THE EFFECTS OF GRAPHIC ORGANIZERS ON BUILDING COMPREHENSION IN STUDENTS ON THE AUTISM SPECTRUM

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Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

December 2018

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Kliemann, Karen Karin R. *The Effects of Graphic Organizers on Building Comprehension in Students on the Autism Spectrum*. Doctor of Philosophy (Special Education), December 2018, 94 pp., 3 tables, 1 figure, 6 appendices, references, 48 titles.

Many students on the autism spectrum display a strong ability to process and comprehend information at elevated levels when presented with it visually. Despite this, students who have autism are increasingly being educated in general education content classrooms that utilize lessons directed to whole groups of students and limit the use of visually presented material. For some students with an autism spectrum disorder (ASD), this presentation introduces difficulties related to attention as well as comprehension and retention of material. Research indicates promising results associated with using a graphic organizer to increase comprehension accuracy in students who answer *wh*-questions following the reading of a short passage. The purpose of this study was to document the relationship between using a graphic organizer and increasing reading comprehension. The study employed a single-subject multiple baseline design across participants to evaluate if the use of a graphic organizer impacted the correctness of answering *wh*-questions for grade-level social studies content. Participants included four eighth grade students in an urban public school who had been diagnosed with ASD. Results supported research by showing an increase in comprehension skills with the use of a graphic organizer.
ACKNOWLEDGEMENTS

My sincerest thanks are given first and foremost to my advisor and committee chair, Dr. Miriam Boesch for taking on my work the past three years. I am grateful for her guidance and support of my abilities and success.

Immeasurable thanks and gratitude are offered to Dr. Kevin Callahan for serving on my committee and providing invaluable mentoring, support and encouragement in both my professional and personal lives. His guidance and support have allowed me to remain committed to my learning and education through incredibly challenging situations.

Sincerest thanks are also extended to Dr. Wendy Middlemiss for agreeing to step in and serve on my committee this past year. She and Dr. Bertina Combes reignited the fire within me by allowing and expecting students to think outside the box and see value in the research possibilities more nontraditional venues offered.

I would also like to thank Dr. Melissa Savage, my additional committee member, for the time and commitment she gave to reviewing and critiquing my dissertation. Thanks is also offered to Dr. Darrell Hull and Dr. Qi Chen for their talent and skill in making statistical analysis an understandable content for one who was nervous about grasping it well.

Sincere gratitude is offered to my doctoral colleagues who have shared life with me on this path. I would like to believe our experiences were richer for having been companions through the learning. Specific acknowledgement and thanks is offered to Dr. Katrina Hovey for always being in my corner and unfailingly supporting me through this process. Thanks to Dr. Endia Lindo, formerly of the University of North Texas (UNT), for her guidance, perspective, support, confidence, and belief in my abilities and success.
Special thanks are offered to the instructional specialists, teachers, students, and parents who participated in this research project. Thanks is also extended to my copy editor, Marcella Hines. Without their participation, I would not have met this milestone.

Last, yet never least, I offer heartfelt thanks and gratitude to the following for their continued support and faith in my ability to attain this goal: my parents, Richard Hal and Raye Etta Kliemann; my siblings—Kristin Kliemann Sweeting, Greta Kliemann Browder, and Hal Kliemann—and their families; and my circle of friends and expressly my friend David Schmidt. They have been my cornerstone and safe harbor, encouraging, chastising, loving, and pushing me forward to a successful end. I am indebted to all for the constant, caring hands and hearts that have held me up as I have walked this path.
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Introduction

In the past two decades, two legislative laws have significantly influenced inclusive opportunities for students with disabilities. No Child Left Behind (NCLB, 2001), recently replaced by the Every Student Succeeds Act (ESSA, 2015), and the Individuals with Disabilities Education Improvement Act (IDEIA, 2004), have mandated participation, increased access, and heightened rigor in the general education curriculum for all students, including those with disabilities. Under NCLB (2001), states were required to address gaps in all students’ achievement through accountability testing and monitoring of academic progress. Provisions for the least restrictive environment (LRE) were outlined in the IDEIA (2004). The provisions of an LRE require school districts to educate students who have disabilities in regular classrooms to the maximum extent possible. This means that students with disabilities should have access to general education curriculum with the use of supplementary aids and services so that students may make progress on their Individual Education Programs (IEPs). The intent of both laws is to support the belief that all students should have opportunities to acquire the knowledge and skills that increase their likelihood of becoming adults who are contributing members of their society.

Yet while all students are experiencing greater participation in inclusive settings, meaningful understanding of general curriculum content continues to be a daily struggle for many students with disabilities. Based on the results of the report from the National Center for Educational Statistics (NCES, 2009), the percentage of fourth and eighth graders with disabilities who scored below the basic level in reading achievement was higher (66% and 63%, respectively) than the percentage of fourth and eighth graders without disabilities (31% and 22%,
respectively). Scores from the NCES (2009) suggest that fourth- and eighth-grade students with disabilities who participated in the test did not understand the grade-level text well enough to comprehend the reading passages (Jitendra & Gajria, 2011). Furthermore, only 8% of students in eighth grade and 12% of students in twelfth grade were considered proficient readers, which indicates a downward trend for students with disabilities.

Hall, Kent, McCulley, Davis, and Wanzek (2013) expanded these findings to include more subject areas than just reading for students with learning disabilities. In their publication “A New Look at Mnemonics and Graphic Organizers in the Secondary Social Studies Classroom,” they stated what they feel teachers of secondary students with learning disabilities already know, “Text comprehension is a formidable challenge for many of their students in U.S. history, world geography, and other subjects in the social sciences” (p. 48). Students with disabilities often lack the reading skills necessary to understand complex texts (Hall et al., 2013). The ability to extract meaning from text involves many processes, beginning with recognizing letters and words and extending to deciphering, analyzing, and interpreting messages within the text itself (Nation & Norbury, 2005). These processes are often the critical needs identified for individualized instruction in a student’s IEP, particularly for a student with ASD.

Comprehension Difficulties in ASD

Students with ASD often have additional struggles with reading comprehension based on the compounding social deficits that accompany their disability (Cronin, 2014; Henderson, Clarke, & Snowling, 2014; Jacobs & Richdale, 2013). They experience deficits often referred to as a “triad of impairments” in the areas of social language and communication, social interaction, and social imagination (Wing & Gould, 1979). This triad affects reading comprehension by
imposing difficulties in understanding the perspectives, thoughts, and feelings of others. Students with ASD have difficulty understanding character motivation and subsequent actions based on emotional states. They also struggle to problem-solve and predict events. These skills are related to understanding the perspectives of others and intricacies of social interaction (Carnahan, Williamson, & Christman, 2011; Cashin & Barker, 2009), which play a large role in comprehending texts in multiple content areas.

However, the research into reading comprehension of students with ASD is either inapplicable or lacking. As Spencer, Evmenova, Boon, and Hayes-Harris (2014) have noted, much of the existing research focuses on spelling, writing, and direct-instruction practices for mixed elementary grade levels rather than the more in-depth processes involved in comprehension, such as mental imagery, connection with prior knowledge, and interpreting meaning from text. Furthermore, research for secondary-level students with ASD focuses on individual strategies in content areas. But this research is currently scant. To address practices for improving reading comprehension that specifically target the deficits often seen in students with ASD, it is critical to investigate current evidence-based practices in the fields of both reading and autism. Finnegan and Mazin (2016) recognize that “this position is especially tenuous for teachers of students with ASD ... as no evidence-based practices in teaching reading comprehension have been identified” for this population.

Evidence-Based Strategies in Comprehension

Currently, teachers rely on evidence-based practices from other student populations and attempt to interpret and modify processes to benefit students with autism (Finnegan & Mazin, 2016). Strategies identified from the National Reading Panel (NRP, 2000), the National Autism
Center (NAC, 2015), and the National Professional Development Center on Autism Spectrum Disorder (NPDC, 2014) serve as their main guide for doing so. In general, these organizations focus specifically on identifying reading strategies for students from preschool to grade 12 as well as general content strategies for students with autism. While both the NAC (2015) and NPDC (2014) do not address reading comprehension specifically, both resources identify practices that show promise when applied to instruction in reading. Examples of these practices include discrete trial training (DTT), modeling, prompting, task analysis, and visual supports. Detailed information on strategies can be found in the reports on the websites of both the NAC (2015) and NPDC (2014).

The NRP, on the other hand, identifies evidence-based practices in reading comprehension. The *Report of the National Reading Panel: Teaching Children to Read: An Evidence-Based Assessment of the Scientific Research Literature on Reading and Its Implications for Reading Instruction* (NRP, 2000) identified the following seven evidence-based practices in the area of reading comprehension: (a) comprehension monitoring, (b) cooperative learning, (c) graphic organizers, (d) question/answer, (e) question generation, (f) story structure, and (g) summarization. Detailed information can be found on each of the strategies in the report. While the NRP strategies have shown promise in reading, research has yet to investigate these strategies in depth with students who have disabilities. Yet, as previously mentioned, students with disabilities score below their grade-level peers in reading comprehension and are expected to participate in the general-education content with heightened rigor.

While targeting different types of student populations, commonalities do exist between the strategies identified by the NAC (2015), the NPDC (2014), and the NRP (2000). These include the use of direct instruction and visual supports. The NRP (2000) identified direct
instruction as a viable strategy for teaching vocabulary, questioning skills, and other components involved in reading (e.g., phonemic awareness and word recognition) to individuals without disabilities. Additionally, the NRP (2000) supported that reading comprehension can be taught to students through the use of visual supports, including story maps, and graphic organizers. The NPDC (2014) defined visual supports as “any visual display that supports the learner engaging in a desired behavior or skills independent of prompt” (p. 22). Both story maps and graphic organizers identified in the NRP (2000) report meet the NPDC (2014) definition for visual support. While the NAC (2015) did not specifically list visual supports as a strategy, it identified the following established and emerging treatments as having visual components involved in implementation: schedules, story-based interventions, augmentative and alternate communication systems, Picture Exchange System, scripting, and structured teaching. There is strong evidence in autism research for the use of DTT and visual supports to address a range of educational and behavioral characteristics of students with autism.

A systematic review of literature by Finnegan and Mazin (2016) illustrated this. After reviewing literature from 1985 to 2015 that investigated targeted strategies for increasing comprehension skills in students with ASD, Finnegan and Mazin, reported that all of the 15 studies meeting inclusion criteria utilized teacher-led direct-instruction procedures. The majority of the reviewed studies employed a multiple-baseline design ($n = 9$). Five of the studies used graphic organizers as an intervention, while two studies used direct instruction. A total of 88 participants with ASD were represented in the 15 studies. Participants ranged in age from 7 to 17 years old. Seven studies included elementary-age participants, six studies included middle-school-age participants, and two studies included high-school-age participants (Finnegan & Mazin, 2016). Findings indicated that the effectiveness of interventions was mixed, making it
difficult to draw significant conclusions about the correlation between ASD, reading comprehension, and instruction strategy. Finnegan and Mazin (2016) categorize findings as highly effective, moderate to high effectiveness, moderate effect and small effect. Graphic organizers such as thinking maps, w/h-question organizers, story maps, Venn diagrams, or character maps were found to be highly effective along with direct instruction, lending support for the use of these strategies in reading for students with ASD. (Finnegan & Mazin, 2016).

Additional research on the use of a visual support for reading comprehension can be found in Whalon and Hanlon’s (2008) investigation of the NRP strategy of cooperative learning. The investigation employed a single-subject, multiple-baseline design that used cooperative learning pairs for question generation and response. Participation included three students with ASD and nine general-education peers. Cooperative pairs consisted of one participant with ASD paired with one general-education peer (Whalon & Hanlon, 2008). Each pair took turns reading a pre-established story that was followed by story cards, question word cards, a storyboard, and a self-monitoring checklist. Results indicated increases in unprompted question generation and response during reading instruction. Participants were provided a graphic organizer in the form of a visual story map following intervention, which further increased frequency of question generation and response (Whalon & Hanlon, 2008). Evidence from multiple areas of research shows promise for the use of visual supports to increase reading comprehension skills for students with ASD.

Graphic Organizers as Visual Supports

The organizations serving as teachers’ main guides for modifying reading processes to benefit students with autism have shown a relationship between reading comprehension and
visual supports. While the NRP (2000) has shown increases in comprehension and improved recall of information with the use of graphic organizers, the NPDC (2014) and NAC (2015) support increases in educational and behavioral skills with the use of visual systems. But these organizations are not the first to offer support for this.

Theoretical support for the use of graphic organizers to visually connect ideas and relationships has its roots in Ausubel’s meaningful learning theory (Ausubel, 1963). According to this perspective, learning begins with existing knowledge, called cognitive structures, and is broadened and strengthened through the incorporation of new information (Kim, Vaughn, Wanzek, & Wei, 2004). Ausubel argued that concept maps and graphic organizers serve as a concrete framework for students to relate existing knowledge to new learning (Kim et al., 2004). Applying the use of graphic organizers to the reading process holds promise for students with ASD by providing a visual framework that shows connections between ideas and promotes the ability to incorporate new learning into existing learning (Kim et al., 2004).

This visual framework is key for promoting learning for students with a diagnosed learning disability. Graphic organizers can take on a variety of types, including story webs, flowcharts, Venn diagrams, or fishbone diagrams. Jitendra and Gajria (2011) contend that the ability to design an organizer to depict different structures and patterns is a fundamental strength of using graphic organizers.

