DIFFERENTIATING READING INTERVENTION TO SUPPORT LEVELS OF COMPREHENSION WITH STUDENTS WITH INTELLECTUAL DISABILITIES

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by

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APPROVAL PAGE

The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

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DEDICATION PAGE

I dedicate this dissertation to the three students who spent an entire year reading with me. Their involvement in this study emphasizes the value in shared learning experiences; we taught each other things that went beyond the content of the pages we read.

ACKNOWLEDGEMENT PAGE

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ABSTRACT

National reading data indicate that students with intellectual disabilities (ID) fall behind their peers in reading. Reading is important for academic achievement and learning to read can increase independence in several settings including school, work, home, and community or social (Wilson & Hunter, 2010). Students with ID have historically received vocabulary instruction with less emphasis on the other components of reading, including reading comprehension. The purpose of this study was to examine the effect of three interventions on reading comprehension with three participants with ID. The participants in this study were high school students between the ages of 15-18 years. The interventions are grounded in the Construction-Integration Model (Kintsch, 1991; van Dijk & Kintsch, 1983), which included three different levels of text representation (i.e., linguistic, text base, and mental representation of text). Given that students with ID have shown variation in skill development, a brief experimental analysis (BEA) was used to identify the most effective intervention for each participant. Then extended analysis was used to further evaluate the effect of the selected interventions by measuring their performance on a researcher-modified Maze. Pre- and post-data was collected on three measures that aligned with each intervention. In the BEA, the participants' reading comprehension scores on the Maze exceeded baseline after receiving

the linguistic intervention, anaphor resolution (Dommes et al., 1984). The selected intervention resulted in varying effect sizes on reading comprehension, but the participants demonstrated increased performance on intervention-specific measures. They did not maintain their positive trends in the maintenance phase.

Chapter I: INTRODUCTION

Intellectual disability (ID) is defined similarly to the general construct of disability; difficulties or deficits individuals experience that interfere with their functioning in a several social contexts (Schalock, 2010). ID is characterized by differences in intellectual efficiency, limited adaptive behavior in social environments, and an early age of diagnosis (American Psychological Association [APA], 2013; Schalock et al., 2010; Schalock, 2011).

Identifying the degree in which students' disability impacts their functioning in a classroom is useful for selecting individualized supports and services (Luckasson et al., 2002; Schalock et al., 2010), including effective academic instruction. The current study uses the definition of ID to inform research and provide individualized support. Supports refer to resources and strategies that promote development, education, interests, and well-being (Thompson et al., 2009), which parallels the goal of special education.

Students with ID make up 6.26% of the special education student population and 0.9% of the entire public school student population and (U.S. Department of Education, 2019), which may be an underestimate, because this data does not capture students with multiple disabilities or other eligibility categories like autism and developmental delay, which are known co-occurring conditions with ID (Braun et al., 2015). State-wide measures of achievement testing indicates that students with disabilities fall behind their peers in reading. In 2019, only 10% of eighth graders and 10% of fourth graders with disabilities were proficient and above in reading. This suggests that many students with disabilities struggle with core standards in reading such as integration, interpretation, and application of text; drawing conclusions and making evaluations; providing information,

summarizing main ideas and themes, making inferences, and analyzing text (National Assessment for Educational Progress, 2019). The impact of reading difficulties does not stop in elementary school, as many reading scores on standardized testing dropped in 2019 (National Center for Education Statistics, 2020). Student outcome data on standardized college tests provide more insight to students' reading performance, but specific data for students with specific disabilities, like ID, are not provided. The lack of standardized data is likely due to the fact that students with ID are tested with alternative assessments and accommodations are not made for students to participate in the SAT and ACT. Nonetheless, the Individuals with Disabilities Education Act (IDEA) and Every Student Succeeds Act (2015) mandated that accountability systems include students with significant disabilities, which includes the allowance for 1% of students tested with alternative assessment. Students with ID represent 10% of students tested with alternative assessments (Kearns, 2011). High-quality academic instruction became a priority, which was a significant change for students with ID, because they were not included in accountability measures and their education traditionally focused on functional outcomes (Bruce, 2011).

National reading scores and intervention research suggest there is an on-going need to evaluate effective methods to teach reading skills to teach to students with severe disabilities (Spooner & Browder, 2015). Reading is important for academic achievement, and for students with ID, learning to read can increase independence in several settings including school, work, home, and community or social (Wilson & Hunter, 2010). However, academic instruction with students with ID has historically lacked emphasis on learning to read (Katisms, 2000; Kliewer et al., 2006; Browder et al., 2006). Even with

the shift to evidence-based reading instruction for this population, students with ID continue to demonstrate poor postsecondary outcomes and lower performance on measures of reading achievement.

If students with ID do not receive adequate reading instruction, their ability to fully participate in society is limited (Lundberg & Reichenger, 2013). Students with ID are more likely to drop out of high school, are less engaged in postsecondary education, training, or employment, and are less likely to live independently (Sanford et al., 2011; Prince, et al., 2018). For example, in 2005, only 28.1% of students with ID engaged in postsecondary education, which was a significant increase from the 8.4% of students in 1990. Far more individuals with ID were working outside the home, but there was a decrease from 46.5% in 1990 to 29.8% in 2005 (Sanford et al., 2010). Moreover, students with ID often leave high school with a certification of completion rather than a diploma (Chapman et al., 2011), which suggests differences in achievement and expectations for students with ID. In regard to reading development, individuals with ID typically fall far behind their peers (Allor et al., 2014a; Laws et al., 2016). One study with 13 adults with ID (ages 27-56) demonstrated that their reading accuracy, rate, and comprehension was comparable to elementary aged children as young as six years old. In fact, some participants did not meet basal levels in these reading skills and only could recognize letters (Moni et al., 2011).

Early reading achievement consistently predicts later achievement (Adelson et al., 2016; Hernandez, 2011; Lesnick et al., 2010), but this is less clear with students with ID. In a sample of fifth and eighth grade students with ID (n= 330), only 32% of students with ID participated in state standardized testing, while the majority participated in

alternative assessments (Afacan, 2018). Of the students that participated in standardized testing, only 4% of fifth graders and 3% of eighth graders performed at and above proficient levels, which was much lower compared to those who participated in alternative assessments at fifth (48% proficient or above) and eighth grade (50% proficient or above). Similar to studies in Florida (Trexler, 2013) and North Carolina (Schulte et al., 2016), the majority of students with ID performed at minimal levels on statewide reading achievement tests, which may explain why students with ID shown nonsignificant changes in reading development across grades in this study (i.e., Afacan, 2018). Students with ID require more time to even demonstrate small changes in reading performance, and standardized reading tests may be too broad to capture these small changes in skill acquisition (Pfost et al., 2014). Alternative assessments are designed to capture growth for those students who do not demonstrate progress on typical measures and use alternative academic achievement standards, which vary by state and are criticized for also being too board (Kearns et al., 2011) and do not often inform comprehensive reading instruction.

Curriculum-based measures (CBMs) may be an appropriate substitute as they were developed for educators to monitor students' academic progress and measure effectiveness of intervention and instruction (Deno, 1985). While students with ID demonstrated low achievement on CBM word passage reading in accuracy and rate compared to peers with other disabilities, increased rates of achievement were observed with increasing grade level across two types of CBM reading measures (Lemons et al., 2013). Taken together, students with ID demonstrate low performance on several different measures of achievement, and appropriate reading instruction is needed to

increase outcomes for students with ID, whether that is testing scores or postsecondary options. As education for students with ID has shifted toward evidence-based practices typically developing peers receive, educators might consider how to further improve instruction to improve reading skills (Cihak & Grim, 2018) and closely monitor progress with assessments that measure discrete skills within reading.

Despite the historical lack of academic focused instruction and the daunting postsecondary outcomes for this population, evidence-based reading intervention and instruction is advantageous for students with ID. Specifically, instruction that includes the five components of reading (i.e., phonemic awareness, phonics, fluency, vocabulary, and reading comprehension; National Reading Panel [NRP], 2000) and effective instructional strategies geared to support students with specific needs. A content comparison across 2004 and 2010 teacher cohorts suggests special educators more recently used explicit instruction more, taught more components of reading overall, and increased the number of activities and components per reading lesson with students with IQs lower than 55 (Algrim-Delzell & Rivera, 2015). Moreover, all of the teachers in the 2010 cohort used comprehension strategies with their students, and the change in the number of comprehension activities used in 2004 to 2010 resulted in a large effect (d= 1.55). There were strong effects for all the components of reading that were coded in the study (range of effect d= 0.85-1.55), which included vocabulary, alphabet knowledge, concept of print, phonological memory, phonological awareness, phonics, and comprehension. This study suggests that special educators are including evidence-based reading content and instruction more often. However, this study was done with a small sample of teachers that consented to participate in research. On a larger scale, 535

special educators were surveyed in one state in the United States, and they reported a high amount of variability in their use of 27 instructional practices. 18 of the 27 practices had evidence for teaching content to students with ID and/or autism, three had promising or emerging evidence, and the most frequent practices were explicit instruction, modeling, and modifications to the environment (Knight et al., 2019).

When individuals with ID received evidence-based reading intervention, over time they demonstrated small increases in reading (Moni et al., 2018). Moreover, this study showed that older individuals with ID were interested in reading and writing and often tried to engage in these activities. Beyond academic and vocational outcomes, social-emotional benefits of reading provide stronger rationale to continually support reading development in individuals with ID. Moni and colleagues (2011) interviewed adults living in Australian community centers and it was evident that the centers had a lack of access to literary materials and activities, which adds an additional barrier to reading development. Others have highlighted the importance of increasing exposure to literature for this population from a young age and across their development (Browder et al., 2009).

Statement of the Problem

Research supports use of evidence-based reading instruction for students with ID, but research and practice focused on building early literacy skills. Models of comprehension identify decoding and language comprehension as important skills to build reading comprehension (Gough & Tunmer, 1986). Early literacy skills such as phonemic awareness, decoding, and vocabulary are known to build a foundation for reading, but intervention research has shown that relying on these early skills to boost

comprehension is unlikely to lead to significant differences in reading comprehension (e.g., Allor et al., 2010a; 201b). It is more likely that comprehension skills and strategies need to be directly and explicitly taught, especially to this population of students that experience unique cognitive and linguistic skill deficits. Less is known about effective interventions that can directly support reading comprehension, as well as measures that assess the multiple, underlying skills within comprehension. The need for specific skill instruction is mirrored in other models of comprehension. Readers need to actively build their understanding at multiple levels, including the linguistic and text base levels, and learn to use higher-level reading skills to actively develop a situational model or mental representation of text (Kintsch & Rawson, 2005; Perfetti et al., 2005; Oakhill, 2020). Models of reading comprehension may be used to design interventions to address specific need at these different levels, and data could be collected to determine the most appropriate intervention for individual students.

Purpose of the Current Study

The purpose of the current study is to examine the effect of three interventions on reading comprehension with three students with ID. The interventions are grounded in models of comprehension (i.e., Gough & Tunmer, 1986; Kintsch, 1991; van Dijk & Kintsch, 1983), and are expected to benefit students with poor comprehension skills based on previous research (Oakhill, 2020). The intervention involved strategies that have evidence of increasing coherence at the word, sentence, and passage level. Moreover, preliminary research with students with ID has shown that this population can also benefit from comprehension specific intervention and instruction. This study took place over 21 weeks, with intervention sessions occurring twice or three times a week.

Given that students with ID have shown variation in skill development, a brief experimental analysis (BEA) was be implemented to identify the most effective intervention for each student. Then extended analysis was used to further evaluate the effect of the selected interventions. This study fills a gap in the literature by going beyond instruction relying on early literacy skills and evaluating strategies for reading comprehension intervention for students with ID. Moreover, the current study evaluated whether and how BEAs can be used to individualize reading intervention.

Research Questions

1. To what extent do interventions targeting the *linguistic level*, *text base level*, and *mental construction of text* have differentiated effects on reading comprehension with students identified with an intellectual disability?
2. To what extent do the selected interventions lead to growth in reading comprehension with students identified with an intellectual disability?
3. What effect will intervention strategies have on students' understanding of the *linguistic level, text base level* and *mental representation of text* of reading comprehension with students identified with intellectual disabilities?
4. To what extent will students identified with an intellectual disability maintain the effects of intervention on comprehension after 2 and 4 weeks following the termination of the intervention?

Definitions of Key Terms

The following terms are defined for this study to ensure clarity for the reader.

Intellectual Disability

ID is characterized by differences in cognitive ability, limited adaptive behavior skills, and an early age of diagnosis (APA, 2013). Specifically, students with a full-scale intelligence quotient (FSIQ) between 55-70 (i.e., "mild" ID) were included in the study, which indicates that students with mild cognitive impairments (as indicated on a standardized IQ measure) were recruited for the current study.

Decoding

The Simple View of Reading (SVR) identifies decoding skills and language comprehension as two necessary components for readers to develop reading comprehension. In the current study, decoding is defined as quick and accurate word reading based on readers' ability to match graphical symbols to phonemes (i.e., letter sound correspondence).

Language Comprehension

Gough and Tunmer (1986) originally identified language comprehension as "listening comprehension," and was described as the process by which lexical or word information, sentences and discourses are interpreted. This construct cannot be measured perfectly (Tunmer & Chapman, 2012) and a variety of reading measures are used in research. In the current study, language comprehension is used instead of listening comprehension, because it involves several language skills such as vocabulary, syntax, and oral listening.

Reading Comprehension

Reading comprehension is defined in the current study in reference to guiding theories. Reading comprehension is an active process where readers simultaneously use decoding and language comprehension (SVR) to understand written text at varying levels

(i.e., linguistic, text base) to construct meaning by integrating their own ideas with the information in the text (NRP, 2000). The following definitions represent different levels of text representation with the construction-integration model (Kintsch, 1991; van Dijk & Kintsch, 1983):

Linguistic level. This refers to the readers' ability to understand individual words and phrases within text.

Text Base Level. The text base is the meaning within and expressed by the written text, which consists of the microstructure and macrostructure.

Microstructure Text Base. One element of the text base that consists of propositions organized by semantic and syntactic relationships in a sentence or section of text. When readers understand elements in the microstructure, they are understanding the local meaning.

Macrostructure Text Base. The second element of the text base that involves processing semantic and syntactic information across multiple sections of text. Also known as global understanding of the text.

Mental Representation of Text. This is the highest level of comprehension and considered the final product of reading (Oakhill, 2020) where readers construct a mental image or schema described by the text. This level requires the integration of information within the text as well as readers' prior background knowledge.

Assumptions

Several assumptions guide the current study. Reading comprehension is a complex and multifaceted skill, and several instructional strategies have been promoted to help with different and/or multiple strands of reading comprehension. As such, finding

a single measure of reading comprehension that captures multiple aspects of the skill is challenging. The study used *DIBELS® 8th Edition* Maze passages as a repeated measure for monitoring participants' progress in reading comprehension over time. I assumed that the Maze passages were adequate measures, because they were designed to monitor progress, were endorsed by researchers (e.g., Conoyer et al., 2016), and correlated with other traditional measures of comprehension including question and answer techniques (r= .84; Gellert & Elbro, 2013). I modified the Maze passages to include distractors for each item that challenged participants to use varying levels of comprehension to answer correctly, which was based on recommendations to modify missing words in cloze passages to intentionally target reading skills (i.e., Gellert & Elbro, 2010) and modify measures to be semantically complex (Kemper, 1983). Additionally, it was assumed that the intervention-specific measures were appropriate as they were carefully selected and designed to match the three targeted levels of comprehension.

It is assumed that the interventions and instructional strategies would work as they were designed from three reading theories. The first was the Simple View or Reading (SVR) applied to individuals with ID (van Wingerden et al., 2017, 2018). Oakhill's (2020) research review posits a complex view of the SVR and extends the model to readers with poor comprehension skills. Similarly, the construction-integration model (CI Model) has been evaluated with students with students with poor comprehension skills and has been used to design an intervention implemented with culturally and linguistically diverse adolescents and included students in special education (e.g., Kim et al., 2016).

The three interventions in the study were designed to explicitly teach participants' instructional strategies to support their comprehension skills at word, sentence, and passage level. The interventions were separated to identify which skill participants need the most support, because eventually, students are expected to engage with information at multiple levels of text and integrate information they already know (Kintsch, 1998). The interventions were designed to align with the levels identified in the CI Model including the linguistic, text base, and situation model levels. At the linguistic level, accurately identifying anaphora are two strategies to support participants' comprehension at this level. Early research indicates that comprehension is limited by word recognition, but only in word reading speed/ automaticity and not semantic quality (Rosinski et al., 1975, Yuill & Oakhill, 1991). However, other studies did not find a significant difference between good and poor comprehenders in speed (Perfetti 1978). Moreover, explicit instruction for anaphor has demonstrated increased skill (i.e., Dommes et al., 1984), but has yet to be evaluated with students with ID. When processing the text base, readers are creating coherent local and global meanings of proposition sequences in text, so previewing and summarizing strategies were selected to support participants' ability to do this (i.e., Pressley & Afflerbach, 1995). Students with ID were able to identify main ideas and supporting details after receiving summarization instruction (Bilgi & Özmen, 2018), and previewing may further support their ability to create global meaning. Goal setting and self-monitoring strategies are selected to support participants' ability to integrate background knowledge and monitor understanding in order to achieve a complete, coherent mental representation of text (Cromley & Azevedo, 2007; Elbro & Buch-Iversen, 2013; Flores & Ganz, 2007; Perfetti et al., 2005;). It is assumed that the

selected strategies and subsequent interventions will adequately address the three levels of comprehension.

Finally, the inclusion criteria for this study required participants to demonstrate adequate decoding skills on leveled reading passages that were within their instructional level (Gickling & Thompson, 1985). Teaching with materials within students' instructional level allows them to read quickly, accurately and frees their attention and focus on developing their comprehension (Gickling & Thompson, 1985), or their mental representation of the text. It is well established in reading theory and research that adequate fluency cannot be achieved without strong word recognition skills (NRP, 2000). The instructional level assumes that the students have achieved word recognition, through decoding and sight word instruction, for a high percentage of the words in the provided text (i.e., 93-97% words known; Gickling & Thompson, 1985).

Delimitations

There are a few delimitations that limit the scope of the study. First, only high school students with ID with mild cognitive impairments (i.e., FSIQ = 55-70) and proficient decoding ability were recruited to be included in the current study. Theory on reading comprehension suggests that it is the product of decoding and language comprehension (Gough & Tunmer, 1986), and several early literacy skills contribute to reading comprehension. In part, the decoding inclusion criteria explain why only students in high school were recruited for the study. Individuals with ID develop reading skills more slowly (e.g., Mervis, 1990; Spooner & Brown, 2011) and recruiting older students would increase the likelihood of identifying eligible participants.

The proposed study appears to be the only one that has used reading comprehension theory to design interventions for students with ID. The rationale for recruiting students with ID were three-fold: individuals with ID have been historically excluded from education settings (Polloway et al., 2011), students more commonly received functional rather than academic interventions (Dymond et al., 2018), when they did receive reading instruction, it emphasized early literacy skills, discrete responses (Spooner et al., 2012), and sight-word reading (Browder et al., 2006), and research with students in secondary education settings was limited (Bouck, 2012). There is an on-going need to identify and evaluate evidence-based reading intervention and instructional strategies as increased reading comprehension will grant students with ID independence.

There are several skills and processes associated with reading comprehension, but the current study focuses on specific skills within the linguistic, text base, and situational model within the CI Model (Kintsch, 1991; van Dijk & Kintsch, 1983). Specifically, the linguistic skill targeted in the current study was anaphor resolution (i.e., identifying the word a pronoun or proposition refers), understanding of text base was targeted with previewing elements in text (e.g., title, characters) and summarizing paragraphs strategies, and construction of mental representation of text was supported through self-monitoring strategies.

Limitations

There are three possible limitations to the current study. First, several strategies exist that have evidence for supporting reading comprehension. The instructional strategies in the current study were selected based on guiding theory as well as research done with students with learning disabilities or identified as "poor comprehenders," as

there is limited research conducted with students with ID. Other strategies and interventions may be more effective for this population, but hopefully, additional research will be conducted to add to the literature.

The Maze passages were manipulated in in a few ways. First, every passage was revised to have a consistent and predictable structure, which was identified as a helpful text adaption for this population (Hudson et al., 2013a). The Maze passages were also revised by intentionally omitting words and creating multiple-choice answers that target three levels of comprehension. This method has not been empirically evaluated and was created by the principal investigator based on recommendations in previous research (i.e., Conoyer et al., 2017; Gellert & Elbro, 2013). To differentiate the original Maze and the researcher-modified Maze, "*DIBELS®* Maze" and "Maze" will be used to reference these measures respectively.

