Does a Question Development Strategy Bridge the Social-Pragmatic Inference Gap for Readers with Autism Spectrum Disorders?

by

Seulbi Lee

A dissertation accepted and approved in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

in Special Education

Dissertation Committee:

Gina Biancarosa, Ed. D., Chair

Stephanie De Anda, Ph. D., Core Member

Wendy Machalicek, Ph. D., BCBA-D, Core Member

Kathryn Mills, Ph. D., Institutional Representative

University of Oregon

Spring 2026

© 2026 Seulbi Lee

DISSERTATION ABSTRACT

Seulbi Lee

Doctor of Philosophy in Special Education

Title: Does a Question Development Strategy Bridge the Social-Pragmatic Inference Gap for Readers with Autism Spectrum Disorders?

Narrative comprehension is a critical cognitive process that allows individuals to construct mental models to derive meaning from their experiences. Central to this is social-pragmatic inferencing: the ability to bridge explicit content with implicit social cues, such as character motives and emotions. Individuals with Autism Spectrum Disorder (ASD) often exhibit a detail-oriented cognitive disposition, described by Weak Central Coherence (WCC) theory, which facilitates local processing but often hinders the global integration required for narrative coherence. While visual modalities like graphic narratives are frequently proposed as scaffolds for these readers, research suggests they function as distinct literacies that do not inherently resolve comprehension difficulties. The current study investigated the efficacy of Question Development (QD) intervention on the social-pragmatic inference skills of two elementary-aged students with ASD. It further examined whether different modalities (i.e., text vs. graphic) influenced the integration of world knowledge during the inferential process. Utilizing a nonconcurrent multiple baseline single-case design, the study staggered the introduction of a QD strategy across participants. Visual and statistical analyses demonstrated that the QD intervention successfully improved social-pragmatic inferencing. For Participant 1, the intervention yielded significant functional relations in graphic modality (Tau- $U = 0.850$), whereas the trend lines in text modality showed nearly identical angle across phases with an increasing baseline trend line (Tau-$U = 0.625$). For Participant 2, the text modality showed significant gains (Tau- $U = 0.625$), while the graphic modality showed positive but non-significant movement. Regarding modality, no statistically significant difference was found. This intervention supports student-led inquiry and independence, demonstrating that social-pragmatic learning is accessible across different modalities when the underlying inferential process is targeted. Limitations and future directions are discussed.

ACKNOWLEDGMENTS

My profound appreciation is reserved for my advisor and committee chair, Dr. Gina Biancarosa. Her guidance has not only bolstered my confidence throughout this dissertation and program but has also enriched my journey beyond academia.

I am also profoundly thankful to the distinguished members of my committee, Drs. Stephanie De Anda, Wendy Machalicek, and Kathryn Mills, for their responsive feedback, insights, and support.

My sincere thanks to Drs. Alexander Blum and Neil Cohn, whose ideas and advice have influenced my dissertation project.

I also thank Emily Wilke, who was graciously willing to help code my scoring despite her busy schedule.

Finally, to my best friend, Bongeun Lee, who drew all the visual narrative materials for my study and offered endless moral and emotional support throughout this journey.

DEDICATION

I am forever grateful to all those who have guided and supported me throughout this journey. Their wisdom, encouragement, and unwavering belief in me have been invaluable.

Above all, I dedicate this work to my family, whose faith in my abilities has never wavered, even as I pursued my academic journey abroad for a decade, especially during the challenging process of this dissertation.

To my father, Heunjoo Lee, who has always been there to listen, offering comfort and reassurance, even in the early hours of the morning, never ending a call without making sure I was feeling better;

To my mother, Bokchun Oh, who instilled in me resilience and perseverance, kindled my passion for learning, nurtured my endless quest for books, and taught me the virtue of sharing with others;

To my sister, Hansol Lee, my greatest supporter and lifelong best friend, whose belief in me has been a constant source of strength;

To my fiancé, Daniel Lougen, from the very first to the final word on this dissertation, your love, encouragement, and belief in me have carried me through;

Finally, to my former and future students, my colleagues from UMD and UO, friends from all across the globe, and Seungkwan. So many of you have kept me encouraged, even from across thousands of miles. Your support has meant the world to me, and I could not have achieved this without you.

이 여정을 함께하며 저를 더 나은 길로 안내하고 지지해 주신 모든 분들께 영원히 감사드립니다. 여러분들의 지혜, 격려, 그리고 변함없는 믿음은 저에게 무엇보다 소중한 힘이 되었습니다.

무엇보다도, 이 연구를 저의 가족에게 바칩니다. 해외에서 공부를 이어온 지난 10 년이 넘는 시간 동안, 특히 이 논문을 완성하는 과정에서 저를 믿어 주시고 단단히 지지해주신 마음 덕분에 무사히 끝마칠 수 있었습니다.

언제나 제 이야기를 들어주시고, 새벽에 걸려온 전화에도 위로와 격려를 아끼지 않으시며, 전화를 끊기 전까지 반드시 제 기분이 나아졌는지 확인해 주셨던 아버지께,

저에게 회복탄력성과 인내심을 심어주시고, 배움의 열정을 채워주시고, 끊임없이 책을 찾게 하시며, 가진 것을 나누는 법을 가르쳐 주신 어머니께,

그리고 저의 가장 든든한 지지자이자 평생의 가장 친한 친구, 변함없는 믿음으로 언제나 가장 큰 버팀목이 되어준 내 동생, 한솔이에게,

이 논문의 첫 단어부터 이 마지막 단어를 적는 이 순간까지, 사랑과 격려, 변함없는 믿음으로 지탱해 주었던 나의 약혼자 대니얼 로건에게,

마지막으로, 예전 그리고 앞으로 만나게 될 나의 학생들, 메릴랜드와 오레건에서 만난 동료들과 세계 곳곳에 있는 친구들, 그리고 승관에게. 수천 마일의 거리를 두고서도 저를 응원해 준 여러분 덕분에 여기까지 올 수 있었습니다. 여러분의 지지는 저에게 너무도 큰 의미였고, 여러분 없이는 이 모든 것을 이루어 낼 수 없었을 것입니다.

TABLE OF CONTENTS

CHAPTER I. INTRODUCTION **10**

CHAPTER II. A REVIEW OF THE LITERATURE **14**

UNDERSTANDING NARRATIVE COMPREHENSION 14

Frameworks of Comprehension *14*

Frameworks of Narrative Comprehension Across Modalities *16*

The Significance of Inferencing Skills *18*

How Modalities Affect Inferential Reasoning *19*

Neurodiversity and Narrative Comprehension *20*

CENTRAL COHERENCE THEORY 27

Weak Central Coherence and ASD *28*

Weak Central Coherence and Other Neurodivergence *31*

QUESTION-ANSWER RELATIONS 32

Question Development Intervention *33*

RESEARCH QUESTIONS 34

CHAPTER III. METHODS **36**

THE PRESENT STUDY EMPLOYED A SINGLE-CASE EXPERIMENTAL DESIGN (SCED) TO EVALUATE THE EFFECTS OF THE QUESTION DEVELOPMENT (QD) INTERVENTION ON THE SOCIAL-PRAGMATIC INFERENCING OF ELEMENTARY STUDENTS WITH ASD. SPECIFICALLY, A MULTIPLE-BASELINE DESIGN ACROSS PARTICIPANTS WAS USED TO DEMONSTRATE A FUNCTIONAL RELATION BETWEEN THE INTERVENTION AND THE TARGET BEHAVIORS. 36

PARTICIPANTS AND SETTINGS 36

MEASURES 37

Screening Measures *37*

Descriptive Measures *38*

Outcome Measure *41*

MATERIALS 47

Question Development Intervention Texts *47*

Graphic Organizer *47*

Outcome Measure Narratives *48*

EXPERIMENTAL DESIGN 48

PROCEDURES 49

Screening *50*
Baseline Phase *51*
Intervention Phase *51*
Fidelity of Implementation *52*
INTERRATER AGREEMENT 52
SOCIAL VALIDITY 53
ANALYSIS 53
CHAPTER IV. RESULTS 55
INTERRATER AGREEMENT 55
FUNCTIONAL RELATION BETWEEN QD AND SOCIAL-PRAGMATIC INFERENCE SKILLS 56
Participant 1 ..... *56*
Participant 2 ..... *61*
MODALITY EFFECTS ON WORLD KNOWLEDGE USE FOR SOCIAL-PRAGMATIC INFERENCES 64
Participant 1 ..... *64*
Participant 2 ..... *65*
CHAPTER V. DISCUSSION 67
INTERVENTION EFFECTS 67
MODALITY EFFECTS 71
SOCIAL VALIDITY AND CLINICAL SIGNIFICANCE 74
LIMITATIONS 75
FUTURE DIRECTIONS 78
IMPLICATIONS 80
CONCLUSION 81
REFERENCES 83
APPENDICES 101

LIST OF FIGURES

Figure Page

1. Figure 1 42

2. Figure 2 43

3. Figure 3 57

4. Figure 4 59

5. Figure 5 62

6. Figure 6 66

LIST OF TABLES

Table Page

1. Table 1 46

2. Table 2 50

3. Table 3 56

4. Table 4 60

5. Table 5 63

6. Table 6 65

7. Table 7 65

Chapter I. Introduction

Autism Spectrum Disorder (ASD) has a unique set of characteristics, especially as it relates to a person's way of thinking about, using, and interpreting information as well as communicating socially (American Psychiatric Association, 2013). Success in a neurotypical environment is most often measured in terms of social milestones achieved by children. On the other hand, research indicates that individuals with autism have a strong propensity to think logically and to process details that lead to success in areas such as systems and detail orientation (Baron-Cohen et al., 2009; Happé & Frith, 2006). In addition, this view is supported by the concept of central coherence which points out the tendency for individuals with ASD to favor local processing rather than global (Frith & Happé, 1994). Rather than saying that individuals with ASD lack the ability to comprehend, many of these individuals have a highly unique pragmatic ability to use language in specific contexts and to be very direct and clear in their communication while possibly lacking the nuances of social interaction (Andrés-Roqueta et al., 2020; Cappelli et al., 2022; Deliens et al., 2018). While navigating a neurotypical social environment (e.g., eye contact, turn taking) may require more cognitive energy, individuals with ASD are able to thrive in environments where explicit communication and objective data are valued (Carter et al., 2005; Carter et al., 2005; Marocchini, 2023; Philofsky et al., 2007). The variability in integrating context into an individual's interpretation of a social interaction may affect their ability to connect with others in social interactions and make meaning of those interactions (Blum, 2019; Nuske & Bavin, 2011; White et al., 2004).

In a time of diversity in reading profiles, Solari et al. (2019) utilized latent profile analysis to map the reading profiles of students with ASD. The results indicated four distinct profiles existed. Of the 11 year old readers studied, 18% were classified as having a typical level

of word decoding and comprehension; 24.2% of the readers were identified as having specific reading comprehension difficulties; 23.6% had a pattern of both word decoding and reading comprehension difficulties although they had strong receptive vocabulary; and 34.3% had difficulties in both aspects of reading as well as broader language abilities. Thirty months later, the distribution of the profiles was 31.2%, 18.3%, 29.9%, and 20.6% respectively. The profile analysis clearly showed that while many students with ASD are successful at decoding words, a large percentage of them have a comprehension profile that varies significantly from what would be expected in a neurotypical child.

In order to better promote understanding how students with ASD as they interact with text, researchers could utilize the framework of Question-Answer Relations (QAR). Developed by Pearson and Johnson (1978) and expanded upon by Raphael (1986), relationships between questions and answers exist based on the source of information needed to fill in gaps within a narrative. When both the question and the answer are contained within the same sentence, then the relationship is referred to as text-explicit and requires literal recognition. When the reader needs to synthesize and link two or more propositions located throughout different sentences or paragraphs to create a cohesive understanding of a narrative, then the relationship is called text implicit. Lastly, when the reader cannot find the answer to a question in the text itself, then they need to draw upon their world knowledge and internal scripts to generate an understanding of a story.

The purpose of the current single case research study is to investigate the functional relationship between a QAR-based intervention and the development of social-pragmatic inference skills in students with ASD. This study examines if providing questions can serve as a cognitive scaffold for students with ASD to facilitate their ability to bridge narratives and world

knowledge. The study specifically assesses whether this tool can aid in the transition of inferential success from visual-heavy graphics to traditional text. By studying this transition, the study aims to move beyond deficit-based models of teaching and provide a practical roadmap for teachers to capitalize on the unique pragmatic strengths of learners with ASD.

This dissertation will be divided into five chapters. After the current introductory chapter, Chapter II will synthesize research related to narrative comprehension and the various frameworks associated with. Instead of simply examining difficulties in narrative comprehension among students with ASD, this synthesis will illustrate the unique comprehension abilities of readers with ASD.

Chapter III will outline the single-case experimental design employed to assess the effectiveness of the question development intervention. It will also provide information about recruitment, the narrative content material development, and experiment procedures. Additionally, this chapter will detail the visual analytical methods employed to determine if a functionally relevant relationship existed between the QD intervention and the participants' performance.

Chapter IV will present the empirical findings of the study. The results of the study will be illustrated through the display of data trends for each participant across both the text and graphic modalities. In addition, these results will highlight if the visual nature of the graphics resulted in higher baseline performance and to what extent the QD intervention reduced the performance differences between the two modalities.

Finally, Chapter V will synthesize the empirical results in the context of existing literature and the theoretical frameworks discussed in Chapter II. Specifically, it will interpret how the QD intervention provides a necessary cognitive scaffold for students with ASD.

Furthermore, Chapter V will explore the practical implications for educators to accommodate neurodivergent reading profiles. The dissertation will conclude with an acknowledgment of the study's limitations and suggestions for future research aimed at real-world social-pragmatic inference of students with ASD.

Chapter II. A Review of the Literature

Understanding Narrative Comprehension

Narrative is a form of representation that organizes and gives meaning to experience and allows people to make sense of their world and to share that understanding with others (Bruner, 1991; Graesser et al., 1994; McAdams, 2006; Özyürek & Trabasso, 1997). In any type of narrative, including both written and visual narratives, not all events can be conveyed explicitly; readers should make inferences between sentences, panels, or scenes based on previously provided information and their background knowledge to maintain narrative coherence (Cohn, 2013; Graesser et al., 1994; Hutson et al., 2018; Magliano et al., 2016). Readers' unique social life experiences influence the skills and insights individuals possess for processing social scenarios (Blum, 2019). Consequently, social processing differences, such as those found in ASD, can significantly influence this interpretive process (Blum, 2019; Graesser et al., 1994; Losh & Capps, 2003). This section will discuss frameworks of comprehension in written and visual narratives, distinct patterns of narrative comprehension among readers with ASD, and theoretical insights into these unique processing profiles.

Frameworks of Comprehension

Comprehending a text involves building a mental representation of its content (Perfetti et al., 2005). This construction happens through a series of layered processes that span from individual words to the entire text. These stages involve word identification, the parsing of word strings into constituents, and referential mapping of meaning. Crucially, this mental model is constructed through a variety of inference processes, which serve as the cognitive tools that allow readers to make inferences between sentences or scenes by integrating their background

knowledge, language abilities, and memory processes (Carlson et al., 2022; Compton et al., 2014; Graesser et al., 1994; Trabasso & Magliano, 1996).

According to Kintsch and van Dijk (1978), reading is complex because it involves deriving meaning from interconnected ideas in the text. The construction-integration (CI) model (Kintsch, 1988; 1998; Kintsch & Van Dijk, 1978) explains that readers construct three levels of mental representation for comprehension in memory: the surface structure, the text base, and the situation model. In the CI model (Kintsch, 1988), readers initially form the surface structure by accurately decoding visual information, which remains in memory for only a short time. By connecting decoded information to their knowledge base, readers form the text base, representing the explicit semantic content in memory. Then, by integrating this semantic content with prior knowledge and making inferences to form implicit connections, readers construct the situation model, which represents the overall meaning in memory (Kintsch, 1988).

When readers make the implicit connections within a narrative, they imbue the narrative with coherence of the narrative and make inferences by integrating the information provided to create a detailed understanding (Kintsch, 1988; Trabasso & Wiley, 2005; van Kleeck, 2008). Failing to make connections between information may make the narrative appear fragmented and complicate the understanding of the characters' goals and the story's themes (Blum, 2019; Trabasso et al., 1984; Trabasso & Wiley, 2005). In addition, readers consider events with more causal relations as more important than the events with fewer causal relations (Lynch et al., 2008; van den Broek et al., 1996), and generations of more causal connections result in more accurate information retention (Briner et al., 2012; Wolfe et al., 2005). For learners to fully comprehend narratives, therefore, it is crucial that they can piece together various elements (e.g.,

events that create causes and effects) for a deeper understanding (Briner et al., 2012; Lynch et al., 2008; Trabasso et al., 1984; van den Broek, 1990; van Kleeck, 2008).

Frameworks of Narrative Comprehension Across Modalities

The modern reader (Magliano et al., 2018) engages in diverse literary activities while comprehending and utilizing a range of text-based information products. These products are presented in different formats, including not only text, but also comics, movies, and video games (Magliano et al., 2018). Furthermore, the methods readers employ to engage with these formats and delivery platforms are not uniform but differ based on disciplines (Shanahan & Shanahan, 2008), genres (Bazerman, 2004), and contexts (e.g., educational, social, family, professional; Magliano et al., 2018). Among the different modalities, this section will mainly focus on visual narratives, which involve "sequences of images created with meaningful intent, typically illustrating a continuous event sequence, particularly to tell a story" (Cohn & Magliano, 2020, p. 198).

Magliano and colleagues (2013) developed a framework to explore the extent to which shared cognitive systems support narrative comprehension across both print and visual media. Despite the differences in cognitive and brain systems utilized to encode texts and images (Magliano et al., 2013), they proposed that there might be underlying similarities in how narratives are processed, focusing on constructing mental models (i.e., situation model; Kintsch, 1998) being a central aspect of comprehension across modalities. Magliano et al. (2013) describe front-end processes as the initial extraction and interpretation of incoming visual information to understand the current narrative context, whereas back-end processes involve higher-level cognitive operations such as event segmentation, inferencing, and structure building that organize this information into comprehensive mental representations. Front-end processes vary

by modality (decoding text versus processing visual imagery), but back-end processes show greater convergence across media types. Their framework suggests that while the methods for gathering information differ between text and graphic narratives, the cognitive processes for building coherent mental representations remain largely shared (Magliano et al., 2013). Recent research has supported this framework by demonstrating that the development of comprehension constructs operates similarly across different modalities (e.g., Coderre et al., 2018; Cohn & Kutas, 2015; Cohn & Wittenberg, 2016; Cohn et al., 2012; Magliano et al., 2012; Magliano et al., 2016; Radvansky & Zachs, 2014).

The Parallel Interfacing Narrative-Semantics (PINS; Cohn, 2020) model integrates cognitive processes involved in interpreting sequential images (e.g., comics, picture stories) through the interaction of two primary representational levels: semantics and narrative structure. The semantic level involves extracting visual information from images and activating relevant knowledge from memory to build an evolving mental model of the discourse. The narrative structure level organizes this semantic information into coherent sequences by assigning images to categorical roles within schematic patterns stored in memory (Cohn, 2020). Both levels engage in iterative cycles of access, prediction, and updating that occur continuously throughout comprehension rather than as sequential phases. The model suggests these processing mechanisms are domain-general, as evidenced by similar brain responses across visual narratives, music, and language, indicating shared underlying systems for narrative comprehension across modalities (Cohn, 2020). This parallel processing architecture allows graphic narratives to be processed through both visual-semantic pathways and structural-narrative pathways simultaneously.

The integration of these three models provides a deeper understanding of the complex interplay between cognitive processes and narrative structures in the comprehension of diverse literary formats. The CI model (Kintsch, 1988; 1998; Kintsch & Van Dijk, 1978) provides a foundational understanding of how propositions are encoded and integrated, while Magliano et al. (2013) distinguish between front-end processes (extracting information from the visual stream) and back-end processes (event segmentation, inferencing, and structure building). The PINS model (Cohn, 2020) emphasizes the parallel, iterative interaction between semantic and narrative structural processing throughout comprehension. Together, these models illustrate the multifaceted nature of narrative comprehension and emphasize the construction and integration of mental models as central to understanding narratives across various media.

The Significance of Inferencing Skills

Inferencing, as described earlier, is one of the most fundamental skills in cognition that supports information processing in all areas of everyday life. Inferential processing involves taking provided information (i.e., the actual text) and using prior knowledge to make inferences about information that is not explicit. Kintsch (1998), Oakhill (1994), and van den Broek (1994) discuss how reading is the process of making connections between what is actually written and what you already know. In terms of reading, a skilled reader would use the following sentence: "She grabbed her umbrella and ran outside," to infer that it is raining which is an important connection that is not explicit in the words themselves. Reading performance differences of individuals can also be linked to their inferential processing styles.

Some of the major methods of inferential processing, that will be reviewed in this research study include:

- Causal or Coherent inferences: These are the types of inferences needed to establish the basic coherent relationship among events, sequences, actions to support the cohesive development of the narrative (Trabasso & van den Broek, 1985).
- Elaborative inferences: These inferences, of which causal inferences are a type, are not always required to support comprehension at the moment but are used to enhance the reader's representation by providing additional information and supporting predictions. Elaborative inferences may connect discourse to extra-textual knowledge and may not always be causal (Carlson et al., 2014; McMaster et al., 2012; Rapp et al., 2007).
- Local and global inferences: Inferential activity operates on a continuum. Local inferences (text-connecting) establish coherence between adjacent propositions to maintain immediate flow. In contrast, global inferences (gap-filling) integrate information across the entire discourse to construct macro-level themes or identify the central thesis (Graesser et al., 1994; Long & Chong, 2001).

How Modalities Affect Inferential Reasoning

To determine whether there are differences in how people use general comprehension strategies in order to interpret content from different media, researchers have compared how readers' inference generation can be affected by format and type of content. Ness-Maddox (2022) found that although large correlations were present between the number of inferences generated from text-based narratives and those generated from graphic narratives, the frequencies of specific types of inferences varied based upon the modality of the content. When participants were asked to provide a verbal explanation during think-aloud sessions for graphic narratives, they reported a greater frequency of bridging, anaphoric, and emotional inferences

than did participants who read text-based narratives; conversely, the participants who read text-based narratives provided a greater number of goal statements and more specific story details than did the participants who read graphic narratives (Ness-Maddox, 2022).

Building on the idea that modality shifts the type of inferences generated, Blum (2019) investigated whether these shifts could specifically benefit populations with social-cognitive differences. He challenges the common assumption that simply adding visual elements to a narrative (e.g., comic) automatically improves inferential reasoning. In a study comparing autistic (n = 18) and neurotypical adolescents (n = 112), he found that while participants with ASD initially showed lower performance in Integrative Inferential Reasoning (IIR) within traditional text-only narratives, the introduction of a comic-plus-text format did not universally close this gap (Blum, 2019). Instead, the results revealed that narrative comprehension is not a monolithic skill, but one heavily moderated by the reader's relationship with the medium. The critical factor was comic experience and engagement: autistic individuals who were highly familiar with the comic medium performed at a level comparable to their neurotypical peers across both formats (Blum, 2019). This suggests that for those with ASD, a visual modality is not a "quick fix" for comprehension; rather, it functions as a distinct literacy that, when mastered, can support the high-level integration of story elements. By positioning inferential thinking as a continuum of integration (Blum et al., 2020) rather than a set of discrete 'deficits', this work supports a neurodiversity lens. It suggests that the challenges faced by readers with ASD are not fixed but are instead influenced by the interaction between the structural features of the modality and the reader's unique cognitive disposition (Blum, 2019; Blum et al., 2020).