Kim et al. (2004) provided further evidence to support Ausubel’s theory and this variety in design strength. They reviewed literature from 1963 to 1997 that reported on the success of various graphic organizers in increasing reading comprehension. The following graphic organizers were evaluated: semantic organizers, cognitive maps with mnemonic, cognitive maps without mnemonic, and framed outlines. Instruction was either teacher-directed or researcher-
directed. Participants numbered 848 students with a diagnosed learning disability and ranged from kindergarten to grade 12. Effectiveness was found in both the upper elementary (fourth through sixth grades) and secondary settings, along with larger effect sizes ($d$) for teacher-directed versus researcher-directed graphic organizer instruction ($d = 1.05$ and $d = 0.96$, respectively) (Kim et al., 2004). Effect sizes were reported based on type of organizer and are as follows: (a) nine studies implementing semantic organizers reported effect sizes ranging from 0.81 to 1.69, (b) two studies implementing cognitive maps with a mnemonic reported effect sizes of 0.81 and 0.91, (c) four studies implementing cognitive maps without a mnemonic reported effect sizes ranging from 0.096 to 5.07, and (d) two studies implementing framed outlines reported effect sizes of 0.80 and 1.78 (Kim et al., 2004). Based on the findings from the research graphic organizers hold promise as an effective tool for educators to consider for increasing reading comprehension for students with ASD.

Significance and Purpose of the Study

Research has shown that students with disabilities struggle with understanding grade-level texts well enough to comprehend what is being addressed in reading passages. This is particularly true for passages in the social sciences (Hall et al., 2013; Jitendra & Gajria, 2011). This study set out to investigate that providing access to visual supports in the form of graphic organizers could facilitate an increase in reading comprehension for students with autism. The purpose of this study was to replicate the use of a graphic organizer to measure the impact of using this tool to answer $wh$-questions with school age students with autism based on the work of Bethune and Wood (2013). Further extending the work of Bethune and Wood (2013) by using grade-level social studies content topics on each participant’s independent reading level and
generalizing the use of a graphic organizer to the general education setting with grade level text and materials. Lastly, this study investigated the effects of teacher training on fidelity of implementation and social validity of the intervention.

Research Questions

The study investigated three research questions:

1. Is there a functional relationship between the use of graphic organizers and reading comprehension as measured by answering *wh*-questions in grade level social studies content for students with ASD?

2. Can teachers be trained to implement intervention with fidelity?

3. What is the social validity of using graphic organizers in an inclusive general education classroom for students with ASD, as measured by feedback from parents, participants, and teachers?

Method

Recruitment

Students were recruited from the eighth grade of one public junior high school in an urban Texas school district. Families with students who met the study inclusion criteria, outlined in section below, received a letter that explained the study’s purpose and procedures as well as the investigator’s contact information (Appendix A). Four participants with a formal diagnosis of ASD chose to participate. Parents of participating students signed the informed consent letter (Appendix A), while participating students signed an informed assent letter (Appendix A).

Participants

District curriculum assessment data provided the rationale for concentrating on eighth grade. Historically, district students receiving special education services in grade eight do not
meet the passing standard for content knowledge in social studies (AEIS, 2011). The school represented a convenience sample based on the investigator’s current feeder pattern assignment. A feeder pattern is designated as the flow of schools that students within a district attend based on their home address as they progress in grades from elementary through junior high to high school. Participants meeting the following criteria were selected to participate:

(a) Had an educational determination of ASD based on district protocols and in agreement with either the 4th revised edition or the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* and using standardized measures administered by a licensed specialist in school psychology (LSSP)

(b) Had IQ ranges from 65 to 120 as measured by a Wechsler Intelligence Scale for Children (WISC), Kaufman Assessment Battery for Children (KABC), or Woodcock Johnson IV (WJ-IV) (Schrank, McGrew, Mather, & Woodcock, 2014); had language and communication skills comparable to typically developing same-age peers, including the ability to speak in full sentences; make personal needs known; answer factual and literal *wh*-questions; understood vocabulary common to typically developing same-age peers, based on a review of the full individual evaluation (FIE), including but not limited to results of a current Assessment Test of Pragmatic Language, the Pragmatics Profile, or the Adaptive Behavior Assessment, if available

(c) Were between 13 to 14 years of age

(d) Had a designated IEP time in curriculum that reflected services and support for social studies content in a general education setting.

Students who had a history of challenging behaviors, including significant tantrums or aggression, were excluded from participation in order to maintain the focus on improving reading comprehension and not compound the intervention with behavior shaping techniques.

Data summaries for each participant were gathered by reviewing the student’s most recent full and individual evaluation (FIE), which law mandates must be reviewed and considered every three years. The FIE dates; comprehensiveness of evaluation summaries; and tools used for assessing the components of autism, language, cognitive, and achievement components varied among the participants. The section below includes a brief description of
each participant and a table that summarizes results. Pseudonyms were used throughout the study.

**Participant 1: Jack**

FIE date: 2016. Jack was a 14-year-old Caucasian male. He was educationally identified as a student on the autism spectrum through the Autism Spectrum Rating Scale Teacher-Parent Ratings (ASRS). The rating scale is designed to be used in conjunction with other measures to help determine the likelihood of behaviors associated with autism. Based on his responses, Jack fell within the clinical diagnosis of autism disorder. Additionally, Jack participated in Module 3 of the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2). Jack’s performance on this assessment produced an overall total score of 8, which was within the range of autism cutoff threshold.

In the area of language, Jack was administered the Test of Pragmatic Language, Second Edition (TOPL-2). His scores ranged between 85 and 115, and his overall standard score was 87—all within what is considered the normal range. Jack verbally communicated his ideas, preferences, and needs using complex sentence structures.

Jack presented with a scatter of score ranges and the comorbid diagnosis of an intellectual disability, which is consistent with some individuals on the autism spectrum. Jack’s IQ was assessed with selected tests from the Woodcock Johnson IV Tests of Cognitive Abilities (WJ IV COG, 2014). The assessment represents broad categories of cognitive performance as well as a composite score that represents a student’s general intellectual ability (GIA). Jack’s GIA was assessed to be 67, which should not be interpreted as reliable, as the examiner noted that it was not cohesive with the subtest information.
Additionally, Jack was administered the Adaptive Behavior Assessment, Third Edition (ABAS-3). Administration involves gathering ratings from a variety of respondents (e.g. parents and teachers) which is then interpreted by a professional to describe overall areas of strength and weakness. Overall summary recommendations noted the importance of emphasizing Jack’s strength of visual processing (105) by providing visual material and repetition.

Achievement performance was assessed using formal and informal measures. Jack was administered selected tests from the Woodcock Johnson IV Tests of Achievement (WJ IV.), which can be used to determine a person’s current academic strengths in comparison to students of the same age. Based on testing results, Jack’s achievement performance was below average in basic reading (68), reading comprehension (79), and reading fluency (58). Jack met criteria for dyslexia.

Participant 2: Kevin

FIE date: 2013. Kevin was a 14-year-old Asian male educationally identified as a student on the autism spectrum. He was evaluated for autism using the Childhood Autism Rating Scale, Second Edition–High Functioning Version (CARS2-HF). This rating scale assesses the severity of autism from mild to severe. Total score for the CARS2-HF may range from 15 to 60. Scores are categorized as follows: (a) 29 and below are minimal to no symptoms, (b) between 30 and 36 are mild to moderate symptoms, and (c) over 37 is severe symptoms. Kevin scored overall a 37 falling into the severe category. Additionally, Kevin participated in the second module of the ADOS-2. While a numeric score was not reported in the FIE results, the summary statement supported that Kevin’s overall performance fell within the autism classification.

In the area of language, Kevin was administered the Pragmatic Profile. The criterion
score for this profile is 136, and Kevin scored 104, indicating an impairment in pragmatic language. While formal testing indicated that Kevin performed below peers his age, he verbally communicated his preferences and needs using compound and complex sentence structures. Kevin was found to usually understand what was said to him and asked for help when needed. It was noted that Kevin rarely answered questions or participated in classroom discussions.

Kevin was assessed for cognitive performance using the Kaufman Assessment Battery for Children, Second Edition (KABC-II). This battery of subtests is designed to assess mental processing and cognitive development. Based on the results of the KABC-II, Kevin was found to be within the below average range. However, the examiner stated that the results should be viewed with caution due to Kevin’s diagnosis of autism.

Kevin was also administered the ABAS-2. Based on the data review, it appeared that the examiner did not gather information from the parents for this assessment. Scores from the teacher rating were between 74 and 72, with overall composite for adaptive behavior being a 71. The examiner concluded again that scores should be interpreted with caution.

Achievement testing was assessed using the Classroom Assessment Scoring System (CLASS), which is a criterion-referenced assessment tool. Results indicated that Kevin was performing at the beginning of first-grade level at the time of the assessment in 2013. Unfortunately, FIE did not contain any more recent data on achievement.

Participant 3: Ethan

FIE 2012. Ethan was a 14-year-old Caucasian male educationally identified as a student on the autism spectrum. He was evaluated for autism using the CARS-2-HF. Overall, Ethan scored a 28, which placed him in the mild to moderate category. Additionally, Ethan participated
in module 2 of the ADOS-2. While a total overall numeric score was not reported in the FIE results, the summary statement supported that Ethan’s performance fell within the autism classification.

In the area of language, Ethan was administered the Pragmatic Profile. The criterion score for this profile is 136, and Ethan scored 104, indicating an impairment in pragmatic language. While formal testing indicated that Ethan performed below peers his age, he verbally communicated his preferences and needs using compound and complex sentence structures. Ethan was found to usually understand what was said to him and asked for help when needed. It was noted that Ethan rarely answered questions or participated in classroom discussions.

Ethan was assessed for cognitive performance using the KABC-II. Based on the results of the KABC-II, Ethan performed in the average range of intelligence. Ethan was also administered the ABAS-2. Based on the data review, it appeared that the examiner did not gather information from the parents for this assessment. Ethan was rated in the below average range by teacher in the areas of communication and functional academics. The examiner noted that Ethan’s intellectual functioning and adaptive behavior scores were not consistent.

Formal or informal achievement testing was not reported in the current FIE. Because Ethan had intellectual scores in the average range, it was concluded that Ethan performed on or close to grade level.

Participant 4: Daniel

FIE date: 2014. Daniel was a 13-year-old Caucasian male educationally identified as a student on the autism spectrum. He was evaluated for autism using ASRS. Two teacher ratings revealed that Daniel had difficulty relating to children and tolerating changes in routine, used
language in an atypical manner, engaged in unusual behaviors, and had problems with attention and/or impulse control, however these behaviors were not significant enough to impact his participation. While specific scores were not noted in the FIE, the examiner reported that parent ratings on the ASRS indicated that Daniel had difficulty tolerating changes in routine, used language in an atypical manner, engaged in unusual behaviors, overreacted to sensory stimulation, and had difficulty focusing. Additionally, Daniel participated in the Autism Diagnostic Observation Schedule (ADOS). Daniel’s overall performance fell within the autism classification with a communication score of 3 (cutoff score =3) and a reciprocal social interaction of 8 (cutoff score =8). In the area of language, Daniel was administered the TOPL-2. Daniel scored 102, which is considered average. Daniel was found to express himself using complex sentences, answer when called on after being given a “wait time,” and ask for clarification when needed.

Daniel was assessed for cognitive performance using the WJ IV Cog. All scores fell within the average range for performance. It was reported that Daniel’s adaptive behavior was assessed using informal measures and was consistent with his intellectual functioning.

Formal or informal achievement testing was not reported in the current FIE. However, with intellectual scores in the average range, it was concluded that Daniel was performing on or close to grade level.
Table 1

Assessment Summary for Participants

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Score</th>
<th>Conclusion</th>
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<tr>
<td><strong>Participant 1: Jack</strong></td>
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<tr>
<td><strong>ASRS</strong></td>
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<tr>
<td>Social communication: Teacher 68; Parent 64</td>
<td></td>
<td></td>
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<tr>
<td>Peer socialization: Teacher 77; Parent 68</td>
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<tr>
<td>Social emotional: Teacher 66; Parent 58</td>
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<td></td>
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<tr>
<td>Behavioral rigidity: Teacher 71; Parent 60</td>
<td>Clinical diagnosis of autism.</td>
<td></td>
</tr>
<tr>
<td>Sensory sensitivity: Teacher 65; Parent 59</td>
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<td></td>
</tr>
<tr>
<td><strong>ADOS-2, module 3</strong></td>
<td>8</td>
<td>Autism cutoff threshold.</td>
</tr>
<tr>
<td><strong>TOPL-2</strong></td>
<td>87</td>
<td>Normal range</td>
</tr>
<tr>
<td><strong>WJ IV-COG</strong></td>
<td>67</td>
<td>Noted not cohesive with subtest information. Not to be interpreted as accurate.</td>
</tr>
<tr>
<td><strong>ABAS-3</strong></td>
<td>Below average</td>
<td>Below average in communication and functional academics. Strength in visual processing.</td>
</tr>
<tr>
<td><strong>WJ IV</strong></td>
<td></td>
<td>Overall below average reading comprehension and reading fluency.</td>
</tr>
<tr>
<td>Math problem solving 95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic reading 68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comprehension 79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading fluency 58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math calculations 77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Written expression 67</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participant 2: Kevin</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CARS2-HF</strong></td>
<td>37</td>
<td>Severe symptoms of autism.</td>
</tr>
<tr>
<td>Assessment</td>
<td>Score</td>
<td>Conclusion</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ADOS-2, module 3</td>
<td>No score reported</td>
<td>Overall performance fell within autism.</td>
</tr>
<tr>
<td>Pragmatic Profile</td>
<td>104</td>
<td>Impairment in pragmatic language.</td>
</tr>
<tr>
<td>KABC-II</td>
<td>Below average range</td>
<td>Noted to be viewed with caution.</td>
</tr>
<tr>
<td>ABAS-2</td>
<td>Teacher only report 71</td>
<td>Below average in communication and functional academics. Strength in visual processing.</td>
</tr>
<tr>
<td>CLASS</td>
<td>Beginning first grade</td>
<td>Assessment completed in 2013.</td>
</tr>
<tr>
<td>Participant 3: Ethan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CARS2-HF</td>
<td>28</td>
<td>Mild to moderate range of autism.</td>
</tr>
<tr>
<td>ADOS-2, module 2</td>
<td>No score reported</td>
<td>Summary notes autism classification.</td>
</tr>
<tr>
<td>Pragmatic Profile</td>
<td>104</td>
<td>Impairment in pragmatic language.</td>
</tr>
<tr>
<td>KABC-II</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>ABAS-2</td>
<td>Teacher report only Below average</td>
<td>Below average in communication and functional academics.</td>
</tr>
<tr>
<td>Achievement testing</td>
<td>None reported</td>
<td></td>
</tr>
<tr>
<td>Participant 4: Daniel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASRS</td>
<td>No score reported</td>
<td>Atypical for language, changes in routine, and sensory stimulation.</td>
</tr>
<tr>
<td>ADOS</td>
<td>Communication 3</td>
<td>Autism classification.</td>
</tr>
<tr>
<td>TOPL-2</td>
<td>102</td>
<td>Average.</td>
</tr>
<tr>
<td>WJ IV-COG</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>Adaptive Behavior (noted informal assessment)</td>
<td>Considered average</td>
<td></td>
</tr>
<tr>
<td>Achievement testing</td>
<td>None reported</td>
<td>Noted performing at grade level.</td>
</tr>
</tbody>
</table>

Setting

This study took place in a public-school classroom setting. Baseline and intervention sessions were conducted in a specialized support classroom. A specialized support classroom is defined as a special-education classroom designed to provide instruction to students receiving special education services. Individualized instruction based on students’ IEPs is provided by a teacher certified in special education and/or a paraprofessional. The interventionists sat at a 45- to 90-degree angle across the table from the student. Each session lasted no longer than 30 minutes.

