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Targeting Oral Language and Listening Comprehension Development for Students with Autism Spectrum Disorder: A School-Based Pilot Study

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Abstract

This study investigates the effects of an integrated oral language and listening comprehension intervention for early elementary students with ASD. Students ($n = 43$) were randomly assigned to intervention or control comparison conditions, with intervention students receiving instruction in small groups of 3 or 4. Groups were led by special education classroom teachers 4 days per week across 20 weeks in the school year. Significant group differences were detected on measures of expressive vocabulary, narrative ability, and listening comprehension. This study provides preliminary evidence of the intervention's feasibility and effectiveness for intervening in language and early reading skills for students with ASD.

Keywords Autism spectrum disorder · Elementary · Reading comprehension · Oral language · School-based intervention

Introduction

Extant data has demonstrated that individuals on the autism spectrum (ASD) experience difficulties in the development of academic skills (Fleury et al. 2014; Jones et al. 2009). These obstacles are evident across the autism spectrum; children who are considered higher functioning, or children with ASD without intellectual disabilities (IDD), often exhibit learning challenges that are discrepant from their IQs (Estes et al. 2011). One particular area that recent studies have begun to document is the development of reading comprehension and its underlying component skills (e.g., Jones et al. 2009; McIntyre et al. 2017a, b; Nation et al. 2006, Ricketts et al. 2013; Solari et al. 2017, 2019). Studies examining individuals with ASD suggest that between 37 and 65% of samples have marked difficulties with reading comprehension (Estes et al. 2011; Huemer and Mann 2010; Jones et al. 2009; Mayes and Calhoun 2008; McIntyre et al. 2017b; Nation et al. 2006; Solari et al. 2019). This is a prevalence rate much higher than in typically developing individuals. This increased rate of comprehension difficulties may suggest that there are syndrome-specific deficits that disrupt adequate reading comprehension development (McIntyre et al. 2017b, Nation and Norbury 2005; O'Connor and Klein 2004; Randi et al. 2010).

Given the increased prevalence of reading comprehension difficulties in individuals identified with ASD, it has been suggested that there may be deficits inherent to ASD symptomology that also disrupt reading comprehension development (Nation et al. 2006; O'Connor and Klein 2004; Randi et al. 2010). As reading comprehension is a foundational skill that is crucial for academic and vocational success, research-based instructional practices to address the factors underlying these comprehension difficulties are much-needed in schools (Brown et al. 2013).

Reading Comprehension Development

Theoretical models and empirical data suggest that reading comprehension requires adequate performance on several underlying component skills; these skills are broadly characterized into two larger constructs: decoding and linguistic comprehension (Simple View of Reading; Gough and Tunmer 1986). Readers must first have adequate word-reading abilities in order to accurately and fluently decode the words on a page, then will need to combine these word-level skills

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with higher-order oral language processes to engage with and understand written text (Kirby and Savage 2008; Perfetti 2007).

Skilled readers have the foundational word reading abilities and linguistic skills needed for attentional resources to be allocated towards the construction of a 'situation model,' or coherent mental representation of the occurrences described within a story (e.g., Kintsch 1988). It is the case, especially with narrative or fictional text, that authors often do not provide a full, cohesive narrative to their readers. They may include semantic vagueness and causal or temporal discontinuities in their storylines (e.g., Zwaan et al. 1995). In order to gain meaning from text, skilled readers resolve these ambiguities by drawing upon their background knowledge to fill in the gaps (Kintsch and van Dijk 1978). For example, consider the following sentences: "The power went out on Friday night. Tom and Betty decided to have ice cream for dinner." To make sense of the latter sentence, readers must activate their prior knowledge that ice cream will melt in the freezer when the power goes out, and infer that Tom and Betty are attempting to avoid this outcome (Bowyer-Crane and Snowling 2005). By monitoring the events of the story and protagonists' actions, readers can create a coherent and richly connected situation model (Zwaan and Radvansky 1998). This level of text representation is associated with deep processing of the story—a depiction not of the text itself, but what the text is about (van der Schoot et al. 2010). In populations of children with ASD, very few studies have concentrated on interventions that target both the development of oral language skills as well as developing the narrative and inference-making abilities needed to engage in adequate mental representation of text.

Empirical studies have investigated these important aspects of reading comprehension in samples of children and adolescents with ASD. In general, the research suggests a higher incidence of reading comprehension disturbances despite intact word-reading and decoding abilities in many children and adolescents with ASD (e.g., Jones et al. 2009; Nation et al. 2006). However, as in typically developing children, individuals with ASD may present with heterogeneous reading profiles that change across time (Nation et al. 2006; Solari et al. 2019). The results of these studies suggest that several underlying subcomponents of reading comprehension may be of importance for students with ASD, including oral language and linguistic comprehension. This is similar to children who are typically developing, but there is an underlying factor that may be uniquely applicable to students with ASD: social cognition, or the ability to understand what others are thinking and feeling.