Neurodiversity and Narrative Comprehension

Autism Spectrum Disorders (ASD)

To better understand and connect with narrative characters, readers must grasp the psychological or motivational aspects behind events or actions (Graesser et al., 1994; Mar, 2004; Rashkin et al., 2018). Understanding the dynamics of agents within a narrative is essential for deeper comprehension, as it helps learners generate causes and motives for narrative events or actions (Graesser et al., 1994; Song et al., 2021). However, individuals with ASD often face challenges in accessing and integrating contextual information in order to relate to characters or construct meanings from narratives (Blum, 2019; Capps et al., 2000; Frith & Happé, 1994).

A meta-analysis of 36 studies comparing students with and without ASD in reading comprehension concluded that students with ASD had more pronounced difficulties with texts requiring a higher level of social knowledge compared to those with lower social knowledge demands (Brown et al., 2013). Specifically, generating causal inferences is often more demanding when the 'cause' is social pragmatic in nature, such as understanding a character's implicit motive or internal state. More studies have revealed slower rates of development in pragmatic and nonliteral language abilities among readers with ASD (Baixauli-Fortea et al., 2019; Whyte & Nelson, 2015). Moreover, they experience difficulties explaining how they use context to make inferences even when they are able to make them (Loukusa et al., 2007).

Loukusa et al. (2018) noted that research has historically compartmentalized social-pragmatic language skills together (e.g., understanding irony, humor, metaphors, idioms) and social perception abilities (e.g., difficulties in recognition of emotion or verbal theory of mind), studying each component independently rather than examining how they work and social perceptions. Nonetheless, considering that pragmatic language usage devoid of social context is unrealistic in real world, it is essential to adopt methodologies that integrate pragmatic and social perception elements in the interpretation of utterances, which can mirror real-life communication

scenarios or narratives where these elements are interwoven (Loukusa et al., 2018). Therefore, in this study, the term social-pragmatic inferencing skill will be used to express how contextual information aids in understanding utterances, intentions, emotions, and beliefs in narratives.

Norbury and Bishop (2002) compared the inferential processing abilities of children with ASD, specific language impairments (SLI), pragmatic language impairments (PLI), and typical development (i.e., controls). Participants were asked to answer comprehension questions about the literal content and two types of inferences: text-connecting and gap-filling. The results indicated that control children significantly outperformed all three clinical groups on story comprehension, though the clinical group means did not differ significantly from each other. However, categorical analysis revealed important within-group variation, with children with HFA being more likely to have specific inferencing difficulties (70% of children with ASD compared to 25% of with SLI and 17% of with PLI). Error analysis showed that while all children could make inferences, children with ASD had particular difficulty making context-appropriate inferences, their inferences were often irrelevant to the story context, supporting the weak central coherence theory. The study concluded that pragmatic difficulties in autism compromise the comprehension process necessary for building stable mental representations of stories.

Siller et al. (2014) provided an in-depth look at narrative production in children with ASD using wordless picture books. Despite equivalent performance on standardized language assessments, children with ASD produced narratives with significantly reduced volume across three measures: fewer total utterances, fewer total words, and a narrower range of unique verbs and adjectives, indicating reduced lexical diversity in descriptive language. Additionally, after controlling for narrative volume, children with ASD used significantly fewer terms describing characters' emotions compared to typically developing controls, though no significant

differences emerged for cognitive state terms. The finding supported the notion that specific patterns in narrative skills among children with ASD may be attributed to divergent ways of interpreting others' internal states (Siller et al., 2014) and set the stage for a more comprehensive understanding of their unique profiles in narrative comprehension.

These findings are reinforced by neuroimaging studies that have explored the neural underpinnings of language processing in ASD. Kotila et al. (2020) used functional magnetic resonance imaging (fMRI) to understand the neural processing differences in young adults with and without ASD while observing complex social events requiring pragmatic communication processing. Similar brain processing patterns were observed between the two groups for most social scenes. However, the study found that the ASD group showed different neural responses in social brain network components during these multimodal communication scenarios. They interpreted this as indicating that individuals with ASD experienced increased processing load or challenges when required to shift perspective between two overlapping communication events, one verbal and one non-verbal occurring simultaneously (Kotila et al., 2020).

The convergence of cognitive, linguistic, and neuroimaging research paints a detailed picture of the intersection between pragmatic language difficulties and narrative comprehension in individuals with ASD. It becomes clear that the skills leveraged for understanding the pragmatic nuances of language are also essential for narrative processing. Thus, divergent patterns in pragmatics are not only relevant in social communication but also shape the ability to comprehend narratives, where understanding others' mental states and the context is pivotal. This overlap emphasizes the importance of considering both the cognitive processes and the pragmatic aspects of language use when addressing the distinctive narrative comprehension profiles of individuals with ASD.

Attention Deficit Hyperactivity Disorder (ADHD)

Recent research highlights that the reading challenges associated with ADHD are often more complex than simple decoding errors. To better understand these nuances, Ghelani et al. (2004) conducted a study on adolescents aged 14-17. They compared groups with reading disability (RD), ADHD, comorbid ADHD+RD, and typical development (i.e., controls). The primary goal was to compare their performance on oral and silent reading comprehension tasks, as well as measures of reading rate, accuracy, and rapid naming speed. Results indicated that adolescents in the RD groups (RD-only and ADHD+RD) exhibited a distinct and divergent performance profile across most reading tasks, specifically showing significant difficulties in isolated word reading and decoding, as well as persistent impairments in reading accuracy, rate, and rapid naming speed. While the ADHD-only group demonstrated adequate single-word reading abilities, they still exhibited subtle weaknesses in text reading rate and accuracy compared to the control group. Interestingly, although overall reading comprehension scores for the clinical groups often fell within the average range, their underlying processing patterns were notably different from the control group.

Martinussen and MacKenzie (2015) study directly parallels Ghelani et al.'s (2004) findings. They examined whether youth with ADHD demonstrate comprehension difficulties compared to matched controls and exploring individual differences within the ADHD group. The study included 87 adolescents aged 13-18 years, with 45 having clinical ADHD diagnoses, who were matched on word recognition ability using standardized assessments. The researchers found that youth with ADHD scored significantly lower than matched controls on reading comprehension measures despite similar word recognition abilities, though mean scores remained in the average range. Path analysis revealed that expressive vocabulary and word

recognition significantly predicted reading comprehension, while teacher-rated executive functions did not account for unique variance. Both expressive vocabulary and word recognition mediated the relationship between ADHD symptoms and reading comprehension. They stated that divergent patterns in comprehension are not typical in ADHD but are most apparent in readers with ADHD who possess certain linguistic profiles such as poor expressive vocabulary (Martinussen & MacKenzie, 2015).

Studies conducted by Landau et al. (1992), Lorch et al. (2000), and Lorch et al. (2004) involved having 7 to 11-year-old children with and without ADHD view two videos. One video included toys, and the other did not include any distractor. Their visual attention was recorded while they viewed the videos. The research reveals a striking dissociation in how attention reductions affect different types of cognitive processing in children with ADHD. Landau et al. (1992) found ADHD boys spent half as much time attending to television when toys were present compared to controls but showed no significant differences in attention or recall of didactic content when toys were absent. Lorch et al. (2000) observed that ADHD boys showed similar cued recall of discrete information units regardless of attention differences, whereas tasks requiring knowledge of relations among events showed impaired recall when attention was reduced.

The ability to make causal connections between events appeared particularly compromised, with comparison children answering significantly more causal relations questions than children with ADHD in studies using video-based narratives. Lorch et al. (2000) observed that when the complexity of a television narrative required an understanding of how different events were interlinked, the attentional difficulties in boys with ADHD hindered their ability to accurately recall the story. Lorch et al. (2004) specifically demonstrated that comparison children

answered significantly more causal relations questions than ADHD children. This pattern suggests that while ADHD children can process surface-level information efficiently, they struggle with the sustained cognitive engagement required to build coherent situation models that connect information across time and establish causal relationships.

More studies have consistently shown students with ADHD struggling with inference-making abilities. Students with ADHD had challenges identifying text inconsistencies (Berthiaume et al., 2010), which suggest difficulties with monitoring the coherence of situational models. In another study, children with ADHD generated fewer essential and coherence inferences compared to peers during story comprehension, with these difficulties appearing both during story processing and during recall (van Neste et al., 2015). Seabra et al. (2023) also found that individuals with ADHD, compared to students with dyslexia, showed better performance in tasks involving decoding and fluency but struggled more with tasks requiring integration of information for comprehension. This pattern suggests that surface-level processing of individual words or simple sentences may be relatively preserved, while higher-order integration and inference processes are more vulnerable to ADHD-related difficulties.

Although children with ADHD recalled more central than peripheral information overall, they showed significantly greater difficulties relative to controls specifically on central information (Miller et al., 2012), which suggests difficulties in identifying and prioritizing the most important elements of texts. This disposition was evidenced by think-aloud protocols. Yeari and Lavie (2021) found that adolescents with ADHD generated fewer responses reflecting deep, efficient text processing and reinstated fewer prior text ideas, particularly central ones, during reading. The proportions of deep processing responses positively associated with performance on

both recall and comprehension tasks, indicating that shallow processing during reading led to poorer subsequent comprehension and memory (Yeari & Lavie, 2021).

The detail-oriented processing pattern of the ADHD group is analogous to the processing dispositions described in the central coherence framework (Frith & Happé, 1994). Viewing ADHD through the lens of weak central coherence enables us to understand why students with ADHD so frequently struggle to bridge the gap between explicit text base information and the implicit social-pragmatic inferences that are necessary for coherent narrative comprehension.

Central Coherence Theory

There has been consistent documentation of a detail-oriented cognitive disposition, such that individuals with ASD and ADHD show proficiency in recognizing patterns and specific details (e.g., Frith & Happé, 1994; Happé & Booth, 2008; Happé & Frith, 2006; Jones & Klin, 2013; Klin et al., 2009; Nuske & Bavin, 2011; Rumpf et al., 2012; Schlooz & Hulstijn, 2014; van der Hallen et al., 2015). In fact, this detail-oriented disposition can hinder their communication abilities and may be related to their difficulties in sensitivity to pragmatics (Jollife & Baron-Cohen, 2000). Also, the narrow "attention tunnel," which refers to the tendency for autistic minds to maintain "only very few simultaneous interests, with each one highly aroused and intensely focused upon," can complicate communication which requires quick processing of diverse sensory and social information (Williams, 2021).

Transitioning to the mechanisms underpinning narrative comprehension, local coherence, which refers to linking contiguous elements within a story, is often managed well by readers with ASD and ADHD (Graesser et al., 1994). However, achieving global coherence, which involves synthesizing these details into a unified theme or concept, often functions as a more effortful cognitive process. These readers may demonstrate a unique pattern when integrating narrative

propositions with their general knowledge to draw broader inferences from narratives (Blum, 2019; Nuske & Bavin, 2011; White et al., 2009). The discussion on the unique narrative profiles encountered by students with ASD who engage with narratives has been grounded in a social cognitive theory, the central coherence framework (Blum, 2019; Frith, 1989; Frith, 2003; Happé & Booth, 2008; Happé & Frith, 2006). Frith (1989) first suggested that the unique strengths and processing patterns originated from a single cognitive source and proposed an imbalance in how information is integrated at various levels as a feature of ASD. This contrasts with typical information processing, where there is a natural inclination to synthesize varied information to form a more complex understanding or "central coherence" (Frith, 1989). Frith and Happé (1994) explained that people typically grasp the main idea of a story effortlessly but exhibit difficulty in recalling exact details, which are less prioritized in memory. On the contrary, individuals with ASD are inclined to pay more attention to local information while showing a specific orientation toward local rather than global coherence.

Weak Central Coherence and ASD

A review of 58 studies (Happé & Frith, 2006) supported the notion of a detail-focused processing inclination (i.e., weak central coherence, WCC) in individuals with ASD. Nonetheless, the review yielded a nuanced finding; it indicated inconsistent outcomes concerning weak central processing, suggesting WCC represents a processing disposition and a tendency to favor local over global tasks (Happé & Frith, 2006). In other words, individuals with ASD can perform global tasks when properly prompted rather than unable to do so (Blum, 2019; Happé & Frith, 2006). Thus, differences observed being reflect a processing disposition rather than a deficit in comprehension (Happé & Frith, 2006).

Further investigation into this cognitive disposition by Happé and Booth (2008) sought to tease apart the elements of local and global processing. They argued that previous research had conflated global processing with local processing, making it difficult to determine whether ASD was characterized by reduced global processing, enhanced local processing, or both (Happé & Booth, 2008). They suggested that distinguishing between these two processing types is crucial for understanding WCC in ASD (Happé & Booth, 2008). They also discussed how enhanced local processing and reduced global integration may represent independent dimensions of WCC by underscoring the importance of revisiting Frith's (1989) notion of reduced integrative processing in ASD and by developing tasks that can independently assess global and local processing (Happé & Booth, 2008).

Nuske and Bavin (2011) examined narrative comprehension in children with ASD using the WCC theory and hypothesized that children with ASD would process inferences differently based upon global vs. local processing (i.e., mental representations vs. deductive reasoning). Consistent with these hypotheses, they found that children with ASD demonstrated fewer script-based inferences than their neurotypical peers; however, no statistically significant differences were found in terms of making deductive inferences. Therefore, these results indicate that there is not always a cognitive advantage in terms of local processing in narrative comprehension (Nuske & Bavin, 2011).

Using the same logic applied to the visual domain, O'Hearn et al. (2011) assessed how individuals with and without ASD detected changes in videos of either a person or an inanimate object moving from one location to another. The results of the study indicated that individuals with ASD did not demonstrate the typical developmental increases in detecting changes in the start and stop points of movements for both video scenes of people and objects. The fact that

similar patterns were not specifically linked to social aspects or the understanding of others' goals, but to a general trend of processing complex visual scenes, may be a result of an individual's tendency to focus on individual elements within a scene as opposed to the total visual scene configuration (Happé & Booth, 2008; Happé & Frith, 2006). This observation is consistent with the tendency noted in students with ASD during reading, known as weak central coherence (Frith, 1989), which is akin to their visual processing bias, where focus is placed on individual elements of a scene rather than on the overall meaning or flow (Happé & Booth, 2008; Happé & Frith, 2006).

A meta-analytic study conducted by van der Hallen et al. (2015), analyzed data from 56 studies, with approximately 1000 participants with ASD to examine local and global visual processing. The results of the meta-analysis found that individuals with ASD displayed slower global processing, however, individuals with ASD also did not display enhanced local processing or inherent limitations in global processing compared to their neurotypical counterparts. However, the results of the meta-analysis indicated that global and local processing are not on the same continuum but rather represent two separate skill sets. Research has suggested that the preference for local processing may arise from the cognitive cost of switching between local and global tasks (Soriano et al., 2018) or simply because of the tendency for stimuli that will only allow one type of processing may be more pleasing for an individual to focus on (Pijnacker et al., 2020). These insights may be helpful in developing more effective intervention methods that build upon the unique detail-focused abilities of individuals with ASD while assisting in developing the ability to integrate and coordinate the necessary skills for global coherence to enhance their narrative comprehension.

Weak Central Coherence and Other Neurodivergence

Recent research has expanded investigation of WCC beyond ASD, demonstrating that the local processing bias occurs across neurodiversity. Gambra et al. (2024) used specialized tasks to assess 252 school children and found WCC cognitive style in children with non-verbal learning disorder combined with ADHD (NVLD+ADHD), social communication disorder (SCD), and ASD. Importantly, children with ADHD alone showed normal global processing, indicating that executive function challenges do not inherently cause WCC. This finding supports earlier evidence that local bias "appears not to be a mere side-effect of executive dysfunction" (Happé & Frith, 2006). The research confirms WCC as a distinct cognitive processing difference that significantly impacts context interpretation and inferencing across several neurodivergent profiles, rather than as a secondary consequence of other cognitive difficulties.

Several studies have suggested that working memory plays a more central role in comprehension difficulties among students with ADHD. Kofler et al (2008) describe working memory as a "core, causal cognitive process" in ADHD. Building on this causal framework, Miller et al. (2013) found that working memory accounted for the most unique variance in how children with ADHD navigate reading comprehension challenges and completely mediated the relationship between ADHD characteristics and central information recall ability.

Empirical evidence shows children with ADHD face significant narrative and comprehension challenges. Zenaro et al. (2019) found that children with ADHD often struggle with structural story grammar elements, particularly maintaining central themes and outcomes, which are fundamental for narrative coherence. Similarly, Jepsen et al. (2025) observed that children with ADHD produced narratives with less overall coherency and more ambiguous references. Miller et al. (2013) identified a "centrality deficit" where children with ADHD

showed disproportionately greater difficulty recalling central versus peripheral information from passages, despite having equivalent word decoding abilities. This suggests specific difficulties in building coherent mental representations that distinguish important from less important information.

However, the role of executive function in these difficulties appears more complex than initially suggested. While Miller et al. (2013) found working memory completely mediated reading comprehension difficulties, Jepsen et al. (2025) found that executive function did not mediate the association between ADHD and narrative language difficulties. Instead, they found that core language skills, rather than working memory, mediated morpho-syntactic errors in narratives. These findings suggest that children with ADHD experience narrative and coherence difficulties (Jepsen et al., 2025; Zenaro et al., 2019), though the underlying mechanisms remain unclear. The evidence points to both working memory (Kofler et al., 2008; Zenaro et al., 2019) and core language (Jepsen et al., 2025) as potential contributors.

Question-Answer Relations

Question-Answer Relations (QARs; Pearson & Johnson, 1978) provides an explicit structure for answering questions, which can be viewed as a cognitive map that guides the reader's attention from focusing on the local aspects of the text to the global integration needed to produce coherent narratives. Instead of requiring the reader to exert a significant amount of cognitive effort to create a coherent mental model by linking local aspects of the text together, QAR prompts the reader to explicitly categorize information into one of three categories: literal, inferential or prior knowledge based.

Pearson and Johnson (1978) highlighted QAR's importance in classroom discussions and assessing reading comprehension. They argued that understanding comprehension requires

analyzing both the question posed and the reader's answers, with the latter revealing how the reader integrates the text's content with their own knowledge (Pearson & Johnson, 1978). Also, studies have shown young readers tend to make more inferences when asked questions (e.g., Omanson et al., 1978; Paris & Lindauer, 1976). Asking questions encourages readers to generate inferences by cueing the connections between relevant information (Graesser & Franklin, 1990; Kendeou et al., 2020). Interventions utilizing the QAR strategy have been implemented in several studies among students in elementary grades (e.g., McMaster et al., 2012), with learning disabilities (e.g., Mason, 2004; Taylor et al., 2002), and with ASD (e.g., Åsberg & Sandberg, 2010; Solis et al., 2016).

These diverse applications are supported by comparative research examining how different questioning frameworks impact student performance. For example, McMaster et al. (2012) compared different questioning interventions (causal, general, and literal wh-questioning) with fourth-grade students and found that all readers made reliable comprehension gains. Furthering the focus on student-led inquiry, Taylor et al. (2002) found that a modified self-questioning strategy was as effective as story mapping for overall comprehension, with students scoring slightly higher on inferential questions in the self-questioning condition. Mason (2004) compared explicit self-regulated strategy development with reciprocal questioning, which improved significantly on oral reading comprehension measures.

Question Development Intervention

Åsberg and Sandberg (2010) investigated the effectiveness of QAR intervention to improve discourse comprehension in students with ASD. In this intervention, students read a story, answered comprehension questions, and classified each question by type. Questions were prompted to answer the questions categorized into three types: literal ("Right there"), inferential

("Reflect and Search"), and knowledge-based or evaluative ("On my own"). The results showed notable improvements in discourse comprehension post-intervention, and most teachers answered they would continue using the same instructional method. This study suggested that explicit, scaffolded comprehension instruction can positively affect discourse comprehension for students with ASD (Åsberg & Sandberg, 2010).

Solis et al. (2016) also employed a QAR-inspired, specifically utilizing the QAR strategy to improve reading comprehension in students with ASD. They reasoned that question development can help provide the necessary cognitive structure for effectively identifying and organizing key points (i.e., Happe & Frith, 2006). Contrary to Åsberg and Sandberg (2010) that had students both answer questions and classify them by question type, Solis et al. (2016) asked participants to develop only literal questions (i.e., who, what, when, and where questions) based on the reading passages. They compared question development alone with question development enhanced by applied behavior analysis (ABA) techniques (i.e., visual supports, token economy system, and use of readings based on students' interests). The results revealed that the QD along with ABA condition produced more immediate and significant improvements in reading comprehension for all participants. In the current study, a QAR-inspired approach was used with students with ASD. Students were prompted to develop three types of questions including literal, inferential, and knowledge-based or evaluative types.

Research Questions

1) Is there a functional relation between the question development (QD) intervention and increased social-pragmatic inference skills in narratives among students with autism spectrum disorders?

2) To what extent does student use of their world knowledge to make social-pragmatic inferences differ across modalities (text v. graphic) prior to and as a result of the question development intervention?

Hypotheses

For Research Question 1, it was hypothesized that the QR intervention would lead to an improvement in social-pragmatic inference skills in narratives among students diagnosed with ASD. It was further hypothesized that the visual analysis of the data would illustrate low and relatively flat levels of inferences during the baseline phase. Following the implementation of the QD intervention, it was expected that there would be an immediate increase in the degree of integration of script-implicit and text-implicit QARs. The intervention phase was expected to display a clear upward trend with limited data overlap between phases, suggesting that systematic questioning enables the reader to integrate local and global elements of the narrative.

For Research Question 2, regarding modality differences, it was hypothesized that participants may initially have a greater frequency of script-implicit inferences when reading graphic narratives compared to text narratives due to visual cue (e.g., facial expression, situational context) scaffolding for social-pragmatic reasoning. It was also hypothesized that the QD intervention would close the initial gap in modalities by enhancing the reader's ability to construct a comprehensive situation model in text narratives. Finally, it was hypothesized that the QD intervention would decrease the difference in modalities, resulting in a more universal and integrated inferential reasoning profile across both graphic and text narratives.

Chapter III. Methods

The present study employed a single-case experimental design (SCED) to evaluate the effects of the question development (QD) intervention on the social-pragmatic inferencing of elementary students with ASD. Specifically, a multiple-baseline design across participants was used to demonstrate a functional relation between the intervention and the target behaviors.

Participants and Settings

The study involved two elementary students who have been diagnosed with ASD and ADHD with either educational or medical diagnosis. Social media (e.g., Instagram, Facebook) were used to share a flyer that included a brief introduction to the study and a QR code caregivers could use to complete a prescreening Qualtrics survey to express their interest in their student's participation. Caregivers of a potential participant were called to confirm eligibility and schedule their sessions. First, they were asked if their child has a medical diagnosis or educational classification of ASD, ADHD, or social communication disorders. To better address research questions, participant eligibility was limited to English monolingual children whose caregiver agreed to participate in a token economy (i.e., applied behavioral analysis procedures) and who did not use augmentative and alternative communications (AAC) devices. A token economy system was prepared based on their caregivers' responses to the current reward system used at home or in educational environments (e.g., a snack of their choice after collecting four stickers). After the pre-screening survey, potential participants and caregivers were invited to a screening session and completed descriptive and screening measures. Approximately 50 Facebook users expressed their interests in participation, and twenty-eight completed the Qualtrics survey. Of 15 screened participants from May to November 2025, two qualified for the

study by exhibiting grade-level decoding but poor comprehension as described later. All sessions were taken in their home environments.

