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Research Article

Secondary Analysis of Reading-Based Activities Utilizing a Scripted Language Approach: Evaluating Interactions Between Students With Autism and Their Interventionists

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Students with autism spectrum disorder (ASD) often exhibit challenges with reading development. Evidence-based interventions and specialized approaches to reading instruction are currently being implemented across educational contexts for learners with ASD (Machalicek et al., 2008), yet there is limited understanding of how core ASD features may impact effective delivery of instruction and student participation. We begin to address this need by evaluating the reciprocity between instructional talk and student participation within a reading intervention utilizing a scripted language approach that was being piloted on students with ASD.

Method: This study used archival video-recorded observations from the beginning of a reading intervention to examine the interactions between 20 students (18 boys, two girls) with ASD (7–11 years old, M = 9.10, SD = 1.74) and their interventionists (n = 7). Lag sequential analysis was used to examine the frequency of student initiations and responses following the interventionists' use of responsive, open-ended, closed-ended, and directive language.

Results: Findings describe the types of and illustrate the variability in interactions between students and their interventionists, as well as highlight language categories that are linked to student participation.

Conclusions: These data provide a snapshot of the nature and quality of interactions between students with ASD and their interventionists. Findings suggest that delivery of instruction, including the language that interventionists use, may be an important area of focus when evaluating the effectiveness of reading-based practices across educational settings for learners with ASD, even within the confines of highly structured interventions.

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by differences in social communication and the presence of fixated interests and/or repetitive behaviors (American Psychiatric Association [APA], 2013). Current prevalence estimate that one in 59 children in the United States has ASD (Baio et al., 2018)—a rise in prevalence since 2016. Children with ASD are the fourth largest category of students served under the Individuals with Disabilities Education Act, constituting 11% of the 7.1 million children receiving special education services nationwide (Hussar et al., 2020). Many children with ASD face academic challenges and underachieve in reading development despite average to above average intellectual functioning (Huemer & Mann, 2010; Jones et al., 2009; Keen et al., 2016; Mayes & Calhoun, 2008; McIntyre et al., 2017). Although limited, studies have suggested that the core features associated with the ASD phenotype, such as the capacity for joint attention and social reciprocity, may interfere with active participation in learning opportunities (Iovannone et al., 2003; Kasari & Smith, 2013; Rotheram-Fuller et al., 2010) and may be linked to the high rate of academic difficulties observed in students with ASD (APA,

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2013; Bodner et al., 2015; Ricketts et al. 2013; Tirado & Saldaña, 2016).

In response to this critical area of need, available evidence-based interventions and specialized approaches to reading instruction are currently being implemented with students with ASD both within and outside the classroom. However, this raises two potential concerns. First, the effectiveness of these interventions for supporting reading development in students with ASD is unknown (LaBarbera & Soto-Hinman, 2009; Plavnick et al., 2015). That is, it is unclear whether the interventions are sensitive to and address the social communication needs observed in students with ASD (i.e., joint attention, initiating communication) or whether they need to be adapted for students to fully benefit from the learning opportunities. Second, given that students with ASD exhibit core social communication difficulties, it may be especially important to evaluate the quality of interactions between students with ASD and their instructors during reading interventions.

The types of talk that instructors use to encourage student participation and how instructors adapt their language to meet the individual needs of their students might be a critical component of the intervention's success. In the current study, we begin to address this need by examining the nature of and variability in interactions between students with ASD and their instructors during a language-based reading intervention in order to identify types of instructor language that support student participation. We believe that examining instructor–student interactions may provide a promising method for evaluating the effectiveness of the intervention for learners with ASD while highlighting salient instructional practices that promote student participation and learning.

Instructor–Student Interactions

Instructor–student interactions have been identified as a "key asset" in student development and an important intervention target for students with typical development and those at risk (e.g., Downer et al., 2010; Pianta, 2016). Empirical evidence has documented direct links between instructor talk and student talk (Connor, Adams, et al., 2019; Connor, Kelcey, et al., 2019; Jadallah et al., 2011) as well as predictive associations between high-quality interactions and students' reading development (Burchinal et al., 2008; Connor, Kelcey, et al., 2019; Downer et al., 2010; Mashburn et al., 2008; Murphy et al., 2009). It is suggested that interactions provide a means for instructors to facilitate critical thinking and a deeper understanding of text by encouraging students to contribute ideas and ask questions related to the text (Connor, Kelcey, et al., 2019; Lawrence et al., 2015; Michaels et al., 2008; Murphy et al., 2009; Taylor et al., 2005). Hence, through talk, students learn how to formulate and express their ideas, leading to a stronger mental representation and greater understanding of the text (Rapp et al., 2007).

Instructors' use of open-ended language has been highlighted as an element of talk that encourages participation and, thus, facilitates the learning process (Milburn et al., 2014; Pianta et al., 2002; Rimm-Kaufman et al., 2005). Open-ended language, such as asking open-ended questions ("Why do you think they are putting money in the machine at the laundromat?"), modeling academically rich vocabulary ("Realize. When you realize something you understand it. You can tell by her face that she realizes something."), and making contextual statements ("She's helping her daddy clean up by putting laundry into the machine."), has been associated with student participation (Ponitz et al., 2009), accelerated academic development (Burchinal et al., 2008; Hamre & Pianta, 2005), communication and language development (Walsh, 2002), and an increased frequency of student initiations (Mercer, 1996; Westgate & Hughes, 1997). Open-ended language has also been shown to elicit higher-order thinking (i.e., making predictions, drawing conclusions) and generative or interactive talk, in which students generate new ideas and make contributions to the topic (Connor, Kelcey, et al., 2019; Duke et al., 2011).

In contrast, instructors' use of closed-ended language, such as asking a choice and yes/no questions, often elicits simple, fixed, or constrained responses from students and has been associated with fewer instances of generative responses (Milburn et al., 2014; Sadler & Mogford-Bevan, 1997; Walsh, 2002). For example, asking a choice or yes/no question, such as "Was she at the store or in the house?" or "Did she go to the park?" will often elicit a one-word response, "store" or "yes." Although the use of closed-ended language may provide more structure to the interaction (e.g., Mirenda & Donnellan, 1986), it may limit opportunities for students to think critically about a text (Taylor et al., 2005), make inferences, express their ideas, and generate new ideas and creative responses—contributions linked to reading comprehension gains within the literature (e.g., Connor, Kelcey, et al., 2019; Kelcey & Carlisle, 2013; Murphy et al., 2009).

While interaction has shown to be an important platform for learning to read and comprehend text for many students, it might be an instructional barrier for learners with ASD due to core and associated social communication and language differences characteristic of the ASD phenotype. It is possible that the elements of talk that have been found to facilitate the learning process, such as open-ended language, operate differently among learners with ASD. Instructors might need to adapt their language to meet the unique communication needs of their students with ASD in order to facilitate successful participation and comprehension of the text (El Zein et al., 2014; Fleury et al., 2014; Whalon et al., 2009). Hence, the need to evaluate instructor–student interactions centered on text within language-based reading interventions and identify types of instructor talk that support active participation in learners with ASD has to be advanced.

Instructors' Responsiveness as a Core Intervention Component

Best intervention practices for learners with ASD call for a balance between systematic and consistent instruction

of curriculum content in which the intervention is implemented with high fidelity and flexibility of delivery (Iovannone et al., 2003; Schreibman et al., 2015), with instructors individualizing interventions to meet the needs of each learner (e.g., incorporating preferred activities, being responsive to the student's communication, progressing through or reviewing specific content). Most interventions have "active ingredients" or core components central to the intervention's effectiveness that are outlined on fidelity measures and guide training procedures and protocols (Kasari & Smith 2013; Schreibman et al., 2015). Yet, identified core components within interventions often center on specific curriculum content or predetermined instructional delivery (Kasari, 2002), with little emphasis given to how student characteristics may impact effective delivery. As Connor, Kelcey, et al. (2019) highlight in a recent article, "Teachers' practices can help us understand teaching, but they do not inform us about students' contributions to learning [as cited in Fenstermacher & Richardson, 2005]. Observations of teachers' practices without a measure of students' role in these learning opportunities are likely to be incomplete" (p. 2). This begs the question as to whether intervention manuals, training procedures, and fidelity measures should specifically highlight core components that center on the reciprocity between instructors and their students rather than solely focusing on the instructor.

Responsive Language

Instructors' responsiveness to students' contributions may be a core component of reading interventions for learners with ASD and a means for measuring the reciprocity between instructors and their students. Responsive language has been identified as a critical feature of high-quality interactions involving children with and without ASD (e.g., Howes et al., 2008; Koenen et al., 2019; Milburn et al., 2014; Whittaker et al., 2018). Broadly, responsive language has been defined as language that follows the child's lead, is warm and respectful, and delivered in an affectively positive manner (Burchinal et al., 2008; Girolametto & Weitzman, 2006; Landry et al., 2006). Within interactions, instructors who are responsive make "continuous mutual adjustments" (Nomikou et al., 2016) to acknowledge, provide feedback, and/or expand on their students' contributions. For example, an instructor might recognize a student's contribution as important, express interest in the student's ideas, and provide the student with feedback in a respectful and genuine manner (Connor, Kelcey, et al., 2019; Hamre, 2014; Lawrence et al., 2015). Instructors' use of responsive language in general education classrooms has been linked to higher levels of student achievement (Curby et al., 2009; Hamre & Pianta, 2005), social competence (Wilson et al., 2007), and fewer problem behaviors (Rimm-Kaufman et al., 2005). These effects are even stronger for at-risk populations (Merritt et al., 2012). Although there is far less available information on the effect of instructors' directiveness with their students, unlike responsiveness, instructors often use directive language to control student behavior, such as to stop and redirect students' behavior (de Kruif et al., 2000). Studies have suggested that instructors' use of directive language may be intrusive and negatively impact active participation in activities, as well as jeopardize the overall quality of the learning environment (de Kruif et al., 2000; McWilliam et al., 2002; Williford et al., 2017).