Individuals with ID learning and reading development is slower compared to peers without ID (e.g., Allor et al., 2010a), so participants in the current study may not demonstrate significant change even with 20+ weeks of intervention. The current study is designed to individualize intervention for each participant, but it is likely that every participant could benefit from receiving every intervention rather than just one.

Organization of the Dissertation

This dissertation includes five chapters that outline the study. Chapter 2 is a literature review that starts with cognitive and linguistic factors that impede reading comprehension for students with ID. Next, three models of comprehension are reviewed discussing skills, processes, and levels within reading comprehension and related intervention for students with ID. Chapter 3 outlines the design of the study and includes

details about the participants, setting, measures, procedures, and analyses. Chapter 4 will describe the results of the analyses. Chapter 5 will contain the Discussion, which will highlight key findings and contextualize them in research and practice.

Chapter II: LITERATURE REVIEW

Understanding the factors that impede or facilitate reading comprehension is necessary to understand how to best intervene with students with intellectual disabilities (ID). The purpose of this chapter is to review the existing literature related to factors that impact reading comprehension in students with ID. Next, an overview of the guiding theories and related interventions will be reviewed to build a conceptual framework for the current study. Reading comprehension theories can be used to identify effective interventions and instructional strategies for students with ID. Research and intervention on explicit instruction, decoding, reading fluency, and comprehensive reading interventions will be discussed within the guiding theories. While intervention with students with ID has included most components of reading, their comprehension abilities are often evaluated as an additional outcome measure rather than emphasizing comprehension instruction. In an effort to fill this gap, three levels of reading comprehension in the construction-integration model are reviewed to understand how they may increase students' understanding at the word, sentence, and passage levels. Finally, specific instructional strategies are reviewed that may increase these levels of comprehension for students in the current study.

Reading Comprehension and Intellectual Disability

Individuals with ID experience increased reading difficulty due to the complex nature of reading comprehension. There are several individual-student characteristics related to their cognitive functioning that may impede their achievement, which are described in more detail below.

Phonological Processing

Phonological processing appears to have a significant relationship with word, sentence, and passage level comprehension skills for students with ID. Phonological processing is the use of sound to process written and oral information, and consists of three related abilities: phonological awareness, phonological memory, and naming speed (Anthony et al., 2007). Specifically, phonemic awareness and rapid naming have been identified as two factors creating a best-fit phonological processing model with data from 294 students with ID (Barker et al., 2013). Early literacy skills have been consistently measured with phonemic awareness tests of rhyme, blending, deletion, and letter knowledge (Barker et al., 2013; van Wingerden et al., 2017; van Wingerden et al., 2018). Phonemic awareness and rapid naming predicted decoding for participants with ID (van Wingerden et al., 2017; van Wingerden et al., 2018), and with children with Down Syndrome (Soltani & Roslan, 2013). Moreover, when vocabulary level and comprehension were controlled, phonological awareness accounted for significant variance in word and nonword decoding (Wise et al, 2010), which provides evidence that skills in phonemic awareness directly impact decoding among students with ID.

Language Comprehension

Children with ID develop language more slowly than typically developing children, even in acquiring spoken language. For example, children with Williams Syndrome correctly identified an average of 100 words by age 3 (Mervia et al., 2003), which was significantly lower than typically developing peers who could usually say 200-1,000 words between ages 2 and 3 (American Speech-Language-Hearing Association, 2020; Hoecker, 2021). Moreover, children with ID typically did not produce three-word phrases until they were 9 years old (Rondal, 2009).

In van Windergen's earlier model (2017), language comprehension was predicted by vocabulary and grammar, but only vocabulary in their second study. However, structured equation modeling revealed that a path between grammar and language comprehension significantly improved the model fit (van Windergen et al., 2018). Language comprehension also accounted for more variance in reading comprehension, as compared to reading accuracy and reading fluency (Roch & Levarto, 2009).

Degree of Intellectual Efficiency

Differences in the level of intellectual disability (i.e., mild, moderate, severe, profound) can result in differences in reading performance. Teachers reported that individuals with mild ID were able to attain some reading skills, but individuals with an IQ below 40 (i.e., moderate) did not acquire reading skills (Pezzino et al., 2019; Ratz & Lenhard, 2013). Even when students with ID were matched to peers with the same reading ability or comprehension ability, they performed lower on measures of decoding, nonverbal ability, recall, and working memory (Nash & Health, 2011).

Memory and Processing Speed

Individuals with ID demonstrate a deficit in working memory when compared to peers matched by mental age (Schuchardt et al., 2010), and may have a tendency to perform better with numbers rather than words (Pezzino et al., 2019). Phonological memory has been considered essential to working memory in individuals with ID as it is correlated with word reading, but not phonemic awareness (Conners et al., 2001; Soltani & Roslan, 2013). Moreover, poor comprehenders show differences in short term memory (Oakhill et al., 1989; Cain, 2006), and verbal working memory may limit their skills due

to an inability to actively integrate information from text to construct the situational model (Oakhill, 2020).

Processing speed is a basic component of intellectual functioning, that has also been associated with IQ and reading difficulties (Jacobson et al., 2011). Reaction times for students with borderline and mild ID were slower than typical readers and poor readers, and there was more variance in the group with lower IQ (Bonifacci & Snowling, 2008). Given that reading comprehension requires considerable executive demand (Follmer, 2018), as readers need to read efficiently while integrating information with background knowledge to create a situational model, slow processing may lead to delayed word identification at the word, sentence, and passage level (Perfetti et al., 2005). Speech and language perception has predicted reading comprehension (van Wingerden et al., 2017), which further suggests that the difficulty students with ID experience in reading may be attributed to difficulty in processing information.

Cognitive and linguistic factors impede reading comprehension in students with ID and play a role in their reading development as outlined in many reading comprehension theories. Additionally, there are several other skills and processes that make reading comprehension a complex skill. This is further explored in the following review of reading comprehension theories that were selected to guide the current study. The three theories of reading comprehension that are used to guide this literature review including the simple view of reading (Gough & Tunmer, 1986), a coherent model of reading comprehension proposed by Oakhill (2020), and construction-integration model (Kintsch, 1991; van Dijk & Kintsch, 1983), which are described below.

The Simple View of Reading

The simple view of reading (SVR) describes reading as the product of decoding and language comprehension (Gough & Tunmer, 1986). Decoding skill requires quick and accurate word reading (i.e., word recognition), which is dependent on the ability to match graphical symbols to phonemes (i.e., letter sound correspondence). It has been argued that decoding skills alone cannot account for reading, especially when readers are confronted with irregular words such as team, maid, or area (NRP, 2000). Language comprehension is the process of interpreting written or spoken words; even when readers master word recognition through decoding, understanding the meaning of words and sentences is essential for reading comprehension (Gough & Tunmer, 1986). The SVR is a multiplicative process; decoding skills and language comprehension skills together produce reading comprehension (Hoover & Gough, 1980).

SVR research

The relationship between decoding, language comprehension, and reading comprehension described in the SVR has been validated and applied in many studies. Meta-analytic research indicated that, across 56 studies, decoding and language comprehension explained 50% of the variance in reading comprehension for English-speaking students (Ripoll & Aguado, 2014). Further, variance in reading comprehension was largely explained by the shared predictive variance between decoding and language comprehension (41 to 69%) in a study with 757 elementary students (Lonigan et al., 2018). Research supports SVR in diverse groups of readers including bilingual students (Hoover & Gough, 1990), students using non-English orthographies (Florit & Cain, 2011; Catts et al., 2006), students across grade levels (Kershaw & Schatschneider, 2012), and adults with low reading skills (Sabatini et al., 2010).

Students with specific decoding and comprehension deficits have been compared to demonstrate the SVR and support the hypothesis that if a student struggles in one area, then their ability in the others are limited. Students with poor comprehenders and adequate decoding skills had difficulty in language comprehension, while poor decoders demonstrated difficulties on measures of phonological processing and did well with language comprehension (Catts et al., 2006). Developmentally, decoding skills are more predictive of reading comprehension in early years, whereas language comprehension is more salient for students in secondary education (Catts et al., 2006; Kershaw & Schatschneider, 2012; Lonigan et al., 2018). Fluency has predicted reading comprehension in addition to decoding and language comprehension (Kershaw & Schatschneider, 2012. Moreover, vocabulary predicted reading comprehension for children with high reading comprehension skills but not for students with low reading comprehension skills (Lonigan et al., 2018). This finding is important for students with ID as they experience many barriers to skilled reading.

Research with 81 children with ID found that decoding and language comprehension consistently predicted reading comprehension (van Wingerden et al., 2017), even over time (van Wingerden et al., 2018). Given the strong relationship between reading comprehension and IQ (Bransford et al., 2000; Stanovich, 1985), individuals with ID may also be at disadvantage when mastering decoding and language comprehension. Some have argued for cognitive skills to be added to the SVR (Geva & Farnia, 2012), but interventions that target cognitive skills (i.e., memory) do not lead to significant increases in reading comprehension (Melby-Lervåg & Lervåg, 2014). Moreover, speech and language perception predicted reading comprehension (van

Wingerden et al., 2017), but not over an extended amount of time (van Wingerden et al., 2018). Speech and language perception has been identified as a necessary cognitive skill that supports the ability to perceive the order of phonemes and words in speech, which is mediated by phonemic awareness (Malenfant et al., 2012), which suggests that early literacy skills may be dominant in models of reading for students with ID.

SVR and Reading Intervention

Decoding skills and language comprehension skills may be a target of intervention depending on the skills students have or lack. Language comprehension was initially defined as a process of interpreting sentences and discourses when provided with word information (Gough & Tunmer, 1986), which has been interpreted as encompassing all language skills such as vocabulary, syntax, and listening comprehension. Interventions targeting these language skills, particularly vocabulary interventions, with students with ID are briefly reviewed. Decoding skills are commonly taught via phonics instruction, and outcomes for students with ID are reviewed as well. Accurate word reading may support students' memory for words, and with increased practice, they will have better reading fluency. This hypothesis has been evaluated in intervention research; thus, fluency interventions are reviewed as well.

In Browder et al.'s (2006) review of research investigating instruction practices with students with ID, vocabulary was the most common component (n = 83, 65%), which often consisted of sight word instruction. Despite the importance of early literacy skills, few studies included phonemic awareness (n= 5, 4%) and phonics (n= 13, 10%). Reading fluency was more often included as an outcome measure and reading comprehension instruction commonly emphasized functional applications (n = 18, 58%)

instead of academic (n = 13, 42%). As evident in Browder and colleagues (2006), researchers have just begun to study practices for reading instruction with this population, which are further reviewed below.

Vocabulary. Vocabulary is highly correlated with reading comprehension and poor vocabulary acts as a barrier to comprehension (NRP, 2000). Vocabulary instruction has rarely been implemented with the goal of improving comprehension of students with ID, and sight-word recognition was the most common instructional target (Browder et al., 2006; Browder & Xin, 1998). Sight-words are words that are immediately and effortlessly identified, without specific instruction on the relationship between the sounds and letters (Warley et al., 2015), and the spelling patterns, pronunciation, and meaning help students remember them (Ehri, 1995, 2014). Explicit instruction has been used to teach students sight word instruction, which also supported their ability to correctly identify learned sight words in subsequent reading passages with 60-100% accuracy (Ruwe et al., 2011). Preteaching words to students with learning disabilities has led to increased reading fluency (d = 0.38) and almost doubled the number of comprehension questions answered correctly (d = 1.76) (Burns et al., 2004), but the effects were immediate and not measured over time, and students were diagnosed with a learning disability rather than an ID.

Sight-word instruction has been used with students with ID to elevate passages to their instructional level (i.e., 93-97% known words), which can result in increases in word recognition, fluency, and comprehension (Gickling & Thompson, 1985; Burns & Parker, 2014; Treptow et al., 2007). Three students with ID received 6 weeks of a preteaching intervention, which led to increased word recognition and fluency, but not

increased reading comprehension (Stevens & Burns, 2021). However, Roberts et al (2019) included preteaching keywords in a larger task analytic intervention for three high school students with ID, and while there was high variability in comprehension data, there was no overlap between baseline and intervention session. Beyond preteaching words, systematic prompting procedures have been effective in teaching vocabulary (Browder et al., 2006). When traditional flashcard techniques were presented with a constant time delay word acquisition and retention of complex and advanced words (e.g., prognosis, liability, cardiovascular) from expository texts increased, but there was no clear effect on comprehension due to high overlap between control and intervention sessions (Hua et al., 2013).

Teaching connected text may further support students' access to more text, because more than one word is taught at a time. Systematic sight-word instruction in connected test with students with ID increased the accuracy with which the words were read in related passages or their natural settings (Alberto et al., 2010). However, this study did not collect baseline data, which limited interpretations of the intervention effect. Allor et al., (2018) demonstrated increases in word recognition in students with ID who previously were unresponsive to a comprehensive reading intervention by exposing students to regular and irregular words in different passages and contexts and then tested their acquisition of words. With the support of intensive instruction (i.e., 70+ sessions) non-responding students with ID significantly increased their word recognition from baseline.

The Edmark Reading Program (Tague et al., 1967) was specifically designed to provide effective teaching strategies to teach word recognition, picture and phrase

matching, and story reading to students with ID. Similar to the studies described above, the program effectively teaches words to students with ID, but it has been criticized due to the lack of instruction focused on other components of reading, notably, phonemic awareness and phonics (Bruni & Hixson, 2017). Moreover, comprehensive reading programs led to significant increases in all skills for students with ID when directly compared to the Edmark Reading Program (Browder et al., 2008; Browder et al., 2012).

Sight-word instruction has limited students' ability to identify new words and in new contexts (Browder & Xin, 1998) even when students were presented with phonetically similar words (e.g., m*an* and f*an*; Baurdin & Hourcade, 1990). Instruction that includes other components of reading is likely more effective for students with ID, because when early literacy skills were included in comprehensive literacy programs, students with ID vocabulary still increased.

Phonics and Decoding. A scaffolded approach to decoding is encouraged for students with and without ID where teachers start with letter-sound correspondence, move on to sounding words out, and gradually increase difficulty of word patterns (Allor et al., 2009). Instruction is similar to that of students in general education, but there is some evidence that verbalizing phonemes in a continuous way and emphasizing target sound (e.g., /sssat/ instead of /s/ /a/ /t/) benefited students with ID (Allor et al., 2009). Staggering the presentation of different phonemes has been a successful instructional strategy for this population as well. For example, if a student was learning to say the sounds in the word "cat," interventionists would first focus on the /c/ sound before moving on to the final or middle sound. Additionally, when students practiced letter

sounds and/or words, the interventionist always connected it to a real example by using a sentence (e.g., I fed my cat last night) (Allor et al., 2009).

Meta-analytic research supports use of phonics instruction for students with ID as an evidence-based practice, indicating a large effect size across 14 studies (g = 1.42; Dessemontet et al., 2019). The meta-analysis included other components of reading (i.e., phonemic awareness, vocabulary, fluency, and comprehension), and explicit instruction was a significant moderator in phonics instruction for students with ID and resulted in stronger effect sizes. Moreover, the setting of intervention was considered important when interpreting the strength of evidence; intense and individualized instruction (i.e., 4 days of instruction per week in a one-to-one format) was commonly used and resulted in positive reading outcomes for students with ID. Researchers have implemented interventions that target more than one component of reading. For example, Allor et al., (2010a, 2010b) implemented *Early Interventions in Reading* with 35 students with ID, which targeted applied concepts of print, phonological and phonemic awareness, oral language, letter knowledge, word recognition, vocabulary, fluency, and comprehension. The intervention resulted in increases in every reading skill, but there were only significant, moderate to low effects (d= 0.04 to 0.60) on skills related to phonemic awareness (i.e., blending, segmenting) and phonics (i.e., word attack).

Decoding may be a relative strength for students with ID. Italian students with ID performed better when they read pseudowords across grade levels, and authors hypothesized that they were able to efficiently translate written letters to sounds (i.e., letter-sound correspondence), which helped them identify more pseudowords (Di Blasi, Buono, Cantagallo, Fillippo, & Zoccolotti, 2019). It is important to note that this study

took place in Italy, and researchers described the Italian language as having regular orthography. Nonetheless, Di Blasi's (2019) findings parallel early research that suggests that are relatively good at sounding out words, and sometimes without additional intervention (Conner et al., 2006). Compared to other components of reading, students with ID tend to perform better in reading accuracy compared to fluency and comprehension, and their performance in fluency and comprehension decreases as they advance in grade level (Dr. Blasi et al., 2019).

Reading Fluency. Compared to the early literacy skills discussed up to this point, less attention has been devoted to increasing reading fluency in students with ID. Fluency is gradually prompted by first asking students to read single words quickly (Allor et al., 2009), and once students can identify words accurately, they begin to read words more quickly (i.e., word automaticity) in sentences. Decodable books are used to practice decoding skills while also promoting fluency by having students read known words quickly (Allor et al., 2009). Students with ID typically exhibit better reading accuracy than reading fluency (Di Blasi et al., 2019), which may be explained by cognitive deficits (Schuchardt et al., 2010, Jacobson et al., 2011; van Wingerden et al., 2017).

Reading fluency is rarely the target of intervention for students with ID but is often included in intervention packages or used as a measure of reading outcomes (Browder et al., 2006). Meta-analytic research suggests that fluency interventions resulted in increased fluency for students with disabilities, including students with ID (Morgan et al., 2012). Specifically, goal setting was the most effective way to increase fluency for students with disabilities, which is followed by reinforcement, previewing or repeated reading, and word level reading (Morgan et al., 2012).

Repeated reading may be the most commonly used fluency interventions where students read one passage multiple times until they reach appropriate levels of fluency, and it is effective for students with and without disabilities (Therrein, 2004). Meta-analytic research indicated that repeated reading was highly effective for students with reading difficulties (g= 1.41; Lee & Yoon, 2017). Moreover, repeated reading was more effective for elementary students than secondary, and, similarly, students reading at an elementary level performed better (g= 1.25) than secondary level (g= 0.80). While goal setting and external rewards did not lead to a statistically significant difference in repeated reading (Lee & Yoon, 2017) error correction, has led to immediate increases in reading rate (Strickland et al, 2020).

Reread-Adapt Answer-Comprehend (RAAC) is a multicomponent intervention initially developed for students with LD where students read one passage several times (i.e., repeated reading; Therrien et al., 2006). Following the RAAC intervention, participants' reading rate and accuracy improved from baseline as all three students oral reading fluency (ORF) exceeded third and sixth grade levels of ORF growth (1.0-1.5 words per week and 0.3-0.65 words a week respectively; Hue et al., 2012). RAAC combined with goal setting increased in fluency with some of the participants with ID, but the baseline and intervention data overlapped (Hua et al., 2018). Overall, these studies offer some evidence that repeated reading positively fluency for students with ID.

Fluency and Comprehension. Reading fluency is an indicator for reading comprehension in both students with and without disabilities (Burns et al., 2004; Burns et al., 2011; Klauda & Guthrie, 2008; van Wingerden et al., 2017). In fact, repeated reading has demonstrated positive effects for fluency (d= 0.83) and comprehension (d= 0.67;

Therrin, 2004). However, Wexler et al. (2010) reviewed the efficacy of repeated reading and wide reading interventions with high school students with disabilities, and found little to no effect on reading fluency, comprehension, or word recognition when compared to typical reading instruction (*d*= -0.31 to 0.26). When directly compared, repeated reading outperformed whole word reading instruction (*d*= 0.06 to 0.27; Wexler et al., 2010). Instructional strategies such as passage preview (*g*= .94), number of repeats (i.e., four reads; *g*= 1.73) are effective when using repeated reading with struggling readers (Lee & Yoon, 2017). Preteaching keywords with students with ID increased fluency, but there were no clear effects on reading comprehension (Stevens & Burns, 2021). There was high variability in comprehension following the RAAC interventions that used a system of least prompts (Hua et al., 2012), goal setting (Hua et al., 2018), and error correction (Strickland et al., 2020).

Comprehensive Reading Intervention. Due to the need for intensified intervention for students with ID, it may be more efficient to implement comprehensive reading programs that target multiple components of reading at once. Comprehensive reading instruction with added instructional strategies like constant time delay, system of least prompts, and shared stories led to large effects on nonverbal literacy (*d*= 1.22), text awareness (i.e., turning pages, identifying characters; *d*= 1.57) and phonemic skills (*d*= 1.35) in students with moderate ID (Browder et al., 2008). Lemons et al. (2015) administered a phonemic awareness intervention to students with ID, and performance increased on first-sound phoneme identification, word recognition, passage comprehension, and the rate of learning phonemes increased for a few of the students.