Participant 1 was a male, Asian American 5th-grade student and was diagnosed with ASD. His word reading efficiency, as measured by the TOWRE-2, was at the 99th percentile for his age. In the MOCCA, he was categorized as a paraphraser, which was a critical eligibility criterion for this study. In other words, he had intact word reading skills but struggled with comprehending texts and making inferences. Both his mother's and father's highest education were 4-year degrees. He was screened in August 2025, started baseline sessions the following month, and attended intervention sessions from October 2025 through early December 2025. He liked SpongeBob, talking about traveling to different countries, and pizza as rewards.

Participant 2 was a male, African American 3rd-grade student and was diagnosed with ASD and ADHD. His word reading efficiency scored at the 63rd percentile for his age. In the MOCCA, he was categorized as a paraphraser. His mother's highest education was a professional degree, and his father's highest was a doctorate degree. He was screened in November 2025, started baseline sessions the following week, and attended intervention sessions from January through February 2026. He liked playing with his fidget toys, spending time with family, and playing Nintendo games as rewards.

Measures

Screening Measures

During their screening session, two screening measures were to further determine potential participants' eligibility for the study. The aim was to identify students with adequate word reading abilities but poor comprehension.

Word reading efficiency. The Test of Word Reading Efficiency, Second Edition (TOWRE-2; Torgesen et al., 2012) includes two subtests. Sight Word Efficiency measures the ability to read sight words, and Phonemic Decoding Efficiency assesses the ability to decode "made-up" phonetically regular words. Standard scores are derived from the number of words read correctly on each task and summed up to derive a composite score. Virtual form word cards were used. Participants must score at or above the 25th percentile on the composite measure. The test-retest reliability of TOWRE-2 ranges from .89 to .93, and the interrater reliability is .99 (Tarar et al., 2015). The correlation coefficients for criterion validity of subtest and composite scores fall between .89 and .96 (Tarar et al., 2015). Participants took the TOWRE-2 during the screening session.

Reading comprehension ability. MOCCA is an online diagnostic assessment of reading comprehension that identifies students who struggle with making causal inferences and offers diagnostic classifications to inform instructional practices. The four comprehender classifications are causal, elaborating, paraphrasing, and inconclusive comprehenders (Biancarosa et al., 2019; Davison et al., 2018). Only participants who were categorized as paraphrasing comprehenders continued their participation. Participants took the MOCCA during the screening session.

Descriptive Measures

Two descriptive measures were administered to better describe the participants' visual language fluency and social-pragmatic skills. These measures were completed on their own electronic devices. Parents were given a digital copy to complete through OneDrive where they can edit to mark their responses on the document without saving the form elsewhere.

Visual language fluency. The Visual Language Fluency Index (VLFI; Cohn et al., 2012) quantifies participants' visual language comprehension skills (Cohn, 2014) by having

respondents rate the experience of consuming and creating visual narratives. Both participants and their parents completed this measure during the initial screening session. Then, the average scores were aggregated following the formula (Cohn, 2014):

$(\textit{mean comic reading frequency} * \textit{comic reading expertise}) + (\frac{\textit{comic drawing frequency} * \textit{drawing ability}}{2})$

The adapted VLFI questionnaires (Cohn et al., 2012) are in Appendices F and G. Scores are classified into three tiers: low (≤ 8), average (10–19), and high (≥ 20).

Participant 1's self-reported data results in a VLFI score of 4.75. He reported a low mean reading frequency of 1.25, based on reading comic books occasionally and other formats never. This was multiplied by an average reading expertise rating of 3. He reported drawing comics with a frequency of 1 (never) and a drawing ability of 2 (slightly below average). On the other hand, his parent's assessment results in a VLFI score of 8.0. The parent perceived a higher reading frequency of 2.5, noting the child reads most comic formats sometimes. The parent rated the child's reading expertise as 3 (average) and reported a drawing frequency of 1 (never) with a drawing ability of 1 (below average). The mean score of self- and parent-reported scores for Participant 1 was 5.125, which indicates low visual language fluency.

Participant 2's self-reported data results in a VLFI score of 14.25. He reported a mean reading frequency of 3.75, based on reading comic books and manga frequently, graphic novels sometimes, and comic strips never. This was multiplied by an average reading expertise rating of 3. He reported drawing comics with a frequency of 2 and an average drawing ability of 3. On the other hand, his parent's assessment results in a VLFI score of 12.0. The parent perceived a mean reading frequency of 3.0, noting the child reads graphic novels often but rarely reads manga or comic strips. The parent also rated the child's reading expertise as 3 (average) and reported a

drawing frequency of 2 and a drawing ability of 3 (average). The mean score of self- and parent-reported scores for Participant 2 was 17.5, which indicates average visual language fluency.

Social-pragmatic skill measure. The Social Responsiveness Scale – Second Edition (SRS-2; Constantino & Gruber, 2012) is a 65-item rating scale assessing behaviors associated with autism. SRS-2 was completed by the parent during the initial screening session. It includes five subscales: social awareness, social cognition, social communication, social motivation, and restricted interests and repetitive behaviors. SRS-2 produces two cluster scores, including social communication and interaction (SCI) and restricted interests and repetitive behavior (RRB), that are compatible with DSM-5 scores (American Psychiatric Association, 2013). The SRS-2 demonstrates a high internal consistency with a reliability coefficient (Cronbach's alpha) of 0.95 (Dellapiazza et al., 2022). SRS-2 has a correlation coefficient of 0.68 with Autism Diagnostic Observation Schedule (ADOS-2; Sanchez & Constantino, 2020). Parents completed the SRS-2 while the student is taking the screening measures during the initial screening session.

Participant 1's SRS-2 results indicated a severe level of support needs across all measured domains. The SCI T-score of 104 and the RRB T-score of 92 are both significantly above the clinical threshold (≥76), which indicates a profile characterized by very distinct social and behavioral processing. Specifically, domain-specific scores reflect severe differences in social awareness (T=76), social cognition (T=85), social communication (T=91), and social motivation (T=83). Participant 1's social motivation score falls within the severe range, which suggests a consistent requirement for high-intensity support across both the social-emotional and behavioral components of the assessment.

Participant 2's SRS-2 results indicated a severe level of support needs across most domains. The SCI T-score of 84 and the RRB T-score of 86 both fall well above the clinical

threshold (≥76), which suggests a profile that differs significantly from neurotypical social patterns. Specifically, domain-specific scores highlight severe differences in social awareness (T=92), social cognition (T=85), and social communication (T=93). While social motivation (T=73) was relatively lower compared to other subscales, it remains within the mild to moderate range. These scores collectively align with a clinical diagnosis of ASD and reflect the participant's unique way of perceiving and responding to social cues.

Outcome Measure

When they joined Zoom for the subsequent baseline and intervention sessions, the participant completed two inference tasks, one text- and one graphic-based.

Inference task. Each participant was given a maximum of 24 narratives in each format (i.e., text or graphic), or 48 narratives in total across modalities. The order of these 48 narratives was randomized for each individual, and the order of modality (i.e., text first or graphic first) was counterbalanced across participants and held constant across sessions. By randomizing the order of narratives, the risk that the sequence in which participants receive the stimuli influences their responses was minimized, which reduces bias and enhances reliability and generalizability. Counterbalancing the order of modalities ensured that any differences in inference outcomes due to the order in which modalities (text vs. graphic) are presented is averaged across participants, enhancing the internal validity of the study.

Figure 1

Examples of Graphic Narratives



Note. Illustrated by Bongeun Lee. All rights reserved.

Figure 2

Integrative-Inferential Reasoning (IIR; Blum et al., 2020) Map Adapted with a New Scenario

Scenario: Jinny looks stressed while flipping through her notes. Satomi comes and asks, "Do you need help? I can explain it." Jinny nods. Satomi sits next to Jinny and starts explaining the topic.					
Level	**Degree of Integration**	**Motivational Inference**: Why did Satomi offer to help Jinny study?	**Meta-Reasoning**: What made you think of that answer?	**Evaluative Inference**: What lesson could someone learn from this story?	**Meta-Reasoning**: What made you think of that answer?
Level 3: Combination (Local + Global)	**Text + Script Explicit:** Combines specific text details with internal schemas	**State + Emotion:** Because Satomi is a kind friend **AND** she saw Jinny flipping through her notes looking stressed, so she knew Jinny was struggling.	**World + Text:** My teacher says friends should support each other when they see someone in distress **AND** the story says Satomi saw her looking stressed and asked to help.	**Thematic + Causal:** Helping others reduces their anxiety **AND** Satomi sat down to explain the topic because Jinny nodded and needed it.	**Memory + Text:** I remember when a tutor helped me feel better before a test **AND** the text shows Jinny was stressed until Satomi offered to explain.
Level 2: Script-Implicit (Global)	**Script Explicit / Text Implicit:** Relies heavily on social norms/scripts	**Thematic:** Because helping a peer in need is the right thing to do. **Superordinate Goal:** Because Satomi wanted to help Jinny succeed and feel less overwhelmed. **State:** Because Satomi is an observant and empathetic person. **Character Emotional Reaction:** Because Jinny looked like she didn't understand her notes. **Causal Antecedent:** So that Jinny wouldn't have to	**World Knowledge:** My parents told me that if you see someone struggling with work, you should offer a hand.	**Thematic:** You can learn that a small offer of help can make a big difference in someone's day. **Superordinate Goal:** We should always be aware of our friends' emotions and offer support when they look stressed. **State:** This story teaches that being a supportive classmate is a positive character trait. **Character Emotional Reaction:** You can learn that making someone feel supported makes you feel like a good friend too.	**Personal Experience:** I felt panicked during a math project once and a classmate sat with me to explain it, just like Satomi did.

		study alone while feeling stressed.		**Causal Antecedent:** If someone is flipping through notes and looks upset, it's a sign they might be confused by the material. **Causal Consequence:** Being helpful is how you build strong, supportive friendships.	
Level 1: Text-Implicit (Local & Referential)	**Script Absent / Text Explicit:** Relies only on what is literally happening in the scene	**Thematic:** Because the text says you can ask "Do you need help?" when someone is flipping through notes. **Superordinate Goal:** Because Satomi wants to explain the topic to Jinny. **State:** Because Jinny looks stressed while flipping through her notes. **Character Emotional Reaction**: Because Jinny nods after Satomi asks her a question. **Causal Antecedent:** Because Satomi comes over to where Jinny is looking at her notes. **Causal Consequence:** So that Satomi can sit next to Jinny.	**Text-Base:** The story says Jinny is flipping notes and Satomi asks, “Do you need help?”	**Thematic:** That when someone nods to a question about help, you should sit and explain. **Superordinate Goal:** That Satomi's goal is to explain the topic to the person who is stressed. **State:** That Jinny is a person who flips through notes while looking stressed. **Character Emotional Reaction:** That Jinny reacts to Satomi by nodding her head. **Causal Antecedent:** That Satomi asks if Jinny needs help before she sits down. **Causal Consequence:** That the result of Jinny nodding is Satomi explaining the topic.	**Text-Base:** Because the text states Satomi asks, “I can explain it” and then she starts explaining.
Level 0: No inference	**Absent:** No connection to text or script.	"I don't know" or "Because she was bored."	"I just thought of it."	"You should study hard."	“I don’t know” **OR** irrelevant

Each probe was displayed on the screen, assessing inferential reasoning involving moral and ethical issues such as sharing, helping, cheating, and stealing. Following the narrative shown by each sentence or panel on the screen, participants were given prompts requiring inferential reasoning. For example, given the first narrative from Figure 1, participants were prompted to answer a motivational inference question (e.g., "Why did Satomi offer to help Jinny study?"), an evaluative inference question (e.g., "What lesson could someone learn from this story?"), and two meta-reasoning questions (i.e., "What made you think of that answer?").

In the IIR (Blum et al., 2020), at the lowest level (i.e., Level 0: No Inference), there is no integration of script or text-based information, and responses might be irrelevant or simply "I don't know." Level 1: Text-Implicit involves explicit text-based reasoning without integrating broader script knowledge. Responses are based on explicit details from the text itself, such as recognizing that asking if a friend needs help is good but not connecting this with broader themes or knowledge. Level 2: Script-Implicit includes explicit script-based reasoning while text-based reasoning is implicit. This level involves integrating broader knowledge about themes like "a small offer of help can make a big difference" or the superordinate goal of being nice even though such connections are not directly stated in the text. The highest level (i.e., Level 3: Combination) requires both text-based and script-based reasoning to be explicit. It combined specific details from the text with broader world knowledge, resulting in a deeper understanding and using conjunctions (e.g., because) in responses.

The task was audio-recorded for transcription and coded based on the IIR (Blum et al., 2020; see Figure 2) by two graduate students. Each inference generated was coded by the cognitive process, degree of integration (i.e., implicit or explicit at text-based and script-based levels), and level of associated coherence (i.e., levels 0 through 3), as shown below in Table 1.

Table 1

Example of Coding Sheet

Answer 1	Score 1	Rationale 1	Answer 2	Score 2	Rationale 2	Answer 3	Score 3	Rationale 3	Answer 4	Score 4	Rationale 4
Maybe because so Jinny can feel better and get a good grade maybe next time.	2	Script-Implicit: Infers a goal (grades/success) based on a general educational script.	She literally came to Jim Jinny and said, do you need help?	1	Text-Base: Direct quote from the story text.	Maybe sometimes help your friends when they're having trouble with getting a good grade	2	Script-Implicit: Focuses on a superordinate goal (academic success) found in school scripts.	When she said that 'Do you need help? I can explain it.'	1	Text-Base: Points directly to a specific quote in the text.
Because maybe she knew that Samira had to tell something important	2	Script-Implicit: Infers a social motive based on a script about the importance of information.	Good	0	Irrelevant: Does not explain the reasoning process.	To be kind	1	Script-Implicit: Applies a general moral value (State/Trait) to the story.	Okay	0	Irrelevant: Does not explain the reasoning process.
Because Victor was feeling lonely	2	Character Emotional Reaction: The text says he "doesn't know anyone," but the student infers the internal state of "lonely" (Script-Base)	Victor is feeling lonely and he's new to the school.	2	Script-Implicit: Uses world knowledge to explain that being new equals being lonely.	You could invite people if you can invite people to sit with you. If someone is feeling new and they don't have anyone to sit next to, you can invite them to play or do something with you.	2	Superordinate Goal/Personal Experience: Justifies the lesson by citing a general social practice and social knowledge about including others.	Victor's new and Caleb invites him to sit with his group.	1	Text-Base: Reverts to the explicit text to justify why they thought of the lesson.

Materials

Question Development Intervention Texts

Frog and Toad Are Friends (1970), *Frog and Toad Together* (1972), *Frog and Toad All Year* (1976), and *Days with Frog and Toad* (1979) by Arnold Lobel were used as intervention texts. Frog and Toad books each contain five simple stories about interactions between the two characters, and the reading levels are on the second-grade level (Lexile 380 – 480). Despite their simplicity, these books provide rich content from which to elicit social-pragmatic inferences.

Graphic Organizer

In addition to the intervention texts, Appendix H presents an intervention graphic organizer designed to support participants in structuring their questions. This material is structured to help forming three types of questions (Åsberg & Sandberg, 2010):

1. Right There questions that are literal questions (i.e., who, what, when, and where questions),
2. Think and Search questions that require information to be found in more than one place and put together, and
3. Author and You questions that require participants to answer inferential questions by making connections between what they read and what they already know about the topic.

During intervention sessions, one full monitor was shared via Zoom, with a scanned book on the left side and the graphic organizer on the right side. Participants were able to access to the graphic organizer throughout the intervention.

Outcome Measure Narratives

All inference task materials were developed for the dissertation study purpose only. An outline for each narrative was written first, followed by the text version of the narrative, and then shared with the illustrator with brief scenarios for the graphic versions. There were six themes of narratives included: offering help (e.g., helping someone carry heavy books), social inclusion and group participation (e.g., inviting a peer to play), emotional support and comforting (e.g., noticing a peer is sad and offering kind words), resource sharing (e.g., sacrifice or sharing), academic help (e.g., explaining a difficult math problem), and collaborative cooperation (e.g., teamwork, task completion).

Text narratives were written at a second-to-third-grade readability level using the Flesch Kincaid readability grade-level formula. Graphic narratives included two to three essential components (e.g., character's facial expression, hand gestures) and two to three distractors that were unrelated to inference generation (e.g., a kid in the background who is not involved in conversations with the main character, cars in the background) per panel. These narratives were developed based on Cohn's (2007) narrative grammar theory, meaning each narrative included establishing acts, initiating acts, peaks, and releasing acts (Cohn, 2007). Appendices I and J include the randomized and counterbalanced order of narratives and modalities.

Experimental Design

A multiple baseline (MB) is a type of single-case experimental design (SCED) that evaluates the effects of an intervention by staggering its introduction across different participants, settings, or behaviors to establish a cause-and-effect relationship (Ledford & Gast, 2018). Specifically, a nonconcurrent multiple baseline (NCMBD) single-case design across participants was utilized, a choice often necessitated by recruitment difficulties. Supporting this,

Morin et al. (2024) found that of the studies specifying a rationale for adopting a nonconcurrent design, 20% cited difficulty recruiting participants, despite most studies not explicitly stating their reasons. In contrast to traditional MBDs, Levin and Ferron (2021) and Kratochwill et al. (2022) argue that NCMBDs improve external validity by allowing researchers to assess if intervention effects generalize across different points in time. Furthermore, Morin et al. (2024) indicated that NCMBD may be especially beneficial and useful in special education research, considering ethical issues (e.g., delays in the intervention) and access to participants (Kazdin, 2021).

Baseline durations varied for each participant, with Participant 1 remaining in the baseline phase for 10 sessions and Participant 2 for 12 sessions. This design allowed for the demonstration of a functional relation by showing that changes in the target behavior occur only after the introduction of the intervention at different points in time.

Procedures

Each participant attended a virtual meeting twice weekly for twelve weeks, excluding an initial screening session. A minimum of 6 data points were collected for each tier (equivalent to at least three weeks of baseline). Table 2 shows the order of task administration and duration in minutes across phases.

Table 2

Order of Task Administration and Durations

Phase	Task	Duration (minutes)
Screening	Consent and assent forms	5
Screening	TOWRE-2, MOCCA (completed by participant)	20
Screening	Demographic questionnaire, SRS-2 (by parent)	20
Screening	VLFI (by both participant and parent)	5
Baseline	Inference task (a set of one text, one graphic narratives)	10
Intervention	Introductory lesson (first intervention session only)	25
Intervention	Intervention	20
Intervention	Inference task (a set of one text, one graphic narratives)	10

Screening

The day before the initial screening session, instructions on how to set up for a virtual meeting and complete the forms that were shared through OneDrive on their electronic devices. During the screening session, TOWRE-2 was virtually administered at the beginning of their first session, and participation was discontinued if a participant did not score at or above the 25th percentile on the measure. Otherwise, participants moved onto the next measure, MOCCA. Participants had to be categorized as paraphrasing comprehenders to continue their participation. While potential participants were given screening measures, parents also completed SRS-2. At the end of session, both parents and potential participants were given VLFI. No clinical diagnosis or treatment recommendations based on descriptive or screening measures were provided

because these results were solely for research purposes and not intended to substitute for professional evaluations.

Baseline Phase

During the baseline phase, participants read narrative passages (both text and graphic formats) and were prompted to answer four inferential questions per narrative. No instruction or feedback was provided during this phase to establish an unassisted baseline for their inferencing skills. Participant 1started the intervention after four weeks, and Participant 2 began the intervention after six weeks, based on the tiers they were randomly assigned before starting the procedure.

Intervention Phase

The QD intervention began with a 25-minute strategy introductory lesson, developed by Solis et al. (2016) and adapted in Grade 2 reading level. This lesson included three phases of explicit instruction (Archer & Hughes, 2011): modeling, guided practice, and independent practice. After the lesson, participants read a selected section of text aloud then used a graphic organizer to generate questions at each predetermined stopping point. The QD intervention focused on the three types of questioning (Åsberg & Sandberg, 2010). If participants experienced difficulty forming questions, the interventionist modeled the process by highlighting key details in the text and demonstrating how to turn that information into a question. After this modeling, the participants attempted to generate another question independently. Participants completed each of text and graphic narrative inference task at the end of each intervention session (i.e., after one passage).

Participants earned tokens of their favorite emojis for desired behaviors (i.e., staying engaged) as well as behavior-specific praise for appropriate and engaging behaviors during

independent practice. Every 4 tokens were exchanged for a tangible reward related to their interests, which parents identified during an initial screening session. Parents were notified when they earned four tokens and awarded these tangible rewards.

Fidelity of Implementation

An implementation validity checklist was completed for each session. The fidelity checklist addresses instructional procedures, use of materials, verbal praises, and a token economy. For each session, the interventionist recorded whether each procedural step was observed or not observed. Fidelity was calculated by dividing the number of observed steps by the number of planned steps, resulting in a mean implementation fidelity of 98.9% (range = 91–100%). Participant 1's mean fidelity across 19 sessions was 98.7%, and Participant 2's mean fidelity across 17 sessions was 99.1%. The template is attached in Appendix K.

Interrater Agreement

To ensure the objective assessment of the scripted responses and to minimize rater bias, the following procedures were implemented:

- Independent Scoring: The second rater conducted a secondary review of 100% of the data once data collection was completed by the first rater. While the chronological order of the responses was maintained within each participant's record to preserve the context of the scripted interactions, all indicators of phase transitions (e.g., labels for Baseline or Treatment) were removed. The second rater was provided only with anonymized participant identification numbers.
- Weighted Kappa and Agreement: Reliability was calculated using weighted Kappa (κ) to account for the magnitude of disagreement in the subjective scoring rubric.

Additionally, exact agreement (%) and adjacent agreement (%) within 1-point difference were calculated to demonstrate the consistency of judgment direction.

- Full Data Coverage: In accordance with the What Works Clearinghouse (WWC; 2022) 5.0 requirement for a minimum of 20% inter-rater agreement (IAA) data, this study exceeded the standard by performing a 100% census scoring ($N = 288$) of all data points across all participants and phases.

After the independent scoring process, any discrepancies between the two raters were resolved by reviewing the scripted responses against the scoring rubric until 100% agreement was reached. These finalized, consensus-based scores were used for all subsequent visual and statistical analyses.

Social Validity

The social validity of the intervention was evaluated through a 10-item Likert-scale survey. This survey focused on three primary domains: perceived effectiveness, usability, and enjoyment of the lessons. Upon completion of the intervention, participants were asked to rate their experience on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The survey was intended to capture the participants' subjective perspective on the feasibility and instructional value of the intervention. Appendix L shows Participant 2's completed survey. Participant 1 did not complete the survey.

Analysis

The levels of social-pragmatic inferences made during the narrative task were analyzed using visual analyses to examine the effectiveness of QD intervention. Coded responses were graphed in R (R Core Team, 2025) as well as reliability calculation. Data patterns were analyzed for trend, level, stability, and consistency within conditions, and for trend, level, stability,

immediacy, overlap, and consistency across conditions (Kratochwill et al., 2013; Lane & Gast, 2014). Tau-U non-parametric effect size measure was used for effect size to account for both level and trend changes across phases, using Tau-U calculator web-based application from singlecaseresearch.org (Vannest et al., 2016).

Chapter IV. Results

The primary objective of this study was to evaluate the efficacy of Question Development (QD) intervention on the social-pragmatic inference skills of students with autism spectrum disorder (ASD). Prior to addressing the core research questions, this chapter details the interrater agreement protocols and the consensus-building process employed by coders. Visual analysis and statistical measures were employed to determine if a functional relation exists between the intervention and narrative inference performance across two modalities: text and graphic. Visual analysis of the data was conducted first to evaluate level, trend, and variability, followed by the calculation of Tau-*U* effect sizes to quantify the magnitude of change.