The Role of Oral Language and Social Cognition in the Development of Reading Comprehension for Children with ASD

Oral language skills are related to and predictive of reading comprehension in individuals with ASD (Lucas and Norbury 2014; McIntyre et al. 2017b; Norbury and Nation 2011; Ricketts et al. 2013). Oral language is comprised of several linguistic domains including structural skills (e.g., vocabulary, semantic and grammatical skills) as well as higher-order language skills (e.g., inferential and conceptual language, narrative discourse) (Catts et al. 1999). Structural skills emerge relatively quickly and easily for most children in early childhood and serve as the foundation to higher-level language skills that develop as children mature (Cain et al. 2004). When engaging with a story, the reader applies these skills to create and enhance a mental representation of the text. Therefore, students with ASD, who often display impairments and delays in spoken language, may find it difficult to glean the semantic context of a story and to resolve ambiguities within a text (Tager-Flusberg 2006). Even if structural language abilities are intact, children with ASD may still demonstrate reading comprehension impairments related to higher-order language difficulties such as inference generation (Norbury and Nation 2011; Ricketts et al. 2013).

Research has suggested that inference-making, or generating connections between textual elements to derive meaning about information not explicitly stated within a text, may be a particular challenge for individuals with ASD (Norbury and Bishop 2002; Norbury and Nation 2011; Saldaña and Frith 2007; Tirado and Saldaña 2016). Tirado and Saldaña (2016) found that even when individuals with ASD were able to detect inconsistencies within text and produce inferences at the local level, they were unable to respond to questions about the content of these inferences. This suggests that readers with ASD may be failing to integrate relevant information with background knowledge to create a rich representation of text (Cain et al. 2001; Tirado and Saldaña 2016; van der Schoot et al. 2012).

These oral language difficulties may be compounded by syndrome-specific social-cognitive impairments. This includes theory of mind, or the ability to infer others' mental states and emotions and to predict behavior (Howlin et al. 1999). Higher-order language abilities, including inference generation, are contingent upon this social understanding. During narrative text reading, students use knowledge about their own social experiences and the experiences of others as a lens to simulate and interpret the emotions experienced by the protagonists (Mar and Oatley 2008; Mouw et al. 2019). Understanding the perspectives

of the characters in a story and making predictions based on these viewpoints requires making social inferences about the story (Ricketts et al. 2013). Even simple children's tales often require social inferencing skills—for example, in *Little Red Riding Hood,* a young reader needs to infer that the wolf has dressed up as Red Riding Hood's grandmother and plans to eat her.

To investigate the role of social cognition in understanding narrative stories, Pelletier and Astington (2004) examined developing theory of mind abilities in 4- and 5-year-olds and their comprehension of spoken story narratives. They found that children with more advanced theory of mind demonstrated a coherent understanding of the story, over and above their oral language abilities. Therefore, the existing social deficits associated with ASD may be impeding text-inferencing abilities, especially for fictional texts that have highly social content (Bodner et al. 2015; Brown et al. 2013; Jolliffe and Baron-Cohen 1999). Children with ASD may be unable to extrapolate the social content of narrative stories and incorporate their own relevant experiences to support a rich mental representation and to derive coherent and meaningful ideas from text (Tirado and Saldaña 2016).

Instructional Strategies to Improve Oral Language and Listening Comprehension Skills

Explicit instruction of comprehension skills in oral contexts may allow students to develop key skills in oral language and listening comprehension while also supporting later reading comprehension abilities (Kendeou et al. 2005; Nation and Snowling 2004; Tabors et al. 2001). A study by Clarke et al. (2010) found that an intensive oral language intervention targeting vocabulary and spoken language was successful in improving the reading comprehension scores of typically developing 8- and 9-year-old children with comprehension impairments. These types of shared reading activities, where adults read out loud to children and promote text engagement by asking questions or commenting about the story (Hudson and Test 2011), may be one way to support oral language and comprehension development. Shared reading has demonstrated positive effects on the receptive and expressive language, social communication, and comprehension skills of young children (NELP 2008; Zevenbergen et al. 2003). Several studies have found that shared reading techniques are particularly useful in facilitating vocabulary growth (e.g., Walsh and Blewitt 2006, Zevenbergen et al. 2003) and listening comprehension skills in typically developing children (NELP 2008).

There is also evidence to support the delivery of these interventions in the classroom for children with ASD. A recent meta-analysis of shared reading interventions in children with ASD (aged 2 to 14) by Boyle, McNaughton, and Chapin (2019) found positive effects for shared reading interventions across a variety of age groups for learners with ASD. Shared reading had particularly large effects on listening comprehension when implemented by parents or teachers, which suggests that school-based interventions with a classroom teacher can be a powerful intervention strategy for students with ASD.

