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EFFECTS OF EXPLICIT INSTRUCTION AND SELF-DIRECTED VIDEO PROMPTING ON TEXT COMPREHENSION OF STUDENTS WITH AUTISM SPECTRUM DISORDER

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EFFECTS OF EXPLICIT INSTRUCTION AND SELF-DIRECTED VIDEO PROMPTING ON TEXT COMPREHENSION OF STUDENTS WITH AUTISM SPECTRUM DISORDER

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in Special Education in the
College of Education
at the
University of Kentucky

By

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ABSTRACT OF DISSERTATION

EFFECTS OF EXPLICIT INSTRUCTION AND SELF-DIRECTED VIDEO PROMPTING ON TEXT COMPREHENSION OF STUDENTS WITH AUTISM SPECTRUM DISORDER

The purpose of this study was to investigate the effects of explicit instruction combined with video prompting to teach text comprehension skills to students with autism spectrum disorder. Participants included 4 elementary school students with autism. A multiple probe across participants design was used to evaluate the intervention's effectiveness. Results indicated that the intervention was successful for all participants. All participants mastered the comprehension skills; however, data were highly variable during the acquisition phase. Implications for researchers and practitioners are discussed.

KEYWORDS: Autism spectrum disorder, Text comprehension, Self-directed video prompting, Explicit instruction, Generalization

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April 23, 2016
Date

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CHAPTER ONE

Introduction

Autism spectrum disorder (ASD) often presents numerous challenges in the education setting as teachers attempt to design instruction that allows for access to the general curriculum (El Zein, Solis, Vaughn, & McCulley, 2014; National Research Council, 2001). In recent years, research has begun to emphasize the importance of literacy instruction for all learners, including those with significant disabilities (e.g., Browder et al., 2009). Some researchers believe that "…literacy is one of the most important educational goals for all students because of the opportunities it provides to gain strategies for further learning and access to information about the world" (Mims, Browder, Baker, Lee, & Spooner, 2009, p. 409).

Until recently, reading instruction focused primarily on functional sight word instruction for students with severe disabilities (Browder et al., 2009) and students with ASD (Chiang & Lin, 2007). Researchers have increasingly begun to emphasize that all learners should have access to comprehensive literacy instruction that includes phonemic awareness, phonics, vocabulary, fluency and reading comprehension (Browder, Ahlgrim-Delzell, Courtade, Gibbs, & Flowers, 2008) as well as access to literature (Browder et al., 2009).

The area of text comprehension, in particular, is often especially problematic for students with ASD (Nation, Clarke, Wright, & Williams, 2006; Nation & Norbury, 2005). Unlike many individuals with other disabilities, some students with ASD have relative strength in the area of word reading due to strong visual memory, but significant deficits in the area of comprehension (Nation et al., 2006; Nation & Norbury, 2005). The

ability to comprehend text is a crucial academic skill, and students need to use many strategies in order to understand text (Carnine, Silbert, Kame'enui, Tarver, & Jungjohann, 2006). Access to comprehension instruction is essential for students with ASD (Roux, Dionne, Barrette, Dupere, & Fuchs, 2015; Whalon, Al Otaiba, & Delano, 2009).

Impairment in communication is a salient characteristic of individuals with ASD. People with ASD often have difficulties with both receptive and expressive communication, which can lead to problems with comprehension (Chan, Leung, Cheung & Cheung, 2005; Howlin, 2006; National Research Council, 2001; Prizant & Wetherby, 2005; Sexton, 2001). In addition, people with ASD also may have trouble with organizing and planning, understanding concepts within larger contexts, and comprehending characters' perspectives – skills that may impede text comprehension (Carnahan, Williamson, & Christman, 2011; Gately 2008).

Evidence Based Practice for Text Comprehension

An emphasis on evidence-based practice (EBP) in the treatment of ASD is evident in the literature (Wong et al., 2015; Wong et al. 2014). In a recent report, Wong et al. (2014) examined the research support for *comprehensive treatment models* (consistently implemented combinations of practices) as well as *focused intervention practices* (interventions addressing a single practice) across a wide range of areas, including academic, social, and communication domains. They compiled a list of interventions with sufficient support to be considered EBP based on predetermined criteria (e.g., sufficient number of studies, participants, research teams). These interventions addressed a broad range of areas (e.g., play, communication, academic, social). A follow-up review by Wong et al. (2015) focused exclusively on the *focused intervention practices* explored in

the 2014 review. These two reviews reported EBP (e.g., antecedent based intervention, cognitive behavioral intervention, functional behavioral assessment, naturalistic interventions) across multiple skill domains.

While a majority of the EBPs in these reviews were applied to interventions addressing communication, social skills, and problem behaviors, recent research has begun to explore these practices more extensively in academic contexts. As research in the area of academics has been growing quickly in recent years, some of these practices, such as visual supports, task analysis and prompting (Wong et al. 2015; 2014), have been examined specifically in relation to text comprehension. Reading instruction for students with ASD in particular has expanded to include a greater emphasis on comprehension compared with previous years (Chiang & Lin, 2007; Whalon, Al Otaiba, & Delano, 2009). Recent reviews have shown that an increasing body of literature is emerging to address text comprehension for individuals with ASD (El Zein et al., 2014; Knight & Sartini, 2015). El Zein et al. (2014) reviewed the literature on reading comprehension instruction for students with ASD. They found that four studies used strategy instruction, two studies used anaphoric cueing, and three studies used explicit instruction (El Zein et al., 2014). In a review of research targeting text comprehension (both listening and reading) for students with ASD, Knight and Sartini (2015) examined 23 studies. Of these, 13 achieved "adequate" or "strong" ratings according to the criteria established by Reichow (2011) for examining quality of evidence for single case research designs. The authors then used Reichow's formula to determine which interventions had sufficient support to be considered EBP for teaching text comprehension to students with ASD. They determined that response prompting strategies and visual supports are EBPs.

Response prompting strategies used in the research included: model-lead-test (MLT); the system of least intrusive prompts (SLP); constant time delay (CTD); example and non-example modeling; simultaneous prompting; and response prompting within Direct Instruction programs.

Both comprehension reviews (El Zein et al., 2014; Knight & Sartini et al., 2015) determined that systematic instruction and visual supports have considerable support in the text comprehension literature for students with ASD. These results are consistent with the EBP reviews conducted by Wong et al. (2015; 2014), who evaluated practices across several domains (e.g., academic, social, communication). Wong et al. determined that visual supports, task analysis, and prompting are EBPs for students with ASD, although they did not determine EBP within specific domains.

Study Significance

While there is increasingly more research addressing text comprehension for students with ASD, there is need for more research in this area. In particular, the use of self-initiated strategies for comprehension for students with ASD has not been extensively addressed in the research (Knight & Sartini, 2015). Students with ASD require interventions that lead to increased independence (Hume, Loftin & Lantz, 2009). Video modeling and video prompting have extensive research support for students with ASD in a range of skill areas, such as self-care (Gardner and Wolfe, 2013) and communication (e.g., Wong et al., 2015), but there has been little attention to the use of these methods in the context of text comprehension. In addition, while instructional techniques such as response prompting strategies and visual supports have research support, limited attention has been given to their implementation in the general education

setting (Spencer, Evmenova, Boon, & Hayes-Harris, 2014). This study will contribute to the text comprehension research for students with ASD, with a specific emphasis on teaching students to increase their ability to access the general educational curriculum independently through learning to self-manage video prompts.

Research Questions

This study was designed to extend the research on comprehension instruction for students with ASD. Specifically, it investigated the effects of explicit instruction with a graphic organizer and self-initiated video prompting on the question answering skills of students with ASD. Students were taught to use a graphic organizer to determine answers to "wh" questions while reading and or / listening to text. This study investigated the following questions:

1. Does a functional relation exist between self-initiated video prompting combined with explicit instruction and the acquisition of graphic organizer use and question answering skills for elementary students with ASD?
2. Does student prompt independence increase during the intervention?
3. Will students generalize the video prompting intervention across materials, instructors, and settings?
4. What are general education teacher and paraprofessional perceptions of the feasibility and usefulness of the intervention?
5. How do the students with ASD evaluate the intervention?

Delimitations

This study, which investigated the effects of self-directed video prompting combined with systematic instruction to teach graphic organizer use and question

answering skills, has some delimitations. The study examined only students in first through fifth grade, and therefore may not generalize to students of other ages. In addition, a special education teacher and doctoral student who was the primary investigator conducted the intervention in a special education setting, with generalization probes conducted by a pareducator in the general classroom. Results may not generalize to other interventionists in other contexts.

Definitions

Text comprehension- Comprehension is "the process of simultaneously extracting and constructing meaning through interaction and involvement with written language" (Snow, 2002, p. 11). Text "is broadly construed to include any printed text or electronic text" (p. 11) and can be visually and /or verbally presented. *Text comprehension* in this study refers to both listening and reading comprehension.

Explicit instruction – Instruction "characterized by a series of supports or scaffolds, whereby students are guided through the learning process with clear statements about the purpose and rationale for learning the new skill, clear explanations and demonstrations of the instructional target, and supported practice with feedback until independent mastery has been achieved" (Archer & Hughes, 2011, p. 1).

Video prompting- A type of video modeling that "involves breaking the behavior into steps and recording each step with incorporated pauses during which the learner may view and then attempt a step before viewing and attempting subsequent steps" (Wong et al., 2015, p. 101). *Self-directed video prompting* refers to video prompts initiated by the student.

Graphic organizer- "A visual and graphic display that depicts the relationships between facts, terms and or ideas within a learning task" (Hall & Strangman, 2002).

System of least intrusive prompting (SLP)- A method of explicit instruction in which a predetermined set of planned prompts is implemented systematically during the lesson. Prompts are delivered in order according to a preset prompt hierarchy, with less intrusive prompts occurring before more intrusive prompts (Snell & Brown, 2011).

Model-lead-test –A method of explicit instruction in which the teacher first models the skill, then performs the skill with the student, and finally asks the student to perform the skill independently (Archer & Hughes, 2011).

Delayed test – a component of error correction in which the teacher returns to the missed content later in the lesson and offers the student another opportunity to respond to the task (Carnine et al., 2006).

CHAPTER TWO

Review of the Literature

Students with autism spectrum disorder (ASD) often exhibit significant difficulty with text comprehension (Nation et al., 2006; Nation & Norbury, 2005). The following section will describe the comprehension difficulties typically displayed by students with ASD and discuss cognitive theories that may explain these difficulties. An outline of the text comprehension research for students with ASD will be discussed.

Comprehension and ASD

Students with ASD struggle with communication, which can affect text comprehension (e.g., Chan et al., 2005; Howlin, 2006; Prizant & Wetherby, 2005). In addition to communication deficits, other unique characteristics of ASD may contribute to comprehension difficulties. Three prevalent cognitive theories may help to explain the unique text comprehension difficulties experienced by many individuals with ASD (El Zein, et al., 2014). These three perspectives are: Theory of Mind (ToM), Weak Central Coherence (WCC) and Executive Dysfunction Theory (EDT; El Zein et al.). While these three theories describe characteristics that apply to multiple domains, they may be especially useful in explaining difficulties with text comprehension. These theories may be present in combination (Rajendran & Mitchell, 2007); and more than one of these theories could potentially explain difficulties of individuals with ASD (LeSourn-Bissaoui, Caillies, Gierski, &, 2011). An examination of all three, however, helps to illuminate the specific characteristics of ASD and contribute to the development of interventions aimed at addressing these characteristics.

Theory of Mind. The ToM perspective refers to the inability of many individuals with ASD to take the perspectives of others (Carnahan et al., 2011; Colle, Baron-Cohen, Wheelright, & van der Lely, 2008; Frith, 2012; Jolliffe & Baron-Cohen, 1999a). Several experiments have illustrated how the TofM deficit affects text comprehension for many individuals with ASD (Colle et al., 2008; Jolliffe & Baron-Cohen, 1999a; Le Sourn-Bissaoui et al., 2011). Colle et al. (2008), for example, compared the story retelling skills of 12 adults with ASD to typically developing (or neurptypical) adults in a control group. They found that although the participants with ASD used language as complex as those in the other group, they had more difficulty using temporal expressions (e.g., "yesterday") and anaphoric expressions (e.g., pronouns) to orient the listener to the story. Colle et al. (2008) attributed these deficits to ToM difficulties, noting that temporal and anaphoric expressions are *referential* and require the storyteller to consider the perspective of the listener. This study suggests that comprehension may be problematic for individuals with ASD due to the social demands it presents.

Further support of the ToM perspective appeared in a study conducted by Jolliffe and Baron-Cohen (1999a), comparing the reading comprehension skills of three groups of adults, one with Asperger syndrome, one with ASD, and one control group (matched for age and IQ) with no diagnoses of ASD. In this study, the researchers presented each group with short stories. One category of story, the *mentalistic* type, required individuals to understand mental states and apply pragmatic and social cues to interpret character motivation correctly. In one story, for example, a character sarcastically comments that it is "a lovely day for a picnic" (p. 405) when rain interrupts a planned outing. The participants were asked to state whether the character's statement was true and infer why

the character made this statement. These stories included social concepts such as misunderstandings, persuasion, sarcasm and jokes. In the other category of story, the *physical* type, the participants had to make inferences of similar difficulty, but did not have to interpret a character's mental state or apply social cues. The authors found that individuals with ASD and Asperger syndrome did not perform as well as those in the control group on the *mentalistic* stories, although they performed equivalently on the *physical* stories. The researchers posited that the participants with ASD struggled with the *mentalistic* stories because of ToM difficulties.

Le Sourn-Bissaoui et al. (2011) examined the inferential skills of adolescents who were diagnosed with Asperger syndrome. In this study, participants were asked to read two sentences and answer a "why" question. They were also asked to read passages, make predictions about the next event, and judge the probability of an event occurring. In addition, participants listened to a scenario requiring them to interpret characters' actions based on information the characters received in the story (ToM task). Their results showed that participants with ASD had more difficulty on inferential tasks and the ToM task than their matched control counterparts. The authors also found that participants who were able to perform the ToM task had fewer problems with inferential comprehension. The authors did note, however, that WCC could also have contributed to the participants' difficulty with making inferences.

In order for readers to comprehend complex text fully, they need to employ a variety of ToM skills. Skills such as interpreting character motivation, understanding characters' actions, and making predictions based on characters' experiences and

personal feelings require ToM (Carnahan et al., 2011; Gately, 2008). Mastery of such skills is necessary for readers to understand a variety of texts.

Weak central coherence. The WCC theory describes the difficulties that many individuals with ASD have with understanding larger context and synthesizing detail. While people with ASD may be able to perceive individual details, they often struggle to interpret the information globally (Jolliffe & Baron-Cohen, 2001; Jolliffe & Baron-Cohen, 1999b). Jolliffe and Baron-Cohen (2001) examined the ability of individuals with ASD to incorporate components of line drawings into logical scenes as well as compare drawings for similarities. They found that participants with ASD were able to find similarities as well as their matched controls, but demonstrated impairments in their ability to integrate the drawings into coherent scenes. In a second experiment, the authors demonstrated that participants with ASD were also less able to find equivalent objects and identify the scenes. The researchers attributed this difference to WCC present in the participants with ASD.

Jolliffe and Baron-Cohen (1999b) applied the WCC theory specifically to text comprehension. In one experiment, they asked individuals with and without ASD to interpret which meaning of a homograph was relevant based on a previous sentence. They determined that the participants with ASD were less able to use the sentence to interpret the homograph. In a second experiment, the authors asked participants to read pairs of sentences and connect the pairs with missing sentences. The participants with ASD had more difficulty selecting the correct connecting sentences. In a third experiment, in which participants were asked to use context to interpret an ambiguous

statement, individuals with ASD had more difficulty interpreting the statement. Jolliffe and Baron Cohen interpreted these results as evidence of WCC.

Le Sourn-Bissaoui et al. (2011) noted that WCC could have contributed to difficulties with the ability of their participants with ASD to make inferences in their study. They noted that inferential comprehension requires the reader to apply the details of a text in relation to a larger body of previously acquired knowledge. Difficulties with central coherence affect a variety of comprehension tasks, such as summarizing, identifying main ideas, and determining which events, details, and character actions are significant. In addition, WCC can affect a reader's ability to access prior knowledge and apply it to text (El Zein et al., 2014; Gately, 2008).

Executive dysfunction. The EDT perspective posits that frontal lobe brain activity in individuals with ASD leads to difficulties regulating a variety of self-monitoring behaviors, such as planning and maintaining attention (Ozonoff & Jensen, 1999). In a series of executive functioning tests, Ozonoff and Jensen (1999) examined the differences between individuals with ASD, ADHD, and Tourette syndrome. They measured three executive functioning components: flexibility, planning, and inhibition. In the flexibility measure, participants were asked to perform a sorting task requiring attention to frequent changes in the attribute sorted. To measure planning, the task required participants to move pegs and discs to a location in the least number of moves possible. In the inhibition task, participants had to perform a Stroop task, in which they had to suppress automaticity in order to give a non-intuitive response (e.g., read the color word "blue" written in a different color). The authors found that individuals with ASD struggled more with planning and flexibility than the other two disability groups as well

as the control group. They also found, however, that inhibition in individuals with ASD was unaffected. Lopez, Lincoln, Ozonoff, and Lai (2005) reported similar profiles among their participants with ASD on a battery of executive functioning assessments. Although individuals with ASD in this study struggled with cognitive flexibility and planning, they exhibited relative strengths on inhibition and working memory measures.

The planning difficulties that result from executive dysfunction can also lead to difficulties with initiation among individuals with ASD (Hume et al., 2009). As a result of difficulty with initiation, students with ASD can become overly dependent on adult prompting. This dependence impedes their ability to function independently (Hume et al., 2009). Cognitive flexibility and planning are necessary for successful reading comprehension (El Zein et al., 2014). Students with ASD also may have difficulty monitoring their own comprehension and initiating strategies such as asking for help, rereading or self-correcting if they do not understand the text (Carnahan et al., 2011).

Strategies for Teaching Text Comprehension

In the past decade, the text comprehension research base for students with ASD has substantially expanded, with researchers investigating instructional strategies for teaching text comprehension across content areas (Knight & Sartini, 2015). Table 2.1 lists the instructional strategies that have research support for teaching text comprehension to students with ASD. In the next few sections, these strategies will be described in more detail. In particular, the evidence for graphic organizers, systematic instruction, and video modeling / video prompting will be considered.