There is currently limited research regarding the role of instructors' responsiveness or directiveness on the learning and development of school-age children with ASD; however, the current literature examining young children with ASD may provide some insight. In a number of studies, responsiveness has been operationalized as adult behaviors that follow and build upon the child's focus of attention, such as responding contingently or using "follow-in" language to comment on what the child is seeing/experiencing or request additional information (e.g., Flippin & Watson, 2015; McDuffie & Yoder, 2010; Qian, 2018; Walton & Ingersoll, 2015). Parental responsiveness has repeatedly been shown to support early communication and language development in young children with ASD (Haebig et al., 2013; Yoder et al., 2001). Studies examining children with ASD in early childhood settings have also documented the important role that responsiveness plays in the development of language comprehension and expression, cognition, and social emotional skills (Girolametto & Weitzman, 2002). Although further research is needed to evaluate whether these effects are present during the school years, studies linking the use of instructors' responsive language to the development of social communication, language comprehension, and expression might be especially important to draw from, as they highlight skill areas that underlie reading development (National Reading Panel, 2000; Randi et al., 2010; Rapp et al., 2007).

Scripted Language Approaches for Learners With ASD

The vast heterogeneity of skill profiles observed in learners with ASD (Charman et al., 2011) may interfere with consistent and effective instructional delivery of interventions (Mandell et al., 2013; Suhrheinrich et al., 2013). Core social communication differences might make responding to instructors' questions or initiating ideas and questions difficult for many students with ASD (e.g., Kucan & Beck, 1997; Merritt et al., 2012). A limited capacity for joint attention, the ability to coordinate attention between social partners and objects (Mundy & Burnette, 2005; Mundy et al., 2016), might create challenges for some students with ASD to attend to shared materials or follow a common conversational topic during interactions. Finally, expressive and receptive language often develop at different rates and different levels of competence in students with ASD (Eigsti et al., 2011), and extant research has demonstrated a link between oral language deficits and reading comprehension challenges in this population (Norbury & Nation, 2011; Ricketts et al., 2013).

Commonly developed scripted language approaches that outline explicit procedures in a scripted manner maximize fidelity of implementation and the likelihood of replication

across people and settings (Plavnick et al., 2015). Scripted language approaches are often highly structured and utilize predictable routines—instructional features that hold promise for students with ASD (Watkins et al., 2011). However, the effectiveness of these approaches for learners with ASD is unknown, as the literature demonstrates, previous studies "fell short of an established evidence-base" (Plavnick et al., 2015, p. 57). The current literature examining such approaches with learners with ASD does not adequately describe participant characteristics, intervention procedures, and whether gains in learning occurred because of modifications or adaptations made to the curricula. Hence, scripted language approaches may need to be modified or adapted to support the individual and highly variable communication needs of students with ASD. That is, students with ASD may not fully benefit from approaches that rely on communication and language skills as the primary modality for learning—they may need additional support to effectively follow along and engage in a common topic, comprehend oral language, and/or express their ideas and questions—this might be more intensified for learners who exhibit more ASD severity and/or co-occurring cognitive impairment (Mundy et al., 2012; Tager-Flusberg et al., 2005).

Although scripted language approaches, in which instructors ask guiding questions centered on a text, may provide a platform for students to practice using language and communication skills within a structured learning opportunity, they also do not highlight responsiveness as an important instructional feature and might not prompt effective communication in students with ASD. Scripted instruction often does not allow the flexibility for instructors to follow students' attentional focus or shift the topic of discussion to respond to students' contributions and interests—an instructional feature that may be critical for participation and learning. Training instructors to deliver scripted reading interventions without this flexibility might not adequately prepare them to respond to students' contributions or adapt their language to meet the needs of learners with ASD. Indeed, recommendations for best practices for learners with ASD suggest that, rather than a "one size fits all" formula, high-quality interventions are dependent upon the expertise of instructors to effectively individualize instruction and maximize the learning opportunity (Schreibman et al., 2015; Wetherby & Woods, 2006; Wong et al., 2015).

High-quality interventions should allow for flexibility and individualization of implementation while considering limits of acceptable variability (Kasari & Smith, 2013). Therefore, there is a potential tension between fidelity of intervention implementation and the need for instructional flexibility. Navigating this issue raises important questions regarding instructional quality and effectiveness of reading interventions for students with ASD. Evaluating the nature of and variability in instructor–student interactions within reading interventions might provide some insight into effective instructional practices for learners with ASD by highlighting malleable interaction features that support student participation and influence the overall quality of the interaction (Keen et al., 2016; Wong et al., 2015).

Study Purpose and Objectives

This study used archival video-recorded observations of a reading intervention that utilized a scripted language approach to examine the interactions between students with ASD and their interventionists. We conceptualized interventionist language across four categories derived from the research literature and the intervention protocol (responsive language, open-ended questions, closed-ended questions, and directive language) and student participation across two categories (communication initiations and responses). As part of the reading intervention, the interventionists followed a curriculum that included open- and closed-ended guiding questions. We included responsive language in our coding system because it has been identified as a key intervention feature for young children with ASD and an indicator of interaction quality within the classroom context (e.g., Downer et al., 2010). Similarly, we included directive language in our coding system because studies have suggested that it lowers interaction quality and limits students' participation (e.g., de Kruif et al., 2000). We discuss each component in detail within the Method section and within Table 1.

Overall, we were interested in understanding if there was variability in the types of language interventionists used and the degree to which students participated within the confines of a scripted language, reading intervention. We hypothesized that, even within the confines of a scripted intervention, decisions must be made by interventionists regarding how to respond to and scaffold students' contributions. This issue may be especially complex when working with students with ASD who demonstrate vast heterogeneity of communication and language skills. Interventionists' language, therefore, might be largely influenced by students' contributions within the interaction. The primary research aims of this study were to (a) gather information on the type and frequency of interventionist language and student participation, (b) examine the association between the two dimensions, and (c) evaluate patterns of interaction between students and their interventionists using lag sequential analysis.

Method

Sample Participants

Twenty school-age children (17 boys, three girls) with ASD of ages 7–11 years (M = 9.10, SD = 1.74) were recruited from local school districts and the University of California, Davis, MIND Institute participant database to participate in a reading intervention that was being piloted for students with ASD. All participating students met the following criteria: (a) had a clinical diagnosis of autistic disorder, Pervasive Developmental Disorder—Not Otherwise Specified, or Asperger's syndrome as defined by the *Diagnostic and Statistical Manual of Mental Disorders, Fourth*

Table 1. Interventionist language and student participation dimensions: definitions, examples, and coding specifications.

Interventionist language: Responsive language	**Examples**	**Coding specifications**
Immediate, affectively positive verbal responses that follow students' communicative contributions (Kim & Mahoney, 2004). Responsive language acknowledges and validates students' contributions within a given interaction and communicates to students that the interventionist is listening and interested in their thoughts and ideas. Interventionists respond to students' initiations and responses by commenting on or asking students to provide further information, seeking clarification, shaping or expanding on students' contributions, or responding in a manner that demonstrates genuine enthusiasm.	S: I have a puppy. We got him from a farm. T: *Wow, getting a dog sounds exciting!* S: I can make a wiggle cake. T: *Yes, you made the earthworm cake!* S: Embarrassed means like you are shy. T: *I love the way you have linked the word embarrassed to feeling shy. That's really good thinking!*	These codes yield the number of instances and percentage of times that interventionists respond to students' communication (initiations and responses). Codes are marked to indicate whether the interventionist directs language toward the individual student or the group.
Interventionist language: Opened-ended questions	**Examples**	**Coding specifications**
Content-related, open-ended questions in which the answer is not predetermined by the adult (Milburn et al., 2014). Open-ended questions challenge students to generate their own answers, eliciting generative responses that can be built upon for further discussion. Interventionists might pose questions in a manner that is unstructured or that encourages students to reason or inference. Interventionists might also ask follow-up questions to encourage students to expand on their responses.	*What are some ways that people can exercise?* *Where do people go to run errands?* *How do you think the girl will feel when she realizes what she has done?* *Why is she embarrassed? Tell me more.*	These codes yield the number of instances and percentage of time that interventionists ask students content-related, open-ended questions. Codes are marked to indicate whether the interventionist directs language toward the individual student or the group.
Interventionist language: Closed-ended questions	**Examples**	**Coding specifications**
Content-related, closed-ended questions that are structured in a manner to elicit a specific response, often a single word or short fixed responses (Milburn et al., 2014). Close-ended questions consist of interventionists' use of choice questions (e.g., Was she at the store or in the house?), yes/no questions (e.g., Did she have to go to the store to buy milk?), simple *wh*-questions (e.g., Where did she buy milk?), and fill-in questions (e.g., She went to the store to buy_____).	*How many dogs did the child have at the end of the story?* *At the beginning of the story, who was missing?* *Did they have to turn around?* *They went back to get the _____.*	These codes yield the number of instances that interventionists ask students content-related, closed-ended questions. Codes are marked to indicate whether the interventionist directs language toward the individual student or the group of students.