Allor and colleagues implemented a comprehensive reading intervention (i.e., *Early Interventions in Reading;* Mathes & Torgesen, 2005) with students with ID over the course of 1-1.5 (Allor et al., 2010b) and 2-3 years (Allor et al., 2010a). In their first study, post-testing revealed that students performed significantly better on measures of phonemic awareness and phonics, posttest reading comprehension was not significant despite moderate effect sizes (Allor et al., 2010b). Moreover, a majority of the students required extended time to progress from the first lesson, and most students did not demonstrate growth on progress monitoring assessments until week 15-20. Allor et al. (2010b) found significantly increased performance on several skills for students with ID including phoneme blending and segmenting, (d = 0.87, d = 0.88) passage comprehension (d = 0.69), but the effect on comprehension was no longer significant after controlling for Type I error. Moreover, Browder and colleagues' (2008) reading interventions for students with ID led to large effects on nonverbal literacy (d = 1.22), text awareness (i.e., turning pages, identifying characters; d = 1.57) and phonemic skills (d = 1.35).

Although comprehensive interventions support early literacy skills and may save time and cost for special educators, the effect on reading comprehension remains limited and relying on early literacy skills such as decoding to influence reading comprehension may not be enough. Comprehension has been indirectly intervened upon or included as an outcome measure, but students with ID may require interventions that explicitly teach comprehension strategies.

A Coherent Model of Reading Comprehension

It is difficult to teach and learn comprehension without paying attention to the skills and processes that are connected to it. Oakhill (2020) conducted a review of literature that describes the underlying skills and processes that support comprehension to propose a coherent model of comprehension. This research is supported in studies with children described as poor comprehenders (PCs), or children with specific reading comprehension difficulty. The role of vocabulary, decoding, and memory are reviewed in Oakhill's (2020) review, as well as a new coherent model of comprehension that extends on previous theories like the simple view of reading (SVR).

Research

Early reading theory suggests that comprehension problems were related to insufficient decoding accuracy and speed (i.e., Bottleneck Theory; Perfetti, 1985). If readers did not have strong word reading skills, then subsequent reading comprehension is limited. Specifically, creating mental representations at the world level (i.e., vocabulary knowledge) was one possible explanation for the differences in skill between good and PCs. However, early studies only found differences in their word reading speed rather than access to semantic quality of words (Rosinski et al., 1975, Yuill & Oakhill, 1991).

Short-term memory has inconsistently explained poor comprehension skills. PCs remembered less information in text (Oakhill, 1982), but still had difficulty recalling text details even when provided with the text to refer back to (Oakhill, 1984) and directed to specific parts of the text (Cain & Oakhill, 1999) rather than relying on memory. However, working memory was lower in PCs (Cain, 2006, Nation et al., 1999, Oakhill et al., 2011, Yuill et al, 1989), which impeded their ability to integrate information in text while reading (Perfetti et al., 2005). Research related to working memory led to studies

investigating differences in readers' ability to integrate information while reading and suggests that verbal working memory may play a larger role. Comprehension monitoring strategies were used to support poor comprehenders' verbal working memory due to difficulties integrating meaning across sentences and paragraphs (Perfetti et al., 2005). PCs could not identify inconsistencies in text when the information was spread across multiple sentences (i.e., global coherence) as readily as their peers with good comprehension skills (Yuill et al., 1989). In summary, working memory was thought to explain differences between good and PCs, which also explained differences in inferencing and integration skills (Oakhill, 2020).

Researchers understood comprehension to be more complex than poor decoding or memory. Oakhill (2020) suggests that it is more productive to understand reading comprehension in regard to its underlying processes, because there is not one reading comprehension theory or framework that provides a thorough explanation of comprehension development and individual differences. For example, the simple view of reading (SVR) identified decoding and language comprehension as predictors of reading comprehension but did not identify other skills and processes connected to these components. Oakhill (2020) extends on the SVR by reviewing skills and processes within language comprehension. Language comprehension includes word and sentence level skills (e.g., vocabulary, understanding sentences). Despite the strong and causal relationship between vocabulary and comprehension (Quinn et al., 2015; Verhoeven & Leeuwe, 2008), differences in reading comprehension cannot only be explained by vocabulary alone (Oakhill & Cain, 2012). Thus, higher-level reading skills including inference and integration, comprehension monitoring, and understanding text structure,

have been evaluated to understand their contribution to language comprehension and subsequent reading comprehension.

Higher-level skills have explained variance in comprehension when decoding and vocabulary were controlled (Oakhill & Cain, 2012). In regard to inference and text integration, PCs made fewer text-connecting inferences when reading and listening (Oakhill, 1982, 1984) and demonstrate difficulties with text coherence when information is spread across the passage (i.e., global meaning) and close together (i.e., local meaning; Cain & Oakhill, 1999). Several contributing factors make inference and integration more complex including standard for coherence (Van der Broek et al., 1995), working memory (Cain et al., 2006), and use of background knowledge (Elbro & Buch-Iversen, 2013). Moreover, PCs have difficulty identifying inconsistencies in text, especially when the inconsistencies are separated by several sentences (Oakhill et al., 2005). This finding suggests that comprehension monitoring, text integration skills, and working memory are all interconnected.

Intervention

Oakhill's (2020) concludes with the recommendation to teach young children skills and processes underlying language and reading comprehension early and alongside decoding instruction. Moreover, educators may not monitor students' comprehension until after they demonstrate adequate decoding skills, which can leave students with underdeveloped language and reading comprehension skills. Intervention related to key components of Oakhill's (2020) research are reviewed here to emphasize the need for early language and reading comprehension intervention. In this section, research on

higher-level skills (i.e., inference and integration, comprehension monitoring, and text structure awareness) are reviewed for students with ID and other disabilities.

Inferencing. The first higher-level comprehension skill is inference making and integration. Inferences are needed to fully understand text and make connection when there are gaps in text or text is not completely explicit (McNamara, & Magliano, 2009). Moreover, background knowledge and vocabulary are necessary to make inferences (Cromley & Azevedo, 2007). For students with ID, reading comprehension significantly increased following an online intervention that included a component to increase students' background knowledge among other reading strategies (Coyne et al., 2012). In research with two students with low cognitive abilities, explicit instruction increased correct inferences from 52% to 97% and 41% to 93% following the intervention (Flores & Ganz, 2007). Adolescents with ID demonstrated significant increased reading skills and engagement after receiving reciprocal teaching with explicit instruction on comprehension strategies including prediction and summarization (Lundberg & Reichenberg, 2013). The control group received an intervention that focused on answering inference questions with more teacher support, and there were no significant differences between the groups. Moreover, there were significant effects on sentence reading for both groups (η^2_p = .22-.35), but only a large, significant effect on reading comprehension in the inference condition (η^2_p = .31), which may have suggested that teaching inferencing directly supports the skill and subsequent reading comprehension.

Self-Monitoring. Comprehension monitoring is the process of the reader evaluating their understanding of the text while reading (Oakhill et al., 2005), and when inconsistencies are detected, they must be addressed for comprehension to occur (Hacker,

1998). Peer support and goal settings are two strategies that have been used with students with ID to support comprehension monitoring. Self-monitoring has supported students with severe disabilities in reading, art, Spanish, and history classes (Giberts et al., 2001). Self-monitoring cards have been created to support students in requesting help from educators and peers. In a study with three elementary students with ID, requesting peer support led to increased correct responses to comprehension questions and the students demonstrated more independence over time (i.e., less prompts to find the correct answers; Hudson et al., 2014). Meta-analytic research suggests that goal setting results in greater improvements in reading fluency for students with ID (Morgan et a., 2012A), which may indirectly support reading fluency as an indicator for reading comprehension in both students with and without disabilities (Burns et al., 2004; Burns et al., 2011; Klauda & Guthrie, 2008; van Wingerden et al., 2017). Goal setting was a critical component in a fluency intervention for adults with ID (Hua et al., 2013), but this finding was not replicated with young adults (Hua et al., 2018) Group goal setting may be a more effective strategy than individual goals as Reed and Lynn (2016). In this study, students with disabilities performed better when they received the group goal setting component to their inference and comprehension monitoring intervention compared to those who received only the inference and/or individual goal settings components (Reed & Lynn, 2016).

Text Structure. The third higher-level comprehension skill is awareness of text structure. Text structures vary by genre, text layout, and linguistic styles, which presents new challenges for readers. This skill involves readers' awareness of the text narrative as well as knowledge about text features like titles, keywords, and beginnings and ends

(Perfetti et al., 2005). Bilgi and Özmen (2018) used explicit instruction to teach and model how to identity text features to students with ID and their subsequent text summarizations improved in length and quality. Moreover, creating passages that follow consistent and predictable structures has been identified as an appropriate text adaption for students with ID (Hudson et al., 2013b).

Three Components of Intervention. The inferencing, self-monitoring, and text structure strategies are often used together in intervention research to create comprehensive interventions for students with ID. Denton and colleagues (2017) implemented a brief intervention with high school students that consisted of multiple reading strategies to support higher-level comprehension skills. Students in intervention performed higher than the control group on multisyllable word reading and a researcher-made thinking aloud measure, but the differences from pre-test were not statistically significant. However, the intervention had strong effects on thinking aloud items (e.g., character identification, integration of text ideas), but not inferencing or comprehension. The use of these strategies has also support other components of reading including phonics and fluency. Following a systematic and explicit intervention that included strategies for text prediction, activation of background knowledge, text structure, and keywords, adolescents with ID significantly increased on measures of phonics, word recognition, fluency, and comprehension over time and with moderate to large effects (i.e., η^2_p = .09 - .31; Chatenoud et al., 2020).

Research suggests that comprehension skills such as awareness of comprehension, regulation (i.e., monitoring), and coherence predict reading comprehension in students with ID (Soto et al., 2018), but more research is needed to further understand how these

higher-level comprehension skills are effectively taught and learned by students with ID. Given that students with ID are less aware of cognitive strategies and are less likely to use the strategies described here (Erez & Peled, 2001), they may benefit from explicit instruction in this area of reading. Moreover, given the complexity of reading comprehension, brief experimental analyses (BEAs) may be a useful tool in selecting which skills to target in intervention.

Explicit and Systematic Instruction

Explicit instruction is an effective instructional approach that has supported typical and struggling readers with five components of reading (i.e., phonemic awareness, phonics, fluency, vocabulary, comprehension), including students with disabilities (Swanson & Hoskyn, 2001). Explicit instruction involves a systematic sequence of reviewing previous material, teaching new content, modelling, and providing guided and independent practice, which is repetitive and offers several opportunities to respond (Rupley et al., 2009). Meta-analytic research indicates an overall strong average effect size for explicit instructions (d = 1.98), which outperformed other instructional strategies like hands-on activities, computer assisted learning, and mnemonic strategies (Scruggs et al., 2010). Explicit instruction is also useful for teaching comprehension strategies like inference making, text monitoring, and understanding text structure (Gersten et al., 2001).

Given that students with ID experience several difficulties in linguistic and cognitive processes, they need instruction that support their unique needs and characteristics. It is widely accepted that students with ID benefit from explicit and systematic instruction over a long period of time (Alnahdi et al., 2015; Allor et al., 2009). Elementary aged students with ID received a comprehensive intervention that used

explicit instruction, systematically introduced students to reading skills in a set sequence, and continued to practice learned skills with high repetition, which led to low to moderate effects on early literacy skills and oral language (Allor et al., 2010a). Explicit instruction has also increased sight word acquisition (Ruwe et al., 2011) and reading comprehension (Flores & Ganz, 2009) for this population.

Students with ID require explicit instruction over long periods of time to demonstrate growth (Allor et al., 2014; Algrim-Delzell et al., 2014; Lemons et al., 2010; Lemons et al., 2015; Hill, 2016). Longitudinal data suggested that students with ID consistently performed lower than their peers with other disabilities on progress monitoring measures, but over time they did follow significantly positive growth rates like their peers (Wei et al., 2011). However, elementary-aged students with ID required 15-20 weeks of instruction before they demonstrated growth on progress monitoring measures (Allor et al., 2010b), and it may require 105 weeks of comprehensive, systematic instruction for students with ID to meet low benchmarks on the *DIBELS®* nonsense word fluency measure (Allor et al., 2010a).

The Simple View of Reading described reading comprehension as a product of decoding and language comprehension, which was supported among students with ID (Roch & Levarto, 2009; van Wingerden et al., 2017, 2018). Oakhill's (2020) coherent model of comprehension, based on research with poor comprehenders, states that comprehension was not a product of one skill or process. Reading comprehension occurs at difference levels of reading, and the skills discussed in both SVR and the Coherent Model are captured within word, sentence, and passage comprehension. The skills,

processes, and levels discussed in these models all contribute to the final product of reading, which is a coherent mental representation of text (Kintsch, 1991).

Brief Experimental Analysis

Due to the limited effect of comprehensive programs on reading comprehension for students with ID, it may be more effective to target comprehension systematically. Brief experimental analyses (BEAs) are used to test hypotheses and identify the most effective intervention for students by analyzing the instructional components that improve academic and behavior outcomes (Daly et al., 1997). BEAs support selection of individualized reading (McComas et al., 1996; Wagner et al., 2017) and mathematical intervention (Codding et al., 2010; Atabasi & Sanir, 2018) for struggling students. Students with ID benefited from early literacy skill intervention that was selected with a BEA (Özmen & Atabasi, 2016). Using BEAs to select different comprehension strategies may be useful due to the complex nature of comprehension which involves intertwining cognitive, language, and reading skills (Oakhill, 2020) at varying levels of difficulty. A BEA was used to effectively select appropriate comprehension strategies for students with ID (Güler & Özmen, 2010; McComas et al., 1996), but most BEA research focuses on reading fluency (Burns & Wagner, 2008) and more research is needed to further understand the usefulness of BEAs in selecting effective comprehension strategies and interventions.

Construction-Integration Model

Unlike the SVR, the Construction-Integration Model (CI Model; Kintsch, 1991) focuses on readers' ability to understand written text rather than spoken language. Kintsch (1991) describes multiple levels of processing that occur within reading

comprehension, including the (a) linguistic level, (b) microstructure and macrostructure text base level, and (c) construction of the situational model. The integration of all three levels leads to reading comprehension.

The linguistic level of the CI Model involves the identification of graphemes to decode, recognize meaning of words, rules of syntax, and strategic construction of propositions (van Dijk & Kintsch, 1983; Kintsch, 1988). The linguistic level supports readers to identify meaning of words they simultaneously integrate words into meaningful messages (Perfetti et al., 2005). The text base level, or the semantic information expressed by text by a network of propositions, involves identification of the micro- and macrostructures (van Dijk & Kintsch, 1983; Kintsch, 1988). Elements such as word meaning, propositions and syntactic relationships between words and sentences allow the reader to derive meaning locally (i.e., microstructure), where recognizing global themes and relationships in the text is the macrostructure. At this level, readers are creating meaningful connection between words and text to create a coherent meaning of text (van Dijk & Kintsch, 1983). Finally, the situational model is how the reader interprets information from the text base and integrates their background knowledge to create a mental representation of the text (Kintsch, 1988). In order to construct a mental model of the text, readers need to accurately read text, understand meaning at the micro- and macrostructural levels, and integrate this information with their background knowledge (Kintsch & Rawson, 2005).

CI Model research

Skills within linguistic processing level, such as phonemic awareness, decoding, and word identification, are lower-level skills that are essential for readers to master so

they can allocate more cognitive capacity and attention to the higher-level skills (Kintsch & Rawson, 2005). Poor comprehenders demonstrate poor receptive vocabulary and grammatical understanding compared to typical readers and peers with poor decoding ability; they had difficultly on a task where they had to follow oral directions (e.g., "Before you point to the little, white triangle, point to the little squares"; Catts et al., 2006). Language comprehension predicted reading comprehension in samples of readers with ID (Roch & Levarto, 2009), and readers with ID had similar reading profiles as poor comprehenders (Nash & Heath, 2011). The linguistic processing provides a foundation for more advanced processes and skills.

There is evidence that different strategies and text adaptions can support the three levels of comprehension within CI Model. Use of pictures in auditory and written text improved comprehension at the linguistic level and mental representations for children ages 7-13 (Pike et al., 2010; Seger et al., 2019; Wannagat et al., 2020), but use of pictures led to mixed findings related to text base. Students were more accurate in identifying the correct meaning of a sentence (i.e., text base) when pictures were presented to them before the written sentences, but there were no significant findings for the other comprehension levels (Seger et al., 2021). This is consistent with previous research using auditory text (Wannagat et al., 2018), as well as larger frameworks that suggest that readers' situational model is constructed based on written or verbal information and updated with information from illustrations, which may cause the situational model to change is presented later (i.e., integrated model of text and picture comprehension; Schnotz, 2014). However, this effect was not applicable to text with animated pictures and/or videos (Seger et al., 2019).

Good reading comprehension is associated with integration of both text content and background information, which are also necessary for inference making (Cain & Oakhill, 1999). Inferencing is a factor that directly supports the mental representations of text, and several types of inferences made during reading support the CI Model (Graesser et al., 2015). Knowledge- and text-based inferences occur at both micro- and macrostructure levels to connect information with what was previously read and fill in gaps. Coherent inferences allow readers to construct meaning at local and global levels in text, which aligns with the CI Model (Keneou, 2015; Kintsch & Rawson, 2005; McNarma & Magaliano, 2009).

CI Model Levels of Reading Comprehension and Intervention

Intervention research with students with ID has typically focused on word skills and increases in reading comprehension have been rare or indirect. Beyond the need to directly teach comprehension, students with ID may benefit from instruction that targets comprehension skills and processes at one specific or multiple levels. In the current study, interventions will be selected to evaluate the contribution of word, sentence, and passage strategies to different levels of comprehension (i.e., linguistic, text base, and situational model). In addition to decoding skills, boosting students' knowledge of syntactic and semantic qualities of words (i.e., linguistic level) help readers make connections within the local and global text bases and build their mental representations of text. (Kintsch & Rawson, 2005).

Linguistic Level of Comprehension. Identification of graphemes, decoding, word recognition, and grammar are considered linguistic skills that support higher levels of comprehension. In the current study, anaphor resolution will be explicitly taught

students in an effort to facilitate readers' processing at the linguistic level of reading comprehension.

Anaphor resolution. Identifying anaphor facilitates reader's understanding of the microstructure of text. An anaphor is a single word that replaces and refers to antecedent detail(s) of the text. Anaphora can come in many forms, but they always maintain text cohesion, and anaphora repeat information with less detail which in turn may increase reading rate. The correct identification of anaphora is necessary to create mental representations of text, thus impacting reading comprehension. The properties of a sentence and the anaphor has led to differences in responding; when there is more distance between the anaphor and its antecedent information, skilled and poor comprehenders made more errors in correctly identifying the correct referent information (Oakhill & Yuilll, 1986). In the same study, morphological cues like gendered pronouns help both groups of readers resolve anaphora. However, findings from Tavares et al. (2015) contradicts these findings as authors concluded that using semantic information to resolve anaphora may be more useful than using morphological clues because young adults with ID (ages 16-24) and a control group of typical developing adults were quicker to resolve anaphors when their anaphor selection required knowledge of word meaning (i.e., semantics) rather using gender clues. As expected, the control group performed more quickly and accurately than the adults with ID. An interesting finding from this study was that the adults with ID exhibited no significant difference between their accuracy on the semantic and morphological conditions. This suggests that individuals with ID may not pay close attention to subtle details like morphological aspects of words, but when the task relied on word meaning, they performed faster.

It is well documented that quick and accurate reading (i.e., fluency) frees readers' attention and mental capacity for skills related to reading comprehension. While Tavares and colleagues (2015) first experiment compared the participants with ID to typically developing adults of the same age (i.e., chronologically matched in age; CMA), their second experiment compared them to children at the same reading level. While the reading-level matched (RMA) group consisted of 11–12-year-olds, their reading ability was not significantly different than the ID group. In the second experiment, participants with ID responded more accurately to a comprehension question about the anaphor when the sentence was consistent. This study was conducted with Spanish speaking participants, and consistence was defined as matching the pronoun to the gender of the subject in the sentence. The CMA and RMA groups also performed better in the consistent conditions and correctly answered more comprehension questions, but eye tracking methods revealed that the control groups spent more time looking at pronouns when trying to resolve them. The ID group did not show any differences on the eye tracking. Researchers concluded that this may be a result of the metacognitive deficits individuals with ID experience.