Graphic organizers. Many researchers have investigated the use of visual supports during text comprehension instruction for students with ASD (El Zein et al.,

2014; Knight & Sartini, 2015). Visual supports, including graphic organizers, checklists / prompts with visual cues, and visual diagrams have been included in numerous interventions targeting text comprehension (El Zein et al., 2014; Knight & Sartini, 2015). Graphic organizers in particular have led to successful comprehension for students with ASD in several studies (e.g., Bethune & Wood, 2013; Knight, Spooner, Browder, Smith, & Wood, 2013; Mims, Hudson, & Browder, 2012; Stringfield, Luscre, & Gast, 2011; Whalon & Hanline, 2008).

One such study investigated the use of graphic organizers with three elementary students with cognitive scores in the average range (Whalon and Hanline, 2008). In this study, instructors taught students with ASD to comprehend text. In a cooperative learning intervention, students learned to use a story map with visual cues to comprehend the key elements of reading passages. This study used a multiple baseline across participants design to demonstrate the success of graphic organizer use in a cooperative learning context.

Further evidence was provided through a study conducted by Stringfield et al. (2011), who used a graphic organizer to improve the reading comprehension of three elementary school students with ASD and cognitive scores in the below average to average range (70-115). Using a multiple baseline across participants design, researchers used a story map with places for characters, setting, beginning, middle and end. They used the example / non-example strategy to teach students to complete the story map. Students improved their ability to complete the story map and use it to answer questions. Their performance further supports the use of graphic organizers during text comprehension instruction for students with ASD.

Mims et al. (2012) extended previous graphic organizer research with students with ASD to apply to students with severe intellectual disability. Researchers employed the system of least prompts (SLP) and graphic organizers to teach four students to answer questions during read-alouds of adapted biographies within the context of a multiple probe across participants design. The system of least prompts was modified (i.e., rule for answering "wh" questions as well as rereading were inserted in the prompt hierarchy). In this study, participants included four students with ASD (ages 12-14) and severe intellectual disability. Within a prompt hierarchy, the authors embedded rules for answering "wh" questions (e.g., "who: listen for a name") and reminded the students of these rules as prompts. They also used a sequencing graphic organizer with squares for "first," "next," and "last". All participants increased the numbers of unprompted questions answered correctly and generalized this skill to unfamiliar text. This study demonstrated that the use of SLP and graphic organizers effectively taught students with ASD as well as significant intellectual disabilities to answer "wh" and sequencing questions.

Bethune and Wood (2013) also examined "wh" questions in the context of graphic organizer instruction. Using a multiple probe across participants design, researchers presented a graphic organizer to teach "wh" questions to three elementary students with ASD. These students, who had cognitive scores ranging from 67-90, were taught to sort "wh" words into a graphic organizer with columns for each question type (e.g., "the park" was placed in the "where" section). The researchers used the SLP to teach the students to understand the question types and answer the questions after reading the passage orally. In this study, all participants improved their ability to sort the words

into correct question types and answer "wh" questions about the story. In addition, students were able to maintain progress after 3 to 5 weeks and generalized their ability to answer questions to reading instruction in their special education classes. This study supports the use of both SLP and graphic organizers with students with ASD and mild to typical intellectual disabilities.

As graphic organizer use gained momentum in the text comprehension research, researchers began to explore the practice across content areas. Knight et al. (2013), for example, extended the graphic organizer research to include comprehension of science text. In this study, which employed a multiple probe across participants design, the researchers used graphic organizers to teach abstract science concepts such as convection. Participants (ages 13-14) with ASD and cognitive scores in the moderate range (40-55) improved their correct responses and generalized to untrained exemplars. Students learned to place vocabulary words such as "precipitation" and "evaporation" near pictures depicting these words on the graphic organizer. Three different graphic organizers were used during instruction, with untrained novel organizers presented for generalization. This study provides promising evidence that graphic organizer use could be beneficial when applied to science text.

Carnahan and Williamson (2013) further explored the use of a graphic organizer (Venn diagram) to teach comprehension of science text. Using a reversal design, the researchers taught students how to compare and contrast concepts while reading science texts. In this study, participants included three 13-year-old students described as having high functioning ASD. All students improved their ability to answer comprehension

questions and fill out the Venn diagram to compare and contrast concepts from science texts.

In addition to the areas of reading and science, researchers began to examine graphic organizers in the context of social studies instruction. The use of graphic organizers was applied to social studies text in a study conducted by Zakas, Browder, Ahlgrim-Delzell, and Heafner (2013). Using a multiple probe across participants design, the researchers taught three middle school students with ASD and mild intellectual disabilities (IQ scores of 61-69) to record significant information on a graphic organizer while reading social studies text. The participants learned to record events, people, places, events, details and outcomes on a blank story map. The researchers provided the students with picture cues and definitions for each graphic organizer component (e.g., "Location is where the event takes place"). Students learned to fill out the organizer independently and generalized this skill to unfamiliar text.

Schenning, Knight, and Spooner (2013) further expanded the use of graphic organizers with social studies text. In this study, researchers used a multiple probe across participants design to teach three middle school students with moderate intellectual disabilities and ASD to fill out a graphic organizer with picture cues during a social studies lesson. The interventionists used a task analysis to guide students through the inquiry process. All students met criteria on the comprehension probes, which measured their ability to fill out the graphic organizers correctly and answer comprehension questions correctly using the organizers. In addition, all participants maintained growth after 4-7 weeks and generalized the strategy to questions requiring real-world connections.

Explicit instruction. In addition to the use of graphic organizers, explicit instruction is an EBP for students with ASD in the area of text comprehension (Knight & Sartini, 2015). Explicit instruction involves the systematic, direct, and clear instruction of skills, in which learner demands are clearly conveyed and modeled and tasks are broken down and carefully sequenced. During instructional presentation, the teacher provides the opportunity for skill practice with scaffolded support that is gradually faded as the student approaches mastery (Archer & Hughes, 2011; Rosenshine, 1986). In a comprehensive literature review, Knight and Sartini (2015) noted that systematic instruction, specifically response prompting strategies, resulted in successful acquisition of comprehension skills in 11 of the 13 quality studies. In the studies they examined, SLP, model-lead-test, and presentation of examples and non-examples were among the systematic strategies supported in the literature.

System of least intrusive prompts. The SLP strategy has been frequently used to address text comprehension for students with ASD, especially those with intellectual disability (Browder, Trela, & Jimenez, 2007; Mims et al., 2012; Muchetti, 2013). Browder et al. (2007), for example, used a multiple probe across participants design to demonstrate effectiveness. They instructed teachers in the use of a task analysis and SLP to teach two students with ASD and moderate severe cognitive delays (IQs below 55) to comprehend orally presented text within a special education classroom in the middle school setting. In this study, students improved their ability to answer multiple choice comprehension questions during a story-based lesson.

Muchetti (2013) examined engagement and text comprehension among four students with ASD, intellectual disability, and limited verbal ability. These students, ages

5-6, were taught using adapted texts (e.g., reduced complexity, pictures, objects). The interventionist used SLP to teach students to interact with the materials (e.g., touch objects, turn pages) and answer comprehension questions using response boards. Students improved their ability to answer comprehension questions as well as attend to the literacy lessons.

Model-lead-test. Knight & Sartini (2015) noted that the model-lead-test format is becoming more widely used to increase comprehension for students with ASD. In their review, a majority of studies that utilized systematic instruction employed the model-lead test strategy. In this strategy, the teacher first models an answer or task, performs it with the student, and finally asks the student to perform it independently.

Two studies used model-lead-test as part of the *Corrective Reading* Direct Instruction program (Flores & Ganz, 2009; Flores & Ganz 2007). In these studies, researchers used a scripted program with embedded systematic instruction, including model-lead-test. Students with ASD were taught to interpret inductive and deductive statements (Flores & Ganz, 2009) and to infer, use facts, and understand analogies (Flores & Ganz, 2007).

Rockwell, Griffin and Jones (2011) implemented the model-lead-test format to teach math story problems. The researchers taught a 10-year-old student with ASD to solve three types of one-step addition and subtraction word problems (group, change, and comparison). The student was taught to use a mnemonic specifying the steps for the problems and apply visual diagrams for each problem type. During instruction, model-lead-test was used to teach the use of the strategy. In this study, the student obtained 100% mastery on all problem types and generalized to unfamiliar problems. This study is

a strong example of successful instruction in abstract thinking. The use of graphic organizers with three different types of problem sets led to comprehension across a range of problem types. The student learned to conceptualize each problem within realistic contexts.

Knight et al. (2013) extended the model-lead-test strategy to teach comprehension of science text. This study focused on developing conceptual understanding of science vocabulary words. After teaching words and definitions to students using constant time delay, Knight et al. used multiple exemplars (with examples and non-examples) to teach students to sort multiple pictures into a T-chart with "yes" and "no" sections. The interventionist used model-lead-test with the T-chart to present pictorial examples and non-examples of the vocabulary concepts (e.g., precipitation).

Smith, Spooner and Wood (2013) used a variation of the model-lead-test strategy to teach science vocabulary to students with ASD and intellectual disabilities. In this study, general education teachers and peer tutors used an iPad application to teach students definitions for science vocabulary words (e.g., chromosomes). A model-test presentation was embedded into the iOS application. Three middle school students with ASD and intellectual disability learned to identify pictures that matched science terms and generalize to untrained exemplars.

Schenning et al. (2013) implemented the model-lead-test format during instruction in graphic organizer use and comprehension of social studies text. The researchers created a task analysis to guide students through the structured inquiry process. During the first reading of the text for each session, interventionists used the model-lead-test format to teach each step of the task analysis. On the second reading,

students completed the steps independently. In this intervention, the students were able to reach criterion on comprehension probes, which measured students' ability to fill out a graphic organizer and answer comprehension questions.

The model-lead-test strategy has been used to teach students with ASD text comprehension across content areas, including reading (Flores & Ganz, 2009; 2007), science (Knight et al., 2013; Smith et al., 2013) social studies (Schenning et al., 2013) and math (Rockwell et al., 2011) and should be explored further as a potential effective practice for text comprehension instruction (Knight & Sartini, 2015).

Examples and non-examples. The use of multiple exemplars with examples and non-examples has emergent research support as a potential strategy for students with ASD. Secan, Egel, and Tilley (1989) used a multiple exemplar approach in the area of comprehension, specifically to teach students to answer "wh" questions about pictures. In this study, researchers used 50 different photographs as examples while teaching four elementary students to answer "why", "how" and "what" questions. Researchers selected the pictures to represent a range of possible answers for each question type. For example, the word "what" was presented in its potential function as asking for an "object or noun" as well as expressing "which". The word "why" was presented in multiple functions. These functions included: explaining cause and effect, explaining emotion (e.g., "Why is she crying?") and anticipating an action (e.g., "Why does he have a broom?"). The teachers used a model-test format as an error correction during the training (i.e., modeled the correct answer and asked the question again). Participants not only learned to answer questions about untrained pictures, but generalized when shown illustrations in books and

when asked questions in naturalistic contexts (e.g., during daily routines). This study demonstrated that exemplars can be used to clarify the range of attributes of a concept.

Knight et al. (2013) also used examples and non-examples to express a range of attributes. This study focused teaching science concepts to students with ASD. The researchers selected exemplars that would ensure that students attended to all the necessary components of the concept (e.g. used examples that varied the key attributes of the concept). Knight and Sartini (2015) noted that the use of examples and non-examples in conjunction with model-lead-test might help to form students' conceptual understanding. The example and non-example approach may assist with WCC by teaching students to attend to multiple important attributes simultaneously, thus building their global comprehension. In the Knight et al. study, for example, the interventionist presented an example of "precipitation" with a picture of a cloud and rain falling from it. In a non-example, the teacher presented a cloud without rain, and explained that this picture did not exemplify precipitation, referring to the definition of precipitation during the explication of the concept ("This is NOT precipitation. See, it has a cloud, but no rain falling from it"). Students needed to attend to the essential attributes to be able to distinguish between the examples and non-examples.

Video Modeling and Video Prompting

The use of video modeling has been well established in the literature as an EBP for students with ASD (Wong et al., 2015; Wong et al., 2014). Video modeling has been implemented successfully across a variety of skills (e.g., communication, play, social, behavioral, adaptive) with students with a range of cognitive levels, such as mild, moderate and severe intellectual disability (Gardner & Wolfe, 2013; Wong et al, 2015).

Video prompting is a type of video modeling in which the videos are broken into small components, where students watch each step individually (Wong et al., 2015).

Gardner and Wolfe (2013) reviewed the literature examining the use of video modeling and video prompting to teach individuals with ASD to complete daily living skills. They determined that video prompting was effective and video modeling was somewhat effective in teaching students with ASD to acquire the targeted skills. In two studies they reviewed, video prompting was more effective than static picture prompting. In addition to examining study effectiveness, Gardner and Wolfe (2013) explored the instructional techniques used during implementation of video modeling and video prompting interventions. They found that prompting was used in all studies, especially to begin the tasks. Frequently, SLP was used throughout studies in order to ensure that the least intrusive prompt was used.

Video modeling using an iPad application was used by Spriggs et al. (2014) to teach academic as well as functional tasks. Researchers used the *My Pictures Talk* ™ iPad application to teach four high school students with ASD and mild to moderate intellectual disability to write paragraphs, solve algebraic equations, and enter data into a computer. Researchers created visual activity schedules with video models embedded into the schedules. Using a multiple probe across participants design, researchers demonstrated that all participants were able to complete the targeted tasks independently. Students were able to generalize to a static schedule after the instructor removed the video models.

Researchers have suggested multiple reasons for the success of video modeling with participants with ASD. Some have posited that video modeling is effective because

it involves few social demands (e.g., Charlop-Christy, Le, & Freeman, 2000; Corbett and Abdullah 2005). Charlop-Christy, et al. (2000) noted that because camera angles can be manipulated to ensure appropriate focus, video modeling reduces the chance that students will focus on irrelevant stimuli. Executive dysfunction, particularly difficulties with self-monitoring, planning, and processing speed, can impede the ability of individuals with ASD to initiate social interactions as well as functional and academic tasks (Hume et al., 2009). Video modeling, particularly self-directed video modeling, may be effective because it minimizes difficulties with initiation and adult prompt dependence experienced by many with ASD (Hume et al., 2009). Increased independence has been an area of focus for researchers across both functional and academic domains. Research in self-directed instruction, for example, has been conducted to examine the extent to which students can manage their own instructional prompting.

Self-Directed Instruction

Researchers have explored different methods of teaching self-instructional strategies to individuals with disabilities. Smith, Shepley, Alexander, and Ayres (2015) describe self-directed instruction as a pivotal skill that can lead to future learning opportunities. Students who are taught to self-instruct will be more likely to develop independence; they will be able to use their knowledge to approach future novel tasks without reliance on prompting from others. Smith et al. conducted a comprehensive review examining the literature on self-instruction and generalization. In this review, they reviewed 19 studies that included self-instruction using a range of prompts (i.e., pictorial, tactile, auditory, video). Students were trained to use prompt materials prior to the intervention (e.g., with non-targeted skills) and to self-instruct when approaching

unfamiliar functional tasks (e.g., setting the table). Smith et al. determined that 56% of the participants across the studies were able to generalize the prompting materials to untrained chained tasks. The authors emphasized the need for addressing generalization during training in self-instruction and reiterated the importance of teaching self-instruction as a pivotal skill that will endure after students leave settings that provide systematic instruction (e.g., schools).

Researchers have also examined self-directed instruction in the context of academic instruction. Using a multiple baseline across participants design, Agran, Cavin, Wehmeyer, & Palmer (2006) implemented self-directed instruction in general education science and geography classes for three junior high school students with moderate to severe intellectual disability. One participant had an additional diagnosis of ASD. Researchers used the Self-Determined Learning Model of Instruction, in which students select goals, determine a plan to achieve goals, and evaluate progress. In this study, students selected self-directed strategies (e.g., self-monitoring) they would use to approach the academic tasks. All students mastered the targeted sills and maintained mastery. This study was novel in its approach to including students with significant disabilities in the process of planning their own instruction in the general classroom.

Agran, Wehmeyer, Cavin, and Palmer (2008) used a multiple baseline across participants design to further demonstrate the effectiveness of the Self-Determined Learning Model of Instruction. Three junior high school students with intellectual disability were instructed in selecting goals, determining and implementing a self-monitoring strategy to address goals, and evaluating goals. Goals were related to participating actively in the general classroom (e.g., locating supplies, writing in journal,

participating in group activities). All participants improved in their self-selected skills and maintained improvement. The researchers stressed the importance of using time in the general education setting to teach self-determination as an enduring skill that will lead to success in post-school settings.

Self-directed video prompting. Some of the video prompting research has attempted to increase independence by teaching students to self-prompt using hand-held devices (e.g., Bereznak, Ayres, Mechling, & Alexander, 2012; Mechling & Savidge, 2011; Van Laarhoven, Kraus, Karpman, Nizzi, & Valentino, 2010). Van Laarhoven et al. (2010) used an adapted alternating treatment design to compare video prompting and picture prompting during adaptive skill instruction. In the video prompting condition, two middle school students with ASD were provided with access to video prompts using a power point program during instruction in laundry and cooking skills. The picture prompting condition provided the picture prompts in a static booklet format. Students were able to increase the percentage of correct steps during skill performance in both conditions. In addition, they decreased the number of prompts necessary to use both the video technology and booklet. In the video condition, however, students achieved more independent correct responses.

Bereznak et al. (2012) taught three high school students with ASD to use video self-prompts on an iPhone while completing vocational and adaptive tasks (e.g., laundry, copy machine use). All of the were able to complete the tasks indpendently, and two of the students were able to learn to prompt themselves with the iPad to learn the tasks. The authors concluded that not only is video prompting an effective intervention for students with ASD, it can potentially increase independence as students learned to self-prompt.

Smith et al. (2016) demonstrated similar results in their study of self-instruction using video prompting. In this study, self-instruction occurred when the student removed the iPhone independently, found the appropriate video model, and completed a novel task. Researchers used progressive time delay to teach students to self-instruct. Using a multiple probe across participants design, researchers demonstrated that four high school students with ASD and mild to moderate intellectual disability learned to initiate access to video models on an iPhone when confronted with a novel functional task (e.g., cooking). All participants mastered the skill of self-instruction, three of the four participants generalized across instructors, and two of the four participants generalized to novel settings. Authors noted that teaching self-instruction in the initiation of video models warrants attention in future research as a means of decreasing student reliance on adults to present instruction.

