EXAMINING READING COMPREHENSION ACCOMMODATIONS FOR STUDENTS WITH READING DIFFICULTIES: THE SIMPLE VIEW OF READING

By

Jessica Violet McKindles Hubbell

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ABSTRACT

Educators often provide students with disabilities reading accommodations to help them access content during instruction, but research has shown that not all students benefit from those accommodations. Given the importance of content area instruction, there is a need for further research on how to efficiently identify reading accommodations that are the most beneficial for individual students given their unique needs. The current study applied an alternative treatments single-case design approach to investigate the corresponding impact of two different reading accommodation conditions (i.e., decoding accommodation, decoding + language comprehension accommodations) on the comprehension of social studies text among six fourth-grade students who were classified according to the simple view of reading as specifically in need of decoding support. Results indicated that very few participants displayed clear benefits of either reading accommodation condition. These findings suggest that it remains difficult to predict which students benefit from accommodations and the conditions under which they benefit from them. Related suggestions for future research that might meaningfully extend the present findings are provided.

This Dissertation is dedicated to my family and
friends who have always believed in me.

TABLE OF CONTENTS

CHAPTER I: INTRODUCTION

Purpose

The purpose of the current study was to examine the effects of reading comprehension accommodations for students with poor decoding skills on general comprehension of informational texts. Many students have not met expected proficiency levels on content area achievement tests (National Assessment of Educational Progress [NAEP], 2018, 2019, 2022a); one reason may be that many students struggle with reading demands required during content area instruction and testing. In general, accommodation supports have been used to assist students in the classroom (Salvia et al., 2017); specifically, reading comprehension accommodations have been found to be beneficial for many students (Bharadwaj & Lund, 2018; Buzick & Stone, 2014; Reed et al., 2014; Wood et al., 2018). However, studies have also found the effectiveness of a given accommodation varies considerably across individual students (Bolt & Thurlow, 2007; Fuchs et al., 2005; Helwig et al., 2002). In the current study, we empirically examined the potential for the simple view of reading to aid in the identification of reading comprehension accommodations that improve a student's comprehension of informational text. This study correspondingly has the potential to improve the efficiency with which school teams identify accommodations that are beneficial for individual students.

Background

At the middle school level, accessing printed text is crucial because teachers use textbooks to guide their instruction and delivery of content (Bruhn & Hasselbring, 2013; Kulm et al., 1999; Mastropieri & Scruggs, 2005). In social studies classes, a considerable amount of independent reading and answering questions from a textbook is required (Scruggs &

Mastropieri, 2013). Therefore, being able to comprehend content area text is essential for students.

According to the NAEP, on the content area assessments (i.e., social studies), the majority of fourth and eighth-grade students were not meeting proficiency levels. For students in fourth grade, twenty-four to thirty-eight percent of students scored at the proficient level or above in social studies (NAEP, 2010), meaning that they were able to interpret information from a variety of sources, including texts (NAEP, 2010). For eighth-grade students, fourteen to twenty-two percent of students scored at the proficient level or above (NAEP, 2022a), meaning that they were able to "communicate ideas about historical themes while citing evidence from primary and secondary sources" (NAEP, 2022a).

One of the reasons for low content area achievement scores may be that the instruction of content area subjects is often conveyed through textbooks (Bruhn & Hasselbring, 2013). The foundation of social studies instruction in middle school courses has long been textbooks (Gewertz, 2012; Groves, 2016). Moreover, the reading levels of textbooks are usually more advanced than the grade for which the books are designed (Jitendra et al., 2001). Students find expository reading in textbooks difficult because the textbooks are typically written at levels above what students, in general, can understand (Bulgren et al., 2013; Edmonds et al., 2009; Saenz & Fuchs, 2002; Scruggs et al., 2010). When the text requires advanced reading skills, students with low vocabulary and underdeveloped decoding and fluency skills are disadvantaged in that subject area (Neuman et al., 2014; Tyree et al., 1994).

According to the NAEP, the majority of fourth and eighth-grade students were not meeting proficient levels on the reading assessments. The NAEP reading assessment measures reading comprehension by asking students to read grade-level passages and then answer

questions about the passage, which were then scored. For fourth-grade students, thirty-three percent of students scored proficient or above on the reading assessment (NAEP, 2022b), which means that they were able to apply their understanding of the text, draw conclusions, and make an evaluation (NAEP, 2022b). For students in eighth grade, thirty-one percent of students scored proficient or above (NAEP, 2022b), meaning that they could provide inferences about a text, analyze text features, and substantiate judgments about the content (NAEP, 2022b). This suggests many students are struggling to read proficiently.

For students with reading difficulties, a possible solution to the barrier of using complex text for instruction is accommodations. Accommodations are used to help bridge the gap between the student's skills and the information they are trying to access, which often entails changes to the mode or format of presentation of material to facilitate learning and measurement (Nolet & McLaughlin, 2000; Salvia et al., 2017). An accommodation is intended to allow students access to the general curriculum and to give them an opportunity to display their knowledge without altering the curriculum or content standards being assessed (Elliott et al., 2002).

Importance

One potential reason for varying findings of the effectiveness of reading comprehension accommodations mentioned earlier might be related to the varying reading skills of students using the accommodations. For example, many studies that examine students with learning disabilities in general (and not specifically those with reading difficulties) show minimal positive impact of reading accommodations (Elbaum et al., 2004; Schmitt et al., 2012). In studies that focus on students with limited reading skills (i.e., poor decoders, and those with reading-based learning disability), unique benefits of using reading accommodations are more apparent

(Fletcher et al., 2006; Helwig et al., 2002; Laitusis, 2010). It seems to be the case that students with different types of reading skills may benefit from different accommodations.

Rationale

Taking into account students' specific reading difficulties in a systematic manner may help improve accommodation recommendations. According to Fuchs and colleagues (2000a), objective data sources can "supplement teacher judgments to enhance accommodation decisions" (p. 83). Compared to teachers independently and subjectively choosing accommodations, studies found that an objective and systematic manner of choosing accommodations resulted in a more effective accommodation choice (Fuchs et al., 2000a; Fuchs et al., 2000b; McKevitt & Elliott, 2003).

The simple view of reading (SVR) may offer an effective framework to improve accommodation decision-making that may be relatively easy to apply. According to this framework, reading comprehension has two major components: decoding and language comprehension (Gough & Tunmer, 1986). The ability to decode requires a completely different skill set than that which is needed for language comprehension, which accordingly may require different accommodations. However, empirical evidence is needed to determine if, indeed, students benefit from accommodations that are particularly identified through the SVR.

CHAPTER II: LITERATURE REVIEW

Theoretical Framework

The simple view of reading (SVR) may offer guidance in matching specific students' reading difficulties to effective accommodations. According to this theory, there are two major components of reading comprehension: decoding and language comprehension (Gough & Tunmer, 1986). Reading comprehension (R) is considered the product of the variables of decoding (D) and language comprehension (C) or R = D x C. Each contributing variable ranges from 0 (no skills) to 1 (perfection). However, in practice, a reader would likely never fall in the no skills (0) and/or perfect skills (1) categories. Therefore, it is helpful to think about the skills on a continuum. For example, if a fourth-grade student attempts to read a passage from a college medical textbook, they may be able to recognize many of the words but would likely grasp little of the overall meaning. They may know it is about a certain system in the body but not comprehend the specific information. In this example, the reader possesses the ability to decode text but has insufficient language comprehension, leading to poor overall reading comprehension. Another example would be a young child who is still learning to decode and can only understand a children's book when it is read aloud. In this example, the reader has poor decoding skills but sufficient language comprehension skills; therefore, without the support of someone reading to them, they would not be able to comprehend the text. In both examples, the readers have some skill in both decoding and language comprehension, but due to the degree of skill and whether it is sufficient for the text presented, they struggle to comprehend text. Any given student's decoding and language comprehension skills can be considered to be at some point on different continua that may or may not be sufficient for comprehending a given text passage. The more recent SVR model has replaced the term decoding with word recognition.

Word recognition is the ability to read words in isolation (Adlof et al., 2006). More specifically, "word recognition is the act of seeing a word and recognizing its pronunciation immediately and without any conscious effort" (Murray, 2016b, p. 30). The aspects required for word recognition are phonological awareness, word decoding, and sight recognition. First, phonological awareness is the ability to manipulate and break down sounds in language, such as dividing a word into phonemes (individual sounds), syllables (large parts), and rhymes (whole words; Murray, 2016b; Torgesen & Mathes, 2000). Next, word decoding is the "accurate and fast retrieval of the phonological code for written word forms" (Verhoeven & Leeuwe, 2008, p. 407). In other words, decoding is the ability to blend the letter sounds to read words (Murray, 2016b). Finally, sight word recognition refers to accurately reading sight words, which are high-frequency words that have "irregular spellings and cannot be perfectly decoded" (Murray, 2016b, p.36).

Language comprehension is the ability to interpret lexical information (i.e., semantic information at the word level), sentences, and verbal communication (Gough & Tunmer, 1986; Hoover & Gough, 1990). The aspects required for language comprehension are background knowledge, language structures, comprehension monitoring, and vocabulary. First, background knowledge is a specific subset of knowledge (e.g., facts about events, sayings, people, etc.) that the reader needs to comprehend what is presented (Murray, 2016a). Second, language structure is the relationship between the individual words and sentences in a written text (Murray, 2016a). Next, it is important for students to continuously monitor their comprehension level of the passage (Murray, 2016a). In other words, students should question themselves to determine whether they understand the passage. Comprehension monitoring can also be referred to as metacognition, which is the ability to think about, understand, and manage one's learning

(Schraw & Dennison, 1994). Lastly, vocabulary is "the knowledge of the meaning of words in a text" (Murray, 2016a, p.49). Vocabulary is one of the strongest predictors of language comprehension, and ultimately, reading comprehension (Duncan et al., 2007) because if a person does not know the meaning of the words being read, it is not possible to comprehend the meaning of the overall passage.

By using the two main aspects of the SVR, students can be classified into four categories (poor decoders, poor language comprehenders, mixed deficit, or no impairment). *Poor decoders* have difficulty with phonological awareness (syllables and phonemes), decoding (alphabetic principle and spelling-sound correspondences), and/or sight recognition (of familiar words) but do not have language comprehension difficulties. *Poor language comprehenders* have difficulty with background knowledge (facts and concepts), vocabulary, (breadth, precision, and links), language structures (syntax and semantics), verbal reasoning (inference and metaphor), and/or literacy knowledge (print concepts and genres), but do not have word recognition difficulties. People with *mixed deficits* have poor decoding and poor language comprehension skills, while people with *no impairment* have adequate to good decoding and language comprehension skills (Catts & Kamhi, 2005; Foorman et al., 2017). Several studies have categorized students into the SVR groups, and the studies reported a wide range of students in each category. The range for poor decoders was from 14% to 33%, poor language comprehenders were from 31% to 52%, and no impairment was from 33% to 54% (Cain et al., 2000; Catts et al., 2006; Giusto & Ehri, 2019; Nation et al., 2004; Nation & Snowling, 1998). Students who scored low in both decoding and language comprehension seemed to be eliminated from the studies before investigation.

Table 1

Simple View of Reading Categories

Category	Decoding Skills	Language Comprehension Skills
Poor Decoders	Poor	Adequate to Good
Poor Language Comprehenders	Adequate to Good	Poor
Mixed Deficit	Poor	Poor
No Impairment	Adequate to Good	Adequate to Good

Poor Decoders

There is a wealth of evidence showing the connection between decoding and reading comprehension (Foorman et al., 2018; Nation & Snowling, 1998; Snowling, 2005; Stothard & Hulme, 1995; Wang et al., 2019). Catts and colleagues (2006) found poor decoders scored low on measures of phonological processing and scored well on measures of language comprehension. Wang and colleagues (2019) sampled over 11,000 students between fifth grade and tenth grade. Students were split between poor and average decoders and asked to complete a reading comprehension assessment. Results showed poor decoding scores were associated with low reading comprehension scores, which may demonstrate that decoding is an important aspect of reading comprehension. Wood and colleagues (2018) also found that students with poor decoding showed limited growth in reading comprehension compared to typical readers.

Poor Language Comprehenders

There is an abundance of evidence showing the connection between language comprehension and reading comprehension (Cadime et al., 2017; Nation et al., 2004; Nation & Snowling, 1998). According to Nation and Snowling (1998), there is a high correlation between reading and language comprehension and a weaker correlation between language comprehension and nonsense word reading. These results suggest that language comprehension and decoding are two distinct aspects that make up reading comprehension.

Mixed Deficit

Students who are classified as having mixed deficits are considered to have difficulties with both decoding and language comprehension (Catts et al., 2006). While poor decoders should receive support focused on decoding and word-reading skills (Lovett et al., 2000) and poor comprehenders support should focus on language knowledge and comprehension strategies (Swanson & Deshler, 2003), students who have difficulties in both areas will likely need support that focuses on decoding and language comprehension (Catts et al., 2006).

No Impairment

If students have adequate decoding and adequate language comprehension skills, they are considered to have no impairment.

Accommodations

An instructional accommodation is an adaptation to the design or delivery of instruction and associated materials in a way that does not change the amount of content or extent of knowledge needed to meet grade-level standards (Ketterlin-Geller & Jamgochian, 2011). The intent of instructional accommodations is for students to learn the same material and perform at the same level as students who do not need the accommodations. Instructional accommodations should support engagement with academic content and "not alter the intended cognitive complexity for the grade-level content standard" (Ketterlin-Geller & Jamgochian, 2011, p. 134).

Instructional accommodations include changes in (a) scheduling of associated activities (e.g., frequent breaks or on-task reminders); (b) instructional settings (e.g., preferred seating or small group); (c) how students respond (e.g., orally or in written format); (d) the way content is presented (e.g., text read aloud or in braille), and (e) equipment or materials students are allowed to use (e.g., text-to-speech technology; Christensen et al., 2011; Lai & Berkeley, 2012). Many

students with learning disabilities and reading difficulties have trouble comprehending printed text. Accommodations are provided to help some students access information through text.

Poor Decoders and Accommodations

According to the SVR, students identified as being poor decoders (e.g., having poor decoding skills and average or above-average language comprehension skills) may experience unique decoding-related barriers to the comprehension of written material; however, if these barriers are removed, the individuals might better comprehend the written material. One way to possibly remove the associated barrier may be to provide accommodations that decode text for such students; a commonly used accommodation for students with disabilities is the read-aloud accommodation (Bielinski et al., 2001; Witmer et al., 2018).

Read-Aloud Accommodation

The read-aloud accommodation utilizes oral presentation of materials that otherwise would only have been available in written text. This accommodation can come in many different forms. For example, meta-analyses completed on the effects of the read-aloud accommodation included a variety of delivery methods, such as recorded human voice, video/audio recording, reading pen, and text-to-speech (Buzick & Stone, 2014; Li, 2014; Wood et al., 2018). A survey of middle school teachers found that 72 percent (344 of the 476 respondents) reported reading to students aloud during instructional time (Ariail & Albright, 2005). However, only 16 percent of the teachers reported reading aloud information/nonfiction books (Ariail & Albright, 2005). Due to the limited number of teachers reading textbooks aloud, it may be beneficial to investigate how schools could use one of the other forms of the read-aloud accommodation to help students access instructional content. There has been an abundance of research on the effects of the read-aloud accommodation for students with learning disabilities and reading difficulties, in which

most of the studies suggest positive findings (e.g., Bonifacci et al., 2022; Dolan et al., 2005; Elkind et al., 1993; Sulaimon & Schaefer, 2023).

Many studies have examined the effect of the read-aloud accommodation for students with disabilities while taking academic tests. Most indicate positive effects, although some do not. For example, Bolt and Thurlow (2007) found positive results for students with disabilities; specifically, the read-aloud accommodation had the greatest effect on difficult to read questions on math assessments. Fletcher et al. (2006), Kosciolek and Ysseldyke (2000), Laitusis (2010), and Weston (2002) all examined the read-aloud accommodation for students with reading disabilities and identified gains as a result of receiving the read-aloud accommodations on academic tests.

Helwig and colleagues (2002) found that elementary students with a learning disability received higher scores on academic tests when using the read-aloud accommodation, but middle school students with learning disabilities performed better when given the standard test. The difference between the elementary and middle school students' results may be due to the math teacher being the one to choose which students would benefit from the read-aloud accommodation (Helwig et al., 2002). In elementary school, the math teacher is most likely also the reading teacher, but this is not likely the case in middle school. Therefore, the elementary school teachers may have had a better understanding of the student's reading skills compared to middle school teachers and, therefore more likely to correctly identify those with reading difficulties who would benefit from the accommodation. The results of a study by Elbaum and colleagues (2004) suggested the read-aloud accommodation resulted in no real difference in test scores for students with disabilities. Specifically, out of all the students with disabilities in the study, 17 percent had a boost in performance, 20 percent had impaired performance, and 63

percent experienced no difference when using the read-aloud accommodation in comparison to their performance on a standard test with no accommodations (Elbaum et al., 2004).

One reason for the inconsistent results may be due to the participants having a variety of different reading skill deficits that may not all be adequately addressed by the read-aloud accommodation. For example, Elbaum and colleagues (2004) included students with disabilities, regardless of reading ability, whereas Helwig and colleagues (2002) included students with disabilities whom their math teacher had identified as potentially benefiting from the read-aloud accommodation. This small distinction might explain why Helwig and colleagues (2002) reported positive results for the read-aloud accommodation among elementary students, whereas Elbaum and colleagues (2004) observed no performance difference. According to the SVR, only those students with decoding difficulties would likely improve their reading comprehension by having the text read aloud. Students with language comprehension difficulties would likely need something different to facilitate reading comprehension.

Fletcher and colleagues (2006) examined how a package of accommodations affected scores on reading assessments for students with dyslexia. Students were categorized into either dyslexic or average reader groups as determined by the results of their Woodcock-Johnson III Test of Achievement, Basic Reading cluster score. The Basic Reading cluster is the combination of the letter-word identification and word attack (decoding nonsense words) subtests. Each of the student's vocabulary knowledge was considered average based on their Woodcock Language Proficiency Battery- Revised Picture Vocabulary subtest scores. Students were randomly assigned to the accommodated or standard version of the reading assessment. The package of accommodations consisted of extending the test time across two days, and an adult read the proper nouns and comprehension questions aloud. Results found the package of accommodations

had a strong positive effect on students with dyslexia's reading comprehension scores but made no difference for typical readers (Fletcher et al., 2006). Overall, this study suggested that students with poor decoding skills may benefit from having written text read aloud. However, the study only examined whether reading proper nouns and comprehension questions aloud, not the whole passage, affected students' reading comprehension.

On the other hand, Meyer and Bouck (2014) found that text-to-speech accommodation did not improve reading comprehension, which raises the question of whether it is effective for everyone. In this study, the text-to-speech accommodation was provided via a computer program that converted text on the screen to spoken words (Meyer & Bouck, 2014). Three students participated in the multiple baseline across participants design study. Results showed that, for the most part, using the text-to-speech accommodation did not improve reading comprehension. However, there was one main limitation to this study: the reading comprehension measurement. The six multiple-choice questions asked after each passage were taken from a book written by Pauk (2010), but the technical adequacy of the comprehension measure had not been examined prior to the study. This may have contributed to difficulties in establishing a stable baseline for each participant, such that the difference between baseline and intervention phases could not be detected. All the variation in student test scores may ultimately have reflected issues with measurement rather than a lack of improvement associated with the accommodation. One interesting finding from the study was that the student who had a positive trend during the intervention phase was the student with the lowest score on the decoding assessment. This may indicate that certain students could strongly benefit from the read-aloud accommodation. Future research should aim to use reading comprehension measures with greater evidence for technical adequacy.

Even though the majority of studies found positive results regarding the effectiveness of the read-aloud accommodation, there were several studies that found conflicting results, which may be due to the studies not taking students' individual reading skills into account. According to the SVR, the students with poor decoding skills may benefit greatly from the read-aloud accommodation compared to students with average decoding skills. It was anticipated that more consistently positive effects from the read-aloud accommodation may be identified for students with specific reading decoding difficulties.

Poor Language Comprehension and Accommodations

According to the SVR, students identified as being poor comprehenders (e.g., poor language comprehension skills and average decoding skills) would experience barriers related to language comprehension while reading; however, if the barriers were removed, the readers might better comprehend the written materials. Unlike the straightforward option of reading aloud materials to address decoding difficulties, identifying possible supports for language comprehension is complex due to the number of components and associated integration work required for language comprehension to occur (e.g., background knowledge, language structures, comprehension monitoring, and vocabulary need to be adequate and applied in a sophisticated manner to comprehend language). Within the empirical literature, vocabulary support and comprehension monitoring represent some of the most commonly studied language-focused supports for students with disabilities (Hawkins et al., 2010; Reed et al., 2014), and have the potential to be provided as accommodations. Researchers have investigated using vocabulary support and comprehension monitoring to accommodate students' comprehension of instructional material. Typically, the associated research has not been framed as an investigation

of accommodations but rather as instruction or intervention more broadly defined. Associated work was briefly reviewed in the following sections.

Vocabulary

Vocabulary support can be presented in many different forms (e.g., word definition, vocabulary previewing) and typically involves the student receiving the definition of a particular word. Researchers have studied the effects of vocabulary supports for all students, and the overall results show a positive effect (Hawkins et al., 2010; Marzano et al., 2000; Reed et al., 2014).

Several studies have examined the effect of vocabulary support for students with disabilities; some indicated positive results, while others did not. For example, Hawkins and colleagues (2010) found that students who received both listening and vocabulary previewing scored higher on factual and inferential comprehension. Listening preview was presented by the teacher reading a sentence aloud, and then the students repeating the sentence together. Vocabulary previewing involved teachers pronouncing difficult words in a passage before the students read the passage. Results found that levels of comprehension and vocabulary knowledge were increased after including vocabulary reviewing (Hawkins et al., 2010). On the other hand, Schmitt and colleagues (2012) found a reading pen with vocabulary function did not result in improved comprehension scores. Based on the studies reviewed, students are most likely to benefit from vocabulary support when they are required to use the support and when only the most difficult words are defined.

Two reasons for the inconsistent results could be differences in when the definitions of words were provided (e.g., before the passage or while reading the passage) and the difficulty level of the defined words (e.g., difficult words or all words). For example, in Hawkins and

colleagues' (2010) study, the students only received the definitions of the words chosen by the teacher, and these definitions were provided before they read the passage. On the other hand, in the Schmitt and colleagues (2012) study, students had control over what words they wanted to be defined and were given the definition while they were reading the text. As such, in the Schmitt and colleagues (2012) study, students may not have actually used the reading pen function that allowed for word definitions to be provided very frequently. These small distinctions may be the reason Hawkins and colleagues (2010) found positive results for the vocabulary support, and Schmitt and colleagues (2012) found no improvement. In general, studies have shown that providing a definition of difficult vocabulary words can improve students' reading comprehension and academic achievement, but the way definitions are presented and/or what words are defined may predict whether the students will benefit.

Comprehension Monitoring

Comprehension monitoring is a strategy that is conceptualized as requiring meta-cognitive skills, involving students questioning themselves to determine if the passages make sense (Bharadwaj & Lund, 2018). By questioning and reflecting on what they are reading, it was anticipated that they are more likely to understand the passage (Fletcher et al., 2006; Nation, 2005). There are various ways to potentially support these actions when students are reading information, such as through repeated prompts that facilitate questioning and summarizing activities (Guthrie et al., 2004). According to the National Reading Panel (2000), the effectiveness of reading-comprehension monitoring for students with reading difficulties has been well supported by research (Biancarosa & Snow, 2004; Block & Duffy, 2008; Edmond et al., 2009; Guthrie et al., 2004; Marzano et al., 2000; Mastropieri et al., 2003).

Guthrie and colleagues (2004) found that when questioning and summarizing (i.e., comprehension monitoring) were included in a comprehension strategy package, students performed better on reading comprehension assessments. Specifically, students were introduced to concept-oriented reading instruction (CORI), which was designed to provide students with multiple strategies to increase reading comprehension and academic achievement. The CORI components included strategies, such as activating background knowledge, asking questions, searching for information, summarizing, organizing paragraphs, and structuring stories. Students who received the CORI, compared to the traditional instruction, scored significantly higher on passage comprehension (Guthrie et al., 2004). However, the authors did not report whether students with disabilities were included in the study. Therefore, future studies should examine how reading comprehension strategies affect reading comprehension for students with disabilities, specifically students who struggle with language comprehension.

Boardman and colleagues (2015) found using collaborative strategic reading (CSR) in middle school science and social studies classes improved reading comprehension and access to complex information text. CSR includes activating prior knowledge, fixing comprehension when there is a misunderstanding, identifying the main ideas of short sections (i.e., get the gist), developing questions, and reviewing main ideas.

These studies indicate that when students are taught comprehension monitoring strategies and are supported while practicing, the students are more successful with reading comprehension. However, very few studies examined comprehension monitoring strategies as accommodations for instructional materials. If comprehension monitoring was presented as an accommodation, it may similarly help students access the instructional information.

According to the SVR, students with poor language comprehension skills may particularly benefit from both the vocabulary support and comprehension monitoring accommodations. Vocabulary and comprehension monitoring are two aspects of language comprehension, which may indicate that vocabulary support and comprehension monitoring will especially benefit those with poor language comprehension skills. It was anticipated that students with poor language comprehension skills would experience positive effects of the vocabulary support and comprehension monitoring, whereas those with adequate language comprehension skills may not benefit from the supports.

Identifying which Accommodations are most Effective for Individual Students

According to several studies, teachers are not particularly accurate in identifying which students need support and which accommodations meet their needs; therefore, systematic assessments have been developed to help teachers make decisions. For example, a study by Fuchs and colleagues (2000b) examined how well teachers' accommodation decisions corresponded with decisions based on the Dynamic Assessment of Test Accommodations (DATA). The DATA involves systematic testing of various testing accommodation conditions for each individual student to determine which accommodation combination results in the highest score. According to the results, students who were identified and assigned an accommodation using the DATA benefited more compared to the students who were identified and provided accommodations using teacher recommendations. It was also found that the DATA was more accurate than teachers in predicting which students would benefit from support (Fuchs et al., 2000b). Similarly, McKevitt and Elliott (2003) and Fuchs and colleagues (2000a) found that a systematic assessment was more helpful when identifying which accommodations were most effective than the teacher-recommended accommodation.

Even though DATA may be a beneficial tool when making accommodation decisions, it is unlikely to be used due to time and money. This assessment was designed to be administered by teachers, and both the math and reading sections have several subtests. Since most teachers do not have the time to administer this lengthy assessment to their students with learning disabilities, they are more likely to assign accommodations during educational team meetings in an informal and nonempirical manner (Fuchs et al., 2003). Also, many schools have limited funds, and instead of buying a new assessment; it is anticipated to be more practical to use information from previously administered assessments to help inform accommodation decision-making.