Whalon and Hart (2011) implemented one such intervention, using a question generation protocol with three children aged 5 to 10 with ASD. In one-on-one sessions, instructors taught participants to generate and respond to "wh-" (who, what, when, where, why) questions by verbally walking through the mental processes used to construct a question during reading. In subsequent sessions, instructors took turns with students in generating and responding to questions, and students completed visual checklists to monitor their participation and question-generating behaviors during story reading. Participants showed gains in the frequency of questions asked independently and an increase in the number of questions that were specific and relevant to the story. Additionally, a recent study Kim et al. (2018) found encouraging results in three students with ASD (aged 6 through 8). By using prompts before, during, and after one-on-one reading sessions, students were encouraged to activate relevant background knowledge to make inferences about the text and to summarize and retell the story. Participants demonstrated growth in narrative comprehension as well as improvements in on-task engagement.

Many children with ASD may also benefit from visual cues and pictorial supports during instruction. These visual devices support learners with ASD by restricting the language resources required for understanding or responding to a prompt (Marans et al. 2005). Whalon and Hart (2011) suggest that these visual representations may be even more important for younger students with ASD who are not yet reading independently. Additionally, allowing students to demonstrate mastery of concepts through a nonverbal format like drawing or writing may be better suited to their learning preferences and strengths (Leach and Duffy 2009). These strategies may also increase engagement during instructional time and provide opportunities for social interaction between students. For example, drawing a pivotal scene for the characters in the story may allow students to better consider characters' emotions and thoughts and how they relate to the story's plot (Leach and Duffy 2009).

Though the research base is still limited regarding the effectiveness of shared reading interventions for young learners with ASD, these studies suggest that shared reading activities may stimulate improvements in reading engagement and reading comprehension for students with ASD. However, the small sample sizes of these intervention studies may limit their generalizability and more research needs to be conducted as to whether these types of interventions are feasible for daily use in typical educational settings.

Current Study

Given the rising number of students with ASD (CDC 2018), school systems require interventions that address the specialized learning needs of children with ASD while still being practical for use in the classroom. Moreover, the Every Student Succeeds Act (ESSA 2015) and IDEA 2004 mandate that all children receive explicit and systematic reading instruction consistent with the findings from the National Reading Panel (NICHD 2000). Research is needed to define interventions that are feasible for educators to implement, thereby enhancing adoptability. Indeed, several studies have cited the need for interventions to be tested in the settings in which they are intended to be delivered, rather than clinical research environments (Cook and Odom 2013; Dingfelder and Mandell 2011; Kasari and Smith 2013). This is especially important for teacher-implemented, classroom-based interventions, as implementation challenges that arise in the school setting can potentially jeopardize the integrity of the intervention or diminish treatment effects.

Teacher-implemented interventions that take place in a child's regular classroom allow instructors to leverage the time children spend in school. It is important to consider whether an intervention requires extensive training, resources, or specialized skills that may impede delivery in the school setting (Busby et al. 2012). Interventions that are relatively easy to learn and are well-organized will be less burdensome for teachers and will have a higher chance of being using consistently in the classroom. Structured supports including step-by-step instructions, the use of manuals, and regular meetings with coaches are ways to decrease barriers to implementation and improve treatment outcomes (Wilson and Landa 2019). Additionally, providing group instruction rather than one-on-one sessions may be more efficient at meeting students' needs in classrooms and may better prepare these students for participation in social settings (Flores et al. 2013).

This study investigated whether the implementation of an integrated language and listening comprehension intervention would improve the oral language and listening comprehension abilities of elementary students with ASD. A small but growing research pool has shown the efficacy of shared reading intervention strategies to improve oral language and comprehension outcomes for children with ASD. This intervention incorporated these shared reading instructional design principles as well as other characteristics of effective instruction for students with ASD, including visual supports (e.g. Whalon and Hart 2011), repeated reading of texts (e.g., Lanter and Watson 2008), and multimodal forms of expression and learning (e.g., Leach and Duffy 2009). The majority of published reading comprehension interventions for students with ASD have used single-subject designs (e.g., Flores and Ganz 2009, Kim et al. 2018; Stringfield et al.

2011; Whalon and Hanline 2008). Though single-subject research is imperative in establishing effective practices for learners with ASD, the small number of participants may make it more difficult to provide group instruction or to aggregate findings and identify instructional practices as evidence-based. Given the heterogeneous nature of reading difficulties in students with ASD, a randomized controlled design may provide more insight into whether a single intervention could show positive impacts for a variety of learners rather than a single subset. Therefore, this study used a randomized controlled design to investigate the following research questions:

1. Do elementary-aged students with ASD randomly assigned to receive a targeted oral language and listening comprehension intervention demonstrate significant gains as compared to a no-treatment control condition on measures of oral language?
2. Do students who receive the intervention demonstrate improvements on measures of listening comprehension, compared to control students?
3. Are classroom teachers able to implement the intervention with adequate fidelity, and do they feel that the intervention is feasible for implementation in the classroom?