While less research exists relating to self-directed video modeling in academic domains, some studies have demonstrated success with academic skill instruction (e.g. Burton, Anderson, Prater, & Dyches, 2013; Spriggs, Knight & Sherrow, 2014). Burton et al. (2013) implemented a video self-modeling intervention on an iPad to teach four students (ages 13-15) with ASD to complete word problems involving money. Participants were asked to read (or watch the model) and solve the story problems (e.g., find change, cost, use smallest possible amount of bills). Students learned to initiate use of the video self-models as prompts while completing the problems. The researchers faded the self-models, and students completed the problems independently. Students were also able to generalize to a novel problem (one not included on the videos). There is a need for greater emphasis on text comprehension research for students with ASD,

particularly applied to the general classroom setting (Knight & Sartini, 2015; Spencer et al., 2014). Interventions that facilitate independence are especially necessary for students with ASD (Hume et al., 2009). In addition, interventions that address unique cognitive difficulties associated with ASD should be considered. In this study, the use of a graphic organizer was implemented to help direct student attention to important story elements, which could ameliorate WCC and executive dysfunction by helping students conceptualize important information and plan how to gather information from the text. The combination of examples and nonexamples with explicit instruction was implemented to address WCC; broad example selection will help students gain a thorough perception of the concept of question words (i.e., "who," "what," "where," "when"). Video prompting was implemented to help students initiate the task and monitor their own prompting, skills that may be affected by executive dysfunction. The combination of video prompting and explicit instruction during text comprehension instruction could be a promising way to teach students to engage in text comprehension strategies independently across a range of settings.

Table 2.1
*Strategies used in text comprehension research for students with ASD (*Knight & Sartini, 2015; Sartini, Knight, Spriggs, & Allday, 2016*)*

Intervention	Articles	Participants
Graphic organizer	• Bethune & Wood (2013) • Carnahan & Williamson (2013) • Chia & Kee (2013) • Knight et al. (2013) • Mashal & Kasirer (2011) • Mims et al. (2012) • Rockwell et al. (2011) • Schenning et al. (2013) • Stringfield et al. (2011) • Whalon & Hanline (2008) • Zakas et al. (2013)	N: 64 36 (SCD) 28 (group)
Model-lead-test	• Asberg & Sandberg (2010) • Flores & Ganz (2009; 2007) • Jimenez et al. (2014) • Knight et al. (2014) • Knight et al. (2013) • Rockwell et al. (2011) • Schenning et al. (2013) • Smith et al. (2013) • Spooner et al. (2015) • Zakas et al. (2013)	N= 41 29 (SCD) 12 (group)
Strategy instruction	• Agran et al. (2006) • Burton et al. (2013) • Carnahan & Williamson (2013) • Reutebuch et al. (2015) • Rockwell et al. (2011) • Stringfield et al. (2011) • Whalon & Hanline (2008)	N=20 (SCD)
Example / nonexample	• Agran et al. (2006) • Jimenez et al. (2014) • Knight et al. (2014) • Knight et al. (2013) • Spooner et al. (2015) • Stringfield et al. (2011) • Zakas et al. (2013)	N=18 (SCD)

Intervention	Articles	Total Number of Participants
Time delay	• Browder et al. (2007) • Hua et al. (2013) • Jimenez et al. (2014) • Knight et al. (2013) • Riesen et al. (2003) • Schenning et al. (2013) • Spooner et al. (2014)	N=17 (SCD)
System of least intrusive prompting (SLP)	• Bethune & Wood (2013) • Browder et al. (2007) • Mims et al. (2012) • Muchetti (2013) • Spooner et al. (2015) • Spooner et al. (2014)	N=18 (SCD)
Cooperative learning	• Dugan et al. (1995) • Kamps et al. (1995) • Kamps et al. (1994) • Reutebuch et al. (2015)	N=11 (SCD)
Story based lessons	• Browder et al. (2007) • Muchetti (2013) • Spooner et al. (2015) • Spooner et al. (2014)	N=11 (SCD)
Direct Instruction	• Flores & Ganz, (2009; 2007)	N=4 (SCD)
Computer assisted instruction	• Knight et al. (2014) • Smith et al. (2013)	N=7 (SCD)
Video prompting / video modeling	• Burton et al. (2013) • Charlop-Christy et al. (2000)	N= 4 (SCD)
Anaphoric cueing	• O'Conner & Klein (2004)	N=20 (group)
Embedded Instruction	• Hundert & Delft (2009)	N=3 (SCD)
Interactive video clips	• Evmenova & Behrmann (2014)	N=1 (SCD)
Repeated reading	• Hua et al. (2012)	N=1 (SCD)
Simultaneous prompting	• Riesen et al. (2013)	N=1 (SCD)

CHAPTER THREE

Method

This study examined the effects of explicit instruction combined with student-initiated video prompting on the acquisition and generalization of graphic organizer use and "wh" question answering skills for elementary school students with autism spectrum disorder (ASD). The three-part intervention included teaching students to: (a) sort story elements into categories (i.e., "wh" answers); (b) fill out an organizer while listening to a story; (c) and refer to the completed organizer to answer story questions. This chapter provides descriptions of the specific procedures implemented in this study.

Participants

Four elementary school students with ASD ranging from first through fifth grade participated in this study. Students were selected based on the following criteria: (a) ability to respond to questions either verbally, in writing, or by touching from a field of at least three choices; (b) ability to respond to simple one step directions; (c) ability to attend to a verbally and visually presented story for at least 5 min; (d) ability to correct an answer after being presented with a model; (e) parental consent to participate; and (f) regular attendance (i.e., no more than one absence every two weeks). All students had diagnoses of ASD determined through educational eligibility and received 3 hr daily of instruction in a special education classroom for students with moderate to severe disability. Table 3.1 displays participant characteristics for students included in the study.

Gloria. Gloria was a Hispanic female with a diagnosis of ASD. At the start of the study, Gloria was an 8-year-old student in the third grade. Gloria's family spoke Spanish in the home. Gloria's score of 32 on the Child Autism Rating Scale –Second Edition

(CARS-2; Schopler, Reichler, & Rocher-Renner, 2010) indicated that her ASD was in the mild to moderate range. According to the Stanford Binet Intelligence Scales-Fifth Edition (SB5; Roid, 2003), Gloria had a full-scale IQ of 42. On the Vineland Adaptive Behavior scales-Second Edition (Vineland II; Sparrow, Cicchetti, & Balla, 2005), Gloria obtained a composite score of 61 and a communication score of 60. Gloria's cognitive, adaptive and communication scores suggested mild to moderate intellectual disability. Gloria communicated verbally, primarily using single sentences, in order to request and make simple comments. On the Kaufman Test of Educational Achievement-Third Edition (KTEA-3; Kaufman & Kaufman, 2014), Gloria's score of 58 was in the .3 percentile, which was in the very low range according to test authors. Gloria was able to decode text at the late first grade level, and she was able to match pictures to printed words at her current instructional level (i.e., words she could read with at least 90% accuracy). She was not consistently able to answer literal comprehension questions (e.g., "wh" questions) about a simple (e.g., kindergarten level) orally or visually presented story. According to the CARS-2 assessment (Schopler et al. 2010), Gloria was described as slower-moving and less active than same-age peers. She generally displayed willingness to engage in reading activities. She had some previous experience using video models.

Daniel. Daniel was an 11-year-old, African American male in the fifth grade. He had a diagnosis of ASD. Daniel's score of 34.5 on the CARS-2 (Schopler et al., 2010) indicated that his ASD symptoms were in the mild to moderate range. Daniel obtained a full-scale IQ of 58 on the SB5 (Roid, 2003). On the Vineland-II (Sparrow et al., 2005), Daniel obtained an adaptive composite score of 64 and a communication score of 65. Daniel's cognitive, adaptive, and communication scores indicated a mild intellectual

disability. Daniel communicated verbally using phrases and short sentences, primarily to request and occasionally to comment. On the reading comprehension subtest of the KTEA-3 (Kaufman & Kaufman, 2014), he obtained a standard score of 64, which is in the 1st percentile. This score is in the low range as described by test authors. Daniel was able to decode text at a fourth grade level. He could match sentences to pictures, but was unable to answer comprehension questions. Activity level according to the CARS-II (Schopler et al., 2010) was described as occasionally calm, but at times highly active. Daniel generally complied with requests, but frequently displayed off-task behavior, including making noises, looking away from work, and occasionally getting out of his seat. He had some previous experience with video models.

Charles. Charles was a 6-year-old, African American male in the first grade. He had a diagnosis of ASD. Charles's score of 34 on the CARS-2 (Schopler et al., 2010) indicated symptoms of ASD in the mild to moderate range. He obtained a full-scale IQ of 58 on the SB5 (Roid, 2003). On the Vineland-II (Sparrow et al., 2005), Charles obtained a composite adaptive score of 74 with a communication score of 78. Charles cognitive score suggested a mild intellectual disability, although his adaptive and composite scores were above this range. Charles communicated verbally through use of simple sentences and phrases of about 1-3 words. On the reading comprehension subtest of the KTEA-3 (Kaufman & Kaufman, 2014), he obtained a standard score of 92, in the 30th percentile, which was described as average by test developers. Charles was able to decode text at an early first grade level. He could match words to pictures, but he was unable to answer simple comprehension questions about text related to story elements. On the CARS-II (Schopler et al., 2010) assessment, Charles' activity level was described as typical. He

often become frustrated during difficult tasks and would occasionally scream or throw materials. Charles had previous experience using video models.

Zach. Zach was a 10-year-old African American male in the fifth grade with a diagnosis of ASD. According to the CARS (Schopler et al., 2010) assessment, Zach's score of 35 suggested that his ASD was in the mild to moderate range. Zach obtained a full scale IQ of 40 on the Stanford Binet Intelligence Scales-Fifth Edition (SB5; Roid, 2003). His Vineland-II (Sparrow et al., 2005) composite score was 64, and his communication score was 62. His cognitive, adaptive and communication scores indicated a moderate to mild intellectual disability. Zach communicated verbally using simple sentences to request and comment. Zach obtained a score of 67, in the 1st percentile, on the reading comprehension subtest of the Kaufman Test of Educational Achievement-Second Edition (KTEA-II; Kaufman & Kaufman, 2004). This score indicated significant difficulty with reading comprehension. Zach was able to match pictures to sentences and decode text at a fourth grade level, but he was unable to answer literal comprehension questions consistently when given simple (e.g., kindergarten level) orally or visually presented text. The CARS-II (Schopler et al., 2014) assessment indicated that Zach's activity level was typically very hyperactive, with Zach easily distracted by other stimuli. He frequently (e.g., during almost every instructional session) displayed off-task behavior, such as making noises, dropping to the floor, and looking away from his work. He had previous experience using video models.

Setting

The study was conducted in a self-contained classroom for students with moderate and severe disabilities within an urban public school in a Southeastern state.

One teacher and one to five paraeducators were present throughout the day in the classroom. All students attended general education classrooms for approximately 3.5 hr daily and the special education classroom for approximately 3hr daily. Areas were set up throughout the special education classroom, including two small group areas, a reading area, a gross motor play area, an independent work station area, a computer area, a cooking area, a teacher desk / storage area, and a restroom. Areas around the room were sectioned with screens and furniture to minimize visual distractions. All baseline sessions, intervention probes, and intervention sessions were conducted in one of the two small group areas, which held a kidney shaped table, chairs, and bookshelves. Generalization probes were conducted in the students' general classrooms, in which a general education teacher and a paraeducator were present, with 20 to 25 other students seated at desks in the room. Participants were seated at their assigned desks in the general classroom with paraeducators seated or standing in close proximity (about 1 ft away) to monitor student work.

Interventionist

The interventionist in this study was the students' special education teacher. She also served as the primary investigator. The teacher was a student in her final year of a doctoral program in special education. She had a special education teaching certificate, a master's degree, and 14 years of experience teaching students with a range of disabilities, including emotional and behavioral disorders, ASD, learning disability, and intellectual disability. She had prior experience with delivering explicit instruction as well as implementing video modeling. The special education classroom was a room for students

with moderate to severe disabilities. The teacher conducted all intervention sessions and administered all assessments.

Materials

Ipad mini with *My Pictures Talk* ™ application. Video prompts were recorded using the *My Pictures Talk* ™ application, which was installed on an iPad mini. The *My Pictures Talk*™ application, which allows teachers to create short videos with voice over narration, is an inexpensive, commercially available video-modeling program. Video prompts for each question word were visible on the first screen, and students could access individual videos by touching the video for the desired question word. Figure 3.1 provides a picture of the home screen. Video prompts were about 5 to 10 s in length. The prompts showed a model of the teacher thinking through the task and putting the word on the graphic organizer (e.g., "This is a person. So I know it's a 'Who.' I'll put it in the 'Who' section"). In order to facilitate generalization to unrecorded examples, the exact words and pictures in the story were not visible in the video model.

Graphic organizers. Two types of graphic organizers were used. The first type, displayed in Figure 3.2, was a laminated piece of cardstock with two columns. The column on the left was a solid color (yellow, purple, blue, or green) and contained a picture of one question word (who, what, when, or where) with a visual prompt. The column on the right was red and contained a visual cue for "not." There were separate graphic organizers for each question word, with the color of the left column varying for each question word. The second graphic organizer consisted of a piece of cardstock with four computer-generated rows in a sheet protector. The words "Who," "What," "When," and "Where," were printed on each row, with picture cues for each word. Rows were

separate colors for each question word. The graphic organizer contained blank places for the students to write in the words using dry erase marker (Daniel and Zach) or place laminated word cards and phrases from the story (Gloria and Charles). Figure 3.3 shows a picture of the graphic organizer used in the study.

ReadWorks passages with adaptations. Passages were obtained from the ReadWorks website (2015), which offers a free library of reading passages across a range of reading levels. In order to select passages, the primary investigator searched for passages with a lexile level of 100-910, which correspond with first through 5th grade level. A total of 70 passages were selected. One to three picture cues were added to each sentence to illustrate key sentence concepts. For Gloria and Charles, the words and phrases in the story were pasted over the original words with repositionable glue so that they could use the cards to fill out the organizer. Figure 3.4 shows a sample organizer with words and phrases on cards. Separate passages were used for each probe session as well as each intervention session, with no passages repeated at any time. Passages were selected at random for each probe and intervention session. A literacy specialist examined passages for text complexity (e.g., sentence length) and vocabulary to ensure that baseline and intervention passages were of equivalent difficulty. She confirmed that the passages were comparable in complexity.

Level 1. For Level 1 text, passages were reduced to a length of three sentences. Passages contained at least one answer each for who, what, when, and where question. In each story, the "who" referred to a person (e.g., the boy, Mr. Tucker), "what happened" referred to an event or action (e.g., spilled the cereal), "when" referred to a time (e.g., yesterday, tonight, noon), and "where" referred to a place (e.g., under the table, the

beach). Figure 3.5 displays a sample passage from a Level 1 text. Stories contained at least one answer for each question word ("who", "what happened", "where" and, "when"). If the original passage did not contain one of the question words, that component was added to the story.

Level 2. Level 2 passages included the content from the Level 1 passages (i.e., at least one answer for "who", "what happened", "where", and "when"), but contained two to six additional sentences. Level 2 stories were five to eight sentences in length and contained information beyond the four basic question types (e.g., descriptions). Figure 3.6 depicts a sample passage from a Level 2 text. Level 2 passages were not required during intervention (see description of screening procedures).

Level 3. Level 3 passages were the original passages retrieved from the website. Researchers did not alter the complexity. Passages contained multiple paragraphs and extra information (e.g., descriptions and dialogue). Figure 3.7 displays a sample Level 3 passage. Level 3 passages were not required during intervention (see description of screening procedures).

Word cards. For Part 1 of the intervention, the teacher presented multiple exemplars of words and phrases with picture cues to demonstrate the meaning of question words. Cards depicted examples of answers to question words, with pictures for key words (e.g., picture of an apple pie for the phrase "made apple pie"). Cards were created with 18-20 pt font and contained either computer generated drawings (e.g., ClipArt) or photographs retrieved from the internet (e.g., Google images). Cards were between 1 x 1 in. and 2 x 2 in. and were printed on white cardstock or paper and laminated. At least 20 words for each question type were used throughout the intervention. Examples were

selected to cover a range of possible words for each type. For example, "where" examples included times as well as places in relation to objects (e.g., under the chair). "When" examples included days, months, and phrases referring to times (e.g., last month). Examples of word cards are provided in Figure 3.8.

Question sheets. Students were given question sheets consisting of four questions about character, event, and setting (i.e., "who", "what", "where," and "when"). Questions were printed on a question sheet with a visual cue for each question word. The visual cues used in the graphic organizer were the same as those used in the questions. Although there were multiple sheets with variation in the orders of the questions, the same questions were used for all sessions. The question sheet is provided in Figure 3.9.

Experimental Design

To determine the effects of the intervention, the researchers used a multiple probe across participants design (Gast, Lloyd & Ledford, 2014). A singe case research design was selected due to the limited number of available students with ASD that could be placed into equivalent groups. Single case designs provide strong internal validity (Gast et al., 2014) and are useful for determining a functional relation with a small sample size of students with dissimilar characteristics. In this design, all students are given probes both intermittently prior to receiving intervention. As the first student begins receiving the intervention, the remaining participants remain in the baseline phase, with intermittent probes administered. Once the first student demonstrates improvement, the second participant enters intervention while the remaining participants remain in the baseline phase. This design allows for a clear depiction of intervention effects by demonstrating that each student's scores improved precisely when he or she entered

intervention. For academic skill instruction, this design is especially effective. When compared with multiple baseline design, there is reduced risk of testing threats because probes are not administered daily for students who have not yet entered intervention.

Probes were administered to all students during a baseline consisting of a minimum of five data points (Kratochwill et al., 2010). Baseline probes were conducted until participants demonstrated a descending or stable trend. Once a stable baseline was established, the first student began intervention while the other students remained in the baseline phase. Participants in the baseline phase received probes at least weekly. Once the first participant achieved two consecutive sessions at mastery on Part 1, the second student entered the intervention. This process was continued for the third participant. Due to the third participant's variability, mastery criteria was changed to three out of four sessions for the third participant. Once the third participant reached this adjusted criterion, the fourth participant entered intervention.

Dependent Variables

Assessments were conducted using single opportunity probes (Cooper, Heron, & Heward, 2007) with the session ending once the student missed a step of the task analysis. Separate criteria were set for each of the three parts and are outlined below. Once a student began intervention, probes were administered daily, with instruction beginning with the intervention part the student had not yet mastered (this process is described in detail in the procedures section).