(*table continues*)

Table 1. *(Continued).*

Interventionist language: Directive language	**Examples**	**Coding specifications**
Interventionists' use of language to direct or redirect student behavior to comply in a specific manner (de Kruif et al., 2000). The use of language to demand the student to perform a given action (i.e., raise your hand) or redirect the student's attention and/or behavior (i.e., hands are quiet). Directive language also includes indirect requests to elicit a particular response (i.e., Where should your hands be?).	*Sit down in your chair.* *Say the word earthworm.* *Put a sticker here (pointing).* *Look over here at the book.*	The directive language codes yield the number of instances that interventionists use language to direct or redirect student behavior to comply in a specific manner.
Student participation: Initiating communication	**Examples**	**Coding specifications**
Initiating communication is a measure of both verbal and nonverbal communicative initiations directed toward others that serve an intention or purpose (Sparapani et al., 2016; Wetherby & Prizant, 2002). Students' initiations are categorized into three areas: *asking questions, making comments,* and *initiating other communication.* Other communication includes initiating a turn, regulating others' behavior, protesting, securing attention, and using repair strategies.	*What does fumble mean?* *Why are they eating that mushy food?* *Look here, they are from different countries!* *Wait, I need to finish this.*	The initiating communication codes yield the number of instances that students initiate communication with their interventionists and peers and the percentage of time that their initiations are on-topic (relevant to the text or activity). The codes are mutually exclusive.
Student participation: Responding	**Examples**	**Coding specifications**
Responding includes students' physical and social responses to questions from interventionists (Sparapani et al., 2016). Responses must be contingent upon the interventionists' question but do not need to demonstrate comprehension or compliance. Students' responses are categorized into two areas: *simple responses* (i.e., answering yes/no, choice, or simple *wh*-questions) and *generative responses* (interactive talk in which students generate new ideas and make unique contributions to the topic; Connor, Kelcey, et al., 2019).	T: What is she doing? S: *Running. (simple response)* T: He sat on the… S: *Floor. (simple response)* T: What do you think machines are made out of? S: *Nuts, bolts, and metal! (generative response)*	The responding codes yield the number of instances and percentage of times that students respond to open- and closed-ended questions from interventionists. Codes are marked in a manner to indicate the student's level of understanding (clear understanding; uncertainty) and are mutually exclusive.

Note. S = student; T = teacher.

Edition (APA, 2000) and (b) without the presence of severe motor delay/impairment, dual sensory impairment, epilepsy, cerebral palsy, psychotic symptoms (e.g., hallucinations or delusions), an identified genetic syndrome (i.e., Fragile X), or any major medical condition that could be associated with extended absences from school. In addition to the above criteria, parents completed the Social Communication Questionnaire, Lifetime Edition (SCQ-Lifetime; Rutter, Bailey, & Lord, 2003) and the Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012) to confirm ASD and gather information on ASD symptomatology. Written parental consent was obtained prior to the start of the intervention, and the study was conducted in compliance with the university institutional review board.

In regard to participant characteristics, the students showed marked variability in parent report of ASD symptoms (SCQ: $M = 22.32$, $SD = 7.13$; SRS-2 total score: $M = 82.06$, $SD = 14.14$), ranging from mild to severe impairment, and intellectual functioning, with an average nonverbal cognitive T score of 40.06 ($SD = 8.87$) and verbal cognitive T score of 34.38 ($SD = 9.56$), as measured by the Wechsler Abbreviated Scale of Intelligence–Second Edition (WASI-II; Wechsler, 2011). The participants also exhibited marked variability in their expressive vocabulary skills ($M = 80.05$, $SD = 19.34$) as measured by standard scores on the Expressive Vocabulary Test, Second Edition (EVT-2; Williams, 2007) and a group average listening comprehension scaled score of 2.5 ($SD = 3.08$) on the Understanding Spoken Paragraphs subtest of the Clinical Evaluation of Language Fundamentals–Fourth Edition (CELF-4; Semel et al., 2003). This variability we observed in our sample reflects the heterogeneity commonly observed among students with ASD (APA, 2013; Masi et al., 2017). Additionally, the participants came from a range of racial/ethnic backgrounds. Thirty percent identified as Caucasian, 20% identified as Asian, 20% identified as Hispanic/Latino, 15% identified as Middle Eastern, 5% identified as African American, and 10% identified as "Other."

Participating interventionists ($n = 7$) included two graduate and four undergraduate research assistants and one postdoctoral research scholar who had varying levels of prior experience working with individuals with ASD. The interventionists received a 2-hr orientation to the reading-based curriculum and training through peer modeling. They were also provided with feedback after their intervention sessions and through biweekly meetings to discuss progress and troubleshoot any problems from the start of the intervention. All interventionists achieved an average fidelity score at or above 90% before administering the curriculum, meaning that they were able to reliably adhere to the scripted curriculum prior to the start of the intervention. It is important to note that the fidelity measure captured instructional features of the session, such as degree of preparation, pacing of instruction, and overall quality. It emphasized the interventionists' use of recommended practices, including explicit instruction, guided practice, and opportunities for students to practice, yet, it only broadly captured whether or not the interventionists used the scripted language approach to scaffold student responses.

Standardized Measures

Students completed a cognitive, language, and vocabulary battery at intervention entry and exit, and parents completed social–emotional questionnaires. The measures administered at intervention entry were reported in the current study to help characterize the sample.

Autism Symptoms

The SCQ is a 40-item parent-rating screening tool that evaluates ASD symptom severity for children 4.0 years and older. In the current study, the SCQ was used to confirm ASD diagnosis for each of the study participants. The SCQ-Lifetime form focuses on the child's developmental history, yielding total scores with a recommended cutoff score of 15 or greater to indicate possible ASD. The SCQ is a widely used valid and reliable tool, with studies documenting strong correlations with the Autism Diagnostic Interview–Revised (Rutter, Le Couteur, & Lord, 2003) and alpha scores of internal consistency from .84 to .93. The SRS-2 is a standardized 65-item rating scale that measures the presence and severity of social impairment within the autism spectrum during naturalistic observations. The Parent Rating Scale (4–18 years) was used within the current study. The SRS-2 yields a total score that serves as an index of severity of social impairment, with a T score of 76 or higher indicating severe impairment, 66–75 indicating moderate deficiencies, and 60–65 indicating mild impairment. T scores of 59 and below are considered within typical limits. The SRS-2 was normed on a nationally representative sample. It is a widely used tool with good reported reliability and convergent validity with the Autism Diagnostic Interview–Revised, the SCQ, and the Autism Diagnostic Observation Schedule (Lord et al., 2002).

Cognitive and Executive Functioning

The WASI-II is an individually administered, norm-referenced measure of cognitive functioning. In the current study, the Block Design and Similarities subtests were used to measure nonverbal and verbal cognitive functioning, respectively. Block Design consists of 13 tasks that evaluate analysis and synthesis of visual stimuli, nonverbal concept formation, fluid intelligence, visual perception and organization, and visual–motor coordination. Similarities is a 24-item subtest that measures a student's verbal concept formation, crystallized intelligence, abstract reasoning, associative and categorical thinking, and verbal expression. WASI-II subtests yield age-normed T scores ($M = 50$, $SD = 10$). It was normed using a large national sample and has good overall reliability, with split-half reliability coefficients ranging from .87 to .91, test–retest coefficients ranging from .79 to .90, and interrater agreement coefficients ranging from .98 to .99.

Language and Vocabulary Skills

The CELF-4 is an individually administered standardized measure of language. The Understanding Spoken

Paragraphs subtest was used in the current study to evaluate students' ability to listen to spoken paragraphs of increasing length and complexity, extract meaning from the oral narrative, answer questions about the content, and use critical thinking strategies to make interpretations beyond the given information. Scaled scores from the CELF-4 (M = 10, SD = 3) were reported to help characterize the sample. The CELF-4 is a widely used measure of language and has overall good reported reliability, with stability coefficients ranging between .71 and .86 for the subtests. The EVT-2 is an individually administered, norm-referenced measure of expressive vocabulary and word retrieval. Standard scores from the EVT-2 (M = 100, SD = 15) were reported in the current study to help characterize the sample. The EVT-2 was normed with a national sample, is widely used, and has good reported reliability (coefficients ranging between .87 and .95).

Procedure

Overview of the Reading Intervention

Each of the students participated in a reading intervention utilizing a scripted language approach that was designed to support reading comprehension and vocabulary development by targeting comprehension skills in a specified scope and sequence. The intervention was drawn from The Simple View of Reading (Dreyer & Katz, 1992; Gough & Tunmer, 1986), a commonly used framework to delineate the separate skills that underlie reading comprehension. According to the Simple View of Reading model, students' linguistic comprehension skills, including structural language and higher-order discourse skills, make necessary and independent contributions to reading and understanding written texts. Hence, listening comprehension and vocabulary development were targeted within the intervention through the use of guided questions. The intervention materials and strategies aligned with recommended practices, including explicit instruction, modeling, and guided practice (Solari et al., 2018). The students were paired into groups of two based on their language and cognitive skills, and instruction was centered on high-quality children's books that matched their developmental abilities. Examples of the children's literature included *Stand Tall Molly Lou Melon, Knuffle Bunny, If You Give a Mouse a Cookie,* and *Miss Nelson Is Missing.*

Three cohorts of students participated in the pilot reading intervention. The first cohort participated in the intervention four times per week across 6 weeks in the summer 2015 (July and August). The second cohort participated in the intervention three times per week across 8 weeks in fall 2015 (October to January), and the third cohort participated three times per week across 8 weeks in winter 2016 (January to March). The curriculum was consistent across each of the cohorts, covering 6 weeks of materials across six books. Instructional levels progressed through the curriculum at different rates, but each group had multiple exposures to the stories with opportunities to answer guided questions and practice using similar vocabulary words.