Method

Participants

Forty-three children with ASD, aged 5 to 9, were recruited from four school sites within a large rural school district in Northern California. All students received special education services under the classification of "Autism" and were enrolled in special day classrooms for students with ASD for 50% or more of the school day. Students in kindergarten or first, second or third grade were eligible to participate. Individuals with comorbidity with other syndromes or major medical disorders, significant sensory or motor impairments, or students who received their primary reading instruction in a language other than English were excluded from recruitment. The *Social Responsiveness Scale, Second Edition* (SRS-2, Constantino and Gruber 2012) was completed by teachers using a maximal cutoff score of 54 to determine inclusion in this sample (Schanding et al. 2012).

This study used a matched pairs block design to randomly assign participating students to either the "business as usual" control condition or the experimental condition. Students were randomized across classrooms. The experimental and control groups did not differ on any constructs or measures at pretest. The regional Institutional Review Board (IRB) approved recruitment and data collection procedures.

Written informed consent was obtained from participants' parents or legal guardians prior to any testing.

Measures

IQ

The Stanford-Binet Intelligence Scales, 5th Edition (SB-5; Roid 2003) provided an age-normed standardized measure to evaluate intellectual ability ($M = 100$, SD = 15). Two routing subtests, a non-verbal task (Object Series/Matrices) and a verbal task (Vocabulary) were administered and used to calculate each participant's abbreviated battery IQ (ABIQ; Roid 2003). For the abbreviated IQ battery, the alpha coefficients for age ranges included in the study were 0.91–0.92, with an average across all age ranges of 0.91.

Autism Symptomatology

The Social Responsiveness Scale, Second Edition (SRS-2, Constantino and Gruber 2012) is a 65-item parent or teacher report index of social behaviors in children with autism or typical development. Items are scored on a 1–4 Likert intensity scale to provide a quantitative index of social behaviors that are sensitive to change over time. The SRS was developed with a sample of 1900 children, and the total score has excellent short- and longer-term test–retest reliability (0.83 to 0.88 respectively; Constantino et al. 2004). The internal consistency alphas for the age ranges in this study ranged from 0.96 to 0.97.

Vocabulary

Expressive vocabulary was assessed with the Expressive Vocabulary Test, Second Edition (EVT-2; Williams 2007); subjects were asked to verbally identify a picture or provide a synonym for a word describing the picture. Coefficient alphas for the ages included in the study ranged from 0.94–0.97. Age-based standard scores ($M = 100$; SD = 15) were used in all analyses of expressive vocabulary.

Narrative Retell

The Narrative Memory subtest of the Developmental NEuroPSYchological Assessment, Second Edition (NEPSY-II; Korkman et al. 2007) was used in this study. The NEPSY-II is a comprehensive instrument designed to assess neuropsychological development in preschool and school-age children. The Narrative Memory subtest assesses story recall and retelling ability. In this subtest, examinees listen to a brief story and are asked to remember details of the story under free recall, cued recall, and recognition conditions. The reliability coefficients for this construct ranged from 0.72 to 0.76 for the age ranges included in this study. Age-based scaled scores ($M = 10$, SD = 3) encompassing all recall conditions were used in all analyses of narrative memory for this study.

Listening Comprehension

The Understanding Spoken Paragraphs subtest of the Clinical Evaluation of Language Fundamentals, 4th Edition (CELF-4; Semel-Mintz et al. 2003) provided an age-normed standardized ($M = 10$; SD = 3), discourse-level oral assessment of the ability to process and understand short passages and then respond to questions requiring both factual recall and inferential skills. The alpha coefficient in the manual for students with ASD was 0.90.

Fidelity

Videotapes of each of the teachers implementing the lessons were coded for fidelity of implementation using an instrument designed to be used with the original intervention program (Solari and Ciancio 2014). No coaching took place during these lessons, ensuring that these sessions were not influenced by the research staff. Two research assistants who had previous experience administering the original intervention program were trained on fidelity codes using a coding manual. Research assistants were blind to experimental condition. Lessons were coded for the following elements: (1) adherence to the program script and activities outlined in the lesson plan, (2) scaffolding students' learning and communication attempts and giving appropriate feedback, and (3) overall quality of the process for engaging students through appropriate instructional pacing, preparation and organization of materials, and the use of behavior management strategies to ensure students are actively involved in the lesson. Coding for adherence involved scoring 12 items as 3 (high fidelity: follows procedures and suggested wording), 2 (moderate fidelity: follows some procedures and uses general wording guidelines), or 1 (low fidelity: not following procedures, wording differs from script). Coding for scaffolding and student responding involved scoring 12 items as 3 (appropriate scaffolding: provides prompting and feedback), 2 (moderate scaffolding: provides some prompting and feedback but is inconsistent), or 1 (low scaffolding: does not prompt or provide feedback). Coding for quality of engagement involved scoring 8 items as 3 (high quality: all materials prepared, good instructional pacing, students engaged), 2 (moderate quality: materials mostly prepared, adequate instructional pacing, students somewhat engaged in lesson), or 1 (low quality: materials not prepared and disorganized, instructional pacing was dragging or rushed, students were distracted and not engaged). Interrater agreement was assessed on 25% of videos and ranged from 0.82

to 0.97. Two lessons from each teacher (one at the beginning and one at the end of the study) were randomly selected to be coded for fidelity.