Number of correct independent responses on task analysis. The number of correct independent responses on task analyzed steps was measured at all probe sessions in all conditions. Table 3.2 displays the task analysis used. The task analysis was divided

into three parts, with four steps for each part. Separate criteria were set for each part of the task analysis, with mastery criteria needed in one set before participants moved on to each of the subsequent sets. Single opportunity probes were used, with the session ending upon an unsuccessful completion of a question.

Number of words sorted correctly into the graphic organizer. Part 1 of the task analysis consisted of steps 1-4, which required the student to sort words into the graphic organizer. Responses were scored as independent if the student sorted the word correctly without adult prompts. Criterion on this part was 100%, or 4 out of 4 steps, for two consecutive sessions.

Number of sections completed correctly on graphic organizer during passage reading. Part 2 of the task analysis consisted of steps 5-8, which required students to listen to a passage and fill in the sections of the graphic organizer. Criterion for Part 2 was 100%, or 4 out of 4 independent steps, for two consecutive sessions.

Number of comprehension questions answered correctly after passage reading. Part 3 of the task analysis, or steps 9-12, required students to answer four comprehension questions about the story elements. Criterion for Part 3 was 75%, or 3 out of 4 steps, for three consecutive sessions. Criteria was lower for this section of the task analysis because 100% mastery at Part 3 was not necessary to complete later steps, as it was at the previous two parts. Part 3 criteria allowed for students to make one error on the task analysis.

Percentage of teacher prompts required to fill out graphic organizer. In order to judge the level of independence students achieved, the teacher noted the types of prompts required for the student to fill out the graphic organizer during story reading. A

specific description of the prompt hierarchy and teaching procedures for prompting is outlined in Part 2 of the intervention procedures section below. The last prompt given before the student answered correctly was recorded on the data sheet.

Procedures

General procedures. Probe and intervention sessions were conducted one to three times daily, with no more than three sessions in a day. More information about session type is described in the results section. Students were taught one-on-one with the teacher. During instruction, other students worked with paraeducators in the classroom on other activities related to their instructional programs. The student sat next to the teacher at a table behind a screen to block visual distractions from the rest of the room. The teacher began all sessions by reminding students of behavioral expectations (e.g., "Keep hands and feet to self"). During all conditions, students had token boards available with picture cues for each of the behavioral expectations. The token boards held five Velcroed pictures of preferred items (e.g., superheroes). Students earned tokens intermittently (at approximately a rate of one every 3 min) for following directions and complying with behavioral expectations. After earning five tokens, students were able to obtain a small reinforcer (e.g., a small snack; 3 to 5 min of free time with a preferred toy). Students received positive verbal praise during probe and intervention sessions for complying with directions and following behavioral expectations. The token economy was in place prior to the study. At all times, students were permitted to refer to the graphic organizer as well as the story.

Screening procedures. A month prior to baseline, students were assessed on sample text to determine their text level. Sample texts were not repeated in baseline or

intervention. The teacher started at Level 1 and read the text twice to the student. After the second reading, the teacher asked the four intervention questions. If the student scored 75% or higher for that test, the teacher moved to the next level of test (e.g., from Level 1 to Level 2). This process was repeated for three days. If a student scored 50% or lower on a text level for three consecutive sessions, the screening was ended and the text with scores at 50% or lower was assigned as the student's entry level. Figures 3.5-3.7 display sample text at each level. All students entered at Level 1.

Probe procedures and data collection. Probe sessions occurred throughout the intervention during baseline, intervention, generalization and maintenance. During intervention, probes were administered immediately prior to intervention instruction. The classroom teacher and primary investigator conducted all baseline, probe and maintenance sessions in the special education classroom. A paraeducator conducted the generalization probes in the students' general education classrooms. Appendix A displays the probe data sheet.

During all probe sessions (baseline, intervention, generalization and maintenance), the instructor used a single opportunity probe. For each question, students had 10 s to initiate each step. Once the step was initiated, students were permitted to take any processing time they required if they were attempting to complete the step (e.g., looking at the text, placing examples on the organizer, looking back in the story, or initiating the video prompt during Part 2 of the task analysis). If students did not initiate an answer to the question within 10 s or answered incorrectly without self-correcting within 10 s, the instructor discontinued the probe and marked a 0 on the data sheet.

For Part 1 of the task analysis, answers were considered correct if the student placed the word card in the correct section of the graphic organizer (e.g., placed "boy" in the "who" section. For Part 2, correct answers required placement of key words in the correct section, either through writing (Daniel and Zach) or card placement (Gloria and Charles). If student put only one key word from a phrase or sentence in a section, the answer was marked correct in that section (e.g., wrote "went" in the "What" section for "went on a field trip"). For Part 3, correct answers consisted of either stating the correct answer or writing it on the question sheet (the student was permitted to choose response mode). If a student answered with only one key word from a phrase, the teacher asked the student for more information (e.g., if the student said "went" instead of "went on a field trip", the teacher said "Say the whole thing about where the student went"). If students responded to this request for more detail with the complete answer, the instructor marked a + for the response. If a student was unable to state or write the complete answer after one request for more information, the instructor marked ½ on the data sheet to indicate half credit for the answer. If students independently activated the video prompt in any section of the task analysis before writing a correct answer, the response was considered correct and the instructor marked a + for the item; students giving correct answers after independently initiating the video prompt were credited with answering the question independently.

For all sections, if a student answered correctly, the instructor marked a + on the data sheet and continued to the next question. If students self-corrected their responses, the item was marked correct. If the student was not attending to the task direction due to distractibility or noncompliance, the teacher repeated the direction and / or gave a

behavioral correction (e.g., “Time to work” while pointing at the behavior chart). Teacher redirections were not counted in the 10 s period following the question. After the teacher stopped to redirect behavior, the question was repeated. When students were complying with directions (e.g., attempting to respond, looking at materials, maintaining a quite voice) behavioral specific praise was provided intermittently on compliance (e.g., “I love how you are sitting quietly and working hard!”). Behavioral corrections were given to students during the probe sessions (e.g., “Look at your work”) but no feedback (error correction or reinforcement) was given about accuracy of student answers. If extreme problem behavior occurred during the probe (e.g., screaming, crying, dropping to the floor), the probe was discontinued and resumed when the student calmed down.

At the start of each probe session, the instructor began by giving an attention cue (e.g. “It’s time for reading”). The instructor began with Part 1 of the task analysis, which consisted of sorting exemplars into the graphic organizer. The teacher presented the student with the graphic organizer and four word cards (one for each question type, i.e., “who”, “what”, “when” and “where”) selected at random from an envelope of 20 exemplars (five for each question type) and directed him or her to sort the words into the graphic organizer (e.g., “Show me what questions these words answer”). For Part 2 of the task analysis, the teacher secured student attention and read the student the story twice. Students were permitted to read along if they preferred. Students were then directed to fill out the organizer. The teacher reread the story to redirect student attention or when students touched a word or asked the teacher to read the story. The iPad was in front of the student with the correct application opened, but the instructor did not direct the student to use the iPad. For Part 3 of the task analysis, the instructor handed the student a

question sheet (see Figure 3.9). Multiple question sheets were available, with the order of questions varying for each session. Questions were the same for each probe, although the order varied. For Part 3, the instructor secured student attention (e.g., "Time to answer questions about the story you just read."). The teacher directed student attention to the question sheet (e.g., "Touch Question 1."). The teacher read each question twice.

Intervention procedures. The intervention was divided into three parts, corresponding to the three components of the task analysis (see Table 3.2). Level of text was determined through screening and was determined to be Level 1 for all students. All students received Level 1 text for the duration of the intervention. All intervention sessions began with a probe, with the procedures outlined in the above section. Student performance on the probe determined the starting point for that intervention session. Instruction occurred immediately after the probe. Students received Part 1 instruction until they reached criterion (two consecutive probes at 100% on Part 1 of the task analysis). They then received Part 2 instruction until they reached criterion on Part 2 (two consecutive probes at 100% on Part 2 of the task analysis). Once students mastered Part 2, they received both Part 2 and Part 3 instruction. If students missed a component on a previously mastered part of the task analysis (e.g., made an error in Part 1 after mastering Part 1 in prior probes) for two consecutive probes, instruction began for that day in the previously mastered part. If a student scored below criterion for more than five sessions without meeting criteria for reteaching (more than one consecutive session below mastery on a part) instruction began on the previously mastered part. Figure 3.10 displays a flow chart showing how instructional decisions were made following each daily probe.

Students received only Part 1 of the intervention until they reached criterion for that part. Procedures for each part are outlined below.

Part 1: Model-lead-test with multiple exemplars. After giving the probe, the instructor began the intervention by directing the student to the activity (e.g., "We are going to learn how to understand what we read"). She presented each of the four question type graphic organizers (see Figure 3.2) one at a time. The instructor pulled pictures at random from an envelope of intervention exemplars (separate from the exemplars used in the probe). In Phase 1, which was implemented for the first three participants, the instructor modeled placement of the exemplar, putting the picture in the correct column while referring to the rule (i.e., "This is a movie theater. I know that's a place. I'll put it in the where section"). The teacher then led the student through the example, helping the student say the rule while placing the picture in the correct section (i.e., "This is a movie theater. Say it with me. I know it's a place. I'll put it in the where section."). The teacher then tested the student on the exemplar, asking questions about the exemplar while the student placed the exemplar on the organizer (i.e., "Your turn. This is a movie theater. Is that a place? So is it a where? Put it on the organizer"). The instructor included three examples and two nonexamples for each question type. The student were given 10 s to place the answer in the test phase. If a student missed a response in the test component of the trial, the teacher stated the correct answer and set the card aside. If the student self-corrected a response before the instructor corrected him or her, the exemplar was considered correct and was not set aside. After completing all examples and nonexamples for a question type, the teacher conducted at least one delayed test of each missed item. In a delayed test, the teacher returns to the missed item after presenting one or more other

examples (Carnine et al., 2006). The amount of delayed tests conducted depended on teacher judgment and varied from one to three. After the teacher finished presenting each organizer, she picked four examples (one for each question type) and asked the student to sort the examples into the second organizer (see Figure 3.3). If the student made an error, the teacher corrected the error by referring to the rule and demonstrating the correct answer. She conducted a delayed test for missed items.

Phase 2, which was implemented due to presence of a decelerating trend for Participant 1 and highly variable data for Participant 2, was identical to Phase 1 except that the teacher used a different example or nonexample for each section of the model-lead-test trial. For example, in the model, or "My turn" part of the trial, the teacher would say: "This is a movie theater. I know that's a place. I'll put it in the where section." In the lead part of the trial, the teacher would say: "This is a dancer. Say it with me. I know that's not a place. So I know it's not a where. I'll put it in the not section". For the test part of the trial, the teacher would say: "This is a bedroom. Is that a place? So is it a where? Put it on the organizer.". Use of examples versus nonexamples varied for each section of the model-lead-test trial (e.g., the example was not always first). A total of nine examples and six nonexamples were used in Phase 2 for each question type.

Part 2: System of least prompts with video prompting. Part 2 also began with a probe. After the probe, the teacher oriented the student to the activity (e.g., "Now we are going to read a story and fill out your organizer"). The teacher directed the student to the story (e.g., touching the story and stating "listen while I read this story to you"). The teacher read the story twice. She then directed the student to fill out the organizer. (e.g., "Fill out your organizer. You can use the iPad to help you."). The SLP prompt hierarchy

consisted of the following steps: (a) independent; (b) student-initiated video prompt; (c) model; and (d) physical prompt. For a step to be considered independent, the student had to independently write or place the correct information on the appropriate section of the organizer, initiating the response within 10 s. For a response to be considered student-initiated, the student had to activate the video prompt and write the correct answer without any teacher direction. If the student filled out an incorrect word, did not answer, or did not initiate a video prompt within 10 s, the teacher proceeded to the model, in which she demonstrated the use of the iPad without activating the video (e.g., pointed to the video options on the screen and used a think-aloud strategy, such as stating "I can use the iPad to help me find the answer. I decide if this is a person, what happened, a place or a time" while gesturing to each option). If the student did not answer or answered incorrectly the teacher initiated the video prompt by physically guiding the student's hand to activate the correct video model and helped the student put the answer in the correct place. The teacher put a check on the data sheet under the type of prompt required for that question type (see Appendix A for examples of the intervention data sheet).

Part 3: Answering questions using the graphic organizer. Once students met criterion on the second part of the intervention, the teacher proceeded to Part 3. Part 3 sessions began with a probe. Following the probe, the teacher implemented Part 2 as outlined above. After completing Part 2, the teacher continued the session by continuing to Part 3. After following Part 2 procedures, the teacher oriented the student to the next part of the task (e.g., "Now let's use your organizer to answer some questions about the story"). She then presented the question sheet to the student and verbally asked the

questions. Comprehension questions, which were the same for all stories, included the following:

1. Who is the story about?
2. What was an event from the story?
3. When does the story take place?
4. Where does the story take place?

Questions were asked in random order after the conclusion of the second reading. If the student did not respond after 10 s, the teacher restated the question. If the student still did not respond or responded incorrectly, the teacher pointed to the answer on the graphic organizer, stated the correct answer, and gave a brief verbal explanation of why it was correct (e.g., "The question asked 'Who' the story is about, so I look in the 'Who' section. The answer is ____."). The teacher then asked the question again. If the student again responded incorrectly, the teacher repeated the error correction. If the student responded incorrectly after this error correction, the teacher stated the correct answer and proceeded to the next question. If the student responded correctly, the teacher proceeded to the next question. The teacher conducted a delayed test of the missed questions after finishing all the test items.

Generalization and maintenance probe procedures. Once students mastered the intervention, three generalization probes were administered by a paraeducator. Procedures were identical to those used in other probes, but were administered in the students' general classrooms during language arts. Other students were engaged in individual reading and written response to reading activities during generalization probes. For the exemplars and stories for generalization and maintenance probes, the instructor

used previously mastered exemplars (i.e., no more than one error on exemplars during intervention probes) and stories (i.e., the last three stories mastered by students).

Inter-observer Agreement

A paraeducator trained in data collection procedures conducted inter-observer agreement (IOA), which the primary investigator calculated using the point-by-point method. The teacher recorded whether an agreement or disagreement occurred for each item on the task analysis. She then added the number of agreements and divided the number of total agreements by the number of agreements and disagreements. The answer was multiplied by 100 to obtain a percent value. While recording data, the teacher and paraeducator used the same data sheets (see appendix A). A screen placed between the two scorers prevented each recorder from observing the other's markings. Prior to the start of the study, the teacher met with paraeducators to discuss operational definitions of targeted behaviors and explain measurement procedures.

Procedural Fidelity

A paraeducator conducted procedural fidelity for the baseline and intervention sessions. Appendix B shows procedural fidelity sheets for all sessions. The teacher conducted procedural fidelity on the generalization probe sessions. During probes, the observer recorded whether the instructor ended the probe after the first wrong answer and refrained from prompting toward the correct answer. During procedural fidelity checks for the intervention, the observer recorded on a checklist (see Appendix B).

The observer recorded a + for each observed component and a 0 for each absent component. The teacher then tallied the number of observed components and divided this value by the number of total components. She multiplied this number by 100. Prior to

beginning the intervention, the teacher met with the observers to explain each intervention component, ensure observers understood each component, and address questions and misconceptions.

Social Validity

To determine social validity, researchers asked general education teacher and student questions about the intervention using questionnaires developed for this study. Teacher and student questionnaires are provided in Appendices C and D, respectively. The teacher questionnaire included statements related to the ease of implementation, importance of the skills taught, and effectiveness of the intervention. Teachers selected from five possible responses (i.e., strongly disagree, disagree, neutral, agree, strongly agree) to rate the statements. The student questionnaire consisted of "yes" and "no" questions to indicate student enjoyment of the intervention and perceptions of its usefulness. Only two options were available to the students because "yes" and "no" were the only responses that students reliably gave (e.g., students did not consistently demonstrate understanding of the word "maybe").

Data Analysis

The number of correct independent responses on the task analysis were graphed for each participant. Included in the task analysis were the number of words sorted correctly into the graphic organizer, the number of sections correctly filled out on the graphic organizer during passage reading, and the number of comprehension questions answered correctly after passage reading. In addition, the number of teacher prompts required for completing the graphic organizer was graphed. After graphing the data, the researchers visually examined the data for changes in level and trend. Tau-*U* calculations

were performed to determine non-overlap effect sizes for each participant. Tau-*U* is a relatively new measure and has been recommended as a promising method for determining effect size in single case research (Parker, Vannest, Davis, & Sauber, 2015). (Parker, Vannest, & Davis, 2011). The overall weighted Tau-*U* score for the intervention was evaluated to measure effect size. Researchers did not adjust for trend in baseline while calculating Tau-*U* due to the lack of trend in baseline.

Table 3.1
Participant Characteristics

Student	Age	Grade	Cognitive Score	Adaptive Scores	Disability Categor
Gloria	8	3	41 SB-5	60 (communication) 61 (composite) Vineland-II	Autism Mild to moderate range CARS-2
Daniel	11	2	58 SB-5	65 (communication) 64 (composite) Vineland-II	Autism Mild to moderate range CARS-2
Charles	6	1	58 SB-5	78 (communication) 74 (composite) Vineland-II	Autism Mild to moderate range CARS-2
Zach	10	5	40 SB-5	62 (communication) 64 (composite) Vineland-II	Autism Mild to moderate range CARS-2

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Table 3.2
Task Analysis

Part 1: Sort examples into GO	1.	Sort "Who" example
	2.	Sort "What" example
	3.	Sort "Where" example
	4.	Sort "When" example
Part 2: Fill out GO from passage	5.	Put "Who" example from passage into GO
	6.	Put "What" example from passage into GO
	7.	Put "Where" example from passage into GO
	8.	Put "When" example from passage into GO
Part 3: Answer comprehension questions	9.	Answer "Who is a character from the story?"
	10.	Answer "What is one event from the story?"
	11.	Answer "Where does the story take place?"
	12.	Answer "When does the story take place?"