As part of the intervention, the interventionists asked guiding questions before, during, and after reading the stories to encourage interaction and support comprehension of the text. All students were asked the same questions (as outlined in the curriculum). However, when students struggled to answer a guiding question, interventionists were trained to use a scripted language approach as a prompting hierarchy to help scaffold student responses. They were trained to first ask questions in an open-ended manner that encouraged students to think or reason about the text (i.e., Why do you think the girl is sad?) or respond with generative or creative answers (i.e., What types of materials are machines made of?). If students showed difficulty with responding, interventionists presented the questions in a closed-ended manner in which students answered with simple (i.e., What is a washing machine?), choice (i.e., Is there a bunny or a dog in the washing machine?), or yes/no responses (i.e., Did she leave her bunny in the washing machine?). If students continued to show difficulty responding, interventionists further simplified their language by using a fill-in strategy (i.e., The bunny was left in the_____) or eventually providing the student with the correct response to the question and asking them to repeat it. See Appendixes A and B for an example transcript and coded event logs, which further illustrate the scripted language approach used within the intervention.

Video-Recorded Observations

Weekly video observations were collected throughout the reading intervention. Each video observation included a lead interventionist and two students. In the current study, we examined the second or third intervention session from the first week of the intervention, when students were hearing the first storybook for the first time. We selected observations from the first week of the intervention in order to gather information on both the interventionists and students at the start of the intervention. The intervention sessions followed a similar scope and sequence and included the following activities: (a) reviewing reading group rules, (b) using hand signals to prompt use of cognitive reading strategies, (c) listening to a story to practice narrative comprehension, (d) answering content questions to monitor understanding, and (e) reviewing vocabulary to build background knowledge. In the current study, we coded interventionist language and student participation during three of the five activities—listening to a story, answering content questions, and reviewing vocabulary—in order to capture interactions centered on the text.

Observational Coding Procedure

We used a multiple pass procedure, coding one participant at a time, and included interventionists and students to ensure that coding was complete (Yoder et al., 2018). Two trained observers first coded the full intervention session to identify each of the activities outlined above from the full session (listening to a story, answering content questions, and reviewing vocabulary) using Noldus Observer

Video-Pro Software (Noldus Information Technology 2016). After activities were identified from the full session, two trained observers coded interventionist language and four trained observers coded student participation (coding one student at a time) across the three activities. See Table 1 for a summary of the definitions. Full definitions of the coding constructs are available from the corresponding author upon request.

Interventionist language was coded across four categories drawn from the current literature and the intervention protocol: responsive language (immediate, affectively positive verbal responses that follow students' communicative contributions), open-ended questions (unstructured questions), closed-ended questions (structured questions that elicit a specific response), and directive language (language used to direct behavior). Each instance of language was coded at the time of occurrence across the three activities to capture a frequency count of the categories of language interventionists used within the reading-based activities. In addition, language was coded in a manner to indicate whether the interventionist directed language toward an individual student or toward the group. Thus, the codes reflect the amount and type of language that each individual student experienced, yielding different counts per student. Student participation included initiating communication (nonverbal and verbal directed communication) and responding (physical and social responses to instructors' content-related questions) adapted from the Classroom Measure of Active Engagement (Sparapani et al., 2016). The initiating communication code derives a frequency count of the number of instances that students asked questions, made comments, and initiated other communication with their instructors and peers as well as a percentage score of their on-topic (relevant to the text or activity) initiations. The responding code derives the percentage of time that students responded to interventionists' language with simple or generative answers and the percentage of time that their responses showed clear understanding. The trained observers were blind to the research aims of the current study. See Appendixes A and B for an example transcript and coded event logs from the video observations.

Interrater Agreement

Interrater agreement for activity identification was calculated using 15% of the data and yielded an average point-by-point agreement score of 81% and an average Cohen's kappa coefficient of .81. Once activities were identified, interrater agreement was established for the instructor language and student participation dimensions using the smaller/larger index, which provides the total number of instances that the observers were in agreement (Yoder et al., 2018). All observers achieved interrater agreement with a minimum criterion of 80% agreement across five consecutive video observations. Once acceptable levels of agreement were established, interrater agreement was calculated for 20% of the coded data (randomly selected), using occurrence agreement, which is calculated by dividing the percentage of agreements among observers by agreements plus disagreements on the occurrence of each behavior (Yoder et al., 2018). Observers exhibited an average agreement score of 80.33% (range: 71.43%–94.10%) for the overall interventionist language dimension and 86.53% for the student participation dimension (range: 83.44%–89.57%). See Table 2 for interrater agreement information. It is important to note that lower interrater agreement between observers may reflect less frequent opportunities to observe specific behaviors (i.e., open-ended questions, asking questions, generative responding).

Analytical Method

Research Aim 1

Count metrics were used to provide information of the total number of instances that interventionists used the varying categories of language during the reading-based activities. Proportion metrics were used to derive the percentage of time that they responded to students' communication (related initiations and responses) as well as the percentage of time they used open- and closed-ended questions. The assumptions for the proportion metrics were met; relations between the numerators and denominators were positive and linear (Yoder et al., 2018). Descriptive statistics, including means and standard deviations, were calculated for each of the categories of interventionist language.

Similar to the interventionist language categories, count metrics were used to provide information of the total

Table 2. Interrater agreement for interventionist language and student participation dimensions.

Dimension	Occurrence agreement (%)
Interventionist language	75.92
Responsive language	71.43
Open-ended questions	94.10
Closed-ended questions	80.91
Directive language	
Student participation	85.30
Total initiations	83.48
Total related initiations	73.41
Asking questions	91.87
Making comments	73.33
Other communication	89.57
Total responses	79.51
Simple responses	75.92
Generative responses	71.43

Note. Interrater agreement was calculated on 20% of the data (randomly selected) using occurrence agreement (agreements/agreements + disagreements). Occurrence agreement is calculated by dividing the percentage of agreements among observers by agreements plus disagreements on the occurrence of each behavior (Yoder et al., 2018). Total initiations = total of all on- and off-topic initiations; Total related initiations = total of all on-topic initiations; Asking questions = on- and off-topic questions; Making comments = on- and off-topic comments; Other communication = initiating a turn, securing attention, using repair strategies; Total responses = simple and generative responses; Simple responses = all simple responses; Generative responses = all generative responses.

number of instances that students responded to interventionists' language and initiated communication. Proportion metrics were used to derive the percentage of time that students responded to open- and closed-ended questions with simple and generative answers as well as the percentage of time they initiated questions, comments, and other communication from their total initiations. In addition, accuracy metrics were calculated by dividing students' responses that showed clear understanding from their total number of responses and their on-topic initiations (relative to the activity or topic) from their total initiations. The assumptions for the proportion metrics were met.

Research Aim 2

The relations among the interventionist language and student participation dimensions (initiations and responses) were examined using Spearman's correlation coefficients due to the skewness observed with the student initiating communication variables as well as the small sample size. Spearman's correlations provide a more robust estimate when one or more variables are skewed or when extreme values are present (Mukaka, 2012).

Research Aim 3

Lag sequential analysis was used to examine the pattern of interaction between the students and their interventionists during the reading activities using Noldus Observer VideoPro Software. Lag sequential analysis is a technique that is used to capture the sequence or unfolding of two or more behaviors as they occur in time (Chorney et al., 2010). The method is often utilized to examine the temporal association between two or more observed behaviors—the extent to which the occurrence of one behavior alters the likelihood of a behavior that follows (Yoder et al., 2018). In this study, we used lag sequential analysis to examine whether the presence of specific interventionist language categories increased the probability of student participation within a 5-s tolerance window. Probability is recorded as a number between 0 and 1, with values approaching 1 indicating a higher likelihood that the occurrence of the following behavior will occur. We examined the following patterns of interactions: (a) the probability or likelihood that student communication (initiations and responses) followed open-ended and closed-ended questions, (b) the probability of students' generative and simple responses following interventionists' open-ended and closed-ended questions, and (c) the probability of interventionists' responsive language following students' initiations within a 5-s tolerance window.

Results

Preliminary Analyses

Distribution properties of the interventionist language and student participation dimensions were examined using descriptive statistics and visual inspection of histograms and scatter plots. For the interventionist language dimension, we identified one outlier for responsive language. For the student participation dimension, we identified two outliers for initiating communication (asking questions and making comments) and two outliers for responding (simple). After bringing the outliers within 2 *SD*s from the mean (Kline, 2015), all interventionist language variables were normally distributed (skewness and kurtosis values of < 2), and the shape of the distribution appeared linear. The distribution values of the student initiating communication variables were positively skewed. See Table 3 for descriptive information of the interventionist language and student participation dimensions.