During the baseline and intervention phase of training, the teacher and student were present. The investigator and independent observer attended periodically to conduct data collection for inter-rater reliability. The generalization phase included the implementation of a graphic organizer into an inclusive general education social studies classroom at the eighth-grade level. Prior to the intervention, baseline probes were taken in the general education setting for just one component of the treatment package, answering wh-questions, for each participant. The probe information is included in the data reporting.

Instrumentation and Materials

The district currently assesses all students on the Istation Internet-based assessment Indicators of Progress (ISIP) (Mathes & Torgesen, 1998). The ISIP provides assessments and curriculum lessons in reading and math, and the district uses it to obtain students’ independent reading levels so teachers may provide targeted reading instruction. Typical grade-level peers score between 278 and 289 in comprehension on the ISIP reading ability assessment. This assessment was utilized with participants to ensure that text selection for intervention was on a
level commensurate with each participant’s score and at an independent reading level. Participants recruited for this study had scores ranging from 240 to 277 in comprehension on the ISIP reading ability assessment.

The investigator used these scores to analyze texts for readability, vocabulary, and decoding. Passages were identified from leveled readers that closely aligned to the topics to help control for external bias and maintain the intervention’s fidelity. The texts chosen for the study covered general topics for eighth-grade social studies content. Text content followed the planned topics based on scope and sequence of general education and the Texas Essential Knowledge and Skills (TEKS, 2014).

The investigator developed a series of eight words for sorting and eight teacher questions based on the social studies passage. The questions were comprised of two questions from each category: who, what, where, what doing/what for which matched the categories on the graphic organizer. The number of questions chosen for this study remained the same as in Bethune and Wood (2103); participants in their study responded to 8 questions. Support for using the same number of questions resulted from each participant’s baseline data. Participants were provided with the graphic organizer template (Appendix D) at the beginning of the session, a reading book for the participant, and a bookmark to track reading if needed for the intervention sessions. Participants’ were also provided with a visual schedule or “to-do” sheet detailing which reading needed to occur and how many questions needed to be answered after the reading. Environmental materials included a chair and desk of appropriate size for each participant and a chair for the interventionist.
Experimental Design

The study used a single-subject multiple-baseline (A-B and generalization) across participants to investigate the impact of a graphic organizer in a staggered phase change design on answering *wh*-questions. A multiple-baseline design presents several advantages. It helps control for threats to internal validity, demonstrates experimental control with three or more data points, and demonstrates experimental control both within a data set and across a series of data sets (Horner et al., 2005). Furthermore, a multiple-baseline design is beneficial for identifying a functional relationship without the need for a reversal (e.g., A-B sequence), and it allows for comparison of an independent variable across participants. There were three phases in the study including baseline, intervention and generalization. Baseline probes were fixed for word-sorting with the graphic organizer in the specialized setting along with fixed baseline probes in the general education setting for answering *wh*-questions without the use of the graphic organizer. Baseline probes for word sorting and general education probes for answering *wh*-questions consisted of at least three data points. Rationale for using a fixed number of data points for word-sorting in the specialized setting was to control for internal threats to validity. It was hypothesized that repeated exposure to the task of word sorting using the graphic organizer had the potential to impact the intervention, as the participants would learn the pattern of the graphic organizer in baseline phase, thus possibly influencing their performance during the intervention phase.

*Baseline Phase*

Baseline for *wh*-questions included at least four data points depicting stable results prior to beginning the intervention phase. The data collection at baseline for answering *wh*-questions
employed a concurrent design with a staggered phase change in the participants’ classrooms. Typical instruction procedures in the school’s general education social studies classroom involved the teacher lecturing on content while the students had access to a note page or summary of reading high points on their desks. Standard practice was for students to read passages or to listen to the lecture and answer *wh*-questions about the content. Thus, baseline procedures consisted of the standard instructional practices without making the graphic organizer present at baseline. Data collection for the baseline phase for *wh*-questions began at the same time for all participants. Once data stability was reached, minimum of 3 data points, for the first participant and intervention was introduced, baseline continued for the remaining participants. This cycle was repeated for participants two, three, and four until the last participant entered the intervention phase.

*Intervention Phase*

Intervention was conducted until change occurred in the measured behaviors. The intervention phase for the second participant began when the data points for the first participant’s intervention phase indicated an upward trend typically evident after 3 to 5 data points. This rolling intervention start was used for the remaining two participants. Intervention sessions were conducted in the same location as the baseline phase.

The interventionists introduced the materials for the lesson at the beginning of each session and stated the topic. This allowed the participants to preview the material for any unknown words and ask questions for clarification. Then, the participants were instructed to read the passage. When the participants were finished, the interventionists provided the index cards
that contained individual words from the reading. The participants were instructed to place the words in one of the four categories on the graphic organizer.

Once the participants had sorted the words (whether correctly or incorrectly) the interventionists presented eight index cards, each containing a question related to the reading. At the end of each session, the interventionists reviewed the number of correct responses with the participants and provided verbal praise for correct answers. Sessions for intervention were conducted weekly.

**Generalization Phase**

Following the conclusion of the intervention phase for the final participant, a final generalization phase consisting of three probes was conducted for each participant. In this phase, participants attended the inclusive general education classroom for social studies, where they participated in the typical lesson format described in the baseline phase, lecture format with note page or reading summary document on their desk. However, given that the participants were skilled at using the graphic organizer, the graphic organizer was presented with word sorting cards to help answer *wh*-questions related to the lesson. Participants completed the generalization phase either in the general education classroom or in a special education classroom following the class period. The general education teachers’ schedules and participants’ comfort levels determined where the sessions were conducted.

**Interventionists**

*Teacher Interventionists*

Two teachers were responsible for providing intervention to the participants. These
teachers were the participants’ current support teachers and were certified in K–12 special education and 4–8 generalist. The female teacher had 14 years of teaching experience while the male teacher had four years of teaching experience. The participants’ special education teachers served as the interventionists for three reasons. First, students diagnosed with autism often respond with heightened anxiety when change occurs. Introducing an alternate teacher who was not familiar to them could have inadvertently and negatively influenced the study’s results. Second, students with autism often have difficulty demonstrating or generalizing skills across settings (Hume, Loftin, & Lantz, 2009). Conducting intervention in the setting where participants were expected to perform the skill regularly could have potentially increased independence and transfer of skills. Third, using the current special education teachers allowed for more flexibility when scheduling intervention sessions, ensured greater communication avenues with the general education teachers, and provided access to materials in a timely manner. Additionally, the special education teachers were on campus on a consistent schedule, which allowed them to establish relationships with campus grade-level staff.

*Interventionist Training*

The investigator trained each teacher responsible for intervention in the following: (a) development and use of the graphic organizer, (b) data collection procedures and (c) steps in the intervention presentation. Training involved a combination of approaches to ensure student understanding and success upon implementation as well as a discussion of presentation of materials. An interventionist was deemed trained following the training session by the investigator if the interventionist was able to model the presentation steps using the protocol as a reference. Both interventionists demonstrated the ability to present the material for intervention
following the protocol in the training session at 100% mastery based on investigator observation. Refer to Appendix B for the protocol. The investigator addressed both nonverbal body language and paraverbal language to maximize the neutral presentation of information. While nonverbal language consists of body language and gestures, paraverbal language refers to a person’s tone, volume, and cadence of speech. Training in paraverbal language was given to minimize unintended teacher influence.

During training, the interventionists had opportunities to ask about the intervention, practice it, and receive feedback on implementing it. Total training time was estimated at 30 minutes per interventionist and was completed prior to initiating intervention with the student participants. Training occurred at each interventionist’s junior high campus during the interventionist’s planning period. Training sessions were recorded electronically on an Apple iPad®.

An instructional specialist employed by the district served as an independent observer and teacher fidelity rater. The independent observer was present for two intervention sessions per participant. Following observation of two sessions, the independent observer then viewed the electronic recording of the training sessions and rated sessions according to the checklist for lesson presentation to ensure fidelity across support teachers (Appendix B).

Data Collection and Analysis

This study measured reading comprehension as the dependent variable. The dependent measure was percent correct. In doing so, it used a graphic organizer designed with four categories corresponding to the topics of the wh-questions asked following a reading passage. Topic headings were; who, what, where and what for. Data obtained for the dependent variable
of answering *wh*-questions were graphed and analyzed. Data obtained for the use of the graphic organizer were also graphed and analyzed including: four probes at baseline, data for all intervention sessions and three probes for generalization. Data analyzed for each session included the following: (1) number of correctly sorted words and (2) number of correct questions answered. Data collection for word sorting involved noting word placement in the graphic organizer. When the participant placed a word in the correct category on the graphic organizer, it was recorded as a correct response by the interventionist. Mastery was operationalized as 80% of words sorted correctly (6 out of 8). Data collection for answering *wh*-questions involved noting responses to questions. Mastery for *wh*-questions answered correctly was operationalized as 80% (6 out of 8). Data from these analyses were graphed using Microsoft Excel. Then, they were visually inspected for level stability and trends, compared to the participants’ baseline measures, and interpreted. Level stability was calculated using the 80% - 20% criteria (Gast, 2010). Based on these criteria, data are considered stable if 80% of the data points fall within 20% of the data range. For each participant, the median was first determined and then the 20% range was calculated. Trend stability was determined using the 80% -20% criteria (Gast 2010). Data was further visually analyzed for immediacy of effect. Effect sizes were also calculated using the Percentage of Non-overlapping Data (PND). Interpretation ranges for effectiveness with PND are: 91% to 100% highly effective, 71% to 90% moderately effective, 50% to 70% minimally effective, and below 50% not effective.

Interobserver Agreement

Interobserver agreement (IOA), defined as the agreement between independent observers on intervention responses, was calculated to ensure integrity of the measurement process. The
investigator served as the primary observer, and an instructional specialist supporting the campus served as the secondary observer. Scoring for sorting took place by the primary observer for 100% of the sessions at baseline. For intervention, the primary and secondary observers were present for 20% of each participant’s sessions. The IOA consisted of four sessions for word sorting and answering \textit{wh}-questions. During the generalization phase, the primary and secondary observers scored three sessions for sorting and answering \textit{wh}-questions. The primary and secondary observers privately recorded correct and incorrect responses of word sorting and answering \textit{wh}-questions.

The IOA for the intervention phase was 100% for all sessions rated. Both the primary and secondary observers indicated 100% agreement for \textit{wh}-questions answered across sessions observed for each participant with each interventionist. During generalization probes, the IOA was also 100%, as both primary and secondary observer indicated 100% agreement for both word sorting and \textit{wh}-questions answered across probe sessions observed for each participant.

Social Validity

A questionnaire was developed to support the work of Reichow, Doehring, Cicchetti, and Volkmar (2011). Six of the seven indicators met by the questionnaire were: (a) consumers are satisfied with results, (b) clinically significant behavior changes are achieved, (c) a socially important dependent variable exists, and (d) the study is time and cost effective (e) independent variable intervention conducted by people who typically come into contact with the participant; and (f) intervention occurred in a natural environment. The only criterion not met was comparison between students with and without disabilities. The questionnaire was distributed to the parents, teachers, and participants at the study’s conclusion. The results of the social validity
questionnaire were analyzed by reporting value ratings on all six questions across audiences. Results were compared according to question and audience.

Results

**Wh-Questions Data Interpretation**

The dependent variable for assessing reading comprehension was using a graphic organizer to answer *wh*-questions. Data were collected on the percentage of questions answered correctly. Data results for answering *wh*-questions mirrored those noted in Bethune and Wood (2013), with participants experiencing an increase in the number of questions answered correctly for during intervention and generalization phases. Prior to intervention, baseline probes were conducted in the general education setting for *wh*-questions. Ethan was the only participant who answered one question correctly in that phase. Overall level and trend stability were calculated using the 80% - 20% rule. Data was labeled as stable if 80% of the data points fell within a 20% range of the individual participants median.