Figure 3.1
Screenshot of video model options in My Pictures Talk™ application
*(*Pictures produced in *Boardmaker* ®)

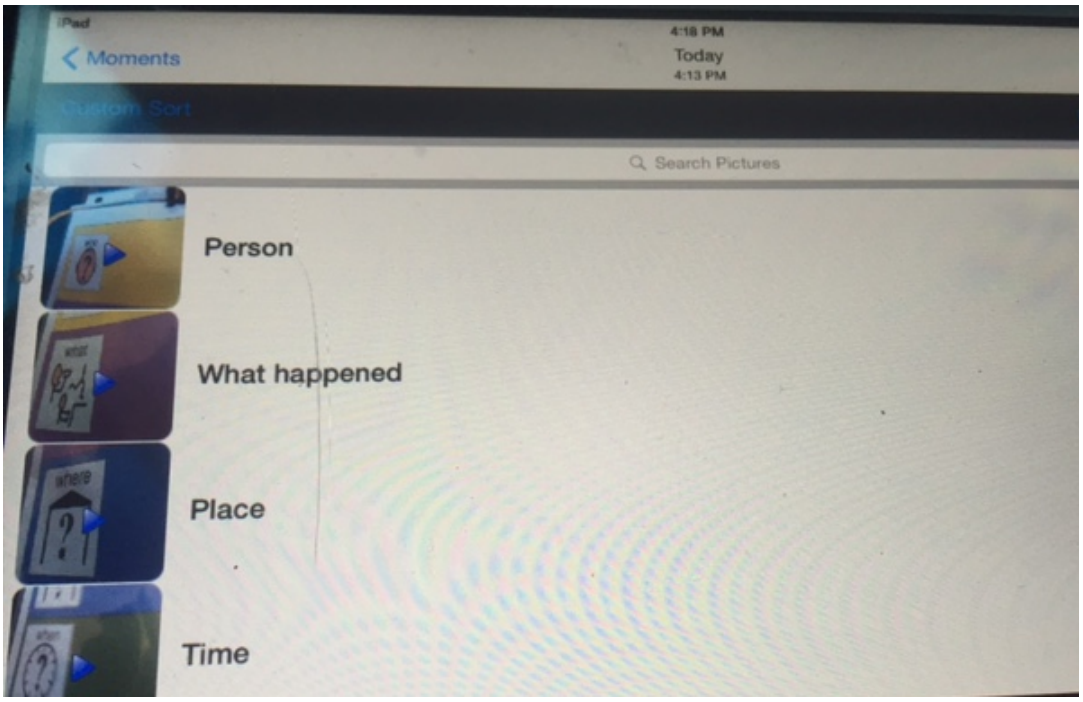


Figure 3.2
Sample graphic organizer for Part 1
*(*Pictures produced in *Boardmaker* ®)

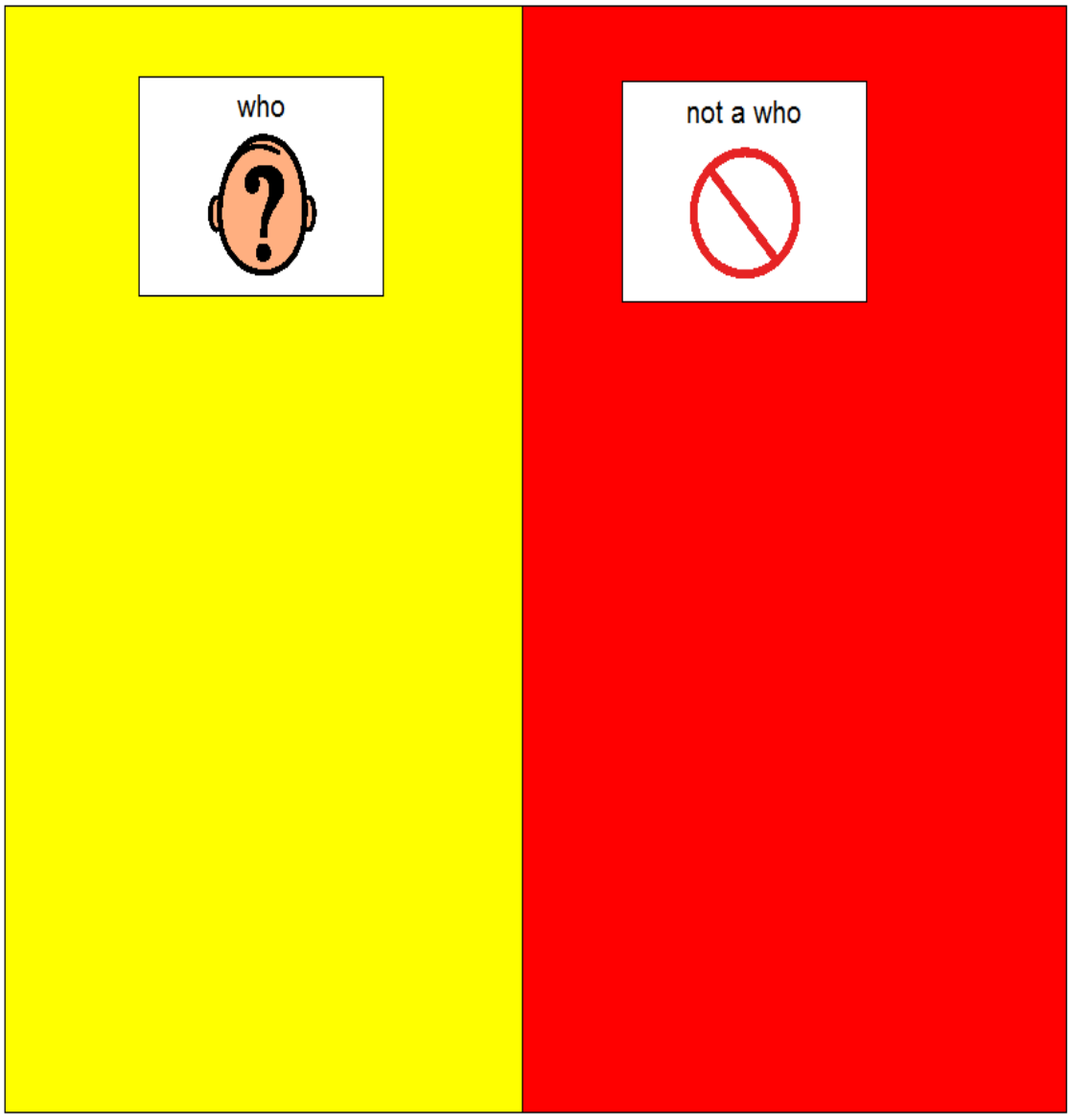


Figure 3.3
Graphic organizer for Parts 2 and 3
*(*Pictures produced in *Boardmaker* ®)

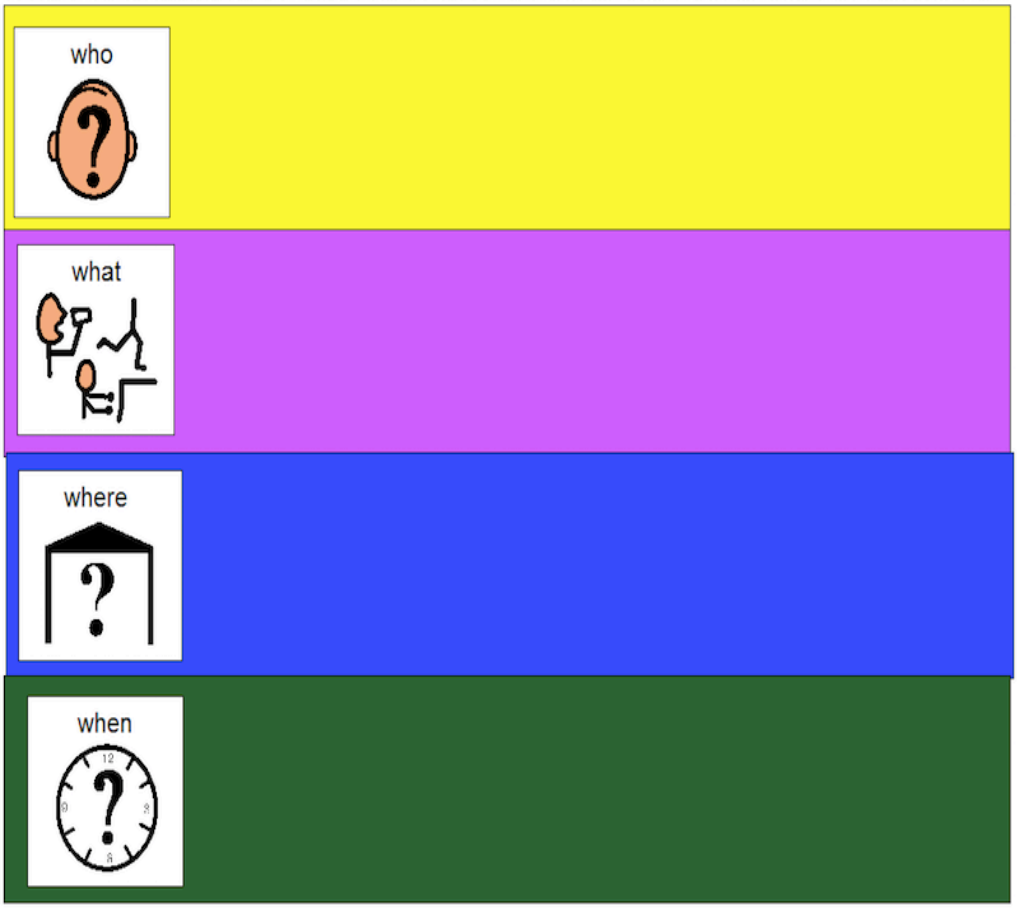


Figure 3.4
Graphic Organizer with word cards
*(*Pictures produced in *Boardmaker* ®)

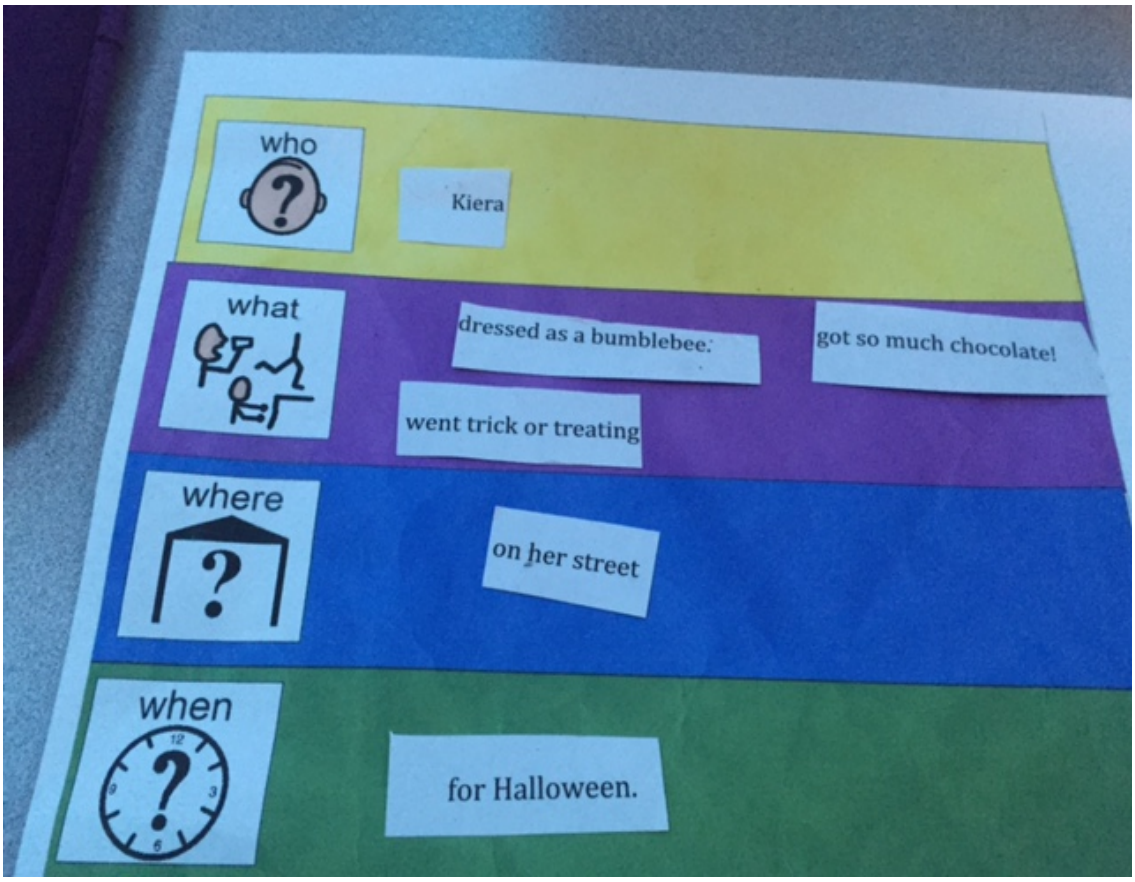
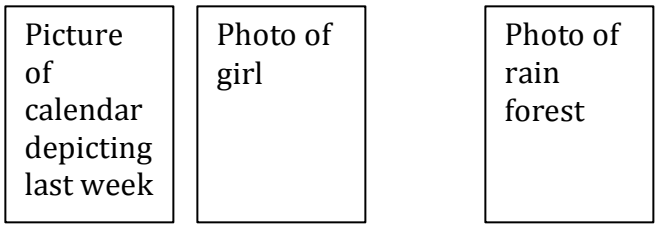
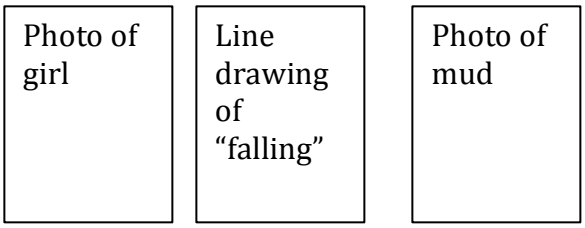


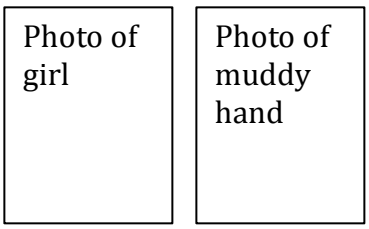
Figure 3.5
Level 1 text
*(Adapted from "Readworks" 2015) *pictures removed for copyright reasons)*



Last week, Chloe was in a rain forest.

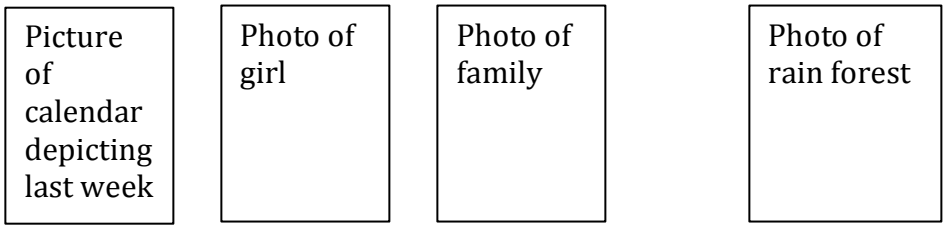


Oh No! She fell in the mud!



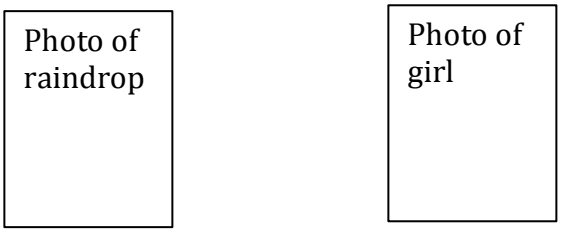
What a mess!

Figure 3.6
Level 2 text
*(adapted from "Readworks," 2015); * pictures removed for copyright reasons*



Last week, Chloe and her family went on a trip to a rain forest.

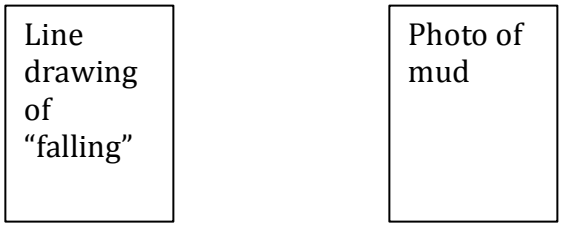
Chloe said, "This mud is slippery!"



Plop! A big raindrop fell on Chloe's face.

Figure 3.6 (continued)

Level 2 text

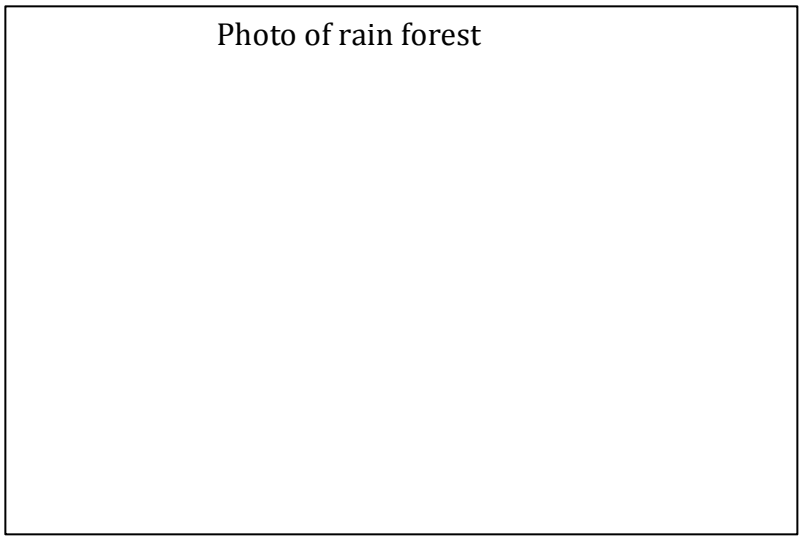


Uh-oh! Chloe slipped and fell in the mud!

"The rain forest is very muddy. But I am the muddiest!" said Chloe.

Yuck! Chloe was a mess!

Figure 3.7
Level 3 text ("Readworks," 2015; picture removed for copyright reasons)



Last week, Chloe and her family went on a trip to a rain forest.

"The rain forest is very hot," said Chloe.

Chloe was looking for birds. There were so many trees. Chloe could see only little pieces of sky.

Plop!

A big raindrop fell on Chloe's face.

"The rain forest is very wet," said Chloe.

Chloe took another step. Uh-oh! Chloe slipped and fell in the mud.

"The rain forest is very muddy. But I am the muddiest!" said Chloe.

