in a different way, based on their language structure. Educators may need to find research strategies to help students with bilingual families.



## **Implications for Practice**

Due to the fact that “spectrum” is an umbrella term, each individual with ASD may have specific needs in their classrooms, home, or public places. Even though researchers and educators focus on social and behavioral needs of the individuals with ASD more, they should also focus on educational needs of these students (Armstrong, 2009). According to IDEA (2004), all students with disabilities have access to the general curriculum and receive appropriate accommodations and modifications to improve their academic performance (Armstrong, 2009). Therefore, educators and researchers should find effective strategies to meet the students’ needs in their academic performance. Via this study, the students improved their reading comprehension skills through the use of anaphoric pronouns via computer-based instruction. Even though this study was conducted under research conditions at the students’ homes and a public library, the strategy could be applied in classrooms by teachers ‘or instructional assistants. Thus, students with ASD could use this strategy at home, public places, and their classrooms. This could assist them in being more independent as they work on improving reading comprehension skills.

Furthermore, teachers may use this strategy to improve the students’ Theory of Mind, Executive Function, and Central Coherence abilities by using different personal pronouns, visual and verbal cues. Therefore, students with ASD may improve not only their comprehension skills, but also, their abilities in these other areas which may ultimately affect their academic performance.

According to the results of research by Knight et al., (2015), computer-based instruction was useful for students with ASD in reading, specifically in regard to sentence construction, decoding and word identification, and basic reading skills. Teachers might use anaphoric

pronouns with automated computer programming to improve these skills. Moreover, through this study, the researcher obtained feedback from the students about using anaphoric pronouns via automated computer programming. The results indicated that the students enjoyed using anaphoric pronouns with the computers while they read the stories even though they had concentration problems during the study. Using anaphoric pronouns via computer assisted instruction has potential for improving engagement in reading for students with ASD.

Based on the IEP records of the students in this study, teachers stated that the students have difficulties following directions while they read. The use of automated computer programming, alleviates this concern because students just need to mouse click to pass to the next step. In addition, when they need to go back, they can easily do it via the computer program. In conclusion, teacher may use this strategy in different ways to improve reading comprehension skills of students with ASD.

### **Limitations**

There are several limitations to this study. First, the researcher used a single-case experimental, AB research design, due to the limited population. In single-case designs, generalizability is considered a limitation; however, for learning about the effectiveness of a treatment for a small population, specifically individuals with disabilities, single-case designs are the most desirable method.

A second limitation is that this research was not conducted during school hours. The participants with ASD were recruited during summer vacation. As a result, they preferred to attend the study at their home, and they had a difficult time concentrating on the stories, due to distractions caused by family members. In addition, the participants did not want to work on the

stories for extended time periods. Therefore, the researcher could not collect more data for the follow-up phase.

Finally, during the study, the participants with ASD sometimes got the highest score for a story, but sometimes they could not focus on the task. Due to the quantitative data pattern used in this study, the researcher could not get information from the participants or their families about instability in this situation.

### **Future Research**

Future research should include Native-English speaking families to identify other reading comprehension variables for children with ASD. The findings may help researchers to understand which variable had the greatest impact on improving the reading comprehension skills of the children in this study.

Future research should be conducted at a school during the academic year. In the current study, the researcher could not collect more data because the participants did not want to continue for a long period of time during summer vacation. For future research, the study could be conducted in a school during the academic year, when researchers might be able to gather more data. In addition, in a school environment, children with ASD would not be distracted by family members, so they could concentrate more on the stories. Furthermore, future research could replicate this study with a larger population of students with ASD to better generalize the findings.

During the current study, on some days the participants were very motivated; however, on other days they struggled to focus. Therefore, motivation was a factor that affected the participants' responses to the reading comprehension questions. Due to the single-case experimental design, it was not possible to discover the reasons for this lack of motivation.

Future research could use different methods, such as a mixed-method design, to learn more about the effectiveness of instruction on anaphoric pronouns on the reading comprehension skills of individuals with ASD.

### **Conclusion**

This study was designed as a follow-up to O'Connor and Klein's (2004) study. It also aimed to address a gap in the literature regarding the use of anaphoric reference support as an effective strategy for improving the reading comprehension of children with ASD. The results of the study indicate that using anaphoric reference support via computer-based instruction improved the reading comprehension of individuals with ASD. The findings support a replication of this study.

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## **APPENDICES**

## Appendix 1: Informed Consent Letter



RESEARCH INTEGRITY AND COMPLIANCE  
Institutional Review Boards, FWA No. 00001669  
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799  
(813) 974-5638 • FAX(813)974-7091

April 17, 2017

Seda Karayazi Ozsayin  
Teaching and Learning  
Tampa, FL 33612

RE: **Expedited Approval for Initial Review**

IRB#: Pro00030315

Title: Improving Reading Comprehension of Children with ASD: Implication of Anaphoric Reference Support with Computer Programming

**Study Approval Period: 4/17/2017 to 4/17/2018**

Dear Mr. Karayazi Ozsayin:

On 4/17/2017, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

**Approved Item(s):**

**Protocol Document(s):**

[Protocol, Version#1.docx](#)

**Consent/Assent Document(s)\*:**

[Parental Permission Version#1.docx.pdf](#)

[Child Verbal Assent, Version#1.docx](#)

\*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved. The child verbal assent is not a stamped form.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110. The research proposed in this study is categorized under the following expedited review category:

**Appendix 2: Social Validity / Likert-type Scale for Children with ASD**

ID	Statements	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
1	Anaphoric reference helped me to find the main concept.					
2	I like to use the anaphoric pronouns.					
3	I feel comfortable					
4	I am bored with it					
5	It (anaphoric pronouns) is easy to use					
Comment						

### Appendix 3: Fidelity Checklist

1	Give the reading text.	
2	Participant reads the text.	
3	Give comprehension quiz.	
4	Read directions on the question sheet.	
5	Ask the participant whether he or she has a questions about the direction.	
6	Participant works on the questions.	
7	When the participant finishes the questions, collect the question sheet.	