**Jack**

Baseline data for Jack was 0% in the specialized setting and 0% for general education probes. During intervention, data for answering *wh*-questions ranged from 75% to 100%. Jack’s data for the generalization phase probes was 100%. Median for Jack during intervention was 93.9%. Based on the 80% -20% rule at least 6 data points fell within a 20% range (19 +/-) of the median indicating stability for level. Trend data indicated a flat line which it renders the data unstable. However, there was an immediacy of effect upon the introduction of the intervention. The PND score was 100%, which is interpreted as a highly effective effect size.
Kevin

Baseline data for Kevin was 0% in the specialized setting and 0% for general education probes. During intervention, data for answering *wh*-questions ranged from 25% to 62.5%, with an average of 42% overall for intervention. Similar to the data for word sorting, Kevin’s data for answering *wh*-questions was variable. Despite the variability during intervention, Kevin’s data for the generalization phase probes was 100%. Median for Kevin during intervention was 37.5%. Based on the 80% -20% rule only 3 data points fell within a 20 % range (8 +/-) of the median indicating variability for level. Trend data indicated an upward trend which it renders the data stable. There was an immediacy of effect upon the introduction of the intervention. The PND score was 100%, which is interpreted as a highly effective effect size.

Ethan

Baseline data for Ethan was 0% in the specialized setting and 12.5 % for general education probes. Ethan was able to answer one question asked of him in both settings prior to intervention at the time of observation. During intervention, data for answering *wh*-questions ranged from 50% to 100%. Ethan’s data for generalization phase probes was 100%. Median for Ethan during intervention was 100%. Based on the 80% -20% rule only 5 data points fell within a 20 % range (20 +/-) of the median indicating variability for level. Stability would have been met with one additional data point in the 20% range. Trend data indicated a flat line which it renders the data unstable. However, there was an immediacy of effect upon the introduction of the intervention. The PND score was 100%, which is interpreted as a highly effective effect size.
Daniel

Baseline data for Daniel was 12.5% % in the specialized setting and 0 % for general education probes. Daniel was able to consistently answer one to two questions in the specialized setting prior to intervention. During intervention, Daniel answered all *wh*-questions during all sessions yielding 100%. Probes for the generalization phase were also 100%. Median for Daniel during intervention was 100 %., all of his intervention sessions were 100%. Level was deemed stable. Trend data indicated a flat line which it renders the data unstable. However, there was an immediacy of effect upon the introduction of the intervention. The PND score was 100%, which is interpreted as a highly effective effect size.

Table 2 summarizes the percentage of correctly answered *wh*-questions at baseline and intervention, noting mean, median, and range for each participant.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline Mean</th>
<th>Baseline Median</th>
<th>Baseline Range</th>
<th>Intervention Mean</th>
<th>Intervention Median</th>
<th>Intervention Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>90.7</td>
<td>93.9</td>
<td>75 to 100</td>
</tr>
<tr>
<td>Kevin</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>42.25</td>
<td>37.5</td>
<td>25 to 62.5</td>
</tr>
<tr>
<td>Ethan</td>
<td>0</td>
<td>0</td>
<td>0 to 1</td>
<td>87.5</td>
<td>100</td>
<td>50 to 100</td>
</tr>
<tr>
<td>Daniel</td>
<td>1.2</td>
<td>1</td>
<td>1 to 2</td>
<td>100</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

*Note.* Figures are given in percentages.

Word Sorting

Word sorting data was graphed and analyzed. While using a fixed number of data probes at baseline rendered the design for word sorting data as non-experimental, the data indicates variability in sorting during baseline and during the intervention phase for three of the participants. It was anticipated that the *what for* category would be difficult for the participants
due to that category involving more inferencing skill then the other three categories. However, two participants at baseline sorted five of six and six of six respectively and during intervention participants ranged from three of eight to seven of eight correct in the *what for* category. Data for participants during baseline ranged from 0% to 75% for three participants, Daniel sorted from 25% to 87.5% in this phase. Intervention ranged from 75% to 100% for two participants (Jack & Daniel), 87.5% to 100 % for Ethan and 37.5% to 87.5% for Kevin.

Participants all experienced 100% on the generalization phase probes answering for *wh*-questions. Participants were in the general education classroom listening to a teacher directed lesson with a note page on their desk and not being required to read the content themselves.

*Figure 1.* Percentage of correctly answered *wh*-questions.
Triangles represent generalization probes for answering \textit{wh}-questions. Squares represent baseline and intervention responses for \textit{wh}-questions.

Procedural/Implementation Fidelity

This study also examined whether there was a functional relationship between teacher training, implementation of intervention fidelity, and participant success. Evidence shows teachers were trained to implement the intervention. Procedural fidelity measures included data evaluating two components identified in the work of Lynch and O’Donnell (2005). The first component was related to process components, which address the quality of delivery. This fidelity measure was included in the intervention description, as the interventionist received training prior to implementation (Lynch & O’Donnell, 2005). Intervention fidelity was measured through observation using the Fidelity of Implementation Checklist (Table 3), which denoted areas covered in the training of teachers prior to implementation of the intervention. The checklist allowed for consistency of implementation and assessed for procedural fidelity across interventionists during intervention. Two intervention sessions were observed by the investigator and the secondary observer. The investigator and the secondary observer then reviewed the recorded training session independent of each other and scored components using the checklist for implementation. Fidelity of Intervention was achieved at 76.5\% for both interventionists. The observers marked 13 of the 17 steps as \textit{Yes} to indicate the steps were completed by the interventionists. The four steps that were marked \textit{No} were steps related to the use of the “to-do” list. As noted in Table 3, these steps were not needed for the intervention presentation as the participants understood the steps in the task after the first presentation session.
Table 3

*Fidelity of Intervention Implementation Checklist Results*

<table>
<thead>
<tr>
<th>Category</th>
<th>Step</th>
<th>Interv. 1</th>
<th>Interv. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session setup</strong></td>
<td>Place the table and chairs in their proper positions.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Prepare the “to-do” list.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Place the materials for the session (“to-do” list, graphic</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>organizer, and reading text) on the table.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Procedures for beginning</strong></td>
<td>Greet the student.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td><strong>intervention</strong></td>
<td>Present the session topic.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Teacher will state the topic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher will ask the participant to preview material for any</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>unknown vocabulary.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Present the session “to-do” list.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Check for understanding.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher will ask the participant to read the “to-do” list.</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Verbally direct the student to the reading material and graphic</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>organizer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allow the student time to read the passage.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Refer to the “to-do” list to indicate what has been concluded and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>what is next.</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Present 8 cards with words on them for sorting.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Allow the student to sort the cards on the graphic organizer.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Remove the organizer to the side of the work space.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Use the “to-do” list to indicate what is next.</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Ask the student the set of questions.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Record responses as correct or incorrect.</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Refer to the “to-do” list to indicate the conclusion of the session.</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

*Note: Y = yes, N= no. The “to-do” list was not needed for any participants following the initial intervention session.*

All participants understood the process after the first session and were able to sort words on the graphic organizer independently. Answering *wh*-questions increased across all participants during the intervention, which could be correlated to the use of a consistent routine established by the interventionists and the checklist.
Procedural fidelity processes also included measures in the structure of intervention. The following were evaluated (Lynch & O'Donnell, 2005):

(a) adherence to the unit of study—Was the unit delivered as written?
(b) exposure—Were length, time, and skills received as intended?
(c) program differentiation—Were there differences from the standard curriculum?

Data for 20% of the sessions during intervention was assessed. Measures included monitoring the session lesson plans and completed data sheets showing question responses and were analyzed to ensure adherence to the time sequence outlined in the intervention description.

The third area under structure of intervention measures did not present fidelity concerns since the curriculum was state approved for grade-level social studies.

Social Validity

The final research question sought to investigate if the use of graphic organizers assisted students well in an inclusive general education setting. Social validity relates to the acceptability of the goals, methods, and outcomes of treatments by the intervention’s consumers (Wolf, 1978).

The questionnaire was designed to obtain information from the stakeholder groups to address indicators (a) satisfaction and (c) socially important variable exists specifically as identified in Reichow et al. (2011). Indicator (b) significant behavior change, was achieved based on the intervention and outcome results. Additional data answered whether the use of a graphic organizer proved useful to the participants, which further addressed indicators (b) and (c). The overall design of the study addressed the final indicator (d) overall time and cost effectiveness (Reichow et al. 2011).

The questionnaire received an 80% return rate (8 out of 10). All four participants, both interventionists, and two parents completed their questionnaires. Overall results from participants
indicated that they felt the intervention was explained well (2) or explained pretty well (2). Three of the participants indicated that the intervention was very important to them in comprehending reading passages in social studies content. The fourth participant indicated it was somewhat important to comprehending reading passages. Teachers reported high satisfaction in all areas for the intervention and high value in the intervention continuing to make a difference in comprehension. One teacher reported very satisfied with the overall intervention results and both teachers reported yes on positive progress with continued intervention. Both parent results indicated that the intervention would continue to make a difference in comprehension, saw importance of using the intervention to teach comprehension and that their child had expressed frustration with school work in the past every now and then. Results analysis suggests that using graphic organizers in an inclusive general education classroom for students with ASD yields high social validity in six of the seven criteria identified by Reichow et al. (2011).

Discussion

The purpose of this study was to expand upon the existing research in reading comprehension for students with autism. Specifically, the degree of impact of graphic organizers on reading comprehension as measured by answering wh-questions in social studies content. This study aimed to provide evidence that supported the use of graphic organizers in content areas other than reading to benefit students with ASD in successfully gaining knowledge and skills in a variety of core content classes. Results of the data gathered for the three research questions demonstrated graphic organizers have the potential to help students with ASD understand content more successfully, that teacher training on implementation of the strategy
may impact student success, and teachers, participants and parents see the strategy as holding relatively high social validity.

The first question hypothesized whether there was a functional relationship between the use of graphic organizers and reading comprehension measured by evaluating the answering of wh-questions in grade level social studies content for students with autism. The intervention yielded increases for all participants in answering wh-questions. These results support similar findings by Bethune and Wood (2013), Iguatova (2013), and O’Conner and Klein (2004). Those studies specifically measured the answering of questions related to text and found functional relationships between the use of graphic organizers and correct responses to questions. A strength of this study is evidenced by the immediacy of effect seen with all four participants with the introduction of the intervention phase. Lastly, effect sizes for all four participants using PND criteria was 100% supporting strength for the intervention.

The second research question addressed whether teachers could be trained to implement the intervention with fidelity. Findings indicated teachers were trained and utilized the checklist for intervention with 76.5% fidelity (13 of 17 steps). All four participants learned the sequence of the intervention after the first session, and three participants (Ethan, Jack, and Daniel) were able to set up the intervention with no teacher prompting and work independently through the sessions after the second session, Kevin required verbal prompting to begin reading through the fourth session. Four of the seventeen steps on the Fidelity of Intervention Implementation Checklist were marked No, resulting in decreased fidelity, yet should be interpreted as a strength for this study. The participants showed early in the intervention that they did not require the “to-do” list, to continue to present these steps had the potential to feel unnatural to the interventionists and participants. Presenting interventions that are not cumbersome or have
unnecessary steps is an important consideration, as it has the potential to make the intervention more desirable to implement. While fidelity of intervention implementation may have measured less, overall satisfaction and ease of intervention was strengthened with the deletion of the four unnecessary steps.

The final research question addressed whether participants, parents, and teachers found the use of graphic organizers in an inclusive setting for students with autism as socially valid. Utilizing the components identified in the research of Reichow et al. (2011), results received from the three groups indicated strong social validity for the intervention. This study showed a number of strengths including an easy to implement intervention, required little to no time or materials, resulted in immediacy of effect in behavior change and all stakeholders reported as valuable to student success.

Implications for Practice

Previous research has shown that students with disabilities struggle with understanding grade-level texts well enough to comprehend what is being addressed in reading passages, especially in the social sciences (Hall et al., 2013; Jitendra & Gajria, 2011). Research has also suggested that students with autism often have difficulty constructing mental models from informational text due to impairments in receptive and expressive language. These language impairments negatively influence their ability to comprehend key factors while reading (Murza et al., 2014; Williamson et al., 2015). One of the primary findings of this study indicated an increase in comprehension of grade-level text when graphic organizers were utilized. A second finding that is a strength of this study is the use of teachers who have relationship with the students as the interventionists. Having current teachers implement the intervention supports the
ability to sustain the use of the intervention over time in general education inclusive settings. Additionally, findings also showed high social validity for the intervention, with relatively low teacher preparation and training required. By incorporating the intervention into a teacher’s existing planning time, it has the potential to be highly beneficial for students with autism while minimizing the additional strain on teachers’ planning processes for lesson preparation.

Limitations and Directions for Further Research

There were limitations associated with this study. First, the participant pool was small which limited the generalizability to the larger public. Future research may consider replicating the study to increase the participant pool or perhaps include other disability categories to determine how the current findings translate to other populations. Additional limitations involved collection of baseline probes for word sorting and the unexpected delay in collecting the generalization probes. Rationalizing the threat of repeated exposure to the graphic organizer in baseline, determining to use a fixed number of data points, and rendering word-sorting data as a non-experimental design is a potential weakness of this study. Future researchers may want to extend this study by collecting data at baseline for both tasks using concurrent measures and not employing two methods of data collection for that phase. An additional area for future research is to conduct intervention probes following the conclusion of the intervention sessions.

A limitation is also noted in the generalization phase due to the state and district testing calendar for STAAR and the general education teachers’ schedule, probes were not collected until some weeks following the conclusion of the intervention. The varying FIE dates; comprehensiveness of evaluation summaries; and tools used for assessing the components of autism, language, cognitive abilities, and achievement among the participants presented a
difficulty in describing participants in a consistent manner presented a limitation. Future studies may benefit from conducting an assessment component prior to intervention to provide more consistent participant characteristics.