Acceptability, Appropriateness, and Feasibility

Following the intervention, teachers answered questions from a 12-item measure of acceptability, appropriateness, and feasibility (adapted from Weiner et al. 2017). This measure used a 5-point Likert scale that ranged from 1 ("completely disagree") to 5 ("completely agree"). This measure has shown good reliability (Cronbach's alphas of 0.85–0.91).

Procedures

To assist with instructional grouping and to provide pretest data, students were administered the appropriate measures of the SB-5, EVT-2, NEPSY-II, and CELF-4. All assessments were administered individually, either in an unoccupied school classroom, school library, or in the school computer lab. Using a matched pairs randomized block design across classrooms, students were randomly assigned to either the experimental group or a control group. First, students were ranked based on their performance on pretest measures of cognition, oral language, and comprehension. Second, the sample was split to create matched pairs based on these scores. Third, students in matched pairs were randomly assigned to an instructional group (experimental or control). After random assignment, the 3 or 4 students that had been allocated to the experimental condition of the intervention in each classroom became the small groups used for instruction in this study. See Table 1 for sample characteristics.

Students' special education teachers provided the intervention within their classrooms. The research team trained teachers during a one day, six-hour professional development session. The session consisted of an overview of the study design and timeline, the theoretical underpinnings of the intervention, and characteristics of evidence-based reading instruction for students with ASD. Training also detailed intervention routines and included video exemplars, facilitated discussion, curriculum-linked knowledge building activities, and curriculum component role-play. In

addition to the initial training, the research team provided in-person coaching and observation during the intervention. Coaching occurred between 1 and 2 times per month, and included a combination of modeling, observation, and feedback to support high-fidelity implementation (Cornett and Knight 2009). Coaches had extensive experience delivering the intervention with special populations. During coaching sessions, the research staff also engaged in problem-solving discussions to consider instructional adjustments that may accelerate student progress but would not compromise the implementation fidelity or level of adherence to the specific procedures of the intervention.

This intervention was considered supplemental instruction to the school's typical English Language Arts (ELA) curriculum and was not used as a substitute or replacement for this basal instruction. All students, both in the experimental and control group, continued to receive the district's ELA curriculum throughout the course of the study. Students received this comprehension intervention during the classroom's language arts center time, in small groups of three or four. Each group met with their classroom teacher approximately 4 days per week for 30 min of instruction across 20 weeks in the school year, with an average number of 65 sessions (range 55–72). All but one of the teachers in this study had students in both the experimental and control conditions in their classroom. To control for potential contamination effects, teachers were requested to ensure that students allocated to the control condition did not participate in the group intervention, and that curricular materials were not accessible to the general classroom population except during scheduled intervention sessions. At the end of the study, posttest measures (EVT-2, NEPSY-II, and CELF-4) were administered to all participants.

Intervention

The intervention used in this study was adapted from a scripted vocabulary and listening comprehension intervention program developed by Solari and Ciancio (2014). The core instruction targeted listening comprehension strategies and story vocabulary using preselected storybooks that were included as a part of the intervention package.

Table 1 Descriptive statistics of demographic and outcome measures

Variable	Control (n=21)		Experimental (n=22)	
	Pretest	Posttest	Pretest	Posttest
Age (years:months)	6:8 (1:3)		6:8 (1:4)	
IQ	89.43 (15.29)		89.17 (10.96)	
Autism symptomatology	66.60 (9.83)		67.91 (8.55)	
Expressive vocabulary	88.00 (14.52)	89.85 (13.56)	86.59 (7.56)	94.14 (9.84)
Narrative retell	4.57 (3.33)	4.33 (2.50)	4.64 (2.68)	6.27 (2.33)
Listening comprehension	5.52 (3.27)	5.81 (3.27)	5.36 (2.28)	8.00 (3.19)

Each 30-min lesson consisted of a read-aloud of a target text (15 min), instruction in story vocabulary (5 min), and a written expression component related to the target text (10 min). Intervention components are outlined in Table 2.

Instruction included increasingly intensive levels of targeted comprehension strategies. Four strategies were included in this intervention: (1) direct recall of information from text, (2) making connections to one's background knowledge, (3) narrative retelling and narrative story elements, and (4) making inferences. Strategies were cumulative, such that the target comprehension strategy required mastery of the previous skill. For example, direct recall of information from the text is critical for drawing connections between one's own background knowledge and the experience of the characters in the text.