Considering the individual students' decoding and language comprehension skills may ultimately help in more efficiently identifying the most effective accommodations. According to the SVR, identifying students' specific reading comprehension subskills (i.e., decoding and language comprehension) may help when choosing appropriate supports. One way to identify skills the student struggles with is to examine existing reading test results, which highlight their lack or possession of specific reading skills; this could then be used to select accommodations to address the specific deficits. For example, when students are tested for special education status, they typically take an extensive set of reading subtests, which includes considerable information that may be used to categorize students based on the SVR (poor decoder, poor comprehender, mixed deficit, or no impairment). In other words, the SVR may offer a framework for appropriately and efficiently identifying which accommodations will be most effective for individual students; however, it should be tested empirically to determine whether this application holds.

Current Study

A limited number of studies have examined accommodation effects for students with disabilities. The majority of these studies have examined how students with disabilities or reading disabilities, in general, are affected by reading comprehension accommodations (Bolt & Thurlow, 2007; Buzick & Stone, 2014; Fletcher et al., 2006; Hawkins et al., 2010; Helwig et al., 2002; Kosciolek & Ysseldyke, 2000; Laitusis, 2010; Li, 2014; Marzano et al., 2000; Reed et al., 2014; Weston, 2002; Wood et al., 2018). The SVR suggests that utilizing a student's overall reading ability will not provide sufficient information to determine which type of support the student needs (Gough & Tunmer, 1986); more specific information is needed regarding the student's skill level to best understand how to potentially support the student.

An applied extension of the SVR would be that readers may benefit from different forms of reading comprehension accommodations (i.e., read-aloud, vocabulary, and comprehension monitoring) depending on their reading skills (i.e., poor decoders, poor language comprehension, and mixed deficit; Murray, 2016a). Students with poor decoding skills will likely benefit from the read-aloud accommodation because it removes the need to decode, thus allowing the student access to written text. Students with poor language comprehension may specifically benefit from vocabulary and comprehension monitoring accommodations. Students with mixed deficits may specifically benefit from the read-aloud, vocabulary, and comprehension monitoring accommodations.

The SVR may be a good framework to help identify appropriate accommodations, but there is a need for empirical examination of this applied extension. The current study represents a preliminary exploration to investigate one group of readers (i.e., poor decoders) regarding whether different accommodation conditions affect their general comprehension of information

texts. If it is found that students in the poor decoding group benefit from the decoding support alone and do not benefit from the additional support, it may offer support that the SVR offers guidance for more efficient assignment of accommodations to individual students.

Research Questions

1. To what extent does the use of the read-aloud accommodation affect general comprehension of text-based material for students with word decoding difficulties?

    Hypothesis: Students with poor decoding skills will benefit from the read-aloud accommodation.

2. To what extent does the read-aloud accommodation, vocabulary support, and comprehension monitoring affect general comprehension of text-based material for students with word decoding difficulties?

    Hypothesis: Students with poor decoding skills will experience a similar but no greater benefit from the combination of the read-aloud accommodation, vocabulary support, and comprehension monitoring compared to the read-aloud accommodation independently.

CHAPTER III: METHODS

A single-case research design, specifically an adapted alternating treatment design, was applied to examine the effects of two different accommodation conditions for participants with poor decoding skills and adequate language comprehension skills.

Participants

To be eligible, participants needed to (a) have a guardian report that they were entering the fourth grade in the fall or enrolled in the fourth grade, (b) have a guardian report that they struggled with reading, (c) pass a technology check (see Pre-Experimental Procedures section for more details), and (d) demonstrate poor decoding skills, average listening comprehension skills, and average working memory skills based on pre-testing (see below for pre-testing eligibility). Table 2 summarizes participant demographics. Pseudonyms were used in place of the participant's actual names to protect their rights to privacy and confidentiality. Two participants did not complete the study due to family vacations and busy summer schedules. Both participants started the alternating treatment phase, but neither completed the treatment phase. Results for these participants were not reported.

Pre-Testing Eligibility Criteria

To qualify for participation in the study, individuals were required to have achieved a score of 1 or more standard deviations (SD) below the grade-level mean on the Woodcock Reading Mastery Test, Third Edition (WRMT-III) word attack subtests, and also to have scored more than 0.5 SD below the age-level mean on the WRMT-III listening comprehension subtest. These criteria were chosen in order to identify those participants who represented "poor decoders" according to the simple view of reading (SVR) conceptualization of reading difficulties, which defines poor decoders as having below-average decoding skills and average to

above-average language comprehension skills (Gough & Tunmer, 1986). Grade-level norms were applied when scoring the word attack subtest because students are typically taught how to decode words in school, and therefore, their decoding skills should be relatively similar compared to their same-grade peers. On the other hand, age-level norms were applied when scoring the listening comprehension subtest because students are not typically taught listening comprehension skills in school, and therefore, their listening comprehension skills should be relatively similar compared to same-age peers regardless of their grade. These criteria are also similar to other studies that categorized students according to the SVR (e.g., Catts et al., 2006; Giusto & Ehri, 2019). In addition, to be eligible, a participant needed to score higher than 2 SD below the age-level mean on the Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V) digit span subtest. This was to ensure results were not inadvertently influenced by a participant's particularly low working memory, which could otherwise hinder the ability to detect the potential effects of the accommodation conditions on reading comprehension. Working memory is considered a prerequisite ability for language comprehension, and as such, it was important to exclude those for whom working memory was extremely low.

James. James was a 9-year-old 4th grader from Michigan whose guardian reported that he struggled with sounding out words. James earned a standard score of 76 on the word attack subtest of WRMT-III and a standard score of 113 on the listening comprehension subtest of WRMT-III. He earned a scaled score of 6 on the digit span subtest of WISC-V.

Robert. Robert was a 10-year-old 4th grader from Georgia whose guardian reported that he struggled with reading fluency. Robert earned a standard score of 76 on the word attack subtest of WRMT-III and a standard score of 155 on the listening comprehension subtest of WRMT-III. He earned a scaled score of 8 on the digit span subtest of WISC-V.

John. John was a 9-year-old 4th grader from New Jersey whose guardian reported that he struggled with decoding. John earned a standard score of 76 on the word attack subtest of WRMT-III and a standard score of 95 on the listening comprehension subtest of WRMT-III. He earned a scaled score of 8 on the digit span subtest of WISC-V.

William. William was a 10-year-old 4th grader from Michigan whose guardian reported that he struggled with sounding out words and reading comprehension. William earned a standard score of 76 on the word attack subtest of WRMT-III and a standard score of 99 on the listening comprehension subtest of WRMT-III. He earned a scaled score of 12 on the digit span subtest of WISC-V.

Matthew. Matthew was a 10-year-old 4th grader from Michigan whose guardian reported that he struggled with reading fluency and decoding. Matthew earned a standard score of 80 on the word attack subtest of WRMT-III and a standard score of 100 on the listening comprehension subtest of WRMT-III. He earned a scaled score of 6 on the digit span subtest of WISC-V.

Mary. Mary was an 8-year-old from Michigan. She started participating in the current study in the summer when she was between the 3rd and 4th grade. Mary's guardian reported that she struggled with sounding out words. Mary earned a standard score of 78 on the word attack subtest of WRMT-III and a standard score of 94 on the listening comprehension subtest of WRMT-III. She earned a scaled score of 9 on the digit span subtest of WISC-V.

Susan. Susan was a 10-year-old 4th grader from Michigan whose guardian reported that she struggled with sounding out words. Susan earned a standard score of 61 on the word attack subtest of WRMT-III and a standard score of 100 on the listening comprehension subtest of WRMT-III. She earned a scaled score of 7 on the digit span subtest of WISC-V.

Table 2

Participants' Characteristics

Participant	Sex	Race	Age	Grade	State	Word Attack[1]	Listening Comp[2]	Digit Span[3]
James	Male	Asian	9	4th	MI	76	113	6
Robert	Male	Caucasian	10	4th	GA	76	115	8
John	Male	Caucasian	9	4th	NJ	76	95	8
William	Male	Caucasian	10	4th	MI	76	99	12
Matthew	Male	Caucasian	10	4th	MI	80	100	6
Mary	Female	Caucasian	8	3rd	MI	78	94	9
Susan	Female	Caucasian	10	4th	MI	61	100	7

Note: [1] = pre-testing measure, WRMT-III word attack task, the participants' standard score was reported. The average score range is between 90 and 110. The cutoff score for eligibility was 84 or below. [2] = pre-testing measure, WRMT-III listening comprehension task, the participants' standard score was reported. The average score range is between 90 and 110. The cutoff score for eligibility was 92 or higher. [3] = pre-testing measure, WISC-V digit span subtest, the participants' scaled score was reported. Average score range is 8 to 12. The cutoff score for eligibility was 4 or higher.

Setting

Research activities occurred via Zoom during a time identified by the participant's guardian to be appropriate. Within each individual participant's experience, the researcher aimed to ensure that the day and time of the research activities were consistent across all meetings. The researcher worked with the guardian at the beginning of the first meeting to help the participant find a quiet place with reliable internet for each meeting. The researcher also worked with the guardian if computer-related troubleshooting was needed throughout the study. The guardian and researcher created a procedure that the guardian used before every meeting to ensure that everything was set up at the agreed upon meeting time (See Appendix A for a procedure outline). The researcher administered the reading passages and reading comprehension measures individually to each participant.

Materials

The main materials for this study included expository reading passages and reading comprehension accommodations; all materials were accessed by the participants via Zoom when meeting with the researcher.

Expository Reading Passages

Reading passages that provided information on various social studies topics were selected from those made available on the website edHelper (https://www.edhelper.com/) and converted into Google Documents. Each passage was similar in length (i.e., 290-300 words) and focused on only one specific topic (e.g., Black Americans in the Civil War; See Appendix B for an example passage). All passages had a Flesch-Kincaid reading grade level score between 7.00 and 7.60. The use of text at a reading level much higher than the participants' current grade level was used because the majority of textbooks used in schools are written at a reading level much higher than the intended grade (Jitendra et al., 2001). Based on the state standards for social studies instruction in Alabama, California, Colorado, Michigan, New York, and Texas, in first grade through fourth grade, students are taught about the rights and responsibilities of citizens in the USA, significant individuals and events in their communities and nationally, geographical features of the earth, and the history of their state (Alabama State Department of Education, 2010; California State Board of Education, 2000; Colorado Department of Education, 2014; Michigan Department of Education, 2019; New York State of Education Department, 2019; Texas Education Agency, 2020). The history of the United States of America is taught in fifth grade, and the history of the Western Hemisphere is taught in sixth grade (Alabama State Department of Education, 2010; California State Board of Education, 2000; Colorado Department of Education, 2014; Michigan Department of Education, 2019; New York State of

Education Department, 2019; Texas Education Agency, 2020). Therefore, to avoid using content in which participants may have already had considerable background knowledge and/or content that they may have learned about in school, passages about the history of the Americas were selected. This was intended to help eliminate any effects on reading comprehension that may have been due to school-based instruction rather than the accommodation conditions. Thirty passages were created, and the order of these passages was randomly assigned for each participant. Participants read between twenty-two and twenty-six passages throughout the study.

Reading Comprehension Accommodation Technology

Participants either read the expository reading passages in a silent independent manner (no accommodation condition) or with the support of various reading comprehension accommodation technologies and supports, including the read-aloud accommodation, vocabulary support, and/or comprehension monitoring, which are further described below.

Read-Aloud Accommodation. For the current study, Natural Reader, an online text-to-speech software, was used as the read-aloud accommodation (NaturalReader, n.d.).

Vocabulary Support. For the current study, vocabulary support materials included an additional document tab that displayed a list of vocabulary words from the passage and the corresponding definitions. In addition, passages used in this condition were adapted versions in which pre-selected vocabulary words were highlighted with blue font (See Appendix C for how vocabulary words were chosen).

Comprehension Monitoring. For the current study, the comprehension monitoring support included adaptations of the passages such that a pause sign was embedded in the given passage; the pause sign was the signal for the participant to summarize the passage verbally.

Independent and Dependent Variables

The independent variable for this study was reading accommodation status (e.g., no accommodation condition, decoding condition, and decoding + language comprehension condition). Each phase of the study had at least one condition. Specifically, within the baseline phase, all sessions were administered under the no accommodation condition, within the treatment comparison phase, sessions were administered in an alternating fashion under no accommodation conditions, decoding conditions, and decoding + language comprehension conditions, and within the best accommodation phase, all sessions were administered under either decoding conditions or decoding + language comprehension conditions. The no accommodation condition consisted of participants reading passages independently and silently. The decoding condition consisted of using the read-aloud accommodation. The decoding + language comprehension condition consisted of using the read-aloud, vocabulary support, and comprehension monitoring accommodations. All the conditions are described in more detail in the procedures section below.

The primary dependent variable for this study was the percentage of content words recalled. To verify these results, the number of words recalled was also measured. The measures were derived from participant responses to the recall reading comprehension prompt ("Now that you have read about _____ (title of the passage), please tell me all about what you just read. Try to tell me everything you can. Begin.") that was presented after participants read the given reading passage under the respective condition.

Percentage of Content Words Recalled Measure

The percentage of content words recalled measure was the number of distinct content words recalled (i.e., proper nouns, common nouns, verbs, adjectives, and adverbs) that were

either an exact match or an exact match with a different tense to a word in the passage divided by the total number of distinct content words in the passage (i.e., proper nouns, common nouns, verbs, adjectives, and adverbs). The percentage of content words recalled measure was adapted from Fuchs and colleagues (1988). See Appendix D for specific steps to create the content words lists necessary to calculate this score (i.e., content words recalled and content words in the passage). Past studies have measured the technical adequacy of the percentage of content words recalled measure and found the test-retest reliability ranged from .27-.69, and interrater reliability ranged from 92%-99% (Good & Kaminski, 2010). As for the validity, the correlation of the percentage of content words recalled with performance on two comprehension subtests on the Stanford Achievement Test, 7th edition (Gardner et al., 1983) was .67 (Fuchs et al., 1988). As noted earlier, the passages used for the current study were selected specifically for the study, and so technical adequacy information for this measure as applied in the current study using the selected passages was unknown, apart from the pilot information and inter-rater reliability information presented in sections below.

Number of Words Recalled Measure

The number of words recalled measure was a direct count of the number of words the participant said while recalling the passage. Any word spoken was counted, but non-word sounds (e.g., 'um,' 'uh') were not counted. Contractions were counted as two words. If the participant mispronounced a word but the word was close enough to recognize, the word was counted. Past studies have measured the technical adequacy of the number of words recalled measure and found the test-retest reliability to be .72 (Friedman & Miyake, 2005). As for validity, correlations of total words recalled with performance on comprehension subtests of two standardized reading measures (i.e., GRADE and TerraNova) ranged from .39 to .51 (Riedel, 2007). It is important to

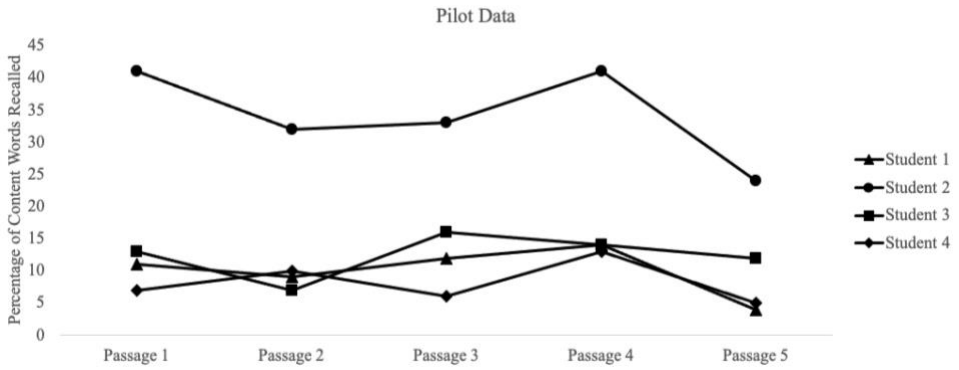
note that although the same score calculations were used in the current study, the passages for the current study were selected specifically for the study, so technical adequacy for the number of words recalled measure using these passages was unknown. However, strict passage selection criteria were used to help promote technical adequacy. More specifically, all passages were selected due to meeting the Flesch-Kincaid reading grade level score between 7.00 and 7.60. Also, the passages focused on social studies content associated with what students typically learn in fifth and sixth grade to prevent potential confounding with background knowledge of the participating students (who had not yet entered 5th grade). Additional information on piloting and inter-scorer reliability for the selected passages was provided in the sections below.

Pilot

To help offer evidence that the selected reading comprehension measures, when applied to new passages, could be anticipated to show stability over time for individual participants, the measures were piloted using recall information from four participants involved in a pilot study (who were not participants in the main study). The pilot participants were asked to read five passages in a silent independent manner and recall what they read. All passages were read in one sitting. The pilot data showed some evidence of stability over time for individual participants (See Figure 1).

Figure 1

Pilot Data: Percentage of Content Words Recalled



Experimental Design

The primary researcher used an adapted alternating treatment design that consisted of three phases: baseline, treatment comparison, and best accommodation (Gast & Ledford, 2014). In the treatment comparison phase for this study, participants read passages across two treatment conditions (i.e., decoding condition and decoding + language comprehension condition) and one comparison condition (i.e., no accommodation condition). Prior to any data collection, a random number sequence tool through Microsoft Excel was used to order the three conditions across twelve sessions separately for each participant for the treatment comparison phase. Each session involved the participant reading and recalling one passage under the designated condition. After a sequence was created, it was determined whether it met the requirements for the study, and if it did not, another sequence was created until one met the requirements for each participant. If the sequence met the requirements, then this sequence was applied to a participant in the treatment comparison phase. The requirements were that the two reading accommodation conditions were administered for a total of five sessions each, the no accommodation condition was administered for two sessions, and no more than two consecutive sessions of the same condition occurred within the sequence. See the hypothetical table in Table 3. Once the condition sequence for an

individual student was determined, the corresponding accommodation technologies described earlier (i.e., embedded pause sign, vocabulary words selected and highlighted with blue font, etc.) were applied to the passages that had been randomly assigned for that student in the corresponding sessions.

Table 3

Hypothetical Condition Sequence During the Alternating Treatment Phase

	Sessions												Met Criteria
A	LC	LC	D	D	NA	LC	LC	NA	D	D	LC	D	Yes
B	D	LC	NA	LC	D	D	NA	D	LC	LC	D	LC	Yes
C	LC	NA	D	D	LC	D	D	NA	LC	LC	LC	D	No
D	D	D	LC	NA	D	LC	NA	D	D	LC	LC	LC	No

Note: D = Decoding condition; LC = Decoding + Language Comprehension condition; NA = No Accommodation condition; Yes = the sequence met the criteria; No = the sequence did not meet the criteria

A baseline phase was conducted until the percentage of content words recalled scores showed stability and provided a solid baseline to use as a comparison for the treatment comparison phase (Wolery et al., 2018). During the baseline phase, the measurement of reading comprehension served as a control to establish the level of reading comprehension before the accommodation conditions were introduced (Gast & Ledford, 2018). At a minimum, there were five no accommodation condition sessions administered during the baseline phase. Prior to the commencement of the alternating treatment phase for each participant, the last three data points for the percentage of content words recalled measure showed either a stable or decreasing trend.

After baseline, but prior to the treatment comparison phase, participants completed pre-training; where they were exposed to all three accommodations. The pre-training was done to ensure that participants were comfortable with using the accommodations. Without this step, a

participant's lack of comfort or skill in using the accommodation(s) could have severely affected the ability to detect potentially strong positive effects of the accommodation(s).

The second phase, or the treatment comparison phase, consisted of alternating between the two accommodation conditions to compare the relative efficiency of the conditions. Additionally, in this phase, two sessions that included no accommodation were completed in order to help confirm that any potential change in reading comprehension scores was due to the accommodations and not a practice effect.

The third phase, or the best accommodation phase, consisted of the participant receiving the accommodation condition that resulted in the highest percentage of content words recalled score during the treatment comparison phase. The purpose of the best accommodation phase was to mitigate multitreatment interference, a type of threat to internal validity. Multitreatment interference occurs when one condition influences performance during another condition (Wolery et al., 2018). This threat to internal validity typically happens during the treatment comparison phase in the form of a rapid alteration effect (Wolery et al., 2018), which was when performance was affected by rapidly changing conditions (Hains & Baer, 1989). The best accommodation phase consisted of five sessions.

Procedures

Pre-Experimental Procedures

After Institutional Review Board approval, flyers (See Appendix E) were sent to reading disability organizations, groups for parents of children with reading disabilities, local teachers, and various businesses in order to recruit possible participants. Guardians who contacted the primary researcher were sent a consent form and were asked about their child's reading background.

The reading background questions were used as the first step in screening participants for the study. Based on the reading background questions, a participant was selected if their guardian reported that their child struggled with reading. Before administering the assessments, the researcher met with the guardian(s) and child via Zoom to discuss the study and determine if they passed a technology check. This check involved exploring whether the participant's internet speed was sufficient for adequate data collection (e.g., lack of substantial video and/or sound lag, lack of Zoom connection issues, etc.). If related concerns were identified, the researcher initially worked to troubleshoot the issues with the family, but if the connection could not be improved, the participant would be discontinued from the study. No participants were discontinued due to computer issues in the study. Chosen participants were administered pre-test measures to determine if they met the specific criteria described in the participants section.

After a participant met the criteria, they began the study. When participants completed their pre-tests, they were sent a Scholastic gift card regardless of being chosen for the study. Participants not chosen for the study were also sent reading resources such as suggested reading interventions and techniques.

Measures Used to Determine Eligibility and Category (i.e., Pre-testing). The following measures were used to determine eligibility and to categorize participants based on the SVR conceptualization of reading difficulties.

Reading Background Questions. To screen participants for the study, each guardian was asked questions about their child's reading background. The questions were, "Does your child struggle in reading? If so, do you know what they struggle with while reading?" (See Appendix G). To be eligible, a guardian had to indicate "yes" that their child struggled in reading. The

guardian's answer to the second question was used to determine the nature of the child's difficulties.

Reading Eligibility Tests. The computerized versions of the tests were administered online by a doctoral-level school psychology intern and used to determine eligibility for the study (See Appendix F for information on administering computerized versions of Pearson assessments). The reliability and validity evidence presented below for each subtest represents evidence for the in-person test format; reliability and validity for the online computerized versions have not been published. However, some initial research has suggested that there was no significant difference between scores acquired in-person and virtually on cognitive and achievement assessments (Hamner et al., 2021; Wright, 2020).

Woodcock Reading Mastery Tests, Third Edition (WRMT-III) Word Attack Subtest. To measure decoding, the WRMT-III word attack task was administered. The measure required participants to read nonsense words; this exercise was designed to specifically test phonological and structural analysis skills (Woodcock, 2011). Indicators of reliability for alternative-form, test-retest, and interrater agreement have been found to be .74 or higher (Woodcock, 2011). With respect to validity, the WRMT-III word attack subtest correlates with the Woodcock-Johnson Tests of Achievement word attack subtest at .55 (Woodcock, 2011) and the Expressive Vocabulary Test (Williams, 2007) at .73 (Woodcock, 2011).

Woodcock Reading Mastery Tests, Third Edition (WRMT-III) Listening Comprehension Subtest. The WRMT-III listening comprehension task measured the participants' ability to comprehend spoken language. A recording of the passages was played to the participants, and the examiner requested that they answer associated questions about the passages (Woodcock, 2011). This task measured both literal and inferential comprehension

skills. Measures of reliability for alternative-form, test-retest, and interrater agreement have been found to be .74 or higher (Woodcock, 2011). With respect to validity, correlations between the WRMT-III listening comprehension subtest and WLPB-R listening comprehension subtest have been found to be .74, which was relatively high (Day, 2017). The listening comprehension subtest was used as a proxy for measuring participants' language comprehension skills.

Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V) Digit Span Subtest. The WISC-V digit span task measured the participants' working memory. The examiner read a sequence of numbers, and the participants were asked to recall the numbers in the same order, reverse order, and ascending order (Wechsler, 2014). Measures of reliability for split test and test-retest have been found to be .79 or higher (Wechsler et al., 2014). With respect to validity, a correlation between the WISC-V digit span subtest and the WISC-IV digit span subtest has been found to be .65 (Wechsler et al., 2014). Also, the correlation between the WISC-V digit span subtest and Wechsler Adult Intelligence Scale Fourth Edition (WAIS-IV) digit span subtest has been found to be .80 (Wechsler et al., 2014).

General Procedures

Scripted protocols were used to ensure all participants received the same training and instructions for each session during the different phases (See Appendix H-L). The protocols introduced the procedures of the sessions, including instructions for each step of the session. Participants did not receive feedback on their performance during the sessions, and dialogue was restricted to general comments before and after the session. These general comments included rapport-building topics, such as their favorite school activities, books, sports, television shows, etc. During all study phases, if participants asked for assistance with technology, the researcher provided assistance. However, no assistance was provided if it was deemed to potentially

compromise the reading comprehension measurement. For example, if a participant forgot how to activate the read-aloud, the researcher walked the participant through the correct steps. However, if the participant queried whether they forgot anything in their recall, the researcher said, “just try your best.”

All sessions were video recorded via Zoom, and all participants’ recalls were transcribed based on the video recording. To evaluate treatment integrity, a trained observer monitored procedural implementation for at least 20% of sessions across all phases (Horner et al., 2005) using the treatment integrity checklist (See Appendix I-L). Treatment integrity was calculated by dividing the number of items marked as done correctly on the checklist by the total number of items on the checklist and then multiplying by one hundred to yield a percentage (see Data Analysis section; Gast & Ledford, 2014). The primary researcher was the only one to implement the conditions.

A schedule was created for each participant and included one or two meetings per week with two or three sessions per meeting (see Appendix M for an example schedule). Some families needed an adapted schedule to participate in the study, so changes that resulted in more or fewer sessions per meeting were made. For example, a few families desired fewer meetings, so they had four sessions per meeting.

At the start of every meeting, the researcher referenced the participant’s passage schedule and pulled up the correct passage on the computer. The researcher read the title of the passage and walked the participant through the appropriate steps to activate the reading accommodation(s) that needed to be activated for the given condition (if any). After the participant finished reading the passage, the researcher stopped sharing the screen and provided the prompt associated with the two reading comprehension measures.

Participants who were chosen were sent additional Scholastic gift cards after baseline, in the middle, and at the end of the study. After the last session, the researcher met with the family to go over the participant's results, and the researcher suggested reading resources that the participant might find helpful.

Baseline

At the start of each no accommodation condition session, a passage was displayed on the computer screen, and the participant was told to begin reading independently and silently. If participants started to read passages aloud during the baseline phase, they were immediately reminded to read the passages silently. A scripted protocol was used for all no accommodation condition sessions (See Appendix H-I).

Pre-training

Participants were shown how to use all three accommodations. Specifically, the researcher used explicit instruction, including modeling and guiding, to teach the participant how to use all the accommodations. For example, the researcher demonstrated how to use the accommodation(s) and then walked the participant through how to use the accommodation(s) step by step (see Appendix J for scripted protocol). After the participant finished reading the passage, they were told to recall what they read.