Interrater Agreement

Inter-rater agreement results are summarized in Table 3. The overall weighted Kappa (κ) for the study was 0.623 ($p < .001$), meeting the WWC (2022) threshold of 0.60 for a Meets Standards rating. Individual weighted Kappa values for the four prompts ranged from 0.536 to 0.621. Prompts 2 and 4 (i.e., meta-reasoning question: *what made you think of that answer?*) showed relatively lower Kappa values ($\kappa = 0.540$ and 0.536, respectively), which may be attributed to the distribution of scores within those specific tasks rather than a lack of coder consistency. All prompts demonstrated high adjacent agreement (90.28% to 98.61%), confirming that discrepancies between raters were minimal (typically within one scale point). Prompt 3 exhibited the highest reliability ($\kappa = 0.621$) and the highest adjacent agreement (98.61%), demonstrating strong consistency in scoring. Consistent with the overall study protocol, any discrepancies in all 288 data points were resolved through a consensus-based process to reach 100% agreement for the final analysis.

Table 3

Interrater Reliability (Weighted Kappa, Exact, and Adjacent Agreement)

Prompts	N	Exact (%)	Adjacent (%)	Weighted κ	*p*
1	72	63.89	95.83	0.578	< .001
2	72	77.78	90.28	0.540	< .001
3	72	54.17	98.61	0.621	< .001
4	72	72.22	90.28	0.536	< .001
Total Aggregate	**288**	**67.01**	**93.75**	**0.623**	< .001

Functional Relation Between QD and Social-Pragmatic Inference Skills

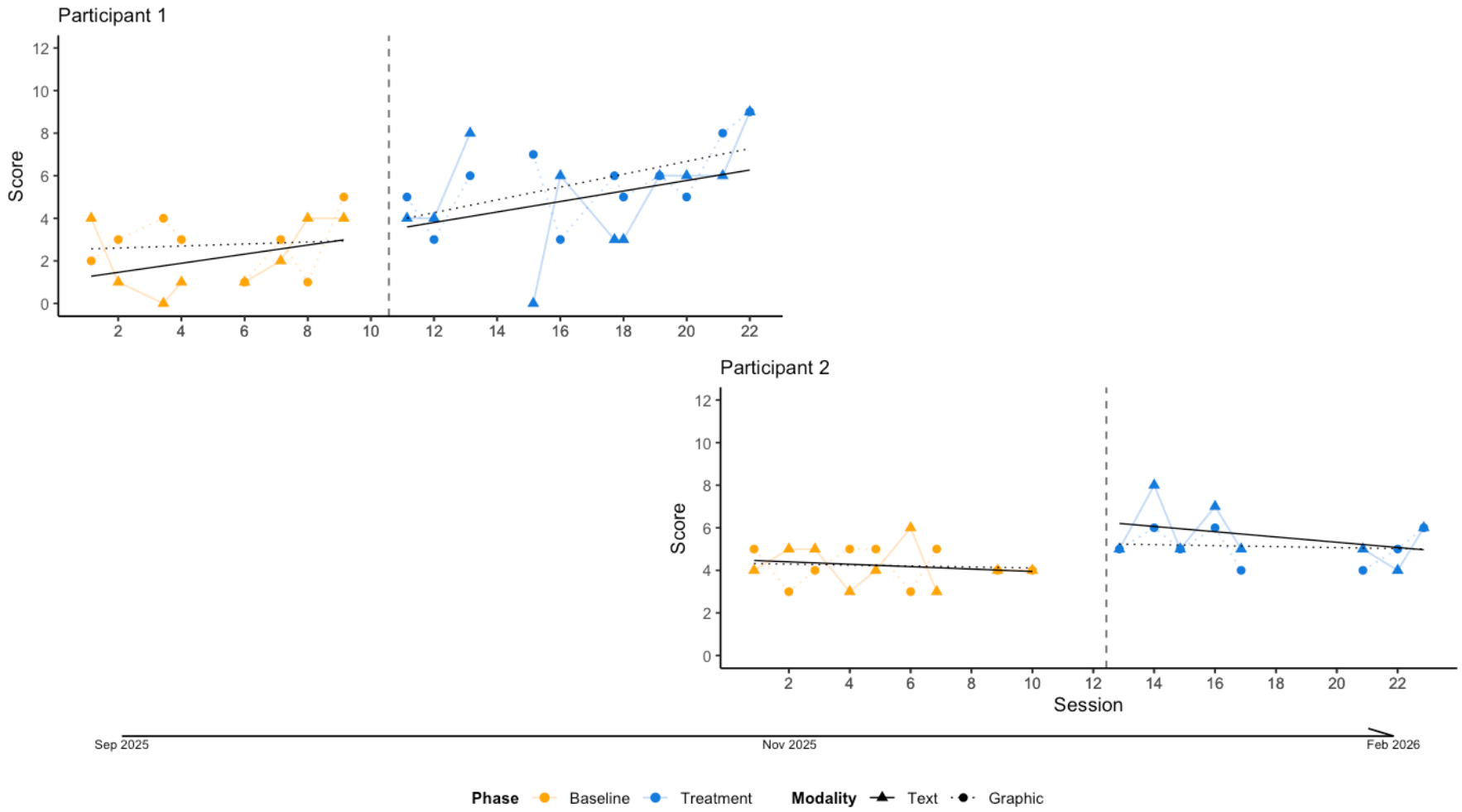
To provide a comprehensive visual analysis of the single-subject study data for Participants 1 and 2, the following paragraphs describe the functional relations, trends, and modality comparisons observed across the baseline and treatment phases.

Participant 1

Visual Analysis. Participant 1's scores reached higher levels following the introduction of the treatment, but the causal relationship between the intervention and this improvement remains ambiguous. In the baseline phase, scores for both modalities remained relatively low and unstable, generally ranging 0 – 6. Notably, the text modality already exhibited an upward trend prior to the start of the intervention. Upon the introduction of the treatment at Session 11, there was no immediate shift in performance; the initial two data points in both modalities overlapped with the baseline range. While scores from Session 13 onward eventually surpassed those observed in the baseline phase, the intervention merely appears to have replicated and continued the pre-existing increasing trend seen in the text modality. Therefore, it is difficult to definitively attribute the higher average scores to the intervention itself, as the improvement may reflect a continuation of the baseline trajectory rather than a distinct effect of the treatment.

Figure 3

Integrative Inferential Reasoning (IIR) Scores on Text and Graphic Narratives



Note. Closed circles and dotted lines represent the graphic modality, while triangles and solid lines represent the text modality. Vertical dashed lines indicate the transition from the baseline to the treatment phase. Thin lines across each phase represent mean score trend lines for each phase and modality.

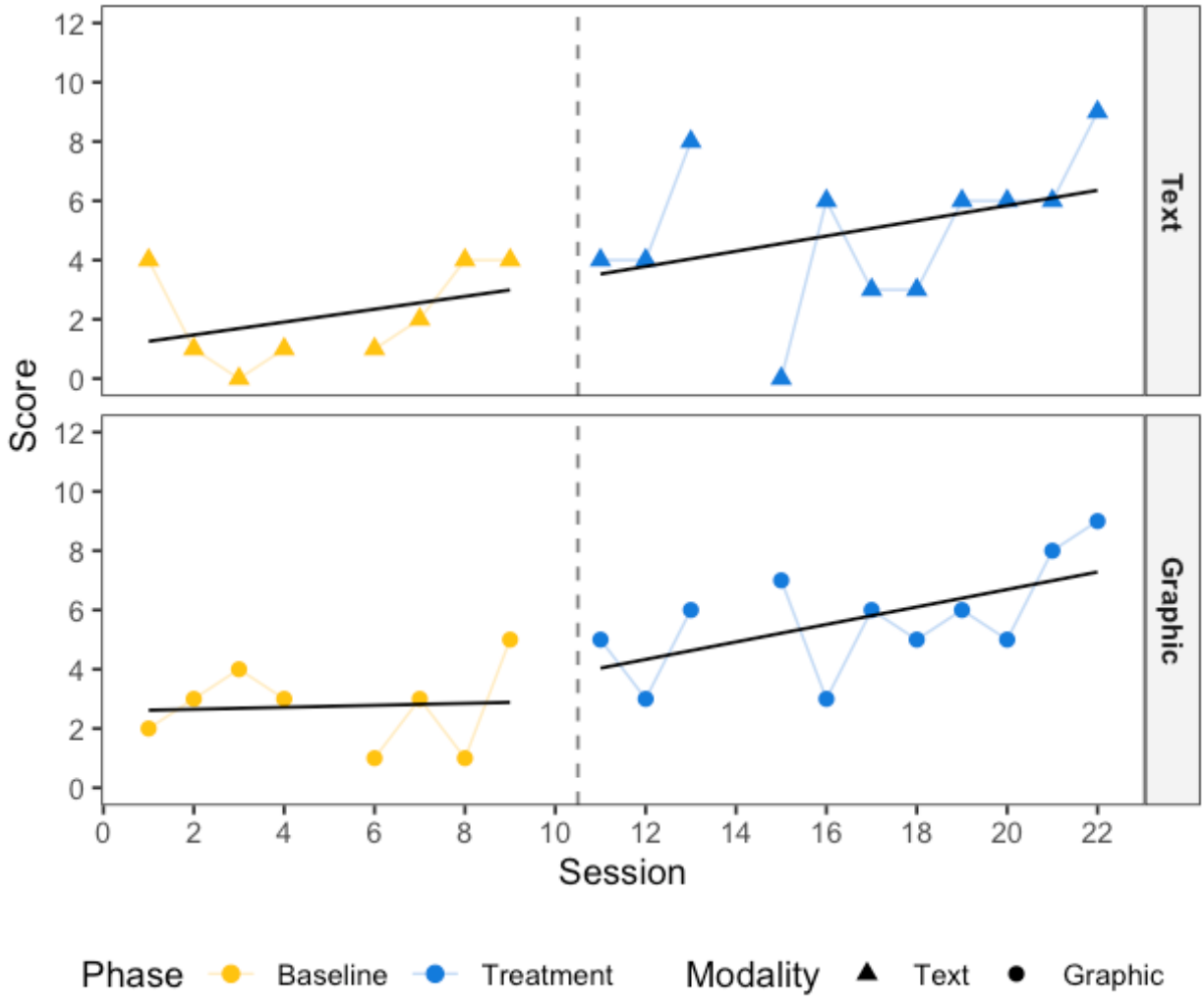
Figure 4 shows Participant 1's scores in each modality. The treatment phase is characterized by significant variability, including most notably a sharp, temporary drop in the text modality score to zero at Session 15, after a missing session. However, the overall regression lines for both modalities show a positive trend. By the final session, both modalities reach their peak value of 9.

Effect Size. The hypothesis that students with ASD would exhibit increased social-pragmatic inference skills following the QD must be interpreted with caution. While initial Tau-*U* analysis indicated statistically significant improvements for Participant 1, yielding a Tau-*U* of 0.625 ($Z = 2.271$, $p = 0.023$) for the text modality, this metric must be viewed alongside the visual data. Because the baseline phase for the text modality displayed a clear, pre-existing upward trend, the application of Tau-*U* is potentially misleading. In the presence of a baseline trend, a standard Tau-*U* calculation can inflate the perceived effect of an intervention by failing to account for the trajectory already in motion. Given that the intervention phase appears to have simply continued the trend already established during the baseline, the calculated 62.5% non-overlap does not necessarily represent a distinct functional relationship caused by the QD intervention.

On the other hand, the graphic modality demonstrated a more robust effect on this participant. The contrast between the graphic baseline and treatment phases resulted in a Tau-*U* of 0.850, indicating an 85% non-overlap. This improvement was highly significant ($Z = 2.931$, $p = 0.003$), suggesting that the graphic modality may have provided a particularly strong scaffold for Participant 1's social-pragmatic inference.

Figure 4

Participant 1's Scores on Text and Graphic Narratives



To further quantify the magnitude of these effects, Table 4 presents a comprehensive statistical summary of the phase contrasts for Participant 1 across both modalities. This data includes the S statistics, standard deviation (SD), and the resulting *Z* and *p*-values, which collectively substantiate the functional relationship findings. By examining these indices, the distinct advantage of the graphic scaffold over the text-based condition becomes empirically evident, which provides a clear numerical basis for the improvements observed during the treatment phase.

Table 4

Tau-U Analysis Results for Participant 1's Intervention Effect

Modality	S	Pairs	Tau-*U*	SD	*Z*	*p*
Text	55	88	0.625	24.221	2.271	0.023
Graphic	71	88	0.850	24.221	2.931	0.003

Note. Tau-*U* calculation for text modality should be interpreted with caution as the assumption of a stable baseline required was violated.

Participant 2

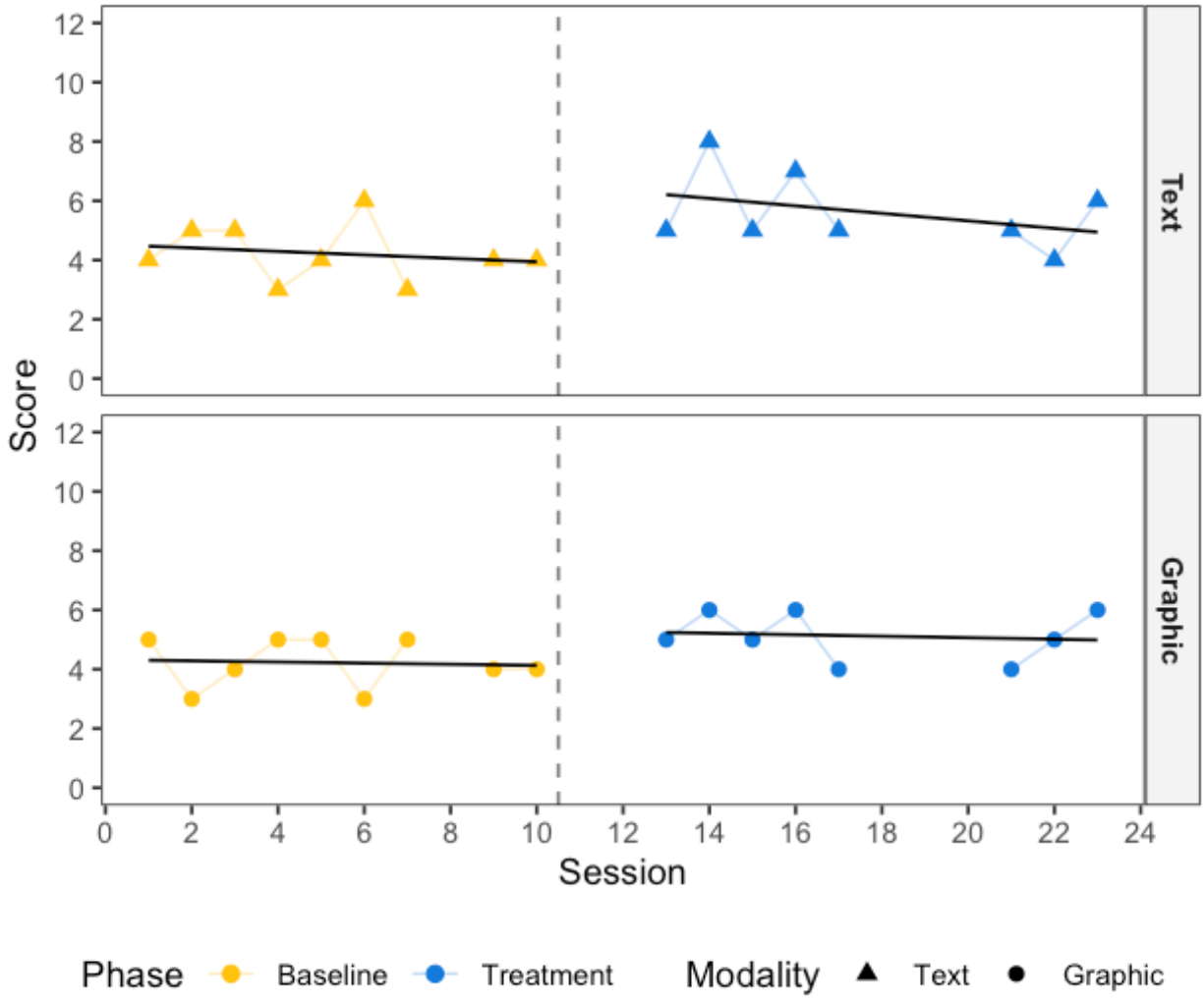
Visual Analysis. Figure 5 shows Participant 2's scores in each modality. Visual analysis of Participant 2's data reveals a relatively stable baseline phase for both modalities. During the first ten sessions, his scores for both text and graphic tasks fluctuated between 3 and 6, showing a slight downward trend. This lack of an improving baseline suggests that without intervention, the participants were unlikely to show spontaneous improvement. The overlap in scores between the two modalities during this phase indicates that, initially, the participant performed similarly regardless of whether the information was presented as text or a graphic.

Upon entering the treatment phase at session 13, there is a visible but inconsistent level shift. The text modality reaches its peak score of 8 in session 14, which is higher than any score achieved during the baseline. However, this peak is not maintained, as scores eventually drop back to 4 and 6 in later sessions. The graphic modality shows a more modest increase, with scores primarily clustering around 5 and 6. While there is a slight upward shift in the average performance during treatment, the regression lines for both modalities show a negative slope, suggesting that the initial gains from the intervention may have diminished over time due to the long term of missing sessions. During his intervention phase, school has shut down due to snowstorms, he was not on his regular school day schedule, which may have affected his behaviors at home.

Finally, *p*-values provide mathematical confirmation of these results. *P*-value for the text modality ($p = 0.154$) is well above the standard 0.05 alpha level, indicating that the observed changes are likely due to chance rather than the intervention itself. The graphic modality ($p = 0.060$) is much closer to the threshold of significance but still does not reach a level of statistical confidence.

Figure 5

Participant 2's Scores on Text and Graphic Narratives



Effect Size. The hypothesis that students with ASD would exhibit increased social-pragmatic inference skills following the QD intervention was partially supported by the data for Participant 2. The analysis reveals that the text modality was an effective intervention, yielding a Tau-*U* of 0.625, as shown in Table 5. This score indicates a 62.5% non-overlap between the baseline and treatment phases, which is statistically significant ($Z = 2.165$, $p = 0.030$).

Conversely, the graphic modality did not demonstrate a statistically significant effect for this participant. The contrast between the graphic baseline and treatment phases resulted in a Tau-*U* of 0.528, indicating a 52.8% non-overlap. While this shows some improvement, the resulting p-value ($Z = 1.829$, $p = 0.068$) exceeds the standard threshold for significance. This suggests that for Participant 2, the text-based medium was a more reliable strategy for increasing performance levels compared to the graphic medium.

Table 5

Tau-U Analysis Results for Participant 2's Intervention Effect

Modality	S	Pairs	Tau-*U*	SD	*Z*	*p*
Text	45	72	0.625	20.785	2.165	0.030
Graphic	38	72	0.528	20.785	1.829	0.068

Modality Effects on World Knowledge Use for Social-Pragmatic Inferences

Modality effects were examined to determine if the presentation modality (text vs. graphic) influenced the participants' scores during both baseline and treatment phases. Visual inspection of the data for Participant 1 and Participant 2 suggested that both modalities followed a nearly identical trajectory. While the first research question addressed the intervention effect across phases, the second research question focuses on the differences in modalities in each phase (Baseline vs. Treatment) or across all phases (Combined).

Participant 1

In Participant 1's case, while there was an overall upward trend in scores during the treatment phase (see Figures 3 and 4), the text and graphic data points remained closely interleaved. This indicates that neither modality offered a distinct advantage in terms of learning rate or performance stability. Statistical results of these observations are provided by the Tau-*U* analysis for Participant 1. During the baseline phase, the Tau-*U* value was 0.219 ($p = 0.462$), indicating no significant difference between the two modalities. This trend continued into the treatment phase, where the Tau-*U* dropped to 0.141 ($p = 0.577$). When considering the combined data across all sessions, the analysis yielded a Tau-*U* of 0.152 ($p = 0.422$). Because the *p*-values consistently remained well above 0.05, it is concluded that there is no statistically significant modality gap for Participant 1.

Table 6

Tau-U Analysis Results for Participant 1's Modality Differences

Comparison	S	Pairs	Tau-*U*	SD	*Z*	*p*
Baseline	14	64	0.219	19.044	0.735	0.462
Treatment	17	121	0.141	30.4576	0.558	0.577
Combined	55	361	0.152	68.506	0.803	0.422

Participant 2

The data for Participant 2 similarly demonstrates a high degree of overlap between modalities, with even less variability between the two conditions than seen in Participant 1. Visually, the regression lines for the text and graphic modalities in the treatment phase are nearly parallel (see Figures 3 and 5), indicating that the participant responded to both formats with the same level of accuracy. The statistical results in Table 7 further support this lack of differentiation. The baseline Tau-*U* was 0.111 ($p = .726$), and the treatment Tau- *U* was 0.071 ($p = .808$). The combined Tau- *U* for Participant 2 was 0.053 ($p = .789$). With *p*-values nearing 1.0, the data suggests that the presentation modality had a negligible effect on Participant 2's ability to make social-pragmatic inferences.

Table 7

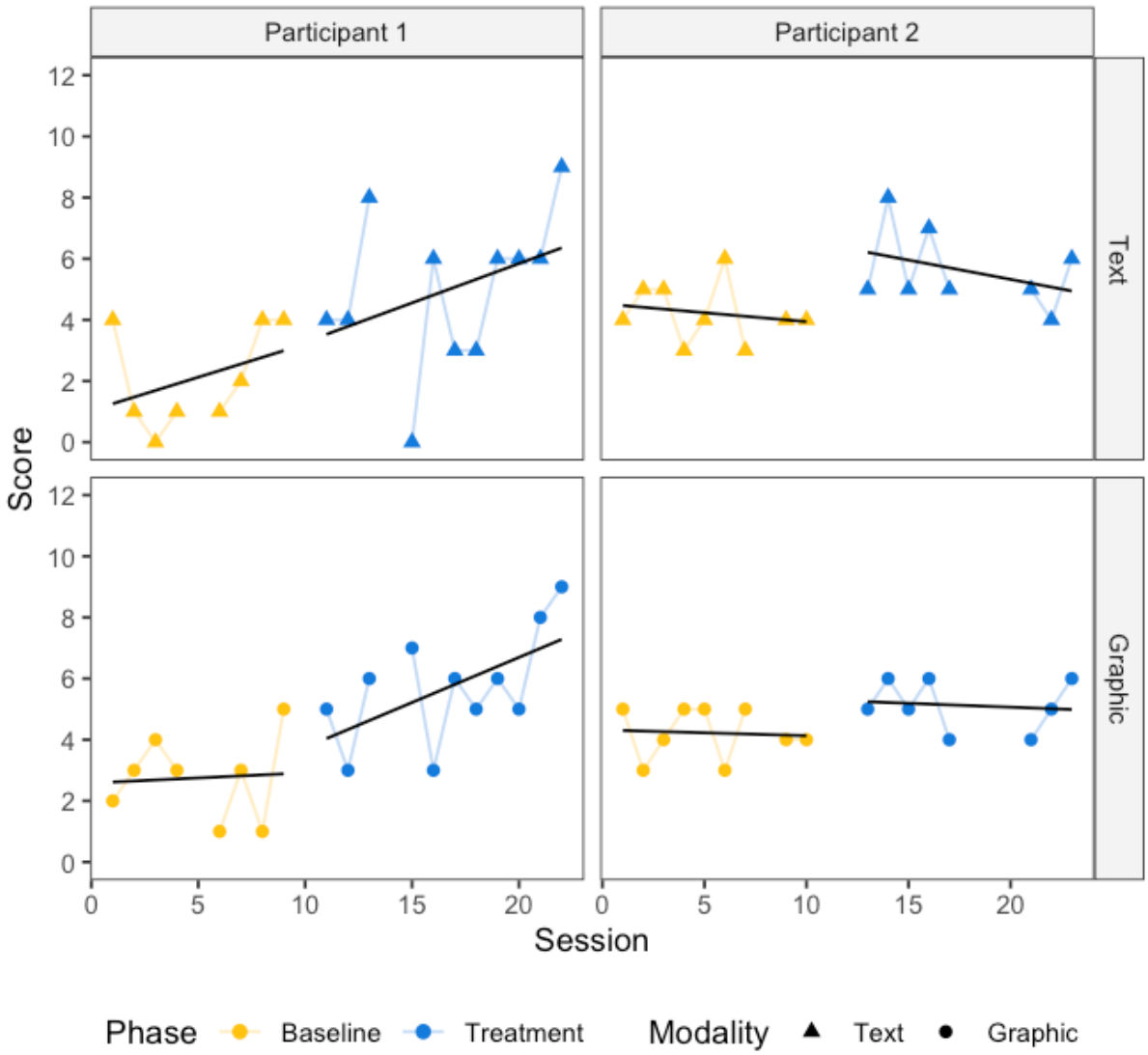
Tau-U Analysis Results for Participant 2's Modality Differences

Comparison	S	Pairs	Tau-*U*	SD	*Z*	*p*
Baseline	3	81	0.037	22.650	0.133	0.895
Treatment	-11	64	-0.172	19.044	-0.578	0.564
Combined	-16	289	-0.055	58.066	-0.276	0.783

In summary, the modality comparison reveals a high level of consistency across both participants. Neither the visual trends nor Tau-*U* suggest that one modality was superior to the other. Both participants showed a general response to the intervention that was independent of whether the stimuli were presented as text or graphics, indicating that the social-pragmatic skills being measured were accessed equally well through both formats. Figure 6 shows the modality comparison by participants.