Adults with and without ID have a subject bias when reading sentences or passages with anaphora. Subject bias is the readers tendency to associate an anaphor to the subject of the sentence. For example, in the sentences "Michelle called her mother. She wanted her to know when the flight arrived," most assume that "she" refers to Michelle. In a study with adults with ID, eye tracking data indicated that the participants spent more time looking at the subject of the sentence (Hawthrone & Loveall, 2020). While the participants with ID looked at the subject less often (i.e., 57% of the time) than

typical developing peers (i.e., 92% of the time), participants with ID with stronger nonverbal abilities exhibited this pattern more clearly. This suggests that level of receptive language also plays a role in anaphor resolution. This study provides evidence that individuals with ID are aware of pronouns and how to resolve them, which makes it an appropriate target for intervention.

Explicit instruction has been used to support anaphora resolution in typically developing readers. In an early study by Dommens et al. (1984), fourth graders were given researcher-made reading passages and were assigned to one of three conditions. In the first condition students were taught to resolve anaphor with modelling, guided and independent practice, and corrective feedback (i.e., explicit instruction). In the second group, students were prompted to retell the story, which was assumed to help them identify inconsistencies in structure and meaning. Students in both these conditions were then given five accompanying reading comprehension questions. The third condition consisted of business-as-usual curriculum and teaching. Following the intervention, the students who received the pronoun specific instruction performed better on a researcher made anaphora identification measure (Dommens et al., 1984). While this study provides supports explicit instruction, comparisons between subjects were made rather than within subjects, which would have suggested which intervention was most effective for individual students. Individualizing instruction is more appropriate for students who do not respond to universal or small group instruction, but minimal intervention research on anaphor resolution has been completed with student with disabilities or specific reading needs.

The complexity of written discourse is illustrated in the results reviewed with studies of anaphor resolution. Word identification increases the accuracy and speed of reading, which may indirectly support comprehension, but this has not been consistently demonstrated in research. In addition to increasing the speed of word recognition, teaching word meaning can support readers' understanding of the microstructure text base (i.e., word and sentence meaning) and macrostructure (i.e., whole text meaning; Kintsch & Rawson, 2005). As previously stated, many factors like morphological cues, location in text, and subject bias can impede readers' ability both identify anaphora and comprehend text. If readers cannot readily identify the meaning vocabulary and anaphora, then they risk creating inaccurate representations of the text base.

Micro- and Macrostructure Text Base Understanding. Once the reader increases their linguistic skills (i.e., semantics and syntactic information of words), they can shift their attention to identifying the main ideas of larger pieces of text. The text base pulls readers closer to comprehension as it requires them to identify local and global themes across the text, which goes beyond understanding words. Previewing and summarizing are two strategies selected to help aid students' in identifying these larger themes. Interventions that occur before and during reading may encourage readers to begin constructing a mental representation that they can add onto as the read (Denner, Rickards, & Albanese, 2003). When students with ID were taught to use comprehension strategies, they were able to identify various strategies they could use before and during reading to further support their understanding of the text. Specifically, students with ID highlighted the benefits of previewing the text (i.e., identifying the title, pictures, topic,

making predictions) before reading and summarizing during and after reading (Bilgi & Özmen, 2014).

Previewing. Previewing activates students' background knowledge before they read (Graves et al., 1983; Chukueggu & Umera-Okeke, 2013), and provides a schema of what is learned from the text before reading begins. Previewing elements of text (i.e., questions, summaries, and vocabulary from the text) has led to increased reading comprehension for students with and without reading difficulties (McCormick, 1989) and for students for whom English is a foreign language (Huang, 2009). There are few students that evaluate the effectiveness of previewing text with students with ID. Bilgi and Özmen (2018) targeted several cognitive strategies to increase reading comprehension, which included previewing text by showing parts of the text and text structure (e.g., title, main idea and details) with support of graphic organizers. Following the multicomponent intervention, students with ID were able to write longer and higher-quality text summaries and identify main ideas. Moreover, they were able to answer more reading comprehension questions correctly throughout different phases of the study, including independent practice sessions, and they maintained their level of performance after 3-12 weeks after intervention concluded.

Summarizing. Summarizing allows students to recall passages and describe them in their own words and has been identified as a meaningful way to encourage student with ID to engage with text (Hudson et al., 2013a). Postsecondary students with ID were able to recall the main ideas and story details after receiving an intervention that targeted reading comprehension with a summarizing strategy (Hue et al., 2014). In this study, researchers evaluated an evidence-based paraphrasing intervention developed by

Schumaker et al. (1982), and students were given explicit instruction to use a three-step process: Read a paragraph, Ask myself "what is the main idea and two details," and Put into my own words (RAP). Posttest results indicate a strong effect of the intervention for both recalling main ideas (d = 4.11) and providing details (d = 2.72). Similarly, adults with ID from the Netherlands benefited from explicit instruction that taught summarizing and three other cognitive strategies in individual and group settings (van den Bos et al., 2007). These studies included participants older than 20 years old, but more recent studies show that summary strategies can be effective for school-aged children with ID. The RAP intervention significantly increased one students' ability to comprehend functional text (i.e., culinary recipes), and identify the main idea and important text details (Sukmawan & Prianto, 2019). Similarly, Ardianingsih and Prianto (2019) found positive effects when using a paragraph summarizing strategy with one student with borderline intellectual functioning (i.e., IQ = 71), as the intervention supported the student's ability to accurately recall details within paragraphs and orally retell more information about the text in a way that was structurally sound. Feeney (2012) further demonstrated paragraph summarizing as an effective strategy to support comprehension of functional expository texts for students with ID. An alternative treatment design was used to evaluate the effects of two comprehension strategies, a paragraph summary and "5 Ws and an H," and both strategies led to increased correct responses. The paragraph strategy intervention had a higher percentage of nonoverlapping data points across all 13 participants and sessions (Feeney, 2012). These studies suggests that students with ID can learn and use cognitive strategies to support their reading comprehension of academic and expository text.

Situational Model -Constructing a Mental Representation of Text.

Comprehension requires more than understand words, syntactic structures, and text base meaning. In order to develop a situational model or mental representation of the text (MRT), students need to be taught how to monitor their understanding, which is one of three higher-level comprehension skills (Kintsch & Rawson, 2005; Oakhill, 2020; Perfetti et al., 2005). If the reader is to construct an MRT, they must be able to self-monitor their knowledge and understanding. However, students with reading difficulties approach text passively and do not utilize strategies to monitor their understanding of text (Barker, 2008; Gersten et al., 2001), which may be related to deficits in metacognition (Tavares et al., 2015). A self-monitoring strategy with a goal setting component will be used in the current study to teach participants to actively assess their understanding of the text.

Self-monitoring Strategies. Metacognitive strategies help students monitor their understanding of text before, during, and after reading (Pressley & Gaskins, 2006). Self-monitoring is a technique where the individual is observing their own behavior, and strategies that prompt self-monitoring are effective in prompting academic outcomes. Examples of specific self-monitoring strategies are goal setting, underlying important content while reading, identifying the meaning of unknown words, reviewing text, and generating self-questions (Pressley & Gaskins, 2006). Poor readers struggle using these strategies. Intervention studies with students with learning disabilities (LD) provide initial insight into the effectiveness of self-monitoring strategies on subsequent reading comprehension. When given explicit instruction on how to use a self-monitoring checklist, main idea comprehension increased for students with LD (Jitendra et a., 2000). Moreover, students with LD were better at identifying main ideas in passages when they

received explicit instruction and were taught to use self-monitoring strategy rather than solely receiving explicit instruction (Graves, 1986). Similarly, students with LD recalled passage details after receiving a summarization intervention with self-monitoring component compared to students who just received summarization intervention (Malone & Mastropieri, 1991).

Students with ID experience difficulty with metacognitive skills needed to monitor reading comprehension. Research conducted by Bilgi and Özmen (2014, 2018) shows that students with ID can identify and use metacognitive strategies in reading once they are taught what they are, how to use them, and given guided and independent practice. In this study, setting a goal for reading was not one of the strategies the students listed, which suggests that students with ID may need to be taught and prompted to do this even after being taught the strategy the first time. These students also increased their reading comprehension and quality of text summaries following the multicomponent intervention they received; they wrote more words, described the main idea in appropriate detail, and the overall quality of their summary improved (Bilgi & Özmen, 2018). Students were able to generalize their performance to in passages with different story structures when the interventionist modelled the strategies. It would have been useful to evaluate how often students could independently use the learned strategies to determine whether or not prompting is necessary for the maintenance of these strategies.

Self-monitoring strategies have also been used to support inference making in students with learning difficulties. Reed and colleagues (2016) designed an intervention where students with LD were randomly assigned to one of three conditions. In the first condition, students only received an inference strategy intervention, and they were given

a set of inference-making prompts (e.g., "I think the reason ___ happened was because ___;" Reed et al., 2016) and a graphic organizer to help them record details and generate inferences. In the second condition, students were given the same intervention condition, but a goal setting strategy was added to encourage their self-monitoring. Finally, the third condition was similar to the second, but instead, a group goal was established. Results illustrated steady increases for the students in the first condition, which provided evidence for the stand-alone inference intervention. However, the third group (i.e., inference and group goal) demonstrated the greatest increases on an *easyCBM* reading comprehension measure. Interestingly, the second group (i.e., inference and individual goal) had the largest variability. This suggests that group goal setting may increase student performance. The work done by Reed and colleagues (2016) is one example of how inference-making can be targeted with explicit instruction and addition instructional strategies like goal setting.

Reading comprehension is a complex process; it requires several cognitive abilities, integration of reading skills and background knowledge, and progression through multiple levels of comprehension with increasing difficulty and cognitive demand. In the current study, reading interventions were designed that include comprehension strategies designed to target different levels of comprehension. Few studies have evaluated these interventions with students with ID, and fewer studies have evaluated how to support these specific comprehension levels. The interventions reviewed - anaphor resolution, previewing, summarizing, and self-monitoring- provide evidence for increasing reading comprehension in students with ID. Pilot data were collected with individuals with ID to determine if the study materials and interventions

were an appropriate target and feasible to implement with this population. Pilot data from six modified Maze passages resulted in 80-96% accuracy and the individuals needed on average, 8 minutes, and 45 seconds to read the entire passage.

Purpose of the Study

The primary purpose of the study is to determine the effectiveness of three intervention strategies on reading comprehension of three high school students with intellectual disabilities (ID). Reading comprehension is a multifaceted skill that can be broke down into smaller skills, including inferencing. Oakhill (2020) poses the question of whether to directly teach comprehension or target the "finer threads." The CI Model purposes that the finer threads involve reading comprehension (a) processing the text at the linguistic level, (b) micro- and macrostructure text base level and (c) construction of a mental representation. While much is known about underlying skills that contribute to reading comprehension, the degree to which they support students with ID needs to be examined.

The study is guided by the following research questions:

1. To what extent do interventions targeting the *linguistic level*, *text base level,* and *mental construction of text* have differentiated effects on reading comprehension with students identified with an intellectual disability?
2. To what extent do the selected interventions lead to growth in reading comprehension with students identified with an intellectual disability?
3. What effect will intervention strategies have on students' understanding of the *linguistic level*, *text base level* and *mental representation of text* of reading comprehension with students identified with an intellectual disability?

4. To what extent will students identified with an intellectual disability maintain the effects of intervention on comprehension after 2 and 4 weeks following the termination of the intervention?

Chapter III: METHOD

This chapter covers the method that will be used to conduct the current study. It is divided into the following sections: (a) purpose of the study; (b) overview of the research design; (c) description of the research participants; (d) description of the research site including setting; (e) description of the measures used in the study; (f) description of procedures for the brief experimental design and extended analysis; (g) fidelity; (h) reliability and (i) data analysis method.

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3. What effect will intervention strategies have on students' understanding of the *linguistic level*, *text base level* and *mental representation of text* of reading comprehension with students identified with an intellectual disability?
4. To what extent will students identified with an intellectual disability maintain the effects of intervention on comprehension after 2 and 4 weeks following the termination of the intervention?

Overview of Research Design

The current study consisted of three phases including a brief experimental analysis (BEA), an extended analysis, and maintenance sessions. Prior to the implementation of the experimental phase of the study, all participants were pre-tested with distal, norm-

referenced measures. The BEA involved one baseline session, followed by the three intervention groups, which were repeated for a second and third time with random ordering of the interventions. The reading strategies within each intervention group were taught to the participants with principles of explicit instruction (Adams & Englemann, 1996).

Following the BEA, a multiple-based, single-case design across participants was used for an extended analysis to further determine the effect of the selected intervention for each student. Contraindication procedures were used during the extended analysis; three baseline sessions followed by three sessions with the non-effective intervention, and then the effective intervention was implemented for the remainder of this phase.

Finally, the maintenance phase was conducted 2 weeks following termination of the intervention. The second maintenance phase was delivered 2 weeks after the first maintenance phase (i.e., four weeks after intervention) to further assess students' retention of strategies and reading comprehension ability.

Selection of Participants

Approval from the university's Institution Review Board (IRB) was obtained in February of 2021, and additional approval from the selected school district was obtained in September of 2021. Students were recruited through contact and consultation with school psychologists, administrators, and teachers at local high schools. When school personnel identified potential students for the study, 10 students' special education re-evaluation were reviewed to confirm eligibility to participate (refer to inclusion criteria below). Five students were selected. Next, two copies of a letter detailing the procedures of the study and a guardian consent letter was emailed and mailed to the students' legal

guardian. A self-addressed stamped envelope was also be provided for guardians to respond via mail. Guardians were given 2 weeks to return the consent form to indicate their decision to allow or deny their student's participation in the study. Guardians were required to return the letter with their decision to "opt-in" or "opt-out" and their signature (i.e., active consent). One week before the deadline, guardians received a follow-up phone call from their student's special education teacher to remind them about the study and the consent deadline as well as answer any questions they may have about the study. Four students were deemed eligible for the study once their consent from their guardians was returned. The four students were given a verbal and written explanation of the study at an ability level comparable to their cognitive level. The principal investigator sat down with the student and their teacher to read the explanation of the study procedures and student assent. Students were allowed to ask questions. Three students agreed to participate in the study and signed the student assent form.

The participants for the study were three high school students in the 9-12 grades in a suburban school district. All three participants were between 15-18 years old at the time of the study. Table 1 includes demographic information for each participant. High school students were recruited to increase the likelihood to identify readers with more developed decoding skills. To be included in the current study, students were identified as having an ID based on state criteria that included a score from a measure of cognitive development that fell at least two standard deviations below
the national mean (i.e., IQ between 55-70), and significant impairments in achievement and adaptive behavior.

Participants also needed proficient decoding abilities while reading the passages, which was accomplished by identifying each student's instructional level for reading. An instructional level refers to grade level passages where readers can accurately read 93-97% accurately (Burns & Parker, 2014). The high level of accuracy (i.e., at least 93%) should indicate adequate decoding of the words in the passage. The grade level used for each student was the grade level of the Maze passages used during interventions.

Table 1

Demographic Data for the Participants

	Kira	Corey	Sam
Age	16 years	15 years	18 years
Gender	Female	Male	Female
Grade	11	9	12
Race/Ethnicity	Black	Black	White
FSIQ on the WISC-V	-	-	59
GCA on the DAS-II	59	67	-
Instructional Level	2nd grade	5th grade	7th grade
Grade Level Passages used for Intervention	4th	8th	8th
Average Reading Accuracy	88%	96%	98%
Average Reading Rate	33 WCPM	83 WCPM	51 WCPM
Average Reading Time	8m, 43s	4m, 95s	7m, 96s
Lexile Level	770-980L	955-1155L	955-1155L

Note. Full Scale Intelligence Quotient (FSIQ), *Wechsler Intelligence Scale for Children, Fifth Edition* (WISC-V), General Ability Composite (GCA), *Differential Ability Scales,*

Second Edition (DAS-II), WCPM = words read correct per minute. Instructional level refers 93-97% known words in a reading passage (Treptow et al., 2007). Participants' average accuracy, reading time, and fluency was calculated from their performance on pre-determined grade level passages (i.e., instructional level) used during intervention phase.

The interventionist was the principal investigator. The current investigator of the study was a white, 26-year-old female school psychology doctoral student. At the start of the study, the current investigator had 3 years of academic intervention experience across three elementary schools, one middle school, and one high school. The interventionist had no prior teaching experience outside of her training and field placements in a doctoral program at a Midwest university. Sociocultural theory emphasizes the relevance of the interaction between the learner and others in their environment (Vygotsky, 1976), which becomes an important element in single-case research as well. The interventionist followed the study protocol for each measure and intervention and interacted with each participate similarly throughout the study (i.e., greeting, warm up period before work, behavior specific praise, small rewards). However, specific steps were not take to measure interventionist effects on participants' performance.

Setting

The study was implemented during the school year over 21 weeks in the students' home school. The pre-testing, post-testing, BEA, extended analysis, and maintenance sessions were conducted during "free-work" periods in order to avoid time and scheduling conflicts that interfere with the participants' academic service hours through their individualized education plans. The sessions were implemented one-on-one in a

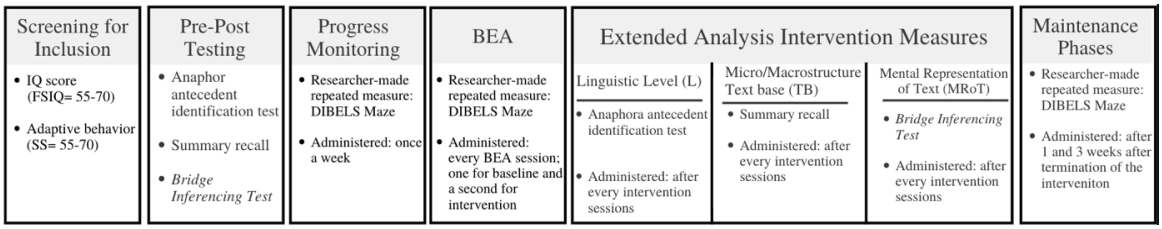
separate quiet room while sitting at a table. The interventionist sat directly across the participant while administering all the procedures of the BEA and extended analysis (i.e., baseline and intervention conditions).

Measures

Three measures were used to determine eligibility for the study, and five measures were used to address the research questions. Research-made measures were used as repeated measures for weekly progress monitoring during the BEA, extended analysis, and maintenance phases (Q1, Q2, Q4). Three intervention-specific measures were used to measure the effect of intervention in pre-post testing (Q3). Social validity was measured with a participant survey following the experimental procedures. The survey was based on measures used by Carter et al. (2011), which was described as rigorous for single-case research (Snodgrass et al., 2018). The survey included questions related to the participant's perception of the interventionist's acceptability, utility, and effectiveness. The measures are described below, and data was collected in a manner displayed on Figure 1.

Figure 1

Data Collection Outline



Inclusion Criteria

Each student's previous educational records were accessed and reviewed for eligibility in the current study. The principal investigator reviewed the participants'

psychoeducational evaluation records to identify their cognitive and adaptive functioning abilities. Their cognitive functioning was identified with standardized measures. Each student had a total IQ score that falls within 2 and 3 standard deviations below the mean (i.e., age-based standard score between 70 and 55). Each also had an overall adaptive behavior score that also falls between 2 and 3 standard deviations below the mean, regardless of the scale used.

Data used for screening for inclusion was obtained from previous psychoeducational evaluations. Students received a standardized, cognitive battery [e.g., *Weschler Intelligence Scale for Child, Fifth Edition (*WISC-V)] within the past 2 years. To be included, each student had an age-based IQ standard score between 55 and 70. The participant's records from previous evaluations were reviewed to identify their adaptive functioning, which was identified through parent/guardian and teacher measures (e.g., *Adaptive Behavior Assessment Scale*, *Vineland Adaptive Behavior Scales*) or written and recorded history from guardians and school personnel.

Progress Monitoring

The experimental phase of the current study involved implementing a brief experimental analysis (BEA) and extended analysis with a multiple baseline, single-case design. Researcher-made repeated measures were used to assess comprehension in the BEA and each participant will receive one measure each week to progress monitor.

Researcher-Made Repeated Measure Reading Comprehension (Q3): Maze. *DIBELS® 8th edition* Maze passages were used as a repeated measure for progress monitoring (University of Oregon, 2020a). DIBELS® oral reading fluency passages will

be administered as a survey level assessment to identify the grade level that has 93-97% known words (i.e., instructional level; Treptow et al., 2007) for each student.