Treatment Comparison

During the treatment comparison phase, participants alternated between the two reading comprehension accommodation conditions and a no accommodation condition.

Decoding Condition. The researcher directed the participant to activate the read-aloud accommodation. The participant clicked on the blue "N" at the top right corner of the screen and then the play button. They were also told to tell the researcher when they were done listening to

the passage. If the participant did not start the reader, they were instructed to listen to the passage instead of reading independently. A scripted protocol was used for all decoding condition sessions (See Appendix K).

Decoding + Language Comprehension Condition. The researcher directed the participant to use all three of the accommodations: read-aloud accommodation, vocabulary support, and comprehension monitoring. The researcher first directed the participant to right-click on the word "vocabulary" in blue under the title of the passage and "open link" to open another tab. Then, the participant was directed to open the read-aloud and listen to the definitions. To open the read-aloud, the participant clicked on the blue "N" at the top right of the screen and then the play button. If the participant did not click on the word vocabulary and/or did not listen to all the definitions, they were instructed to listen to all definitions before listening to the passage.

After listening to the definitions, the participant was told to go back to the passage tab and press play to listen to the passage. The researcher reminded the participant to pause the reader when they got to the pause sign and then tell the researcher in their own words what they have read. After listening to the participant summarize, the researcher told the participant to continue listening to the passage and say when they were done. If a participant skipped the pause sign, they were told to go back and complete it before continuing to read the passage. A scripted protocol was used for all decoding + language comprehension condition sessions (See Appendix L).

No Accommodation Condition. At the start of each no accommodation condition session, a passage was displayed on the computer screen, and the participant was told to begin

reading independently and silently. A scripted protocol was used for all no accommodation condition sessions (See Appendix I).

Best Accommodation

During the best accommodation phase, participants used the reading comprehension accommodation condition that resulted in the highest reading comprehension score based on the percentage of content words recalled measure. The percent of non-overlapping data formula (See Data Analysis section for more information) was applied to the percentage of content words recalled measure during the treatment comparison phase to determine the best accommodation condition. A scripted protocol was used for all best accommodation phase sessions (See Appendix K-L).

Interscorer Agreement

Scorer Training

In order to reduce the potential for bias, it was deemed necessary to train a secondary scorer for the reading comprehension measures who was blind to the condition under which the given measures were administered and the participant to whom the passage was administered. Scoring by this individual was then compared to the primary researcher's scores to examine the inter-scorer agreement. High levels of interscorer agreement help to control for threats to internal validity in single-case research design (Ledford et al., 2018). Training of the blind secondary scorer included providing the scorer with a verbal and visual overview of the two measures (i.e., the percentage of content words recalled and the number of words recalled) and giving the scorer several opportunities to practice scoring measures completed by the pilot participants. The secondary scorer was expected to show strong accuracy with scoring the measures prior to starting to score the actual measures collected during the study. Specifically, the secondary

scorer needed a 90% agreement or higher with the anchor scorer (i.e., the primary researcher) on four consecutive passages. For each administered passage, the number of agreements was divided by the number of agreements plus the number of disagreements and then multiplied by one hundred.

$$\left(\frac{\#\ of\ Agreements}{(\#\ of\ Agreements + \#\ of\ Disagreements)}\right) X\ 100$$

For example, if scorer 1 counted 10 content words in the participant's recall and scorer 2 counted 9 content words, then the number of agreements (9) was divided by the number of agreements (9) plus the number of disagreements (1) and then multiplied by one hundred ($(9 \div (9 + 1)) \times 100 = 90$).

During the experimental component of the study, the anchor scorer scored all the passages, and the secondary scorer scored 96% of the passages. Anytime more than a 10% difference occurred on a single passage between the anchor scorer and a secondary scorer then the scorers double-checked their response to determine if any clear mistakes were made. If no clear mistakes were made, then the scorers met to discuss their responses and come to an agreement.

Interscorer Reliability for Participant Data

It was critical to establish a strong interscorer reliability after the baseline and treatment comparison phases to ensure decisions made at the end of each phase were made based on reliable data. The anchor scores were the scores reported and used to analyze the data, while the secondary scorer's scores were used to check whether the anchor scores were reliable.

The intraclass correlation coefficient (ICC) was used to calculate interscorer reliability. The ICC was calculated to estimate the overall reliability between the anchor scorer and the

secondary scorer. The two-way mixed-effects model was used when calculating the ICC because the anchor scorer and secondary scorer were the only scorers of interest (Koo & Li, 2016). During the baseline phase, the ICC value indicated excellent reliability between the anchor scorer and secondary scorer for the percentage of content words recalled measure [ICC=0.986 with a 95% confidence interval of 0.961 to 0.994 ($F(42,42) = 95.754$, $p<.001$)] and there was perfect reliability between the anchor scorer and secondary scorer for the number of words recalled measure. During the alternating treatment phase, the ICC value indicated excellent reliability between the anchor scorer and secondary scorer on the percentage of content words recalled measure [ICC=0.993 with a 95% confidence interval of 0.985 to 0.997 ($F(82, 82) = 194.294$, $p<.001$)] and perfect reliability between the anchor scorer and secondary scorer on the number of words recalled measure. When considering all data during the experimental portion of the study, the ICC value indicated excellent reliability between the anchor scorer and secondary scorer on the percentage of content words recalled measure [ICC=0.986 with a 95% confidence interval of 0.966 to 0.992 ($F(125, 125) = 178.564$, $p<.001$)] and perfect reliability between the anchor scorer and secondary scorer on the number of words recalled measure. Based on the ICC analysis, the decisions to move to the treatment comparison phase and the best accommodation condition decisions were based on reliable information.

Procedural Fidelity

Procedural fidelity is important in single-case design studies because the independent variables are applied over time (Ledford & Gast, 2018). Measuring procedural fidelity is also important because if the treatment were administered incorrectly, then the results would have been based on inaccurate information. To promote procedural fidelity, scripted protocols were used to ensure all participants received the same training and all sessions had standardized

administration scripts (Appendix H-L). Checklists corresponding with the scripted protocols were created to allow the research assistant to observe and indicate the extent to which the primary researcher followed the scripted protocols. After the completion of the checklist, the percentage of items completed correctly was calculated.

To establish procedural fidelity, the research assistant watched the video recording of the session and completed the fidelity checklist for each selected session. Specifically, procedural fidelity was calculated by dividing the number of items marked as correctly completed on the checklist by the total number of items on the checklist and then multiplying by one hundred to yield a percentage (Gast & Ledford, 2014):

$$\left(\frac{\#\ correct\ items}{total\ \#\ of\ items}\right) X\ 100$$

Procedural Fidelity Training

During the procedural fidelity training, an independent research assistant was trained to observe the sessions to determine if they were administered with fidelity until they met a specific criterion level of performance on the no accommodation, pre-training, decoding condition, and decoding + language comprehension condition. The research assistant was expected to show strong accuracy in calculating procedural fidelity (i.e., 100%) prior to starting to score actual implementation videos. The training entailed an overview of the phases, along with watching implementation videos and calculating fidelity based on checklists. Artificial videos created by the primary researcher and videos from the pilot study were used as practice videos for the research assistant. The research assistant's ability to accurately determine whether the sessions were administered with fidelity during the training sessions was calculated using the same agreement formula used in the scorer training section above. For example, if the primary researcher gave a session 9/10 based on the checklist and the research assistant gave the session a

10/10 based on the checklist, then the number of agreements (9) was divided by the number of agreements (9) plus the number of disagreements (1) and then multiplied by one hundred ($(9 \div (9 + 1)) \times 100 = 90$). When compared to the primary researcher, the research assistant was able to calculate the procedural fidelity with 100% accuracy during procedural fidelity training.

Procedural Fidelity for Participant Data

In case adjustments were needed, the research assistant watched the videos of the early sessions for each phase within a week of implementation. This allowed the primary researcher to make corrections early if any were needed. Besides the early sessions, sessions from each phase were randomly selected for procedural fidelity checks and were conducted for at least 20% of the sessions within the baseline phase, the session within the pre-training phase (where participants were taught how to use the accommodations), 20% of the sessions within the treatment comparison phase, and 20% of the sessions within the best accommodation phase. The procedural fidelity ranged from 99% to 100% across all phases.

Data Analysis

To evaluate the effectiveness of the different accommodation conditions, three approaches were used: an examination of the visual analysis, percent of non-overlapping data, and Wilcoxon Signed-rank test. Visual analysis was used to provide an in-depth evaluation of data within and across all participants and variables (Kazdin, 2011). For the primary dependent variable (i.e., percentage of content words recalled), the data were inspected visually within each phase and corresponding conditions to identify (a) trend (i.e., overall direction of data path); (b) stability (i.e., variability of the data); (c) level (magnitude of the data; Ledford & Gast, 2018). A between condition analysis was used to examine the immediacy of effect, overlap, consistency of data patterns, or sudden changes in level (Ledford & Gast, 2018). The split-middle technique

was used to determine the trend (i.e., increase, decrease, no trend). The stability was defined as at least 80% of the data falling within a 20% range of the median level of all data points in each condition (Gast & Spriggs, 2010). The level was measured by calculating the median level for each condition and comparing it across phases.

To assess the results of the alternating treatment design the percent of non-overlapping data (PND) for the treatment comparison phase were examined (Scruggs et al., 1987). Specifically, participant performance during the reading comprehension accommodation conditions in the treatment comparison phase was compared to their performance during the no accommodation condition in the baseline phase. Each accommodation condition was separately compared to the baseline phase. PND was calculated by counting the number of sessions an accommodation condition was superior to the highest baseline data point and dividing by the total number of accommodation condition sessions (Parker & Hagan-Burke, 2007). For example, if the decoding condition had three out of five sessions that were superior to the highest baseline data point, PND would be:

$$\frac{3}{5} \times 100 = 60\%$$

The PND was also used to determine the best accommodation condition for the best accommodation phase.

The nonparametric Wilcoxon Signed-rank test (Wilcoxon, 1992) was used to determine if there were significant differences between conditions. Specifically, each participant's data were treated as an individual case of ordinal data (i.e., within student), and the medians of each accommodation condition during the alternating treatment phase were compared to the no accommodation conditions in the baseline phase. The best accommodation phase was compared to the adjacent accommodation condition during the alternating treatment phase and the baseline

phase. Statistical Package for Social Sciences (SPSS version 28) was used to run the Wilcoxon Signed-rank Test and to calculate the significance. Using SPSS, a test statistic and its significance were calculated. An effect size was then calculated using the formula $r = \frac{z}{\sqrt{N}}$ with N representing the total number of samples. An effect size larger than 0.5 may be interpreted as large, medium when between 0.3 and 0.5, and small when it is less than 0.3 (Cohen, 1969).

CHAPTER IV: RESULTS

This study examined the effects of reading accommodations on reading comprehension for students with decoding difficulties. After independently reading expository reading passages in a baseline phase, participants alternated between the decoding condition (i.e., read-aloud accommodation) and the decoding + language comprehension condition (i.e., read-aloud accommodation, vocabulary support, and comprehension monitoring) in the alternating treatment phase. The researcher examined reading comprehension scores to determine the extent to which (a) the use of the read-aloud accommodation affected general comprehension of text-based material for students with word decoding difficulties, and (b) the use of the read-aloud accommodation, vocabulary support, and comprehension monitoring affected general comprehension of text-based material for students with word decoding difficulties.

Four main findings of the study were: (a) the difference between the decoding condition and baseline phase was not associated with a statistically significant effect for any participants; (b) two out of the seven participants displayed a positive statistically significant difference between the decoding + language comprehension condition and the baseline phase; (c) the visual differences between the decoding condition and baseline phase were inconsistent, and the majority of participants showed no visual difference between the scores in the no accommodation and decoding condition; and (d) the visual differences between the decoding + language comprehension condition and baseline phase were inconsistent, and the visual difference between the scores in the no accommodation condition and decoding + language comprehension condition were inconsistent.

James

James participated in a total of 23 sessions over 11 meetings with no treatment interruptions. James actively participated in each session, and sessions occurred as originally planned. James had one to three sessions per meeting.

Visual Analysis

Percentage of Content Words Recalled. Figure 2 represents James' percentage of content words recalled across all phases of the study and displayed across sessions; Figure 3 displays the data across meetings. The data were displayed both across sessions and across meetings to determine whether James experienced any practice effects within meetings more accurately. Table 4 represents a data analysis summary of James' percentage of content words recalled for each condition during the three phases. During the baseline phase, James' percentage of content words recalled ranged from 9.6% to 20.7% (Median Level=12.9%). During meetings two and three, James had a slightly increased percentage of content words recalled during the second session. Baseline data were considered stable, in that 83% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-middle technique indicated an increasing trend (White & Haring, 1980). To control for the variable trend present across the third, fourth, and fifth baseline data points, a sixth baseline passage was administered. Following this administration, the last three baseline data points showed a visually stable trend (See Figure 2).

During the alternating treatment phase, James' percentage of content words recalled in the *decoding + language comprehension condition* immediately increased (21.3%) compared to his performance in the last session of baseline (14.0%). James' percentage of content words recalled for the decoding + language comprehension condition during the alternating treatment

phase ranged from 14.7% to 21.3% (Median Level = 18.1%). Only the ninth meeting had two sessions of the decoding + language comprehension condition, and James had a lower percentage of content words recalled during the second session. Data were considered stable in that 80% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Using the split-middle technique, James' data exhibited a decreasing trend (White & Haring, 1980).

During the alternating treatment phase, James' first percentage of content words recalled in the *decoding condition* slightly decreased (13.3%) compared to his performance in the last session of baseline (14.0%). James' percentage of content words recalled for the decoding condition during the alternating treatment phase ranged from 13.1% to 23.3% (Median Level = 20.9%). Only the sixth meeting had two sessions of the decoding condition, and James had a higher percentage of content words recalled during the second session. Data were considered stable in that 80% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). The split-middle technique rendered an increasing trend (White & Haring, 1980).

Using the split-middle technique, James' *no accommodation condition* data exhibited an increasing trend (White & Haring, 1980). Visually, there seemed to be only a small difference between the scores in the no accommodation condition and the two reading accommodation conditions.

Based on the percentage of non-overlapping data analysis (see associated results presented in a later section), the decoding condition was identified as the best accommodation condition and used for the best accommodation phase. During the best accommodation phase, James' first percentage of content words recalled decreased (14.6%) compared to his performance in the last session of the decoding condition in the alternating treatment phase (20.9%). With the exception of the highest score in the best accommodation phase (28.7%), all

the other data points in the phase overlapped with the decoding condition in the alternating treatment phase. During the best accommodation phase, James' first percentage of content words recalled slightly increased (14.6%) compared to his performance in the last session of the baseline phase (14.0%). With the exception of the highest score (28.7) in the best accommodation phase, the other data points in the phase overlapped with the baseline phase. Visual inspection of James' data during the best accommodation phase with the decoding condition revealed data ranging from 12.3% to 28.7% (Median Level = 14.6%). Data were considered variable, as only 60% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-method technique indicated an increasing trend (White & Haring, 1980).

Overall, visually there was no clear data separation between the reading comprehension conditions and the baseline phase.

Figure 2

James' Percentage of Total Content Words Recalled (Sessions)

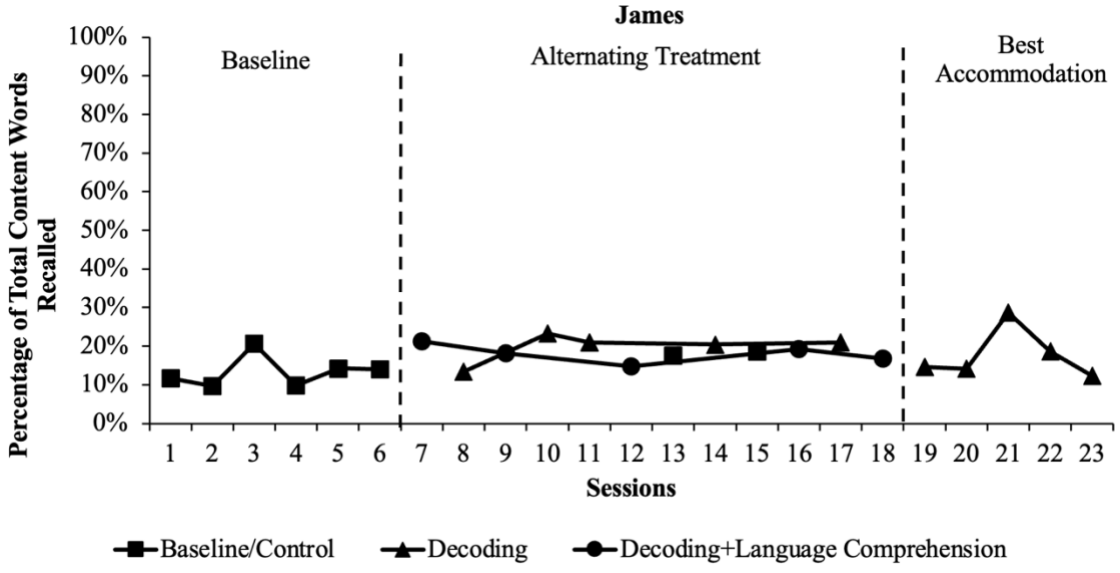


Figure 3

James' Percentage of Total Content Words Recalled (Meetings)

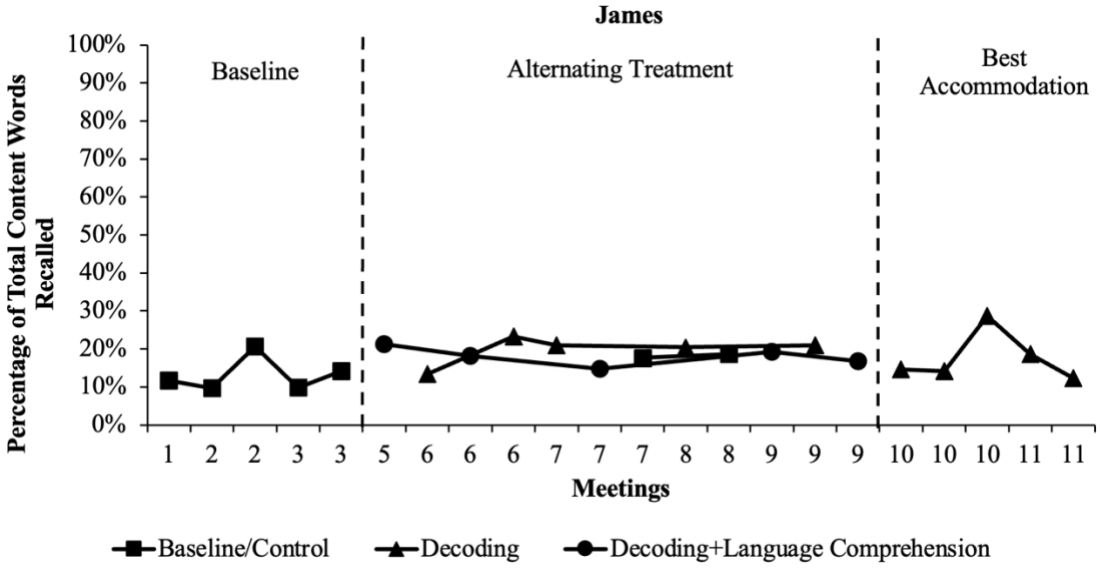


Table 4

Data Analysis Summary of James' Percentage of Total Content Words Recalled

Measure	Baseline	Decoding + Language[a]	Decoding[b]	No Accommodation[c]	Best Accommodation
Range	9.6-20.7%	14.7-21.3%	13.1-23.3%	17.6-18.6%	12.3-28.7%
Median	12.9%	18.1%	20.9%	18.1%	14.6%
Trend	Increasing	Decreasing	Increasing	Increasing	Increasing
Stability	Stable	Stable	Stable	Stable	Variable

Note: [a] = decoding + language comprehension condition; [b] = decoding condition; [c] = no accommodation condition

Percentage of Non-Overlapping Data

The percentage of content words recalled measure was used to calculate the percentage of non-overlapping data. One score in the decoding + language comprehension condition was higher than the highest score in the baseline phase ($\frac{1}{5} \times 100 = 20\%$). Three scores in the decoding condition were higher than the highest score in the baseline phase ($\frac{3}{5} \times 100 = 60\%$). Therefore, the decoding condition was chosen for the best accommodation condition.

Wilcoxon Signed-Rank Test and Sign Test

The Wilcoxon signed-rank test and sign test were used to determine if there was a significant difference between conditions for the percentage of content words recalled. For the Wilcoxon signed-rank test and sign test, it is required to have an equal number of data points in the two conditions being compared. Therefore, sessions two through six were used for the baseline phase because the last three baseline data points show a stable trend, which indicates that the participant was able to move on to the next phase.

***Decoding + Language Comprehension Condition vs. Baseline Phase*.** Due to the fact that the difference scores were approximately symmetrically distributed, as assessed by a histogram with a superimposed normal curve, a Wilcoxon signed-rank test was conducted. James had a higher percentage of content words recalled during the decoding + language comprehension condition in the alternating treatment phase (*Mdn* = 18.1%) than during the baseline phase (*Mdn* = 14.0%). The median difference produced (*Mdn* = 4.9%) was not statistically significant (z = -1.8; p = .08). The effect size of treatment was calculated (z = -1.8, N = 10, r = -.6) and demonstrated a large effect. Table 5 illustrates the results of the Wilcoxon signed-rank test.

Table 5

James' Wilcoxon Signed-Rank Test Results for the Decoding + Language Comprehension Condition vs. Baseline Phase

Test Statistic[a]	Decoding + Language Comprehension vs. Baseline % of Content Words Recalled[b]
Median Difference	4.9%
Z	-1.8
Asymp. Sig.[c] (Two-Tailed)	.08

Note: [a] = Wilcoxon signed-rank test; [b] = percentage of content words recalled; [c] = asymptotic significance

Decoding Condition vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. James had a higher percentage of content words recalled during the decoding condition in the treatment comparison phase (*Mdn* = 20.9%) than during the baseline phase (*Mdn* = 14.0%). The produced median difference (*Mdn* = 6.2%) was not statistically significant ($p = .06$). Table 6 illustrates the results of the sign test.

Table 6

James' Sign Test Results for the Decoding Condition vs. Baseline Phase

Test Statistic[a]	Decoding vs. Baseline % of Content Words Recalled[b]
Median Difference	6.2%
Exact. Sig.[c] (Two-Tailed)	.06

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Best Accommodation Phase vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. James had a slightly higher percentage of content words recalled during the best accommodation phase (*Mdn* = 14.6%) than during the baseline phase (*Mdn* = 14.0%). The median difference produced (*Mdn* = 4.4%) did not elicit a statistically significant difference (p = 1.00). Table 7 illustrates the results of the sign test.

Table 7

James' Sign Test Results for the Best Accommodation Phase vs. Baseline Phase

Test Statistic[a]	Best Accommodation vs. Baseline % of Content Words Recalled[b]
Median Difference	4.4
Exact. Sig.[d] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

James' Overall Data Analysis Summary

Table 8 represents a data analysis summary of James' Wilcoxon signed-rank test and sign test for the percentage of content words recalled and the number of words recalled. Additional analyses were run for the number of words recalled. As presented below, there were no major differences in the scores James obtained for the percentage of words recalled and the number of words recalled.

Table 8

Data Analysis Summary of James' Wilcoxon Signed-Rank Test and Sign Test

Test Statistic	Median Difference		Exact. Sig.[a] (Two-Tailed)		Asymp. Sig.[b] (Two-Tailed)	
	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]
Decoding + LC vs. Baseline[e]	4.9	34	--	.38	.08	--
Decoding vs. Baseline[f]	6.2	43	.06	--	--	.14
Best Accomm vs. Decoding[g]	-1.8	-9	1.00	1.00	--	--

Note: [a] = exact significant used for the sign test; [b] = asymptotic significance used for the Wilcoxon signed-rank test; [c] = percentage of content words recalled; [d] = number of words recalled; [e] = decoding + language comprehension condition vs. baseline; [f] = decoding vs. baseline; [g] = best accommodation vs baseline

The primary outcome of James' results indicated no difference between the baseline and the reading comprehension accommodation conditions. Specifically, based on the visual analysis, there was no clear data separation between the reading comprehension conditions and the baseline phase. The accommodation scores during the alternating treatment phase displayed no difference visually when compared to the two no accommodation session scores within that phase. Based on the PND, James' best accommodation was the decoding condition. Neither accommodation condition displayed a significant improvement over the baseline phase.

Although slight differences were found between the reading comprehension conditions and the baseline phase, the hypothesized pattern did not emerge in either condition.

Robert

Robert participated in a total of 23 sessions over 10 meetings with no treatment interruptions. Robert actively participated in each session, and sessions occurred as originally planned. Robert had one to four sessions per meeting.

Visual Analysis

Percentage of Content Words Recalled. Figure 4 presents Robert's percentage of content words recalled across all phases of the study and displayed across sessions; Figure 5 displays the data across meetings. The data were displayed both across sessions and across meetings to more accurately determine whether Robert experienced any practice effects within meetings. Table 9 represents a data analytic summary of Robert's percentage of content words recalled for each condition during the three phases. During the baseline phase, Robert's percentage of content words recalled ranged from 5.8% to 14.6% (Median Level = 9.3%). During meeting two, Robert had a slightly increased percentage of content words recalled during the second session. Baseline data were variable, as only 50% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-middle technique indicated an increasing trend (White & Haring, 1980). To control for the increasing trend across the third, fourth, and fifth baseline data points, a sixth baseline passage was administered. Following this administration, the last three baseline data points showed a visually decreasing trend (see Figure 4).

During the alternating treatment phase, Robert's percentage of content words recalled in the *decoding + language comprehension condition* immediately increased (7.7%) compared to

his performance in the last session of baseline (5.8%). Robert's percentage of content words recalled for the decoding + language comprehension condition during the alternating treatment phase ranged from 7.7% to 16.9% (median level = 13.3%). The fifth and seventh meeting had two sessions of the decoding + language comprehension condition, and Robert had a higher percentage of content words recalled during the second session. Data were considered variable, as only 60% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Using the split-middle technique, Robert's data exhibited an increasing trend (White & Haring, 1980).

During the alternating treatment phase, Robert's first percentage of content words recalled in the *decoding condition* slightly decreased (6.8%) compared to his performance in the last session of baseline (5.8%). Robert's percentage of content words recalled for the decoding condition during the alternating treatment phase ranged from 6.8% to 17.4% (Median Level = 13.3%). Only the sixth meeting had two sessions of the decoding condition, and Robert had a higher percentage of content words recalled during the second session. Data were considered variable, as only 60% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). The split-middle technique rendered an increasing trend (White & Haring, 1980).