Figure 6

Modality Comparison by Participant



Chapter V. Discussion

This study demonstrates that a Question Development (QD) intervention effectively improves the social-pragmatic inferencing of students with ASD, although results varied between modalities for the two participants. That is, one participant demonstrated improvement in the graphic modality, while the other demonstrated improvement in the text modality. Although the magnitude of these effects was more moderate than in previous school-based studies (i.e., Åsberg & Sandberg, 2010; Solis et al., 2016), this discrepancy is likely attributable to the increased cognitive load and decreased environmental control inherent in home-based delivery. Regarding modality, the findings challenge the assumption that graphic narratives provide a "natural" scaffold for students with ASD. Instead, the data revealed a convergence of performance across text and graphic formats. Drawing on the PINS (Cohn, 2020) and CI models (Kintsch & Van Dijk, 1978), this study suggests that while front-end encoding differs by modality, the back-end cognitive processes, such as semantic integration, are domain-general (Magliano et al., 2013). The results suggest that for students with ASD, the primary barrier to comprehension is not information access (i.e., modality), but the iterative process of mental model updating, which the QD intervention successfully targeted.

Intervention Effects

While visual analysis and statistical measures revealed varying degrees of improvement in inferencing between the two participants, the overall direction of the effects aligns with established frameworks for literacy and behavioral support in the ASD population. The effectiveness of the QD intervention in this study finds strong support in the specific mechanics of previous research (i.e., Åsberg & Sandberg, 2010; Solis et al., 2016). Åsberg and Sandberg (2010) demonstrated that a classroom-based QAR-inspired intervention could effectively address

the unique profile often found in students with ASD. By teaching students to explicitly classify question types, they provided the metacognitive awareness necessary to bridge the gap between literal textual information and script-implicit world knowledge, addressing what Westby (2004) describes as executive functioning difficulties that may affect comprehension monitoring in students with ASD.

The current study built upon these foundations by integrating the question development (QD) methodology utilized by Solis et al. (2016) with the literal question type introduced in Åsberg and Sandberg (2010). Solis et al. (2016) moved beyond passive question-answering by requiring participants to generate questions. Specifically, the intervention tested by Solis and colleagues engages what Cohn (2020) describes in the PINS model as "iterative process of retrieval of semantic and narrative information, prediction of upcoming information… and subsequent updating" of mental models during discourse comprehension. By utilizing this QD intervention, which emphasizes shared explicit concepts and teacher-led scaffolding, the current study successfully prompted students to transition from surface-level reading toward more sophisticated integration of social-pragmatic information, particularly in the text modality.

The empirical evidence for the intervention's success is substantiated by the Tau-*U* analysis. For Participant 1, the intervention yielded significant improvements in the graphic modality alone. The text modality resulted in a Tau-*U* of 0.625 ($p = 0.023$), but it is important to interpret these results with caution because Participant 1 demonstrated an upward trend in the baseline phase that continued into the intervention phase. As shown in Figure 6, the trend lines in both phases share a similar angle, which complicates the ability to clearly disentangle the effect of the intervention from the participant's pre-existing rate of improvement (e.g., repeated reading practice leading to improved inferencing).

Furthermore, while Tau-*U* is a robust measure, it is less appropriate for data exhibiting a naturally increasing baseline trend, as it may attribute ongoing development to the intervention itself. Consequently, while these results suggest promise, we must avoid overstating the efficacy of the QD intervention based on Participant 1's text modality data alone, as the potential for confounding variables remains high.

Nonetheless, Participant 1's graphic modality results showed a robust effect of 0.850 (p = 0.003). This 85% non-overlap suggests that the graphic modality provided a superior scaffold for Participant 1 to improve his inferencing, perhaps by reducing the initial front-end linguistic decoding load and allowing more cognitive resources to be directed toward back-end semantic integration.

For Participant 2, the results were opposite in the sense that the text modality showed a statistically significant improvement (Tau-U = 0.625, p = 0.030), but the graphic modality failed to reach the threshold of significance (Tau-U = 0.528, p = 0.068). Visual analysis revealed that Participant 2's treatment phase was characterized by a visible but inconsistent level shift in both modalities. Specifically, even though he reached a peak score of 8 in the text modality, higher than any baseline score, this performance was not maintained in either modality. This lack of stability is a critical finding, suggesting that while the intervention has the capacity to drive higher performance, external factors (e.g., missing sessions, intervention environment) may significantly moderate its consistency.

A primary hypothesis for the discrepancy in results between the two participants and the high variability observed in Participant 2's data is the difference in environmental settings between this study and the previous literature. Åsberg and Sandberg (2010) and Solis et al. (2016) conducted their research in highly controlled school environments (i.e., literacy

classrooms and special education settings) with minimal competing stimuli. Such settings maintain the formal instructional context that students with ASD find beneficial for improved executive functioning.

In contrast, the home-based delivery of this study may have introduced significant threats to internal validity. For Participant 2, the intervention phase coincided with severe snowstorms and school closures, which disrupted his regular school-day schedule and predictable routine. As visual analysis showed, his regression lines trended negatively during this period and suggested that the loss of school-day structure may have compromised his attention and intervention effect. Furthermore, both participants were susceptible to household distractions; for example, Participant 1 was highly aware of ambient noise, while Participant 2 frequently utilized personal fidget toys. These environmental variables likely increased extraneous cognitive load, making it harder for the participants to apply the updating mechanisms (Cohn, 2020) required for complex inferencing.

Despite these environmental challenges, the study maintained high standards of data integrity. The overall weighted Kappa (κ) of 0.623 exceeds the WWC (2022) threshold for reliability, which ensures that the observed gains were not a byproduct of coder bias. The high adjacent agreement (ranging from 90.28% to 98.61%) confirms that discrepancies were minimal and typically stayed within one scale point. This level of consistency allows for a confident interpretation of the Tau-*U* effect sizes, confirming that for both participants, the QD intervention provided a statistically significant functional relationship that effectively targeted social-pragmatic reasoning though in different modalities for each participant.

Modality Effects

The second research question sought to determine if the presentation modality (text vs. graphic) influenced the participants' ability to generate social-pragmatic inferences. It was initially hypothesized that the graphic modality might provide superior scaffolding during the baseline phase due to visual cues (e.g., facial expressions and situational context) that assist in social-pragmatic reasoning (Ness-Maddox, 2022). This hypothesis was grounded in Ness-Maddox's (2022) findings that narrative modality significantly affects comprehension processes, with graphic narratives facilitating more emotion-focused inferences and backward-oriented processing compared to text narratives (Ness-Maddox, 2022). However, a key methodological distinction should be acknowledged: whereas Ness-Maddox (2022) employed retrospective think-aloud protocols that allowed for unstructured responses after reading, the current study utilized a more scaffolded inference generation task. In other words, in the current study, students were asked questions specifically designed to elicit inferences. These contrasting approaches may explain the difference in modality effects.

Visual inspection and statistical analysis revealed that both participants followed nearly identical performance trajectories across both modalities. For Participant 1, despite an overall upward trend during the treatment phase, the data points for text and graphics remained closely interleaved. The Tau-*U* analysis confirmed this lack of differentiation, with non-significant p-values in the baseline ($p = .462$), treatment ($p = .577$), and combined phases ($p = .422$). Similarly, Participant 2 demonstrated a high degree of overlap, with regression lines for both modalities appearing nearly parallel in the treatment phase. Statistical results for Participant 2 further supported this, with *p*-values nearing 1.0 (baseline $p = .895$; treatment $p = .564$).

The absence of a significant modality gap in this study aligns with theoretical frameworks that emphasize shared cognitive mechanisms across narrative modalities. According to Magliano et al. (2013), while front-end processes, the initial extraction and interpretation of visual input to understand narrative contexts, differ between text and graphic narratives, back-end processes involving inferencing show greater convergence across media types (Magliano et al., 2013). This suggests that the core challenge for these participants was not in the modality-specific encoding processes, but in the higher-level cognitive operations required for meaning integration.

The PINS model (Cohn, 2020) provides additional theoretical support for these findings. The model describes narrative comprehension as involving parallel processing of semantic and narrative structural information through "iterative cycles of access, prediction, and updating" that are domain-general across expressive systems. The similar performance across modalities in this study suggests that both text and graphic narratives engaged the same underlying semantic integration processes, with the participants' difficulties stemming from challenges in the iterative updating mechanisms rather than modality-specific encoding differences.

Crucially, individual differences in Visual Language Fluency Index (VLFI) yielded unexpected results that further illuminate these theoretical implications. While Ness-Maddox (2022) observed that modality can shift the frequency of specific inference types (e.g., more bridging inferences in graphics), the current study suggests that higher baseline fluency in visual narratives does not automatically translate into superior social-pragmatic inferencing. Specifically, Participant 2 (average fluency) did not show a distinct advantage or significant improvement in the graphic condition. In contrast, Participant 1 (low fluency) showed significant gains in the graphic narrative following the intervention. This pattern supports the PINS model's

(Cohn, 2020) distinction between 'front-end' and 'back-end' processes. While visual language fluency may enhance the initial extraction of visual information, it does not necessarily improve the 'back-end' semantic integration and situation model construction crucial for social-pragmatic reasoning.

These results highlight that providing texts in a graphic modality, such as a comic, is not a "quick fix" for students with ASD. This finding aligns with Blum's (2019) research, which demonstrated that comic format alone did not promote integrative inferential reasoning (IIR) among autistic participants. Blum's (2019) study revealed that limited comic literacy negatively impacted autistic participants' performance, with autistic students who had no prior comic experience scoring significantly lower on the IIR scale than their neurotypical counterparts when presented with information in a comic format. Importantly, Blum (2019) found that only autistic respondents with the highest levels of self-rated comic experience performed comparably to their neurotypical peers, suggesting that comics function as a specialized literacy requiring development rather than serving as an immediately accessible scaffold. The success of the QD intervention across both modalities provides evidence that once participants master explicit inferential strategies, these strategies transfer across formats because they target shared back-end processes. Consistent with Magliano et al. (2013), the intervention functioned as a bridge for semantic integration that operates independently of the front-end format. Therefore, interventions should focus on developing explicit strategies for the iterative processes of accessing, predicting, and updating mental models, rather than assuming that visual modalities will automatically provide superior scaffolding.

Social Validity and Clinical Significance

To assess the functional and social relevance of the intervention, Participant 2 completed a post-intervention survey, but Participant 1 did not. Initially, the survey was sent via email after the intervention ended; however, Participant 1's caregiver was unresponsive to communication following the final session. Therefore, Participant 2 was provided with the survey at the end of their last session to prevent similar issues.

Overall, Participant 2 reported high levels of satisfaction with the intervention process and the materials used. Regarding the acceptability of the intervention, Participant 2 indicated a high degree of enjoyment, particularly in learning new skills via computers or tablets (Item 10) and the overall fun of being part of the study (Item 1), both of which received Strongly Agree ratings. The participant also perceived the intervention as effective for his academic growth; he agreed that the lessons helped him develop better questioning skills and story comprehension (Item 2).

The participant's ratings for engagement and peer recommendation were more reserved. While the participant agreed that the lessons were clear (Item 3) and a good use of time (Item 9), he provided neutral ratings for whether the activities were fun and exciting (Item 4) and whether he would recommend the lessons to his peers (Item 8). Furthermore, Participant 2 remained neutral on whether the skills learned would be helpful in a broader school context (Item 7). While the participant felt more confident within the intervention, he did not automatically generalize that confidence to the classroom. This disconnect reflects the challenges students with ASD face in generalizing 'back-end' mental model updating strategies to new environments without specific transition support (Magliano et al., 2013), reinforcing the need for explicit instruction on how to transfer QD strategies to diverse academic and social settings.

Despite these neutral points, the physical components of the intervention received the highest possible praise. Participant 2 strongly agreed that the books and graphic organizers provided were both helpful and easy to read (Item 6).

A key finding in the social validity data was the participant's reported increase in confidence when answering questions (Item 5). This subjective increase in self-efficacy is a vital outcome; as the participant moved from literal to inferential reasoning, his self-perception as a competent reader improved. In addition, at the end of his last session, his parent also reported that she was able to observe his increased comprehension at home and school.

Overall, the positive visual analysis results paired with favorable social validity ratings suggest that the QD intervention is a socially responsible and effective approach, even though Participant 1 did not complete the survey. The high praise for multimodal materials suggests that these scaffolds successfully reduced the extraneous cognitive load. By lowering the 'front-end' effort required to organize information, these materials enabled the participant to dedicate more cognitive resources to the core inferential tasks (Kintsch & Van Dijk, 1978).

Limitations

While the results of this study provide promising evidence for the effectiveness of the QD intervention, several limitations must be considered when interpreting these findings. A primary limitation of this study involves the small sample size and its structural alignment with the most rigorous evidence-based research standards. While data collection was exhaustive, yielding 8 to 10 data points per phase and significantly exceeding the minimum threshold of five to six required for visual and statistical analysis, the study has inherent constraints when evaluated against the What Works Clearinghouse (WWC) Single-Case Design standards. To achieve a rating of *Meets WWC Standards Without Reservations*, a multiple baseline design must typically

incorporate at least six phases across three tiers, with treatment introduced at three distinct points in time to establish temporal concurrence. Because this study utilized a two-tier design (i.e., two participants) and did not meet the requirement for three-point concurrence, it is categorized as *Does Not Meet WWC Standards*, despite the high volume of data within each phase. Also, the absence of an A (baseline) – B (treatment) – A (baseline/maintenance) or A (baseline) – B (treatment) – C (generalization) design structure limits the ability to empirically confirm the maintenance of acquired skills or their generalization to novel settings, as the study concluded without a formal withdrawal or follow-up maintenance phase.

Social validity data was even more restricted in scope. Because feedback was only obtained from Participant 2, it is impossible to conduct a cross-case comparison of the intervention's perceived utility. The absence of Participant 1's perspective leaves an empirical gap regarding whether the instructional materials and the QD process were viewed as equally acceptable across different learner profiles.

In addition, the heterogeneity of the participants' clinical profiles presented a significant challenge for comparative analysis. Whereas Participant 1 was diagnosed with ASD, Participant 2 had diagnoses of ASD and ADHD. This neurodevelopmental diversity made it difficult to isolate whether the observed variations in results were due to the intervention's mechanics, the influence of ADHD-related executive functioning difficulties, or environmental factors. The inclusion of additional participants with more homogenous profiles, or a larger cohort representing both groups, would have allowed for a more robust comparative analysis of how comorbid ADHD potentially moderates the effectiveness of QD intervention.

Home-based delivery model introduced several extraneous variables that functioned as threats to internal validity, potentially masking the true magnitude of the intervention's effects.

Environmental disruptions, specifically severe snowstorms and resulting school closures, precipitated significant shifts in Participant 2's regular routines, oscillating between structured school days and unstructured non-school days. These disruptions led to missed sessions during the treatment phase, attributed to the participant losing track of time while engaged in other activities, being away from home, or exhibiting less regulated behaviors throughout the day. Such interruptions can hinder the momentum of skill acquisition and may explain the fluctuations observed in the data.

Additionally, the informal nature of the home setting created a field of competing stimuli that is generally absent in controlled, clinical, or school-based environments. For instance, Participant 1 demonstrated frequent awareness of ambient household noises, while Participant 2 often paid attention to his toys in his hand, instead of the zoom sessions, during the tasks. Their presence in a home-based session suggests a higher extraneous sensory and cognitive load, as the participants had to divide their attention between the intervention's metacognitive demands and the familiar distractions of their domestic space.

Moreover, the study did not systematically account for participants' baseline oral language fluency. Given that the production of questions requires high-level linguistic integration and the age gap between the two participants (Grade 5 and Grade 3), it is possible that variations in oral expressive language skills, rather than just inferencing ability, moderated the participants' capacity to articulate the mental models they were constructing during the QD process. Future research should account for baseline differences between participants in their oral language fluency.

Certain procedural elements within the QD intervention may have inadvertently influenced the participants' performance trends. Throughout the treatment phase, participants

were given the autonomy to choose which of the three question types to generate. However, a clear behavioral pattern emerged: both participants demonstrated a strong preference for literal questions. Because literal questions rely on literal information that is explicitly stated in the text or graphics, they require significantly less cognitive effort than inferential or evaluative questions. This self-selection bias meant that participants were not always intellectually challenged to make the deeper connections necessary for social-pragmatic reasoning. Without a predetermined distribution or 'forced choice' mechanic to ensure a balance of question types, the intervention may have primarily reinforced the participants' existing strengths in literal identification rather than consistently stretching their ability to integrate script-implicit and text-implicit information.

Finally, the measurement scale with the current narratives for IIR questioning requires further refinement. Because different narratives possess varying degrees of inherent item difficulty, the variability in participants' results may partially be a product of differences in the difficulty of the items encountered.

Future Directions

The findings and limitations of this study provide a clear roadmap for future research. First, expanding the sample size is essential. Future studies should recruit a larger and more homogenous group of participants to enhance generalizability. Specifically, future research should aim to differentiate between students with ASD only and those with comorbid ADHD to better understand how different neurodivergent profiles respond to the QD protocol. Utilizing a three-tier multiple baseline design with at least three participants would also allow the research to meet the most rigorous WWC standards.

Regarding broader generalization, future iterations should move beyond the current study's parameters to assess the intervention's impact across diverse contexts. Researchers should investigate whether the QD protocol remains effective in small-group instructional settings and with more complex narrative materials that push beyond the simplicity of the texts used here. Furthermore, re-administering the MOCCA post-intervention will provide essential data on whether targeted training in question generation leads to sustained, generalized improvements in underlying causal comprehension.

Second, future research should incorporate objective neuro-cognitive measures, such as eye-tracking technology. While this study relied on verbal products to infer comprehension, eye-tracking would allow researchers to observe front-end processing in real-time. By tracking gaze patterns, researchers can determine if participants are attending to salient social cues (e.g., facial expressions or background context) or if they are becoming fixated on irrelevant local details (e.g., Drysdale et al., 2018). This would provide empirical evidence for the weak central coherence theory and show how multimodal materials help redirect attention.

Third, to prevent the self-selection bias observed in this study, where participants favored easier literal questions, future iterations should implement a balanced-choice or laddered approach. By requiring a specific number of inferential or evaluative questions before moving to the next task, practitioners can ensure that students are consistently pushed beyond their literal 'comfort zone.' This added structure would force the iterative updating of mental models.

The last limitation of the current study is the absence of item scaling analysis to validate the ordinal structure of the IIR framework (Blum et al., 2020) with the narrative materials and population. While applying the three-level IIR scoring system, future research should employ partial credit model analysis to confirm that the items function as intended across the

hypothesized levels and that thresholds demonstrate the expected banding pattern (Blum et al., 2020). Item scaling would provide validation evidence for the measurement properties of IIR within the specific context and strengthen claims about participants' dispositional reasoning patterns.

Implications

By providing a structured framework for inquiry, the intervention establishes a scaffolded internal dialogue that helps students move beyond what is explicitly stated to comprehend the underlying social content. This structured approach is particularly effective because it reduces the executive functioning demands required to organize thoughts during a narrative. By giving students a predictable method for questioning, the intervention allows them to offload the cognitive burden of organization and focus their mental energy specifically on identifying and interpreting social cues.

A critical component of this success is the use of graphic organizer within the QD protocol, which acts as a strategic cognitive filter. As noted in the literature review, students with ASD often struggle with WCC, a cognitive profile that can lead to a preoccupation with minor, local details at the expense of the big picture, or coherence, of a text. The graphic organizer addresses this by visually partitioning information, preventing students from becoming 'stuck' on irrelevant or distracting details. This structural support allows them to more efficiently allocate their mental resources toward identifying salient points, the critical pieces of information necessary to form an accurate social-pragmatic inference.

Furthermore, the success of the intervention across both text and graphic modalities is a significant finding for differentiated instruction and Universal Design for Learning (UDL). It validates the idea that social-pragmatic inference is a high-level cognitive skill that exists

independently of a student's literal reading level. Educators can use graphic materials like comic strips or storyboards to leverage the strong visuospatial processing often found in students with ASD thereby allowing students to practice high-level inferencing without being hindered by the cognitive bottleneck of complex text decoding. This practice can help to ensure that students who struggle with literacy are not left behind in their social reasoning development, as they can still master critical social goals through visual media.

Finally, the social-pragmatic nature of these inferences has profound implications for real-world application and student independence. Improving social-pragmatic inference performance during comprehension of text and graphic narratives serves as a vital precursor to better real-time social interactions. That is, if a student can infer a character's motive in a controlled graphic story, then the student is one step closer to inferring a peer's intent on the playground. By teaching students to ask their own questions rather than relying on teacher-led prompting, QD intervention fosters a sense of student-led independence. Over time, this habit of internal questioning can become a vital self-monitoring tool and allow students to navigate complex and unpredictable social environments with greater confidence.

Conclusion

In conclusion, this study demonstrates that QD intervention is a powerful tool for bridging the gap between literal comprehension and social-pragmatic understanding in students with ASD. By utilizing graphic organizers to mitigate a detail-oriented cognitive disposition and providing a structured framework for internal dialogue, the intervention empowers students to bypass distracting details and focus on the salient points required for sophisticated inference-making. Despite individual differences in clinical profiles (ASD vs. ASD + ADHD), the consistent effectiveness of the intervention highlights that social-pragmatic growth depends less

on the format of information and more on the explicit mastery of the inferential processes themselves. These findings further suggest that educators can interchangeably utilize both text and graphic modalities. This flexibility is particularly beneficial for students whose word-reading levels are not yet proficient enough to interpret complex content through text alone. Conclusively, the QD intervention equips students with the active inquiry skills necessary to transition from classroom success to meaningful, real-world social engagement.