Comprehension units were intended to provide extensive exposure to and experience with the target comprehension strategy. The first lesson of the unit contained an introductory lesson with explicit instruction in the new skill and a brief activity for initial practice with the skill. Students were also introduced to a hand signal that was associated with the comprehension skill and would be used during strategy practice, as there is evidence to suggest that kinesthetic movements promote skill retention (Block et al. 2008). All subsequent lessons were centered around children's books. Books were mainly fictional and had an associated sequence of five lessons, with complete read-throughs of the book on the first and last days of the sequence. On the third, second, and fourth days of the sequence, smaller portions of the book were read aloud to provide more instructional time to discuss and practice the comprehension strategy. Through repeated readings, students were able to build on their knowledge of the characters and the narrative arc and deepen their comprehension (Lanter and Watson 2008).

Table 2 Intervention components

Intervention session	Procedure
Read-Aloud	Introduce guiding question and target comprehension strategy
	Read-aloud with teacher cues for think-aloud modeling and question prompts
	Review guiding question
Vocabulary	Provide child-friendly definition
	Students chorally recite words
	Engage in multimodal activity to support deep comprehension of words
Written Expression	Review previous lesson's activity (if applicable)
	Complete writing or drawing activity
	Students share with peers

Read-Aloud Component

Each lesson began with a review of the comprehension strategy featured in that unit and included the introduction of a guiding question for the read-aloud. The guiding question allowed students to focus on a key idea during the read-aloud, thereby setting a purpose for that day's reading. During the read-aloud, instructors paused at predetermined points in the story to engage in think-aloud modeling and prompt students for questions. Following the read-aloud, the instructor restated the guiding question and elicited student responses, using a prompting hierarchy to scaffold where needed. If students were unable to answer the guiding question, the instructor first provided a binary choice (e.g., "Did Imogene grow antlers or dog ears?") to elicit a response. If students continued to respond incorrectly, the instructor called for an imitation of the correct response (e.g., "Say, 'Imogene grew antlers on her head.'"). The read-aloud portion concluded with the instructor highlighting the target comprehension strategy and providing examples of when students used these strategies during the read-aloud.

Story Vocabulary

Each lesson included explicit instruction in 2 or 3 novel story vocabulary words. During the initial encounter of the target words during the read-aloud, the instructor provided brief child-friendly definitions. After the read-aloud portion, instructors provided explicit instruction in the word, presenting a definition and asking students to repeat the word chorally. Next, students engaged in activities to support deeper understanding. Vocabulary activities were multimodal, prompting students to "act out" the word, brainstorm a list of synonyms and antonyms for the word, or look at pictures and guess whether they were an example or non-example of the word. These activities were intended to actively engage students in vocabulary instruction and to allow for repeated contact with each word. On the last lesson of each book, teachers engaged students in a review activity of the 8–12 words that had been previously taught in that book.

Written Expression

The lesson concluded with a writing or drawing activity designed to support comprehension of the story and to provide individual and group practice with the target comprehension strategy. Student journals included activities such as drawing pictures related to the story, summarizing, and creative writing. Drawing activities encouraged visualization of characters, while story maps were used to assist students in sequencing story events and retelling. Other graphic organizers such as character maps or compare/contrast charts encouraged perspective-taking and character analysis and

allowed students to make connections between stories. Written activities included creative prompts inspired by the events in the narratives, such as writing a letter to a story character.

Curriculum Levels

The curriculum was divided into three instructional levels: Level 1, Level 2, and Level 3. These levels were based on story length and complexity and corresponded to content presented in kindergarten, 1st grade, and 2nd grade, respectively. For example, Level 3 storybooks included more words and complex language, whereas stories in Level 1 were simpler and shorter. The vocabulary and written expression activities were varied for each of the levels as well; activities in Level 3 included more paragraph writing and multicomponent graphic organizers, while activities in Level 1 were more focused on drawing and creative expression. In this study, levels were assigned based on age of group participants. If groups included multiple grade levels (e.g., children from 1st and 2nd grade), groups were formed based on the lowest grade level (1st grade, analogous to Level 2).