Using the split-middle technique, Robert's *no accommodation condition* data exhibited an increasing trend (White & Haring, 1980). Visually there seems to be only a small difference between the scores in the no accommodation condition and the two reading accommodation conditions.

Based on the percentage of non-overlapping data analysis (see associated results presented in a later section), the decoding + language comprehension condition was identified as the best accommodation condition and used for the best accommodation phase. During the best accommodation phase, Robert's first percentage of content words recalled decreased (11.7%)

compared to his performance in the last session of the decoding + language comprehension condition in the alternating treatment phase (13.3%). All of the data points in the phase overlapped with the decoding + language comprehension condition in the alternating treatment phase. During the best accommodation phase, Robert's first percentage of content words recalled increased (11.7%) compared to his performance in the last session of the baseline phase (5.8%). All the data points in the best accommodation phase overlapped with the baseline phase. Visual inspection of Robert's data during the best accommodation phase with the decoding + language comprehension condition revealed data ranging from 7.8% to 11.7% (Median Level = 9.6%). Data were considered variable, as only 60% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-method technique indicated a trend of zero (White & Haring, 1980).

Overall, visually there was no clear data separation between the reading comprehension conditions and the baseline phase.

Figure 4

Robert's Percentage of Total Content Words Recalled (Sessions)

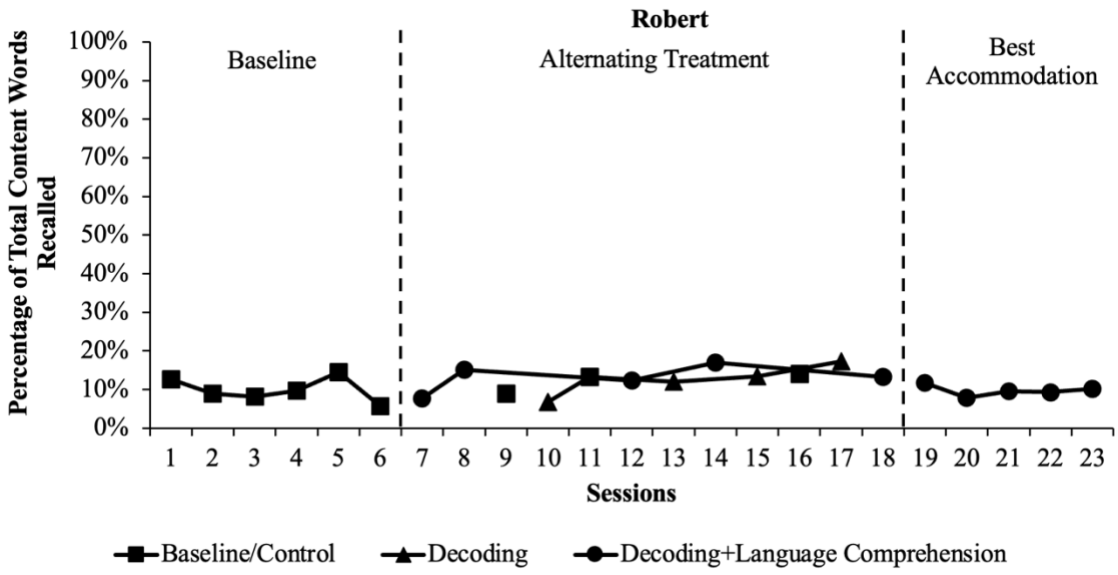


Figure 5

Robert's Percentage of Total Content Words Recalled (Meetings)

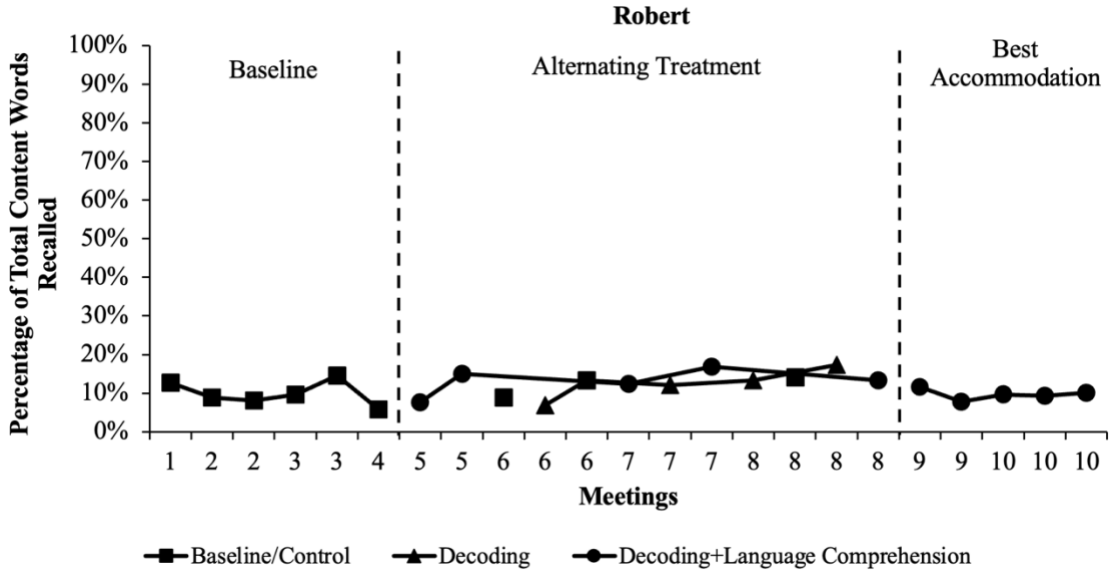


Table 9

Data Analysis Summary of Robert's Percentage of Total Content Words Recalled

Measure	Baseline	Decoding + Language[a]	Decoding[b]	No Accommodation[c]	Best Accommodation
Range	5.8%-14.6%	7.7%-16.9%	6.8%-17.4%	8.9%-14.1%	7.8%-11.7%
Median	9.3%	13.3%	13.3%	11.5%	9.6%
Trend	Increasing	Increasing	Increasing	Increasing	None
Stability	Variable	Variable	Variable	Variable	Variable

Note: [a] = decoding + language comprehension condition; [b] = decoding condition; [c] = no accommodation condition

Percentage of Non-Overlapping Data

The percentage of content words recalled measure was used to calculate the percentage of non-overlapping data. One score in the decoding condition was higher than the highest score in the baseline phase ($\frac{1}{5} \times 100 = 20\%$). In the decoding + language comprehension condition, two scores were higher than the highest score in the baseline phase ($\frac{2}{5} \times 100 = 40\%$). Therefore,

the decoding + language comprehension condition was chosen for the best accommodation condition.

Wilcoxon Signed-Rank Test and Sign Test

The Wilcoxon signed-rank test and sign test were used to determine if there was a significant difference between conditions for the percentage of content words recalled. For the Wilcoxon signed-rank test and sign test, it is required to have an equal number of data points in the two conditions being compared. Therefore, sessions two through six were used for the baseline condition because the last three baseline data points show a decreasing trend which indicates that the participant was able to move on to the next phase.

***Decoding + Language Comprehension Condition vs. Baseline Phase*.** Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. Robert had a higher percentage of content words recalled during the decoding + language comprehension condition in the alternating treatment phase (*Mdn* = 13.3%) than during the baseline phase (*Mdn* = 8.9%). The median difference produced (*Mdn* = 2.7%) was not statistically significant (p = .38). Table 10 illustrates the results of the sign test.

Table 10

Robert's Sign Test Results for the Decoding + Language Comprehension Condition vs. Baseline Phase

Test Statistic[a]	Decoding + Language Comprehension vs. Baseline % of Content Words Recalled[b]
Median Difference	2.7
Exact. Sig.[c] (Two-Tailed)	.38

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Decoding Condition vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. Robert had a higher

percentage of content words recalled during the decoding condition in the treatment comparison phase (*Mdn* = 13.3%) than during the baseline phase (*Mdn* = 8.9%). The produced median difference (*Mdn* = 2.4%) was not statistically significant (p = 1.00). Table 11 illustrates the results of the sign test.

Table 11

Robert's Sign Test Results for the Decoding Condition vs. Baseline Phase

Test Statistic[a]	Decoding vs. Baseline % of Content Words Recalled[b]
Median Difference	2.4
Exact. Sig.[c] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Best Accommodation Phase vs. Baseline Phase. Due to the fact that the difference scores were approximately symmetrically distributed, as assessed by a histogram with a superimposed normal curve, a Wilcoxon signed-rank test was conducted. Robert had a slightly higher percentage of content words recalled during the best accommodation phase (*Mdn* = 9.6%) than during the baseline phase (*Mdn* = 8.9%). The median difference produced (*Mdn* = -.07%) did not elicit a statistically significant difference (z = -.14; p = .89). The effect size of treatment was calculated (z = -.14, N = 10, r = -.04), highlighting a medium effect. Table 12 illustrates the results of the Wilcoxon signed-rank test.

Table 12

Robert's Wilcoxon-Signed Rank Test Results for the Best Accommodation Phase vs. Baseline Phase

Test Statistic[a]	Best Accommodation vs. Baseline % of Words Recalled[b]
Mean Difference	-.07
Z	-.14
Asymp. Sig.[c] (Two-Tailed)	.89

Note: [a] = Wilcoxon signed-rank test; [b] = percentage of content words recalled; [c] = asymptotic significance

Robert's Overall Data Analysis Summary

Table 13 represents a data analysis summary of Robert's Wilcoxon signed-rank test and sign test for the percentage of content words recalled and the number of words recalled. Follow-up analyses were run for the number of words recalled. As shown below, there were no major differences in the scores Robert obtained for the percentage of content words recalled and the number of words recalled.

Table 13

Data Analysis Summary of Robert's Wilcoxon Signed-Rank Test and Sign Test

Test Statistic	Median Difference		Exact. Sig.[a] (Two-Tailed)		Asymp. Sig.[b] (Two-Tailed)	
	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]
Decoding + LC vs. Baseline[e]	2.7	21	.38	.06	--	--
Decoding vs. Baseline[f]	2.4	22	1.00	.13	--	--
Best Accomm vs. Baseline[g]	-.07	32	--	--	.89	.50

Note: [a] = exact significant used for the sign test; [b] = asymptotic significance used for the Wilcoxon signed-rank test; [c] = percentage of content words recalled; [d] = number of words recalled; [e] = decoding + language comprehension condition vs. baseline; [f] = decoding vs. baseline; [g] = best accommodation vs. baseline

The primary outcome of Robert's results indicated no difference between the baseline and the reading comprehension accommodation conditions. Specifically, based on the visual analysis, there was no clear data separation between the reading comprehension conditions and the baseline phase. The accommodation scores during the alternating treatment phase displayed no difference visually when compared to the two no accommodation session scores within that phase. Based on the PND, Robert's best accommodation condition was the decoding + language comprehension condition. Neither accommodation condition displayed a significant improvement over the baseline phase. Although slight differences were found between the reading comprehension conditions and the baseline phase, the hypothesized pattern did not emerge for either condition.

John

John participated in a total of 23 sessions over 12 meetings with no treatment interruptions. John actively participated in each session, and sessions occurred as originally planned. John had one to three sessions per meeting.

Visual Analysis

Percentage of Content Words Recalled. Figure 6 represents John's percentage of content words recalled across all phases of the study and displayed across sessions; Figure 7 displays the data across meetings. The data were displayed both across sessions and across meetings to more accurately determine whether John experienced any practice effects within meetings. Table 14 represents a data analysis summary of John's percentage of content words recalled for each condition during the three phases. During the baseline phase, John's percentage of content words recalled ranged from 2.4% to 10.2% (Median Level= 6.4%). During meetings two and four, John had a lower percentage of content words recalled during the session. Baseline

data were considered variable, as only 50% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-middle technique indicated an increasing trend (White & Haring, 1980). To control for the increasing trend present across the third, fourth, and fifth baseline data points, a sixth baseline passage was administered. Following this administration, the last three baseline data points showed a visually decreasing trend (See Figure 6).

During the alternating treatment phase, John's percentage of content words recalled in the *decoding condition* increased (8.7%) compared to his performance in the last session of baseline (7.5%). John's percentage of content words recalled for the decoding condition during the alternating treatment phase ranged from 8.7% to 23.6% (Median Level = 20.9%). Data were considered stable in that 80% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Using the split-middle technique, John's data exhibited an increasing trend (White & Haring, 1980).

During the alternating treatment phase, John's first percentage of content words recalled in the *decoding + language comprehension condition* slightly increased (15.7%) compared to his performance in the last session of baseline (7.5%). John's percentage of content words recalled for the decoding + language comprehension condition during the alternating treatment phase ranged from 15.7% to 31.7% (Median Level = 23.2%). Only the ninth meeting had two sessions of the decoding + language comprehension condition, and John had a higher percentage of content words recalled during the second session. Data were considered variable, as only 60% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). The split-middle technique rendered an increasing trend (White & Haring, 1980).

Using the split-middle technique, John's n*o accommodation condition* data exhibited an increasing trend (White & Haring, 1980). Visually, the no accommodation condition seemed to be lower compared to the two reading comprehension conditions.

Based on the percentage of non-overlapping data analysis (see associated results presented in a later section), the decoding + language comprehension condition was identified as the best accommodation condition and used for the best accommodation phase. During the best accommodation phase, John's first percentage of content words recalled slightly decreased (24.6%) compared to his performance in the last session of the decoding + language comprehension condition in the alternating treatment phase (26.9%). All the data points in the phase overlapped with the decoding + language comprehension condition in the alternating treatment phase. During the best accommodation phase, John's first percentage of content words recalled increased (24.6%) compared to his performance in the last session of the baseline phase (7.5%). All the data points in the best accommodation phase were higher than the baseline phase. Visual inspection of John's data during the best accommodation phase with the decoding + language comprehension condition revealed data ranging from 17.5% to 24.6% (Median Level = 20.0%). During the ninth meeting in the best accommodation phase, John had a lower of percentage of content words recalled during the second session. Data were considered stable in that 80% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-method technique indicated an increasing trend (White & Haring, 1980).

Overall, visually there was clear data separation between the reading comprehension conditions and the baseline phase.

Figure 6

John's Percentage of Total Content Words Recalled (Sessions)

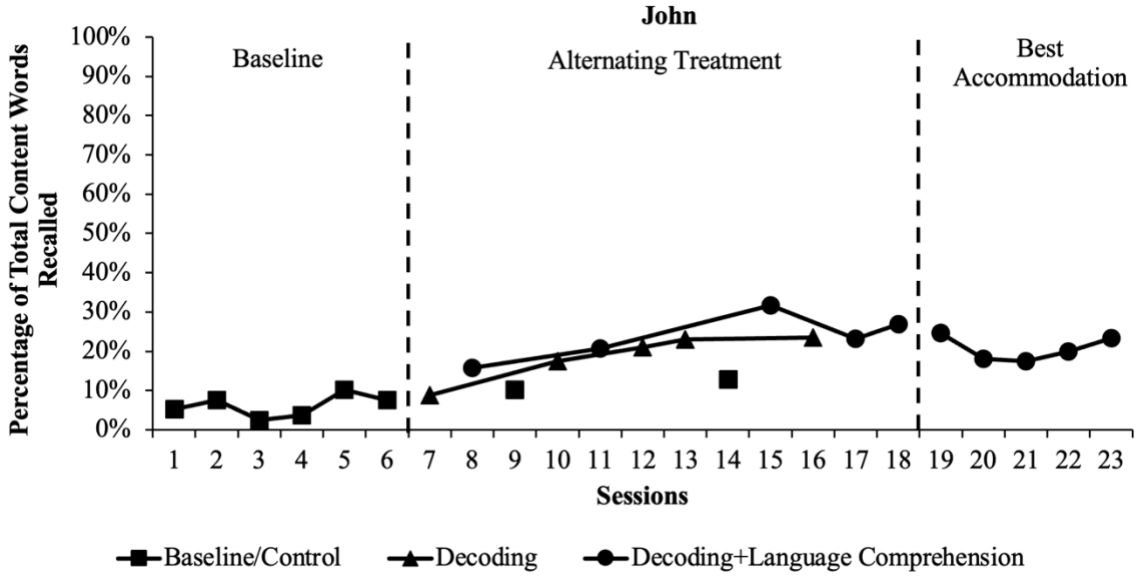


Figure 7

John's Percentage of Total Content Words Recalled (Meetings)

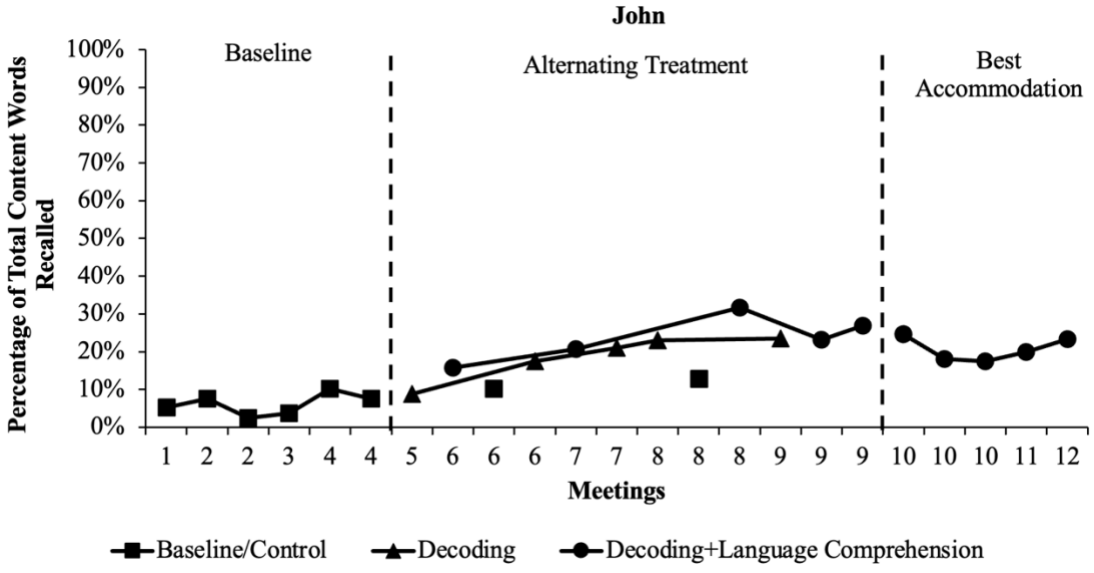


Table 14

Data Analysis Summary of John's Percentage of Total Content Words Recalled

Measure	Baseline	Decoding[a]	Decoding + Language[b]	No Accommodation[c]	Best Accommodation
Range	2.4%-10.2%	8.7%-23.6%	15.7%-31.7%	10.2%-12.8%	17.5%-24.6
Median	6.4%	20.9%	23.2%	11.5%	20%
Trend	Increasing	Increasing	Increasing	Increasing	Increasing
Stability	Variable	Stable	Variable	Stable	Stable

Note: [a] = decoding condition; [b] = decoding + language comprehension condition; [c] = no accommodation condition

Percentage of Non-Overlapping Data

The percentage of content words recalled measure was used to calculate the percentage of non-overlapping data. Four scores in the decoding condition were higher than the highest score in the baseline phase ($\frac{4}{5} \times 100 = 80\%$). Five scores in the decoding + language comprehension condition were higher than the highest score in the baseline phase ($\frac{5}{5} \times 100 = 100\%$). Therefore, the decoding + language comprehension condition was chosen for the best accommodation condition.

Wilcoxon Signed-Rank Test and Sign Test

The Wilcoxon signed-rank test and sign test were used to determine if there was a significant difference between conditions for the percentage of content words recalled. For the Wilcoxon signed-rank test and sign test, it is required to have an equal number of data points in the two conditions being compared. Therefore, sessions two through six were used for the baseline phase because the last three baseline data points show a decreasing trend which indicates that the participant was able to move on to the next phase.

***Decoding Condition vs. Baseline Phase*.** Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. John had a higher percentage of content words recalled during the decoding condition in the alternating treatment phase (*Mdn* = 21.0%) than during the baseline phase (*Mdn* = 7.5%). The median difference produced (*Mdn* = 15.0%) was not statistically significant (p = .06). Table 15 illustrates the results of the sign test.

Table 15

John's Sign Test Results for the Decoding Condition vs. Baseline Phase

Test Statistic[a]	Decoding vs. Baseline % of Content Words Recalled[b]
Median Difference	15
Exact. Sig.[c] (Two-Tailed)	.06

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Decoding + Language Comprehension Condition vs. Baseline Phase. Due to the fact that the difference scores were approximately symmetrically distributed, as assessed by a histogram with a superimposed normal curse, a Wilcoxon signed-rank test was conducted. John had a higher percentage of content words recalled during the decoding + language comprehension condition in the treatment comparison phase (*Mdn* = 23.2%) than during the baseline phase (*Mdn* = 7.5%). The produced median difference (*Mdn* = 18.3%) was statistically significant (z = -2.02, p = .04). The effect size of treatment was calculated (z = -2.02, N = 10, r = -.64), which demonstrates a large effect. Table 16 illustrates the results of the Wilcoxon signed-rank test.

Table 16

John's Wilcoxon Signed-Rank Test Results for the Decoding + Language Comprehension Condition vs. Baseline Phase

Test Statistic[a]	Decoding + Language Comprehension vs. Baseline % of Content Words Recalled[b]
Mean Difference	18.3
Z	-2.02
Asymp. Sig.[c] (Two-Tailed)	.04

Note: [a] = Wilcoxon signed-rank test; [b] = percentage of content words recalled; [c] = asymptotic significance

Best Accommodation Phase vs. Baseline Phase. Due to the fact that the difference scores were approximately symmetrically distributed, as assessed by a histogram with a superimposed normal curve, a Wilcoxon singed-rank test was conducted. John had a higher percentage of content words recalled during the best accommodation phase (*Mdn* = 20.0%) than during the baseline phase (*Mdn* = 7.5%). The median difference (*Mdn* = 15.7%) elicited a statistically significant difference (z = -2.0, p = .04). The effect size of treatment was calculated (z = -2.0, N = 10, r = -.63), suggesting a large effect. Table 17 illustrates the results of the Wilcoxon signed-rank test.

Table 17

John's Wilcoxon Signed-Rank Test Results for the Best Accommodation Phase vs. Baseline Phase

Test Statistic[a]	Best Accommodation vs. Baseline % of Words Recalled[b]
Median Difference	15.7
Z	-2.02
Asymp. Sig.[c] (Two-Tailed)	.04

Note: [a] = Wilcoxon signed-rank test; [b] = percentage of content words recalled; [c] = asymptotic significance

John's Overall Data Analysis Summary

Table 18 represents a data analysis summary of John's Wilcoxon signed-rank test and sign test for the percentage of content words recalled and the number of words recalled. Additional analyses were run for the number of words recalled. As presented below, there was one difference in the scores John obtained for the percentage of content words recalled, and the number of words recalled measure. Specifically, there was a significant difference between the best accommodation phrase and the baseline phase for the percentage of content words recalled but not for the number of words recalled.

Table 18

Data Analysis Summary of John's Wilcoxon Signed-Rank Test and Sign Test

Test Statistic	Median Difference		Exact. Sig.[a] (Two-Tailed)		Asymp. Sig.[b] (Two-Tailed)	
	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]
Decoding vs. Baseline[e]	14.9	62	.06	.06	--	--
Decoding + LC vs. Baseline[f]	18.3	77	--	--	.04	.04
Best Accomm vs. Baseline[g]	15.71	90	--	.06	.04	--

Note: [a] = exact significant used for the sign test; [b] = asymptotic significance used for the Wilcoxon signed-rank test; [c] = percentage of content words recalled; [d] = number of words recalled; [e] = decoding vs. baseline; [f] = decoding + language comprehension condition vs. baseline; [g] = best accommodation vs. baseline

The primary outcome of John's results indicated a disparity between the baseline and the reading comprehension accommodation conditions. Specifically, based on the visual analysis, there was clear data separation between the reading comprehension conditions and the baseline phase. There was a visual difference when comparing the decoding + language comprehension condition to the two no accommodation session scores within the alternating treatment phase for both reading comprehension measures. Based on the PND, John's best accommodation condition

was the decoding + language comprehension condition. The decoding + language comprehension condition displayed a significant improvement over the baseline phase for both reading comprehension measures. To some degree there seems to be positive effects of the decoding condition, which supports the first hypothesis. However, it looks as if the decoding + language comprehension condition may have been even more effective, which does not support the second hypothesis.

William

William participated in a total of 26 sessions over 13 meetings with no treatment interruptions. William actively participated in each session, and sessions occurred as originally planned. William had one to three sessions per meeting.

Visual Analysis

Percentage of Content Words Recalled. Figure 8 represents William's percentage of content words recalled across all phases of the study and displayed across sessions; Figure 9 displays the data across meetings. The data were displayed both across sessions and across meetings to more accurately determine whether William experienced any practice effects within meetings. Table 19 represents a data analysis summary of William's percentage of content words recalled for each condition during the three phases. During the baseline phase, William's percentage of content words recalled ranged from 6.1% to 20.9% (Median Level=12.2%). During meetings two and five, William had a decreased percentage of content words recalled during the second session. However, during meetings three and four, William had an increased percentage of content words recalled during the second session. Baseline data were considered variable, as only 55% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-middle technique indicated an increasing trend (White &

Haring, 1980). To control for the increasing trend present across the third, fourth, and fifth baseline data points, sixth through ninth baseline passages were administered. Following this administration, the last three baseline data points showed a visually decreasing trend (See Figure 8).

During the alternating treatment phase, William's percentage of content words recalled in the *decoding condition* increased (19.0%) compared to his performance in the last session of baseline (11.5%). William's percentage of content words recalled for the decoding condition during the alternating treatment phase ranged from 14.3% to 20.4% (Median Level = 15.8%). Data were considered variable, as only 60% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Using the split-middle technique, William's data exhibited a decreasing trend (White & Haring, 1980).

During the alternating treatment phase, William's first percentage of content words recalled in the *decoding + language comprehension condition* slightly increased (14.7%) compared to his performance in the last session of baseline (11.5%). William's percentage of content words recalled for the decoding + language comprehension condition during the alternating treatment phase ranged from 8.3% to 21.7% (Median Level = 10.8%). The ninth meeting had two sessions of the decoding + language comprehension condition, and William had a lower percentage of content words recalled during the second session. Data were considered variable, as only 40% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). The split-middle technique rendered an increasing trend (White & Haring, 1980).

Using the split-middle technique, William's *no accommodation condition* data exhibited a decreasing trend (White & Haring, 1980). Visually there seems to be only a small difference

between the scores in the no accommodation condition and the two reading accommodation conditions.