We included 18 of the 20 students and their six interventionists within the analyses. Four interventionists taught one session, one interventionist taught two sessions, and one interventionist taught three sessions. We excluded one group (one interventionist, two students) from the analyses because the length of time that the students received instruction related to the text was expressively shorter than the other groups (4:35 [min:s] in total). Much of the session consisted of noninstructional time in which instruction was paused due to frequent off-task and disruptive behaviors, and interactions between the students and the interventionist primarily consisted of behavioral redirects (e.g., "sit down," "don't touch the camera"). Where interactions did focus on instructional materials, the interventionist quickly read through the story and asked the guiding questions—there was very limited participation overall from the students. It is important to note that both of the students in the group were male, in second grade, and 7 years of age. They both exhibited expressive language skills far below average for their age (Student 1: 59, Student 2: 38), which were the lowest scores of the sample. The two students varied in autism symptom severity, with Student 1 exhibiting an SRS-2 score of 49, "within typical limits" and Student 2 exhibiting a score of 76, "severe impairment." See Table 4 for descriptive information of the instructor language and student participation dimensions for these two students.

Overall, the sampled session lasted 25:15 (min:s; *SD* = 4:12) on average, ranging from 20:13 to 33:32 (min:s). The times reflect the total amount of time that students received instruction related to the text; transitions and/or noninstructional times were not included because we were only interested in analyzing interactions during instructional times. All students received the same instructional content across the three activities (listening to a story, answering content questions, and reviewing vocabulary). The differences noted in the sampled session times reflect variation in the amount and type of language that the interventionists used and the degree that students participated in the session.

Interventionist Language

Although the reading curriculum included scripted language, we observed variability in the amount and type of language that interventionists used during the sampled observation. See Table 3 for descriptive information. On average, interventionists responded to students' contributions 29 times (*SD* = 15.70) or 48.61% (*SD* = 24.18) of the

Table 3. Descriptive information of interventionist language and student participation dimensions.

Interventionist language and student participation dimensions	Descriptive statistics		Distribution properties		
	M	*SD*	Skewness	Kurtosis	Range
Interventionist language					
Responsive language	29.00	15.70	0.34	–0.47	4–59
Open-ended questions	9.94	3.80	–0.69	–0.14	2–15
Closed-ended questions	31.61	11.61	0.18	–0.27	13–56
Directive language	32.06	13.42	0.53	–0.06	13–63
Student communication					
Total initiations	41.22	38.12	0.82	–0.77	4–118
Total related initiations	37.00	35.65	1.02	–0.11	4–118
Asking questions	3.50	5.23	1.48	1.27	0–17
Making comments	25.56	26.80	1.08	–0.09	0–82
Other communication	12.17	10.77	1.17	0.56	1–37
Total responses[a]	20.00	6.09	0.46	0.64	8–34
Simple responses[a]	13.33	5.39	0.61	–0.48	6–25
Generative responses[a]	5.00	3.50	0.43	0.07	0–13

Note. Values are frequency counts (n = 18). Total initiations = total of all on- and off-topic initiations; Total related initiations = total of all on-topic initiations; Asking questions = on- and off-topic questions; Making comments = on- and off-topic comments; Other communication = initiating a turn, securing attention, using repair strategies; Total responses = simple and generative responses.

[a]Responses where student shows clear understanding.

time. However, some interventionists responded very frequently (59 times) to their students' contributions (90.32%), while others responded infrequently (four times) to their students' contributions (13.33%). In addition, interventionists asked relatively more closed-ended questions (M = 31.61, SD = 11.61) than open-ended questions (M = 9.94, SD = 3.80) during the reading-based activities, with 74.36% (SD = 12.08) of their total questions (M = 41.56, SD = 11.17) consisting of closed-ended questions. Finally, we documented high variability in the amount of directive language the interventionists used, with an average of 32.06 instances during the sampled observation (range: 13–63).

Table 4. Descriptive information of interventionist language and student participation dimensions for Students 1 and 2.

Interventionist language and student participation dimensions	Frequency counts (Students 1 and 2)	
	S1	S2
Interventionist language		
Responsive language	02.00	10.00
Open-ended questions	00.00	00.00
Close-ended questions	07.00	13.00
Directive language	10.00	16.00
Student communication		
Total initiations	04.00	03.00
Total related initiations	03.00	01.00
Asking questions	01.00	00.00
Making comments	02.00	01.00
Other communication	01.00	02.00
Total responses[a]	02.00	00.00
Simple responses[a]	02.00	00.00
Generative responses[a]	00.00	00.00

Note. Values are frequency counts during reading-based activities (4:35 [min:s]) for the two students excluded from the analyses. S1 = Student 1; S2 = Student 2; Total initiations = total of all on- and off-topic initiations; Total related initiations = total of all on-topic initiations; Asking questions = on- and off-topic questions; Making comments = on- and off-topic comments; Other communication = initiating a turn, securing attention, using repair strategies; Total responses = simple and generative responses.

[a]Responses where student shows clear understanding.

Student Initiations and Responses

On average, students responded (simple and generative) to interventionists' open- and closed-ended questions 65.72% (SD = 21.92) of the time—an average of 25.78 (SD = 6.49) times during the reading-based activities. Furthermore, they responded 63.15% (SD = 33.00) of the time to interventionists' open-ended questions (M = 6.11, SD = 3.38) and 31.13% (SD = 10.89) of the time to interventionists' closed-ended questions (M = 9.11; SD = 2.68). Of students' total responses, 85.93% (SD = 26.40) of their generative responses indicated clear understanding and 71.24% (SD = 16.20) of their simple responses indicated clear understanding. Furthermore, students initiated communication 41.22 (SD = 38.12) times on average during the reading activities, with 53.15% (SD = 21.17) of their initiations consisting of comments and 41.51% (SD = 24.54) consisting of other communication; only 5.35% (SD = 8.60) of their initiations consisted of questions. Of their total initiations, 89.44% (SD = 8.39) were on-topic, relating to the activity (M = 37.00, SD = 35.68). See Table 3 for descriptive information.

Correlations

We next evaluated the relations between the interventionist language and student participation dimensions. We observed moderate, positive correlations between

interventionists' use of responsive language and students' initiations (r_s = .66, p < .01) and simple responses (r_s = .50, p < .01), and interventionists' use of open-ended questions and students' generative responses (r_s = .47, p < .05). There were moderate-to-strong, negative associations observed between interventionists' use of closed-ended questions and students' generative responses (r_s = −.77, p < .001) and initiations (r_s = −.46, p < .05) as well as between interventionists' directive language and students' generative responding (r_s = −.50, p < .05). Finally, we observed a moderate, positive association between students' initiations and generative responses (r_s = .47, p < .05). The correlation matrix is presented in Table 5.

Lag Sequential Analysis

We used lag sequential analysis to examine how interactions between the students and their interventionists unfolded during the reading-based activities. Findings indicated that the probability of student participation (initiations and responses) following interventionists' use of open-ended questions was .49 (*SD* = .24), on average, and following closed-ended questions was .33 (*SD* = .09). We documented a low probability overall when examining students' generative responses following interventions' questions, yet a relatively higher likelihood of occurrence following open-ended questions (*M* = .27, *SD* = .15) than closed-ended questions (*M* = .05, *SD* = .07). The probability that students responded with simple responses was .23 (*SD* = .18) following open-ended questions and .29 (*SD* = .07) following closed-ended questions. Finally, we found that there was a .56 (*SD* = .31) probability that interventionists responded to their students' initiations.

Discussion

The utility of evidence-based interventions to support reading development in learners with ASD is unknown, as they may not fully address the complex and highly variable social communication and language needs that learners with ASD present (Plavnick et al., 2015). Many reading interventions focus on interaction as a key mechanism to support students' developing reading comprehension skills. However, it has been suggested that these recommended language-based approaches, in addition to the social, linguistic, and cognitive demands involved in learning to comprehend text, may present particular challenges for learners with ASD without the use of additional supports and/or adaptations (Charman et al., 2011; Fleury et al., 2014; Iovannone et al., 2003; Pellicano, 2010). Using archival video observations, we examined whether and how instructor–student interactions varied within the first week of a scripted language, reading intervention being piloted for students with ASD. We argue that the types of talk that interventionists use and how they adapt their language to respond to their students' communicative needs may be a core intervention component and a promising method for supporting active participation in learners with ASD.

This study contributes to an understudied area of research by exploring the reciprocity between students with ASD and their interventionists during reading-based activities rather than solely focusing on the instructor, as much of the previous literature has done. Our findings begin to disentangle the complexities involved in educating learners with ASD by (a) explaining salient features of instructional talk that are linked with student participation and (b) highlighting student characteristics that may impact effective delivery of instruction. These data also raise important questions regarding the need for balance between fidelity of implementation and flexible delivery of scripted interventions to meet the needs of learners with ASD. Studies have documented the importance of individualizing instruction for students with ASD while preserving the goals of any given intervention (Kasari & Smith, 2013), suggesting that, without flexible delivery, interventions can become overly rigid and lose the capacity for personalization and overall effectiveness. Yet, too much drift in instruction could potentially lead to deviation from the original intervention goals—which could impact the student's learning opportunity. Implications and future directions are discussed in detail below.

Table 5. Correlations between interventionist language and student participation dimensions.

Variables	1	2	3	4	5	6
1. Responsive language						
2. Open-ended questions	.01					
3. Closed-ended questions	−.06	−.27				
4. Directive language	−.20	−.09	.58*			
5. Total initiations	.66**	.22	−.46*	−.18		
6. Generative responses[a]	.13	.47*	−.77**	−.50*	.47*	
7. Simple responses[a]	.50*	−.43*	.14	.26	.27	−.09

Note. Correlations among the variables were examined using Spearman's correlations due to the skewness we observed with the student participation variables.