REFERENCES

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Andrés-Roqueta, C., & Katsos, N. (2020). A distinction between linguistic and social pragmatics helps the precise characterization of pragmatic challenges in children with autism spectrum disorders and developmental language disorder. *Journal of Speech, Language, and Hearing Research*, *63*(5), 1494–1508. https://doi.org/10.1044/2020_JSLHR-19-00263

Archer, A. L., & Hughes, C. A. (2011). *Explicit instruction: effective and efficient teaching*. Guilford Press.

Åsberg, J., & Sandberg, A. D. (2010). Discourse comprehension intervention for high-functioning students with autism spectrum disorders: Preliminary findings from a school-based study. *Journal of Research in Special Educational Needs*, *10*(2), 91–98. https://doi.org/10.1111/j.1471-3802.2010.01147.x

Baixauli-Fortea, I., Casas, A. M., Berenguer-Forner, C., Colomer- Diago, C., & Roselló-Miranda, B. (2019). Pragmatic competence of children with autism spectrum disorder. Impact of theory of mind, verbal working memory, ADHD symptoms, and structural language. *Applied Neuropsychology Child, 8*(2), 101–112. https://doi.org/10.1080/21622 965.2017.13928 61

Baron-Cohen, S., Wheelwright, S., Spong, A., Scahill, V., & Lawson, J. (2001). Are intuitive physics and intuitive psychology independent? A test with children with Asperger Syndrome. *Journal of Developmental and Learning Disorders, 5*(1), 47-78. https://onlinelibrary.wiley.com/doi/pdf/10.1111/1469-7610.00715

Bazerman, C. (2004). Speech acts, genres, and activity systems. In C. Bazerman & P. A. Prior (Eds), *What Writing Does and How It Does It* (pp. 309–340). Mahwah, NJ: Lawrence Erlbaum Associates.

Berthiaume, K. S., Lorch, E. P., & Milich, R. (2010). Getting clued in: Inferential processing and comprehension monitoring in boys with ADHD. *Journal of Attention Disorders, 14*(1), 31–42. https://doi.org/10.1177/1087054709347197

Biancarosa, G., Kennedy, P.C., Carlson, S.E., Yoon, H., Seipel, B., Liu, B., and Davison, M.L. (2019). Constructing subscores that add validity: A case study of identifying students at risk. *Educational and Psychological Measurement, 79*(1), 65–84. https://doi.org/10.1177/0013164418763255

Blum, A. (2019). *Deficit or difference? Assessing narrative comprehension in autistic and typically developing individuals: comic vs. text*. University of California, Berkeley.

Blum, A. M., Mason, J. M., Kim, J., & Pearson, P. D. (2020). Modeling question-answer relations: The development of the integrative inferential reasoning comic assessment. *Reading and Writing*, *33*(8), 1971–2000. https://doi.org/10.1007/s11145-020-10026-4

Briner, S. W., Virtue, S., & Kurby, C. A. (2012). Processing causality in narrative events: Temporal Order Matters. *Discourse Processes*, *49*(1), 61–77. https://doi.org/10.1080/0163853X.2011.607952

Brown, H. M., Oram-Cardy, J., & Johnson, A. (2013). A meta-analysis of the reading comprehension skills of individuals on the autism spectrum. *Journal of Autism and Developmental Disorders*, *43*(4), 932–955. https://doi.org/10.1007/s10803-012-1638-1

Bruner, J. (1991). The narrative construction of reality. *Critical Inquiry*, *18*(1), 1–21. http://www.jstor.org/stable/1343711

Cappelli, G., Noccetti, S., Simi, N., Arcara, G., & Bambini, V. (2022). Dyslexia and pragmatic skills. https://doi.org/10.31234/osf.io/85as2

Capps, L., Losh, M., & Thurber, C. (2000). "The frog ate the bug and made his mouth sad": Narrative competence in children with autism. *Journal of Abnormal Child Psychology*, *28*(2), 193–204. https://doi.org/10.1023/A:1005126915631

Carlson, S. E., van den Broek, P., Rapp, D. N., Bohn-Gettler, C. M., Kendeou, P., & White, M. J. (2014). Effects of comprehension skill on inference generation during reading. *International Journal of Disability, Development and Education*, *61*(3), 258–274. https://doi.org/10.1080/1034912X.2014.934004

Carlson, S., Broek, P., & McMaster, K. (2022). `. *The Elementary School Journal, 122*, 475–501. https://doi.org/10.1086/719477

Carter, A. S., Davis, N. O., Klin, A., & Volkmar, F. R. (2005). Social development in autism. *Handbook of Autism and Pervasive Developmental Disorders, 1*, 312–334.

Coderre, E. L., Cohn, N., Slipher, S. K., Chernenok, M., Ledoux, K., & Gordon, B. (2018). Visual and linguistic narrative comprehension in autism spectrum disorders: Neural evidence for modality-independent impairments. *Brain and Language*, *186*, 44–59. https://doi.org/10.1016/j.bandl.2018.09.001

Cohn, N. (2007). A visual lexicon. *Public Journal of Semiotics*, *1*(1), 35–56. https://doi.org/10.37693/pjos.2007.1.8814

Cohn, N. (2013). Visual narrative structure. *Cognitive Science, 37*(3), 413–452. https://doi.org/10.1111/cogs.12016

Cohn, N. (2014). The Visual Language Fluency Index: A measure of "comic reading expertise." Visual Language Lab: Resources. www.visuallanguagelab.com/resources.html. First posted online April 2014.

Cohn, N. (2020). Your brain on comics: A cognitive model of visual narrative comprehension. *Topics in Cognitive Science*, *12*(1), 352–386. https://doi.org/10.1111/tops.12421

Cohn, N., & Kutas, M. (2015). Getting a cue before getting a clue: Event-related potentials to inference in visual narrative comprehension. *Neuropsychologia, 77*, 267–278.

Cohn, N., & Magliano, J. P. (2020). Editors' introduction and review: Visual narrative research: an emerging field in cognitive science. *Topics in Cognitive Science*, *12*(1), 197–223. https://doi.org/10.1111/tops.12473

Cohn, N., Paczynski, M., Jackendoff, R., Holcomb, P. J., & Kuperberg, G. R. (2012). (Pea) nuts and bolts of visual narrative: Structure and meaning in sequential image comprehension. *Cognitive Psychology, 65*, 1–38.

Cohn, N., & Wittenberg, E. (2016). Action starring narratives and events: Structure and inference in visual narrative comprehension. *Journal of Cognitive Psychology, 27*(7), 812–828.

Compton, D. L., Miller, A. C., Elleman, A. M., & Steacy, L. M. (2014). Have we forsaken reading theory in the name of "quick fix" interventions for children with reading disability? *Scientific Studies of Reading*, *18*(1), 55–73. https://doi.org/10.1080/10888438.2013.836200

Constantino, J. N., & Gruber, C. P. (2012). *Social Responsiveness Scale, Second Edition (SRS-2).* Western Psychological Services.

Davison, M. L., Biancarosa, G., Carlson, S. E., Seipel, B., and Liu, B. (2018). Preliminary Findings on the computer-administered multiple-choice online causal comprehension

assessment, a diagnostic reading comprehension test. *Assessment for Effective Intervention*, *43*(3), 169–181. https://doi.org/10.1177/1534508417728685

Deliens, G., Papastamou, F., Ruytenbeek, N., Geelhand, P., & Kissine, M. (2018). Selective pragmatic impairment in autism spectrum disorder: Indirect requests versus irony. *Journal of Autism and Developmental Disorders, 48*(9), 2938–2952. https://doi.org/10.1007/s10803-018-3561-6

Dellapiazza, F., Michelon, C., Rattaz, C., Picot, M.-C., & Baghdadli, A. (2022). Sex-related differences in clinical characteristics of children with ASD without ID: Results from the ELENA cohort. *Frontiers in Psychiatry*, *13*, Article 998195. https://doi.org/10.3389/fpsyt.2022.998195

Drysdale, B. M., Moore, D. W., Furlonger, B. E., & Anderson, A. (2018). Gaze patterns of individuals with ASD during active task engagement: A systematic literature review. *Review Journal of Autism and Developmental Disorders*, *5*(1), 1–14. https://doi.org/10.1007/s40489-017-0119-z

Frith, U. (1989). A new look at language and communication in autism. *British Journal of Disorders of Communication, 24*(2), 123–150. https://doi.org/10.3109/13682828909011952

Frith, U. (2003). *Autism: Explaining the enigma* (2nd ed). Hoboken, NJ: Blackwell Publishing.

Frith, U., & Happé, F. (1994). Autism: Beyond "theory of mind." *Cognition*, *50*(1–3), 115–132. https://doi.org/10.1016/0010-0277(94)90024-8

Gambra, L., Magallon, S., & Crespo-Eguílaz, N. (2024). Weak central coherence in neurodevelopmental disorders: A comparative study. *Frontiers in Psychology*, *15*, Article 1348074. https://doi.org/10.3389/fpsyg.2024.1348074

Ghelani, K., Sidhu, R., Jain, U., & Tannock, R. (2004). Reading comprehension and reading related abilities in adolescents with reading disabilities and attention-deficit/hyperactivity disorder. *Dyslexia*, *10*(4), 364–384. https://doi.org/10.1002/dys.285

Graesser, A. C., & Franklin, S. P. (1990). QUEST: A cognitive model of question answering. *Discourse Processes, 13*(3), 279–303.

Graesser, A. C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review, 101*(3), 371–395. https://doi.org/10.1037/0033295X.101.3.371

Happé, F., & Booth, R. D. L. (2008). The power of the positive: Revisiting weak coherence in autism spectrum disorders. *Quarterly Journal of Experimental Psychology*, *61*(1), 50–63. https://doi.org/10.1080/17470210701508731

Happé, F., & Frith, U. (2006). The weak coherence account: Detail-focused cognitive style in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *36*(1), 5–25. https://doi.org/10.1007/s10803-005-0039-0

Hutson, J. P., Magliano, J. P., & Loschky, L. C. (2018). Understanding moment-to-moment processing of visual narratives. *Cognitive Science*, *42*(8), 2999–3033. https://doi.org/10.1111/cogs.12699

Jepsen, I. B., Brynskov, C., Thomsen, P. H., Rask, C. U., & Lambek, R. (2025). The association between attention-deficit/hyperactivity disorder and narrative language: What is the role of executive function? *JCPP Advances*, *5*(4), Article e70007. https://doi.org/10.1002/jcv2.70007

Jolliffe, T., & Baron-Cohen, S. (2000). Linguistic processing in high-functioning adults with autism or Asperger's syndrome. Is global coherence impaired? *Psychological Medicine*, *30*(5), 1169–1187. https://doi.org/10.1017/S003329179900241X

Jones, W., & Klin, A. (2013). Attention to eyes is present but in decline in 2–6-month-old infants later diagnosed with autism. *Nature*, *504*(7480), 427–431. https://doi.org/10.1038/nature12715

Kazdin, A. E. (2021). Single-case research designs: Methods for clinical and applied settings (3rd ed.). Oxford University Press.

Kendeou, P., McMaster, K.L., Butterfuss, R., Kim, J., Bresina, B., and Wagner, K. (2020). The inferential language comprehension (iLC) framework: Supporting children's comprehension of visual narratives. *Topics in Cognitive Science, 12*, 256-273.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A constructive integration model. *Psychological Review, 95*, 163–182.

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge University Press.

Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review, 85*(5), 363–394. https://doi.org/10.1037/0033-295X.85.5.363

Klin, A., Lin, D. J., Gorrindo, P., Ramsay, G., & Jones, W. (2009). Two-year-olds with autism orient to non-social contingencies rather than biological motion. *Nature*, *459*(7244), 257–261. https://doi.org/10.1038/nature07868

Kofler, M. J., Rapport, M. D., Bolden, J., & Altro, T. A. (2008). Working memory as a core deficit in ADHD: Preliminary findings and implications. *ADHD Report*, *16*(6), 8–14.

Kotila, A., Hyvärinen, A., Mäkinen, L., Leinonen, E., Hurtig, T., Ebeling, H., Korhonen, V., Kiviniemi, V. J., & Loukusa, S. (2020). Processing of pragmatic communication in ASD:

A video-based brain imaging study. *Scientific Reports*, *10*(1), 21739. https://doi.org/10.1038/s41598-020-78874-2

Kratochwill, T. R., Hitchcock, J. H., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2013). Single-Case Intervention Research Design Standards. *Remedial and Special Education*, *34*(1), 26–38. https://doi.org/10.1177/0741932512452794

Kratochwill, T. R., Levin, J. R., Morin, K. L., & Lindström, E. R. (2022). Examining and enhancing the methodological quality of nonconcurrent multiple-baseline designs. *Perspectives on Behavior Science*. https://doi. org/10.1007/s40614-022-00341-2

Landau, S., Lorch, E. P., & Milich, R. (1992). Visual attention to and comprehension of television in attention-deficit hyperactivity disordered and normal boys. *Child Development, 63*, 928–937.

Lane, J. D., & Gast, D. L. (2014). Visual analysis in single case experimental design studies: Brief review and guidelines. *Neuropsychological Rehabilitation, 24*, 445–463.

Ledford, J., & Gast, D. (2018). *Single case research methodology: Applications in special education and behavioral sciences* (Third ed.). In Gast, D. L., Lloyd, B. P., & Ledford, J.R. (Eds.). *Multiple Baseline and Multiple Probe Designs.* (pp. 239-277). New York, NY: Routledge.

Levin, J. R., & Ferron, J. M. (2021). Different randomized multiple-baseline models for different situations: A practical guide for single-case intervention researchers. *Journal of School Psychology, 86*, 169–177. https://doi.org/10. 1016/j.jsp.2021.03.003

Lobel, A. (1970). *Frog and toad are friends.* HarperCollins.

Lobel, A. (1972). *Frog and toad together.* HarperCollins.

Lobel, A. (1976). *Frog and toad all year*. HarperCollins.

Lobel, A. (1979). *Days with frog and toad*. HarperCollins.

Lorch, E. P., Eastham, D., Milich, R., Lemberger, C. C., Sanchez, R. P., Welsh, R., et al. (2004). Difficulties in comprehending causal relations among children with ADHD: The role of cognitive engagement. *Journal of Abnormal Psychology, 113*, 56–63.

Lorch, E. P., Milich, R., Sanchez, R. P., van den Broek, P., Baer, S., Hooks, K., et al. (2000). Comprehension of televised stories in attention deficit hyperactivity disordered and nonreferred boys. *Journal of Abnormal Psychology, 109*, 321–330.

Losh, M., & Capps, L. (2003). Narrative Ability in High-Functioning Children with Autism or Asperger's Syndrome. *Journal of Autism and Developmental Disorders*, *33*(3), 239–251. https://doi.org/10.1023/A:1024446215446

Long, D. L., & Chong, J. L. (2001). Comprehension skill and global coherence: A paradoxical picture of poor comprehenders' abilities. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 27(6), 1424–1429.

Loukusa, S., Leinonen, E., Jussila, K., Mattila, M.-L., Ryder, N., Ebeling, H., et al. (2007). Answering contextually demanding questions: Pragmatic errors produced by children with Asperger syndrome or high-functioning autism. *Journal of Communication Disorders, 40*, 357–381.http://dx.doi.org/10.1016/j.jcomdis.2006.10.001 .

Loukusa, S., Mäkinen, L., Kuusikko-Gauffin, S., Ebeling, H., & Leinonen, E. (2018). Assessing social-pragmatic inferencing skills in children with autism spectrum disorder. *Journal of Communication Disorders*, *73*, 91–105. https://doi.org/10.1016/j.jcomdis.2018.01.006

Lynch, J. S., Van Den Broek, P., Kremer, K. E., Kendeou, P., White, M. J., & Lorch, E. P. (2008). The development of narrative comprehension and its relation to other early reading skills. *Reading Psychology*, *29*(4), 327–365. https://doi.org/10.1080/02702710802165416

Magliano, J. P., Kopp, K., McNerney, M. W., Radvansky, G. A., & Zacks, J. M. (2012). Aging and perceived event structure as a function of modality. *Aging, Neuropsychology, and Cognition, 19*(1–2), 264–282.

Magliano, J. P., Larson, A. M., Higgs, K., & Loschky, L. C. (2016). The relative roles of visuospatial and linguistic working memory systems in generating inferences during visual narrative comprehension. *Memory & Cognition, 44*, 207–219.

Magliano, J.P., Loschky, L.C., Clinton, J.A., & Larson, A.M. (2013). Is reading the same as viewing? An exploration of the similarities and differences between processing text- and visually based narratives. In B. Miller, L. Cutting, and P. McCardle (Eds.), *Unraveling the Behavioral, Neurobiological, & Genetic Components of Reading Comprehension*, (pp. 78-90). Brookes Publishing Co.

Magliano, J. P., McCrudden, M. T., Rouet, J.-F., & Sabatini, J. (2018). The Modern Reader: Should changes to how we read affect research and theory? In M. F. Schober, D. N. Rapp, & M. A. Britt (Eds.), *The Routledge Handbook of Discourse Processes* (2nd ed., pp. 343–361). Routledge. https://doi.org/10.4324/9781315687384-18

Mar, R. A. (2004). The neuropsychology of narrative: Story comprehension, story production and their interrelation. *Neuropsychologia, 42*(10), 1414–1434. https://doi.org/10.1016/j.neuropsychologia.2003.12.016

Marocchini, E. (2023). Impairment or difference? The case of Theory of Mind abilities and pragmatic competence in the Autism Spectrum. *Applied Psycholinguistics, 44*(3), 365–383. doi:10.1017/S0142716423000024

Martinussen, R., & Mackenzie, G. (2015). Reading comprehension in adolescents with ADHD: Exploring the poor comprehender profile and individual differences in vocabulary and

executive functions. *Research in Developmental Disabilities*, *38*, 329–337. https://doi.org/10.1016/j.ridd.2014.12.007

Mason, L. H. (2004). Explicit self-regulated strategy development versus reciprocal questioning: Effect on expository reading comprehension among struggling readers. *Journal of Educational Psychology, 96*, 283–296. doi:10.1037/00220663.96.2.283

McAdams, D. P. (2006). The problem of narrative coherence. *Journal of Constructivist Psychology*, *19*(2), 109–125. https://doi.org/10.1080/10720530500508720

McMaster, K. L., van den Broek, P., Espin, C. A., White, M. J., Rapp, D. N., Kendeou, P., . . . Carlson, S. (2012). Making the right connections: Differential effects of reading intervention for subgroups of comprehenders. *Learning and Individual Differences, 22*, 100–111.

Miller, A. C., Keenan, J. M., Betjemann, R. S., Willcutt, E. G., Pennington, B. F., & Olson, R. K. (2013). Reading comprehension in children with ADHD: cognitive underpinnings of the centrality deficit. *Journal of abnormal child psychology, 41*(3), 473–483. https://doi.org/10.1007/s10802-012-9686-8

Morin, K. L., Lindström, E. R., Kratochwill, T. R., Levin, J. R., Blasko, A., Weir, A., Nielsen-Pheiffer, C. M., Kelly, S., Janunts, D., & Hong, E. R. (2024). Nonconcurrent multiple-baseline and multiple-probe designs in special education: A systematic review of current practice and future directions. *Exceptional Children*, *90*(2), 126–147. https://doi.org/10.1177/00144029231165506

Ness-Maddox, H. (2022). “Nuff Said”: Understanding comprehension processes and products for reading text and non-linguistic graphic narratives. College of Education & Human Development, Georgia State University.

Norbury, C. F., & Bishop, D. V. M. (2002). Inferential processing and story recall in children with communication problems: A comparison of specific language impairment, pragmatic language impairment and high-functioning autism. *International Journal of Language & Communication Disorders*, *37*(3), 227–251. https://doi.org/10.1080/13682820210136269

Nuske, H. J., & Bavin, E. L. (2011). Narrative comprehension in 4–7-year-old children with autism: Testing the Weak Central Coherence account. *International Journal of Language & Communication Disorders*, 100824014249025. https://doi.org/10.3109/13682822.2010.484847

Oakhill, J. (1994). Individual differences in children's text comprehension. In M. A. Gernsbacher (Ed.), *Handbook of Psycholinguistics* (pp. 821–848). Academic Press.

O'Hearn, K., Lakusta, L., Schroer, E., Minshew, N., & Luna, B. (2011). Deficits in adults with autism spectrum disorders when processing multiple objects in dynamic scenes. *Autism Research*, *4*(2), 132–142. https://doi.org/10.1002/aur.179

Omanson, R.C., Warren, W.H. & Trabasso, T. (1978). Goals, inferential comprehension, and recall of stories by children. *Discourse Processes, 1*, 337–354.

Özyürek, A., & Trabasso, T. (1997). Evaluation during the understanding of narratives. *Discourse Processes, 23*(3), 305–335. https://doi.org/10.1080/01638539709544995

Paris, S. G., & Lindauer, B. K. (1976). The role of inference in children's comprehension and memory for sentences. *Cognitive Psychology, 8*(2), 217–227. https://doi.org/10.1016/0010-0285(76)90024-4

Pearson, P. D., & Johnson, D. D. (1978). *Teaching reading comprehension*. New York: Holt, Rinehart & Winston.

Perfetti, C. A., Landi, N., & Oakhill, J. (2005). The acquisition of reading comprehension skill. In M. J. Snowling & C. Hulme (Eds.), *The Science of Reading: A Handbook* (pp. 227–247). Blackwell Publishing Ltd. https://doi.org/10.1002/9780470757642.ch13

Philofsky, A., Fidler, D. J., & Hepburn, S. (2007). Pragmatic language profiles of school-age children with autism spectrum disorders and williams syndrome. *American Journal of Speech-Language Pathology*, *16*(4), 368–380. https://doi.org/10.1044/1058-0360(2007/040)

Pijnacker, J., Geurts, B., van Lambalgen, M., Buitelaar, J., & Hagoort, P. (2010). Exceptions and anomalies: An ERP study on context sensitivity in autism. *Neuropsychologia*, *48*(10), 2940–2951. https://doi.org/10.1016/j.neuropsychologia.2010.06.003

Radvansky, G. A., & Zacks, J. M. (2014). *Event cognition*. Oxford, UK: Oxford University Press.

Rapp, D. N., van den Broek, P., McMaster, K. L., Kendeou, P., & Espin, C. A. (2007). Higher order cognitive processes in struggling readers: A perspective for research and intervention. *Scientific Studies of Reading, 11*, 289–312.

Rashkin, H., Bosselut, A., Sap, M., Knight, K., & Choi, Y. (2018). Modeling naive psychology of characters in simple commonsense stories. arXiv.Org. https://doi.org/10.48550/arxiv.1805.06533

R Core Team (2025). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>.

Rumpf, A.-L., Kamp-Becker, I., Becker, K., & Kauschke, C. (2012). Narrative competence and internal state language of children with Asperger Syndrome and ADHD. *Research in Developmental Disabilities*, *33*(5), 1395–1407. https://doi.org/10.1016/j.ridd.2012.03.007

Sanchez, M. J., & Constantino, J. N. (2020). Expediting clinician assessment in the diagnosis of autism spectrum disorder. *Developmental Medicine & Child Neurology, 62*(7), 806–812. https://doi.org/10.1111/dmcn.14530

Schlooz, W. A. J. M., & Hulstijn, W. (2014). Boys with autism spectrum disorders show superior performance on the adult Embedded Figures Test. *Research in Autism Spectrum Disorders*, *8*(1), 1–7. https://doi.org/10.1016/j.rasd.2013.10.004

Seabra, A. G., Brito, G. R., & Carreiro, L. R. R. (2023). Reading assessment in ADHD and dyslexia in Brazilian teenagers. *European Psychiatry*, *66*(S1), S714–S715. doi:10.1192/j.eurpsy.2023.1496

Shanahan, T., & Shanahan, C. (2008). Teaching disciplinary literacy to adolescents: Rethinking content-area literacy. *Harvard Educational Review, 78*(1), 40–59.