Based on the percentage of non-overlapping data analysis (see associated results presented in a later section), the decoding + language comprehension condition was identified as the best accommodation condition and used for the best accommodation phase. During the best accommodation phase, William's first percentage of content words recalled decreased (13.8%) compared to his performance in the last session of the decoding + language comprehension condition in the alternating treatment phase (21.7%). All the data points in the best accommodation phase overlapped with the decoding + language comprehension condition in the alternating treatment phase. During the best accommodation phase, William's first percentage of content words recalled increased (13.8%) compared to his performance in the last session of the baseline phase (11.5%). All the data points in the best accommodation phase overlapped with the baseline phase. Visual inspection of William's data during the best accommodation phase with the decoding + language comprehension condition revealed results ranging from 7.6% to 17.2% (Median Level = 12.7%). During the twelfth meeting, William had a lower percentage of content words recalled during the second session. During the thirteenth meeting, William had a higher percentage of content words recalled during the second session. Data were considered variable, as only 40% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-method technique indicated an increasing trend (White & Haring, 1980).

Overall, visually there was no clear data separation between the reading comprehend condition and the baseline phrase.

Figure 8

William's Percentage of Total Content Words Recalled (Sessions)

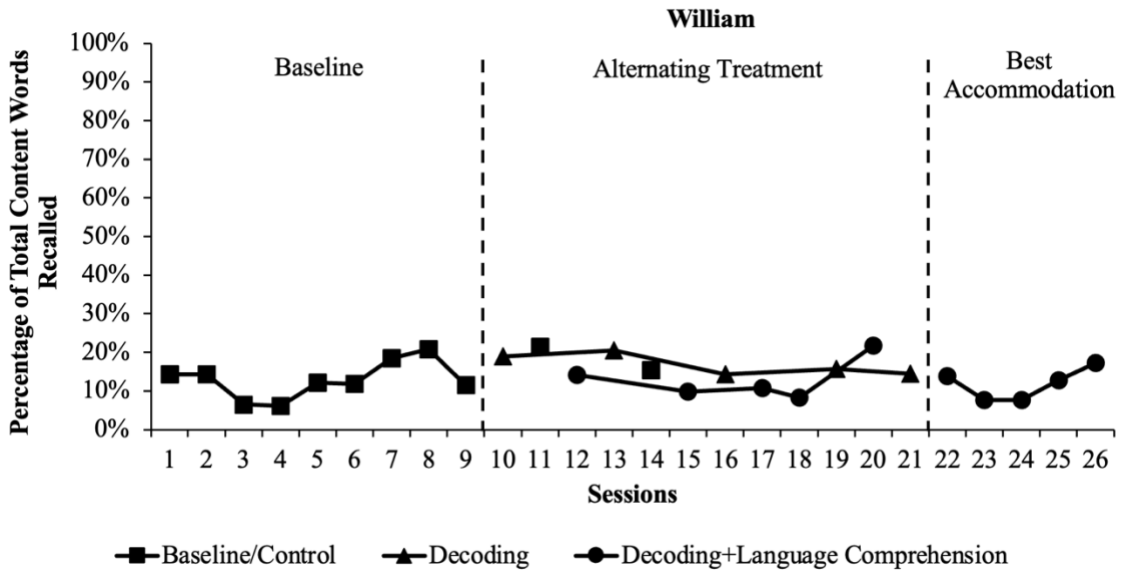


Figure 9

William's Percentage of Total Content Words Recalled (Meetings)

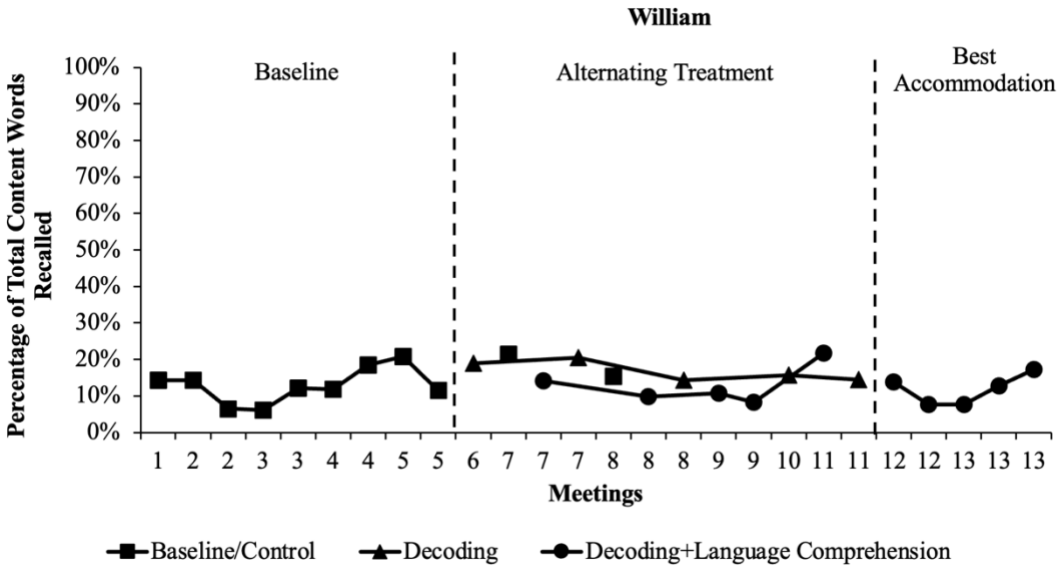


Table 19

Data Analysis Summary of William's Percentage of Total Content Words Recalled

Measure	Baseline	Decoding[a]	Decoding + Language[b]	No Accommodation[c]	Best Accommodation
Range	6.1%-20.9%	14.3%-20.4%	8.3%-21.7%	15.5%-21.4%	7.6%-17.2%
Median	12.2%	15.8%	10.78%	18.4%	12.7%
Trend	Increasing	Decreasing	Increasing	Decreasing	Increasing
Stability	Variable	Variable	Variable	Stable	Variable

Note: [a] = decoding condition; [b] = decoding + language comprehension condition; [c] = no accommodation condition

Percentage of Non-Overlapping Data

The percentage of content words recalled measure was used to calculate the percentage of non-overlapping data. No scores in the decoding condition were higher than the highest score in the baseline phase ($\frac{0}{5} \times 100 = 0\%$). One score in the decoding + language comprehension condition was higher than the highest score in the baseline phase ($\frac{1}{5} \times 100 = 20\%$). Therefore, the decoding + language comprehension condition was chosen as the best accommodation condition.

Wilcoxon Signed-Rank Test and Sign Test

The Wilcoxon signed-rank test and sign test were used to determine if there was a significant difference between conditions for the percentage of content words recalled. For the Wilcoxon signed-rank test and sign test, it is required to have an equal number of data points in the two conditions being compared. Therefore, sessions five through nine were used for the baseline phase because the last three baseline data points show a decreasing trend which indicates that the participant was able to move on to the next phase.

***Decoding Condition vs. Baseline Phase*.** Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. William had a higher percentage of content words recalled during the decoding condition in the alternating treatment phase (*Mdn* = 15.8%) than during the baseline phase (*Mdn* = 12.2%). The median difference produced (*Mdn* = 2.9%) was not statistically significant ($p = 1.00$). Table 20 illustrates the results of the sign test.

Table 20

William's Sign Test Results for the Decoding Condition vs. Baseline Phase

Test Statistic[a]	Decoding vs. Baseline % of Content Words Recalled[b]
Median Difference	2.9
Exact. Sig.[c] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Decoding + Language Comprehension Condition vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. William had a lower percentage of content words recalled during the decoding + language comprehension condition in the treatment comparison phase (*Mdn* = 10.8%) than during the baseline phase (*Mdn* = 12.2%). The produced median difference (*Mdn* = -2.1%) was not statistically significant ($p = 1.00$). Table 21 illustrates the results of the sign test.

Table 21

William's Sign Test Results for the Decoding + Language Comprehension Condition vs. Baseline Phase

Test Statistic[a]	Decoding + Language Comprehension vs. Baseline % of Content Words Recalled[b]
Median Difference	-2.1
Exact. Sig.[c] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Best Accommodation Phase vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. William had a slightly higher percentage of content words recalled during the best accommodation phase (*Mdn* = 12.7%) than during the baseline phase (*Mdn* = 12.2%). The median difference produced (*Mdn* = 4.2%) did not elicit a statistically significant difference (p = 1.00). Table 22 illustrates the results of the sign test.

Table 22

William's Sign Test Results for the Best Accommodation Phase vs. Baseline Phase

Test Statistic[a]	Best Accommodation vs. Baseline % of Content Words Recalled[b]
Median Difference	-4.2
Exact. Sig.[c] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

William's Overall Data Analysis Summary

Table 23 represents a data analysis summary of William's Wilcoxon signed-rank test and sign test for the percentage of content words recalled and the number of words recalled. Follow-up analyses were conducted on the number of words recalled. As seen below, there were no major differences in the scores William obtained for the percentage of content words recalled and the number of words recalled.

Table 23

Data Analysis Summary of William's Wilcoxon Signed-Rank Test and Sign Test

Test Statistic	Median Difference		Exact. Sig.[a] (Two-Tailed)		Asymp. Sig.[b] (Two-Tailed)	
	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]
Decoding vs. Baseline[e]	2.9	1	1.00	1.00	--	--
Decoding + LC vs. Baseline[f]	-2.1	-10	1.00	1.00	--	--
Best Accomm vs. Baseline[g]	-4.22	10	1.00	1.00		

Note: [a] = exact significant used for the sign test; [b] = asymptotic significance used for the Wilcoxon signed-rank test; [c] = percentage of content words recalled; [d] = number of words recalled; [e] = decoding vs. baseline; [f] = decoding + language comprehension condition vs. baseline; [g] = best accommodation vs. baseline

The primary outcome of William's results indicated no difference between the baseline and the reading comprehension accommodation conditions. Specifically, based on the visual analysis, there was no clear data separation between the reading comprehend condition and the baseline phrase. The accommodation scores during the alternating treatment phase displayed no difference visually when compared to the two no accommodation session scores within that phase. Based on the PND, William's best accommodation condition was the decoding + language comprehension condition. Neither accommodation condition displayed a significant improvement over the baseline phase. Although slight differences were found between reading comprehension conditions and the baseline phase, the hypothesized pattern did not emerge for either condition.

Matthew

Matthew participated in a total of 22 sessions over 8 meetings with no treatment interruptions. Matthew actively participated in each session, and sessions occurred as originally planned. Matthew had one to five sessions per meeting.

Visual Analysis

Percentage of Content Words Recalled. Figure 10 represents Matthew's percentage of content words recalled across all phases of the study and displayed across sessions; Figure 11 displays the data across meetings. The data were displayed both across sessions and across meetings to more accurately determine whether Matthew experienced any practice effects within meetings. Table 24 represents a data analysis summary of Matthew's percentage of content words recalled for each condition during the three phases. During the baseline phase, Matthew's percentage of content words recalled ranged from 1.8% to 9.7% (Median Level = 3.5%). During meetings one and two, Matthew had a decreased percentage of content words recalled during the second session. Baseline data were considered variable, as only 40% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-middle technique indicated a decreasing trend (White & Haring, 1980).

During the alternating treatment phase, Matthew's percentage of content words recalled in the *decoding condition* immediately increased (26.2%) compared to his performance in the last session of baseline (2.5%). Matthew's percentage of content words recalled for the decoding condition during the alternating treatment phase ranged from 11.1% to 26.2% (Median Level = 17.8%). Only the fourth meeting had two sessions of the decoding condition, and Matthew had a higher percentage of content words recalled during the second session. Data were considered variable, as only 40% of the data points fell within 20% of the median (Gast & Spriggs, 2010).

Using the split-middle technique, Matthew's data exhibited a decreasing trend (White & Haring, 1980).

During the alternating treatment phase, Matthew's first percentage of content words recalled in the *decoding + language comprehension condition* increased (15.9%) compared to his performance in the last session of baseline (2.5%). Matthew's percentage of content words recalled for the decoding + language comprehension condition during the alternating treatment phase ranged from 2.9% to 15.9% (Median Level = 5.6%). During the fifth meeting there was two sessions of the decoding + language comprehension condition, and Matthew had a higher percentage of content words of recalled during the second session. However, during the sixth meeting he had a lower percentage of content words of recalled during the second session. Data were considered variable, as only 40% of the data points fell within 20% of the median (Gast & Spriggs, 2010). The split-middle technique rendered a decreasing trend (White & Haring, 1980).

Using the split-middle technique, Matthew's *no accommodation condition* data exhibited no trend (White & Haring, 1980). Visually, the no accommodation condition seemed to be slightly lower compared to the two reading accommodation conditions.

Based on the percentage of non-overlapping data analysis (see associated results presented in a later section), the decoding condition was identified as the best accommodation condition and used for the best accommodation phase. During the best accommodation phase, Matthew's first percentage of content words recalled decreased (11.2%) compared to his performance in the last session of the decoding condition in the alternating treatment phase (14.5%). With the exception of the highest score in the best accommodation phase (11.2%), all the other data points in the phase were lower than all the scores in the decoding conditions in the alternating treatment phase. During the best accommodation phase, Matthew's first percentage of

content words recalled increased (11.2%) compared to his performance in the last session of the baseline phase (2.6%). With the exception of the lowest two scores (5.8 and 6.2) in the best accommodation phase, the other data points in the phase are higher than the scores in the baseline phase. Visual inspection of Matthew's data during the best accommodation phase with the decoding condition revealed data ranging from 5.8% to 11.2% (Median Level = 10.2%). Data were considered variable, as only 60% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-method technique indicated a decreasing trend (White & Haring, 1980).

Overall, visually there was clear data separation between the decoding condition and the baseline phase, but there no clear data separation between the decoding + language comprehension condition and the baseline phase.

Figure 10

Matthew's Percentage of Total Content Words Recalled (Sessions)

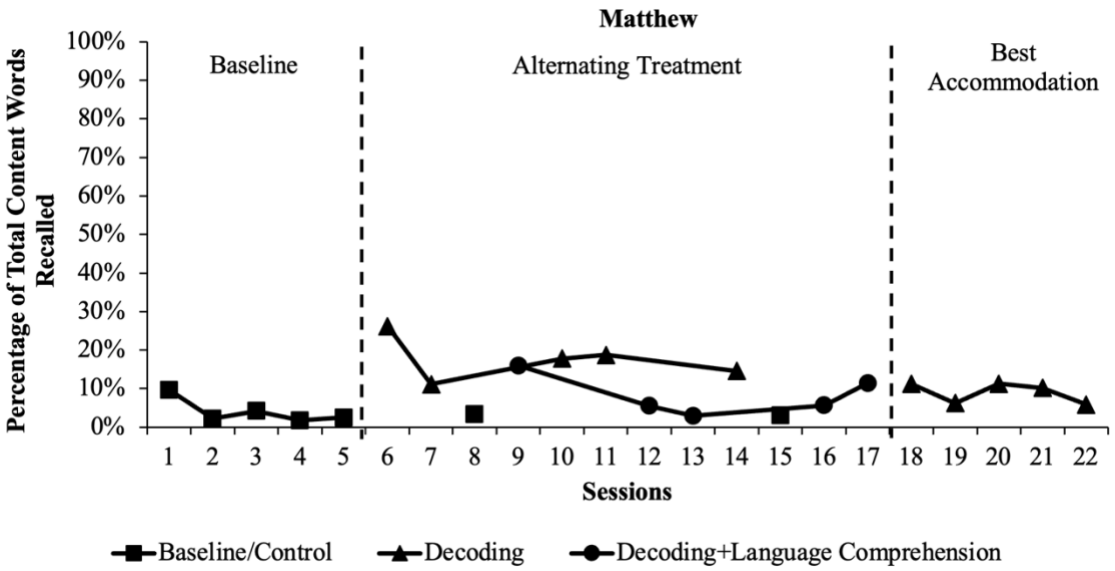


Figure 11

Matthew's Percentage of Total Content Words Recalled (Meetings)

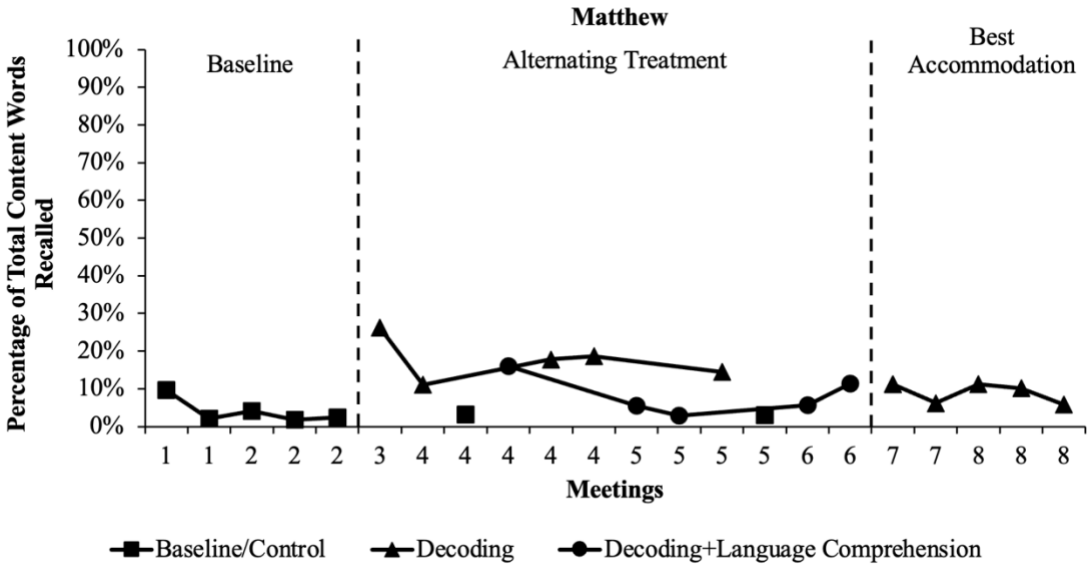


Table 24

Data Analysis Summary of Matthew's Percentage of Total Content Words Recalled

Measure	Baseline	Decoding[a]	Decoding + Language[b]	No Accommodation[c]	Best Accommodation
Range	1.8%-9.7%	11.1%-26.2%	2.9%-15.9%	3.1%-3.3%	5.8%-11.2%
Median	3.5%	17.8%	5.6%	3.2%	10.2%
Trend	Decreasing	Decreasing	Decreasing	None	Decreasing
Stability	Variable	Variable	Variable	Stable	Variable

Note: [a] = decoding condition; [b] = decoding + language comprehension condition; [c] = no accommodation condition

Percentage of Non-Overlapping Data

The percentage of content words recalled measure was used to calculate the percentage of non-overlapping data. Two scores in the decoding + language comprehension condition were higher than the highest score in the baseline phase ($\frac{2}{5} \times 100 = 40\%$). Five scores in the

decoding condition were higher than the highest score in the baseline phase ($\frac{5}{5} \times 100 =$ 100%). Therefore, the decoding condition was chosen for the best accommodation condition.

Wilcoxon Signed-Rank Test and Sign Test

The Wilcoxon signed-rank test and sign test were used to determine if there was a significant difference between conditions for the percentage of content words recalled.

Decoding Condition vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. Matthew had a higher percentage of content words recalled during the decoding condition in the treatment comparison phase (*Mdn* = 17.8%) than during the baseline phase (*Mdn* = 2.5%). The produced median difference (*Mdn* = 13.6%) was not statistically significant (p = .06). Table 25 illustrates the results of the sign test.

Table 25

Matthew's Sign Test Results for the Decoding Condition vs. Baseline Phase

Test Statistic[a]	Decoding vs. Baseline % of Content Words Recalled[b]
Median Difference	13.6
Exact. Sig.[c] (Two-Tailed)	.06

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

***Decoding + Language Comprehension Condition vs. Baseline Phase*.** Due to the fact that the difference scores were approximately symmetrically distributed, as assessed by a histogram with a superimposed normal curve, a Wilcoxon signed-rank test was conducted. Matthew had a higher percentage of content words recalled during the decoding + language comprehension condition in the alternating treatment phase (*Mdn* = 5.6%) than during the baseline phase (*Mdn* = 2.5%). The median difference (*Mdn* = 3.8%) was not statistically

significant (z = -1.76; p = .08). The effect size of treatment was calculated (z = -1.76, N = 10, r = -.56), highlighting a large effect. Table 26 illustrates the results of the Wilcoxon signed-rank test.

Table 26

Matthew's Wilcoxon Signed-Rank Test Results for the Decoding + Language Comprehension Condition vs. Baseline Phase

Test Statistic[a]	Decoding + Language Comprehension vs. Baseline % of Content Words Recalled[b]
Mean Difference	3.8
Z	-1.76
Asymp. Sig.[c] (Two-Tailed)	.08

Note: [a] = Wilcoxon signed-rank test; [b] = percentage of content words recalled; [c] = asymptotic significance

Best Accommodation Phase vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. Matthew had a higher percentage of content words recalled during the best accommodation phase (*Mdn* = 10.2%) than during the baseline phase (*Mdn* = 2.5%). The median difference produced (*Mdn* = 4.0%) did not elicit a statistically significant difference (p = .06). Table 27 illustrates the results of the sign test.

Table 27

Matthew's Sign Test Results for the Best Accommodation Phase vs. Baseline Phase

Test Statistic[a]	Best Accommodation vs. Baseline % of Content Words Recalled[b]
Median Difference	4.0
Exact. Sig.[c] (Two-Tailed)	.06

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Matthew's Overall Data Analysis Summary

Table 28 represents a data analysis summary of Matthew's Wilcoxon signed-rank test and sign test for the percentage of content words recalled and the number of words recalled. Follow-

up analyses were conducted on the number of words recalled. As seen below, there were no major differences in the scores Matthew obtained for the percentage of content words recalled or the number of words recalled.

Table 28

Data Analysis Summary of Matthew's Wilcoxon Signed-Rank Test and Sign Test

Test Statistic	Median Difference		Exact. Sig.[a] (Two-Tailed)		Asymp. Sig.[b] (Two-Tailed)	
	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]
Decoding vs. Baseline[e]	13.6	56	.06	.06	--	--
Decoding + LC vs. Baseline[f]	3.8	6	--	1.00	.08	--
Best Accomm vs. Baseline[g]	4.03	18	.06	--	--	.23

Note: [a] = exact significant used for the sign test; [b] = asymptotic significance used for the Wilcoxon signed-rank test; [c] = percentage of content words recalled; [d] = number of words recalled; [e] = decoding vs. baseline; [f] = decoding + language comprehension condition vs. baseline; [g] = best accommodation vs. baseline

The primary outcome of Matthew's results indicated some disparity between the baseline and the reading comprehension accommodation conditions. Specifically, based on the visual analysis, there was clear data separation between the decoding condition and the baseline phase, but there was no clear data separation between the decoding + language comprehension condition and the baseline phase. The accommodation scores during the alternating treatment phase displayed no difference visually when compared to the two no accommodation session scores within that phase. Based on the PND, Matthew's best accommodation was the decoding condition. Neither accommodation condition displayed a significant improvement over the baseline phase. To some degree there seems to be positive effects of the decoding condition, which supports the first hypothesis. However, minimal differences were found between the

decoding + language comprehension condition and the baseline phase, the hypothesized pattern did not emerge for the second hypothesis.

Mary

Mary participated in a total of 22 sessions over 10 meetings with no treatment interruptions. Mary actively participated in each session, and sessions occurred as originally planned. Mary had one to three sessions per meeting.

Visual Analysis

Percentage of Content Words Recalled. Figure 12 represents Mary's percentage of content words recalled across all phases of the study and displayed across sessions; Figure 13 displays the data across meetings. The data were displayed both across sessions and across meetings to more accurately determine whether Mary experienced any practice effects within meetings. Table 29 represents a data analysis summary of Mary's percentage of content words recalled for each condition during the three phases. During the baseline phase, Mary's percentage of content words recalled ranged from 4.4% to 8.7% (Median Level = 5.0%). During meetings two and three, Mary had a slightly increased percentage of content words recalled during the second session. Baseline data were considered variable, as only 60% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-middle technique indicated a decreasing trend (White & Haring, 1980).

During the alternating treatment phase, Mary's percentage of content words recalled in the *decoding + language comprehension condition* immediately increased (9.5%) compared to her performance in the last session of baseline (5.0%). Mary's percentage of content words recalled for the decoding + language comprehension condition during the alternating treatment phase ranged from 8.3% to 12.1% (Median Level = 9.8%). During meeting four, Mary had a

slightly increased percentage of content words recalled during the second session. During meeting six, Mary had a slightly decreased percentage of content words recalled during the second session. Data were considered stable in that 80% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Using the split-middle technique, Mary's data exhibited a decreasing trend (White & Haring, 1980).

During the alternating treatment phase, Mary's first percentage of content words recalled in the *decoding condition* slightly decreased (4.4%) compared to her performance in the last session of baseline (5.0%). Mary's percentage of content words recalled for the decoding condition during the alternating treatment phase ranged from 4.4% to 15.7% (Median Level = 13.3%). Only the fifth meeting had two sessions of the decoding condition, and Mary had a higher percentage of content words recalled during the second session. Data were considered variable, as only 60% of the data points fell within 20% of the median (Gast & Spriggs, 2010). The split-middle technique rendered an increasing trend (White & Haring, 1980).

Using the split-middle technique, Mary's data *no accommodation condition* exhibited no trend (White & Haring, 1980). Visually there seems to be only a small difference between the scores in the no accommodation condition and the two reading accommodation conditions.

Based on the percentage of non-overlapping data analysis (see associated results presented in a later section), the decoding + language comprehension condition was identified as the best accommodation condition and used for the best accommodation phase. During the best accommodation phase, Mary's first percentage of content words recalled decreased (7.6%) compared to her performance in the last session of the decoding + language comprehension condition in the alternating treatment phase (10.6%). With the exception of the highest score in the best accommodation phase (14.7%), all the other data points in the phase overlapped with the

decoding condition in the alternating treatment phase. During the best accommodation phase, Mary's first percentage of content words recalled increased (7.8%) compared to her performance in the last session of the baseline phase (5.0%). With the exception of the highest score (14.7) in the best accommodation phase, the other data points in the phase overlapped with the baseline phase. Visual inspection of Mary's data during the best accommodation phase with the decoding + language comprehension condition revealed data ranging from 4.2% to 14.7% (Median Level = 7.6%). Data were considered variable, as only 60% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-method technique indicated a decreasing trend (White & Haring, 1980).

Overall, visually there was no clear data separation between the reading comprehension conditions and the baseline phrase.