[a]Simple and generative responses that show clear understanding. *p < .05. **p < .01.

Interventionist Language and Student Participation

Responsive Language as a Core Intervention Component

In a study by de Kruif et al. (2000), teachers were classified into subgroups based on their use of responsive and directive language. Teachers who were responsive asked more open-ended questions, used a variety of language categories, and built upon students' interests, whereas teachers who were directive tended to stop and redirect students' behaviors, ask more closed-ended questions, and rarely elaborate on their students' contributions. Similarly, we found that some interventionists were highly responsive to their students, responding to most of their contributions, while others only responded to a few of their students' contributions. We observed this same pattern with interventionists' use of directive language, with some interventionists using

directive language more frequently than all other language categories. In addition, we found that interventionists' who used more directives also asked more closed-ended questions, and we documented a positive relation between interventionists' responsive language and more frequent student participation (initiations and responses).

Our findings provide preliminary evidence to suggest that instructors' responsiveness during reading-based activities might be an indication of the quality of instructor–student interaction for learners with ASD and a malleable feature of talk that could potentially impact the effectiveness of the intervention. It is possible that higher-quality interactions involving learners with ASD include relatively more responsive language than directive language. That is, listening, flexibly shifting, adapting, and responding to students' contributions may facilitate extended interaction, composition, and generativity and encourage a richer exchange overall (Milburn et al., 2014). However, being responsive requires interventionists to go beyond simply reading a curriculum script as they monitor and change the content and complexity of their language based on their students' contributions. Given that the likelihood for responsiveness in our study was overall low (.56 probability), it might be important to include guidance on using responsive language in training protocols and fidelity measures within reading interventions for students with ASD. Studies evaluating young children with ASD have documented success with training instructors to implement specific responsive language strategies, such as following the child's lead, listening, and responding to the child's communication—which improved reciprocity and led to positive outcomes (Girolametto & Weitzman, 2002; Girolametto et al., 2006; Milburn et al., 2014).

Our data are consistent with the current research literature. Studies have highlighted the critical role of responsiveness on social emotional, communication and language, and academic development in preschool-age children with typical development and those at risk (e.g., Downer, et al., 2010; Hamre & Pianta, 2007; Rimm-Kaufman et al., 2009). There are also a number of studies that have documented the critical role of adult responsiveness in the development of young children with ASD (e.g., Haebig et al., 2013; McDuffie & Yoder 2010; Walton & Ingersoll, 2015). In addition, studies have documented how detrimental the use of directive language without responsive language can be on the overall quality of an interaction, stating that directive language is intrusive and may hinder students' generativity and active participation (de Kruif et al., 2000; McWilliam et al., 2003). For example, Keen et al. (2005) suggested that limited responsiveness may further intensify problematic behavior and "extinguish" student communication (Keen et al., 2005, p. 30).

Affording Different Learning Opportunities

We observed vast heterogeneity in the amount and type of language that interventionists used and the degree to which students responded despite the structured nature of the intervention and scripted language approach that they were trained to deliver. In fact, we observed such significant variation in the language used by interventionists that some students would undeniably have experienced the intervention differently than others. Hence, the language that interventionists used may have afforded different learning opportunities for different students, and this might be explained in part by the degree to which students participated. This speaks to the dynamic, bidirectional interplay between students and their instructors, with each contribution simultaneously influencing and shaping the other throughout the interaction (Jadallah et al., 2011; Sameroff, 2009; Yoshikawa & Hsueh, 2001).

Although the interventionists in our study asked relatively fewer open-ended questions than all other language categories, we documented a positive link between open-ended questions and students' generative responses. There was also a significant, negative relation between their use of closed-ended questions and students' initiations and responses. This suggests that interventionists may have asked more open-ended questions to students who initiated and responded (with generative answers) more frequently and more closed-ended questions to their students who initiated and responded less often. When examining the sequential pattern between instructors' use of questions and students' participation, we also found that students were more likely to initiate and respond with generative answers when interventionists asked open-ended questions.

These data are consistent with the current literature that has outlined the facilitative nature of open-ended questions. Structuring questions centered on text in an open-ended manner may encourage a richer exchange and support text comprehension—providing students the opportunity to share their ideas and think critically about the text (e.g., Connor, Kelcey, et al., 2019; Lawrence et al., 2015; Milburn et al., 2014; Murphy et al., 2009; Ponitz et al., 2009; Sadler & Mogford-Bevan, 1997). While it is important that interventions allow enough flexibility to meet students' individual needs, modifications and/or adaptations should not scale down or jeopardize the quality of the learning opportunity. Rather, interventions should scaffold learning in a manner that affords equitable access to rich learning experiences for all students. In our study, the interventionists may have simplified interactions with their less communicative students by asking fewer open-ended questions and more closed-ended questions, potentially limiting the richness of the language environment (Turnbull et al., 2013). However, utilizing nuanced instructional strategies to help students initiate their ideas and respond to open-ended questions may have created a richer learning opportunity overall (Turnbull et al., 2013).

In addition, the positive relations we observed between interventionist' use of responsive language and students' initiations and simple answers may indicate that, again, interventionists were more responsive with more talkative students than to their less talkative peers—potentially creating a warm and sensitive environment for students who exhibited stronger communication and language abilities. Studies that have examined interactions between

caregivers and their young children with ASD have also documented a similar discrepancy, with caregivers more responsive when their children are communicative and more directive when their children have limited communication and language abilities (Kim & Mahoney, 2004; Sameroff & Fiese, 2000). This is potentially problematic given the importance of responsiveness in the development of communication and language, especially for at-risk populations (Koenen et al., 2019; Merritt et al., 2012; Williford et al., 2017), and might reveal a larger problem with providing equitable learning opportunities among learners with ASD who exhibit comorbid language and cognitive impairment compared to those who do not.

Instructor- and Student-Level Influences

The amount and type of language that the interventionists in our study used might have also been influenced by a number of student-level characteristics (Whittaker et al., 2018), such as students' severity of ASD symptoms, language, and cognitive abilities (MacMahon, 2004, as cited by Kasari & Smith, 2013). We found that the two students who exhibited expressive language skills far below average received less instructional time overall, and the interventionist used relatively more directive language than all other language categories. In addition, the interventionist did not use responsive language and used relatively fewer closed-ended questions and more directive language with Student 2, who exhibited more severe ASD symptoms and expressive language impairment. Similarly, Keen et al. (2005) found that instructors in preschool settings responded a little over half of the time to their students with ASD who exhibited severe expressive and receptive language impairment. In a recent study by Qian (2018), instructors in early childhood settings also used less responsive language, asking fewer follow-in questions to extend interactions, with their students with ASD who exhibited comorbid cognitive and language impairments. Additionally, studies have suggested that instructors are less responsive with their students who exhibit more problematic behavior, which, in turn, intensifies student problematic behavior and decreases the quality of the interaction (Koenen et al., 2019; Partee et al., 2019). Although future research is needed, taken together, this body of research provides evidence that students' language, cognitive skills, behavior, and severity of ASD symptoms impact the quality of their educational experiences and learning opportunities.

Although outside the scope of our study, previous studies have also outlined instructor-level influences that might be important to consider within future work, such as type of experience, level of ASD training (Locke et al., 2015), or level of education (Downer et al., 2010). Studies have documented that instructors with formal classroom teaching preparation often use more open-ended language with their students, such as asking open-ended questions and using strategies to encourage reasoning, than those without formal training (Radford et al., 2011). Additionally, de Kruif et al. (2000) documented that teachers' use of directive language was associated with lower levels of education within early childhood classrooms. Future research is needed to better understand the mediating and/or moderating role of instructor- and student-level influences and the impact they have on an intervention's effectiveness.

Overall, these findings reveal just how significant the role of the interventionist is when deciding how best to interact with students around a shared text. The vast differences in instructional talk that we observed reflect an inconsistency of the instructional approach. Whether differences in decision making are driven by the level of student participation, characteristics of the student, the interventionist's background and/or experience, or a combination, our findings provide evidence that the reciprocity between instructors and their students within interactions centered on text may be important to consider, as well as a means for measuring instructional quality. In addition, these data suggest a need for training interventionists to recognize core ASD features in order to engage with students with ASD in meaningful ways. Interventionists delivering scripted language approaches, therefore, may benefit from specific guidance on how to adapt their language to meet the individual needs of their students with ASD, while affording students equitable opportunities for participation and idea generation.

Strengths and Limitations

This study contributes to a limited body of evidence evaluating interactions between school-age children with ASD and their interventionists within a scripted language, reading intervention. We used a range of reliable and valid measures, including measures of language and cognition, to help characterize the sample and Noldus Observer VideoPro Software to code second-by-second examination of the interventionist language and student participation dimensions. In addition, student initiations were coded in a manner to capture the amount, type, and purpose of communication, and student responding was coded in a manner to capture the amount, type, and accuracy of responding. Furthermore, we used systematic sampling procedures, capturing only the times when students received instruction centered on text, timed-event sampling to code each instant of interventionist and student talk at the time of occurrence, and participant sampling methods to code one participant at a time within the video observation—recommended methods of best practice for systematic observation research (Yoder et al., 2018). Finally, the use of lag sequential analysis allowed us to examine how the interactions between students and their interventionists unfolded over time, highlighting specific categories of language that support (or hinder) student participation.