Figure 3.8
*Sample word cards for Part 1 (*pictures removed for copyright reasons)*

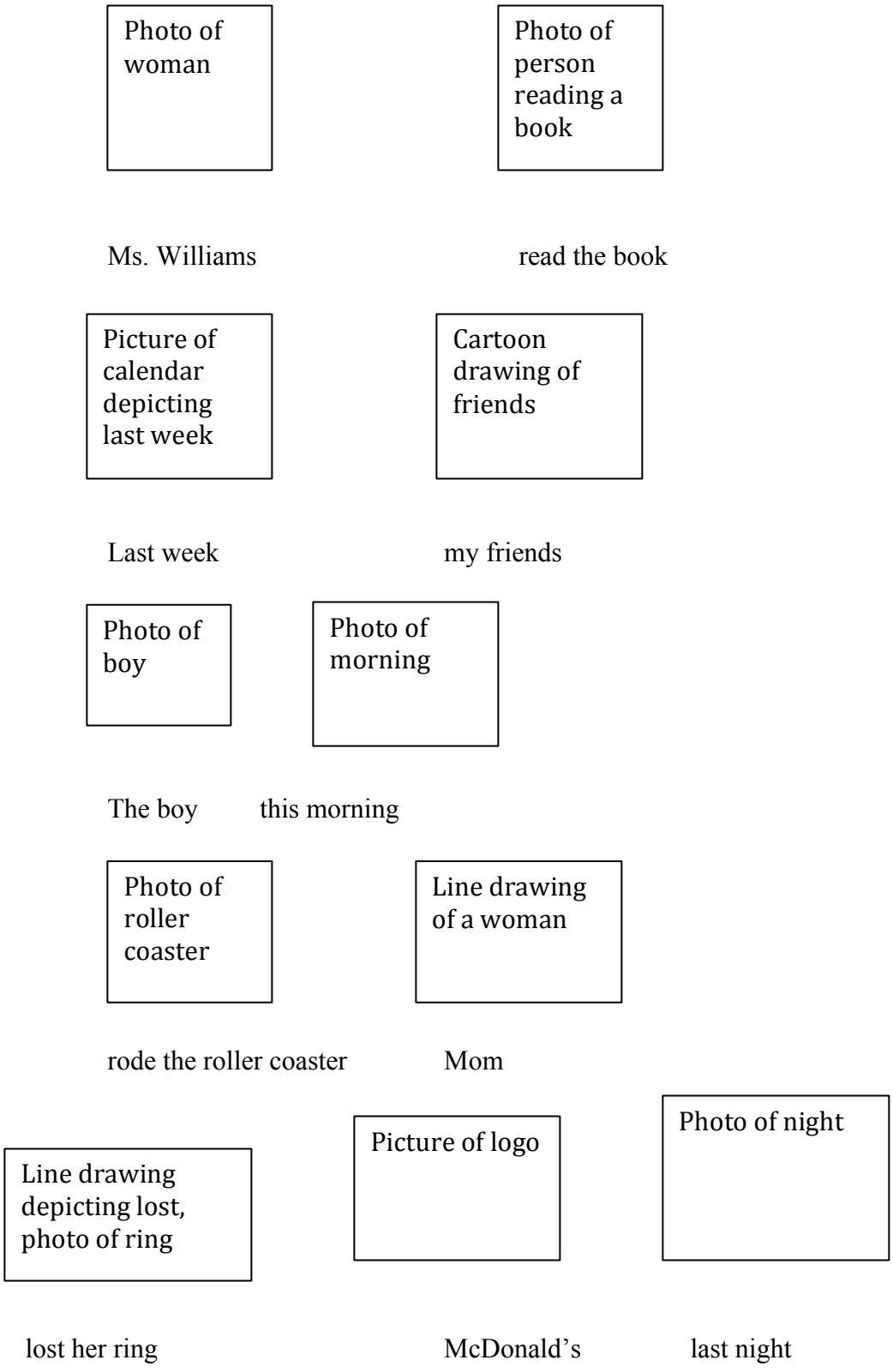


Figure 3.9

Sample question sheet for Part 3
*(*Pictures produced in *Boardmaker* ®)

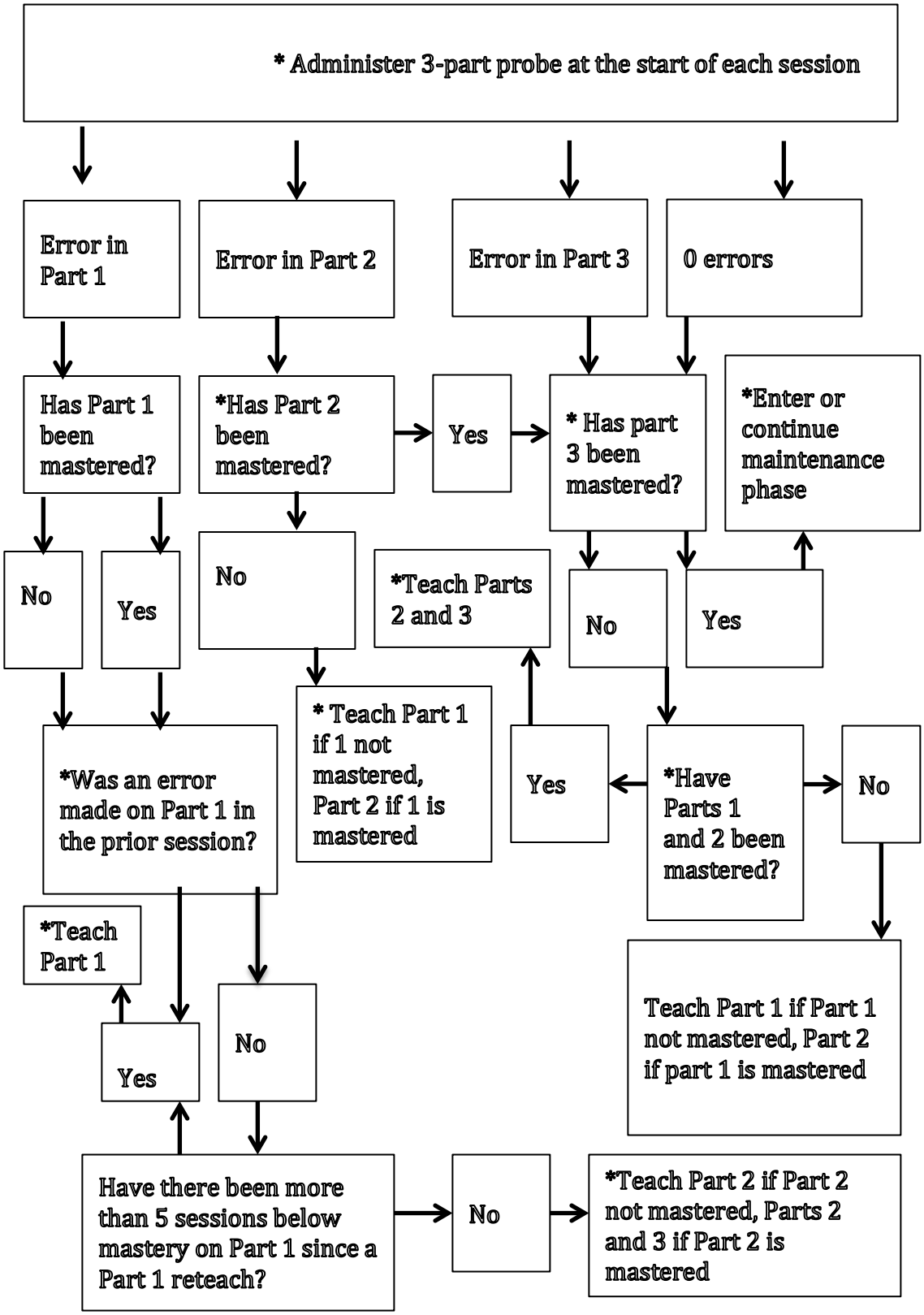
1) What is one event from the story? _____

2) When does the story take place? _____

3) Who is a character from the story?_____

4) Where does the story take place?_____

Figure 3.10
Procedures for instructional decisions following daily probe



CHAPTER FOUR

Results

This study investigated the effects of explicit instruction combined with video prompting on the text comprehension skills of elementary school children with autism spectrum disorder (ASD). Specifically, an investigation was conducted of a functional relation between the combined systematic instruction and video prompting intervention and the acquisition of comprehension skills (i.e., sorting exemplars by question type, filling out a graphic organizer about a story, answering comprehension questions about the story). The results of student skill acquisition are described below, with the number of correct steps of the task analysis recorded. Visual analysis was used to interpret these data, including calculation of relative level change and trend. A secondary measure, Tau-*U* (Parker et al., 2011), was used to evaluate non-overlap and test for magnitude of effect.

In addition, student independence was measured through notation of the levels of prompts necessary during Part 2 of the intervention phase. The study also examined whether students generalized the acquired skills to the general education classroom setting and maintained skills one and six weeks after the intervention. Student, paraeducator, and general education teacher perceptions of the intervention were investigated through questionnaires. Efficiency data were collected through recording of session times for each part, the number of sessions to mastery for each participant, and the number of Part 1 reteaches required for each student.

Reliability

Procedural fidelity and interobserver agreement (IOA) were conducted across all conditions for all participants. For baseline sessions, procedural fidelity was measured for

33% of sessions. For each participant, procedural fidelity scores were 100% during baseline, intervention, generalization, and maintenance, with no errors in implementation noted in any condition.

Reliability for IOA was conducted for 33% of baseline sessions, 21% of intervention sessions, 100% of generalization sessions, and 50% of maintenance sessions for all participants. For Gloria, IOA was 100% for each condition. For Daniel, IOA was 100% for baseline, 99.2% for intervention (range 92-100%), 100% for generalization, and 100% for maintenance. For Charles, IOA was 100% for baseline, 97% for intervention (range 86-100%), 100% for generalization, and 100% for maintenance. For Zach, IOA was 100% during baseline, 99% during intervention (range 83-100%), 100% during generalization, and 100% during maintenance. Errors in IOA occurred when observers disagreed about whether students earned credit for including key words to an answer without including the complete answer. In one instance, the second scorer failed to give credit when the student recorded an event from the story because it was not the main event.

Effectiveness of Intervention

Number of independent task analysis steps. The primary dependent variable was the number of task analyzed steps completed independently during probe sessions. Figure 4.1 displays mean probe scores during baseline, intervention, maintenance and generalization for all participants. The weighted Tau-U score of 0.83 (90% CI=0.64-1.02), calculated for all participants combined, indicates moderate effects for the intervention.

Gloria. Gloria mastered the task analysis after 49 sessions of intervention. During baseline, Gloria demonstrated a slightly variable trend, with five of the six data points at 0 and the final three data points before intervention demonstrating a decelerating trend. Upon introduction of intervention, Gloria had a relative level change of 3.5 points. The split middle method (Gast et al., 2014) was used to calculate the trend of Gloria's data during intervention following the phase change. Using this method, Gloria's data indicated a variable accelerating 1.5 point trend (5.5. to 7). Mean probe scores for Gloria during the first part of intervention (prior to the phase change) were 2.7 (range 0-5), demonstrating an increase over .67 at baseline (range=0-4). After introduction of the phase change, Gloria's mean probe score was 7 (range 0-12). The non-weighted Tau-*U* value of Gloria's scores was calculated to determine the effect size. Parker et al. (2011) effect size scales were used, with values of 0.65 or lower considered weak, values of 0.66-0.92 considered medium, and values of .92 considered large. Gloria's score, .83 (90% CI= 0.41-1.24), indicates medium effects. Gloria's mean score for generalization probes was 12 (100%). She was able to maintain all 12 steps of the task analysis after one week and after six weeks.

Daniel. Daniel mastered the task analysis after 50 sessions of intervention. Daniel exhibited a stable trend at baseline, with scores of 0 for all sessions. Daniel's relative level change following intervention was 4 points higher than baseline. Following the phase change, Daniel demonstrated a variable, accelerating trend of .5. Daniel's mean probe score was 3.78 (range 1-12) during the first phase of intervention, representing an increase over baseline. After the phase change, Daniel's mean probe scores were 6.8 (range 0-12). The non-weighted Tau-*U* value for his scores was .98 (90% CI=0.57-1.39),

indicating large effects. Daniel's mean score for generalization sessions was 12 (100% of steps). He maintained all steps of the task analysis after one week and after six weeks.

Charles. Charles mastered the task analysis after 37 sessions. During baseline, Charles exhibited a slightly variable trend, with data decelerating for the last three data points. Upon introduction of intervention, Charles displayed a slight relative level change of .5 to 1. Upon introduction of the phase change, data showed a variable, accelerating 1 point trend. During the first part of intervention, Charles's mean probe score of .9 exhibited a slight increase over his baseline mean score of .5 (range=0-2). Upon introduction of the phase change, Charles's mean probe score rose to 5.3 (range=0-12). Due to his variable data, Part 1 mastery criteria for Charles was changed to 3 out of 4 consecutive sessions at 100%. The non-weighted Tau-*U* value for Charles's scores was .77 (90% CI=.396 to 1.145), indicating medium effects. During generalization, Charles maintained mastery level for two of three probes, with a mean generalization probe score of 10.3 (range=7-12). He was able to maintain all 12 steps of the task analysis one week post intervention and 4 steps six weeks post intervention.

Zach. Zach mastered the task analysis after 58 sessions. Zach's baseline scores were slightly variable, with a decelerating trend for the final three data points. Upon introduction of the intervention, Zach had a relative level change of 4 points. Zach's trend during intervention was calculated using the split middle method. He exhibited a variable, accelerating 1 point trend during intervention. During baseline, Zach had a mean score of .82 (range=0-4). During intervention, he had a mean score of 4.48 (range=0-12). In the generalization phase, Zach scored at mastery on one out of three probes. His mean generalization score was 7.2 (range=5-11.5). Zach was able to maintain 5 out of 12 steps

of the task analysis both two weeks and six weeks after intervention. Zach's non-weighted Tau-*U* score was 0.78 (90% confidence interval of 0.46 to 1.09), suggesting medium effects.

Level of prompts. Figure 4.2 depicts the percentage of correct independent responses while filling out the graphic organizer during intervention sessions as well as the number of correct responses on the task analysis during probe sessions. The split middle method was used to measure trend for independent correct responses while filling out the graphic organizer. Gloria increased her level of independence on this measure, with an accelerating trend toward independent responses (75% to 100% independent steps). Daniel also displayed an accelerating trend (75%-87.5% independent steps). Charles increased his level of independent steps, with an accelerating trend of 50% to 75%. Zach also displayed an accelerating trend, with a change from 50% to 75% correct independent steps during intervention.

Efficiency of Intervention

Session length. Session length was recorded for 40% of the sessions. Average length for each session was calculated for each part. For Part 1, the average session length was 13 min 52 s (range= 8 min 25 s to 25 min). Average session length for Part 2 was 7 min 43 s (range = 3 min 1 s to 31 min 12 s). For Part 3, the average session length was 6 min 55 s (range= 3 min 30 s to 19 min). A majority, 64%, of the sessions were 10 min or fewer in length.

Sessions to mastery. The number of sessions required to reach mastery on the task analysis was recorded for each participant. Gloria required five sessions to reach initial mastery for Part 1 and 22 sessions to reach mastery for Parts 2 and 3. Gloria met

these two parts simultaneously; she inferred how to use the graphic organizer to answer questions before Part 3 instruction was implemented. Daniel met initial mastery for Part 1 in two sessions. He required 25 sessions to reach mastery on Parts 2 and 3, which were met simultaneously, with Daniel inferring how to use the graphic organizer to answer questions without Part 3 instruction. Charles initially mastered Part 1 after seven sessions. He required 22 sessions to reach mastery on Parts 2 and 3, with both parts met simultaneously before Part 3 instruction. Zach mastered Part 1 after eight sessions. He mastered Part 2 after 37 sessions. He mastered Part 3 after nine sessions.

Reteaches required. The primary investigator recorded how many times the instructor needed to stop Part 2 and / or Part 3 instruction for each student in order to review Part 1. Students reviewed Part 1 following two consecutive probe sessions below mastery on Part 1 or more than five total sessions below mastery on Part 1 (see Figure 3.8 in Chapter 3 for a visual depiction of the reteaching criteria). All students required reteaching on Part 1 after reaching mastery. Each student required reteaching on Part 1 twice during the intervention prior to mastering the task analysis. Gloria, Charles and Zach required reteaching due to scoring below mastery on two consecutive probes. Daniel required reteaching one time due to scoring more than five total sessions below mastery. He required reteaching one time due to scoring below mastery on two consecutive probes.

Social Validity

To assess social validity, general classroom teachers, the paraeducator, and students were given questionnaires. Appendices C and D display the teacher / paraeducator and student questionnaires, respectively. Questionnaires for the three

general education teachers and the paraeducator consisted of a Likert-type scale with five possible responses, ranging from 1 (strongly disagree) to 5 (strongly agree). The participants' general education teachers filled out the questionnaires after generalization sessions were completed. Table 4.2 depicts the general education teacher scores for the intervention. All of the respondents strongly agreed that answering "wh" questions was an important skill for the student or students. In addition, all of the teachers agreed or strongly agreed that the intervention was effective (M=4.67) and easy to implement in the general education classroom (M=4.67). All respondents agreed or strongly agreed that they would like to implement the intervention in the future (M=4.67). Charles's teacher commented that she would like to use the video modeling app with all her students. She stated that she would like to use the graphic organizer with other struggling students.

The paraeducator who was trained to implement the intervention in the general classroom also completed the questionnaire. She strongly agreed that the intervention addressed an important skill for the students and was easy to implement in the general classroom. In addition, she strongly agreed that she would like to use the intervention in the future. She agreed that the intervention was effective for the students, and commented that all of the students in the intervention benefited and have mastered the targeted skills.

The participants completed a paper and pencil questionnaire consisting of four yes or no questions. Table 4.3 displays student responses. All of the students responded that the graphic organizer helped them to answer questions. In addition, they all responded that they wanted to use the graphic organizer and iPad again while reading. Three of the four participants stated that they liked to use the graphic organizer while reading, and two of the four participants stated that they liked to use the iPad.