The intervention relied on the use of one visual support only, specifically a graphic organizer, which did not allow for a results’ comparison for the use of different visual supports. As students with autism continue to have access to inclusive settings, it will be important for researchers to continue to extend the work of Kim et al. (2004) by conducting investigations using cognitive mapping or mnemonic devices. An additional consideration for future researchers would be to replicate the use of the graphic organizer using the intervention of having the students answer wh-questions following the hearing of content to see if the generalization phase probes found in this study were possibly explained by listening to content and not having to perform the task of reading for understanding. Final avenues for future research would be to utilize a different visual support in a content other than social studies and with varying ages of students to provide direction on implementation for practitioners across multiple content and grade levels. Addressing research questions that incorporate best practices from multiple sources and providing practitioners with concrete tools that have the possibility to assist in authentically engaging students with ASD in their classroom and content areas holds promise closing the research to practice gap. Closing this gap with socially valid strategies that are not time consuming to develop, to train, or to implement has the potential to increase a teacher’s willingness to use those strategies for students with autism.

References

*Denotes studies included in the synthesis.*


APPENDIX A

CONSENT FORMS
Parent Informed Consent Form

Before agreeing to your child’s participation in this research study, it is important that you read and understand the following explanation of the purpose, benefits, and risks of the study and how it will be conducted.

Title of Study: Effects of Graphic Organizers for Building Comprehension in Students on the Autism Spectrum

Investigator: Karin (Karen) Ruth Kliemann, University of North Texas (UNT) Department of Educational Psychology

Purpose of the Study: You are being asked to allow your child to participate in a research study that involves teaching your child to use a graphic organizer to assist in understanding topics in grade-level social studies. A graphic organizer is a visual chart designed to organize a student’s knowledge or ideas. For this study, the graphic organizer will be designed to help your child answer *wh*-questions about topics being studied in their general education classroom. The goal of this study is to increase your child’s abilities and skills in comprehending social studies content to a greater degree by providing them with a graphic organizer to sequence and process their knowledge.

Study Procedures: Your child will be asked to participate in a series of 30-minute lessons with their specialized support teacher. Lessons will focus on grade-level social studies content using reading material at your child’s reading level. Your child will be asked to read a passage in a book and then sort vocabulary from that reading into one of the following categories: who, what, where, and what doing (these will be the graphic organizer). Once your child has sorted the vocabulary, the teacher will ask eight questions related to the reading and vocabulary.

Lessons will be three days a week during your child’s special education time as agreed upon by your ARD committee. It is anticipated that lessons will last for a six- to eight-week time period.

Foreseeable Risks: The potential risks involved in this study may include minor frustration experienced by your child if answers are perceived to be incorrect. Should signs of frustration be present, your child will be offered a break with a preferred activity. Lessons will continue when your child has returned to a conducive learning state. No other foreseeable risks are involved in this study.

Benefits to the Subjects or Others: The project may benefit your child by increasing self-esteem and confidence with participating in general education social studies content through the use of employing a graphic organizer.

Compensation for Participants: None

Procedures for Maintaining Confidentiality of Research Records: The confidentiality of your child’s individual information will be maintained in any publications or presentations regarding this study by using pseudonyms for reporting results.
Questions about the Study: If you have any questions about the study, you may contact Karin Kliemann at [omitted] or [omitted].

Review for the Protection of Participants: This research study has been reviewed and approved by the Arlington ISD Research Review Board and UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-4643 with any questions regarding the rights of research subjects.

Research Participants’ Rights: Your signature below indicates that you have read or have had read to you all of the above, and that you confirm all of the following:

- Karin Kliemann has explained the study to you and answered all of your questions. You have been told the possible benefits and the potential risks of the study.
- You understand that you do not have to allow your child to take part in this study, and your refusal to allow your child to participate or your decision to withdraw your child from the study will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your child’s participation at any time.
- You understand why the study is being conducted and how it will be performed.
- You understand your rights as the parent/guardian of a research participant, and you voluntarily consent to your child’s participation in this study.
- You have been told that you will receive a copy of this form.

__________________________                                _______________
Printed Name of Parent      Date

__________________________                                _______________
Signature of Parent      Date

__________________________                                _______________
Signature of Investigator      Date

For the Investigator or Designee: I certify that I have reviewed the contents of this form with the parent or guardian signing above. I have explained the possible benefits and the potential risks discomforts of the study. It is my opinion that the parent or guardian understood the explanation.

__________________________                                _______________
Signature of Investigator or Designee      Date
**Child Assent Form**

You are being asked to be part of a research project conducted by the University of North Texas (UNT) Department of Educational Psychology.

This study involves using a graphic organizer to assist in understanding social studies. A graphic organizer is a visual chart designed to help organize your ideas. The graphic organizer is designed to help you answer *wh*-questions about particular topics being studied in your general education classroom. The goal of this study is to increase your skills in understanding social studies.

You will be asked to participate in a series of 30-minute lessons with your specialized support teacher. You will be asked to read a passage in a book and then sort vocabulary from that reading into one of the following categories: who, what, where and what doing (this will be the graphic organizer). Once you have sorted the vocabulary, your teacher will ask you eight questions related to the reading and vocabulary.

If you decide to be part of this study, please remember you can stop participating any time you want.

If you would like to be part of this study, please sign your name below.

________________________________________

Printed Name of Child

________________________________________

Signature of Child

Date

________________________________________

Signature of Investigator

Date
APPENDIX B

TRAINING COMPONENTS
Introduction

Overview of research question and design

Overview of intervention format

Graphic Organizer Intro

Rationale for using graphic organizer

Research on benefits for graphic organizer

Paraverbal, Nonverbal Body Language Explanation

Definition

Examples and nonexamples

Modeling of Intervention Presentation

Process for Practice with Feedback

Checklist for Lesson Presentation

Greet the student and present the topic.

Present and explain the “to-do” list for the session.

Check for understanding.

Present the reading material and graphic organizer for the session.

Allow the student time to read the selection for the session.

Refer to the “to-do” list to indicate where you are now in the session.

Present 8 cards with words on them for student to sort onto the graphic organizer.

Once sorted, remove the graphic organizer with cards intact to the side of the workspace.

Refer to the “to-do” list to indicate where you are now in the session.

Ask the student the set of *wh*-questions.

Allow the student to answer verbally.
Record responses as correct or incorrect.

Refer to the “to-do” list to indicate the conclusion of the session.
APPENDIX C

PRISMA FLOWCHART (MOHER ET AL., 2009)
Records identified through database searches
\( (n = 42) \)

Additional records identified through other sources
\( (n = 0) \)

Records after duplicates removed
\( (n = 42) \)

Records screened
\( (n = 42) \)

Records excluded
\( (n = 29) \)

Full-text articles assessed for eligibility
\( (n = 12) \)

Full-text articles excluded, with reasons
\( (n = 1) \)

Studies included in qualitative synthesis
\( (n = 11) \)

Studies included in quantitative synthesis (meta-analysis)
\( (n = 1) \)
APPENDIX D

SAMPLE DATA COLLECTION TOOL FOR PLACING CARDS ON GRAPHIC ORGANIZER
Student name__________________ Teacher__________________

Place an X in either the YES or NO column based on student response.

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<th>Date &amp; Time</th>
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Sample Data Collection Tool for Answering *Wh*-Questions from Content

Student name__________________ Teacher_____________________

Place an X in either the YES or NO column based on student response.

### Answering WHAT Question

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### Answering WHO Question

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### Answering WHERE Question

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### Answering WHAT DOING/WHAT FOR Question

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APPENDIX E

GRAPHIC ORGANIZER SAMPLE
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<th>What Doing / What For</th>
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APPENDIX F

INCREASING READING COMPREHENSION SKILLS FOR STUDENTS WITH AN AUTISM SPECTRUM DISORDER: A LITERATURE SYNTHESIS
To understand the intricacies involved in increasing reading comprehension skills for students with autism spectrum disorder (ASD) it is imperative to first capture what the diagnosis of ASD brings to the equation. Psychologists Leo Kanner and Hans Asperger were the first to write about persons they were working with who had what they referred to as autistic characteristics. Wing and Gould (1979) enriched our understanding by describing impairments associated with ASD as a “triad of impairments” that affects the areas of social language and communication, social interaction, and social imagination.

**Triad of Impairments**

Social language and communication impairments are often reflected both expressively and receptively. Expressive impairments include the inability to effectively communicate wants or needs, a monotone or flat affect, and poor nonverbal communication skills (Cashin & Barker, 2009). Receptive impairments are often related to the inability to interpret social nuances (including another person’s facial expressions), tone of voice, abstract language, or use of homographs and idioms in written and spoken context (Cashin & Barker, 2009). Difficulties in receptive skills such as understanding idioms and irony in oral language have shown to negatively influence reading comprehension, especially of narrative texts (Williamson, Carnahan, Birri, & Swoboda, 2015). Receptive and expressive language impairments negatively influence reading comprehension because students with an ASD typically have difficulty constructing mental and situational models from information in text, an ability that involves integrating text with prior knowledge (Murza, Nye, Schwartz, Ehren, & Hahs-Vaughn, 2014; Williamson et al., 2015).
These difficulties with understanding hidden social nuances have an impact on students’ social interactions, the second area of impairment in the ASD triad. Social interaction impairments are closely associated with issues related to language, communication, and the reading of social nuances; which are difficulties associated with theory of mind (Cashin & Barker, 2009). Social interaction impairments are closely associated with issues related to theory of mind (Cashin & Barker, 2009). Theory of mind relates to the inability to understand situations from another perspective. Students on the autism spectrum struggle with understanding different perspectives. This can lead to difficulty in social situations, as students are unable to “read” the thoughts and feelings of others and understand how they influence actions (Cashin & Barker 2009; Carnahan, Williamson, & Christmas, 2011; Frith, C and Firth, 2006; McKinney, Simpson, & Rose, 2013). These inabilities translate to difficulties in reading comprehension as students are unable to make inferences.

A companion theory was formulated by Frith (1989). Termed central coherence theory, it reveals that students on the autism spectrum do not automatically regard complex text as a coherent whole; they see it as separate parts, thus making it difficult to draw conclusions. Further, central coherence theory advocates that inflexible cognitive processes may lead to complications in interpreting meaning from context-dependent text (Roux, Dion, Barrette, Dupéré, & Fuchs, 2015). For example, pronouns present difficulties to students with ASD because they struggle to understand whom the pronoun refers to based on the context in which it is used (Roux et al., 2015). Consider the pronoun she in the following two sentences: Mary likes to run. She goes to the park. identifying who “she” is can be problematic for students with ASD.

Because of the triad of impairments, difficulties with theory of mind, and possible weaknesses in central coherence, students on the autism spectrum face challenges in reading
comprehension that include making inferences, understanding character development, and understanding character motivation with information that is nonfactual (Carnahan et al., 2011).

Inflexibility presents further challenges for students with ASD in social imagination, the third impairment in the triad. Social imagination, sometimes referred to as behavioral inflexibility, relates to the inability to problem solve, predict events, adjust to changes, and illustrate varied and flexible interests (Autism, n.d.; Cashin & Barker, 2009; Gina, 2010). Reading difficulties can arise in students experiencing social imagination impairments due to inflexible thinking patterns and literal thinking styles. For example, students on the autism spectrum may not understand how a character solves a problem if the problem or solution does not align with their particular way of seeing the world. A character that must determine a choice based on events in the story may pose problems for students on the autism spectrum if their thinking processes differs from how the character sees the events. Additionally, with limited or unvaried interests, students on the autism spectrum may lack the motivation to learn to read or discern the rules necessary for understanding the components of reading (Gina, 2010).

Approaching the task of reading comprehension from the framework of how the disability effects students is therefore imperative if practices are to be developed that increases the success for students on the autism spectrum.

Reframing the Triad

Within the last decade, Cashin and Barker (2009) have proposed redefining the triad of impairments to focus more on cognitive processes that are affected by ASD. Cashin and Barker (2009) define the triad in terms of impairments with linguistic processing, thinking in abstraction, and regulating communication and social context (making inferences). While Cashin
and Barker come from the medical nursing field, this perspective has implications educators should consider in regard to the difficulties students on the spectrum experience with reading comprehension.

Linguistic processing involves the ability to formulate concepts based on a person’s understanding and use of language. Students on the autism spectrum are more concrete and visual processors, which potentially limits their understanding of concepts (Cashin & Barker, 2009). Researchers suggest that language delays typically experienced by individuals on the autism spectrum create difficulties in semantic processing but not necessarily in language impairment. This finding holds promise that some students on the autism spectrum may have the ability to learn to better process linguistic information with targeted interventions (Randi, Newman, & Grigorenko, 2010).

The ability to think in abstraction allows a person to draw on previous experiences and information from context to interpret the world or text. Students on the autism spectrum often lack the internal systems to unify past experiences into useable categories for future learning and relating to new content (Cashin & Barker, 2009). Difficulty with abstraction presents difficulties in reading comprehension due to the inability to make inferences. Drawing inference involves the ability to make conclusions based on circumstantial evidence or prior conclusions. Randi et al. (2010) reported that students on the autism spectrum struggle with inference perhaps due to relying more on concrete details rather than on more abstract attributes.

Impairments in linguistic processing and the ability to think abstractly do not impact just the ability to understand perspectives—they also hinder the ability to incorporate new or novel information into existing information for the formulation of new ideas (Cashin & Barker, 2009). The inability to readily see another’s perspective proves problematic in reading comprehension.
when determining text purpose and communicative intent as well as when interpreting problems, solutions, and themes (Randi et al., 2009, Roux et al., 2015).