There are a few notable limitations. This study evaluated interactions in 20 students with ASD and their interventionists during a pilot reading intervention. The study was conducted within a clinical setting, outside the typical school day. The interventionists in the current study included undergraduate and graduate students (and one postdoctoral scholar) who were trained to deliver the intervention

with fidelity, rather than classroom teachers. Furthermore, fidelity was only captured prior to the start of the intervention. The fidelity measure used within the intervention centered on the interventionists' use of recommended practices (i.e., guided practice) and whether the interventionists used the scripted language approach to scaffold student responses. Less emphasis was given to "how" interventionists used the scripted language approach. This highlights a potential need for fidelity measures to include core intervention components that center on how interventionists use language to encourage reciprocity—as we highlight in the discussion. The small sample size and heterogeneity of the participants limit generalizability of the research findings. Future research is needed to replicate these findings using a well-characterized sample of students with ASD within a classroom setting.

Educational Implications and Future Directions

Improving educational experiences for learners with ASD inside and outside classroom settings is a critical area of focus for research and clinical practice. Because children's literature includes rich language and social scenarios, leveraging evidence-based book reading practices might provide a platform for promoting social communication and language development in addition to supporting reading comprehension skills in students with ASD. Interactions centered on text may afford students with ASD opportunities to practice initiating communication, such as making comments and asking questions related to a text. Small-group, reading interventions that are tailored to meet students' unique communicative needs might also provide opportunities for students with ASD to practice using language in a flexible and creative manner with their instructors and peers. Additionally, systematic observational research methods for evaluating instructor–student interactions may provide a promising method for assessing student participation and performance during reading-based activities for learners with ASD. Because of the marked heterogeneity observed within the ASD population, understanding specific student- and instructor-level influences that relate to high-quality interactions might be especially important.

Previous studies utilizing scripted language approaches encourage students to take responsibility within an interaction; instructors might ask an open-ended question and provide ample opportunities for students to respond and self-correct as necessary (Radford et al., 2015). Our findings may illustrate the need to outline specific guidelines on how to support high-quality interactions in which instructors ask open-ended questions and students contribute with generative responses, highlighting wait time, opportunities to self-correct, and the use of follow-up questions to allow students to expand on their contributions. Similar to previous studies, our findings also provide primary evidence that learners with ASD who exhibit more severe ASD symptomology and/or comorbid language and/or cognitive impairment may need additional support to actively participate in interactions centered on text (El Zein et al., 2014). For example, in a study by Muchetti (2013), students with ASD who were minimally verbal used response boards and other visual supports to express their ideas rather than solely relying on expressive language abilities to encourage participation within the reading intervention. Incorporating evidence-based practices for learners with ASD into reading intervention protocols could potentially improve instructional practices and support student participation within rich learning opportunities.

Finally, observing interactions involving students with ASD may help inform training and fidelity procedures. Training focus and the target for fidelity of implementation of reading interventions for learners with ASD might best be captured within the context of instructor–student interactions, interventionists' flexible delivery of language use, and the degree of student participation during the exchange rather than solely focusing on interventionists' knowledge of the curriculum content. Interventionists who are able to adapt their language to align with students' contributions would be fostering student participation and thus delivering the intervention with high fidelity. However, the effectiveness of this approach may be dependent upon how savvy instructors are in ASD symptomatology and their ability to individualize or adapt instruction to meet their students' unique communication needs. Since studies have suggested that high-quality interactions "drive learning" and support development (Pianta, 2016), targeted interventions designed to improve the quality of interactions among learners with ASD and their instructors during reading-based activities may be an important area of focus for future research.

Author Contributions

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Appendix A

Example Transcript: Reviewing Vocabulary Activity

Example Transcript: Reviewing Vocabulary Activity

*The interventionist is holding a book and asking the students a guiding question, as outlined in the curriculum. The **scripted language** from the intervention curriculum is bolded, and the non-scripted language is not bolded. Student 1 (S1) and Student 2 (S2).*

Interventionist: What's a laundromat? *Waits several seconds for the students to respond. When the students do not respond, the interventionist continues.* (**Open-ended question**)

Interventionist: **It will tell us in the book.** Let's find out.

S1 leans forward to turn the page of the book.

Interventionist: Wait a sec S1, I have to read this page first. (Responsive language)

S1: No! *He bites his hand.* (Initiation)

Interventionist: It's okay, S1. You can turn the page after I finish reading the words. (Responsive language)

S1 waits and then turns the page.

Interventionist: *Points to page.* **What is she doing? (Close-ended question**)

S2: She's cleaning up. (Simple response)

Interventionist: Yeah, she's helping her daddy clean up by putting laundry into the machine. See how she's helping her daddy, S1? (Responsive language)

S1: Laundry. (Initiation)

Interventionist: Yeah, they are putting laundry in the machine. (Responsive language)

Interventionist: I know that because I heard it from the book. *She uses a hand gesture from the curriculum to indicate direct recall of details from the book.*

S1: Four more to go? (Initiation)

Interventionist: *Points to the visual schedule in front of the students.* Yeah S1, we have four more items left on our agenda, and then we'll have a snack. (Responsive language)

S1 looks down at the schedule.

S1: Okay. (Simple response)

S2: Ohhhh, why is there money? *Points to page in book.* (Initiation)

Interventionist: Yes, these kinds of washing machines you have to put money in to turn on. They don't have a washing machine at their house. (Responsive language)

S2: Yeah, I have one at my house. (Initiation)

Interventionist: Hey S1, S2 says he has a washing machine at his house. Do you have a washing machine at your house? (Close-ended question)

S1: No. I mean yes. (Simple response)

Interventionist: S1, tell S2 about the washing machine you have at your house. Turn your body so you are looking at her when you talk. (Directive)

S1 turns to S2.

S1: We don't have money. (Generative response)

S2: Yeah. (Simple response)

Interventionist: S1, tell S2 what you put in your laundry machine at home. Shoes? Books?

S1: (laughing) That is ridiculous! (Initiation) I put like underwear, dirty laundry in the machine. (Generative response)

S2: Dirty laundry! (Initiation)

Interventionist: Right. You both have machines that you don't have to add money to. At the laundromat, you have to pay money! (Responsive language)

Here, the interventionist asks **an open-ended question, but when there is no response, the interventionist scaffolds the interaction by providing a visual and simplifying the question**. When S1 gets upset about turning the page, the interventionist uses responsive language to acknowledge his feelings and provide a predictable endpoint.

The interventionist is using responsive language, responding to the student's contribution to shape and expand on the student's response by modeling rich language.

S1 initiates communication and the interventionists briefly responds by providing predictability and a clear endpoint before moving forward with the curriculum content.

S2 initiates a question about the picture in the book. The interventionist responds by providing information. The interaction continues as S2 initiates a comment when making a connection with the text. The interventionist then tries to engage S1 in the interaction by asking a close-ended question. S1 responds with a simple response.

Continuing the discussion, the interventionist asks S2 an open-ended question but scaffolds the interaction by providing choices. S2 first initiates and then responds with a generative response. The interventionist wraps up the extended interaction by responding to the students' contributions.

Appendix B (p. 1 of 4)

The following sample extracts provide detail of interventionist–student interactions across three different sessions from the reading intervention. The extracts are from coded event logs captured using Noldus Observer Video-Pro Software (Noldus Observer Software XT 14, 2017) and include every instance of interventionists' language across the following four dimensions at the time they occurred: responsive language, open-ended questions, closed-ended questions, and directive language. The sample extracts also indicate whether the interventionists directed language toward an individual student or the group of students. In addition, every instance that students' initiated communication (*asking questions, making comments, initiating other communication*) and responded (*simple and generative responses*) to interventionists' questions were also recorded at the time of occurrence. See the article and Table 1 for detailed definitions of the teacher language and student participation dimensions.

The extracts include the interventionist language and student participation during approximately 2 min of the same reading-based activity, *answering content questions.* During this activity, the interventionists asked the students guiding questions centered on the text to encourage interaction and support comprehension as outlined in the curriculum. However, as can be seen in the extracts, the scriptedness of the intervention, whether and how the interventionists used the prompting hierarchy to scaffold student responses, was highly variable. See the main article for detail on the scripted language approach. The purpose of these extracts are twofold: (a) to highlight the scripted versus nonscripted language that the interventionists used within the reading-based activity and (b) to demonstrate the variability in instructor language and student participation that we observed across different intervention sessions, as discussed in the main body of the article. To this end, extracts were purposefully selected to represent a diverse sample of delivery styles among the interventionists. Hence, the sample extracts illustrate the tension between fidelity of intervention implementation and the need for instructional flexibility while highlighting features of talk that encourage reciprocity, a balance of turns between interventionists and their students.

Within each extract, the students' contributions are in white, and the interventionists' contributions are in gray. The instructors' use of nonscripted language is italicized. Notice the instructors' use of open- and closed-ended questions and the frequency of students' contributions—whether they initiated communication (on- or off-topic) and/or responded to questions with simple or generative answers. Also, notice the degree to which the interventionists responded to the students' contributions (responsiveness) and the frequency they directed and/or redirected students' behavior and attention (directive language).

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Sample Extracts From Event Logs of Interventionist–Student Interactions

Extract 1. Interventionist A, Students 1 and 2.