## Appendix 4: Copyright Permission for GORT-5



page 1

### Approval of Permission to Use PRO-ED Test Material

July 28, 2017

Reference Permission Request #T3786

Ms. Seda Karayazi Ozsayin  
University of South Florida  
13431 Thomasville Circle  
Tampa, FL 33617 USA

For permission to use of the Gray Oral Reading Tests–Fifth Edition (GORT-5) Complete Kit by Bryant, , Austin: PRO-ED. Kit 13925. Number of copies: 8 total No fee assessed..

#### **USAGE:** Research for Master's Thesis or Dissertation

I will use the test to measure reading level of individuals with Autism Spectrum Disorder for my dissertation. The individuals will do a Form A as a pre-test and then they will do Form B as a post-test to learn their reading level.

#### **LIMITATIONS:**

Permission is granted to utilize the GORT-5 in this dissertation study. Requester agrees to not copy, modify, or otherwise alter the GORT-5 or any of its components.

**PAYMENT:** No fee will be assessed.

**Total Paid:** \$

#### **APPROVAL:**

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Approved by PRO-ED, Inc. Representative

**Terri Cooter**

Terri Cooter

Tests Permissions Department

PRO-ED, Inc.

July 28, 2017

PRO-ED, Inc. Tax ID: 74-1916673

## Appendix 5: Copyright Permission for TNL



page 1

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Reference Permission Request #T3787

Ms. Seda Karayazi Ozsayin  
University of South Florida  
13431 Thomasville Circle  
Tampa, FL 33617 USA

For permission to use of the Test of Narrative Language (TNL) Complete Kit by Gillam, Pearson, , Austin: PRO-ED. Kit 11380. Number of copies: 8 total No fee assessed..

#### USAGE: Research for Master's Thesis or Dissertation

I will use the test to measure reading level of individuals with Autism Spectrum Disorder for my dissertation. I will conduct 4 pretests and 4 posttests.

#### LIMITATIONS:

Permission is granted to utilize the TNL in this dissertaiton study. Requester agrees to not copy, modify, or otherwise alter the TNL or its components in any way.

**PAYMENT:** No Fee assessed.

**Total Paid:** \$

#### APPROVAL:

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## Appendix 6: Copyright Permission for TNL-2



page 1

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July 28, 2017

Reference Permission Request #T3785

Ms. Seda Karayazi Ozsayin  
University of South Florida  
13431 Thomasville Circle  
Tampa, FL 33617 USA

For permission to use of the Test of Narrative Language: Second Edition (TNL:2) Kit by Gillam, Pearson, , Austin: PRO-ED. Kit 14560. Number of copies: 1 administration No fee assessed..

#### **USAGE:** Research for Master's Thesis or Dissertation

I will use the test to measure reading level of individuals with Autism Spectrum Disorder for my dissertation.

#### **LIMITATIONS:**

Permission is granted to utilize the TNL-2 in this dissertation study. Requester agrees to not copy, modify, or otherwise alter the TNL-2 or its components in any way.

**PAYMENT:** No fee assessed.

**Total Paid:** \$

#### **APPROVAL:**

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**Terri Cooter**

Terri Cooter

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July 28, 2017

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## Appendix 7: Copyright Permission for Stories from education.com

7/28/2017

University of South Florida Mail - Your request to use Education.com content



Seda Karayazi Ozsayin <seda@mail.usf.edu>

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### Your request to use Education.com content

---

Education.com Support <support@education.com>  
Reply-To: "Education.com Support" <support@education.com>  
To: seda@mail.usf.edu

Thu, Jul 13, 2017 at 6:28 PM



Hi there,

Thanks so much for getting in touch! Our worksheets can be reprinted for classroom and school use. We only ask that you maintain all attributions on the worksheets and workbooks (our Education.com logo) and do not alter the content in any way.

If you are a Pro member or have purchased individual workbooks, you have the right to print copies of those workbooks for every student in your class only, not for all students at your school. If other teachers wish to print copies of the workbooks for their classes, they would need to create and pay for a separate Pro membership.

Hope that helps! Please feel free to get in touch with any other questions.

Best,

Patricia - Education.com Customer Service Team

---

JUL 12, 2017 | 11:46AM PDT

seda replied:  
Hi Patricia,

Thank you for responding my e-mail. I am a member of education.com. I am looking for 3rd and 4th grade level reading fiction comprehension stories. They are under "worksheets" in the website. I have attached them. I will use them for 6 participants who are in 3rd grade and 4th grade levels. They will read the stories and answer the "wh" questions on the stories. If the stories do not have "wh" questions, I do write "wh" questions about the stories. This study is for improving reading comprehension skills of children with Autism Spectrum Disorders. In the treatment session of the study, I will ask the individuals to find the pronouns in the stories. Hopefully, finding pronouns and answering "wh" questions will improve their comprehension skills. Thank you so much. It is a great website. I love it. I suggested my parents to become member of education.com. I am looking forward to hearing from you.

Sincerely,  
Seda

---

[Quoted text hidden]

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1/1