Table 4.1

Mean # of independent TA steps for Participants across Conditions

	Baseline	P1	P2	Generalization	Maintenance
Gloria	*M*=.67 (range=0-4)	*M*=2.7 (range=0-5)	*M*=7 (range=0-12)	*M*=12	*M*=12
Daniel	*M*=0	*M*=3.78 (range=1-12)	*M*=6.8 (range=0-12)	*M*=12	*M*=12
Charles	*M*=.5 (range=0-2)	*M*=.9 (range=0-2)	*M*=5.3 (range=0-12)	*M*=10.3 (range=7-12)	*M*=8 (range=4-12)
Zach	*M*=.82 (range=0-4)	NA	*M*=4.48 (range=0-12)	*M*=7.2 (range=5-11.5)	*M*=5

Table 4.2

Mean Social Validity Scores for General Classroom Teachers.
Scores are on a 1-5 scale (1=strongly disagree- 5=strongly agree)

Question	Mean	Range
1. Answering "wh" questions is an important skill for this student.	5	
2. This intervention is effective.	4.67	4-5
3. This intervention is easy to implement in the general classroom.	4.67	4-5
4. I would like to use this intervention in the future.	4.67	4-5

Table 4.3

Social Validity Scores for Participants

Question	Gloria	Daniel	Charles	Zach
1. Do you think that the graphic organizer helped you to answer questions?	Yes	Yes	Yes	Yes
2. Did you like using the iPad to help you while your read?	Yes	No	Yes	No
3. Did you like using the graphic organizer to help you while you read?	Yes	No	Yes	Yes
4. Do you want to use the graphic organizer or the iPad again?	Yes	Yes	Yes	Yes

Figure 4.1

# of independent correct responses on task Analysis. Circles represent baseline, intervention, and maintenance probes; triangles represent generalization probes.

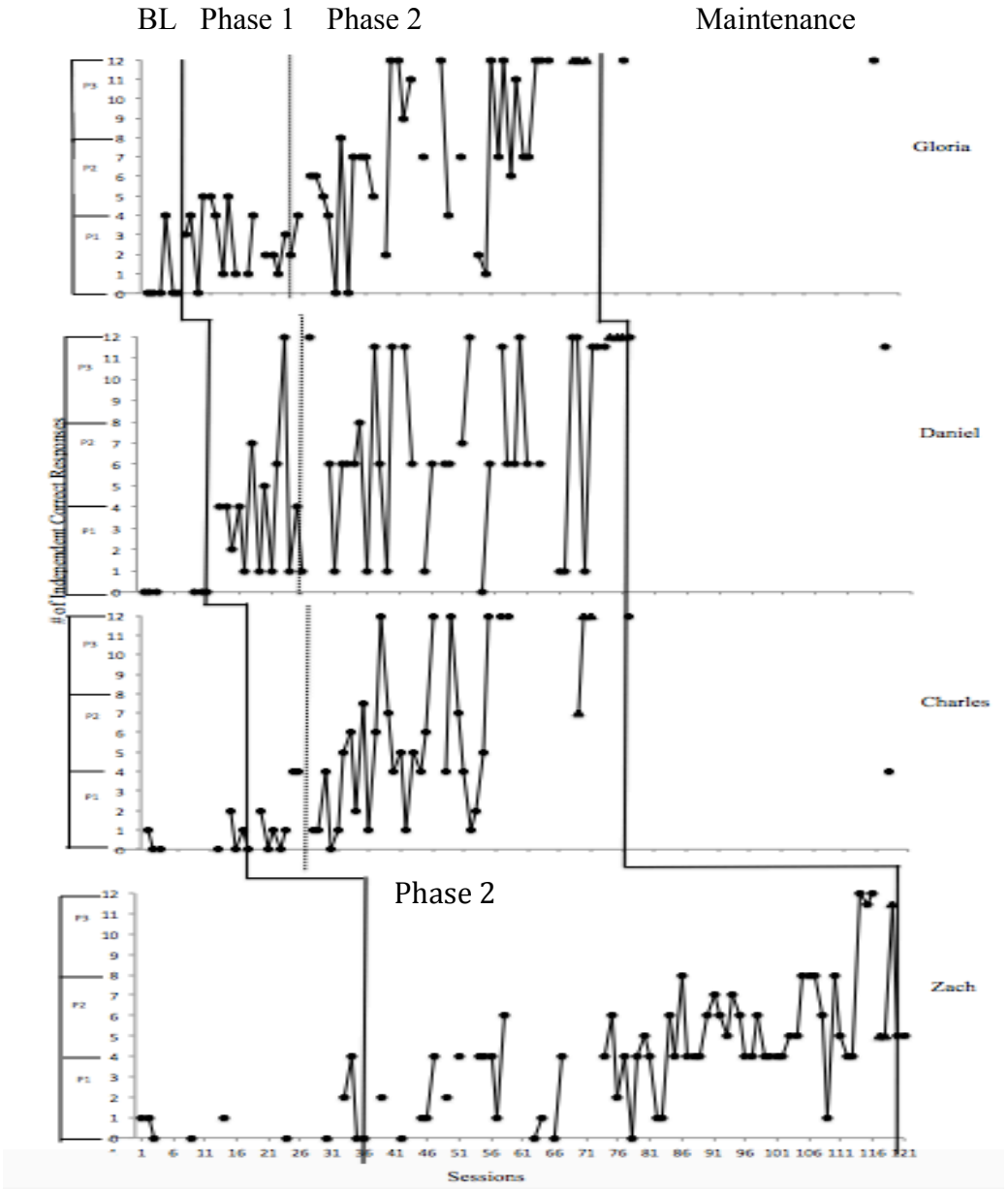
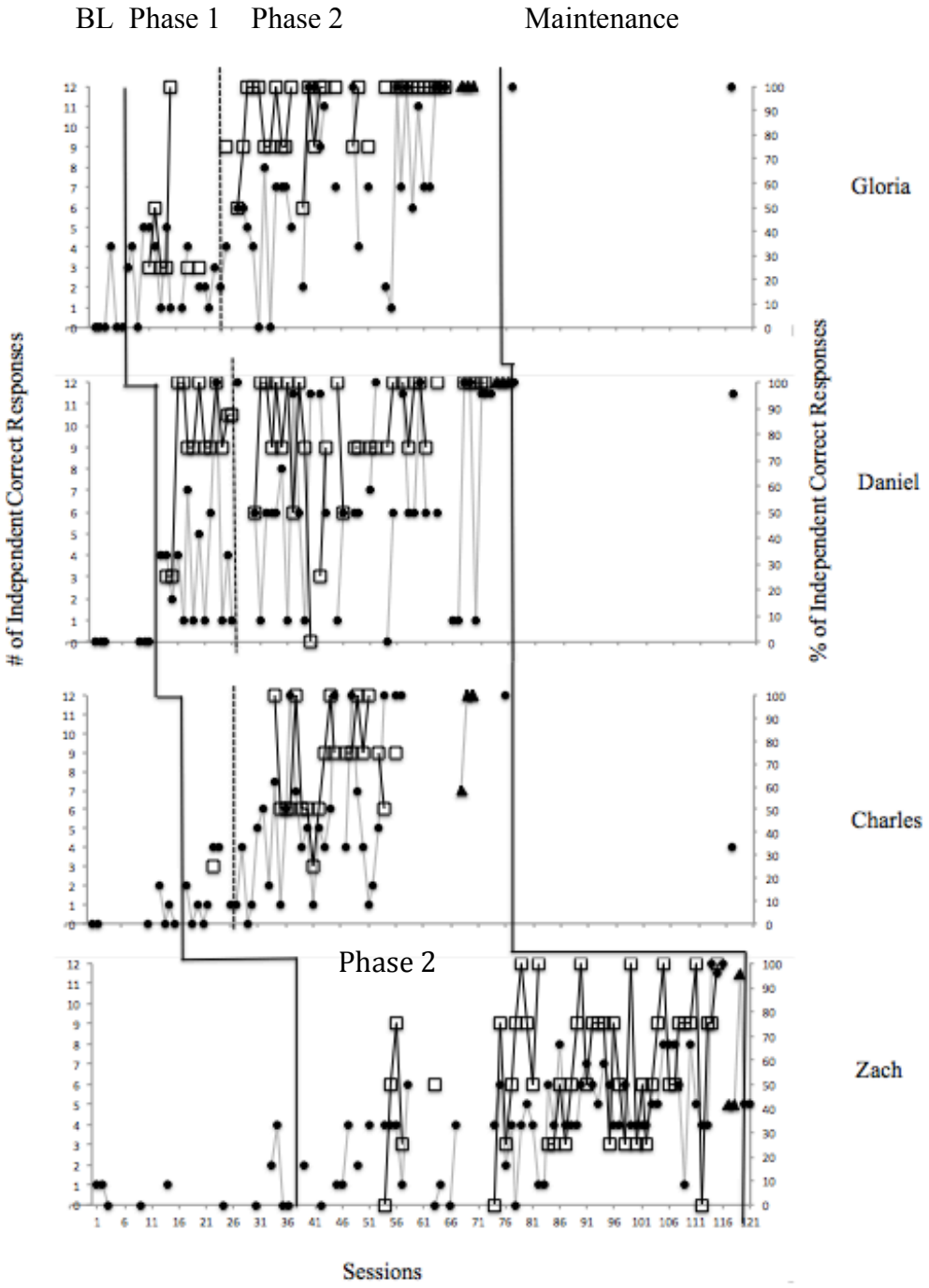


Figure 4.2

# of Independent Correct responses and % of Independent Correct Responses. Closed circles depict the # of independent correct responses on task analysis during baseline, intervention, and maintenance probe sessions; closed triangles depict generalization probes; and open squares depict the % of independent correct responses during Part 2 intervention sessions.



CHAPTER FIVE

Discussion

The purpose of this study was to evaluate the effects of a combined systematic instruction and self-directed video prompting intervention to improve the comprehension skills of four elementary school students with autism spectrum disorder (ASD). Effects of the intervention on students' ability to independently complete a twelve-step task analysis were evaluated. The study addressed the following research questions: (a) Does a functional relation exist between self-initiated video prompting combined with systematic instruction and the acquisition of question answering skills and graphic organizer use for elementary students with ASD? (b) To what extent does student prompt independence increase as a result of the intervention? (c) To what extent will students generalize the skills to the general education setting? (d) What are general education teacher and paraprofessional perceptions of the feasibility and usefulness of the intervention? And (e) How do the students evaluate the intervention?

Results of Research Questions

Acquisition of question answering skills. Visual analysis and Tau-*U* were used to determine whether a functional relation exists between the independent variable and the primary dependent variable. All students mastered the task analysis; however, data for all participants prior to mastery were highly variable. Each participant demonstrated a positive relative level change. Daniel and Zach demonstrated level changes of 4 points, and Gloria demonstrated a level change of 3.5 points. Charles' level change was slight, increasing from .5 to 1 point. All students demonstrated accelerating trends based on split middle calculations. Gloria accelerated 1.5 points, Daniel accelerated .5 points, and

Charles and Zach each accelerated 1 point. While all participants displayed accelerating trends, data should be interpreted with caution due to the high degree of variability for all participants.

Tau-*U* calculations were conducted to determine effect size. Values of 0.65 or lower are considered weak, values of 0.66-0.92 are medium, and values of .92 or higher reflect a large effects (Parker et al., 2011). Tau-*U* is recommended because it is a distribution free method that allows for control of baseline trend, considers level change, and aligns well with visual analysis due to its consideration of overlap (Parker & Vannest, 2012; Rakap, 2015). The Tau-*U* measure has some limitations, however, and results must be interpreted with caution. Although Tau-*U* is intended to indicate magnitude of effect, the wide ranges provided in the 90% confidence intervals make such interpretations difficult (Lane & Ledford, 2015). In addition, Tau-*U* calculations occasionally yield results that are inconsistent with interpretations achieved through visual analysis (Ledford, Lane, Zimmerman, & Shepley, 2016), which is the optimal method of evaluating results of single case design studies (Gast et al., 2014).

The results of this study indicate that a functional relation exists between the intervention and the dependent variable, with the number of correct responses on the task analysis increasing for all participants until mastery was attained. Although data were extremely variable throughout intervention, all participants mastered the task analysis. All four participants demonstrated accelerating trends, increases in relative level change, and Tau-*U* scores indicating medium effects for three participants and strong effects for one participant. The weighted Tau-*U* value for the intervention was 0.83 (90% CI=.64 to 1.02), which represents medium effects. Two of the participants, Gloria and Daniel,

maintained mastery performance after six weeks. Charles and Zach did not maintain mastery levels after six weeks, although they performed above baseline levels. Charles and Zach maintained 4 and 5 steps of the task analysis after six weeks, respectively.

Although analyses indicate that a functional relation does exist, a high degree of caution must be used in evaluating these results. Each participant displayed dramatic variability, frequently vacillating between floor and ceiling levels. In addition, while the weighted Tau-*U* score of 0.83 suggests moderate effects, the wide 90% confidence interval (0.64-1.02) indicates a range of weak to strong effects, thus hindering a clear evaluation of effect magnitude (Lane & Ledford, 2015). Overall, data indicate that this intervention may be effective for teaching "wh" question words and comprehension skills to students with ASD, but further research is needed to address ways to minimize the high degree of variability before the intervention can be recommended to practitioners without reservation.

Prompt independence. The percentage of correct independent student responses during intervention was recorded to determine if students increased independence during the intervention phase of the study. All of the students experienced an increase in the median percentage of independent prompts, with accelerating trends of 25% for Gloria, Charles, and Zach and 12.5% for Daniel. These data indicate that student independence increased throughout the intervention, and student reliance on adult prompting decreased. All students improved their ability to respond independently by either recording the correct answer into the graphic organizer or independently initiating the video model to arrive at the correct answer. These data suggest that video prompting may contribute to increased independence as students learn to use the iPad to manage their need for

prompting. These results are promising, and indicate that video prompting deserves consideration as a method of improving independence during the acquisition phase of comprehension skill instruction.

Generalization of mastered skills. The third research question examined the presence of generalization across materials, exemplars, instructors, and settings. Generalization across materials was measured through daily probe data, with new stories used for each probe session as well as each intervention session. All participants were able to master the skills with novel stories, suggesting that they were able, to some extent, to generalize across materials. Students did struggle, however, with several of the exemplars used in Part 1. The exemplars used during Part 1, in which students were taught to sort "wh" answers into the organizer, were different from those used during probe sessions. Participants had difficulty with some exemplars (e.g., woods, cafeteria). Students may have not been able to integrate these exemplars into their understanding of the concept due to weak central coherence. Discrimination assessment focusing on the determining the extent to which students could separate details from holistic integration of the picture might be beneficial (e.g., examine if students see "woods" as separate from "tree"). Student difficulty with these exemplars likely contributed substantially to the high degree of variability present throughout the intervention. Because single opportunity probes were used, difficult exemplars frequently resulted in probe discontinuation. For example, if a student did not know that "cafeteria" was a place, he or she did not pass Part 1 of the probe and was not able to display knowledge on the rest of the task analysis. The instructor ultimately needed to select examples for instruction to help address student misconceptions (e.g., taught "autumn" with a separate picture to help students understand

"fall"). While all participants were able to apply the majority of untaught exemplars to the question word rules taught during Part 1, they were not able to generalize the rule to all examples. The instructor observed that students did not consistently use process of elimination while sorting. They did not always sort the exemplars that they knew first, a skill which perhaps would have helped them narrow down options for more difficult choices. For example, if a student did not know the "woods" exemplar, he or she did not always place the other examples on the organizer before placing "woods" in an incorrect section.

Generalization across instructors and settings was assessed simultaneously, with the paraeducator implementing generalization probes in the general classrooms. Gloria and Daniel were able to generalize at mastery level on 100% of the generalization probes. Charles generalized at mastery level on two out of the three probes, with one of the probes below mastery, but above baseline levels. For this probe, Charles independently completed 7 steps of the task analysis, scoring at mastery (4 out of 4 steps) on Part 1 of the task analysis and completing 3 out of 4 steps on Part 2. Zach performed at mastery on one of the three generalization probes, with two of the probes below mastery, but above baseline levels. For both of these two probes, Zach correctly completed 5 of these steps, scoring at mastery on Part 1 and completing 1 step on Part 2 before making an error. Timing of the generalization probes may have affected Zach's scores; he mastered the intervention the day before a two week break from school, and his generalization probes were not administered until two weeks after the end of intervention. Zach's difficulties may have been related to a problem with maintenance rather than generalization. Overall, results of generalization probes indicate that all participants demonstrated some ability to

generalize to the general classroom with a paraeducator, with two of the participants at 100% on all generalization probes, one participant mastering two of the three probes, and the third participant scoring above baseline levels, but only scoring at mastery on one generalization probe.

Unplanned generalization across tasks occurred as well in this study. Three of the four participants inferred how to use the graphic organizer to answer questions without explicit instruction in this skill. Once Gloria, Daniel, and Charles understood how to fill out the graphic organizer, they used the information from the graphic organizer to the comprehension questions without receiving instruction in this skill; thus meeting criteria on Parts 2 and 3 simultaneously. These results suggest that students developed a conceptual understanding of "wh" questions and were able to apply this new understanding once provided with a visual means of organizing the content. Their ability to make this connection is promising, suggesting that graphic organizer use may enable students to apply knowledge independently across some skills without depending on adult assistance.

Overall, generalization data from this study suggest that this intervention may be beneficial for helping students transfer skills across exemplars, stories, settings and people. Reliance on the graphic organizer and the iPad for stimulus control of the comprehension tasks may have decreased the need for students to depend on adult prompting. The graphic organizer and iPad are student initiated and portable, easily able to be moved to different settings. Once students begin to learn the concepts, the role of the instructor is minimized, with students able to manage their own prompting (Hume et

al., 2009). As this level of independence is established, students likely become less reliant on the adults present, and are thus more likely to transfer skills across settings and adults.

Social validity. The fourth and fifth research questions addressed social validity measures for the paraeducator, general classroom teacher, and student perceptions of the intervention. The third question examined adult perceptions of the intervention's usefulness and feasibility in the general classroom. All respondents agreed or strongly agreed with all of the measures. Questionnaire responses demonstrated that all three general education teachers and the paraprofessional strongly agreed that the intervention was useful for the students. Two of the three teachers and the paraprofessional strongly agreed that the intervention was easy to implement and they would like to implement the intervention in the future. Charles' first grade teacher commented that she would like to use the graphic organizer for other students in her classroom. She also felt the video modeling app would be effective for all of her students and stated that she would like to have an iPad with the video modeling app at each cluster of student desks to minimize student dependence on teacher assistance. In interpreting these questionnaire results, it is important to note that use of some survey words (e.g., useful), may be potentially ambiguous, with respondents perhaps interpreting this word differently. For this reason, caution must be used in evaluating the survey results.

Teacher and paraprofessional scores and comments suggest that the intervention has potential to be useful and feasible in the general classroom, without requiring significant time or preparation from the teacher. Teachers felt that the intervention addressed a significant skill for the students and was effective in improving their question answering skills. Professional social validity scores suggest that video prompting may be

a feasible method for helping students with ASD access the general education curriculum.