Figure 12

Mary's Percentage of Total Content Words Recalled (Sessions)

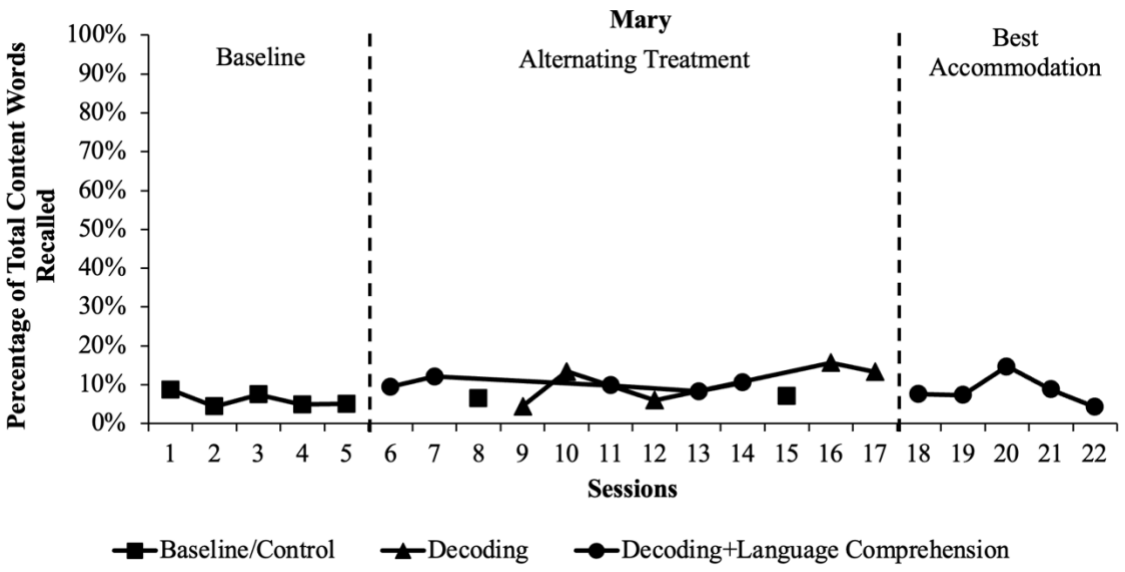


Figure 13

Mary's Percentage of Total Content Words Recalled (Meetings)

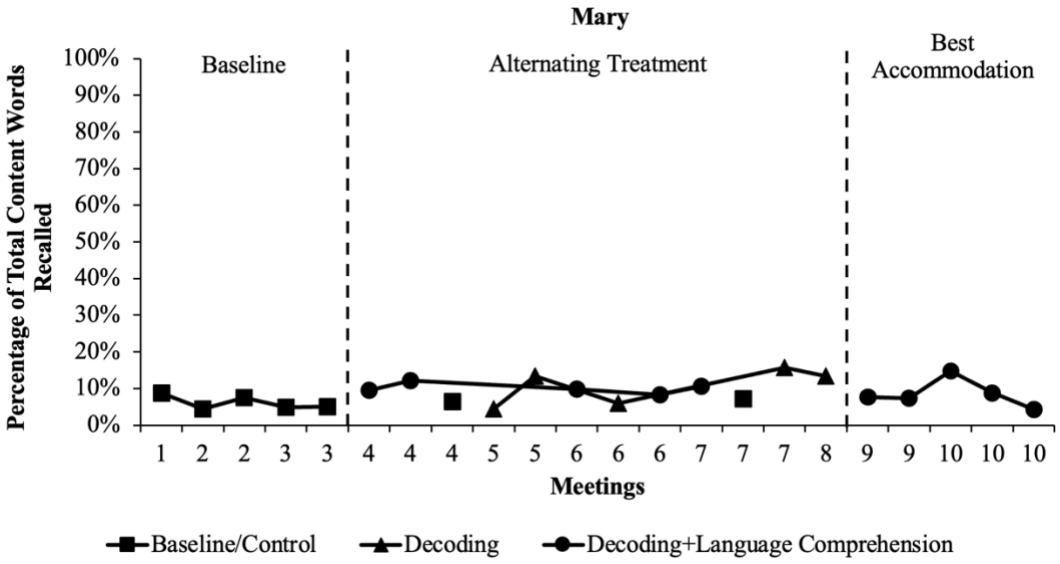


Table 29

Data Analysis Summary of Mary's Percentage of Total Content Words Recalled

Measure	Baseline	Decoding + Language[a]	Decoding[b]	No Accommodation[c]	Best Accommodation
Range	4.4%-8.7%	8.3%-12.1%	4.4%-15.7%	6.5%-7.1%	4.2%-14.7%
Median	5.0%	9.8%	13.3%	6.8%	7.6%
Trend	Decreasing	Decreasing	Increasing	None	Decreasing
Stability	Variable	Stable	Variable	Stable	Variable

Note: [a] = decoding + language comprehension condition; [b] = decoding condition; [c] = no accommodation condition

Percentage of Non-Overlapping Data

The percentage of content words recalled measure was used to calculate the percentage of non-overlapping data. Three scores in the decoding condition were higher than the highest score in the baseline phase ($\frac{3}{5} \times 100 = 60\%$). Four scores in the decoding + language comprehension condition were higher than the highest score in the baseline phase ($\frac{4}{5} \times 100 = 80\%$).

Therefore, the decoding + language comprehension condition was chosen for the best accommodation condition.

Wilcoxon Signed-Rank Test and Sign Test

The Wilcoxon signed-rank test and sign test were used to determine if there was a significant difference between conditions for the percentage of content words recalled.

***Decoding + Language Comprehension Condition vs. Baseline Phase*.** Due to the fact that the difference scores were approximately symmetrically distributed, as assessed by a histogram with a superimposed normal curve, a Wilcoxon signed-rank test was conducted. Mary had a higher percentage of content words recalled during the decoding + language comprehension condition in the alternating treatment phase (*Mdn* = 9.8%) than during the baseline phase (*Mdn* = 5.0%). The median difference produced (*Mdn* = 3.4%) was statistically significant (z = -2.02; p = .04). The effect size of treatment was calculated (z = -2.02, N = 10, r = -.64), highlighting a large effect. Table 30 illustrates the results of the Wilcoxon signed-rank test.

Table 30

Mary's Wilcoxon Signed-Rank Test Results for the Decoding + Language Comprehension Condition vs. Baseline Phase

Test Statistic[a]	Decoding + Language Comprehension vs. Baseline % of Words Recalled[b]
Mean Difference	3.4
Z	-2.02
Asymp. Sig.[c] (Two-Tailed)	.04

Note: [a] = Wilcoxon signed-rank test; [b] = percentage of content words recalled; [c] = asymptotic significance

Decoding Condition vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. Mary had a higher

percentage of content words recalled during the decoding condition in the treatment comparison phase (*Mdn* = 13.3%) than during the baseline phase (*Mdn* = 5.0%). The produced median difference (*Mdn* = 8.3%) was not statistically significant (p = 1.00). Table 31 illustrates the results of the sign test.

Table 31

Mary's Sign Test Results for the Decoding Condition vs. Baseline Phase

Test Statistic[a]	Decoding vs. Baseline % of Content Words Recalled[b]
Median Difference	8.3
Exact. Sig.[d] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Best Accommodation Phase vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. Mary had a slightly higher percentage of content words recalled during the best accommodation phase (*Mdn* = 7.6%) than during the baseline phase (*Mdn* = 5.0%). The median difference produced (*Mdn* = 2.9%) did not elicit a statistically significant difference (p = 1.00). Table 32 illustrates the results of the sign test.

Table 32

Mary's Sign Test Results for the Best Accommodation Phase vs. Baseline Phase

Test Statistic[a]	Best Accommodation vs Baseline % of Content Words Recalled[b]
Median Difference	2.9
Exact. Sig.[c] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Mary's Overall Data Analysis Summary

Table 33 represents a data analysis summary of Mary's Wilcoxon signed-rank test and sign test for the percentage of content words recalled and the number of words recalled. Follow-

up analyses were conducted on the number of words recalled. As presented below, there was one difference in the scores Mary obtained for the percentage of content words recalled and the number of words recalled measures. There was a significant difference between the decoding + language comprehension condition and the baseline phrase for the percentage of content words recalled, but there was no significant difference for the number of words recalled.

Table 33

Data Analysis Summary of Mary's Wilcoxon Signed-Rank Test and Sign Test

Test Statistic	Median Difference		Exact. Sig.[a] (Two-Tailed)		Asymp. Sig.[b] (Two-Tailed)	
	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]
Decoding + LC vs. Baseline[e]	3.4	0.0	--	1.00	.04	--
Decoding vs. Baseline[f]	8.3	32	1.00	.38	--	--
Best Accomm vs. Baseline[g]	-1.89	-11	1.00	--	--	.89

Note: [a] = exact significant used for the sign test; [b] = asymptotic significance used for the Wilcoxon signed-rank test; [c] = percentage of content words recalled; [d] = number of words recalled; [e] = decoding + language comprehension condition vs. baseline; [f] = decoding vs. baseline; [g] = best accommodation vs. baseline

The primary outcome of Mary's results indicated a disparity between the baseline and the reading comprehension accommodation conditions. Specifically, based on the visual analysis, there was no clear data separation between the reading comprehension conditions and the baseline phrase. The decoding + language comprehension condition scores during the alternating treatment phase displayed a difference visually when compared to the two no accommodation session scores within that phase. Based on the PND, Mary's best accommodation was the decoding + language comprehension condition. The decoding + language condition displayed a significant improvement over the baseline phase for the percentage of content words recalled. Although differences were found between the decoding condition and the baseline phase, the

hypothesized pattern did not emerge for the first hypothesis. It looks as if the decoding + language comprehension condition may have been more effective, which does not support the second hypothesis.

Susan

Susan participated in a total of 22 sessions over 8 meetings with no treatment interruptions. Susan actively participated in each session, and sessions occurred as originally planned. Susan had one to four sessions per meeting.

Visual Analysis

Percentage of Content Words Recalled. Figure 14 represents Susan's percentage of content words recalled across all phases of the study and displayed across sessions; Figure 15 displays the data across meetings. The data were displayed both across sessions and across meetings to more accurately determine whether Susan experienced any practice effects within meetings. Table 34 represents a data analysis summary of Susan's percentage of content words recalled for each condition during the three phases. During the baseline phase, Susan's percentage of content words recalled ranged from 4.9% to 17.9% (Median Level=6.7%). During meetings one and two, Susan had an increased percentage of content words recalled during the second session. Baseline data were considered variable, as only 40% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-middle technique indicated an increasing trend (White & Haring, 1980).

During the alternating treatment phase, Susan's percentage of content words recalled in the *decoding + language comprehension condition* decreased (3.2%) compared to her performance in the last session of baseline (5.9%). Susan's percentage of content words recalled for the decoding + language comprehension condition during the alternating treatment phase

ranged from 3.2% to 23.3% (Median Level = 16.4%). Only the fifth meeting had two sessions of the decoding + language comprehension condition, and Susan had a slightly higher percentage of content words recalled during the second session. Data were considered variable, as only 60% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). Using the split-middle technique, Susan's data exhibited an increasing trend (White & Haring, 1980).

During the alternating treatment phase, Susan's first percentage of content words recalled in the *decoding condition* slightly decreased (4.1%) compared to her performance in the last session of baseline (5.9%). Susan's percentage of content words recalled for the decoding condition during the alternating treatment phase ranged from 4.1% to 29.1% (Median Level = 18.9%). During the fourth and fifth meetings, Susan had a higher percentage of content words recalled during the second session. Data were considered variable, as only 40% of the data points fell within the 20% of the median (Gast & Spriggs, 2010). The split-middle technique rendered an increasing trend (White & Haring, 1980).

Using the split-middle technique, Susan's data *no accommodation condition* exhibited an increasing trend (White & Haring, 1980). Visually there seems to be only a small difference between the scores in the no accommodation condition and the two reading accommodation conditions.

Based on the percentage of non-overlapping data analysis (see associated results presented in a later section), the decoding condition was identified as the best accommodation condition and used for the best accommodation phase. During the best accommodation phase, Susan's first percentage of content words recalled decreased (10.9%) compared to her performance in the last session of the decoding condition in the alternating treatment phase (19.5%). All the data points in the phase overlapped with the decoding condition in the

alternating treatment phase. During the best accommodation phase, Susan's first percentage of content words recalled increased (10.9%) compared to her performance in the last session of the baseline phase (5.9%). All the other data points in the phase overlapped with the baseline phase. Visual inspection of Susan's data during the best accommodation phase with the decoding condition revealed data ranging from 5.7% to 16.3% (Median Level = 12.4%). Data were considered variable, as only 40% of the data points fell within 20% of the median (Gast & Spriggs, 2010). Trend estimation using the split-method technique indicated a decreasing trend (White & Haring, 1980).

Overall, visually there was no clear data separation between the reading comprehension conditions and the baseline phrase.

Figure 14

Susan's Percentage of Total Content Words Recalled (Sessions)

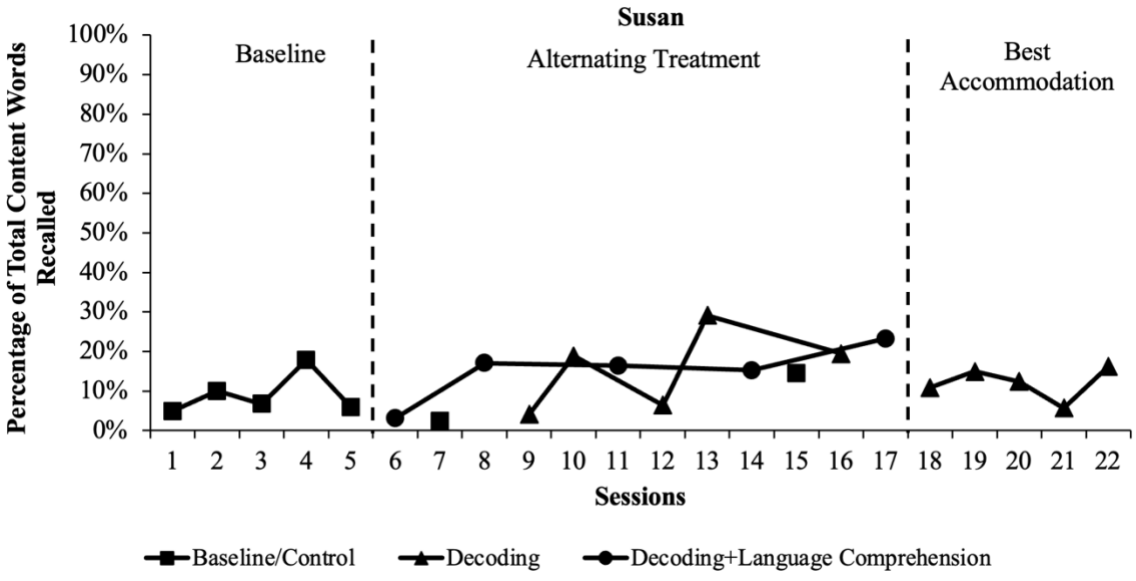


Figure 15

Susan's Percentage of Total Content Words Recalled (Meetings)

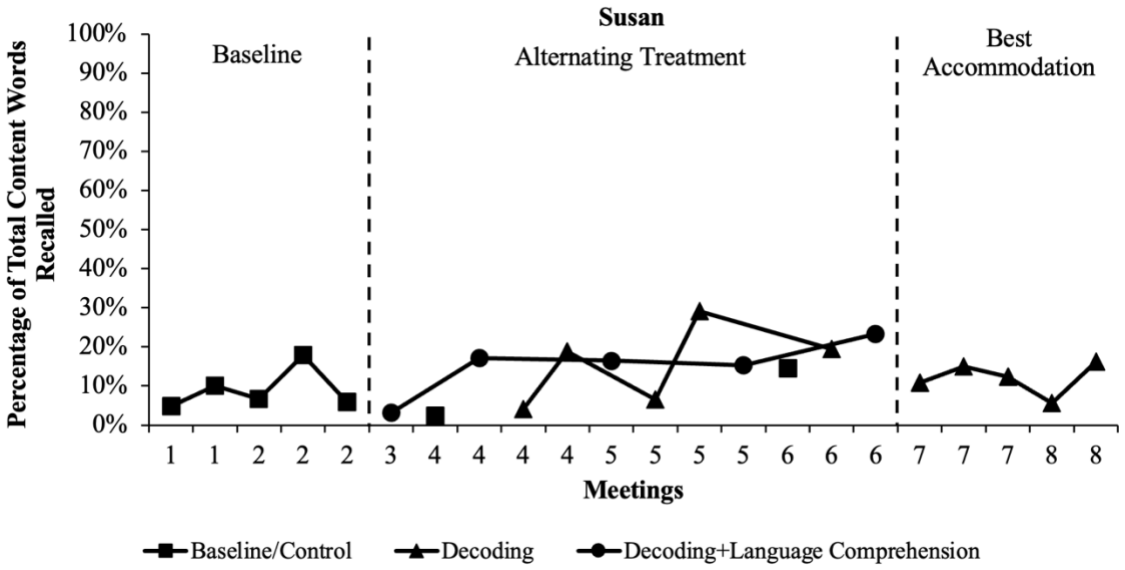


Table 34

Data Analysis Summary of Susan's Percentage of Total Content Words Recalled

Measure	Baseline	Decoding + Language[a]	Decoding[b]	No Accommodation[c]	Best Accommodation
Range	4.9%-17.9%	3.2%-23.3%	4.1%-29.1%	2.4%-14.5%	5.7%-16.3%
Median	6.7%	16.4%	18.9%	8.5%	12.4%
Trend	Increasing	Increasing	Increasing	Increasing	Decreasing
Stability	Variable	Variable	Variable	Variable	Variable

Note: [a] = decoding + language comprehension condition; [b] = decoding condition; [c] = no accommodation condition

Percentage of Non-Overlapping Data

The percentage of content words recalled measure was used to calculate the percentage of non-overlapping data. One score in the decoding + language comprehension condition was higher than the highest score in the baseline phase ($\frac{1}{5} \times 100 = 20\%$). Three scores in the

decoding condition were higher than the highest score in the baseline phase ($\frac{3}{5} \times 100 = 60\%$). Therefore, the decoding condition was chosen for the best accommodation condition.

Wilcoxon Signed-Rank Test and Sign Test

The Wilcoxon signed-rank test and sign test were used to determine if there was a significant difference between conditions for the percentage of content words recalled.

Decoding + Language Comprehension Condition vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. Susan had a higher percentage of content words recalled during the decoding + language comprehension condition in the alternating treatment phase (*Mdn* = 16.4%) than during the baseline phase (*Mdn* = 6.7%). The median difference produced (*Mdn* = 7.1%) was not statistically significant ($p = 1.00$). Table 35 illustrates the results of the sign test.

Table 35

Susan's Sign Test Results for the Decoding + Language Comprehension Condition vs. Baseline Phase

Test Statistic[a]	Decoding + Language Comprehension vs. Baseline % of Content Words Recalled[b]
Median Difference	7.1
Exact. Sig.[d] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Decoding Condition vs. Baseline Phase. Due to the fact that the distribution of differences was not symmetrically shaped, a sign test was conducted. Susan had a higher percentage of content words recalled during the decoding condition in the treatment comparison phase (*Mdn* = 18.9%) than during the baseline phase (*Mdn* = 6.7%). The produced median difference (*Mdn* = 8.9%) was not statistically significant ($p = 1.00$). Table 36 illustrates the results of the sign test.

Table 36

Susan's Sign Test Results for the Decoding Condition vs. Baseline Phase

Test Statistic[a]	Decoding vs. Baseline % of Content Words Recalled[b]
Median Difference	8.9
Exact. Sig.[d] (Two-Tailed)	1.00

Note: [a] = Sign test; [b] = percentage of content words recalled; [c] = exact significance

Best Accommodation Phase vs. Baseline Phase. Due to the fact that the difference scores were approximately symmetrically distributed, as assessed by a histogram with a superimposed normal curve, a Wilcoxon signed-rank test was conducted. Susan had a higher percentage of content words recalled during the best accommodation phase (*Mdn* = 12.4%) than during the baseline phase (*Mdn* = 6.7%). The median difference (*Mdn* = 5.7%) did not elicit a statistically significant difference (p = .50). The effect size of treatment was calculated (*z* = -.67, N = 10, *r* = -.21), suggesting a small effect. Table 37 illustrates the results of the Wilcoxon signed-rank test.

Table 37

Susan's Wilcoxon Signed-Rank Test Results for the Best Accommodation Phase vs. Baseline Phase

Test Statistic[a]	Best Accommodation vs. Baseline % of Words Recalled[b]
Mean Difference	5.7
Z	-.67
Asymp. Sig.[c] (Two-Tailed)	.50

Note: [a] = Wilcoxon signed-rank test; [b] = percentage of content words recalled; [c] = asymptotic significance

Susan's Overall Data Analysis Summary

Table 38 represents a data analysis summary of Susan's Wilcoxon signed-rank test and sign test for the percentage of content words recalled and the number of words recalled. Additional analyses were conducted on the number of words recalled. As presented below, there were no major differences in the scores Susan obtained for the percentage of content words recalled and the number of words recalled.

Table 38

Data Analysis Summary of Susan's Wilcoxon Signed-Rank Test and Sign Test

Test Statistic	Median Difference		Exact. Sig.[a] (Two-Tailed)		Asymp. Sig.[b] (Two-Tailed)	
	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]	% of Words[c]	# of Words[d]
Decoding + LC vs. Baseline[e]	7.1	41	1.00	.06	--	--
Decoding vs. Baseline[f]	8.9	20	1.00	.38	--	--
Best Accomm vs. Baseline[g]	5.69	32	--	.38	.50	--

Note: [a] = exact significant used for the sign test; [b] = asymptotic significance used for the Wilcoxon signed-rank test; [c] = percentage of content words recalled; [d] = number of words recalled; [e] = decoding + language comprehension condition vs. baseline; [f] = decoding vs. baseline; [g] = best accommodation vs. baseline

The primary outcome of Susan's results indicated no difference between the baseline and the reading comprehension accommodation conditions. Specifically, based on the visual analysis, there was no clear data separation between the reading comprehension conditions and the baseline phrase. The accommodation scores during the alternating treatment phase displayed no difference visually when compared to the two no accommodation session scores within that phase. Based on the PND, Susan's best accommodation condition was the decoding condition. Neither accommodation condition displayed a significant improvement over the baseline phase.

Although slight differences were found between reading comprehension conditions and the baseline phase, the hypothesized pattern did not emerge for either condition.

Reading Comprehension Measure Summaries

Overall, only a few of the participants displayed a statistically significant difference between the reading accommodation condition and the baseline phase, and in only one case were significant positive results similarly identified in the best accommodation phase. Table 39 displays a summary of the median differences and statistical significance of the percentage of content words recalled for the Wilcoxon signed-rank test and sign test for each participant.

Table 39

Percentage of Content Words Recalled: Summary of Median Difference and Statistical Significance

Test Statistic	James	Robert	John	William	Matthew	Mary	Susan
Decoding vs. Baseline[a]	6.2 (*p*=.06)	2.4 (*p*=1.00)	15 (*p*=.06)	2.9 (*p*=1.00)	13.6 (*p*=.06)	8.3 (*p*=1.00)	8.9 (*p*=1.00)
D+LC vs. Baseline[b]	4.9 (*p*=.08)	2.7 (*p*=.38)	18.3 (*p*=.04)*	-2.1 (*p*=1.00)	3.8 (*p*=.08)	3.4 (*p*=.04)*	7.1 (*p*=1.00)
Best Accomm vs. Baseline[e]	4.4 (*p*=1.00)	-.07 (*p*=.89)	15.7 (*p*=.04)*	-4.2 (*p*=1.00)	4.0 (*p*=.06)	2.9 (*p*=1.00)	5.7 (*p*=.50)

Note: [a] = decoding condition vs. baseline phase; [b] = decoding + language comprehension conditions vs. baseline phase; [c] = best accommodation phase vs. baseline phase; * $p < .05$, which indicates a significant difference.

CHAPTER V: DISCUSSION

Overview of the Study

This study examined the effects of reading comprehension accommodations on the reading comprehension of students who were considered poor decoders but demonstrated average or above average listening comprehension. Seven participants read expository texts across a baseline phase (i.e., with no accommodations provided), an alternating treatment phase, and the best accommodation phase. In the alternating treatment phase, participants alternated between receiving the decoding condition (i.e., read-aloud), the decoding + language comprehension condition (i.e., read-aloud, vocabulary support, and comprehension monitoring), and the no accommodation condition (i.e., reading independently). In the best accommodation phase, the accommodation condition identified as corresponding with the strongest reading comprehension performance was repeated to validate the effects of the corresponding accommodation condition.

Two main findings from the current study were identified. First, none of the participants demonstrated a statistically significant increase in reading comprehension scores corresponding to the decoding condition. Second, two participants (i.e., John and Mary) experienced a statistically significant increase in reading comprehension scores that corresponded with the decoding + language comprehension condition; however, these significant benefits were inconsistent across measures, as described below.

Reading Comprehension Accommodations

Research Question 1: To what extent does the use of the read-aloud accommodation affect general comprehension of text-based material for participants with word decoding difficulties? The present study revealed minor effects regarding the practical use of the decoding

condition, with no statistically significant difference observed between the condition and the baseline. Based on the percentage of content words recalled measure, the visual analysis displayed some data separation between the decoding condition and the baseline phase for only two participants (i.e., John and Matthew). Based on the PND, the best accommodation condition for three participants (i.e., James, Matthew, and Susan) was the decoding condition. Based on the Wilcoxon signed-rank test and sign test results, none of the participants experienced a statistically significant increase in reading comprehension scores corresponding to the decoding accommodation condition. The results raise questions about the effectiveness of the read-aloud accommodation for students with poor decoding skills. Based on past research, the results of the current study were unexpected due to the abundance of high effect sizes that were found in studies where students with disabilities utilized the read-aloud accommodation (Bonifacci et al., 2022; Buzick & Stone, 2014; Ceyhan & Yildiz, 2021; Li, 2014; Schiavo et al., 2021; Sulaimon & Schaefer, 2023). However, the current study exhibited some differences from the past studies that found high effect sizes. Some potential explanations for the differences include the following: the current study did not allow participants to view the passage while recalling, the majority of participants did not utilize the option to reread parts of the passages, the participants were only provided the read-aloud accommodation, and participants were able to decode many words during eligibility testing and in the baseline passages. These are all discussed in the following paragraphs.

One explanation for the limited effects identified in the current study is that participants were not able to view the passage while responding to the comprehension prompt. A consistent theme across multiple studies, which reported a limited impact of the read-aloud accommodation on reading comprehension, is that participants were unable to simultaneously view the passage

while responding to the comprehension questions (Meyer & Bouck, 2014; Schmitt et al., 2011; Sorrell et al., 2007). In contrast, several other studies that allowed participants to view the passage while answering comprehension questions found that the increase in reading comprehension scores while using the read-aloud accommodation was statistically significant (Bonifacci et al., 2022; Sulaimon & Schaefer, 2023). Similar to past studies that found no significant effect, the current study did not allow participants to view the passage while answering the comprehension question, which may be one reason why only minimal effects were found.

In the current study, while participants were instructed on how to reread parts of the passage using the read-aloud accommodation, very few participants utilized the option. Many researchers have reported that rereading texts improved reading comprehension (e.g., Dunlosky, 2005; Pressley & Afflernach, 1995; Walczyk et al., 2004). According to Pressley and Afflernach (1995), successful readers enhance their comprehension of a passage by employing various strategies, such as revisiting unclear or confusing sections during the initial reading. Although students in the current study could have maneuvered the read-aloud accommodation in a manner that would allow them to engage in rereading of selected text sections, doing so could be particularly challenging. Specifically, it would take the ineffective reader several steps to reread particular parts of a passage using the read-aloud accommodations. The reader would first need to recognize that they do not comprehend something; then, navigate the read-aloud to the specific section of the passage and activate it to reread the text. Therefore, the minimal gains in the reading comprehension scores may have been due to the participants' reluctance to reread parts of the passages.