Statistical Analyses

All analyses were conducted using SPSS Version 25.0 (IBM Corp 2018). Two-way mixed analysis of variance (ANOVA) models were conducted to analyze the research questions of this study. A two-way mixed ANOVA is used where there are two or more groups measured repeatedly on the same scale. The first research question looked at whether there was a statistically significant interaction within groups over time, with a significant increase in the oral language constructs of expressive vocabulary and narrative retelling. The second research question examined whether there was statistically significant interaction within groups over time, with a significant increase in listening comprehension for the experimental group compared to the control group. The assumption of normal distribution was assessed using Kolmogorov–Smirnov and Shapiro-Wilks tests to determine kurtosis and skew of the data. The assumption of homogeneity of variance was tested using Levene's test for equality of variances. Independent t-tests were run to determine whether group means were significantly different on key pretest measures, as this could impact the interpretation of the results of the ANOVAs. There were no significant differences between groups on pretest measures of IQ, oral language or listening comprehension. A Bonferroni correction was applied to all univariate F-tests of simple main effects to reduce the risk of Type 1 error (i.e., the family-wise p-value of 0.05 was divided by the number of variables in the analysis, leading to a more stringent p-value of 0.025).

Results

A total of 45 participants were consented to enroll in the study; one child did not meet inclusion/exclusion criteria. Of the 44 students who participated in the intervention, one child was dropped from the study due to an extended absence from school. Data from 43 participants were included in the analyses. The sample of children for whom experimental outcome data are available included 35 males and 8 females with a mean age of 6:8 (SD = 1:3). Mean SB-5 Abbreviated IQ was 89.30 (SD = 13.04) indicating that most children in the sample did not have concurrent Intellectual Disability (IQ < 70). The sample included 13 White, 16 Hispanic/Latinx, 7 Asian, 1 Black, 1 Pacific Islander and 5 bi- or multi-racial participants. The sample included 2 participants who had a home language other than English. Six teachers provided the intervention in their classrooms. This sample included 4 White teachers, 1 Hispanic/Latinx teacher, and 1 Black teacher. Five of the teachers were female and 1 was male. Teachers had between 1 and 20 years of teaching experience prior to participating in the study, with an average of 7.7 years.

Oral Language

A two-way mixed ANOVA on expressive vocabulary scores with one repeated factor (time; pretest and posttest) and one grouping factor (experimental group vs. control group) was conducted. The ANOVA revealed a statistically significant interaction between experimental condition and time on expressive vocabulary, $F(1, 41) = 4.65$, $p = 0.04$, partial $\eta^2 = 0.10$; see Fig. 1. At posttest, there was not a statistically significant difference in the mean expressive vocabulary scores of students in the experimental and control conditions, $F(1, 41) = 1.41$, $p = 0.24$, partial $\eta^2 = 0.03$. However, there was a statistically significant increase on expressive
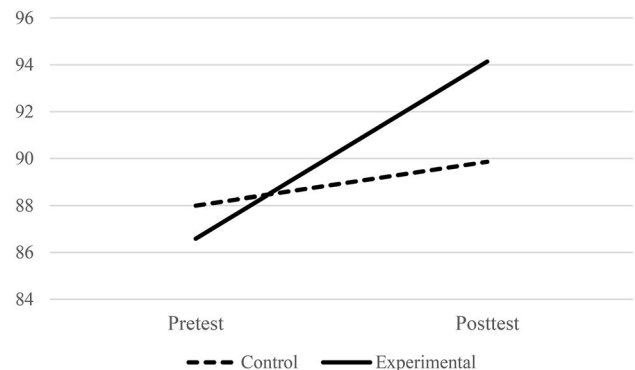
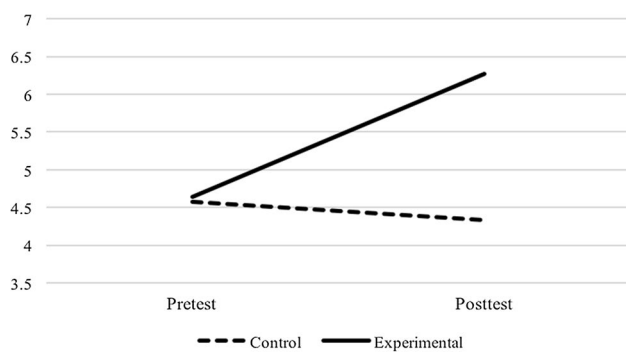**Fig. 1** Mean EVT-2 standard scores at pretest and posttest by experimental condition

Fig. 2 Mean NEPSY-II narrative scaled scores at pretest and posttest by experimental condition

Fig. 3 Mean CELF-4 listening comprehension scaled scores at pretest and posttest by experimental condition

vocabulary scores from pretest ($M = 86.59$) to posttest ($M = 94.14$) for students in the experimental condition, $F(1, 21) = 15.00$, $p < 0.01$, partial $\eta^2 = 0.42$. These results were not echoed for students in the control condition, whose mean scores at pretest ($M = 88.00$) and posttest ($M = 89.85$) were not statistically significantly different, $F(1, 20) = 1.10$, $p = 0.31$, partial $\eta^2 = 0.05$.