Maze passages are administered for 1-3 minutes while students read independently. The first sentence is left unchanged but every seventh word in the remaining sentences is omitted. Readers are required to fill in the missing words with one of three options (i.e., correct answer and two distractors). Maze tests correlate with other common comprehension measures including question and answer techniques (r = .84), are related to receptive language, and have high criterion validity with standardized measures (Conoyer et al., 2017; Gellert & Elbro, 2013). However, limitations exist with the use of Maze measures. Maze measures have been criticized for measuring lower-level comprehension skills and may rely more on code-related skills. However, creating missing words in Maze passages that are more challenging may be more effective at measuring deeper levels of comprehension (Gellert & Elbro, 2013). For example, if the interventionist wants to test the student's ability to integrate information across sentences, then creating a gap that requires students to use information from multiple sentences would be ideal.

Maze passages in the current study were selected and edited at the participants' instructional level (referred to as Maze). Rather than omitting every seventh word, words were omitted based on specific criteria. Three comprehension levels were addressed within each passage as the omitted words and accompanying answer options were created to test the participants' ability to complete missing words that require knowledge at the word, sentence, and passage comprehension levels. Each Maze passage had 15 missing words. Five missing words required simple word knowledge (i.e., word level

comprehension) and the two distractors were semantically different. Five required participants' understanding of sentence structure (i.e., sentence level comprehension), which required knowledge of semantic or syntactic links (e.g., pronouns) to complete sentences. Finally, five missing words required participants to integrate information across two or more sentences to correctly answer the gap (i.e., passage comprehension). A total of 72 Maze passages were modified for the procedures of this study which included 18 second grade passages, 15 fourth grade, 18 fifth grade, and 21 eighth grade passages. Refer to Appendix A for an example of the three types in one passage.

The participants' ability to identify 15 missing words was assessed after they completed the Maze passage. Participants were given as much time as they needed to read and complete all 15 missing words. Previous research recommended 3-minute reading time because reliability increased with longer durations in reading time (Conoyer et al., 2017). However, a timer was used to determine participants' words correct per minute (WCPM) at the 1-minute mark as well as words correct for the entire passage. The participants were able to read every passage in 10 minutes or less. Refer to Table 1 for more information on the participants' reading time. The interventionist presented the standard directions for Maze passages and followed along with a rubric (refer to Appendix A for an example) of the passage as they completed the reading. The participants read the entire passage and the percentage of missing words correctly identified in Maze passages is the dependent variable of interest. The number of correct missing words was divided by the total number of missing words attempted in the time period (in seconds), and then multiplied by 100 to obtain a percentage of correct missing words identified in the Maze passage.

Extended Analysis Intervention Measures

Each intervention targeted one level of comprehension (i.e., linguistic, text base, mental representation processing) with different strategies. Thus, individual and specific measures were used to measure the specific skills within the extended analysis intervention sessions.

Linguistic Level Understanding (Q1, Q3): Anaphor Antecedent Identification Test. When the participants receive the intervention targeting linguistic level skills, they were given explicit instruction on how to identify anaphora (i.e., a single word that replaces and refers to antecedent details in the text). For example, in the sentence "Lizzie enjoys reading, and her favorite place to read is at the beach." readers need to understand the "she" (anaphor) refers to "Lizzie" (antecedent detail) to accurately comprehend the sentence. Anaphor skill was measured with an independent passage that included 10 pre-selected points within the passage where the interventionist asked the participants to circle the antecedent detail that matches the anaphor. The number of correct anaphora was divided by 10 and multiplied by 100 to obtain a percentage of correct resolved anaphora. This test measures participants' ability to identify antecedent information an anaphor (e.g., pronoun, proposition) references in the context of text, and is modeled from previous research that used the Pronoun Antecedent Identification test (Dommes et al., 1984). Refer to Appendix B for an example of the antecedent anaphor identification test.

Micro/Macrostructure Text Base Understanding (Q1, Q3): Summary Recall. When the participants receive the micro- and macrostructure text base processing intervention, summarizing and previewing strategies were taught and used to increase

reading comprehension. Similar to previous research with students with ID (i.e., Ardiningingish, 2019; Bilgi & Özmen, 2018), the current study scored the participants' summary recall on a scale of 0 to 2. Main idea scoring procedures from Bilgi and Özmen (2018) were used, which have been shown to have strong interobserver agreement (*M* = 98.6%; range of 80-100%). If participants recall the correct main idea and provide supporting details, they received a score of 2, if they recall the main idea correctly without details they received a 1, and if they did not state the correct main idea or provide details, they received a 0. Participants' summaries of every paragraph in the passage were measured. However, due to the varied number of paragraphs in the intervention passages, only the first 5 paragraphs were measured. Based on this scoring system, participants could obtain a minimum of 0 or maximum of 10 points. The total points of 10 as the primary score of interest for this summary measure. Finally, the main idea and supporting details were be identified before the intervention and written on a checklist to score participants' paragraph summaries.

Mental Representation of Text (Q1, Q3): *Bridging Inferences Test, Picture Version*. Inference making requires readers to infer information that not be directly stated in the text as well as their background knowledge. As such, inferencing and constructing a mental representation of text have been identified as cognitive tasks important for deep comprehension (Kintsch, 1991). Participants' construction of a mental representation of text was measured by participants' ability to make bridging inferences, which have been identified as crucial in constructing a mental representation of text (Graesser et al., 1994). Moreover, people tend to learn more efficiently when text is presented with pictures (i.e., multimedia principle; Butcher et al., 2014; Mayer, 2014), which also supports readers'

construction of mental representations of text (Seger et al., 2019; Wannagat et al., 2018). When presented with text with connected pictures, readers benefit from pictures that are consistent with information that needs to be activated to make the inference (Pike et al., 2010). Moreover, individuals with ID benefit from text adaptations, including use of pictures (Hudson et al., 2013a). *The Bridging Inferences Test, Picture Version* (Pike et al., 2010) test was used to measure participants' ability to integrate knowledge from text and background knowledge to make an inference. Specifically, individual sentences from the intervention passage were restated to each participant, and they were asked to select the picture that best explains the sentence from 3 picture-sentence pairs. Each intervention passage had 10 sentences and participants completed a bridge inference for each sentence. The number of correct inferences was the primary score of interest for this measure. Refer to Appendix C for an example of bridge inferencing materials.

When the participants receive intervention that targets construction of a mental representation, they were taught to use self-monitoring cue cards and individual goal setting. In addition to the total number of correct inferences from the *Bridging Inferences Test, Picture Version,* the frequency in which participants refer to their self-monitoring cue card (for an example refer to Appendix D) was measured as well as their progress towards pre-determined goals.

Pre- and Post-testing

Three intervention-specific measures were administered during pre-testing and a second time for post-testing, following the termination of the intervention and maintenance phases. These include the anaphor antecedent identification test (Dommes et al., 1984), summary recall (e.g., Bilgi & Özmen, 2018), and the *Bridging Inferences*

Test, Picture Version (Pike et al., 2010). These measures were used to evaluate the effect of intervention on the participants' comprehension at the linguistic, text base, and mental construction of text levels respectively. The pre-post measures are described in previous sections.

Measure Reliability

The current study used four measures that are researcher-made or modified to target different levels of comprehension. These include the researcher-made Maze passages, anaphor antecedent identification test, summary recall, and *Bridge Inference Test*. Test-retest reliability and interobserver agreement were calculated for the Maze measures and intervention specific measures. Parallel form reliability was calculated for the Maze measures only.

Interobserver agreement (IOA). IOA was be calculated for the interventionist's scoring in 20% of baseline, intervention, and maintenance conditions. During the baseline and maintenance sessions, reliability was only calculated for the Maze scoring, and in the intervention sessions, reliability was calculated for the Maze and corresponding intervention-specific measure. A second independent observer recorded the participants' performance on a separate copy of the measures and reviewed the participants products to score their performance on the intervention measures. The number of items correct or incorrect was divided by the total and multiplied by 100. Refer to Appendix E which includes the IOA form used by the independent observers during sessions. The estimates of IOA in baseline and maintenance was 100% for the Maze passage. Across five intervention sessions, IOA on scoring the Maze passages was 100% between the interventionist and second observer and 98% for the anaphor

antecedent identification test. Data was not collected for the remaining two intervention-specific measures, summary recall and *Bridge Inference Test*, because they were not used during the intervention phase.

Parallel form reliability. Parallel form reliability was calculated to determine the extent in which different forms of the Maze passages were comparable. This was calculated by correlating the Maze scores separately for fifth grade (n = 18), eighth grade passages (n = 21), and all forms (n = 39). The second and fourth grade passages were only administered to one student and were not correlated. The fifth-grade Maze passages were significantly related to each other ($r = .78, p < .05$), and the eighth-grade passages were also significantly related ($r = .70, p < .05$). Finally, all forms were moderately correlated ($r = .73, p < .05$).

Social Validity

Social validity in a single-case design study is enhanced by selecting a dependent variable that is appropriate to address clinical need and is socially acceptable (Horner et al., 2005). Social validity has been defined as clinically significant change in behavior and the extent it impacts the individual (Kazdin, 1977) and the degree to which "consumers of an intervention like it" (Baer, et al., 1987, p. 322). Moreover, multiple stakeholders should be involved to understand the social validity of a given intervention such as recipients of the intervention and people who interact with direct recipients (Schwartz & Baer, 1991). Social validity was measured with a participant survey based on previous measures (Carter et al., 2011) identified as psychometrically acceptable for single-case research (Snodgrass, et al., 2018). The survey included questions related to the participant's perception of the intervention's acceptability, utility, and effectiveness.

Procedure

The current study used a brief experimental analysis (BEA) and an extended analysis in the form of a multiple baseline design across participants for Research Questions 1, 2, 3, and 4. The phases for the multiple baseline were staggered every three data points and participants were randomly ordered to the tiers. The BEA was used to select the most effective intervention for each participant, and the extended analysis further evaluated the effect of the selected intervention on reading comprehension and related skills over time. Finally, two maintenance sessions were implemented to determine the effect of the intervention once sessions are terminated. Each are described below, and data was collected in a manner displayed on Figure 1. Research Question 2 was further explored with nonexperimental pre- and post-testing data.

BEA

A BEA was used to determine which intervention is most effective for three high students with intellectual disabilities (ID). Three intervention conditions were implemented within the BEA and each participant received each condition 3 times. Three reading interventions are designed to target the "finer threads" (Oakhill, 2020) underlying reading comprehension, and explicit instruction was used to teach the reading strategies within each intervention. Explicit instruction breaks down challenging content into components, models strategies, offers guided and independent practice, and provides immediate, corrective feedback to students (Adams & Englemann, 1996). The three interventions targeted (a) processing at the linguistic level, (b) micro- and macrostructure text base level, and (c) construction of mental representation of text. The design of the interventions and how they support reading comprehension are described in detail below.

Each participant received all three interventions three times, and the second administrations were randomly ordered. Students read and completed Maze passages in baseline and after receiving the intervention, and the percentage of missing words correctly identified in Maze passages was the dependent variable of interest. Following the nine BEA sessions, Maze data across the sessions were analyzed to determine which of the three interventions was most effective in increasing students reading comprehension.

Extended analysis

The most effective intervention was selected and administered to participants over the following 13 weeks, after a brief contraindication phase. A multiple baseline across participants design was used to further evaluate the effectiveness of the selected, individualized intervention plans. The extended analysis consisted of a baseline phase, intervention phase, and two maintenance phases. The primary dependent variable was the percentage of missing words correctly identified in *DIBELS®* Maze passages. Maze passages were administered in each baseline session, once a week during the intervention phase, and in each maintenance session. Additionally, the intervention specific measures were used to measure the effect of the individual intervention on the skills taught and practiced in the extended analysis (Q3). If the participants received the linguistic level intervention in the extended analysis, their performance was measured with the anaphor antecedent identification test in addition to completing a Maze once a week. Participants completed the summary recall if they received the text base level intervention, and the *Bridging Inferences Test* if they received the mental representation of text intervention in the extended analysis.

Baseline Phase. In baseline participants were given passages to read independently for 10 minutes and then completed the Maze progress monitoring measure. Baseline sessions continued for 1 to 4 weeks with three sessions per week. Kira received three baseline sessions, Corey five sessions, and Sam received seven. The order with which baseline sessions end was randomly determined, and the baseline sessions were extended if participants demonstrate a trend in baseline.

Intervention Phase. The initiation of intervention sessions was staggered and the order with which the next phase began was ordered randomly by participant. Contraindication procedures were used prior to the implementation of the most effective intervention. After identifying the most effective intervention with the BEA, one of the two remaining interventions was randomly selected and implemented for three sessions while the remaining participants continued to receive baseline. Next, the participant received the intervention that demonstrated the highest increase in performance during the BEA. This pattern continued until all three participants were in the intervention phase of the extended analysis. This resulted in approximately 3 contraindication sessions for each participant and 14-16 interventions sessions across the participants (5-7 data collection sessions). The intervention sessions consisted of one of three interventions which were determined to be effective in the BEA. The interventions are (a) processing at the linguistic level, (b) micro- and macrostructure text base level, and (c) construction of mental representation of text. The guiding theories and research were used to guide the selection of the interventions, which are described in detail below and in the literature review.

The first intervention condition involved a reading strategy that targeted participants' understanding of linguistic level skills (L), and specifically target semantical and syntactical qualities of words. Low-level comprehension skills, such as processing content at the word and sentence level, are necessary to achieve higher-level skills. Access to word meaning (i.e., vocabulary) and syntactic rules [e.g., nouns, prepositions, anaphora (referents in place of nouns)] help students to process text at the word and sentence level. In other words, vocabulary and syntax instruction is necessary to help students learn to use strategies that help them recognize words and create meaning in a sentence. Anaphor resolution was used for the linguistic level intervention, and sessions were completed in 20-22 minutes. First, students were given brief instruction on what anaphora are, and an example was provided for students to solve. Specifically, the interventionist asked each student to read a sentence that included a pronoun (target anaphor), and the interventionist directed the student's attention to the target anaphor. The participants were explicitly taught that the target anaphor was a "replacement word," but while reading, the interventionist asked them to identify it in the say way every time by saying "what does (target anaphor) stand for" (Dommes et al., 1984). Then the participants followed the interventionist in guided practice to identify anaphora. The interventionist provided a text with 10 anaphor resolution opportunities, and the interventionist helped participants identify the first three and then the participants identified the following seven independently (i.e., Dommes et al., 1984). When participants incorrectly resolved anaphora, the interventionist provided corrective feedback [i.e., "no, not quite. (Target anaphor) stands for (previous text details)"] and asked the participants to repeat the correct answer.

Summarizing allows students to recall passages and describe them in their own words and has been identified as a meaningful way to encourage student with ID to engage with text (Hudson et al., 2013a). Postsecondary students with ID were able to recall the main ideas and story details after receiving an intervention that targeted reading comprehension with a summarizing strategy (Hue et al., 2014). The second intervention targeted the micro- and macrostructure, to help participants process the local and global meaning within text base. The text base intervention was conducted within 20-25 minutes and consisted of two instructional strategies – previewing and summarizing. The combined strategies align with the text base level as they support activation of background knowledge before reading, enable readers to create mental images of text more readily (Graves et al., 1983; Chukueggu & Umera-Okeke, 2013), and encourage readers to describe text microstructures (Hudson et al., 2013a). First, the interventionist taught the participants the strategies via explicit instruction; specifically, participants were told the parameters of a "good," "okay," and "poor" summary (aligned with Bilgi & Özmen, 2018 0-, 1-, and 2-point method). The intervention sessions included brief guided practice rounds where the interventionist and participant worked together to preview key text elements (i.e., title, text image, and first sentence of the passage) and summarize a passage. Next, the participant was given a novel passage to do this independently. They were given specific prompts to preview the text (i.e., identify the title, keywords, etc.), and then stopped after every paragraph to summarize it. Paragraph summarizing reduces memory or cognitive load by offering more breaks and reducing the amount of information to retrieve and recall in a given time period, and is an effective strategy for comprehension with students with disabilities (Feeney, 2012).

The third condition targeted participants' construction of a mental representation of text (MRT) and used strategies to prompt student attention towards the text and their coherence of the text. Many readers have executive functioning (i.e., attention, self-monitoring, regulation, etc.) difficulties, especially students with disabilities. Providing readers with specific goals and encouraging them to self-monitor their coherence can help in focus their attention on the text. The MRT intervention sessions were completed within 20 minutes. At the beginning of the session participants were allowed to choose one of four goals that targeted (1) increased words read, (2) increased accuracy, (3) increased time, and (4) accurate summaries. Participants also identified a prize they wanted if they met their identified goal. Next, they were taught how to self-monitor their coherence of the text with a cue card (refer to Appendix D). They were given the direction when they felt confused while reading; participants were told to pause and tell the interventionist, and the interventionist gave them a list of brief prompts to help them identify what they needed.

Maintenance Phases. The procedures of the maintenance phases are similar to the baseline phase as participants read passages independently and completed the Maze progress monitoring measure. Maintenance consisted of two phases where students were tested 2 and 4 weeks following the intervention. The three participants received one maintenance sessions in both maintenance phases resulting in two final sessions. Participants were reminded to use strategies they learned from intervention but were not given any additional assistance.

Intervention Fidelity

A total of 20% of the intervention conditions (Kratochwill et al., 2010) were observed by a second independent observer using an intervention checklist (refer to Appendix F). The number of items observed were divided by the total number of items (22) and multiplied by 100 to compute a percentage for treatment fidelity. The result was an average of 99% correct implementation across five intervention sessions (range= 95-100%), and 100% fidelity during one maintenance session.

Data analysis

Descriptive data were reported for all Research Questions. Percentage exceeding the median was used to answer Research Question 1. A visual analysis was conducted to answer Research Questions 2 and 4. Research Question 3 was answered using pre-post data from the three intervention-specific measures. Each are described below.

RQ 1 - Percentage Exceeding the Median

The median baseline Maze scores were examined to answer Research Question 1. Then, the intervention data points for each intervention type were compared to the median baseline score. The intervention with the most improvement (i.e., Maze scores most frequently above the median baseline) was determined most effective and used in the experimental intervention phase. This method, along with an indicator of effect, has been suggested and used in meta-analytic research of BEAs (Burns & Wagner, 2008).

To further evaluate the effectiveness of the intervention on each dependent measure in the BEA, the percentage of non-overlapping of all pairs data (NAP) was calculated as an indicator of effect. NAP was calculated by comparing baseline and intervention data points across all three BEA phases. NAP summarizes data in two phases of a single-case design by summing the number of nonoverlapping pairs, adding

the number of ties multiplied by .5 and dividing by the total number of data pairs (i.e., NAP= ([Pos + .5 x Ties] /Pairs); Parker, Vannest, & Davis, 2011a). Moreover, NAP was selected because it may outperform other methods of calculating overlap (e.g., percentage of non-overlapping data, percentage of all non-overlapping data, percentage exceeding the median) due to the use of visual judgement, size of confidence intervals, less influence from outliers, and its relationships with R^2 (Parker & Vannest, 2009). An effect size calculated by NAP is interpreted as strong if the number falls between 0.92 and 1.0, a medium effect falls between 0.66 and 0.92, and anything lower than 0.66 is a weak effect (Parker & Vannest, 2009).

RQ 2 AND 4 - Visual analysis

To answer Research Questions 2 and 4, visual analysis procedures were used as graphed data to determine the influence of the intervention on the participants' reading comprehension. Visual analysis involved assessing the level, variability, trend, immediacy of effect (or intercept gap), overlap of the data, and consistency between similar phases (Vannest & Ninci, 2015). Additionally, to answer Research Questions 2 and 3, the data from the experimental phase was evaluated with visual analysis between baseline, contraindication and intervention conditions. Research Question 4 was answered with visual analysis to determine the effect of intervention after it is terminated.

Similar to the BEA, NAP was also calculated as a measure of effect. Specifically, NAP was calculated for data pairs in three ways: first, comparing baseline and contraindication, next, contraindication and intervention data points were compared, and finally, baseline and intervention. A Tau-U was also calculated to determine the percent of data that showed improvement over time when considering all phase/condition

nonoverlap and the intervention trend while controlling for the baseline trend (Parker et al., 2011b). NAP and Tau-U closely align with visual analysis, are a comprehensive indicator of effect, are sensitive to increasing trends found within intervention phases, and control for undesirable trends in baseline in a single-case design (Parker et al., 2011a; Parker et al., 2011b). Tau-U effect sizes of 0.20 or less is considered a small effect, 0.20-0.60 moderate, 0.60-0.80 large, and above 0.80 is considered a very large effect (Vannest & Ninci, 2015).