Clearly the social and cognitive impairments that accompany ASD present barriers for students in not just engaging with academic texts, but with interfacing with the world at large as well (Murza et al., 2014; Randi et al., 2009). Being knowledgeable about the impairments a diagnosis of autism brings to the equation alone, however, is not enough to impact change for students on the autism spectrum. Educators must also commit to intentionally planning and instructing students in ways that allow for students on the autism spectrum to flourish socially, cognitively, and academically. Thus, it is critical for educators to familiarize themselves with the complexity of the components involved in reading comprehension so they may best address and assist all students, including those on the autism spectrum, in developing reading comprehension skills.

Components of Reading Comprehension

Due to the complexity and multifarious nature of the components involved in reading comprehension, students on the autism spectrum have historically struggled with it (Nation, 2001). Reading comprehension involves many component skills for making meaning of text (National Reading Panel [NRP], 2000). Orthographic knowledge, phonemic knowledge, and word recognition are foundational skills for all students in learning to read. However, those skills alone are not adequate for successful reading comprehension (Nation, 2001). Randi et al. (2010) stated the following about reading comprehension:

skilled text comprehension is a complex process that depends on knowing the meaning of words, in addition to such skills as analyzing syntactic and semantic structures of word combinations, drawing upon one’s background knowledge to interact with the topic of
discourse, applying logical inferential abilities, and relying on metacognitive structures, such as self-monitoring. (p. 891)

The NRP (2000) identified seven strategies found to have “a firm scientific basis” for improving comprehension in readers without disabilities: (a) comprehension monitoring; (b) cooperative learning; (c) graphic organizer; (d) question answering; (e) question generating; (f) story structure; and (g) summarization.

Comprehension monitoring involves a metacognitive process of thinking about the act of reading while one is reading. Specifically, it involves being aware of and checking whether a person understands what is being read and is taking appropriate actions when a breakdown in reading the text occurs. Cooperative learning refers to an instructional model that has students engaged in working together on a common task, typically in small groups or pairs. Graphic organizers are visual templates or diagrams that provide an external means to assist learners in organizing ideas and constructs. Question answering is an intentional, focused process intended to assist students in learning the procedures for answering questions. Question generation teaches students to pose and answer questions while they are reading. Story structure is a visual structure intended to provide a sequence or time line of events for the readers. Summarization allows readers to learn to generalize the text and identify main idea (NRP, 2000). Though these strategies have been found effective in improving reading comprehension outcomes in the general population of readers, little is known about their effectiveness with students on the autism spectrum.

Purpose of the Literature Synthesis

Much of the existing research around reading comprehension and students on the autism spectrum focuses on spelling, writing, and direct instructional practices involving mixed grade
levels at the elementary level (Spencer et al., 2014). Research at the secondary level targets specific strategy instruction in content areas and is currently very sparse (Spencer et al., 2014). While evidence-based practices have been identified in the field of autism by the National Autism Center (NAC, 2009) and concurrently by the National Professional Development Center on Autism Spectrum Disorder (NPDC, 2014), these practices are not specifically related to reading comprehension in content areas. Thus, the purpose of the current literature synthesis is to expand the work of the NRP and Randi et al. (2010) by asking the following question: Which evidence-based reading comprehension strategies affect increases in reading comprehension skills for students on the autism spectrum? Analyzing the skills and strategies involved in learning to read for comprehension has tremendous potential to impact the social, cognitive, and academic success of students on the spectrum.

Method

Search Procedures

This search was developed to serve as an extension of the work done by Randi et al. (2010) to better understand the possibilities and challenges of teaching reading comprehension to students on the autism spectrum. An electronic database search was conducted in EBSCOhost using Academic Search Complete, Education Source, Primary Search, Professional Development, PsycINFO, and Teacher Reference Center. The following search terms were entered: autism and reading comprehension. The terms yielded 342 total articles, which became 217 articles when duplicates were removed. Of this 217, 40 articles were saved for coding. Articles that did not include participants with an autism diagnosis or did not target reading comprehension were excluded from coding. A second search was conducted using the following
terms: *ASD* and *reading comprehension*. The second search returned 162 articles, 82 of which were duplicates from the first search. Of the 80 new articles identified in the second search, 4 articles were saved for coding after abstract-level review.

Early decisions for inclusion were made by reviewing the article abstracts based on inclusionary criteria. If the abstract included discussion of reading instruction and participants on the autism spectrum, then the full article was read and coded. Of the 44 articles coded for inclusion, 24 met criteria for final analysis. See Figure F.1 for a flowchart of procedures for the study identification.

Inclusion/Exclusion Criteria

Articles for inclusion in this analysis met four criteria:

(a) Each study included at least one participant between the ages of 5 to 17 with a diagnosis of autism. The diagnosis was either indicated as autism specifically or as ASD.

(b) Research design included single-subject, pretest-posttest, or a control group comparison.

(c) Studies reflected a 20-year time span with publication between 1995 and 2015. The 20-year span was chosen to focus on more recently published research, while also honoring the work spanning two decades.

(d) Criteria for inclusion required that studies had a focus on reading comprehension through either single or multiple interventions or through comprehension outcome.

Exclusion criteria included the following: literature reviews, literature syntheses, or meta-analyses. In addition, studies targeting other reading or literacy skills without including a comprehension component or articles targeting informational aspects for practitioners were excluded.
Coding

Of the original 44 articles, 9 articles were randomly selected and coded for inter-rater reliability for inclusionary/exclusionary criteria by a trained graduate student in the field of special education. The following information was coded for all studies included in this analysis:

(a) Demographic: Participants’ gender, age, and disability

(b) Methodological: Research design employed and reading skills targeted

(c) Intervention characteristics: Intervention type, frequency, and length

Prior to coding the 9 articles, the first coder (primary coder) trained the second coder in how to extract the data and code. Training occurred using 2 articles not originally selected for independent reliability purposes. Training produced 100% agreement between both coders.

Inter-rater agreement was computed by calculating the number of agreements divided by the total of agreements plus disagreements and multiplying by 100. Agreement between coders was 100% for all categories across the 9 randomly selected articles. Additionally, inter-rater reliability was conducted on 7 of the 24 articles selected for inclusion with agreement between coders at 100% for all categories.

Results

Participants

A total of 1,299 participants were represented across the 24 studies included in this review. Treatment samples ranged from 3 to 384.

Males represented the majority of participants ($n = 715, 55\%$) for studies reporting gender. Of the 24 studies, 7 studies (29%) did not specify gender (Asberg & Sandberg, 2010; Davidson & Weismer, 2014; Lucas & Frazier-Norbury, 2015; Murray, 2008; Reutebuch et al., 2015; Roux et al., 2015; Williamson et al. 2012).
Seventeen of the studies reported participant age ranges. Six of the studies reported age as a mean age format. Four studies included participants as young as 5.5 or 6 years of age. Eight of the studies conducted intervention with participants under 11 years of age. Seven studies involved participants 11 to 17 years of age, while the remaining 9 studies included participants under 11 and up to 16 years of age.

Twenty of the studies investigated participants categorized as having ASD based on criteria from the American Psychiatric Association (1994 or 2000) *Diagnostic and Statistical Manual of Mental Disorders* (DSM–IV–TR). Of the 20 studies, 3 studies also included participants with additional disabilities outside of the autism spectrum. Specifically, Flores and Ganz (2009) and Flores, Nelson, Hinton, and Franklin (2013) included participants with developmental delay (DD), and Huemer and Mann (2011) included a comparison group of 100 participants meeting criteria for dyslexia and autism. Asperger’s syndrome was the participants’ diagnosis in 3 of the studies investigated (i.e., Murray, 2014; O’Conner & Klein, 2004; Smith-Myles, Hilgenfeld, Barnhill, Griswold, Hagiwara, & Simpson, 2002) and the final study used criteria from the World Health Organization for diagnosing autism (Nation, Clarke, Wright and Williams, 2006). See Table F.1 for Intervention Characteristics Summary.

Design

*Pretest-Posttest Design*

A pretest-posttest research design was conducted by almost half of the studies (*n* = 12). Testing locations varied, ranging from a typical classroom or quiet room at school to settings on university campuses, community centers, or individual homes.
Eleven of 12 studies reported treatment duration. Six of the 11 studies reported duration of sessions from 20 minutes to 70 minutes (Asberg & Sandberg, 2010; Cronin, 2014; Flores et al., 2013; Henderson, Clarke, & Snowling, 2014; Iguatova, 2013; Lucas & Frazier-Norbury, 2015), while 3 studies reported durations ranging from 1½ hours to 2 hours (Huemer & Mann, 2010; Lucas & Frazier-Norbury, 2014; Nation et al., 2006).

Frequency of intervention was reported by 9 of the studies. Six of the pretest-posttest designs conducted testing across 1 or 2 sessions (Cronin, 2014; Davidson & Weismer, 2014; Henderson et al., 2014; Huemer & Mann, 2010; Lucas & Frazier-Norbury, 2014; Nation et al., 2006). The remaining 3 studies conducted intervention for 3 or more sessions (Asberg & Sandberg, 2010; Flores et al., 2013; and Lucas & Frazier-Norbury, 2015).

Overall, the pretest-posttest designs found that students with an ASD performed lower on measures for comprehension and inference than same-age, typically developing peers and peers diagnosed with dyslexia or with autism and language impairments. Davidson and Weismer (2014) found that early language appears to be a predictor of successful reading skills, and Lucas and Frasier (2015) supported this with findings that display early oral language development as a strong predictor of successful inferencing and reading comprehension. Findings also supported stronger reading comprehension for students who exhibited higher nonverbal cognition and social behavioral cognition (Davidson & Weismer, 2014; Lucas & Frasier, 2015).

In evaluating students with Asperger’s syndrome, Smith-Myles et al. (2002) found that participants performed below grade level on silent reading and independent reading tasks as measured by the Classroom Reading Inventory (CRI, 1998). Further findings reported that instructional and frustration reading levels were on grade level (Smith-Myles et al., 2002). Instructional levels of reading are commonly defined as the highest level at which a student can
read with little or no errors and has adequate background knowledge for the topic to be understood. Frustration levels in reading are typically defined as those levels in reading that require extensive assistance for the student to read and understand. While the setting was not indicative of a typical classroom and the sample size was small (16), having instructional and frustration levels on grade level could pose difficulties for teachers in choosing texts for students on the spectrum. The texts would need to provide a learning challenge without being overwhelming because the variance is so small between the student being able to effectively read and the student becoming frustrated with the reading.

A final notable conclusion of the pretest-posttest designs is that 2 studies found support for the hypothesis that students on the autism spectrum can improve skills in reading comprehension and inferencing through the use of targeted interventions (Asberg & Sandberg, 2010; Flores et al., 2013).

**Designated Control Group**

Eight studies investigated interventions testing both students on the autism spectrum (treatment group) and a designated control group. Henderson, Clarke, and Snowling (2014); Jacobs and Richdale, (2013); and Saldana and Frith (2007) investigated interventions using typical peers. Henderson et al. (2014) and Saldana and Firth (2007) matched the treatment group ($N = 49$, $N = 16$, respectively). Henderson et al. (2014) participants were matched approximately on gender (control was 44/49 male; treatment was 47/49 male) and group-matched on age. Saldana and Frith matched control and treatment groups for chronological age and scores for standard word reading and receptive vocabulary on the British Picture Vocabulary Scale, Second

Duration of intervention for the control group designs ranged from 30 minutes to 240 minutes and were not reported by Norbury and Nation (2010) or Saldana and Firth (2007). Frequency of intervention ranged from as few as 1 session per week to as many as 5 sessions per week and were not reported by Norbury and Nation (2010) or Saldana and Firth (2007). Sessions ranged from 1 session per week to 3 sessions per week for 16 weeks.

Henderson et al. (2014) and Jacobs and Richdale (2013) showed mean scores falling lower for students on the autism spectrum than for typical peers. Henderson et al. (2014) assessed reading comprehension using the Neale Analysis of Reading Ability (Form-B, NARA-II, Neale, 1997), while Jacobs assessed using Woodcock Reading Mastery Tests–Revised, Form G (WRMT-R) and the Neale Analysis of Reading – Third Edition (Neale-III). Results for Henderson et al. (2014) specified \( M = 79.88 \) for students on the autism spectrum and \( M = 103.53 \) for typical peers. Likewise, Jacobs (2013) reported \( M = 99.83 \) for students on the autism spectrum and \( M = 101.8 \) for typical peers. Effect size for Henderson et al. (2014) was \( d = 2.03 \), a very large effect, while calculated effect size for Jacobs and Richdale (2013) was \( d = 0.168 \), a small effect.

Huemer and Mann (2010) and Lucas and Frazier-Norbury (2015) conducted the pretest-posttest with a control group. Findings supported students on the autism spectrum experiencing more difficulty with text comprehension when compared to a control group. Calculated effect sizes for Huemer and Mann (2010) employed a control group of participants with a diagnosis of dyslexia to participants with autism (\( N = 171 \)), participants with Asperger’s syndrome (\( N = 94 \)), and participants with pervasive developmental disorder (PDD) (\( N = 119 \)). Effect sizes were \( d = \)
1.26, \( d = 0.389 \) and \( d = 1.03 \), respectively. The studies purported very large effects for participants with autism and PDD compared to the control group and medium effects for participants with Asperger’s syndrome on reading comprehension scores.

Norbury and Nation (2010) tested interventions with a treatment group of 14, a control group consisting of typical peers (\( N = 19 \)) and an additional group defined as having ASD and language impairment (\( N = 13 \)). Findings supported a previous research hypothesis: Students with oral language deficits present with difficulties in reading comprehension along with students who have a diagnosis of autism.

Similarly, difficulties in reading comprehension are seen among students who are not on the autism spectrum but so have language impairments (Catts, Adlof, & Ellis-Weismer, 2006; Nation et al., 2004; Norbury & Nation 2010). Calculated effect sizes for Norbury and Nation (2010) revealed \( d = 1.35 \) for interactions between word decoding and reading comprehension, which is a very large effect between both treatment groups and the control group. Roux et al. (2015 a.b.) found moderate to large effect sizes (\( d = 0.66 \)) for students in the intervention group when compared to the control group (participants on the spectrum randomly assigned) in retelling of text, answering questions, and receiving no instructed vocabulary words.