A second explanation for the minimal effects of the read-aloud accommodation identified in the current study may be that the read-aloud accommodation is only particularly effective when paired with other related supports. The current study supports the notion that some students may benefit more from multi-component accommodations. Specifically, the decoding + language comprehension condition, but not the decoding condition, corresponded to significant improvements for both John and Mary. Other studies suggest additional supports may result in different findings as well. A study by Schiavo and colleagues (2021) paired the read-aloud accommodation with eye-tracking technology to give students more control over the speed and help them stay focused on the passage. The eye-tracking technology, Gaze and Read it by Yourself (GARY), moves through the text, following the reader's gaze while the text is highlighted and read aloud. GARY monitored whether the reader looked at the words following the highlighted text, and if not, then GARY paused the reading. Schiavo and colleagues (2021) found that students with dyslexia scored higher on reading comprehension measures while using the read-aloud accommodation with eye-tracking technology compared to traditional read-aloud technology. Ceyhan and Yildiz (2021) investigated the effects of interactive read-aloud on reading comprehension, incorporating the use of graphic organizers, scaffolding, and think-aloud strategies. For example, while listening to a story, the teacher supported students in re-creating images in their minds, making connections, asking questions, identifying main themes, summarizing, checking the predictions, evaluating, and learning new vocabulary words. Ceyhan and Yildiz (2021) found that using these techniques positively affected students' reading comprehension. Overall, in previous studies, it was reported that students benefit from using multi-component reading support strategies, which supports the notion that participants in the current study may have required more support than just the read-aloud to meet their needs.

Another reason for the lack of effects identified may be that the participants in the current study did not have such low word decoding skills that they ultimately needed the accommodation(s) to be able to comprehend. Although all participants had low Word Attack scores based on the standardized test used for screening, they ultimately were able to decode many words of the texts used during the baseline phase (i.e., without accommodation) that were of the same difficulty as those used during the accommodated conditions. Thus, it may be the case that readers either need much lower decoding skills to benefit from the accommodations examined in the current study, or more difficult-to-decode passages to demonstrate the effectiveness of the accommodation. Interestingly, one of the students who showed positive effects (albeit only when both decoding and language comprehension support were provided) was the one student who was in a lower grade level (i.e., Mary). It may be the case that she had particularly low decoding skills (especially since her screening threshold was 'lower' than others given that it was based on a grade-based standard score), and that the accommodation effects identified for her were in part due to her lower decoding skills. This would align with other existing research highlighting how the effectiveness of the read-aloud accommodation varies by grade level. A meta-analysis by Li (2014) reported that the effects of read-aloud accommodations were significantly stronger for elementary school students than those in middle school. Another meta-analysis by Buzick and Stone (2014) also found that a student's grade level is a significant moderator of the effects of the read-aloud accommodation. Therefore, the lack of gains in the reading comprehension scores may have been due to the fact that participants had enough decoding skills to read many words and that the read-aloud accommodation was ultimately not necessary to remove a barrier to accessing new information.

Overall, the current study raises questions about the effectiveness of the read-aloud accommodation when provided in isolation. Moreover, although the read-aloud accommodation in isolation may be effective for some students, it appears that merely using the standardized score from a Word Attack subtest (as applied in the given study) may not be sufficient to identify who will benefit accurately.

Research Question 2: To what extent does the read-aloud accommodation, vocabulary support, and comprehension monitoring affect general comprehension of text-based material for students with word decoding difficulties? Based on the simple view of reading (SVR), it was anticipated that participants would experience a similar but no greater benefit from the combination of the read-aloud accommodation, vocabulary support, and comprehension monitoring compared to the read-aloud accommodation alone. However, for more than half of the participants, their best accommodation condition was the decoding + language comprehension condition.

The current study is the first to investigate the read-aloud accommodation, vocabulary support, and comprehension monitoring as an accommodation package for participants with poor decoding skills. The present study revealed some positive effects of the decoding + language comprehension condition for three students. Based on the percentage of content words recalled, the visual analysis displayed data separation between the decoding + language comprehension condition and the baseline phase for only one participant (i.e., John). Based on the PND, the best accommodation condition for four participants (i.e., Robert, John, William, and Mary) was the decoding + language comprehension condition. John and Mary displayed a significant increase in reading comprehension scores that corresponded to the decoding + language comprehension condition.

John was the only participant for which positive effects were evident across both the two measures and phases (i.e., effects were evident based on data from both the alternating treatment and best accommodation phases). Only for John's case is it, therefore, possible to rule out the possibility of multitreatment interference as a reason for the gains identified; for all other cases, the effectiveness identified may have been due to multitreatment interference (see Chapter III for more information on this possible effect). When considering the two participants (i.e., John and Mary) whose decoding + language comprehension condition displayed a statistically significant effect, the one apparent difference between them and the other participants was that their Listening Comprehension subtest scores were lower than the other participants. It may be the case that benefits from support that integrates decoding, vocabulary, and comprehension monitoring are more likely among those with both low decoding and low language comprehension scores. If so, this would ultimately be aligned with the SVR, and it may simply be the case that the threshold for determining adequate language comprehension in the current study was not accurate. This also indicates that the threshold for language comprehension used in this study may have been below what was necessary for the student to have sufficient language comprehension for understanding the passages used in the study.

Findings of prior research have suggested much more consistent positive effects of these accommodations for a variety of students (e.g., Boardman et al., 2015; Fletcher et al., 2006; Gaskin et al., 1996; Guthrie et al., 2004; Hawkins et al., 2010). Some potential explanations for the differences between the current study findings and past work include the following: a limited amount of time for participants to learn vocabulary words, participants were only expected to summarize and not engage in other related activities, and insufficient participant exposure to technology. These are discussed in the following paragraphs.

A limited amount of time allocated to teaching vocabulary words during the decoding + language comprehension condition is one possible reason for the lack of gains in reading comprehension. Each participant used the read-aloud technology to listen to the definitions of each vocabulary word before listening to the passage. The participants also had the option to pause the reader and go back to the vocabulary list to look at the definitions. However, very few participants returned to the vocabulary list while listening to the passage. In past studies, participants' reading comprehension scores benefited from vocabulary previewing (Hawkins et al., 2010; Koury, 1996). In their 2010 study, Hawkins and colleagues engaged in the following for the vocabulary previewing condition. First, the researcher read the vocabulary word and asked the participant to repeat it aloud, then the researcher provided a definition and used the word in a sentence. Compared to Hawkins's study (2010), the participants in the current study received a very brief exposure to the vocabulary words and definitions. This lack of engagement in quality teaching of the vocabulary words may have been a reason for the lack of gain in reading comprehension scores in the current study.

Requiring participants to only summarize what they read and not engage in a more thorough review and engagement in the material covered may be another explanation for the lack of gains on the reading comprehension measures compared to other studies (Boardman et al., 2015; Fletcher et al., 2006; Guthrie et al., 2004). In the current study, participants were asked to pause and summarize what they read halfway through the passage. Many researchers have reported that participants' reading comprehension scores increased when the comprehension monitoring included summarizing, developing questions, and reviewing the main idea (Boardman et al., 2015; Fletcher et al., 2006; Guthrie et al., 2004). Compared to past studies, the current study did not require participants to do more than summarize. It may be the case that had

the current study involved a more thorough review than merely summarizing, more positive effects may have been identified.

Insufficient exposure to the technology during the decoding + language comprehension condition may be another possible reason for the lack of reading comprehension gains. Explicit instruction was used when teaching the participants how to utilize the technology, and step-by-step instructions were given during each session. Each participant was also given one session to familiarize themselves and practice with the technology. However, researchers have suggested that taking time to interact with and practice using reading technology can improve reading comprehension outcomes (Elkind et al., 1993; Parr, 2012). Therefore, the participants may have needed more time to familiarize themselves with the technology.

The current study was the first to investigate whether students with poor decoding skills would benefit from the combination of the read-aloud accommodation, vocabulary support, and comprehension monitoring. Although somewhat more evidence was identified, suggesting positive effects of this accommodation combination compared to the corresponding evidence for the decoding accommodation (in isolation), positive effects were again only evident for fewer than half the participants and tended to vary based on measure and were rarely evident across both expected phases. Much more support may be needed for many students to experience gains from these accommodations.

Motivation. When considering the lack of positive effects overall, the dearth of rereading and reviewing of vocabulary strategies used by participants, as well as the fact that this was a research study in which there were no positive or negative personal consequences for students' comprehension of the material, it is important to note another important factor that may have played a role in the findings: student motivation to comprehend. According to many studies, a

reader's motivation affects their reading comprehension (Ahmadi, 2017; Grabe & Stroller, 2002; Guthrie & Wigfield, 2000; Seymour & Walsh, 2006). Participants' potential lack of motivation may have been a barrier to determining if the accommodation conditions truly could affect their reading comprehension (Gottfried et al., 2005). Overall, the measurement of comprehension may have been compromised by limited motivation among participants during the activity.

Social Validity. In the current study, social validity (e.g., how useful students find the accommodations (Wolf, 1978)) was not directly measured. However, looking at the number of times participants used a feature of the accommodations when it was an option instead of a demand may give some insight into whether they found the particular accommodations useful. During the decoding + language comprehension condition, participants were told they had the option to review the vocabulary definitions while reading the passage. However, only one participant reviewed the definition of one vocabulary word. Therefore, it may be the case that the participants in the current study did not find the vocabulary support accommodation useful. According to a literature review by Lovett and Leja (2013), if a student does not find an accommodation helpful, they will likely not use it if given the option. It is important to understand students' thoughts/feelings about the accommodation(s) because some students find accommodations distracting (Lovett & Leja, 2013), which could negatively impact their ability to learn. Therefore, since social validity was not measured it is unknown whether students would use these accommodations outside the context of the study and/or if they found the accommodations distracting.

Direct and Indirect Effects Model of Reading (DIER). In the current study, there appeared to be an overall lack of evidence to support accommodation decisions based on the simple view of reading; as noted above, many other factors may have influenced our ability to

detect the anticipated effects of accommodations. One recent framework that has been described and empirically studied may be of value in future related work: The direct and indirect effects model of reading (DIER). The DIER framework suggests a more complex view than the simple view of reading. Specifically, the "DIER proposes that the following skills, abilities, and knowledge contribute to reading development: word reading, listening comprehension, text reading fluency, background knowledge, socio-emotions or reading affect, higher order cognitions and regulations, vocabulary, syntactic/grammatical knowledge, phonology, morphology, orthography, and domain general cognitions or executive function." (Kim, 2020, p. 6). An important component of the DIER framework is the dynamic relations hypothesis, which indicates that there is an interaction between an individual's reading development and the text demands of the passage (Kim, 2020). The DIER framework, namely the dynamic relations hypothesis, may better explain the results of the current study, such that the nature of the passages may have played a role in the extent to which students' decoding and language comprehension skills were at a sufficient level for the accommodation(s) to show effects on the particular passages used. Even though the passages in the current study had similar reading levels and lengths, other aspects of the passage that put more demands on the reader were not taken into account, such as the sophistication of the vocabulary words, the location of relevant information, and the density of the information (Kim, 2020). This may be why the majority of participants' scores in the current study did not demonstrate stability based on the visual analysis of the data. In other words, different passages may have had more or less demands on the reader, which may have contributed to the student performing worse or better on the reading comprehension measure. Overall, the student's performance on the comprehension measures may

be better explained using the DIER framework because reading may be more complex than the simple view of reading suggests.

Limitations

The interpretation of these results must be viewed in light of several limitations of the study, which are highlighted below.

Background Knowledge. The first limitation concerns a lack of control of the participants' background knowledge and the corresponding impact that background knowledge may have had on variation in reading comprehension scores. Background knowledge represents the prior knowledge the participants had on the topics the passages described in the study and is a critical factor that influences the comprehension of new material (Guthrie et al., 2004). Although passages were selected to prevent background knowledge from influencing the findings (see Chapter III on how passage topics were chosen), some passages portrayed topics that could be considered common knowledge (i.e., Underground Railroad) compared to more obscure ones (i.e., Colonial Architecture). The participants' background knowledge was not assessed before administering the passages. Therefore, their reading comprehension scores may have been influenced by their background knowledge instead of their reading comprehension level alone.

Possible Practice Effects. The second limitation is related to possible practice effects. In the current study, participants were asked to read multiple passages per day, which seemed to cause a practice effect for some participants. A practice effect occurs when participants have become familiar with some aspects of the experiment from engaging in multiple measurement occasions in a short period of time. As a result of this effect, participants may have performed worse in the first session compared to the second session. Therefore, their reading

comprehension scores may have been influenced by how comfortable the participants were with the materials instead of solely the reading comprehension accommodation conditions. Moreover, the possibility of practice effects becomes even more apparent when examining data for the comparison conditions. More specifically, during the alternating treatment phase, when examining the two no accommodation conditions during the alternating treatment phase, four out of the seven participants displayed at least one no accommodation condition that was visually higher than the highest score during their baseline phase. For example, John demonstrated a significant increase between the decoding + language comprehension condition and the baseline phase for the percentage of content words recalled measure. For this measure, John also showed a visual increase in his reading comprehension score during the second no accommodation condition compared to his highest score during his baseline phase. This begs the question of whether John's reading comprehension scores were due to implementing the decoding + language comprehension condition or simply learning how to respond to the prompts more effectively over time.

Reading Comprehension Measures. The third limitation is related to the technical adequacy of the reading comprehension measures. Recall measures (which were the type of reading comprehension measures applied in the current study) have been criticized for lack of technical adequacy in prior work (Keenan et al., 2008; Reed & Vaugn, 2012). For example, according to a study by Carlisle (1999) students without disabilities perform better on recall tasks compared to students with learning disabilities. Also, the recall measure is dependent on the student's verbal language abilities (Johnston, 1981). Therefore, the recall measures used in the current study may not have accurately measured reading comprehension.

Moreover, although some evidence of technical adequacy is available for the scores used in this study (i.e., "number of words recalled" and "percentage of content words recalled") when applied using similar passages, technical adequacy for the scores when applied to the specific passages used in this study was not available. A pilot study was conducted on a few of the passages to examine whether the passage selection criteria that were applied corresponded to passages that showed a basic level of reliability. However, only four students were in the pilot study, and they only read five passages. Therefore, it is unknown whether the technical adequacy of the reading comprehension measures was solid.

Study Eligibility Testing. The fourth limitation is relevant to the eligibility testing for the current study. Eligibility testing for the study was conducted virtually due to the COVID-19 pandemic. Initial research has suggested no significant difference between scores acquired in-person and virtually on cognitive and achievement assessments (Hamner et al., 2021; Wright, 2020). However, during in-person administration, the researcher can have more control over the environment compared to virtual administration. For example, a few participants got distracted during testing due to activities going on in their homes and/or just by being on a computer. Therefore, it is a possibility that some participants did worse than they would have if tested in person, which may have caused some participants to meet the SVR criteria when they typically would not have.

Another limitation of the eligibility testing was whether students were accurately identified as fitting the category of a "poor decoder" according to the SVR. Although the criteria used were similar to other studies that categorized students according to the SVR (e.g., Catts et al., 2006; Giusto & Ehri, 2019), cut scores and metrics for measuring decoding and language

comprehension of the SVR are highly variable (Fletcher et al., 2018). Therefore, without having more uniform criteria for the SVR, participants may not have been categorized correctly.

Implications for Future Research

Findings from the current study offer some potentially helpful directions for future research discussed in this section.

Simple View of Reading. The current study examined the effects of accommodations for students who fall into just one of the four types of readers according to the SVR: the poor decoding group. As discussed, it was found that few displayed clear benefits of the decoding condition, which does not align with the SVR. Along with potentially exploring alternative thresholds for assigning students to SVR groups, it may be helpful to also study the other groups in the SVR to develop a stronger understanding of whether the SVR may be an efficient and accurate way to assign accommodations to other reading groups.

Intensive Accommodation Supports. Based on the results of the current study, more evidence of positive effects was found for the larger accommodation package (i.e., the decoding + language comprehension condition) compared to the read-aloud accommodation alone. This may suggest that more intensive accommodation supports are ultimately needed for more students to benefit. Relatedly, it could be helpful for researchers to explore whether multi-component reading support strategies (i.e., combining the read-aloud with eye-tracking technology and combining the read-aloud with instruction on using a graphic organizer) are more beneficial for students with poor decoding skills. Future research should study an adapted read-aloud accommodation that more easily facilitates rereading or adapt the current study to include a requirement that the participants complete two readings of each passage prior to measuring their recall. In the current study, the vocabulary support accommodation was utilized. As stated

above, in past studies, it was reported that a more comprehensive vocabulary previewing procedure resulted in higher reading comprehension scores (Hawkins et al., 2010; Gaskins et al., 1996). Therefore, replicating parts of the current study and including a more comprehension previewing of vocabulary words may result in an increase in reading comprehension scores. Participants in the current study also utilized the comprehension monitoring tool. As previously discussed, in past studies, it was reported that when a reader summarized, developed questions, and reviewed main ideas, the reader had stronger reading comprehension scores (Boardman et al., 2015; Fletcher et al., 2006; Guthrie et al., 2004). Therefore, it may also be beneficial to investigate whether utilizing different comprehension monitoring skills (e.g., summarizing, developing questions, reviewing the main idea, etc.) affects reading comprehension. Overall, future research that examines more comprehension accommodation supports may show stronger effects.

Accommodation and/or Instruction. In the current study, participants were provided several supports, but overall, it was questionable whether the supports were effective. According to Cavanaugh (2002), reading accommodations can be appropriate to help students access the curriculum, but it is important not to rely solely on the accommodations. King-Sears and Bowman-Kruhm (2010) stated that accommodations do not replace specialized reading instruction. Thompson and colleagues (2004) suggest that students with learning disabilities may benefit from the combination of direct instruction in reading comprehension strategies and reading accommodations. By combining the two approaches, students may develop stronger reading comprehension skills while aiding them to meet grade-level requirements that do not require decoding (Thompson et al., 2004). Therefore, researchers should investigate which approach, accommodations alone, high-quality comprehension instruction/ decoding instruction,

or a combination of accommodation and high-quality instruction results in better long-term effects for students with poor decoding skills.

Student Level Predictors. In the current study, a few participants did benefit from the reading comprehension accommodation(s), so it would be helpful to investigate other possible student-level predictors of those who benefited. For example, researchers should measure participants' comfort level, knowledge, and ease of technology use as possible predictors of benefit. As previously stated, one potential reason the current study found few significant results may be due to the threshold used to determine whether participants were eligible for the study; a careful review of results suggested that those with lower skills may be more likely to benefit. Research that examines accommodation effects for large numbers of students representing a wide range of decoding skill levels may be helpful in determining if there is a particular threshold that can help identify who will benefit from a read-aloud accommodation. In the current study, very few participants utilized the rereading or review vocabulary options, which may be indicators that they had low motivation. The current study did not measure motivation or interest, but it would be beneficial for future studies to examine whether higher motivation results in more use of accommodation(s) and, therefore, results in higher comprehension scores.

Implications for Practice

Results from the current study hold several implications for practice, which are highlighted below.

The results of this study beg the question of whether providing a read-aloud accommodation will be helpful for many students; it is critical for teachers to avoid assumptions that an accommodation will necessarily increase the comprehension of material among all students to whom it is provided. The results of the current study support the notion that reading

accommodations may have different effects for different students and that it remains difficult to predict who will benefit. One tool developed in the past to help facilitate related predictions (i.e., the Dynamic Assessment of Test Accommodations (DATA; Fuchs et al., 2000b), was indeed found to be better than teacher recommendations at predicting benefits from accommodations; however, it is no longer available for purchase, likely due to the excessive time necessary for administration and corresponding questions about the value added of administration. As discussed in Chapter II, it was thought that the SVR could be a more cost and time-efficient way to identify which students would benefit from certain accommodations, but such was not found. Therefore, until more information is available about the student-level predictors associated with accommodation benefits, it may be best to return to a DATA-type approach if one wants to better determine whether a student will benefit. Such involves repeated testing of a student under accommodated and non-accommodated conditions to examine the extent of benefit.

Although accommodations may help some students, it is also important to emphasize that they may not be a particularly fruitful and ideal solution for addressing the reading-related barriers that many students experience during instruction and learning. To date, considerable literature highlights how many reading difficulties could be prevented or addressed through the provision of high-quality reading instruction and intervention (Archer & Hughes, 2011; Carnine et al., 2004; Coyne et al., 2006; Daly et al., 2005; McCormick, 2003; Rupley et al., 2009). An emphasis on ensuring high-quality reading instruction and intervention is in place should ultimately be emphasized for those who are considered to need accommodations. Indeed, past literature has found that combining accommodations with reading comprehension interventions/strategies improves understanding of an expository text (Roberts et al., 2012), and practitioners are correspondingly encouraged to ensure any student who is provided a reading

accommodation should similarly be receiving quality reading instruction and intervention such that the accommodation may not be needed in the future.

Conclusion

Reading comprehension accommodations are one tool students might use to gain access to and understanding of written material. Overall, upon visual inspection of the descriptive data, the results of the current study demonstrated little to no separation between the reading comprehension conditions and the baseline phase, which indicates that the study did not show effectiveness of the reading comprehension accommodations for the participants. The results of the current study also highlight that it remains difficult to predict which students benefit from accommodations and the conditions under which they benefit from them. Although some benefit, additional research may be helpful to identify the characteristics of those who do, as well as the specific accommodation features necessary to promote access. Without clear guidance about who will benefit, practitioners are encouraged to engage in close monitoring of student performance with and without accommodations to gauge the conditions under which they are helpful.

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APPENDIX A: Procedure for Guardians to use before Every Session

1. Start setting up about 5 minutes before the meeting time.
2. Make sure the computer is set up in a quiet place where distractions are minimal, the wifi has a strong signal and your child will be comfortable.
3. If your child prefers, they can wear headphones. If they do want to wear headphones, please have them set up before the meeting.
4. Click on the zoom link from my original email and type in the password.
5. Make sure to join with audio and video

APPENDIX B: Example Passage

Black Americans in the Civil War

While many people loyal to the Union lived in the South, no group was more supportive of the Union than African Americans. They not only served as spies, providing information on plans and troop movements, but they also fought for the freedom they earnestly desired.

Harriet Tubman, one of the leaders of the Underground Railroad, was also a spy during the Civil War. In 1863, she began taking short trips to the Confederate states to spy on enemy forces. One time she led a Union force of 150 men up the Combahee River in South Carolina where they surprised a Confederate camp. They destroyed a huge cache of supplies and brought out 750 slaves.

When the Civil War started, there was a rush of black men who wanted to sign up to fight. At first, they turned away. Lincoln did not want to alienate the border states more than necessary. Many white soldiers did not think blacks could fight well. In May 1863 the Government established the Bureau of Colored Troops. Once they were deployed on the battlefield, black soldiers proved their courage over and over again.

Not everything was rosy for the black soldiers, however. They were paid less than white soldiers, their weapons were often in poor shape, and other supplies were of lower quality. Many struggled for equal pay, refusing their pay for months until Congress gave it to them in June 1864.

While only ten percent of the whole Union army was black, their losses were high. As many as one-third died. Still, their bravery and courage under fire were proven by the 16 Medals of Honor that were awarded. Few records of the deeds of black Americans have survived. Some were lost, while others were purposely destroyed. Even so, enough information remains to show us their valuable contribution.

APPENDIX C: Procedure for How Vocabulary Words Were Chosen

1. https://readabilityformulas.com/free-readability-formula-tests.php
2. Show word statistics
3. Show all unique and hard words
4. Delete duplicates
5. Delete proper nouns
6. Delete words defined in passage
7. Compare words left to the vocabulary lists from grades 4-7
    a. https://docs.google.com/spreadsheets/d/1DDQ4mfkLV_guepo7m6ALIzUTr_HRU54KKG_edlrNfEA/edit?usp=sharing
8. The words found on the higher grade levels will be defined
9. Ten words will be chosen
10. The following website was used to define the words
    a. https://kids.wordsmyth.net/we/?ent=activites

APPENDIX D: Procedure for How to Create the Content Words List

- Make contractions into two words
    - Won't = will not
    - Isn't = is not
- Remove sounds
    - Um, oh, ah,
- Copy and paste transcribed recall into the online automatic parts of speech checker (https://parts-of-speech.info/).
- Use the results to make a list including all the proper nouns, common nouns, verbs, adjectives, adverbs, and numbers based on the online automatic parts of speech checker results.
    - Delete all words that are not highlighted
    - Copy and paste list into excel sheet
- Working on the list of words
    - Delete duplicates – including different tenses
        - For example, if the passage has the words "is" and "are," then one will be deleted
    - Split up proper nouns
        - For example, United States will be worth two points
    - Include numbers
        - Each digit is worth one point (The number 438 is worth four points = four, hundred, thirty, eight)
    - Put list in alphabetical order

APPENDIX E: Flyer for Study

Figure 16

Flyer for the Study

Pearson

Using Your Digital Assets on Q-global: Digital Stimulus Books, Manuals, & Additional Administration Components

Appropriate Use

The Q-global End User Licensing Agreement (EULA) indicates that you may not reproduce or transmit this product in any form or by any means, electronic or mechanical without permission in writing from Pearson. Review the full EULA: https://downloads.pearsonassessments.com/images/components/qglobal/Q-global-License-agreement.pdf.

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Before Testing

Print the Examiner Administration Directions (if applicable)

Before you begin testing, download the file from the Resource Library to your preferred device. Printing is allowed for the Examiner Administration Directions files. The Digital Stimulus Book Examiner Administration Directions include essential instructions to the examiner that appear in the printed Stimulus Book and explain how to present demonstration, start, and test items. Additional information on administration may also appear in the Test Manual, where indicated.

Download the audio files (if applicable)

Where applicable, Examiner Administration Directions (e.g., KTEA-3 Form A Examiner Stimulus Book 1 and Audio Files.pdf) also include embedded audio files as required for administration. These audio files must be accessed or downloaded using a free third-party PDF viewer such as Acrobat Reader®. With the Examiner Administration Directions file open in Acrobat Reader, click the audio link () in the Table of Contents to show/hide the Attachments panel. Save the audio files from the Attachments panel to your computer for use during administration.

Note. Using a web browser to access attached audio files is NOT recommended because not all browsers support the functionality necessary to access the attachments panel.

For digital components intended to be viewed by the examinee (e.g., stimulus materials, questionnaires)

Verify Your Screen Size

Minimum screen size is 9.7" measured diagonally, similar to an iPad or iPad Air. Smaller screens, such as iPad minis and mobile phones, are not allowed for examinee-facing content, as these have not been examined empirically and may affect stimulus presentation, examinee response, and subsequent equivalency of the digital test results to the print test (see References below).