RQ 3 - Pre-post Data

Research Question 3 was answered using pre-post data from the three intervention-specific measures. Due to the small sample size, it is unlikely that the data were normally distributed. Therefore, a Wilcoxon signed-ranks t test was used to analyze the pre-post data because it uses rank order and not absolute value.

Chapter IV: RESULTS

Chapter IV focuses on the results for each research question. The study addresses the following research questions: (1) to what extent do interventions targeting the *linguistic level*, *text base level,* and *mental construction of text* have differentiated effects on reading comprehension, as measured with a BEA, with students identified with an intellectual disability? (2) To what extent do the selected interventions lead to growth in reading comprehension over time with students identified with an intellectual disability? (3) What effect will intervention strategies have on students' understanding of the *linguistic level*, *text base level* and *mental representation of text* of reading comprehension with students identified with an intellectual disability? (4) To what extent will students identified with an intellectual disability maintain the effects of intervention on comprehension after 2 and 4 weeks following the termination of the intervention? Finally, social validity was collected from each participant with a survey. The results for each participant are discussed respectively.

Research Question 1 - Differentiated Effects with the BEA

A BEA was used to determine the most effective intervention for three high students with intellectual disabilities (ID). Each participant completed the three intervention conditions three times for a total of nine phases. The interventions targeted (a) the linguistic level, (b) text base level, and (c) construction of mental representation of text (MRT). The order of interventions was randomly selected. Students read Maze passages at their instructional level (i.e., 93-97% known words; Treptow et al., 2007), which was determined prior to implementing the BEA using *DIBELS®* oral reading fluency passages. Kira's instructional level was at a second grade reading level, Corey's

instructional level was at a fifth-grade level, and Sam's instructional level was at a seventh-grade reading level. See Table 2 and Figure 2 for data from the BEA, which are also described in detail below.

Kira

In the first BEA phase, Kira participated in the text-based intervention first, which was followed by the linguistic and MRT interventions, respectively. In the second BEA phase, she received the text base, linguistic, and MRT interventions. Finally, in the third BEA phase, Kira received the linguistic, text base, and MRT interventions. Kira's results from the BEA are displayed in the top panel in Figure 2. As indicated by the dotted line, Kira's median baseline score was 73%. Kira's Maze scores exceeded her baseline performance in 2 of the 3 linguistic intervention sessions, 0 of the 3 text base intervention sessions, and 2 of the 3 MRT intervention sessions. This suggested that both the linguistic and MRT interventions had an effect on her reading comprehension. NAP analysis was conducted to determine which intervention was most effective. The data for the linguistic intervention resulted in a medium effect of NAP = .69, and the MR intervention led to a medium effect of NAP = .61. The linguistic intervention, anaphor resolution, was selected for the experimental, multiple baseline phase.

Corey

In the first BEA phase, Corey participated in the text-based intervention first, which was followed by the linguistic and MRT interventions respectively. In the second BEA phase, he received the linguistic, MRT, and text base interventions. Finally, in the third BEA phase, Corey received the linguistic, MRT, and text base interventions. Corey's results from the BEA are displayed in the middle panel on Table 2. Corey's

median baseline score was 93% in the BEA. Despite his high performance in baseline, 2 of the 3 linguistic intervention sessions exceeded his baseline performance. However, this was not observed for the other interventions as 0 of both the text base and MRT intervention sessions exceeded baseline. The linguistic intervention was selected for the experimental phase, but for consistency across participants, NAP was also calculated for each intervention type. The data for the linguistic intervention led to a medium effect of NAP = .72, and a medium effect for text base and MRT of NAP = .69 each.

Sam

In the first BEA phase, Sam participated in the text-based intervention first, which was followed by the linguistic and MRT interventions. In the second BEA phase, she received the linguistic, text-base, and MRT interventions. Finally, in the third BEA phase, Sam received the MRT, text-base, and linguistic interventions. Sam's results from the BEA are displayed in the bottom panel on Table 2. Sam's median baseline score was 93%, and 2 of the 3 linguistic intervention sessions exceeded her baseline performance. Her performance following the text base and MRT intervention sessions also exceeded baseline, but this only occurred once for both the text base and MRT sessions because the other two scores were equal to baseline. The linguistic intervention was selected for the experimental, multiple baseline, but NAP was also calculated for each intervention type, which resulted in a medium effect of NAP = .72 for the linguistic intervention, NAP = .69 for the text base intervention, and NAP = .33 for the MRT interventions.

Summary for Research Question 1

The three participants' performance was evaluated with their accuracy on the researcher modified Maze passages, which was then compared to their median baseline

performance. Kira had high performance in the linguistic and MRT interventions, and Corey and Sam's performance was highest following the linguistic intervention. Estimates of effect with NAP were consistent with the PEM data results, and were used to identify one intervention for Kira and Sam. As result, the linguistic intervention was determined to be the most effective intervention for all three participants.

Following the three BEA phases, one follow-up session was conducted with the most effective intervention and measured with a Maze that was at a higher grade level. Participants maintained the effect of the intervention when they obtained 80% or higher accuracy on the Maze. Kira's intervention materials were increased to fourth-grade level passages, Corey and Sam were given eighth-grade level passages.

Table 2

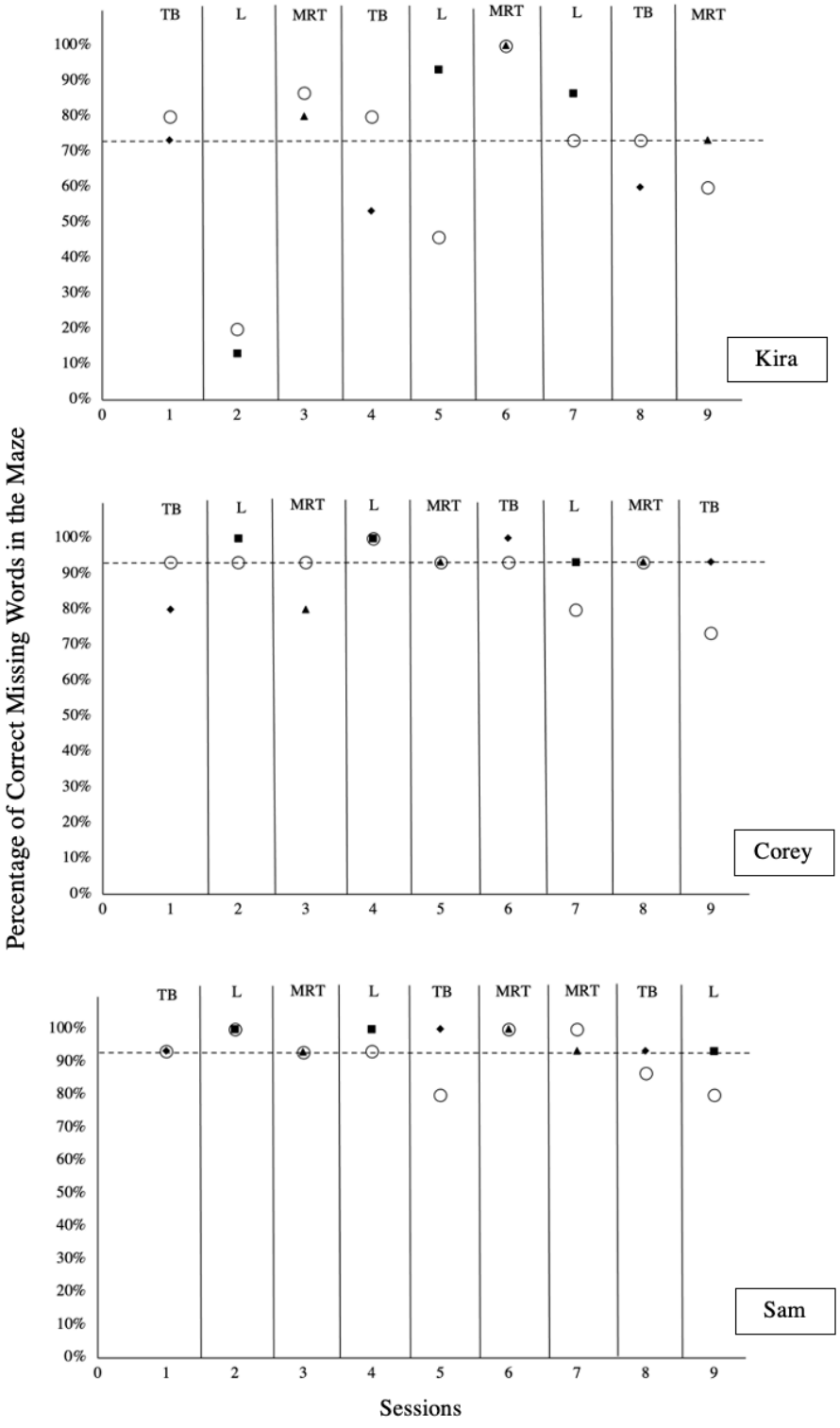
Descriptive Data from the Brief Experimental Analysis

	Kira	Corey	Sam
Average Performance in Baseline	73%	93%	93%
Baseline Score Range	20-100%	73-100%	80-100%
Intervention Score Range	13-100%	80-100%	93-100%
NAP for L Intervention	69%	72%	72%
Effect Magnitude	Medium	Medium	Medium
NAP for TB Intervention	6%	69%	69%
Effect Magnitude	Small	Medium	Medium
NAP for MRT Intervention	61%	69%	33%
Effect Magnitude	Medium	Medium	Small
Grade Level Passage in Follow Up	4th	8th	8th
Maze Score in Follow up	88%	96%	95%

Note. NAP = Nonoverlap of All Pairs, L = linguistic intervention, TB = text base intervention, and MRT = mental representation of text intervention.

Figure 2

Participants' Performance in the Brief Experimental Analysis on Linguistic (L), Text Based (TB) and Mental Representation of Text (MRT) Interventions



Research Question 2 – Intervention Effects on Reading Comprehension

During the experimental phase of the study, the participants received baseline, a contraindicated intervention, and the indicated intervention. In the baseline sessions, the participants read a passage at their instructional level. In the contraindication phase, one of the two interventions that were *not* the most effective in the BEA was randomly selected and implemented three times. Finally, in the intervention sessions, the most effective intervention was implemented across several weeks. A Maze reading passage was administered once a week to assess the intervention effects. The percentage of correctly identified missing words in the Maze passage was the dependent variable. Refer to Figure 3 for all participants' graphed data in the extended analysis. Additionally, their reading accuracy and rate were recorded for every session as well and their average performance across intervention sessions, as shown in Table 1.

Kira

In three baseline sessions, Kira completed the missing Maze words 73%, 67%, and 67% correctly (i.e., 10-11 correct out of 15), which suggested a low level of performance with a decreasing trend. In the contraindication phase, the text base level intervention was randomly selected and administered where Kira obtained 67%, 73%, and 60% correct on the outcome measure with a decreasing trend. Kira's performance in baseline and contraindication was favorable as her level of performance was low and there is evidence of decreasing performance across these two phases. Given the similar performance across baseline and contraindication, Kira's performance was stable across these phases (i.e., range = 60-73%, Δ = 13%). NAP was calculated between baseline and

contraindication, which resulted in a NAP of 0.61. This suggests the contraindication intervention was not effective.

Kira participated in the linguistic intervention for 7 weeks, which resulted in 13 intervention sessions with 6 data collection days. She was absent for several data collection sessions, which is illustrated on the graph. Kira identified the correct missing words with a range of 53-87% accuracy, and her average performance (74%) was higher compared to baseline (69%) and contraindication (67%). Her intervention data showed a favorable, increasing trend but plateaued at the end of the phase. An immediate effect was not observed for the intervention as her performance decreased immediately after the contraindication phase. Baseline and contraindication sessions were similar in range and level, but her level of performance was higher in the intervention phase. While there was variability across all phases (i.e., range = 53-87%, Δ = 34%), Kira's level of performance increased over time in the intervention phase. Visual analysis suggested moderate overlap in the comparison baseline and contraindication to her performance in intervention. NAP was computed between the contraindication and intervention phase and resulted in a medium effect of NAP = .83. NAP was also calculated between 18 data points from baseline and intervention, which resulted in a medium effect of NAP = .69.

Corey

Across five baseline sessions, Corey identified the correct missing Maze words with a range of 53%-93% accuracy (i.e., 10-15 correct out of 15), but there was a noticeably decreasing trend. In the contraindication phase, the MRT level intervention was randomly selected and administered to Corey. An immediate effect was observed in contraindication, followed by a decrease in level with scores of 87%, 93%, and 60%

correct. Corey's performance in baseline was favorable as his data indicated a decreasing trend, which was also observed in the contraindication phase. However, given his high scores at the beginning of this phase, there was variability across these two phases (i.e., range = 53%-100%, Δ = 47%). The 15 data pairs between the baseline and contraindication sessions were compared and resulted in 57% NAP, which was a weak effect and suggested the contraindication intervention was not effective.

Corey participated in the linguistic level intervention for 7 weeks, which resulted in 16 intervention sessions with 5 data collection days. After receiving intervention, Corey identified the correct missing words with a range of 60%-93% accuracy. His average performance in intervention was at a higher level (81%) than baseline (76%) and contraindication (80%). An immediate effect was not observed between contraindication and intervention (i.e., 60% in the last contraindication phase and first intervention phase). His intervention data showed an increasing trend but high overlap with the baseline and contraindication phases. All phases were similar in range and level. Only two data points did not overlap across phases, which indicated considerable overlap. However, Corey's showed an increasing trend in the intervention phase compared to all other phases where his performance indicated a decreasing trend. Visual analysis suggested high overlap, and 15 total data pairs between contraindication and intervention resulted in a NAP of .47, which was a weak effect. NAP was also calculated between 25 baseline and intervention, which resulted in .55 NAP and a weak effect.

Sam

Across nine baseline sessions, Sam identified the correct missing Maze words with a range of 60%-93% accuracy (i.e., 9-15 correct out of 15), which suggested

variability in baseline data and a slight increasing trend. In the contraindication phase, the MRT level intervention was randomly selected and administered to Sam. An immediate effect was observed in contraindication as her scores decreased from 73% to in level to 60% and continued to decrease to 47%, and 73% correct. Her performance in contraindication was at a lower level than baseline, which was favorable. NAP was calculated between baseline and contraindication, which resulted in a very weak effect of NAP = 0.11. This suggests the contraindication intervention was not effective.

Sam participated in the linguistic intervention for 7 weeks, which resulted in 16 sessions with 7 data collection days. After receiving intervention, Sam identified the correct missing words with a range of 67%-100% accuracy. Her average level of performance was higher for intervention (84%) than previous phases (i.e., 77% baseline, 60% contraindication), and there was less variability in her performance during intervention (i.e., range = 67%-100%, Δ = 33%) than in baseline/contraindication (i.e., range = 47%-93%, Δ = 46%). Sam's intervention data showed an increasing trend with overlap with the baseline phase. Visual analysis suggested some overlap, but 18 total contraindication-intervention data pairs resulted in a NAP of .98, which was a strong effect. NAP was also calculated between 18 baseline and intervention data pairs, which resulted in a NAP of .75, which was a medium effect.

Summary of Research Question 2

The linguistic intervention appeared to lead to increased performance in the participants' reading comprehension over time. All three participants demonstrated an increasing trend in the intervention phase. Refer to Table 3 for a synthesis of the visual analysis. NAP analysis indicated high percentage of overlap with baseline and

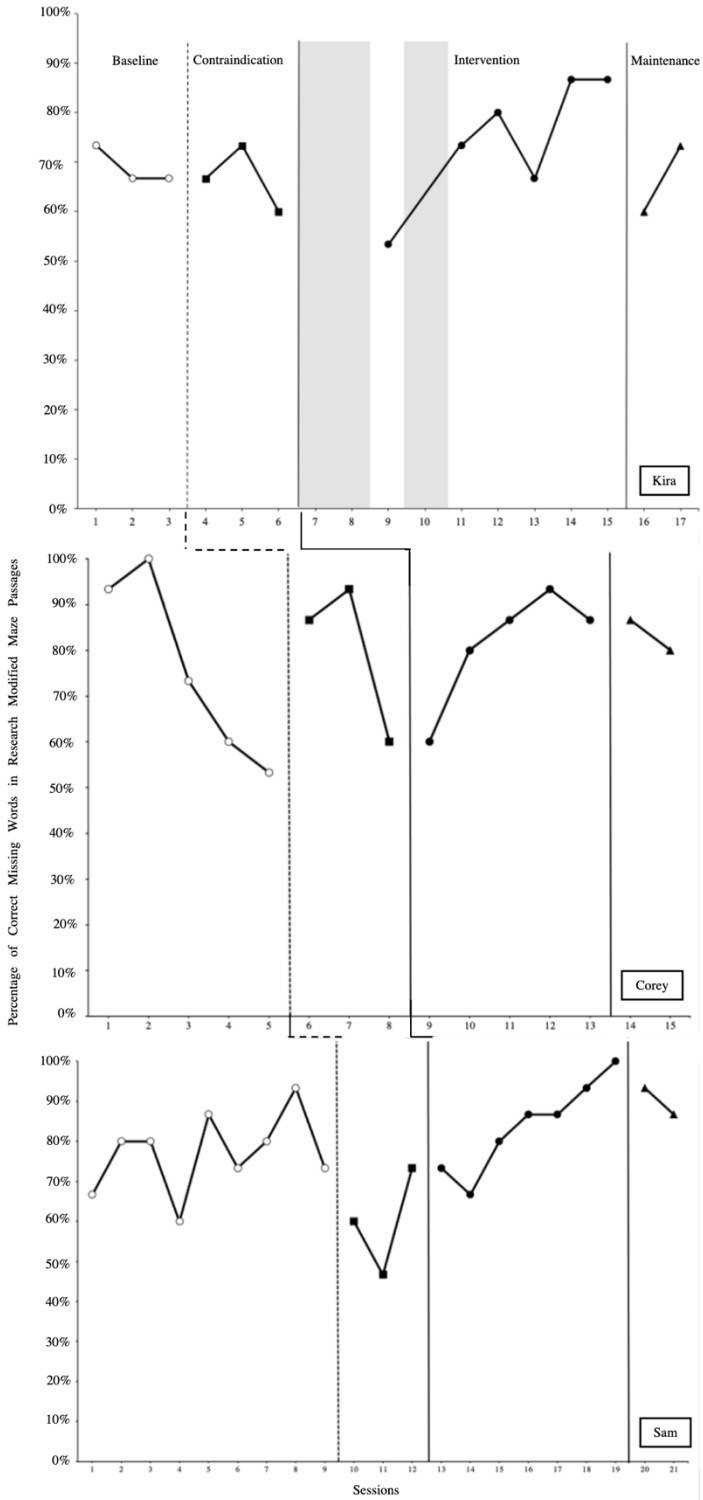
contraindication phases, and the contraindication was not effective for all three participants. The contraindication and intervention phases were analyzed with NAP, which suggested varying effects of the intervention across participants. The intervention was most effective for Sam, but medium to large effect was noted for Kira, and a small effect was noted for Corey. Additionally, the weighted Tau-U across all phases resulted in moderate effects. There was a moderate effect of 0.45, $p = 0.07$, 95% C.I. [-0.04 - 0.93] for the contraindication and intervention comparison, and a moderate effect of 0.42, $p = 0.05$, 95% C.I. [-0.004 - 0.84] for the baseline and intervention comparisons.

Research Question 3 – Intervention Effects on Comprehension Levels

Pre- and post-testing were conducted to further evaluate the interventions' effect on the participants' reading comprehension at three levels described in the CI Model (i.e., linguistic, text base, and mental representation of text levels). Data were collected with three intervention-specific measures were administered during pre- and post-testing to evaluate the effect of intervention on the participants' comprehension at the linguistic, text base, and mental construction of text (MRT) levels. These include the anaphor antecedent identification test (Dommes et al., 1984), summary recall (e.g., Bilgi & Özmen, 2018), and the *Bridging Inferences Test, Picture Version* (Pike et al., 2010). The anaphor antecedent was the primary dependent variable for Research Question 3 as all three participants received the linguistic intervention in the extended analysis. However, data from all three measures are provided in Figure 4. A Wilcoxon signed-ranks *t* test was used to analyze the pre-post data because it uses rank order and not absolute value.

Figure 3

Participants' Performance in the Multiple Baseline



Note. The shaded areas indicate the weeks participants were absent.

Kira

Kira received the linguistic intervention during the extended analysis and completed all three intervention specific measures in pre-post testing. Her performance on the linguistic measure increased from 30% to 80% in post-testing. In comparison, her performance decreased on the text base measure and remained the same on the MRT measure. As such, the linguistic intervention appeared to have a direct impact on her performance on the anaphor antecedent identification test.