The fifth research question examined student perceptions of the intervention. Student perceptions were positive for two of the four questions. When asked if the graphic organizer helped them answer questions, all participants stated or circled "yes." All participants also responded that they wanted to use the graphic organizer or the iPad again. Student responses were mixed for the two questions regarding the enjoyment of the intervention, with three of the four participants stating that they liked using the graphic organizer and two of the four participants responding that they liked using the iPad.

Conclusions

Systematic instruction. Results of this study are consistent with previous literature on the use of systematic instruction to teach text comprehension. Previous research on teaching literacy skills to students with ASD supports the use of systematic instruction. The model-lead-test strategy, for example, has recently gained support in the text comprehension research (e.g., Jimenez, Lo, & Saunders, 2014; Knight & Sartini, 2015; Knight, Wood, Spooner, Browder, & O'Brien, 2014). When combined with example and nonexample instruction, it has been implemented successfully to teach multiple comprehension skills, including science concepts (Jimenez et al., 2014; Knight et al., 2014; Knight et al., 2013), social studies concepts (Zakas et al., 2013) and story vocabulary (Spooner, Kemp-Inman, Ahlgrim-Delzell, Wood, & Davis et al., 2015). The results of the present study are consistent with that research, and extend the model-lead-test strategy with example and nonexample instruction to include "wh" questions words.

The use of the system of least prompts (SLP) to teach comprehension skills has been used successfully in reading nonfiction text (Mims et al., 2012) and literary text (Bethune & Wood, 2013; Browder et al., 2007; Muchetti, 2013; Spooner et al., 2015; Spooner, Ahlgrim-Delzell, Kemp-Inman, & Wood, 2014). Bethune and Wood (2013) used SLP to teach students to sort words from a story into a "wh" question word organizer. Most of the studies using SLP to teach text comprehension skills for students with ASD did so in the context of story based lessons (Browder et al., 2007; Muchetti, 2013; Spooner et al., 2015; Spooner et al., 2014) in which students answered literal comprehension questions when provided with multiple choice options. The present study extends the SLP research to include teaching students to fill out a graphic organizer while reading. Mims et al. (2012) and Bethune and Wood also used SLP to teach "wh" questions. Bethune and Wood combined the SLP procedure with graphic organizer use to teach students to answer questions. The current study, however, is the first to use SLP to teach students to fill out an organizer from a text. In Mims et al., students used visual cues with question words to answer multiple choice questions. In the Bethune and Wood study, students were given key words from the story to sort into the organizer prior to story reading, but they were not required to extract the words from the text to place into the organizer. The results of the current study are consistent with previous SLP research, suggesting that SLP can lead to successful independent graphic organizer completion.

The use of multiple exemplars, which was employed in this study to teach the meaning of question words, is a recommend method for facilitating generalization (Stokes & Baer, 1977). Use of multiple exemplars to teach concepts allows the teacher to present students with a complete conception of the possible meanings. A recent review of

generalization in text comprehension research for students with ASD revealed that the use of multiple exemplars has been used in 23 studies demonstrating successful generalization (Sartini, Knight, Spriggs, & Allday, 2016). It is possible that the multiple exemplar strategy did contribute to the students' ability to generalize to most "wh" exemplars in the present study. These results suggest that the use of model-lead-test combined with examples and nonexamples helped to address the central coherence deficits of students in the study.

Graphic organizer strategy. The use of strategy instruction for students with ASD has some research support (e.g., Burton et al., 2013; Carnahan & Williamson, 2013; Rockwell et al., 2011). Graphic organizers have been used successfully across content areas, including reading (Bethune & Wood, 2013; Carnahan & Williamson, 2013; Chia & Kee, 2013; Mashal & Kasirer, 2011; Mims et al., 2012; Stringfield et al., 2011; Whalon & Hanline, 2008;), math (Rockwell et al., 2011), social studies (Schenning et al., 2013; Zakas et al., 2102), and science (Knight et al., 2013). Results of the present study are consistent with those found in the literature; however, data were more variable than seen in prior studies. In addition, more sessions were required for students to reach mastery. This decreased efficiency may be partially due to the cognitive levels of the population examined. Much of the graphic organizer strategy research with students with ASD was conducted with students without cognitive deficits (e.g., Carnahan & Williamson, 2013; Chia & Kee, 2013; Mashal & Kasierer, 2011; Rockwell et al., 2011; Stringfield et al., 2011; Whalon & Hanline, 2008). Few studies have attempted to teach students with both ASD and intellectual disability to use a graphic organizer as a strategy to approach unfamiliar text. Most of the graphic organizer strategy studies that did target students

with cognitive delays in addition to ASD differed from this study in the response modes required; students were provided with multiple choices to answer the questions (Mims et al., 2012; Schenning et al., 2013), which may have been easier for students than writing the answers without access to multiple choice options. This study is novel in that it taught students to use the graphic organizer as a strategy independently. Students did not merely answer questions, they independently used the strategy to approach novel text without depending on adults pre-sorting the content to according to meaning. Their ability to employ the graphic organizer strategy suggests that they developed true comprehension of the content. The graphic organizer may have helped ameliorate weak central coherence by guiding students toward the important information in the texts. In addition, it helped students plan their approach to the text and maintain focus on key elements, skills which can be difficult for students with ASD due to executive dysfunctioning.

Video prompting. Video modeling and video prompting are evidence-based practices for students with ASD when skill areas (e.g., communication, social) are examined in combination (Wong et al., 2015). However, these strategies have not been frequently examined in the text comprehension research. The little research that does exist in the area suggests some positive results. Burton et al. (2013) effectively addressed video modeling for teaching text comprehension during math instruction to students with ASD. As in the present study, students with ASD were taught to initiate the video models as needed to complete the problems. Students were able to initiate the models successfully and complete the problems, as well as generalize to a novel problem. Charlop-Christy et al. (2000) used video modeling with one participant to teach "wh" comprehension questions after story reading. This study demonstrated mastery of the

questions for the student with comprehension goals as well as generalization to a new story; however, only two generalization probes were administered and stories were repeated throughout intervention, so it is difficult to infer the extent to which the students generalized to other text as a result of the intervention.

This study adds to the sparse research addressing video prompting and text comprehension. To date, no other studies have addressed video prompting or self-directed video prompting for text comprehension skills, and only two have addressed video modeling. The results from this study suggest that video prompting, when combined with explicit instruction, may be a potentially beneficial method for teaching students to fill out a graphic organizer with maximum independence. This study is also novel in its use of self-directed prompting. Student independence increased, suggesting that they were able to learn to use the video prompts as a resource when approaching tasks. The use of self-directed prompting helps to address the difficulties with initiation present among students with ASD due to executive dysfunction.

Implications for Practitioners

The results of this study can be used to help guide practitioners. Student performance on three separate parts of the intervention provides information about how to maximize instruction in graphic organizer use and "wh" question answering skills. The use of the model-lead-test strategy as well as the SLP may be worthy of consideration for teachers attempting to instruct students in understanding question words and filling out a graphic organizer. Based on this study, practitioners might also consider using video prompts to assist students in accessing the curriculum independently in the general classroom.

While students were able to master the majority of "wh" words presented during the probe sessions, each participant had one or two words that they consistently missed during probe sessions. Teachers wishing to implement this intervention should make sure to provide a wide range of exemplars while teaching Part 1. The instructor may need to select some examples that are very similar to exemplars that are problematic for the students. It may even be necessary for the teacher to explicitly teach some exemplars from stories if students are unable to apply "wh" rules in specific instances.

After mastering Part 1, all students required two returns to Part 1 instruction, either due to scoring below mastery on Part 1 for two consecutive probes, or, in one instance, scoring below mastery on Part 1 for more than five non-consecutive probes (Daniel). Students' difficulty maintaining Part 1 mastery could be due to their need to see a large amount of exemplars before the question word meanings could be fully understood. Practitioners implementing this intervention could include brief Part 1 reviews once students enter Part 2, ensuring that the students fully comprehended and maintained Part 1 skills before instruction ended. In addition, some students may struggle with maintaining Part 2 skills after the task analysis is mastered, as seen in Zach's difficulty maintaining mastery performance. In order to minimize difficulties with maintenance, teachers should implement frequent booster sessions after students master the task analysis.

Limitations

Several limitations exist in this study. Of foremost concern in interpreting these results is the high degree of variability for all participants during intervention. It is likely that the use of a single opportunity probe contributed to this variability. While a single

opportunity probe was necessary once story comprehension was introduced in Parts 2 and 3, with steps dependent on completion of previous steps, Part 1 may have worked better as a multiple opportunity probe, with probe sessions proceeding to Part 2 even if Part 1 errors occurred. Students may have been able to perform Part 2 and 3 skills when presented with the story, in spite of difficulty sorting one of the unrelated Part 1 exemplars. Use of a multiple opportunity probe in Part 1 would have allowed for a clearer image of the students' learning patterns, and may have reduced variability. For example, with a multiple opportunity probe, a student who confused "who" and "what" in Part 1 may have scored correctly on the rest of the steps and achieved 10 out of 12 steps, rather than 0 or 2 out of 12 steps.

It may have also been beneficial to allow for a longer period of mastery on Part 1 before starting each subsequent participant. In this study, two consecutive sessions at mastery were required before the second and third participants began the intervention. This criterion was changed to three out of four sessions at mastery before the fourth participant entered intervention because of the third participant's variability. Due to the high variability, it would have been easier to see the effects of the intervention if a longer period of Part 1 mastery was in place for each participant before subsequent participants began intervention.

For the fourth participant, timing of mastery made interpretation of the generalization probes problematic. The first three participants were given generalization probes the day after mastery occurred. Due to a two-week school break immediately after the fourth participant reached mastery, generalization probes were not administered for the last participant until sixteen days after instruction ended. It is unclear if the student's

difficulty on two of the three generalization probes was due to failure to maintain or failure to generalize.

Another weakness of this study was the need for a phase change in Part 1 (a detailed explanation of differences between Phase 1 and Phase 2 is provided in Chapter 3). Students may possibly have been echoing the instructor's models in Part 1 for the lead and test sections of the trials and not optimally conceptualizing the exemplars. It is likely that the Phase 2 format provided a clearer conceptual picture of the content presented. It would be better to eliminate Phase 1 in future studies and use only the Phase 2 format during the model-lead-test segment of the intervention.

Directions for Future Research

This study adds to the research on text comprehension instruction for students with ASD, contributing to the quickly expanding body of literature. Future research is necessary for this knowledge base to continue to grow. This study should be modified to address the limitations outlined in the above section. A replication of this study with these modifications would be beneficial in helping researchers determine if positive results can be achieved with more stability. If similar results could be achieved with less variability and more efficiency, this intervention could be recommended without reservation.

This study also requires replication across more participants, in more settings, and with different texts before this intervention can be recommended. The use of self-initiated video prompting during text comprehension instruction has received very limited attention and should be further explored. In addition, the use of systematic instruction to

teach abstract comprehension concepts should be examined with a range of comprehension skills (e.g., summarizing, questioning, identifying main idea).

Future research could also be conducted to increase the efficiency of the intervention. While the majority of sessions were brief (under 10 min), the intervention was conducted one on one, which is not always feasible for teachers with multiple students. This intervention could be explored in the context of group instruction, with students learning and practicing the skills simultaneously.

Students with ASD are frequently unable to enjoy independence in school and work settings. Interventions that do not rely solely on adult prompting, such as the use of self-initiated video prompting, may be promising for this population (Hume et al., 2009). The necessity of developing appropriate interventions to increase independence and generalization must remain at the forefront of our research focus. In addition, researchers must consider interventions that address the unique needs of students with ASD. Weak central coherence and executive dysfunction affect a variety of comprehension skills and can interfere with students' ability to both conceptualize and generalize information and apply this information independently. As researchers develop interventions that allow students to access the core curriculum, we must continue to consider the importance of generalization and the development of independence, ensuring that students with ASD develop skills that will be of upmost importance in the future.

APPENDIX A

Data Sheets

Probe data sheet

Name: Date: Examiner: IOA score:
Condition: Baseline Intervention Generalization

Sort words into GO	**word**	**+ or 0**
1) Put "Who" word on organizer		
2) Put "What" word on organizer		
3) Put "When" word on organizer		
4) Put "Where" word on organizer		
Total for Part 1		

Fill out GO from passage	**+ or 0**	**Student answer**
1) Put "Who" word on organizer		
2) Put "What" word on organizer		
3) Put "When" word on organizer		
4) Put "Where" word on organizer		
Total for Part 2		

Answer comprehension questions	**+ or 0**	**Student answer**
1) "Who is this story mostly about?"		
2) "What is the main thing that happened in the story?"		
3) "When did the story mostly take place?"		
4) "Where did the story mostly take place?		
Total for Part 3		

Intervention data sheet for Part 2

Fill out GO from passage	**Independent**	**Student-initiated video prompt**	**Model**	**Physical**
1) Put "Who" word on organizer				
2) Put "What" word on organizer				
3) Put "When" word on organizer				
4) Put "Where" word on organizer				
Total for Part 2				

APPENDIX B

Procedural Reliability Sheets

Procedural Reliability: Probe					
Date:					
Observer: 1) Did not prompt toward answer					
2) Ended the probe after the first error					
Total:					

KEY: (+) Correct; (0) Not correct

Procedural Reliability: Probe					
Date:					
Observer: 1) Did not prompt toward answer					
2) Ended the probe after the first error					
Total:					

KEY: (+) Correct; (0) Not correct

Procedural Reliability: Probe					
Date:					
Observer: 1) Did not prompt toward answer					
2) Ended the probe after the first error					
Total:					

KEY: (+) Correct; (0) Not correct

Procedural Reliability: Part 1 (Phase 1)						
Date:						
Observer: 1) **Model** at least **4** examples of each question word while stating the rule						
2) **Lead** sorting at least **4** word of each type into graphic organizer						
3) **Test** sorting words at least **1** word of each type into graphic organizer						
4) Corrected all errors						
5) Conduct at least **1** delayed test on missed items						
Total:						

KEY: (+) Completed; (0) Not completed; (NA) Not applicable

Procedural Reliability: Part 1 (Phase 2)								
	Who		What		When		Where	
Observer: 1) **Model** sorting into T chart while stating the rule	Ex 1___ 2___ 3___	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___
2) **Lead** sorting into t chart while stating the rule	Ex 1 __ 2 ___ 3___	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___
3) **Test** sorting into T chart while stating the rule	Ex 1 __ 2 __ 3__	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___	Ex 1___ 2___ 3___	Nonex 1___ 2___
4) Corrected all errors								
5) Delayed test if item missed								
6) Final sort of one of each ex into GO	Score only once for all four _____							

KEY: (+) Completed; (0) Not completed; (NA) Not applicable

Procedural Reliability: Part 2							
Date:							
Observer: 1) Provided access to GO and iPad							
2) Read the story twice							
3) Implemented prompt hierarchy for "Who"							
4) Implemented prompt hierarchy for "What"							
5) Implemented prompt hierarchy for "When"							
6) Implemented prompt hierarchy for "Where"							
Total:							

KEY: (+) completed; (0) not completed

Prompt hierarchy
1) Independent
2) Student-initiated video prompt
3) Model
4) Physical

Procedural Reliability: Part 3						
Date:						
Observer: 1) Asked all questions on the sheet						
2) Corrected all missed items						
3) Repeated rules during error correction						
4) Gave explanation during error correction						
5) Asked question again immediately after correcting						
6) Conducted at least 1 delayed test on each missed item						
Total:						

KEY: (+) completed; (0) not completed

APPENDIX C

General Classroom Teacher Questionnaire

Classroom Teacher Questionnaire

Please circle your response to the following statements.

1. **Answering "Wh" questions is an important skill for this student.**

Strongly disagree Disagree Neutral Agree Strongly agree

2. **This intervention is effective.**

Strongly disagree Disagree Neutral Agree Strongly agree

3. **This intervention is easy to implement in the general classroom.**

Strongly disagree Disagree Neutral Agree Strongly agree

4. **I would like to use this intervention in the future**.

Strongly disagree Disagree Neutral Agree Strongly agree

5. **Please list any comments you have about this study.**

APPENDIX D

Student Questionnaire

(Pictures produced in *Boardmaker* ®)

Name: _____

*Read questions to the students, pointing to GO and iPad when mentioning those items.

1. Do you think that the graphic organizer helped you to answer questions?

2. Did you like using the iPad to help you while you read?

3. Did you like using the graphic organizer to help you while your read?

4. Do you want to use the graphic organizer and the iPad again while you read?

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PUBLICATIONS

Knight, V., **Sartini, E.,** & Spriggs, A. D. (2015). Evaluating visual activity schedules as evidence-based practice for individuals with autism. *Journal of Autism and Developmental Disorders 45,* 175-178.

Knight, V.F., & **Sartini, E.** (2014). A comprehensive literature review of comprehension strategies in core content areas for students with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, doi:10.1007/s10803-014-2280-x

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MANUSCRIPTS UNDER REVIEW

Owiny, R.L., Spriggs, A.D., Mills, J.R., & **Sartini, E.** (2016). *Response cards as evidence-based practice*. Manuscript submitted for publication.

Sartini, E.S., Knight, V.F., Spriggs, A.D., Allday, R. A. (2015). *Generalization and comprehension across content areas for students with ASD: A comprehensive review*. Manuscript submitted for publication.

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Sartini, E.S., Spriggs, A.D., & Allday, R.A. (2015). *The effects of task interspersal on skill acquisition for students with autism spectrum disorder*. Manuscript in preparation for publication.

Allday, R.A., & **Sartini, E.** (2015). *Understanding educator perspectives on challenging behavior*. Data collection currently underway.

PRESENTATIONS

Knight, V.F., Mims, P., & **Sartini, E**. (2015, January). *Comprehension Strategies for Including Students with Significant Support Needs in Core Content*. DADD Annual Conference, Clearwater, FL.

Spriggs, A.D., & **Sartini, E**. (2013, August). *Using Activity Schedules to Increase Independence for Individuals with Autism*. Annual Summer Autism Institute, Lexington, Kentucky.

Knight, V.F., Spriggs, A.D., & **Sartini, E**. (2012, June). *Using Activity Schedules to Increase Independence for Individuals with Autism* [Invited Presentation]. Kentucky Autism Training Center Institute, Louisville, KY.

Sartini, E. (2011, August). *Learn about Edmark reading programs* [Invited Presentation]. Annual Summer Autism Institute, Lexington, KY.

TEACHING

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Spring 2014	Co-taught with Dr. Amy Spriggs
Fall 2012	Co-taught with Dr. Robert McKenzie