Siller, M., Swanson, M. R., Serlin, G., & Teachworth, A. G. (2014). Internal state language in the storybook narratives of children with and without autism spectrum disorder: Investigating relations to theory of mind abilities. *Research in Autism Spectrum Disorders*, *8*(5), 589–596. https://doi.org/10.1016/j.rasd.2014.02.002

Solari, E. J., Grimm, R. P., McIntyre, N. S., Zajic, M., & Mundy, P. C. (2019). Longitudinal stability of reading profiles in individuals with higher functioning autism. *Autism*, *23*(8), 1911–1926. https://doi.org/10.1177/1362361318812423

Solis, M., El Zein, F., Vaughn, S., McCulley, L. V., & Falcomata, T. S. (2016). Reading comprehension interventions for students with autism spectrum disorders: An alternating treatments comparison. *Focus on Autism and Other Developmental Disabilities*, *31*(4), 284–299. https://doi.org/10.1177/1088357615583464

Song, H., Park, B., Park, H., & Shim, W. (2021). Cognitive and neural state dynamics of narrative comprehension. *The Journal of Neuroscience, 41*, 8972 - 8990. https://doi.org/10.1523/JNEUROSCI.0037-21.2021.

Soriano, M. F., Ibáñez-Molina, A. J., Paredes, N., & Macizo, P. (2018). Autism: Hard to switch from details to the whole. *Journal of Abnormal Child Psychology*, *46*(6), 1359–1371. https://doi.org/10.1007/s10802-017-0384-4

Tarar, J. M., Meisinger, E. B., & Dickens, R. H. (2015). Test Review: Torgesen, J. K., Wagner, R. K., and Rashotte, C. A. (2012), "Test of Word Reading Efficiency-Second Edition" (TOWRE-2). Austin, TX: Pro-Ed. *Canadian Journal of School Psychology*, *30*(4), 320-. https://doi.org/10.1177/0829573515594334

Taylor, L. K., Alber, S. R., & Walker, D. W. (2002). The comparative effects of modified self-questioning strategy and story mapping on the reading comprehension of elementary students with learning disabilities. *Journal of Behavioral Education, 11*, 69–87. doi:10.1023/A:1015409508939

Torgesen J. K., Wagner R. K., Rashotte C. A. (2012). Test of Word Reading Efficiency–Second Edition. Austin, TX: Pro-Ed.

Trabasso, T., & Magliano, J. P. (1996). How do children understand what they read and what can we do to help them? In M Graves, P. van den Broek, & B. Taylor (Eds.), The first R: A right of all children (pp. 160–188). New York: Columbia University Press.

Trabasso, T., Secco, T., and van den Broek, P. (1984). Causal cohesion and story coherence. In H. Mandl, N.L. Stein and T. Trabasso (Eds). *Learning and Comprehension of Text. Hillsdale: Erlbaum*, 83-111.

Trabasso, T., & Wiley, J. (2005). Goal plans of action and inferences during comprehension of narratives. *Discourse Processes, 39*, 129–164. https://doi.org/10.1080/0163853X.2005.9651677.

Trabasso, T., & van den Broek, P. (1985). Causal thinking and the representation of narrative events. *Journal of Memory and Language, 24*(5), 612–630.

van der Hallen, R., Evers, K., Brewaeys, K., Van Den Noortgate, W., & Wagemans, J. (2015). Global processing takes time: A meta-analysis on local–global visual processing in ASD. *Psychological Bulletin*, *141*(3), 549–573. https://doi.org/10.1037/bul0000004

van den Broek, P. (1990). The causal inference maker: Towards a process model of inference generation in text comprehension. In D. A. Balota, G. B. Flores d'Arcais, & K. Rayner (Eds.), *Comprehension processes in reading* (pp. 423–445). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

van den Broek, P. (1994). Comprehension and memory of narrative texts: Inferences and coherence. In M. A. Gernsbacher (Ed.), *Handbook of Psycholinguistics* (pp. 539–588). Academic Press.

van den Broek, P., Risden, K., Fletcher, C. R., & Thorlow, R. (1996). A "landscape view" of reading: fluctuating patterns of activation and the construction of a stable memory representation. In B. K. Brtitton & A. C. Graesser (Eds.), Models of understanding text (pp. 165–187). Mahwah, NJ: Erlbaum.

van Kleeck, A. (2008). Providing preschool foundations for later reading comprehension: The importance of and ideas for targeting inferencing in storybook-sharing interventions. *Psychology in the Schools*, *45*(7), 627–643. https://doi.org/10.1002/pits.20314

van Neste, J., Hayden, A., Lorch, E. P., & Milich, R. (2015). Inference generation and story comprehension among children with ADHD. *Journal of Abnormal Child Psychology*, *43*(2), 259–270. https://doi.org/10.1007/s10802-014-9899-0

Vannest, K.J., Parker, R.I., Gonen, O., & Adiguzel, T. (2016). Single Case Research: web-based calculators for SCR analysis. (Version 2.0) [Web-based application]. College Station, TX: Texas A&M; University. Retrieved Sunday 24th March 2024. Available from singlecaseresearch.org

What Works Clearinghouse. (2022). *What Works Clearinghouse procedures and standards handbook* (Version 5.0). U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance. https://ies.ed.gov/ncee/wwc/Handbooks

White, S., Hill, E., Happé, F., & Frith, U. (2009). Revisiting the strange stories: revealing mentalizing impairments in autism. *Child Development*, *80*(4), 1097–1117. https://doi.org/10.1111/j.1467-8624.2009.01319.x

Whyte, E. M., & Nelson, K. E. (2015). Trajectories of pragmatic and nonliteral language development in children with autism spectrum disorders. *Journal of Communication Disorders*, *54*, 2–14. https://doi.org/10.1016/j.jcomdis.2015.01.001

Williams, G. L. (2021). Theory of autistic mind: A renewed relevance theoretic perspective on so-called autistic pragmatic 'impairment.' *Journal of Pragmatics, 180*, 121–130. https://doi.org/10.1016/j.pragma.2021.04.032

Wolfe, M. B., Magliano, J. P., & Larsen, B. (2005). Causal and semantic relatedness in discourse understanding and representation. *Discourse Processes, 39*, 165–187.

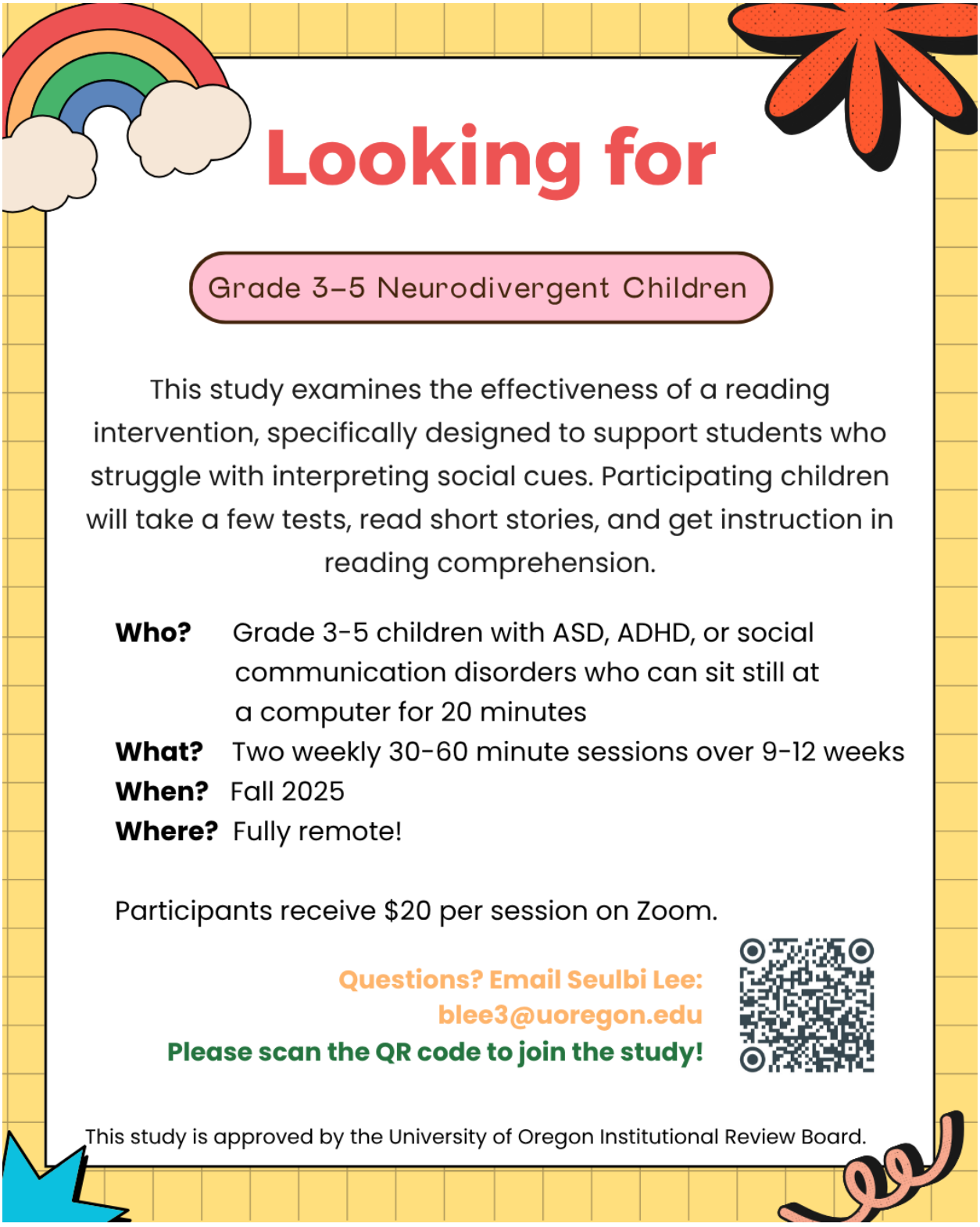
Yeari, M., & Lavie, A. (2021). The role of surface text processing in centrality deficit and poor text comprehension of adolescents with attention deficit hyperactivity disorder: A think–aloud study. *Learning Disabilities Research & Practice*, *36*(1), 31–43. https://doi.org/10.1111/ldrp.12237

Zenaro, M. P., Rossi, N. F., Souza, A. L., & Giacheti, C. M. (2019). Estrutura e coerência da narrativa oral de crianças com transtorno de déficit de atenção e hiperatividade [Oral narrative structure and coherence of children with attention deficit hyperactivity disorder]. *CoDAS*, *31*(6), Article e20180197. https://doi.org/10.1590/2317-1782/20192018197

Appendices

Appendix A

Recruitment Materials



Se buscan

Niños neurodivergentes
de 3° a 5° grado

Este estudio investiga la efectividad de una intervención de lectura, diseñada específicamente para apoyar a estudiantes que tienen dificultades para interpretar las señales sociales. Los niños participantes tomarán algunas pruebas, leerán cuentos cortos y recibirán instrucciones sobre comprensión lectora.

¿Quiénes? Niños en 3°, 4° o 5° grado con autismo, TDAH, o trastornos de la comunicación social que puedan permanecer sentados frente a una computadora por 20 minutos

¿Qué? Dos sesiones por semana de 30 a 60 minutos, durante 9 a 12 semanas

¿Cuándo? Otoño del 2025

¿Dónde? ¡Totalmente remota!

Los participantes recibirán $20 por sesión en Zoom.

¿Preguntas? Envíe un mensaje a Seulbi Lee:
blee3@uoregon.edu

Por favor escanee el código QR para participar en este proyecto!

Este investigación está aprobado por la Junta de Revisión Institucional de la Universidad de Oregón.

Appendix B

Invitation to Study Email

Subject: Invitation to Participate in a Research Study

Dear [Parent's Name],

Thank you for your interest in our research study on reading and inferential reasoning skills for children. The study involves inviting you and your child to attend online meetings to complete a series of reading and comprehension tasks. During this study, we will have your child read or see comics and answer questions to better understand how children process both text and graphic narratives. Your child will receive virtual tokens to help keep them engaged. For every 4 tokens, I would like them to have a small tangible reward for engagement. This can be 20 minutes of free time on iPad, their favorite snacks, stickers, or other things that you use as a reward on a daily basis at home, which means I would need your assistance with this throughout.

We'd like to invite you and your child to participate in this exciting study. Participation includes a **screening session** to determine eligibility, followed by regular sessions over **nine to twelve weeks** if your child is eligible.

Here's what to expect during the screening session:

- **Duration:** Approximately 30-60 minutes.
- **Compensation:** Both you and your child will each receive a 10 gift card for this session.
- **Location:** Remote (Zoom link to be shared)

To schedule the screening session, please reply to this email with your availability or let me know a good time for a follow-up call.

If you have any questions or need additional information, feel free to contact me at _____.

We look forward to hearing from you!

Best regards,

Seulbi Lee

Appendix C

Pre-Screening Qualtrics Survey

Introduction

My name is Seulbi Lee, and I am a PhD candidate in Special Education at University of Oregon. This study aims to find out how effective instruction in asking and answering questions is for improving the social-pragmatic inferencing skills of neurodivergent students who struggle with interpreting social cues. I'm seeking Grade 3-5 students who are able to attend virtual meetings twice a week, for 9 to 12 weeks.

This survey is to determine your child's eligibility for the study. It begins with a few eligibility questions. If your child is eligible, you will be asked to provide additional personal and demographic information for further contact. If your child is not eligible, the survey will automatically end.

I appreciate your time and consideration in helping with my study. If you have any questions, please email me at blee3@uoregon.edu.

Eligibility

Is your child in Grade 3, 4, or 5?

- ☐ Yes
- ☐ No

What medical or educational conditions has your child been diagnosed with?

- ☐ Autism spectrum disorder
- ☐ Attention-deficit/hyperactivity disorder
- ☐ Social communication disorder
- ☐ Other
- ☐ No diagnosis

Do you agree with the use of a token economy for positive reinforcement during the study?

- ☐ Yes
- ☐ Maybe
- ☐ No

Please provide detailed information about the token economy system currently being used with your child at home or in their learning environments. Include specifics such as the type

of tokens used (e.g., stars, stickers, points), the behaviors or tasks being reinforced, the frequency of reinforcement, and how and when tokens are exchanged for rewards if applicable. Additionally, share details about the types of rewards offered (e.g., tangible items, activities) and any preferences your child has shown for particular rewards. This information will assist the interventionists in preparing personalized rewards for your child during the intervention.

_____

_____

The study involves you and your child attending virtual meetings twice a week for up to 60 minutes per visit for at least nine weeks. It will require you to be present in the same room with your child while they participate in the intervention. You will receive 20 per session. Are you able to participate in this manner?

- ☐ Yes
- ☐ Maybe
- ☐ No

Does your child speak any language other than English?

- ☐ Yes
- ☐ No

Is your child able to stay seated to complete tasks, in front of a screen, for up to 20 consecutive minutes?

- ☐ Yes
- ☐ Maybe
- ☐ No

Does your child use an augmentative and alternative communication (AAC) device? If so, please describe below.

- ☐ No
- ☐ Yes

Personal Information

What is your name? _____

What is your phone number? _____

What is a good number to text you at? _____

What is your email address? _____

What is your preferred method of contact? Check as many as apply.

- ☐ Phone call
- ☐ Text
- ☐ Email

When is the best time for me to contact you? Please provide days and times (e.g., Monday morning). _____

_____

Please check the time zone you are in.

- ☐ Eastern
- ☐ Central
- ☐ Mountain
- ☐ Pacific

Please share what state you are in. _____

Please check all the days and times you and your child are regularly available.

	9-10am	10-11am	11am-12pm	12-1pm	1-2pm	2-3pm	3-4pm	4-5pm	5-6pm	6-7pm
Mon										
Tues										
Wed										
Thurs										
Fri										
Sat										

Appendix D

Demographic Questionnaire

PID: _____ Date: _____

1. What is your child's race? You may choose more than one.
   - ☐ White
   - ☐ Black or African American
   - ☐ American Indian or Alaska Native
   - ☐ Asian
   - ☐ Native Hawaiian or Pacific Islander
   - ☐ Other: _____
   - ☐ Prefer not to say

2. What is your child's ethnicity?
   - ☐ Hispanic/Latino
   - ☐ Not Hispanic/Latino
   - ☐ Prefer not to say

3. What is your child's gender?
   - ☐ Male
   - ☐ Female
   - ☐ Non-binary/third gender
   - ☐ Prefer not to say

4. Is your child receiving special education services?
   - ☐ Yes
   - ☐ No

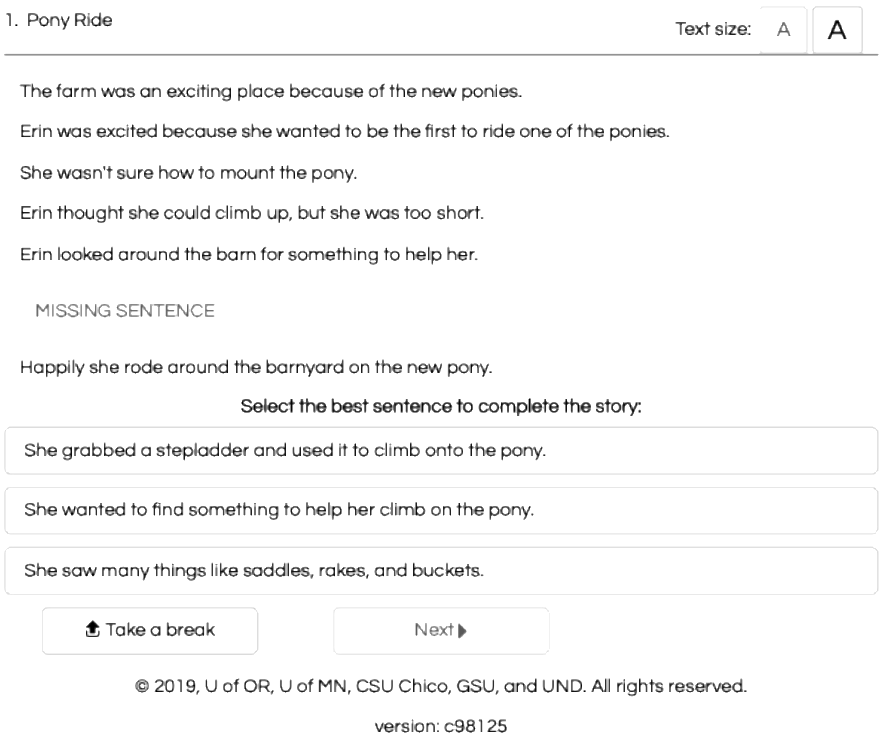
5. What is your child diagnosed with? Check all that apply.
   - ☐ Autism spectrum disorders (ASD)
   - ☐ Attention-deficit/hyperactivity disorder (ADHD)
   - ☐ Social communication disorder (SCD)
   - ☐ Other: _____

6. What is the child's mother's highest level of education attained?
   - ☐ Less than high school
   - ☐ High school graduate
   - ☐ Some college
   - ☐ 2-year degree
   - ☐ 4-year degree
   - ☐ Professional degree
   - ☐ Doctorate
   - ☐ Prefer not to say

7. What is the child's father's highest level of education attained?
   - ☐ Less than high school
   - ☐ High school graduate
   - ☐ Some college
   - ☐ 2-year degree
   - ☐ 4-year degree
   - ☐ Professional degree
   - ☐ Doctorate
   - ☐ Prefer not to say

Appendix E

MOCCA Example Questions and Layouts



1. Pony Ride

Text size: A A

The farm was an exciting place because of the new ponies.

Erin was excited because she wanted to be the first to ride one of the ponies.

She wasn't sure how to mount the pony.

Erin thought she could climb up, but she was too short.

Erin looked around the barn for something to help her.

MISSING SENTENCE

Happily she rode around the barnyard on the new pony.

Select the best sentence to complete the story:

She grabbed a stepladder and used it to climb onto the pony.

She wanted to find something to help her climb on the pony.

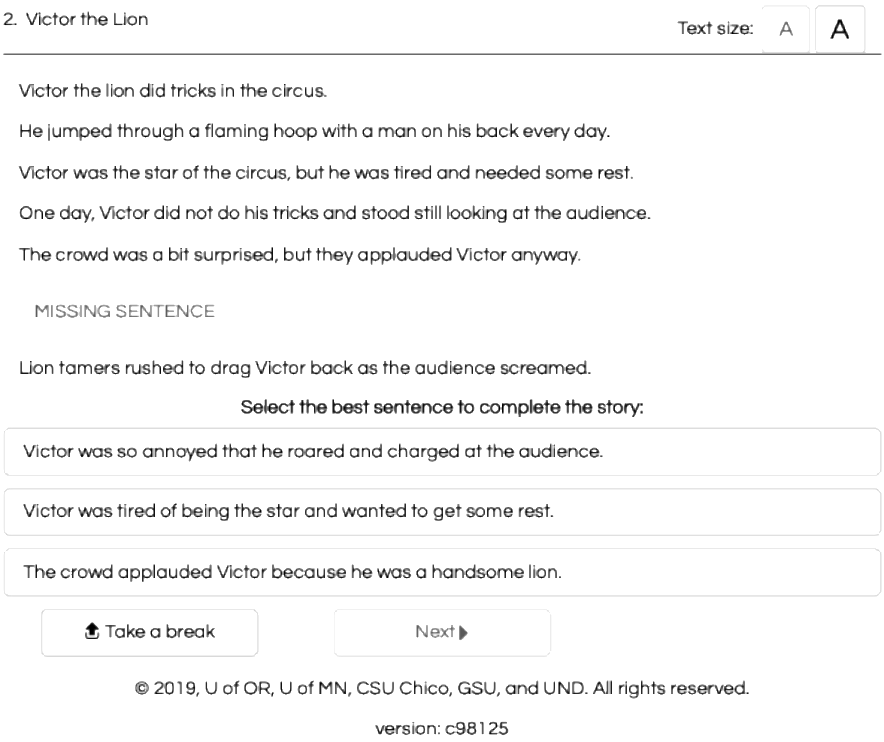
She saw many things like saddles, rakes, and buckets.

Take a break

Next

© 2019, U of OR, U of MN, CSU Chico, GSU, and UND. All rights reserved.

version: c98125



2. Victor the Lion

Text size: A A

Victor the lion did tricks in the circus.

He jumped through a flaming hoop with a man on his back every day.

Victor was the star of the circus, but he was tired and needed some rest.

One day, Victor did not do his tricks and stood still looking at the audience.

The crowd was a bit surprised, but they applauded Victor anyway.

MISSING SENTENCE

Lion tamers rushed to drag Victor back as the audience screamed.

Select the best sentence to complete the story:

Victor was so annoyed that he roared and charged at the audience.

Victor was tired of being the star and wanted to get some rest.

The crowd applauded Victor because he was a handsome lion.