Corey

Corey received the linguistic intervention during the extended analysis and completed all three intervention specific measures in pre-post testing. Corey's performance on the intervention-specific measures was similar to Kira. His performance on the linguistic measure increased from 60% to 100%. His performance decreased from pre to post on the test base measure, there was no change from pre to post on the MRT measure. Overall, the linguistic intervention appeared to have a direct impact on his performance on the anaphor antecedent identification test, while performance remained high on the MRT measure.

Sam

Sam received the linguistic intervention during the extended analysis and completed all three intervention specific measures in pre-post testing. Sam demonstrated improvement on all three intervention measures. She had the biggest change in the linguistic intervention measure as her score increased from 40% in pre-testing to 90% in post-testing. Her performance on the linguistic measure increased from 30% to 80% in post-testing. In comparison, her performance increased by 30% on the text base measure

and 10% on the MRT measure. While Sam demonstrated improvement on all three measures following intervention, she showed the largest increase in performance on the anaphor antecedent identification test.

Summary of Question 3

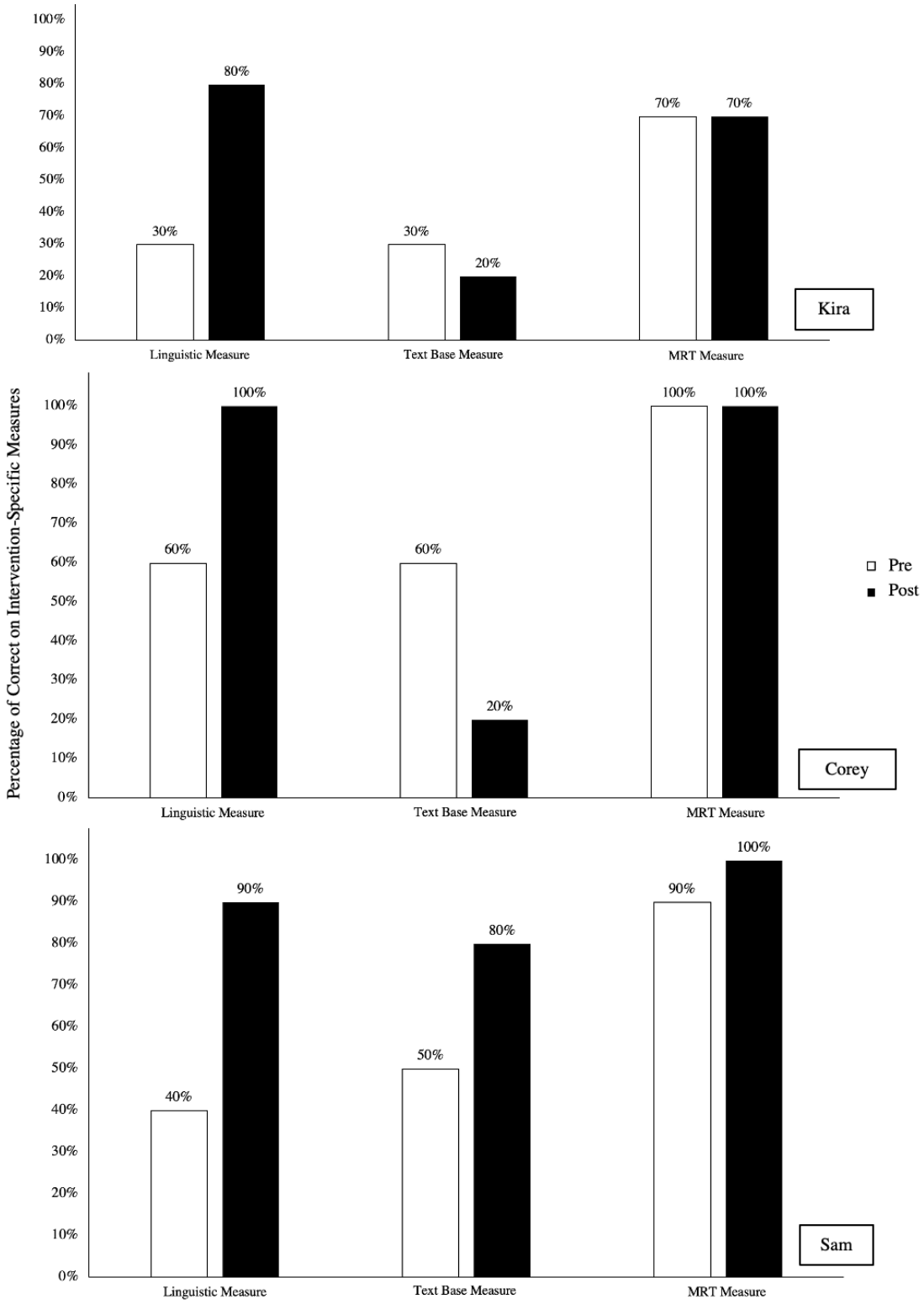
All three participants showed increased performance on the anaphor antecedent identification test, which was the measure directly connected to the linguistic intervention. This suggests that the participants made progress on the word level comprehension skill that was taught in intervention. That is, participants were able to accurately identity anaphor to the corresponding antecedent detail following intervention. A Wilcoxon Signed-Ranks Test demonstrated inconsistent findings. Specifically, the test indicated that the post-test scores on the anaphor antecedent identification test were not reliably different than pre-test scores $Z = -1.63$, $p = 0.32$, with 3 positive ranks, 0 negative ranks, and 0 ties. Given that there were 3 out of 3 positive ranks, this nonsignificant finding is likely due to the small sample size. Wilcoxon Signed-Ranks tests were also conducted for the two other intervention specific measures administer in pre-post testing. The post-test results on the text base measure (i.e., summary recall) was not reliably different than pre-test scores with 1 positive rank, 2 negative ranks, and 1 tie. Finally, the post-test scores on the *Bridge Inference* Test were not reliably different than pre-test scores, with 1 positive rank, 0 negative ranks, and 2 ties.

Research Question 4 – Maintenance

The final phase of the extended analysis consisted of the maintenance phase, and participants were tested 2 and 4 weeks following the termination of the linguistic intervention. Participants were reminded to use strategies they learned from intervention

Figure 4

Pre-Post Performance on Intervention-Specific Measures



but were not given additional assistance. They read passages independently and completed the Maze progress monitoring measure. The results are described below and illustrated in Figure 3.

Kira

Kira completed the maintenance Maze passages with 60% and 73% accuracy. An immediate decrease in performance was observed from intervention to maintenance. Moreover, her level in performance dropped and was similar to her scores in baseline and contraindication phases.

Corey

In the maintenance phase, Corey completed the Maze passages with 87 and 80% accuracy. Corey demonstrated a slightly decreasing trend from intervention to maintenance, which continued in the second maintenance session. There was complete overlap with baseline and contraindication phases.

Sam

Sam completed the Maze passages with 93 and 87% accuracy. Her performance in the maintenance phase showed a slight decreasing trend at a high level. Her data overlapped with the baseline and intervention phases, as her performance was also high in these sessions.

Summary of Research Question 4

All three participants performance on the Maze passage decreased in the maintenance phase. This was demonstrated by trend and overlap. Kira also had decreased performance in level and immediacy of effect, while Corey and Sam's level of performance was somewhat consistent with their performance in intervention. This

suggests that the participants may have required more time with explicit instruction and linguistic intervention procedures.

Social Validity

The sociality validity assessment included three sections with questions to capture participants' perceived acceptability, usefulness, and effectiveness of the interventions. Participants completed the social validity survey at the end of the study.

Acceptability of Intervention

In regard to acceptability, all three participants reported that they would continue to practice the skills they learned in the linguistic level intervention. However, when they were asked which intervention was their favorite, Corey was the only one to identify the linguistic intervention. Kira preferred the mental representation of text intervention (MRT) intervention, and Sam preferred the text base intervention. Participants rated how much they liked the different components of intervention on a Likert scale from 1 - 6 (i.e., 1 representing "I did not like it at all. Not even once" and 6 representing "I liked it every single time we did it."). The participants rated the MRT higher with scores of 5, 5, and 6, and next the linguistic level intervention (scores of 4, 5, and 6) and third, the text base intervention (i.e., scores 3, 4, and 6). Finally, all three appeared to like the progress monitoring component the least with scores of 1, 3, and 3, and two participants reported that they would remove this part of the session if they had the choice to remove anything from the sessions. When they were asked to share what the enjoyed the most during their time in intervention, two participants shared that they liked completing the practice activities with the interventionist during the linguistic intervention.

Usefulness of Intervention

The participants perceived usefulness of the linguistic intervention was asked with two questions and a Likert scale from 1-6 (i.e., 1 representing "I never used these skills" and 6 representing "I always used these skills."). All three participants rated the usefulness at a 6 *during* intervention time, and similarly, rated usefulness *outside* of intervention (e.g., in class) at a 5, 6, and 6. Overall, the participants believed that the linguistic intervention not only helped them during intervention time, but also in other places.

Effectiveness of Intervention

Finally, the participants were asked questions about the effectiveness of the linguistic intervention. Two questions asked them about their ability to complete the learned skills alone and teaching others, and a Likert scale from 1-6 (i.e., 1 representing "I cannot do it at all." and 6 representing "I do it and get it right every time.") was used for these two questions. The participants rated their ability to complete the learned skill (i.e., anaphor resolution) independently at 4, 5, and 5. In other words, after receiving intervention, the participants felt somewhat to mostly confident that they could do this work on their own. However, when they were asked about their ability to teach the skill other others, their responses were variable. Kira responded to this question "yes," Sam said "no," and Corey said "maybe," but later Corey shared that he thought he could use this to help his family learn to read one day. All participants felt that their reading improved after receiving the intervention. Kira shared, "I used to read slow all the time, which made me not like it. [The intervention] helped a lot when I needed to read in front of my class." Overall, the participants recognized that their reading improved after intervention and could start working independently.

Chapter V: DISCUSSION

The purpose of the study was to determine the extent in which three interventions were effective on the reading comprehension of three high school students with intellectual disabilities (ID). Reading comprehension is a multifaceted skill that can be broken down into smaller skills and Oakhill (2020) poses the question of whether to directly teach comprehension or target the "finer threads" (p.415). The construction-integration model (CI Model) describes reading comprehension as a process of understanding text representation at three levels (Kintsch, 1991; van Dijk & Kintsch, 1983). First, readers acquire skills within the linguistic level of comprehension to gain knowledge of words and phrases within the text. Next, skills at the text base level require the ability to connect the words learned at the linguistic level to then understand local parts of the text (e.g., sentences, small parts of the passage) and eventually, build a global understanding of the entire passage. Finally, mental representation of text (MRT) is the highest level of comprehension, which involves integrating readers' background knowledge and their skills learned in the two previous levels to create a mental image of the text while reading. The interventions in the current study were selected to algin with the CI Model, which were compared in the brief experimental analysis (BEA) to determine which comprehension level to target. All three participants demonstrated the highest improvement following the linguistic level intervention, which indicated an appropriate target for intervention for all three. The participants demonstrated favorable, positive trends on the researcher modified Maze after they received 21 weeks of intervention on anaphor resolution (i.e., linguistic level intervention). While they had favorable trends and level of performance, there was overlap with contraindication and

baseline phases. This resulted in a moderate intervention effect for Kira, weak effect for Corey and a strong effect for Sam. Their performance was minimally sustained during the maintenance sessions. However, there were improvements on the linguistic intervention measure following intervention.

While there were positive effects for the anaphor resolution intervention, it is important to evaluate the results for each individual participant given the nature of this single-case design study. The intervention effect was strong for Sam, but weak and moderate effects were found for Corey and Kira. The differences in the participants performance may be explained by several factors such as initial reading level and reading fluency. First, Sam's level of reading was higher than the other participants at the beginning of the study. Reading fluency is an indicator for reading comprehension in both students with and without disabilities (Burns et al., 2004; Burns et al., 2011; Klauda & Guthrie, 2008; van Wingerden et al., 2017), and preintervention reading fluency skills predict the effects of different reading interventions (Parker & Burns, 2014; Szadokierski et al., 2017).

There are also environmental factors that may also explain differences in their performance. Notably, absences became a concern for some participants, which impacted both intervention time and data collection. Students who are chronically absent (i.e., missed 14 days in a school year) scored lower on reading achievement tests, and are less likely to graduate and complete high school (Smerillo et al., 2019). Kira missed 9 intervention sessions, Corey missed 2, and Sam missed 0 sessions over the course of 7 weeks in the experimental phase. In other words, Kira missed 43% of her scheduled sessions, while her peers missed 0-9% of their reading intervention time. Disruptive

behavior varied across the three participants, which may have impacted Corey's performance. Specifically, Corey was easily distracted and acted in ways that were immature (e.g., requesting to play videos during reading, acting silly, creating make-believe words during reading). Individuals with ID experience difficulties regulating their behavior, which includes their ability to maintain their attention to a task, inhibit impulses, and control emotions (McIntyre, Blacher, & Baker, 2006). General behavior management strategies like creating predictable routines, providing clear and consistent rules, and using positive reinforcement encourage positive behavior in children with ID. As a result, behavior management strategies may have been an appropriate addition to the interventions used in this study.

Although there was variability in student response, the consistent positive effects have potential implications for research, theory, and practice. Each area (research, theory, and practice) is discussed next.

Implications for Research

The current data were consistent with previous research but extended the literature as well. The results of the study were consistent with previous research that found that students with ID benefitted from word-level reading interventions (Hua et al., 2018; Stevens & Burns, 2021). In regard to word meaning, young adults with ID were quicker to resolve anaphor when their selection required knowledge of the words meaning rather than morphological clues (Taveares et al., 2015). The current study goes beyond most previous reading research with students with ID where vocabulary knowledge via sight word instruction (Browder et al., 2006; Browder & Xin, 1998, Ruwe et al., 2011, Warley et al., 2015) or preteaching keywords (Robert et al., 2019, Stevens &

Burns, 2021) was the targeted word level skill. Although the previous studies found positive effects, the interventions did not have an effect reading comprehension (e.g., Stevens & Burns, 2021; Warley et al., 2015). Anaphor resolution is different than vocabulary instruction because the meaning of the anaphora is important for text cohesion and anaphors are frequently repeated in a passage. As such, the anaphor resolution intervention has instructional components that support word meaning and complex qualities of words that are important for comprehension of grammar.

The results of this study extend BEA literature by investigating the effects of interventions targeting three different levels of reading comprehension with students with ID. This study is one of few that used a BEA to select reading intervention for students with ID (i.e., Özmen & Atabasi, 2016), or more specifically, targeted reading comprehension with this population (Güler & Özmen, 2010). Multiple component reading interventions have been shown to support reading outcomes for students with ID (Allor et al., 2010a), and BEAs have been used to show the same effect, but over a shorter period of time (Güler & Özmen, 2010). Previous research did not consistently lead to remarkable reading comprehension performance, whereas in the current study, the BEA did indicate growth and suggested that BEAs may be appropriate method to identify the levels in which readers need more support in reading comprehension.

Knowledge- and text-based inferences occur at both word and sentence levels to connect information with what was previously read and to then fill in gaps (Graesser et al., 2015). In the current study, the participants made inferences every time they attempted to resolve an anaphor, because they had to identify the correct meaning of the word by using previous details learned in the text. In other words, they had to infer

meaning based on previous text knowledge. Previous research found that explicit instruction in inferencing directly supported subsequent reading comprehension in students with ID (Flores & Ganz, 2007; Lundberg & Reichenberg, 2013). As such, the current study likely boosted the participants' ability to infer the meaning of pronouns, reflexives, and other types of anaphors, which may have contributed to their construction of an accurate mental representation of the text, but this is a hypothesis for future research. Moreover, previous research found large effects of inferencing instruction on inferencing and literal outcome measures for less skills readers (Elleman, 2017), the "less skilled reader" population was identified as poor comprehenders or readers with learning disabilities. More research is needed to understand inferencing specifically with students with ID, as well as inferencing skill within the three levels of reading comprehension.

Implications for Theory

This is one of the first studies to use the CI Model and a BEA to triage reading comprehension intervention for students with ID. The results of this study have implications for the CI Model and support the processes described in this theory. Anaphor resolution may act as a direct bridge between linguistic and text base comprehension because accurate resolution leads to sentence cohesion, which supports understanding of the microstructures in the text base (CI Model). Comprehension of microstructure text base then enables readers to link sentences together and shift their attention to global understanding (i.e., comprehension of the macrostructures within the text base). In this model, accurate MRTs are created with successful constructions and integrations of linguistic and text base representations of text. The data support this

conclusion as all three participants demonstrated significant improvement on the Maze, which was a general outcome measure for reading comprehension.

Instruction on simple word qualities (i.e., subject, predicate, pronouns, anaphor resolution) may have influenced general reading comprehension for these three students with ID. Linguistic level skills likely act as the first, essential step to subsequent levels of comprehension identified in the CI Model. As readers learn linguistic skills, their "knowledge nets" (i.e., a network of concepts and propositions; Kinstsch, 1988) expand, which allows more flexibility to select, modify, and arrange propositional elements to create meaning of the text base. That is, the words positioned in sentence are better understood when "knowledge nets" (Kinstsch, 1988, p. 165) are constructed and expanded to reflect text base. Intervention and instruction can act as a mechanism to expand readers' "knowledge nets," and increase accurate understanding of the text base. The anaphor resolution intervention did this by explicitly teaching the participants meaning of anaphor, which then added the word meaning to their "knowledge net" and allowed them to identify the meaning of the word and subsequent text base quickly and accurately in one or several sentences throughout the passage. Underdeveloped linguistic skills may predict lower achievement in the other two reading comprehension levels. This is a worthy and necessary question to further investigate in research, as it would inform instructional practices in special education.

The linguistic level of text representation involves integrating the meaning of words into meaningful messages (i.e., understanding the text base). Students with ID often rely on semantic meaning of words (Tavares et al., 2015), but they have difficulty tracking the correct subject of a given sentence (Hawthrone & Loveall, 2020). Subject

bias in common in readers (Frederickson, 1981), but weaker subject bias may suggest incomplete ability to infer the subject at all. In the current study, the instruction on anaphor did more than simply teach the meaning of pronouns to participants. Explicit instruction was used to identify what the anaphor and antecedent details represented in the sentence and text as a whole. Specifically, participants were taught and frequently reviewed the subject and predicate of sentences, the relationship between the subject/predicate and anaphor words, and examples were presented for practice. This supported participants' comprehension at the word level because the semantic quality of the target anaphor words was targeted, rather than the common practice of memorization through sight word instruction.

Previous knowledge and experience are important components in CI Model (Kintsch, 1988), and in line with this theory, the three participants may have had less experience with anaphor resolution prior to the study (e.g., not received explicit instruction on anaphor resolution, and/or have not received word level instruction for many years). Through anaphor intervention and instruction, participants gained knowledge and experience with this reading skill, which directly had an effect on their mastery, which is reflected in pre-post data that indicate participants' ability to identity pronouns and their meaning was initially low (i.e., 30, 60, 40% accuracy), but increased following intervention (i.e., 80, 90, 100% correct). As previously noted, this was observed for broad reading comprehension as well.

Implications for Practice

Explicit instruction involves a systematic sequence of reviewing previous material, teaching new content, modelling, and providing guided and independent

practice, which is repetitive and offers several opportunities to respond (Rupley et al., 2009). Given that students with ID experience several difficulties in linguistic and cognitive processes, they need instruction that support their unique needs and characteristics (e.g., Lemons et al., 2015). Explicit instruction improved students without disabilities ability to resolve anaphor (Dommes et al., 1984), and the current study provides evidence for using explicit instruction to teach students with ID this as well. It is widely accepted that students with ID benefit from explicit and systematic instruction over a long period of time (Alnahdi et al., 2015; Allor et al., 2009). Like previous research, the current study resulted in low to strong effects following intervention with a strong effect observed for one participant. It is likely that the other two other participants required more time in intervention. Students with ID perform lower on progress monitoring measures, but they follow significant, positive growth rates like their peers (Wei et al., 2011). However, there are studies that did not show growth on progress monitoring until 15-20 weeks of instruction (Allor et al., 2010b). The participants started showing progress in less time during the BEA, but their performance in the maintenance sessions suggest that participants may have required more time in intervention. Moreover, participant interest and motivation may have varied between these phases as a result of decrease social reward and engagement; that is, the maintenance sessions may have been boring for students compared to the intervention sessions. Perhaps creating more engaging baseline and maintenance sessions would control for these variables. While this is not addressed as a quality indicator for single-case design research (Horner et al., 2005), it may be a promising area of future research.