**Single-Subject Design**

Single-subject design or a variation of this design represented 6 of the studies (Bethune & Wood, 2013; Flores & Ganz, 2009; Murray, 2008; O’Conner & Klein, 2004; Reutebuch et al., 2015; Smith-Myles et al., 2002; Williamson et al., 2015). Overall, results suggested promising outcomes for students on the autism spectrum when provided with direct instruction; visual tools; and intentional instruction that employs aspects of scaffolding, cueing, and collaborative
interactions (Bethune & Wood, 2013; O’Conner & Klein, 2004; Reutebuch et al., 2015; Williamson et al., 2015). The final study—Williamson, Carnahan, and Jacobs (2012)—had participants record think-aloud procedures later coded by researchers listening to the results. This study was coded as “other.”

Targeted Skills

Every study included for this review measured reading comprehension outcomes and reported various levels of performance. Bethune and Wood (2013), Iguatova (2013), and O’Conner and Klein (2004) specifically measured participants answering questions related to text. They found functional relationships between the use of graphic organizers and correct responses to questions as well as graphic organizers and the strategies of answering prereading questions, using cloze reading, and using cueing. Asberg (2010), Jacobs and Richdale (2013), and Huemer and Mann (2010) measured decoding and comprehension skills to demonstrate that reading interventions can have positive outcomes addressing deficits connected with a spectrum disorder. In addition to reading comprehension, Davidson and Weismer (2014) included alphabet knowledge, while Cronin (2014) and Rickets et al. (2015) included oral language measures. Roux (2015 a. b.) and Williamson et al. (2012) measured vocabulary meaning, and Smith-Myles et al. (2002) measured listening skills and silent reading comprehension, both of which added to previous research findings that support an improvement in reading comprehension for students on the spectrum when utilizing specific strategies and visual components to assist in understanding.
Interventions and Outcomes

The report from the NRP (2000) was used as the backdrop for interpreting the results of the 24 studies investigated. None of the studies employed the strategies of cooperative learning or summarization. Comprehension monitoring, question/answer, question generation, use of graphic organizers, and story mapping are the strategies the NRP (2000) report found in the included studies involving participants on the spectrum.

Comprehension Monitoring

Reutebuch et al. (2014) adapted and piloted a program, Collaborative Strategic Reading (CSR)-HS, which included processes for comprehension monitoring. The CSR process developed by Vaughn, Roberts, Klingner, Swanson, Boardman, Stillman-Spisak et al. (2013) was composed of strategies for previewing the text, interacting with the text during reading, and interacting with the text after reading. The strategies involved activating prior knowledge, applying fix-up strategies, identifying most-important information, and generating questions following the reading. Findings reported a 50% to 100% accuracy during intervention and a 75% to 100% accuracy at maintenance for the comprehension scores of two participants (Reutebuch et al. 2014).

Question-Answer Relationship

Of the 24 studies, 16 studies employed a Question-Answer relationship strategy as intervention for reading comprehension.

Small effects were calculated for Lucas and Frazier-Norbury (2014, 2015) on the NARA-II when comparing treatment group of autism with control: $d = 0.270$ and $d = 0.118$, 

75
respectively. Conversely, very large effects were calculated when comparing a treatment group of autism with language impairment \((d = 2.40)\), a treatment group of no autism with language impairment \((d = 2.79)\), and a control group, \((d = 2.04)\) (Lucas & Frazier-Norbury, 2014, 2015).

Iguatova (2013), O’Conner and Klein (2004), and Rickets et al. (2013) designed interventions that involved having the participants respond to questions following the reading of different texts. Rickets et al. (2013) reported variance across data measures for participants using regression analysis \(R^2 = 0.03\). Iguatova (2103) reported significant findings for questioning related to comprehension \((p < 0.001)\). In addition to reporting that 100% of nonoverlapping data (PND) across all participants, O’Conner and Klein (2004) and Williamson et al. (2015) also identified three profiles of how students with ASD comprehend and the challenges they are faced with in learning to read.

Flores and Ganz (2009) and Roux et al. (2015a, 2015b) investigated the use of direct instruction for teaching vocabulary and main-idea identification. Flores and Ganz (2013) found positive trends between direct instruction and reading comprehension 100% PND across all four participants using a single-subject design. Medium effect sizes were calculated for Roux et al. (2015a, 2015b) along with Asberg and Sandberg (2010). In all three studies, participants were involved in answering questions following the reading of texts. Williamson et al. (2012) investigated a question-generation approach, instructing students to use a “think-aloud” process while reading passages. Qualitative findings for the think-aloud procedure produced profiles of participants on the autism spectrum for approaching text for comprehension. Profiles discussed areas of strength as well as supported the need for aligning interventions to each student’s profile to address their uniqueness while considering some interventions that may be common to all (Williamson et al. 2012).
Graphic Organizers/Story Structures

Lastly, Bethune and Wood (2013) found that participants were able to answer questions from texts independently with the use of a graphic organizer. Participants increased on average 2 to 3 points from baseline data to the maintenance phase; PND was 100% for two of the participants and 89% for the third participant. Williamson, Carnahan, Birri, and Swoboda (2015) used a single-subject research design across three participants and found increases in reading comprehension using a story-mapping process. Participants increased skills to 97%, 95% and 79% at maintenance, and PND was 100% across all three participants (Williamson et al. 2015).

Other Strategies Employed

Of the remaining 6 studies, 4 did not employ reading strategies. Cronin (2014), Davidson and Weismer (2014), Henderson et al. (2014), and Jacobs and Richdale (2013) investigated predictors of reading success by applying either a pretest-posttest design or control-group design. Huemer and Mann (2010) provided intervention through the Lindamood-Bell Learning Processes (LBLP) and calculated moderate to large effects for treatment groups versus the control group. The final study measured the effects of floortime, or Applied Behavior Analysis (ABA), on reading outcomes for students with autism. Calculated effects for these studies presented a range from small to very large Murray (2008).

See Table F.2 for additional details.

Discussion

Review Significance

This literature synthesis supports the work of Randi, Newman, and Grigorenko (2010) by
investigating current literature in the field of autism and reading comprehension and analyzing that literature based on the seven strategies identified by the NRP report (2000). Results of this review revealed the strongest evidence for the use of Question-Answer relationship strategy techniques. Findings support the use of comprehension monitoring, graphic organizers, question/answer relationship, and story-mapping strategies. However, research is needed to determine the effectiveness of using cooperative learning or summarization as strategies for improving reading comprehension outcomes with students on the spectrum.

The current synthesis further supports Randi et al. (2010) by presenting positive outcomes for the use of direct instruction and vocabulary development. While not direct strategies found in the NRP (2000) report under reading comprehension, both are evidence-based in other areas of that document.

Additional strategies evidenced to be effective for teaching reading comprehension to students on the spectrum are graphic organizers and story mapping. While the sample is small (n = 3) for both Bethune and Wood (2013) and Williamson et al. (2015), the results are worthy of mention for a couple of reasons. First, the results show improvement for participants in reading comprehension. Second, the use of a visual tool shows great promise for students on the spectrum, as it can assist them in bridging the gap between the literal and abstract thinking required for reading comprehension.

Limitations

Variance among the studies made it difficult to draw consistent conclusions about interventions. There was variance in the following areas: research design, control groups,
intervention length, duration, and frequency. Research design and control groups presented the most limitations.

Variance in research design served as the primary limitation of this literature synthesis. Such variance led to difficulty in deducing the overall benefits of strategies and interpreting data for global use.

Variance in the control groups presented further limitations. Control groups varied from as few as 13 participants to as many as 51 and involved typical peers, peers with dyslexia, peers with autism who had an additional language impairment, and students only on the autism spectrum. These variances made it difficult to draw consistent conclusions about interventions.

Future Research

Future research should continue to investigate the use of all evidence-based strategies for positively impacting reading comprehension for students on the spectrum. While this report supports evidence that some of the NRP (2000) strategies can positively impact the learning of students on the spectrum, more research is needed.

Funding

No sources of funding were received for this literature synthesis.

References

* Denotes studies included in the synthesis.


Figure F.1. PRISMA 2009 flow diagram: reading comprehension and autism (Moher et al. 2009).
Table F.1