Enter Full Screen Mode

There are two ways to view digital components in the Q-global Resource Library: through the pdf viewer in the browser window or full screen in presentation mode.

Always use full screen (i.e., presentation) mode for digital components viewed by the examinee. This provides the cleanest presentation of test content without on-screen distractions (e.g., extra toolbars).

To display examinee-facing test components (e.g., stimulus books, questionnaires)

To enter presentation mode, click the icon  on the top of the window.

In presentation mode, each page has forward and back buttons for navigating through the document. In addition, each page has a "home" button that will quickly take you to a page where you can choose the next appropriate test, subtest, and/or start point for the assessment.

Through the Q-global viewer, use the forward and back buttons on the top left portion of the navigation panel.

For examiner-facing test components (e.g., manuals, administration directions)

In presentation mode, use the hyperlinked Table of Contents to jump to specific pages in the manual. Or, scroll up and down through the document as needed.

Through the Q-global viewer, use the hyperlinks in the Table of Contents to go to the desired section of the document or use the document outline. The document outline is accessible in the sidebar of the viewer. You may need to open the sidebar with the Toggle Sidebar button to view them.

If audio files are required with the administration, they are embedded in the Examiner Administration Directions file, and can be found in the Attachments panel. You must download the Examiner

Administration Directions file and open it in a PDF viewer such as Adobe Reader® to access and play the embedded audio files. You may have to download the audio files if they will not play from the Attachments panel (see the "Before Testing" section above).

To exit out of any digital component, press "Esc" to leave full screen mode, and then close the window.

Test Administration

Navigating the Digital Stimulus Book

The Digital Stimulus Book contains visual stimuli you need to present the test items. The Contents page lists specific tests/subtests and may include age-related start points. Each entry in the Contents page is a link to the first test item you present—clicking on a link will take you to the correct page to begin testing. Click on the icons on the page to navigate through the Digital Stimulus Book:

Return to Contents—returns you to the Contents page


Moves forward one screen


Moves back one screen

Recording and Scoring the Examinee's Responses

Use the paper Record Forms and/or Response Booklets to record and score the examinee's responses.

Equivalency Research & Considerations

Equivalency of in-person print vs. digital test administrations

Equivalency studies of Q-interactive administrations of the Wechsler Adult Intelligence Scale, Fourth Edition (Wechsler, 2008) and the Wechsler Intelligence Scale for Children, Fifth Edition (Wechsler, 2014) provide evidence of the effect of displaying stimulus pictures on an iPad rather than in a printed booklet (Daniel, 2012, 2014). On average, there was no format effect for subtests with visual display but no touch response. Examiners still need to use paper record forms to record and score responses; therefore, there is little difference between the digital stimulus book or digital component and standard paper-pencil administration and scoring.

Equivalency of remote digital test administration (via telepractice)

Studies examining the equivalency of telepractice or remote test administration—a session between a professional in one geographical location and a client at a different location—are ongoing. See www.asha.org/telepractice as one example of current research in this area. See the Reference list below for a sample of the existing research for specific test formats and assessments. For considerations regarding remote test administration equivalency of Pearson digital tests, refer to our general telepractice landing page at www.pearsonassessments.com/telepractice. At the bottom of this page, links to

individual pages allow for specific information for that particular product, as applicable. Once you click on the test name, select "Show more" (found near the top of the page), and scroll to "Telepractice: Tips on using this test in your telepractice."

As noted at ASHA.org Telepractice Overview, "Use of telepractice must be equivalent to the quality of services provided in person…". Administering, recording, and scoring responses must mirror the standardized test administration procedures and flow as smoothly as paper administration so that results can be compared to normative data. If it is your professional judgment that the telepractice test administration is not equivalent to the quality of services you could provide in a face-to-face test administration and the examinee's performance was negatively affected due to telepractice test administration, you may provide qualitative descriptions of the examinee's language skills in the telepractice setting.

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APPENDIX G: Reading Background Questions

1. Does your child struggle in reading? Yes or no
2. If so, do you know what they struggle with while reading (i.e., sounding out words, understanding what they read, limited vocabulary, etc.)

APPENDIX H: Scripted Protocols for Introduction and No Accommodation

Introduction and No Accommodation

1. Start recording the meeting
    a. *Share pleasantries*
2. **Hello ____.**
3. **I am Jessica and I am a graduate student at Michigan State University**
4. **We are going to be working together over the next several weeks.**
5. **In this study, I am going to be looking at if different technology tools help you comprehend what you read.**
6. **When we meet you will be asked to read one or more passages**
7. **Starting out you will silently read the passages. After a couple of weeks, I will introduce you to technology that may support your reading, to see if they affect your reading comprehension.**
8. **Some of these passages may be hard for you to read, but all I ask is that you do your best.**
9. **Just so you know, I will be recording our meeting so I can go back and listen to your answers. Only me and a few people working on this project will see these videos.**
10. **If you need to take a break let me know. You can take a break before or after reading a passage but not while reading.**
    a. *If the student does ask for a break while reading a passage say, "If it is an emergency we can stop, but please try to finish reading the passage, and then you can take a break."*
11. **Remember nothing we do here will affect your grades. Also, anything you tell me is strictly between me and you. Unless you tell me that you are hurting someone or someone is hurting you, then I will need to tell someone.**

Let me demonstrate one of these passages:

12. **If at any time you can't hear me, my audio is breaking up and/or a video lag, please let me know!**
    a. See cheat sheet for what to do
13. **As I said, you're going to start by reading the passages silently and at the end I will ask you to tell me all about what you read.**
14. **All of the passages you will be reading are about social studies.**
15. **This passage is titled The Study of the Past**
    a. Share practice passage tab with the student
16. **Are you able to see the passage titled The Study of the Past?**
    a. *If the student cannot see the passage:*
        i. *Make sure you are sharing your screen and the shared screen is correct.*
        ii. *Make sure the student has the zoom window showing on their screen by asking what they see on their screen.*
17. **When I demonstrate I will read the paragraph aloud but when it is your turn you will read silently.**

18. **I will now demonstrate.**
    a. Read paragraph
    b. **The people of the ancient world didn't build skyscrapers, invent the automobile, or send spaceships to Mars. But they did remarkable things. Among their amazing feats were building huge temples, inventing writing, and discovering planets. Every step we take in technology, science, education, literature, and all other fields builds on what people did long ago. We are who we are because of what people did in the past.**
19. **When it is your turn, you will tell me you are done and I will stop sharing my screen and ask you to tell me all about what you just read.**
20. **I will now demonstrate recalling what I just read**
    a. Demonstrate recalling the paragraph
    b. **There were people who lived a long time ago and it was called the ancient world. They didn't invent things like cars or spaceships but they did some really cool things. They did build temples, invented writing, and saw planets. Every new discovery is based on what people did a long time ago.**
21. **Now it is your turn.**
22. **But first, you will take control of the mouse so you can scroll the passage while reading.**
    a. *Give the student access to the mouse*
        i. *If the student has trouble taking control of the mouse or trouble scrolling say, "click on the zoom window and try again." If that doesn't help, make sure on zoom you have clicked on 'remote control', and have given mouse control to the student.*
23. **You should now see a message on your screen asking if you want access to the mouse. After the message goes away, click on the zoom window (or the screen I am sharing with you) to control the mouse.**
    a. Walk the adult/student through this as they are following the steps.
24. **Please try to scroll. Great!**
    a. *If the student has trouble scrolling, ask the student/adult to try moving the pictures so the student can see the scroll bar on the right-hand side of the screen.*
        i. *To move the pictures, just click and drag*
25. **Now, I want you to practice reading and recalling the following paragraph.**
26. **While reading the paragraph, if you see a word you don't know, just try your best. Also, when you are telling me all about what you read, I cannot help you or tell you if you are correct. Please just try your best.**
27. **Please read the paragraph silently and tell me when you are done reading.**
    a. *Answer any of the technology questions the student asks pertaining to the study*
    b. *If the student asks how to pronounce a word or a definition of a word, say, "just try your best."*
    c. *If the student is still reading after about 3 minutes, say, "remember to tell me when you are done reading."*
    d. *If the student is still reading after about 5 minutes, say, "that is a really hard paragraph, let's try a different one."*
        i. Scroll down and there are several different paragraphs the student can practice with.

e. Wait for the student to say they are done reading.

28. Stop sharing screen

29. Now that you have read about The Study of the Past, please tell me all about what you just read. Try to tell me everything you can. Begin.

a. Listen to the recall and do not provide corrective feedback.

b. *If the student asks if they forgot anything from the passage, or along those lines, say, "just try your best."*

30. Great job!

31. Do you feel comfortable with the recall passage and ready to do more on your own, or would you like to practice some more with me demonstrating first?

a. *If the student says no or pauses for several sections say, "you can practice some more if you want."*

b. Practice recalling paragraphs until the student reports they feel comfortable

i. Scroll down and there are several different paragraphs the student can practice with.

32. Any questions so far?

a. *Answer any questions the student has about the study.*

33. If there are technical difficulties during a passage we will stop that passage and begin a new one. If during a practice passage we may have to wait until the next session to practice.

a. See cheat sheet.

34. If at any time you cannot hear me please use the chat feature to tell me.

a. Verbally tell the student where to find the chat and how to send a chat message.

b. Have the student do the steps as you explain

35. **Great! Let's get started with reading the full recall passages**

Steps for Introduction for Recall	**Yes**	**No**
1. Practice recall passage displayed on the computer		
2. Researcher provided the correct directions		
3. Researcher demonstrate how to read and recall the paragraph		
4. Recall questions asked AFTER child indicates they are finished		
5. Researcher stop sharing the passage screen BEFORE recall question		
6. Researcher refrained from providing corrective feedback to reading and recalling the passage		
7. Student practiced recall passage and indicated they feel comfortable		
Total	____/7	_____/7

APPENDIX I: Scripted Protocols for No Accommodation

No Accommodation

1. Reference the student's passage schedule and pull up the correct passage on the computer.
2. Do not share the screen with the student until all directions have been given
3. **While reading the passage, if you see a word you don't know, just try your best. Also, when you are telling me all about what you read, I cannot help you or tell you if you are correct. Please just try your best.**
4. **Please read the passage silently and tell me when you are done reading.**
5. **This passage is titled _____**
    - **a.** Share the passage tab with the student and give them access to the mouse
6. **Are you able to see the passage titled _____?**
    - **a.** *If the student cannot see the passage:*
        - *i. Make sure you are sharing your screen and the shared screen is correct*
        - **ii.** *Make sure the student has the zoom window showing on their screen by asking what they see on their screen.*
7. **Remember to click on the screen to access the mouse and tell me when you are done reading.**
    - a. *Answer any of the technology questions the student asks pertaining to the study*
    - **b.** *If the student asks how to pronounce a word or a definition of a word, say, "just try your best."*
    - **c.** *If there are significant technical difficulties, ask the student to stop reading, fix the technology issues, and start a new passage.*
        - **i.** *Use a backup passage*
    - **d.** *If the student is still reading after about 5 minutes, say, "remember to tell me when you are done reading."*
    - **e.** *If the student is still reading after about 10 minutes, say, "that is a really hard passage, let's try a different one."*
        - **i.** *use a backup passage*
    - **f.** Wait for the student to say they are done reading
8. Stop sharing screen
9. **Now that you have read about _____ (title of the passage), please tell me all about what you just read. Try to tell me everything you can. Begin**
    - **a.** Listen to the recall and do not provide corrective feedback
    - **b.** *If the student asks if they forgot anything from the passage, or along those lines, say, "just try your best."*
10. **Thank you for working so hard on this passage!**
11. **Now you are going to read another passage.**

Steps for No Accommodation	**Yes**	**No**
1. Reference the student's passage schedule and pull up the correct passage on the computer steps		
2. Passage provided AFTER all directions provided		
3. Researcher provided the correct directions		
4. Student read the passage silently		
5. Recall questions asked AFTER child indicates they are finished		
6. Researcher stop sharing the passage screen BEFORE recall question		
7. Researcher refrained from providing corrective feedback to reading and recalling the passage		
Total	____/7	_____/7

APPENDIX J: Scripted Protocols for Pre-Training

Pre-training

Now we are going to learn how to use the technology reading tools.

Read-Aloud Practice

1. **The first tool I will teach you is the read-aloud. With the read-aloud, you will hear the computer reading the passage out loud and you will listen. This may make it easier for you to understand what is written in the passage since you don't have to read it on your own.**
    a. Bring up the read-aloud practice recall passage on the computer screen.
    b. Open Natural Reader (see cheat sheet)
2. **This passage is titled _____**
    a. Share the practice passage tab with the student
3. **Are you able to see the passage titled _____?**
    a. *If the student cannot see the passage*
        i. *Make sure you are sharing your screen and the shared screen is correct*
        ii. *Make sure the student has the zoom window showing on their screen by asking what they see on their screen*
4. **You may have seen many different types of read-aloud accommodations. For this study, Natural Reader is used.**
5. **Look at the top right hand side of the document and you will see a blue play button. You will practice using this a little later.**
    a. Use your mouse to show the student where the play button is.
6. **An important aspect of the read-aloud is choosing a voice and speed you feel comfortable with. I will play you a few options and you will tell me which one you like best.**
    a. To choose voice:
        i. Click settings
        ii. Click "Plus"
        iii. Click each US name and then the play button next to the blue dot
        iv. After playing 3 ask the student to choose which of the three they like best.
        v. After all 8 have been played, use the 3 names they liked the best and play the first three sentences of the passage and then ask the student to choose the name they like the best.
    b. To choose a speed:
        i. Use the voice the student chose
        ii. Click on like next to "Speed"
        iii. Start at 0 and the play button next to their chosen voice
        iv. Preview -1 to +1, after three speeds ask which one they prefer.
        v. After you have 2 numbers, play the two speeds for the student again and have them choose one
7. **If while listening to this practice passage you realize you do not like the voice or speed, please let me know and we can change them.**
8. **Now, I will show you how to use the read-aloud.**

   a. **First I will click the play button.**
   b. **You can see how it highlights the sentence it is reading.**
   c. **If I press the pause button and then the play button. The read-aloud starts from the beginning of the sentence.**
   d. **If you need to skip around you can click the forward or rewind arrows, look next to the play button. You can only do this if the read-aloud is playing.**
   e. **You will need to scroll down as the read-aloud reads the passage.**
      i. *Demonstrate while explaining.*
9. **Now, you will practice using the read-aloud. Remember to click on the zoom window. Move the mouse around to make sure you have control.**
   a. *Give the student access to the mouse*
   b. *If the student does not attempt, tell them the action again. If still no action, ask them if they need help.*
   c. *If the student struggles using the mouse, ask if there is a different type of mouse they can use (i.e., instead of using the pad, using an external mouse). You can also ask their guardian to come back in the room to help*
10. **First I just want you to play around using the read-aloud in the document, starting in the second paragraph. Tell me when you feel comfortable with the read-aloud.**
    a. Give the student a few minutes to just familiarize themselves with the tool
11. **Great now, pause the read-aloud for me.**
    a. Press play again
    b. Press the rewind arrow and then the forward arrow
    c. Then pause
    d. If the student struggles with any of these commands, provide support.
12. **Wonderful!**
    a. Open the next practice passage
13. **Now I want you to try to listen to the next paragraph by yourself. Let me open the document before you begin. Okay, go ahead.**
    a. Have the student practice independently.
14. **Do you have any questions about the read-aloud?**
    a. *Answer student's questions about read-aloud*
15. **Do you feel comfortable with the read-aloud and ready to do more on your own, or would you like to practice some more with me demonstrating first?**
    a. *If the student says no or pauses for several sections say, "you can practice some more if you want*
    b. Practice using the read-aloud until the student reports they feel comfortable.
    c. Scroll down and there are several different paragraphs the student can practice with.
16. **Great!**
17. **I just want to double check you are okay using this is the voice and speed when we meet.**
18. **Now let me show you how to use the vocabulary tool.**

Vocabulary Practice

1. **The second tool I will teach you is the vocabulary tool. This can be helpful because it tells you the definition of words that you may not know the meaning of. Knowing the definition of difficult words may help you comprehend the passage better.**
    - **a.** Bring up the vocabulary practice recall passage on the computer screen.
    - **b.** Make sure the correct voice and speed is selected for the student
2. **For this passage you will use the read-aloud again.**
3. **This passage is titled _____**
    a. Share the practice passage tab with the student
4. **Are you able to see the passage titled _____?**
    a. *If the student cannot see the passage:*
        i. *Make sure you are sharing your screen and the shared screen is correct.*
        ii. *Make sure the student has the zoom window showing on their screen by asking what they see on their screen*
5. **Under the title of the passage, you will see the word "Vocabulary" that is blue and underlined. To get to the vocabulary words you first need to right-click on the word "vocabulary" and then "open link."**
    a. Demonstrate with explaining
6. **When you open the new tab you will see the list of vocabulary words and definitions. You will use the read-aloud to listen to the definitions**
        i. Demonstrate
7. **After you are done listening to the definitions, you will go back to the passage tab and listening to the passage.**
    a. Demonstrate while explaining.
    b. You can see the vocabulary words are in blue.
    c. Read the paragraph outload pointing out the blue words.
8. **Now you try, in the next paragraph.**
9. **Remember you need to click on the zoom window. Then right-click on the word vocabulary in blue word and then the title of the document.**
    a. *Give the student access to the mouse*
    b. Have the student practice independently.
    c. If the student needs help getting to the vocabulary list, provide support.
10. **Great! Now that the vocabulary list is open please use the read-aloud to listen to the definitions**
    a. Wait for the student to read/listen to the definitions
11. **Now that you are done reading all the definitions you can go back to the passage tab and listen to the paragraph.**
    a. Have student read to the second paragraph.
12. **Do you have any questions about the vocabulary tool?**
    a. *Answer student's questions about vocabulary tool*
13. **Do you feel comfortable with the vocabulary tool and ready to do more on your own later, or would you like to practice some more or have me demonstrate more?**
    a. *If the student says no or pauses for several sections say, "you can practice some more if you want.*
    b. Practice using the vocabulary tool until the student reports they feel comfortable.

c. Scroll down and there are several different paragraphs the student can practice with.

14. Great!

15. Now let me show you how to use the summarizing tool.

Comprehension Monitoring Practice

1. **The final tool I will teach you is the summarizing tool. This can be helpful because it provides you time to reflect on what you have read. Reflecting on what you have read may help you comprehend the passage better.**
    a. Bring up the summarizing practice recall passage on the computer screen
    b. Make sure the correct voice and speed is selected for the student
2. **This passage is titled _____**
    a. Share the practice passage tab with the student
3. **Are you able to see the passage titled _____?**
    a. *If the student cannot see the passage:*
        i. *Make sure you are sharing your screen and the shared screen is correct.*
        ii. *Make sure the student has the zoom window showing on their screen by asking what they see on their screen*
4. **While you are reading the passage you will see a pause sign** (show the pause sign to student)**. When you get to the pause sign stop reading and tell me in your own words what you read.**
5. **For this passage we use the read-aloud.**
6. **I will listen to the first paragraph.**
    a. use the reader for the first paragraph.
7. **When I get to the pause** (hover the clicker on the first pause sign in the document) **sign I might say something like,**
    a. See how I summarized in my own words and I didn't read the passage again. Instead of just reading the passage aloud, I took some main ideas and said it in my own words.
8. **Now you try. First, read the paragraph using the read-aloud. when you get to the pause sign, pause the reader and tell me in your own words what you have read.**
    a. *Give the student access to the mouse*
    b. Have the student practice independently.
    c. *Remind them to use the forward arrow until they get to the beginning of the next paragraph.*
9. **Do you have any questions about the summarizing tool?**
    a. *Answer student's questions about the summarizing tool.*
10. **Do you feel comfortable with the summarizing tool and ready to do more on your own later, or would you like to practice some more or have me demonstrate more?**
    a. *If the student says no or pauses for several sections say, "you can practice some more if you want*
    b. Practice using the summarizing tool until the student reports they feel comfortable.
    c. Scroll down and there is an extra paragraph for the student to read. If they need another one they can read the first paragraph.
11. **Great!**

Steps for Accommodation Use Practice	**Yes**	**No**
Read-Aloud		
1. Researcher explained how to use the RA		
2. The researcher demonstrated the RA		
3. The researcher and student practiced using the RA together		
4. Researcher provided the correct directions		
Vocabulary		
5. Researcher explained how to use the vocabulary		
6. The researcher demonstrated the vocabulary		
7. The researcher and student practiced using the vocabulary together		
8. Researcher provided the correct directions		
Comprehension Monitoring		
9. Researcher explained how to use the comp monitoring		
10. The researcher demonstrated the comp monitoring		
11. The researcher and student practiced using the comp monitoring together		
12. Researcher provided the correct directions		
Total	____/12	_____/12

APPENDIX K: Scripted Protocols for Decoding

Decoding

1. Reference the student's passage schedule and pull up the correct passage on the computer.
2. Do not share the screen with the student until all directions have been given
3. Make sure the correct voice and speed is selected for the student.
4. **You will use the read-aloud tool to listen to the passage. For our session today, it is important that you use the read-aloud for the entire passage, even if you do not think it helpful. If you don't use it then we will have to stop and start a new passage.**
5. **After listening to the passage, I will ask you to tell me all about what you just read.**
6. **This passage is titled _____**
    a. Share the passage tab with the student and give them access to the mouse
7. **Are you able to see the passage titled _____?**
    a. *If the student cannot see the passage:*
        i. *Make sure you are sharing your screen and the shared screen is correct.*
        ii. *Make sure the student has the zoom window showing on their screen by asking what they see on their screen.*
8. **Remember to click on the screen to access the mouse.**
9. **Press the play button at top of the screen and tell me when you are done listening.**
    a. *Answer any of the technology questions the student asks pertaining to the study*
    b. *If the student does not listen to the whole passage using the read-aloud, remind the student to use the tool to listen to the whole passage.*
    c. *If the student asks for help using the read-aloud say, "press play and then click on the passage where you want the reader to start."*
    d. Wait for the student to say they are done reading
10. Stop sharing the screen**.**
11. **Now that you have read about _____ (title of the passage), please tell me all about what you just read. Try to tell me everything you can. Begin.**
    a. Listen to the recall and do not provide corrective feedback.
    b. If the student asks if they forgot anything from the passage, or along those lines, say, "just try your best."
12. **Thank you for working so hard on this passage!**

Steps for Decoding Recall	**Yes**	**No**
1. Reference the student's passage schedule and pull up the correct passage on the computer steps		
2. The correct voice and speed are selected		
3. Directions were given step-by-step		
4. Researcher provided the correct directions		
5. Student had the reader read all the words in the passage		
6. Recall questions asked AFTER child indicates they are finished		
7. Researcher stop sharing the passage screen BEFORE recall question		
8. Researcher refrained from providing corrective feedback to reading and recalling the passage		
Total	____/8	_____/8

APPENDIX L: Scripted Protocols for Decoding + Language Comprehension

Decoding + Language Comprehension

1. Reference the student's passage schedule and pull up the correct passage on the computer.
2. Do not share the screen with the student until all directions have been given
3. Make sure the correct voice and speed is selected for the student
4. **You will use the vocabulary, read-aloud, and summarizing tools. For our session today, it is important that you use all three tools for the entire passage, even if you do not find them helpful. If you don't use them then we will have to stop and start a new passage.**
5. **After listening to the passage, I will ask you to tell me all about what you just read**
6. **This passage is titled _____**
    a. Share the passage tab with the student and give them access to the mouse.
7. **Are you able to see the passage titled _____?**
    a. *If the student cannot see the passage:*
        i. *Make sure you are sharing your screen and the shared screen is correct.*
        ii. *Make sure the student has the zoom window showing on their screen by asking what they see on their screen.*
8. **Remember to click on the zoom window to access the mouse.**
9. **To open the vocabulary list right click on the word vocabulary and then open link.**
    a. Wait for vocabulary list to be open
10. **Now, open the reader by clicking on the blue N and then the play button. Remember to listen to all of the definitions.**
    a. Wait for the student to listen to all the definitions
11. **Now that you are done listening, go back to the passage page, press the blue N in the corner and then play button to start listening to the passage. If while listening to the passage you can't remember a definition, you can go back to the vocabulary tab.**
12. **Tell me when you get to the pause sign and pause the reader.**
    a. Wait for student to tell you they are at the pause sign
13. **Tell me in your own words what you have listened to. Tell me when you are done summarizing.**
    a. Wait for student to say they are done summarizing.
14. **Great! Press the play button and continue listening to the passage, if you can't remember a definition you can go back to the vocabulary tab.**
15. **Tell me when you are done listening to the passage.**
    a. *Answer any of the technology questions the student asks pertaining to the study*
    b. *If the student does not listen to the whole passage using the read-aloud, remind the student to use the tool to listen to the whole passage.*
    c. *If the student asks for help using the read-aloud say, "press play and then click on the passage where you want the reader to start."*
    d. *If the student asks for help using the vocabulary tool say, "click on the word "vocabulary" in blue, then the preview icon, and then the arrow in the top right corner."*

e. *If the student does not click on the "vocabulary" or does open the list but switches back to the passage too quickly, the researcher will remind the student that it is beneficial to double-check their knowledge by reading the definitions, even if they already know the meaning of the word.*
f. *If a student skips a comprehension reflection, the researcher will prompt the student to go back and complete the reflection.*
g. *If the student asks for help using the comprehension monitoring tool say, "when you see the pause sign, tell me in your own words what you have read."*
h. Wait for the student to say they are done reading.

16. Stop sharing the screen**.**

17. Now that you have read about _____ (title of the passage), please tell me all about what you just read. Try to tell me everything you can. Begin.

a. Listen to the recall and do not provide corrective feedback.
b. If the student asks if they forgot anything from the passage, or along those lines, say, "just try your best.".

18. Thank you for working so hard on this passage!

Steps for Decoding + Language Comprehension Recall	**Yes**	**No**
1. Reference the student's passage schedule and pull up the correct passage on the computer steps		
2. The correct voice and speed are selected		
3. Directions were provided step-by-step		
4. Researcher provided the correct directions		
5. Student had the reader read all the words in the passage		
6. Student opened the vocabulary list before reading the passage		
7. Student used the comprehension monitoring tools		
8. Recall questions asked AFTER child indicates they are finished		
9. Researcher stop sharing the passage screen BEFORE recall question		
10. Researcher refrained from providing corrective feedback to reading and recalling the passage		
Total	___/10	____/10

APPENDIX M: Example Schedule

Meetings:

1. May 10th
   - 1 session
2. May 12th
   - 2 sessions
3. May 17th
   - 2 sessions
4. May 19th
   - 1 session
5. May 24th
   - 1 session
6. May 26th
   - 3 sessions
7. May 31st
   - 3 sessions
8. June 2nd
   - 2 sessions
9. June 7th
   - 3 sessions
10. June 9th
    - 3 sessions
11. June 14th
    - 2 sessions