It is important to consider motivation and engagement when evaluating reading achievement and progress in reading comprehension (Morgan, Farkas, & Hibel, 2008), including low skilled readers (Logan, Medford, & Hughes, 2012). While the participants held generally positive views towards intervention and their progress, there were individual differences. A significant relationship exists between reading and motivation, which increases in magnitude for high school aged students (Toste et al., 2020). Following the termination of the intervention, the participants reflected on their reading progress and shared that they believed they could work on the intervention skill independently. Students' beliefs about reading, about themselves, and how others may perceive them significantly moderates the relationship between motivation and reading (Toste et al., 2020), and the participants' beliefs in themselves may have grown as they continued to demonstrate improvement in reading overtime. Future studies should measure students' motivation and beliefs before and after intervention to better understand this as it may be an important construct within social validity. Finally, the anaphor resolution intervention was a simple and efficient strategy to deliver, which could be advantageous because teachers may feel overwhelmed when selecting and implementing reading interventions with students with ID (Scruggs & Mastropieri, 1996).

Limitations

Although the current data have implications for research, theory, and practice, they should be considered within the context of their limitations. The current study recruited students with ID based on IQ standard score falling within the range of 55-70, as per the inclusion criteria. The IQ of the three participants was evaluated using two different cognitive measures, indicating a need for future studies to use a single measure

of cognitive abilities and potentially consider stricter inclusion criteria. Decoding was accounted for in the identification and selection of passages according to participants' instructional level, which was assumed to be an appropriate representation of decoding ability. However, participant's decoding ability was not measured before the study procedures. Teaching with materials within students' instructional level allows them to read quickly, accurately and frees their attention and focus on developing their comprehension (Gickling & Thompson, 1985), or their mental representation of the text. It is well established in reading theory and research that adequate fluency cannot be achieved without strong word recognition skills (NRP, 2000). The instructional level assumes that the students have achieved word recognition, through decoding and sight word instruction, for a high percentage of the words in the provided text (Gickling & Thompson, 1985). Future studies should consider utilizing standardized measures of decoding ability and other reading skills as this would provide more robust eligibility criteria. For example, a standard score of 90 on the *Weschler Individual Achievement Test, Third Edition* (WIAT-III) has been used as a criterion for poor comprehenders whom have adequate word reading skills (i.e., Hulme & Snowling, 2011, Kelso et al., 2020, Nation et al., 2004, 2010). Moreover, language comprehension was not measured, which is another factor important for reading comprehension (Gough & Tunmer, 1986), especially for students with ID (Roch & Levarto, 2009).

Second, the Maze passages were modified in the current study to align with the guiding theories. That is, words were intentionally omitted, and multiple-choice answers were created that target three levels of comprehension (Kintsch, 1988). This method has not been empirically evaluated and was created by the principal investigator based on

recommendations in previous research (i.e., Conoyer et al., 2017; Gellert & Elbro, 2013). While three reliability measures were calculated for the modified Maze in this study, more research is needed to evaluate psychometric properties of the revised Maze and its utility with the ID student population.

Third, there is debate on what Maze measures are really evaluating as some argue that Maze does not measure higher level comprehension skill, but rather linguistic level skills (e.g., vocabulary, syntax; Keenan et al., 2008). As such, this argument that Maze measures support linguistic skills, rather than broad comprehension, may further explain the growth observed for word level comprehension skills in the study. Additionally, research using Maze and other CBMs with students with ID is limited in scope as most research commonly focus on early literacy CBMs (e.g., Lemons et al., 2013, Reed et al., 2016). One study has used Maze probes with students with ID to demonstrate generalization with pre-post measurement (Head et al., 2018), but only raw scores were recorded.

Next, intervention fidelity did not account for participant engagement or quality of delivery, which are increasingly important components in determining fidelity of intervention (e.g., Bond et al., 2021, Waltz et al., 2020). As previous discussed, factors like interventionist effects, participant behavior, motivation, and interest impact their engagement in intervention sessions. It is known that individuals with ID's engagement during intervention increases with common modifications (e.g., simplifying language and including visual pictures; Bertoglio et al., 2019), which was completed in this study. Nonetheless, measuring or controlling engagement levels would have resulted in more

decisive evidence supporting the intervention as the primary factor contributing to improved reading comprehension.

Finally, it is important to note that the original study using anaphor resolution intervention found positive effects in performance on this specific skill but did not find that it effected participants' performance on broad reading comprehension measures (Dommes et al., 1984). As a result, this is the first study to evaluate the anaphor resolution's effect on reading comprehension. More research on anaphor resolution is needed to determine whether it is an appropriate instructional target, and studies that explore anaphor's relationship with other reading skills is warranted. For example, does anaphor resolution predict comprehension of the text base, as hypothesized in the discussion. It is essential that studies are designed with rigorous interventions, measures, and inclusion criteria, so that reading research can be applied in a precise and individualized manner for students with ID.

Conclusion

This is one of the first studies to use the CI Model to select and compare reading comprehension interventions for students with ID. The CI Model is a widely accepted model that describes reading comprehension as a bottom-up process starting with background knowledge of concepts and words are integrated with the text represented within sentences and large parts of the passage. These primary components of the model represent three different levels of text representation (i.e., linguistic, text base, and MRT), which is reflected in the interventions utilized. A BEA was used to determine which comprehension level to target, and the participants' reading comprehension exceeded their baseline after receiving the linguistic intervention, anaphor resolution (Dommes et

al., 1984). Explicit instruction and practice of anaphor resolution led to increased performance in both this word level skill and reading comprehension for three high school students with ID. However, they did not maintain their positive trends in the maintenance phase, and effect sizes were variable. Nonetheless, this study addresses many gaps in reading research with students with ID. This study not only provides an appropriate intervention for comprehension, but it goes beyond intervention research as it uses the CI Model to identify multiple skills underlying reading comprehension. Ultimately, this approach to reading intervention illustrates the link between word level skills and comprehension, and uses instruction to break comprehension down into smaller, manageable skills for students with ID. Reading intervention and instruction that supports reading comprehension at multiple levels may be an effective approach to address the specific needs of students with ID. These students face barriers that impact their performance in evidence-based reading instruction (Cihak & Grim, 2018), achievement testing (Afacan, 2018), and post-secondary settings (Chapman et al., 2011; Sanford et al., 2010), and the procedures in this study could be a way to provide adequate reading instruction to support students with ID.

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APPENDIX A: Example of a Researcher Modified Maze Passage

The Time Capsule

One day, when they were both nine, Millie and Pete made a time capsule. They filled an old metal box _____ (around / **with** / in) stuff and buried it in a **secret** place. Two years passed. So much **happened** in the world and in their **lives** since they put that _____ (rock / shovel / metal box) **in** the ground. Millie grew three inches. Pete **got** a dog. Millie's dad found a **new** job and bought a new car. **They** both began writing to pen pals **in** foreign countries. Now it seemed like a **good** time to _____ (dig / listen / catch) up the time **capsule**. They wanted to _____ (compare / list / guess) how they **were** at eleven to how they used **to** be when they were nine. Then **they** would sit down together and write _____ (homework / receipts / **letters**) to their new foreign friends, describing **their** progress on various life goals.

Mille **told** Pete that she had forgotten just what _____ (**they** / it / them) put into the time capsule. **She** remembered a few things, she was **sure**, but not all. It would be _____ (**surprising** / boring / easy) to open it and find out **what** was in it. Pete said that _____ (it / I / **he**) could not remember exactly what they **had** put into the box, either. He **said** it might feel strange to see **these** things that they had not seen **in** two years. Millie found her old **beach** sandcastle set in the back **of** her closet. She and Pete each took **a** plastic shovel and went _____ (out / through / across) into Millie's **back**yard. Pete walked to the base **of** the magnolia tree. Millie walked to **the** weeping _____ (tears / willow / child) about thirty feet away.

"Hey!" **she** shouted. "It's over here!"

"No Way," Pete **replied**. "I know we buried it here."

_____ (We / **They** / It) argued for a bit. Each was **sure** about the

_____ history location kind of the time **capsule**. They used Rock Paper _____ Sand Glue Scissors to **decide** where to dig first. Millie won. **They** spent another hour digging another hole **under** the willow. Nothing. They spent another **hour** digging another hole under the magnolia. **The** capsule wasn't there, either. Five holes **later**, Millie's dad pulled his car into **the** _____ shopping center. road. driveway. He jumped out of the **car** and shouted: "What are you doing?" **Suddenly**, Millie remembered something important about the **day** they _____ stole bought made the time capsule. They had buried it in Pete's yard.

Comprehension target key	
Word level (i.e., vocabulary understanding)	Red text
Sentence level (i.e., use semantic and syntactic information to complete sentence)	Green text
Passage (i.e., integrating information across sentences)	Blue text
Original missing word gaps in Maze (i.e., every seventh word)	**Bolded**

APPENDIX B: Example of the Anaphor Antecedent Identification Test

Text sample	Irena's sister had gotten married that day. If was night now. The wedding reception was still going on. It had turned into a loud dance party.* Irena danced with her father to the loud music. Her father danced in a fast and silly way that made her laugh. He jumped up and down and punched at the air with his fists.* Irena got tired after a while. Then she went back to the table where her mother was sitting. She was hot and sweaty. Her mother picked up a napkin and fanned her face with it.* Irena yawned. She was so sleepy that she forgot to cover the yawn with her hand. Her mother just said, "Why don't you go get some air? It's so much cooler outside."* So, Irena walked out of the hotel onto the lawn. It was night, and crickets were singing. She could see stars, and even the Milky Way. And she could hear waves crashing on the beach across the street from the hotel. She sat down on the grass. A few minutes later, Irena's father came out to fine her. He called her name as he crossed the lawn.* At first, she did not even hear him. The night sky was full of both brilliant and dim stars, amazed her that she'd never looked at it before. It was so big and so expansive! You could not see all of it at once.
Target anaphor & answers	(1) "it" – wedding reception (2) "he" – her father, (3) "it" – napkin, (4) "you" – Irena (5) "her name" – Irena
Example Prompt for anaphor 1	Interventionist: "Stop there please. What word does "it" refer to?" Student: "wedding reception" Interventionist: "Good job!" *OR* Interventionist: "Stop there please. What word does "it" refer to?" Student: "night" Interventionist: "That's not quite right. Let's read those sentences again. … The word "it" is referring to the wedding reception, because she is describing it in a new way."

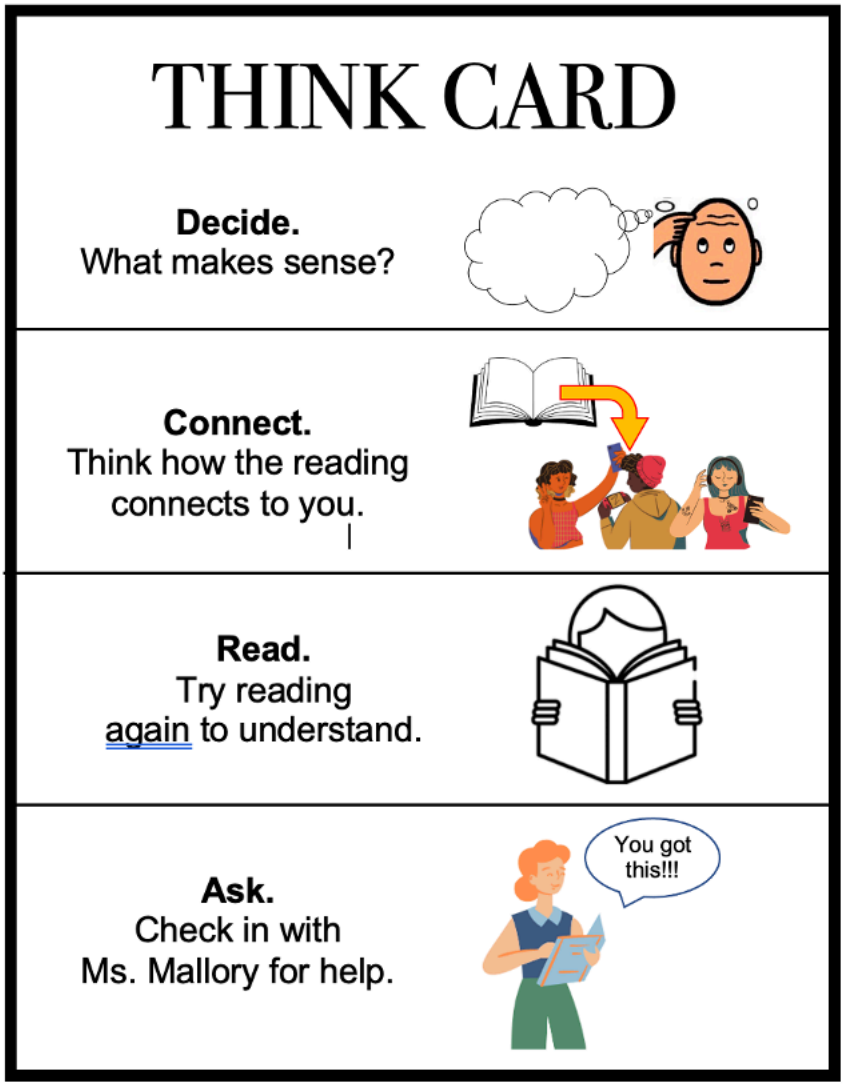
Note. * Indicates points in the passages where the interventionist will ask the student reader to pause. Then the interventionist will deliver a prompt asking the student to identify the word the anaphor refers to in the passage.

APPENDIX C: Example of the *Bridge Inferencing Test* Task

Sentence		
"John has a broken arm from falling off his skateboard last week."		
Picture 1 (incorrect)	Picture 2 (incorrect)	Picture 3 (correct)
		

Note. Material modeled from research procedures by Pike. M. M., Barnes, M. A., & Barron, R. W. (2010). The role of illustrations in children's inferential comprehension. *Journal of Experimental Child Psychology, 105*, 234-255.

APPENDIX D: Example of a Self-Monitoring Cue Card



APPENDIX E: Interobserver (IOA) Reliability Form

(1) ANAPHOR ANTECEDENT TEST

~ Accuracy for 10 examples
- Follow along in the reading passage and score if the student gets them correct or incorrect.
- Divide the number correct by total 10 and multiple by 100

Accuracy=

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(2) DIBELS

NOTE -start a timer when the student starts reading

~ Accuracy for 15 missing words
- Follow along in the reading passage and score if the student gets the missing word correct or incorrect.
- Divide the number correct by total 15 and multiple by 100

Accuracy=

~ Accuracy for reading
- Read along for accuracy in the entire passage
- Word is incorrect if…
    - The student miss pronounces the work
    - Student does not read the word in 3 seconds (unless they are working to complete a missing word)
- Count the number of words correct
- Divide by the total number of words in the passage (listed at the bottom of the page)
- Multiple by 100

Accuracy=

~ Rate (Words Read Correct per Minute)
- Record the time Count the number of words correct
- Calculate the total seconds student read
- Divide correct words by total seconds
- Multiple by 60

Rate=

APPENDIX F: Intervention Fidelity Checklist

Check each box when the interventionist…

BASELINE:
- ☐ Asks the student to read independently
- ☐ Stops the student after 10 minutes

REVIEWS
- ☐ Reviews the subject of a sentence with student
- ☐ Reviews "replacement words" with student
- ☐ Models an example of "replacement words" replacing the subject in a sentence

PRACTICES
- ☐ Practices 1 example
- ☐ Practices a 2nd example
- ☐ Practices a 3rd example

READS PASSAGE
- ☐ Presents the reading passage to student
- ☐ Reminds them of their task (e.g., "I highlighted replacement words in this passage. We will do a few together, and then you will do the rest.")
- ☐ Works through first 3 examples with the student
  - ☐ If the student is correct, praises their works (e.g., "yes that's right!"
  - ☐ If student is wrong
    - ☐ Provides corrective feedback
    - ☐ Asks student to repeat correct answer
- ☐ Guides student through the rest of the 7 replacement words

PROGRESS MONITORING
- ☐ Reviews directions for completing DIBELS
  - ☐ Read every word to make the best answer
  - ☐ Read as fast as you can
  - ☐ If you don't know it, you can skip it or guess
  - ☐ Do your best work
- ☐ Provides reinforcement to student (snack, verbal praise, etc.)

_____ Total check marks from session

*Note. Total possible points for baseline and maintenance = 8, and total possible points for intervention sessions =20.

APPENDIX G: Social Validity Survey

Content	
What is a subject of a sentence? (1 point)	☐ The person that the sentence is talking about ☐ The person, place, or thing that the sentence is talking about ☐ Me
What is a replacement word*? (1 point)	☐ A word that starts with "R" but sometimes can be replaced with words starting with "P" ☐ A word you can use to replace the entire sentence ☐ A word that often replaces the subject in a sentence
Select words that are examples of replacement words (3 point)	☐ summer ☐ you ☐ the student ☐ it ☐ them ☐ through
Select the replacement words someone would use when referring to a group of people (more than 1 person). (4 point)	☐ he ☐ us ☐ we ☐ hers ☐ them ☐ they
Replace the bolded and underlined word. (1 point) *Jim will graduate this semester.* ***Jim*** *is so excited.*	☐ Us ☐ We ☐ He ☐ Them
Replace the bolded and underlined words. (1 point) *Jim will graduate this semester and he is going on a trip with his friends.* ***Jim and his friends*** *are going to go to California.*	☐ Them ☐ Us ☐ He ☐ They
Acceptability	
On a scale of 1 – 6, did you like the replacement word* activity?	I didn't at all. Not even once. 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ I liked it every single time we did it.

Would you continue to practice replacement words if given the chance?	☐ Yes ☐ No ☐ Other: _____
On a scale of 1 – 6, did you like the summary* activity?	I didn't at all. Not even once. 1 2 3 4 5 6 I liked it every single time we did it.
On a scale of 1 – 6, did you like the goal setting and card* activity?	I didn't at all. Not even once. 1 2 3 4 5 6 I liked it every single time we did it.
On a scale of 1 – 6, did you like the fill in the blank* activity?	I didn't at all. Not even once. 1 2 3 4 5 6 I liked it every single time we did it.
Which activity was your favorite?	☐ Replacement words ☐ Summary ☐ Goal setting and card
What did you like MOST about working together?	[open ended question]
What did you like LEAST about working together?	[open ended question]
If you could change anything about our work together, what would you do?	[open ended question]
Usefulness	
How often did you use these skills to do reading activities DURING time with [interventionist name].	I never used my skills. 1 2 3 4 5 6 I always used my skills.
How often did you use these skills to do reading activities OUTSIDE of time with [interventionist name]. For example, in classes.	I never used my skills. 1 2 3 4 5 6 I always used my skills.
Effectiveness	
How much can you recognize replacement words on your own?	I cannot do it at all. 1 2 3 4 5 6 I can do it and get it right every time.
How might your time in reading help you in the future?	[open ended question]
Do you feel like your skill to understand reading passages improved after all our sessions?	☐ Yes ☐ No ☐ Other: _____

How do you know?	
How much do you think you can show other kids how to complete the replacement word activity?	I cannot do it at all. 1 2 3 4 5 6 I can do it and get it right every time.

Note. Language of materials was changed to help students understand what was asked. Replacement words refer to anaphor, and replacement word activity refers to the linguistic intervention. Summary refers to the text base intervention. Goal setting and card refers to the mental representation of text intervention. "Fill in the blank" refers to the researcher modified Maze.

VITA

Originally from Champaign-Urbana, Illinois, Mallory's family moved to St. Louis, Missouri where she was raised and completed early schoolwork. After high school, Mallory attended the University of Missouri -Columbia (Mizzou) where she earned a Bachelor's in psychology as well as minors in sociology, human development and family studies, and art. Before graduating, she worked as a mentor to peers with autism spectrum disorder and other disabilities. This is when her interest in working with this population began. She chose to apply to the School Psychology program at Mizzou to pursue an Educational Specialist degree where she knew she would be able to work with children in special education. In her second year of graduate school, she applied and was accepted to the doctoral program as her interest in research grew. Her research interests include reading intervention with students with disabilities, clinical assessment, and collaborative consultation. In her research career, she hopes to develop a collaborative service model that would allow medical, clinical, and school based stakeholders to provide high-quality care to clients and their families. Mallory is currently completing her clinical internship at an outpatient mental health clinic in Moorhead, Minnesota with plans to complete her post-doctoral fellowship and earn her doctorate in School Psychology in August 2023.