*Intervention Characteristics*

<table>
<thead>
<tr>
<th>Author</th>
<th>Reading Strategy Employed</th>
<th>Skills Targeted</th>
<th>Duration of Intervention</th>
<th>Frequency of Intervention</th>
<th>Effect Size</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asberg &amp; Sandberg (2010)</td>
<td>Question-Answer</td>
<td>Reading comprehension</td>
<td>20 to 30 minutes.</td>
<td>2 to 3 times a week</td>
<td>Pre/Post comparison $d = 0.381$</td>
<td>Medium gains in comprehension following intervention.</td>
</tr>
<tr>
<td>Belthune &amp; Wood (2013)</td>
<td>Graphic organizer</td>
<td>Reading comprehension Nonword decoding</td>
<td>20 to 30 minutes.</td>
<td>2 to 3 times a week</td>
<td>PND 100% for 2 participants PND 89% for third participant</td>
<td>Moderate to high effect; reading comprehension improved an average of 2 to 3 data points when using a graphic organizer.</td>
</tr>
<tr>
<td>Cronin (2014)</td>
<td>None Measured relationship between oral language and reading comprehension</td>
<td>Reading comprehension</td>
<td>50 to 70 minutes.</td>
<td>1 to 2 testing sessions</td>
<td>Group comparison by age $d = 0.133$ for passage comprehension</td>
<td>Group 2 (older students) scored higher on measures of passage comprehension.</td>
</tr>
<tr>
<td>Davidson &amp; Weismer (2014)</td>
<td>None Measured predictors of emergent reading abilities</td>
<td>Reading comprehension</td>
<td>3 to 4 hours</td>
<td>2 sessions both pretest and posttest</td>
<td>Not reported</td>
<td>High effect. Increases in comprehension measures (questions correct/total questions): 1 = 0/5 to 2/5 2 = 1/5 to 3/5 3 = 1/5 to 5/5 4 = 1/5 to 2/5</td>
</tr>
<tr>
<td>Flores &amp; Ganz (2009)</td>
<td>Graphic organizer Question-Answer</td>
<td>Reading comprehension Making meaning from text</td>
<td>20 minutes</td>
<td>2 weeks</td>
<td>Percentage of nonoverlapping data for deductions 100% across all 4 participants</td>
<td>High effect. Increases in comprehension measures (questions correct/total questions): 1 = 0/5 to 2/5 2 = 1/5 to 3/5 3 = 1/5 to 5/5 4 = 1/5 to 2/5</td>
</tr>
<tr>
<td>Author</td>
<td>Reading Strategy Employed</td>
<td>Skills Targeted</td>
<td>Duration of Intervention</td>
<td>Frequency of Intervention</td>
<td>Effect Size</td>
<td>Outcome</td>
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<tr>
<td>Flores, Nelson, Hinton, Franklin, Strozier, Terry, &amp; Franklin (2013)</td>
<td>Question-Answer</td>
<td>Reading comprehension and word decoding with 2 subgroups. Group 1–Corrective reading; Group 2–Language for learning</td>
<td>30 minutes</td>
<td>5 days per week total of 4 weeks</td>
<td>Group comparison by age and program; Group 1–Corrective reading; ( d = 4.43 ); Group 2–Language for learning; ( d = 9.63 )</td>
<td>Strong effect sizes for both direct instruction programs.</td>
</tr>
<tr>
<td>Henderson, Clarke, &amp; Snowling (2014)</td>
<td>None–measured predictors of reading success</td>
<td>Reading comprehension; Word and text meaning</td>
<td>45 minutes</td>
<td>Single session</td>
<td>Group comparison Treatment vs control on reading comprehension measured ( d = 2.03 )</td>
<td>Students with autism (73%) 1 SD below test mean in comprehension.</td>
</tr>
<tr>
<td>Huemer &amp; Mann (2010)</td>
<td>Skills in Lindamood-Bell Learning Program</td>
<td>Word recognition; Nonword decoding; Text accuracy; Text comprehension</td>
<td>2 hours across 2 days or one 4-hour session</td>
<td>1 session or across 2 days</td>
<td>Au vs Dyslexia: ( d = 1.26 ); Asperger vs Dyslexia: ( d = 0.389 ); PDD vs. Dyslexia: ( d = 1.03 )</td>
<td>Very large effects for participants on the autism spectrum and with PDD when compared to participants with dyslexia. Medium effects for participants with Asperger’s syndrome when compared to dyslexia on reading comprehension scores.</td>
</tr>
<tr>
<td>Iguatova (2013)</td>
<td>Question-Answer</td>
<td>Reading comprehension</td>
<td>40 minutes</td>
<td>Not reported</td>
<td>None reported</td>
<td>Small effect size for reading comprehension. No significant differences between treatment or control group.</td>
</tr>
<tr>
<td>Jacobs &amp; Richdale (2013)</td>
<td>None–measured predictors of reading success</td>
<td>Reading comprehension</td>
<td>30 minutes</td>
<td>5 days per week</td>
<td>Group comparison Treatment vs control on reading comprehension measured ( d = 0.168 )</td>
<td>Small effect size for reading comprehension. No significant differences between treatment or control group.</td>
</tr>
<tr>
<td>Author</td>
<td>Reading Strategy Employed</td>
<td>Skills Targeted</td>
<td>Duration of Intervention</td>
<td>Frequency of Intervention</td>
<td>Effect Size</td>
<td>Outcome</td>
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<tr>
<td>Lucas &amp; Frazier-Norbury (2014)</td>
<td>Question-Answer</td>
<td>Reading comprehension</td>
<td>2-hour test</td>
<td>1 session</td>
<td>Au vs Control: $d = 0.270$ Au with Language Impairments vs Control: $d = 2.40$ For test results on Nara-II comprehension</td>
<td>Small effect size for Au vs control. Very large effect size for Au with language impairments, possibly due to small sample size.</td>
</tr>
<tr>
<td>Lucas &amp; Frazier-Norbury (2015)</td>
<td>Question--Answer</td>
<td>Reading comprehension</td>
<td>60 minutes</td>
<td>3 sessions</td>
<td>Au vs. Control: $d = 0.118$ Au with Language Impairments vs Control: $d = 2.79$ Nonautistic with Language Impairments vs Control: $d = 2.04$ For test results on Nara-II comprehension</td>
<td>Small effect size for Au vs Control. Very large effect size for Au with Language Impairments and Nonautistic possibly due to small sample size.</td>
</tr>
<tr>
<td>Murray (2008)</td>
<td>Measured effects of early intervention on reading outcomes using ABA and floortime</td>
<td>Reading comprehension and oral language skills</td>
<td>60-minute sessions of ABA or 20-minute sessions of floortime</td>
<td>8 to 15 hours per week of ABA or 12 sessions (4 hours) of floortime</td>
<td>Not Reported</td>
<td>Comprehension on average 1 SD below population norms. High variability among scores.</td>
</tr>
<tr>
<td>Nation, Clarke, Wright, &amp; Williams (2006)</td>
<td>Question–Answer</td>
<td>Word recognition Nonword decoding Text accuracy Text comprehension</td>
<td>90 minutes</td>
<td>1 session</td>
<td>Low-skilled comprehenders vs skilled comprehenders $d = 1.81$</td>
<td>Group comparison Asperger’s with language impairment vs Asperger’s without language impairment: Large effect between Asperger’s with language impairments, Asperger’s without language impairments,</td>
</tr>
<tr>
<td>Norbury &amp; Nation (2010)</td>
<td>Question–Answer</td>
<td>Reading comprehension Alphabet knowledge</td>
<td>Not reported</td>
<td>Not reported</td>
<td></td>
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</tr>
<tr>
<td>Author</td>
<td>Reading Strategy Employed</td>
<td>Skills Targeted</td>
<td>Duration of Intervention</td>
<td>Frequency of Intervention</td>
<td>Effect Size</td>
<td>Outcome</td>
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<tr>
<td>O'Connor &amp; Klein (2004)</td>
<td>Question–Answer</td>
<td>Reading comprehension (main idea) Vocabulary development</td>
<td>60 minutes</td>
<td>Not reported</td>
<td>$d = 1.35$ Asperger’s with language impairment vs Control on reading comprehension measured $d = 2.15$ Asperger’s without language impairment vs Control on reading comprehension measured $d = 0.820$</td>
<td>and both groups of Asperger’s when compared to control group</td>
</tr>
<tr>
<td>Reutebuch, Zein, Kim, Weinberg, &amp; Vaughn (2015)</td>
<td>Comprehension monitoring</td>
<td>Reading comprehension Word decoding</td>
<td>30 minutes Tutoring 20 to 30 minutes</td>
<td>16 weeks</td>
<td>Not reported</td>
<td>Findings support word recognition and oral language skills as predictors of comprehension.</td>
</tr>
<tr>
<td>Ricketts, Jones, Happe, &amp; Charman (2013)</td>
<td>Question–Answer</td>
<td>Reading comprehension</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Regression analysis: $R^2 = 0.03$</td>
<td></td>
</tr>
<tr>
<td>Roux, Dion, &amp; Barrette (2015)</td>
<td>Question–Answer</td>
<td>Reading comprehension</td>
<td>30 minutes 10 weeks 30 sessions</td>
<td>Treatment vs Control posttest effect $0.66$</td>
<td>Moderate effect for reading comprehension.</td>
<td></td>
</tr>
<tr>
<td>Roux, Dion, Barrette, Dupéré, &amp; Fuchs (2015)</td>
<td>Question–Answer</td>
<td>Reading comprehension Vocabulary development</td>
<td>90 minutes</td>
<td>3 sessions per week for 16 weeks</td>
<td>Treatment vs Control posttest $d = .66$ for comprehension without instructed words</td>
<td>Highly effective in improving vocabulary knowledge and identifying main idea.</td>
</tr>
<tr>
<td>Author</td>
<td>Reading Strategy Employed</td>
<td>Skills Targeted</td>
<td>Duration of Intervention</td>
<td>Frequency of Intervention</td>
<td>Effect Size</td>
<td>Outcome</td>
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<tr>
<td>Saldana &amp; Frith (2007)</td>
<td>Question–Answer</td>
<td>Reading comprehension Verbal and nonverbal ability</td>
<td>Not reported</td>
<td>3 sessions</td>
<td>Treatment vs Control posttest $d=0.13$ for comprehension with instructed words</td>
<td>Reading comprehension strongly correlated with word reading and text accuracy. Nonword reading and text comprehension higher in ASD than in TD</td>
</tr>
<tr>
<td>Smith-Myles, Hilgenfeld, Barnhill, Griswold, Hagiwara, &amp; Simpson (2002)</td>
<td>Question–Answer</td>
<td>Reading comprehension Word decoding</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Factual/Literal vs Inferential: $d=0.95$</td>
<td>Reported significant difference in factual and inferential comprehension.</td>
</tr>
<tr>
<td>Williamson, Carnahan, &amp; Jacobs (2012)</td>
<td>Question–Answer</td>
<td>Reading comprehension Word recognition Oral language</td>
<td>30 minutes</td>
<td>4 sessions</td>
<td>Qualitative results; no effect size able to be calculated</td>
<td>Identified 3 differing profiles and skill abilities.</td>
</tr>
<tr>
<td>Williamson, Carnahan, Birri, &amp; Swoboda (2015)</td>
<td>Question–Answer Story mapping</td>
<td>Reading comprehension</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Percentage of nonoverlapping data for comprehension 100% across all 3 participants</td>
<td>Identified 3 profiles that illustrated how individuals on the autism spectrum comprehend what challenges individuals on the autism spectrum face</td>
</tr>
<tr>
<td>Author</td>
<td>Research Design</td>
<td>Control Group</td>
<td>Diagnosis</td>
<td>Number of Participants</td>
<td>Age</td>
<td>Gender</td>
</tr>
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<tr>
<td>Asberg &amp; Sandberg (2010)</td>
<td>Pretest/Posttest</td>
<td>No control group</td>
<td>ASD</td>
<td>N = 16</td>
<td>M = 13</td>
<td>Not reported</td>
</tr>
<tr>
<td>Bethune &amp; Wood (2013)</td>
<td>Single-subject-delayed multiple baseline</td>
<td>No control group</td>
<td>ASD</td>
<td>N = 3</td>
<td>1 participant: years 10 years 2 participants: 10 years</td>
<td>Male</td>
</tr>
<tr>
<td>Cronin (2014)</td>
<td>Pretest/Posttest</td>
<td>No control group</td>
<td>ASD</td>
<td>N = 13</td>
<td>M = 9.7 2 groups by age Group 1: 7 to 9 years Group 2: 10 to 13 years</td>
<td>2 Female 11 Male</td>
</tr>
<tr>
<td>Davidson &amp; Weismer (2014)</td>
<td>Pretest/Posttest and longitudinal study</td>
<td>No control group</td>
<td>ASD</td>
<td>N = 101</td>
<td>Pretest mean age: 2.5 Posttest mean age: 5.5</td>
<td>Not reported</td>
</tr>
<tr>
<td>Flores &amp; Ganz (2009)</td>
<td>Single-subject multiple probe</td>
<td>No control group</td>
<td>2 ASD 2 DD</td>
<td>N = 4</td>
<td>2 participants: 11 years 1 participant: 13 years 1 participant: 14 years</td>
<td>3 Female 1 Male</td>
</tr>
<tr>
<td>Flores, Nelson, Hinton, Franklin, Strozier, Terry, &amp; Franklin (2013)</td>
<td>Pretest/Posttest</td>
<td>No control group</td>
<td>10 ASD 8 DD</td>
<td>N = 18</td>
<td>2 groups by age Group 1: 8 to 13 years Group 2: 7 to 9 years</td>
<td>18 Male</td>
</tr>
<tr>
<td>Henderson, Clarke, &amp; Snowling (2014)</td>
<td>Pretest/Posttest</td>
<td>Control group</td>
<td>ASD</td>
<td>N = 49</td>
<td>7 to 15 years</td>
<td>2 Female 47 Male</td>
</tr>
<tr>
<td>Huemer &amp; Mann (2010)</td>
<td>Pretest/Posttest</td>
<td>Control group with dyslexia N = 100</td>
<td>171 ASD 94/Asperger’s syndrome 119 PDD-NOS</td>
<td>N = 384</td>
<td>10 to 11 years</td>
<td>68 Female 316 Male</td>
</tr>
<tr>
<td>Iguatova (2013)</td>
<td>Pretest/Posttest</td>
<td>No control group</td>
<td>ASD</td>
<td>N = 10</td>
<td>8 to 9 years</td>
<td>Not reported</td>
</tr>
<tr>
<td>Author</td>
<td>Research Design</td>
<td>Control Group</td>
<td>Diagnosis</td>
<td>Number of Participants</td>
<td>Age</td>
<td>Gender</td>
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<tr>
<td>Jacobs &amp; Richdale (2013)</td>
<td>Experimental design</td>
<td>Control group N = 40</td>
<td>High-Functioning Autism</td>
<td>N = 26</td>
<td>6 to 8 years</td>
<td>4 Female</td>
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<tr>
<td>Lucas &amp; Frazier-Norbury (2014)</td>
<td>Pretest/Posttest</td>
<td>No control group</td>
<td>25 ASD</td>
<td>N = 37</td>
<td>7 to 14 years</td>
<td>7 Female</td>
</tr>
<tr>
<td>Lucas &amp; Frazier-Norbury (2015)</td>
<td>Pretest/Posttest</td>
<td>Control group N = 32</td>
<td>27 ASD</td>
<td>N = 54</td>
<td>7 to 12 years</td>
<td>11 Female</td>
</tr>
<tr>
<td>Murray (2008)</td>
<td>Single-subject, two treatments</td>
<td>No control group</td>
<td>Asperger’s Syndrome</td>
<td>N = 3</td>
<td>7 years</td>
<td>Male</td>
</tr>
<tr>
<td>Nation, Clarke, Wright, &amp; Williams (2006)</td>
<td>Pretest/Posttest</td>
<td>No control group</td>
<td>16 autism</td>
<td>N = 41</td>
<td>6 to 12 years</td>
<td>Not reported</td>
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<tr>
<td>Norbury &amp; Nation (2010)</td>
<td>Experimental design</td>
<td>Control group N = 19</td>
<td>13 Asperger’s with language impairment</td>
<td>N = 27</td>
<td>10 to 11 years</td>
<td>1 Female</td>
</tr>
<tr>
<td>O’Conner &amp; Klein (2004)</td>
<td>Single subject</td>
<td>No control group</td>
<td>Asperger’s syndrome</td>
<td>N = 20</td>
<td>M = 15.11</td>
<td>1 Female</td>
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<tr>
<td>Reutebuch, Zein, Kim, Weinberg, &amp; Vaughn (2015)</td>
<td>Single subject</td>
<td>Paired partners</td>
<td>ASD</td>
<td>N = 3</td>
<td>15 to 17 years</td>
<td>1 Female</td>
</tr>
<tr>
<td>Ricketts, Jones, Happe, &amp; Charman (2013)</td>
<td>Pretest/Posttest</td>
<td>No control group</td>
<td>ASD</td>
<td>N = 100</td>
<td>14 to 16 years</td>
<td>9 Female</td>
</tr>
<tr>
<td>Roux, Dion, &amp; Barrette (2015)</td>
<td>Experimental design</td>
<td>Control group N = 7</td>
<td>ASD</td>
<td>N = 13</td>
<td>M = 9</td>
<td>Not reported</td>
</tr>
<tr>
<td>Author</td>
<td>Research Design</td>
<td>Control Group</td>
<td>Diagnosis</td>
<td>Number of Participants</td>
<td>Age</td>
<td>Gender</td>
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<tr>
<td>Roux, Dion, Barrette, Dupere, &amp; Fuchs (2015)</td>
<td>Experimental design</td>
<td>Control group $N = 21$</td>
<td>ASD</td>
<td>$N = 45$</td>
<td>$M = 9$</td>
<td>6 Female, 39 Male</td>
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<tr>
<td>Saldana &amp; Frith (2007)</td>
<td>Experimental design</td>
<td>Control group $N = 16$</td>
<td>13 ASD, 14 Autism, 19 DD</td>
<td>$N = 16$</td>
<td>$M = 14.9$</td>
<td>16 Male</td>
</tr>
<tr>
<td>Smith-Myles, Hilgenfeld, Barnhill, Griswold, Hagiwara, &amp; Simpson (2002)</td>
<td>Pretest/Posttest</td>
<td>No control group</td>
<td>Asperger’s syndrome</td>
<td>$N = 16$</td>
<td>6 to 16 years</td>
<td>2 Female, 14 Male</td>
</tr>
<tr>
<td>Williamson, Carnahan, &amp; Jacobs (2012)</td>
<td>Not reported</td>
<td>No control group</td>
<td>ASD</td>
<td>$N = 13$</td>
<td>7 to 13 years</td>
<td>2 Female, 11 Male</td>
</tr>
<tr>
<td>Williamson, Carnahan, Birri, &amp; Swoboda (2015)</td>
<td>Single subject</td>
<td>No control group</td>
<td>ASD</td>
<td>$N = 3$</td>
<td>16 to 17 years</td>
<td>3 Male</td>
</tr>
</tbody>
</table>