Time (min:s)	Individual	Interventionist language and student participation	Interventionist directs
4:03	Student 1	Initiates other communication	
4:05	Student 2	Initiates other communication	
4:11	Interventionist A	Asks a closed-ended question	Student 1
4:19	Student 1	Answers with a simple response, uncertainty	
4:21	Interventionist A	Asks a closed-ended question	Student 1
4:26	Student 1	Answers with a simple response	
4:27	Interventionist A	*Responds to student's contribution*	Student 1
4:29	Interventionist A	Asks a closed-ended question	Student 1
4:32	Student 1	Answers with a simple response	
4:35	Interventionist A	*Directs student's behavior*	Student 1
4:53	Interventionist A	Asks a closed-ended question	Student 1
4:56	Student 1	Answers with a simple response, uncertainty	
4:58	Interventionist A	Asks a closed-ended question	Student 1
5:00	Student 1	Answers with a simple response, uncertainty	
5:01	Interventionist A	*Redirects student's behavior*	Student 1
5:05	Interventionist A	Asks a closed-ended question	Student 1
5:06	Interventionist A	Asks a closed-ended question	Student 1
5:08	Student 1	Initiates an on-topic comment	
5:11	Interventionist A	*Redirects student's attention*	Student 1
5:20	Interventionist A	*Directs students' behavior*	Student 1
5:21	Interventionist A	Asks a closed-ended question	Student 2
5:24	Student 2	Answers with a simple response	
5:30	Interventionist A	*Directs student's behavior*	Student 1
5:38	Student 1	Initiates an on-topic comment	
5:43	Interventionist A	*Directs student's behavior*	Student 2
5:54	Student 2	Initiates an on-topic comment	

Note. In the first extract, the students begin the interaction by initiating other communication; however, the initiation is not taken up by the interventionist. Notice that this pattern continues throughout the sample, with students initiating five times collectively, yet the interventionist rarely uses responsive language to extend on or further the discussion. This might suggest an emphasis on progression through the activity over an unanticipated discussion, even when the interaction is centered on the text. Furthermore, the interventionist begins by asking the students the outlined guided question in a closed-ended manner rather than open-ended, as outlined in the prompting hierarchy. This pattern of asking closed-ended questions continues throughout the sample, and in turn, students offer only simple rather than generative responses. Although there appears to be some reciprocity between the interventionist and students, with the students collectively responding to six out of the eight of the interventionists' questions, the exchange rarely evolves beyond a two-turn interaction, with the interventionist asking a simple-ended question and a student responding with a simple answer. Also, notice that the interventionist directs more closed-ended questions toward Student 1 (seven) than Student 2 (one) as well as directs/redirects Student 1's behavior and/or attention seven times. Student 1 also initiates and responds more frequently (three initiations, five responses) than Student 2 (two initiations, one response), which provides evidence that the degree of student participation may be influencing the interaction—the interventionist asks more questions to more talkative students. Overall, the instructors' limited use of responsive language and open questions might be indicative of a lower quality interaction (Koenen et al., 2019) that limits students' opportunities to generate new ideas and think critically around the text (Connor, Kelcey, et al., 2019).

Appendix B (p. 3 of 4)

Sample Extracts From Event Logs of Interventionist–Student Interactions

Extract 2. Interventionist B, Students 3 and 4.

Time (min:s)	Individual	Interventionist language and student participation	Interventionist directs
13:07	Student 3	Initiates other communication	
13:09	Interventionist B	*Responds to student's contribution*	Student 3
13:12	Student 3	Initiates an off-topic comment	
13:15	Interventionist B	*Responds to student's contribution*	Student 3
13:21	Interventionist B	Asks a closed-ended question	Student 3
13:24	Student 3	Answers with a simple response	
13:28	Interventionist B	Asks a closed-ended question	Student 4
13:32	Student 4	Answers with a simple response	
13:35	Interventionist B	*Redirects student's behavior*	Student 3
13:46	Student 4	Answers with a simple response	
13:47	Interventionist B	*Responds to student's contribution*	Student 3
13:57	Student 3	Initiates an on-topic comment	
14:00	Student 4	Initiates an on-topic comment	
14:03	Interventionist B	*Responds to student's contribution*	Student 4
14:04	Interventionist B	*Responds to student's contribution*	Student 3
14:15	Student 3	Initiates an on-topic comment	
14:16	Interventionist B	Asks an open-ended question	Student 3
14:17	Student 4	Initiates other communication	
14:19	Student 3	Answers with a generative response	
14:27	Interventionist B	*Responds to student's contribution*	Student 3
14:28	Interventionist B	Asks an open-ended question	Student 4
14:32	Student 4	Answers with a generative response	
14.41	Student 3	Initiates other communication	
14:43	Interventionist B	*Responds to student's contribution*	Student 3
14:48	Student 4	Initiates an on-topic comment	
14:50	Student 3	Initiates other communication	
14:57	Student 3	Initiates an off-topic comment	
14:59	Interventionist B	*Responds to student's contribution*	Student 3
15:00	Student 3	Initiates an off-topic comment	
15:09	Interventionist B	*Responds to student's contribution*	Student 3
15:15	Interventionist B	*Responds to student's contribution*	Student 3

Note. In the second extract, there is reciprocity between the interventionist and students, and the exchange is rich in quality overall. The interventionist uses a balance of open-ended (two) and closed-ended questions (four) to deliver the curriculum material, utilizing the prompting hierarchy to scaffold students' responses. In addition, the interventionist frequently responds to the students' contributions whether on- or off-topic, and the use of this nonscripted, following language appears to foster reciprocity and encourage extended interaction (13:47, 14:27 [min:s]). Furthermore, the students frequently initiate communication for varying intentions/purposes, and they respond to questions with simple and generative answers. The interventionist uses more responsive language with Student 3, who initiates more frequently (eight) than Student 4 (three) yet asks both students open- and closed-ended questions. The students respond with simple answers to closed-ended questions and generative answers to open-ended questions, highlighting the importance of giving students opportunities to think critically and generate new ideas centered on text.

Appendix B (p. 4 of 4)

Sample Extracts From Event Logs of Interventionist–Student Interactions

Extract 3. Interventionist C, Students 5 and 6.

Time (min:s)	Individual	Interventionist language and student participation	Interventionist directs
6:09	*A major disruption to learning starts at the beginning of the activity and instruction for both students stop*		Both students
6:09	Interventionist C	*Redirects student's behavior*	Student 2
6:10	Interventionist C	*Redirects student's behavior*	Student 2
6:12	Interventionist C	*Redirects student's behavior*	Student 2
6:13	Interventionist C	*Redirects student's behavior*	Student 2
6:20	Interventionist C	*Redirects student's behavior*	Student 2
6:23	Interventionist C	*Redirects student's behavior*	Student 2
6:29	Interventionist C	*Redirects student's behavior*	Student 2
6:34	Interventionist C	*Redirects student's behavior*	Student 2
6:37	Interventionist C	*Redirects student's behavior*	Student 2
6:40	Interventionist C	*Redirects student's behavior*	Student 2
6:46	Interventionist C	*Redirects student's behavior*	Student 2
6:49	Interventionist C	*Redirects student's behavior*	Student 2
6:51		*Instruction restarts for both students*	Both students
6:55	Student 1	Initiates other communication	
6:58	Student 1	Initiates other communication	
7:00	Interventionist C	*Responds to student's contribution*	Student 1
7:02	Interventionist C	*Redirects student's attention*	Student 2
7:11	Student 1	Initiates other communication	
7:14	Interventionist C	*Responds to student's contribution*	Student 1
7:16	*A major disruption to the activity starts and instruction for both students stop*		Both students
7:17	Interventionist C	*Redirects student's attention*	Student 2
7:18	Interventionist C	*Redirects student's behavior*	Student 2
7:19	Interventionist C	*Redirects student's behavior*	Student 2
7:30	Interventionist C	*Redirects student's behavior*	Student 2
7:33	Interventionist C	*Redirects student's behavior*	Student 2
7:39		*Instruction restarts for both students*	Both students
7:52	Interventionist C	*Redirects student's behavior*	Student 2
7:52	Student 2	Initiates other communication	
7:53	Interventionist C	*Redirects student's behavior*	Student 2
7:55	Student 2	Initiates other communication	
7:58	Interventionist C	*Responds to student's contribution*	Student 2
7:58	Student 1	Initiates other communication	
8:03	Interventionist C	*Redirects student's behavior*	Both students
8:04	Student 1	Initiates other communication	
8:07	Interventionist C	*Redirects student's behavior*	Student 2
8:07	Student 1	Initiates other communication	

Note. The third extract was drawn from the intervention session that was excluded from the analyses. We have included it here because it provides an example of how interventionists' language can be largely influenced by students' contributions within an interaction. The interventionist primarily uses language to direct and redirect students' behavior to comply in a specific manner—the quality of the sampled interaction is poor. The interventionist does not deliver key session material as outlined in the curriculum, as the session primarily consists of bids to manage off-task behaviors. In turn, the students are not presented with opportunities to participate in the reading-based activity. Furthermore, the interventionist most often uses directive language following the students' on- and off-topic initiations, which, as outlined in the literature, may have further jeopardized the quality of the interaction and lead to more disruptive behavior (Keen et al., 2005). This suggests a potential hesitation or unpreparedness of the interventionist to engage in unanticipated or "off-topic" exchanges outside the curriculum and points out a challenge of delivering a scripted language approach to students with autism spectrum disorder who demonstrate limited language abilities and/or more severe autism spectrum disorder symptoms (as discussed in the main article).