Take a break

Next

© 2019, U of OR, U of MN, CSU Chico, GSU, and UND. All rights reserved.

version: c98125

Appendix F

Adapted Visual Language Fluency Index (Cohn et al., 2012)

Background Information Questionnaire

Age_____ Sex: M / F ID :_____

1. Using the following scale, on average, how often per week do you…? (place a whole number in the square)

Never ----------Sometimes----------Always
1 2 3 4 5 6 7

	Currently (mark 1 – 7)	**Which is your favorite? (mark with "X")**
…read text-only books for enjoyment		DO NOT MARK HERE
…watch movies		DO NOT MARK HERE
…watch cartoons/anime		DO NOT MARK HERE
…read comic books		
…read comic strips		
…read graphic novels		
…read Japanese comics (manga)		
…draw comics		

2. How would you rate your expertise with reading comics (of any sort)? (Mark "X" once in each row)

	Above average (5)	**Slightly above average (4)**	**Average (3)**	**Slightly below average (2)**	**Below average (1)**
Currently					

3. How would you rate your drawing ability? (Mark "X" once in each row)

	Above average (5)	**Slightly above average (4)**	**Average (3)**	**Slightly below average (2)**	**Below average (1)**
Currently					

4. How old were you when you began reading comics? _____ Drawing comics? _____

Appendix G

Adapted Visual Language Fluency Index - Parent (Cohn et al., 2012)

Background Information Questionnaire

Age_____ Sex: M / F ID :_____

1. Using the following scale, on average, how often per week do your child…? (place a whole number in the square)

Never ----------Sometimes----------Always
1 2 3 4 5 6 7

	Currently (mark 1 – 7)	Which is their favorite? (mark with "X")
…read text-only books for enjoyment		DO NOT MARK HERE
…watch movies		DO NOT MARK HERE
…watch cartoons/anime		DO NOT MARK HERE
…read comic books		
…read comic strips		
…read graphic novels		
…read Japanese comics (manga)		
…draw comics		

2. How would you rate your child's expertise with reading comics (of any sort)? (Mark "X" once in each row)

	Above average (5)	Slightly above average (4)	Average (3)	Slightly below average (2)	Below average (1)
Currently					

3. How would you rate your child's drawing ability? (Mark "X" once in each row)

	Above average (5)	Slightly above average (4)	Average (3)	Slightly below average (2)	Below average (1)
Currently					

4. How old was your child when your child began reading comics? _____ Drawing comics? _____

Appendix H

Intervention Graphic Organizer and Question Bank

Type 1. Right There Question

WHO?	
WHAT?	
WHEN?	
WHERE?	

Type 2. Think and Search Question

1. How did _____ lead to _____?
2. Why did _____decide to _____?
3. What led to _____ despite _____ in the story?
4. Why was _____important for _____?

Type 3. Author and You Question

1. How would you _____ if you _____?
2. How would you feel if _____?
3. What would you do differently if _____?
4. If you could _____ in the story, what would it be and why?

Appendix I

Item Bank Presented to Participant 1

Session	Item number	Modality	Narrative	Prompt 1
1	3-8	text	Aya struggles to make a basket. She has missed multiple shots. Her friend says, “Try to bend your knees more!” Aya follows her advice and makes the next shot. Aya and her friends cheer.	Why did Aya’s friend give her advice?
1	5-2	graphic	Layla was building a tall castle out of sand. Nate watched from the side. Layla looked up and asked, “Do you want to join me building the castle?” Nate nodded excitedly and joined her.	Why did Layla invite Nate to build the sandcastle with her?
2	3-3	text	Tim knocked over Annie’s tower of blocks by mistake. The blocks flew across the floor. Annie looked at the mess with wide eyes. Tim said, “I didn’t mean to! I will help to rebuild it” He started to pick up the blocks. Annie smiled and said, “It’s okay!”	Why did Annie say, ‘it’s okay!’?
2	6-4	graphic	Samira interrupts Ling while she is presenting an idea. Ling frowns then says, “Let’s hear your idea first. We will go back to mine after.” Samira says, “I am sorry. I would like to hear your idea, too.” Ling smiles and says, “It’s okay.”	Why did Ling tell Samira ‘it’s okay’?
3	3-4	graphic	Brian sat alone on the playground. He was looking down at his hands quietly. A group of kids were playing tag nearby. Jamie saw him and came to him to ask, “Hey, do you want to play tag with us?” Brian happily joined them.	Why did Jamie invite Brian to play tag?
3	2-2	text	There was only one spot left on the bench under the tree. Hana was sitting there. Leo walked over, holding his book, and looking unsure. Hana saw and moved over, patting the empty space. “You can sit here!” she said. Leo smiled back and sat down next to her.	Why did Hana make space on the bench for Leo?
4	2-7	text	Liam brings cupcakes to school for his birthday. As he comes to the classroom, he says, “I brought a lot so everyone can have one!” He smiles and starts to give the	Why did Liam bring cupcakes for his classmates?

			cupcakes to his classmates. His classmates cheer and thank him.	
4	6-2	graphic	Zara won the card game and cheered. Henry frowned and looked down. Zara stopped. “Do you want to play another round? Maybe you’ll win this time!” she said. Henry smiled and nodded, ready to try again.	Why did Zara ask Henry to play another round of the game?
5	5-7	graphic	Esme and her friend are raking leaves. Esme notices her friend struggling with a huge pile. She looks frustrated. Esme comes to her friend and says, “I can help you with this pile. It will be faster together.” They finish the work quickly. The backyard looks cleaner.	Why did Esme suggest working together on the pile of leaves?
5	6-1	text	Fred bumped into Gus and spilled his drink. Gus frowned. The juice dripped onto the floor. “I’m really sorry!” Fred said. Fred grabbed some paper towels. He started to clean up. Gus smiled and helped.	Why did Fred help Gus clean up the spilled juice?
6	3-7	text	Viktor is new to school and doesn’t know anyone. Caleb invites him to sit with his group at lunch, saying, “You can join us!” Viktor smiles and sits with them, feeling welcomed.	Why did Caleb invite Viktor to sit with him?
6	5-4	graphic	Beth was baking cookies in the kitchen. She was mixing the dough. Zach stood watching her. Beth smiled and handed him a bag of chocolate chips. “Here, you can add these!” Zach’s face lit up as he added the chips to the dough.	Why did Beth let Zach add chocolate chips to the cookie dough?
7	2-8	graphic	Nico is flying a kite. Behind her, Elias looks interested, but he does not say anything to her. Nico comes to him and says, “Do you want to try it?” She hands the string to him. Elias smiles and takes a turn.	Why did Nico share her kite with Elias?
7	6-3	text	Nia took Tony’s pencil during class without asking him. It snapped in two while she was using it. She said, “I’m sorry. I’ll get you a new one!” Tony looked upset. The next day, she gave him a new pencil. He smiled and said, “Thanks!”	Why did Nia replace Tony’s broken pencil?
8	2-9	text	Sam forgot his jacket and is shivering. JJ notices Sam is feeling cold. He says, “You	Why did JJ offer his sweater to Sam?

			can use my sweater," and hands his sweater over. Sam smiles and puts it on.	
8	6-6	graphic	Jiwoo is waiting in line to go to bathroom. Sora is behind her and looks urgent. Jiwoo asks, "Do you want to go first? I can wait." Sora runs inside saying nothing. Later, Sora thanks Jiwoo saying, "Thank you so much for earlier!"	Why did Jiwoo let Sora use the bathroom first?
9	3-9	text	Auggie is learning to ride a bike but keeps falling. Oliver comes to him and cheers for him. He says, "You are doing great! Keep trying, and you will get it." Auggie tries again and balances for a few more seconds.	Why did Oliver cheer for Auggie while he was learning to ride a bike?
9	4-6	graphic	Amy is sitting alone and looking at the ground. She looks sad. Zoe sits next to her. She asks, "Are you okay? What is wrong?" Amy sighs and says, "I had a bad day." Zoe asks what happened and listens to Amy. After sharing her day with a friend, Amy feels better. She says, "thank you for listening."	Why did Amy ask Zoe if she was okay?
10	3-1	graphic	Jade was swinging high on the playground swing. Nearby, Fay stood quietly, watching her. Noticing her watching, Jade slowed down and asked her, "Do you want a turn?" Fay grinned and sat on the swing.	Why did Jade give Fay a turn on the swing?
10	6-5	text	Lorenzo and Tariq were about to grab the same paintbrush at the same time. They both paused and looked at each other. Lorenzo says, "You can use it first. I can wait." Tariq smiles and says, "Thanks!"	Why did Lorenzo let Tariq use the paintbrush first?
11	5-6	graphic	Jane and Clara are in a race. Jane finishes her race early and sees Clara still running to the finish line. Jane cheers loudly for her. Clara smiles and runs faster to the finish line.	Why did Jane cheer for Clara during the race?
11	2-1	text	Cory was playing with a basketball in the park. Next to him, Jay watched, his eyes following the ball. Cory saw him and smiled. Cory asked Jay, "Do you want to play, too?" Jay nodded. They started playing basketball together.	Why did Cory offer to let Jay play?
12	2-3	text	The rain started as Noor stood in the doorway. Isa, holding her umbrella, glanced	Why did Isa share her umbrella with Noor?

			at Noor. “Come under here,” Isa said. She moved closer to Noor and held the umbrella over both of them. Noor smiled and said “Thank you!” as they walked together.	
12	4-7	graphic	Harry sits in his seat after a test and looks upset. He sighs. Jo notices that her friend is not happy. She sits next to Harry and says, “Don’t worry. Tests are hard for everyone. I struggled, too.” Harry feels better and ready to study more for the next try.	Why did Jo say tests are hard for everyone?
13	2-5	text	Ed was reading a comic book while lying on his stomach in the grass. His little sister sat close by. She kept glancing at the book. Ed noticed and looked up. “Want me to read it to you?” he asked. She nodded with a smile.	Why did Ed offer to read his comic book to his sister?
13	5-5	graphic	Jules struggles to start a campfire. Mike notices he looks frustrated. Mike says, “Let me show you how to set up the sticks better.” Jules watches and learns as Mike does it.	Why did Mike offer to help Jules with the campfire?
14	4-8	graphic	Ming loses a match and looks disappointed. Jun comes to him and says, “You played really well! It was a tough but good game. We will do better next time.” Ming smiles and nods.	Why did Jun compliment Ming after the match?
14	5-1	text	Lisa was placing puzzle pieces while Ted sat down next to her. Lisa paused and looked at him. “Here, you can put in the next one!” she said, handing a piece to him. Ted grinned, picked up the piece, and fit it into the puzzle.	Why did Lisa give Ted a chance to place a puzzle piece?
15	3-5	text	Diego fell in the hall and landed on his face. Joy ran to him to see if he is okay. “Are you okay?” she asked. Holding out her hand to him, she said, “It’s okay. I fell in the hall the other day too. It happens to everyone.”	Why did Joy say ‘it happens to everyone’?
15	1-5	graphic	Carl was staring at his math work, frowning. He could not solve the problem. Priya who was sitting next to him noticed his struggle. “Here, let me help you,” she said. She pointed to the steps on the page. Carl followed along. He smiled, proud he could solve it now.	Why did Priya help Carl solve the math problem?

16	4-2	graphic	Ron was tapping on the notecards while waiting to give a speech in class. Jin saw him looking nervous. She leaned over to say, “You will do great!” Ron looked up. He gave her a smile, saying “Thank you!”	Why did Jin say ‘you will do great’ to Ron before his speech?
16	1-6	text	Jinny looks stressed while flipping through her notes. Satomi comes and asks, “Do you need help? I can explain it.” Jinny nods. Satomi sits next to Jinny and starts explaining the topic.	Why did Satomi offer to help Jinny study?
17	4-4	text	Mei was staring at the ground during recess. Abe walked over wondering if she was okay. He sat down next to her. “Hey, are you okay?” he asked. Mei sighed and told him what was bothering her. Abe listened kindly.	Why did Abe ask if Mei was okay and listen to her?
17	5-8	graphic	Katie and Yumi are picking up trash in the park. Katie looks at her watch and notices the time. Katie says, “I can finish, if you need to go home.” Yumi waves as she leaves. Katie feels proud that she finished the cleanup herself.	Why did Katie suggest finishing the cleanup alone?
18	1-1	text	Fatima is struggling to carry a stack of books down a busy hallway. Kofi saw her and stopped. He smiled and said, “Let me help you.” He took some of the books. Fatima said, “Thank you.” They walked together.	Why did Kofi help Fatima carry her books?
18	3-6	graphic	Zane is playing a board game alone. He moves pieces. Daisy looks curious but hesitant. Zane looks up and asks her, “Do you want to play with me?” Daisy nods and joins the game with a smile.	Why did Zane invite Daisy to play the game?
19	3-10	text	Ethan wins a board game and cheers. His friend looks upset. He says, “I know. Do you want a rematch?” His friend smiles and says, “Sure!”	Why did Ethan offer a rematch?
19	5-3	graphic	After art class, Emma started picking up papers from the floor while Mac stood nearby. “Do you need help?” Mac asked, holding a trash bag. They cleaned the classroom together.	Why did Mac ask Emma if she needed help?

Appendix J

Item Bank Presented to Participant 2

Session	Item number	Modality	Narrative	Prompt 1
1	5-3	graphic	After art class, Emma started picking up papers from the floor while Mac stood nearby. “Do you need help?” Mac asked, holding a trash bag. They cleaned the classroom together.	Why did Mac ask Emma if she needed help?
1	1-5	text	Carl was staring at his math work, frowning. He could not solve the problem. Priya who was sitting next to him noticed his struggle. “Here, let me help you,” she said. She pointed to the steps on the page. Carl followed along. He smiled, proud he could solve it now.	Why did Priya help Carl solve the math problem?
2	4-6	text	Amy is sitting alone and looking at the ground. She looks sad. Zoe sits next to her. She asks, “Are you okay? What is wrong?” Amy sighs and says, “I had a bad day.” Zoe asks what happened and listens to Amy. After sharing her day with a friend, Amy feels better. She says, “thank you for listening.”	Why did Amy ask Zoe if she was okay?
2	2-2	graphic	There was only one spot left on the bench under the tree. Hana was sitting there. Leo walked over, holding his book, and looking unsure. Hana saw and moved over, patting the empty space. “You can sit here!” she said. Leo smiled back and sat down next to her.	Why did Hana make space on the bench for Leo?
3	4-2	text	Ron was tapping on the notecards while waiting to give a speech in class. Jin saw him looking nervous. She leaned over to say, “You will do great!” Ron looked up. He gave her a smile, saying “Thank you!”	Why did Jin say ‘you will do great’ to Ron before his speech?
3	6-5	graphic	Lorenzo and Tariq were about to grab the same paintbrush at the same time. They both paused and looked at each other. Lorenzo says, “You can use it first. I can wait.” Tariq smiles and says, “Thanks!”	Why did Lorenzo let Tariq use the paintbrush first?
4	3-10	text	Ethan wins a board game and cheers. His friend looks upset. He says, “I know. Do	Why did Ethan offer a rematch?

			you want a rematch?" His friend smiles and says, "Sure!"	
4	6-1	graphic	Fred bumped into Gus and spilled his drink. Gus frowned. The juice dripped onto the floor. "I'm really sorry!" Fred said. Fred grabbed some paper towels. He started to clean up. Gus smiled and helped.	Why did Fred help Gus clean up the spilled juice?
5	3-3	text	Tim knocked over Annie's tower of blocks by mistake. The blocks flew across the floor. Annie looked at the mess with wide eyes. Tim said, "I didn't mean to! I will help to rebuild it" He started to pick up the blocks. Annie smiled and said, "It's okay!"	Why did Annie say, 'it's okay!'?
5	5-2	graphic	Layla was building a tall castle out of sand. Nate watched from the side. Layla looked up and asked, "Do you want to join me building the castle?" Nate nodded excitedly and joined her.	Why did Layla invite Nate to build the sandcastle with her?
6	6-6	graphic	Jiwoo is waiting in line to go to bathroom. Sora is behind her and looks urgent. Jiwoo asks, "Do you want to go first? I can wait." Sora runs inside saying nothing. Later, Sora thanks Jiwoo saying, "Thank you so much for earlier!"	Why did Jiwoo let Sora use the bathroom first?
6	1-6	text	Jinny looks stressed while flipping through her notes. Satomi comes and asks, "Do you need help? I can explain it." Jinny nods. Satomi sits next to Jinny and starts explaining the topic.	Why did Satomi offer to help Jinny study?
7	4-1	text	Maya fell off her bike next to the bike rack. Her brother saw her crying and walked over. He knelt down and asked her, "Are you okay? Do you want a hug?" Maya nodded, and her brother gave her a hug.	Why did Maya's brother offer Maya a hug?
7	6-3	graphic	Nia took Tony's pencil during class without asking him. It snapped in two while she was using it. She said, "I'm sorry. I'll get you a new one!" Tony looked upset. The next day, she gave him a new pencil. He smiled and said, "Thanks!"	Why did Nia replace Tony's broken pencil?
8	3-2	graphic	Anika was walking at the park when she saw a red flower. She picked it up and admired it. Luke walked by and saw her holding the flower. "What is that for?" he	Why did Anika give the flower to Lucas?

			asked. Anika gave it to him. Luke thanked her for the sweet gesture.	
8	5-7	text	Esme and her friend are raking leaves. Esme notices her friend struggling with a huge pile. She looks frustrated. Esme comes to her friend and says, “I can help you with this pile. It will be faster together.” They finish the work quickly. The backyard looks cleaner.	Why did Esme suggest working together on the pile of leaves?
9	2-7	graphic	Liam brings cupcakes to school for his birthday. As he comes to the classroom, he says, “I brought a lot so everyone can have one!” He smiles and starts to give the cupcakes to his classmates. His classmates cheer and thank him.	Why did Liam bring cupcakes for his classmates?
9	3-5	text	Diego fell in the hall and landed on his face. Joy ran to him to see if he is okay. “Are you okay?” she asked. Holding out her hand to him, she said, “It’s okay. I fell in the hall the other day too. It happens to everyone.”	Why did Joy say ‘it happens to everyone’?
10	5-4	text	Beth was baking cookies in the kitchen. She was mixing the dough. Zach stood watching her. Beth smiled and handed him a bag of chocolate chips. “Here, you can add these!” Zach’s face lit up as he added the chips to the dough.	Why did Beth let Zach add chocolate chips to the cookie dough?
10	6-2	graphic	Zara won the card game and cheered. Henry frowned and looked down. Zara stopped. “Do you want to play another round? Maybe you’ll win this time!” she said. Henry smiled and nodded, ready to try again.	Why did Zara ask Henry to play another round of the game?
11	4-8	text	Ming loses a match and looks disappointed. Jun comes to him and says, “You played really well! It was a tough but good game. We will do better next time.” Ming smiles and nods.	Why did Jun compliment Ming after the match?
11	5-1	graphic	Lisa was placing puzzle pieces while Ted sat down next to her. Lisa paused and looked at him. “Here, you can put in the next one!” she said, handing a piece to him. Ted grinned, picked up the piece, and fit it into the puzzle.	Why did Lisa give Ted a chance to place a puzzle piece?

12	1-1	graphic	Fatima is struggling to carry a stack of books down a busy hallway. Kofi saw her and stopped. He smiled and said, “Let me help you.” He took some of the books. Fatima said, “Thank you.” They walked together.	Why did Kofi help Fatima carry her books?
12	2-8	text	Nico is flying a kite. Behind her, Elias looks interested, but he does not say anything to her. Nico comes to him and says, “Do you want to try it?” She hands the string to him. Elias smiles and takes a turn.	Why did Nico share her kite with Elias?
13	2-3	graphic	The rain started as Noor stood in the doorway. Isa, holding her umbrella, glanced at Noor. “Come under here,” Isa said. She moved closer to Noor and held the umbrella over both of them. Noor smiled and said “Thank you!” as they walked together.	Why did Isa share her umbrella with Noor?
13	3-7	text	Viktor is new to school and doesn’t know anyone. Caleb invites him to sit with his group at lunch, saying, “You can join us!” Viktor smiles and sits with them, feeling welcomed.	Why did Caleb invite Viktor to sit with him?
14	3-1	graphic	Jade was swinging high on the playground swing. Nearby, Fay stood quietly, watching her. Noticing her watching, Jade slowed down and asked her, “Do you want a turn?” Fay grinned and sat on the swing.	Why did Jade give Fay a turn on the swing?
14	1-7	text	May is struggling to open her locker in the hallway. She looks frustrated. Bobby notices and comes to her. He asks, “Do you need help? Let me try.” Bobby shows how to open the locker, and May says, “Thank you!”	Why did Bobby help May with her locker?
15	3-9	graphic	Auggie is learning to ride a bike but keeps falling. Oliver comes to him and cheers for him. He says, “You are doing great! Keep trying, and you will get it.” Auggie tries again and balances for a few more seconds.	Why did Oliver cheer for Auggie while he was learning to ride a bike?
15	5-6	text	Jane and Clara are in a race. Jane finishes her race early and sees Clara still running to the finish line. Jane cheers loudly for her. Clara smiles and runs faster to the finish line.	Why did Jane cheer for Clara during the race?

16	2-4	graphic	Amir was eating cookies while sitting on the steps. Next to him, Sofie sat silent and looking in her bag. Amir saw her, holding out the cookies. “You can have some of mine!” he said. Sofie’s face lit up as she took a cookie.	Why did Amir offer Sofie a cookie?
16	4-7	text	Harry sits in his seat after a test and looks upset. He sighs. Jo notices that her friend is not happy. She sits next to Harry and says, “Don’t worry. Tests are hard for everyone. I struggled, too.” Harry feels better and ready to study more for the next try.	Why did Jo say tests are hard for everyone?
17	2-9	graphic	Sam forgot his jacket and is shivering. JJ notices Sam is feeling cold. He says, “You can use my sweater,” and hands his sweater over. Sam smiles and puts it on.	Why did JJ offer his sweater to Sam?
17	4-3	text	Kai came in second place in the race. He looked upset. Neil walked over to Kai and said, “You were so close! I could never run that fast!” Kai stopped frowning and looked proud.	Why did Neil compliment Kai after the race?

Appendix K

Self-Monitoring Checklist

Expected Behaviors:

1. Session Preparation and Environment

    □ All required materials were present and accessible at the start of the session.

    □ The interventionist confirmed the participant's internet access and device functionality (e.g., camera, microphone) prior to or at the start of the session.

    □ The interventionist's background was free of significant visual and auditory distractions.

    □ The interventionist confirmed that the session was conducted in a confidential space, free from unauthorized listeners or viewers.

2. Technical Proficiency and Platform Use

    □ The interventionist demonstrated competence in addressing common technical difficulties (e.g., audio/video issues, screen sharing problems) to minimize session disruption.

    □ The interventionist effectively used the virtual platform's tools to facilitate instruction, display materials, and engage the participant.

    □ The interventionist followed established guidelines for secure virtual communication and data handling.

3. Instructional Delivery and Interaction

    □ All steps of the instructional procedure were followed in the correct sequence.

    □ Error correction procedures were implemented consistently and correctly.

    □ Praise statements were provided on a continuous schedule.

    □ A token was provided for on-task behavior on a variable-interval schedule.

4. Data Collection

    □ Data collection procedures were implemented accurately and consistently.

Fidelity Score Calculation:

Number of correctly implemented steps:

Total number of steps:

Fidelity Score (Number of correctly implemented steps / Total number of steps) * 100:

Notes or Comments:

Appendix L

Post-Intervention Survey

ID: Participant 2
Date: February 2nd, 2026

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1. I had fun being part of the study.					X
2. The lesson helped me develop good questions and understand stories better.				X	
3. The lessons were clear and easy to follow.				X	
4. The activities were fun and exciting.			X		
5. I feel more confident answering questions now.				X	
6. The books and graphic organizers we used were helpful and easy to read.					X
7. I think what I learned will help me in school.			X		
8. I would tell other kids to try the lessons too.			X		
9. I think the lessons were a good use of my time.				X	
10. I liked learning new skills on the computers or tablets.					X