A two-way mixed ANOVA yielded a statistically significant interaction between experimental condition and time on narrative retelling scores, $F(1, 41) = 4.36$, $p = 0.04$, partial $\eta^2 = 0.10$; see Fig. 2. At posttest, the experimental group had significantly greater mean narrative retelling scores than the control group, $F(1, 41) = 6.93$, $p = 0.01$, partial $\eta^2 = 0.15$. The experimental group showed a statistically significant increase in scaled scores across time, from pretest ($M = 4.64$) to posttest ($M = 6.27$), $F(1, 21) = 7.49$, $p = 0.01$, partial $\eta^2 = 0.26$. There was no simple main effect for time on narrative retell for control students, as scores at pretest ($M = 4.57$) and posttest ($M = 4.33$) were not statistically significantly different, $F(1, 20) = 0.125$, $p = 0.73$, partial $\eta^2 = 0.01$.

Listening Comprehension

The results of a two-way mixed ANOVA on listening comprehension scores indicated that there was a significant interaction between time and experimental group, $F(1, 41) = 7.82$, $p = 0.01$, partial $\eta^2 = 0.16$; see Fig. 3. Though mean listening comprehension scores did not differ at posttest between experimental and control groups, $F(1, 41) = 4.45$, $p = 0.04$, partial $\eta^2 = 0.10$, results indicate that there was statistically significant increase from pretest ($M = 5.36$) to posttest ($M = 8.00$) on listening comprehension scaled scores for the experimental group, $F(1, 21) = 24.50$, $p < 0.001$, partial $\eta^2 = 0.54$. The control group did not demonstrate a statistically significant simple main effect of time on listening comprehension scores, $F(1, 20) = 0.19$, $p = 0.67$, partial $\eta^2 = 0.01$. Scaled scores at pretest ($M = 5.52$) and
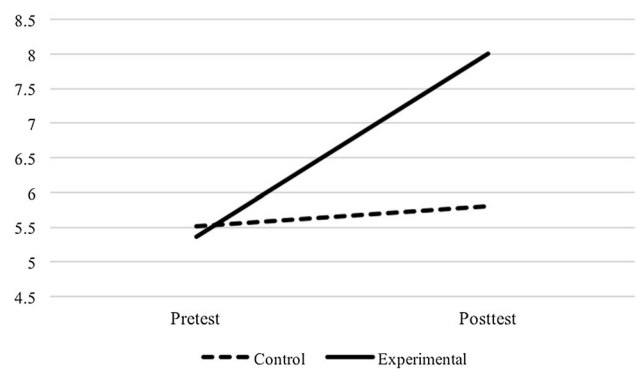
posttest ($M = 5.81$) were not significantly different for the control group.

Fidelity

Research assistants completed instruments assessing teachers' procedural implementation fidelity. Constructs measured included instructors' adherence to intervention script and activities, whether instructors provided appropriate scaffolding and feedback, and overall quality of engagement. All three constructs were measured on a scale from 1 to 3. Results suggest that adherence to the program was consistent throughout the intervention. Instructors scored high on this construct at the beginning ($M = 2.87$, $SD = 0.08$) and moderate-high at the end of the intervention ($M = 2.54$, $SD = 0.16$). Interventionists also scored high on the use of scaffolding and feedback, with high ratings reported at the beginning ($M = 2.89$, $SD = 0.08$) and end of the intervention ($M = 2.78$, $SD = 0.10$). Interventionists' quality of engagement was moderate-high. At the beginning of the intervention, interventionists scored an average of 2.85 on this construct ($SD = 0.07$) before dipping back slightly at the end of the intervention ($M = 2.79$, $SD = 0.14$).

Feasibility, Acceptability, And Appropriateness

Teachers answered survey items detailing whether they believed the intervention was easy and feasible to implement in their classrooms ("this intervention seems easy to use"), whether they found the intervention to be acceptable for use ("this intervention meets my needs"), and whether it was appropriate for their students ("this intervention seems like a good fit for my students"). Items were rated on a Likert scale, with 1 as the lowest score (completely disagree) and 5 as the highest score (completely agree). On average, teachers rated the four items on feasibility a 4.95, which indicates that many found this intervention to be feasible for use in the classroom. On acceptability, the teachers rated

the intervention a 4.92, which suggests that they find this intervention to be acceptable. Teachers rated the test items on appropriateness a 4.12, which suggests that this intervention is generally appropriate for use with school-aged children with ASD.

Discussion

The purpose of this study was to implement and evaluate the effectiveness of a school-based, integrated vocabulary and listening comprehension intervention for students with ASD. There are very few studies that have investigated the effects of shared reading interventions on the language and comprehension abilities of students with ASD, and many have used a single-case design rather than a randomized-controlled trial. Previous research has indicated the need for evidence-based intervention practices to support the comprehension needs of students with autism spectrum disorder (e.g. Nation et al. 2006). To our knowledge, this is the only randomized controlled intervention study with elementary students with ASD investigating a listening comprehension intervention, one of the early precursors to reading comprehension.

Effects of the Intervention on Oral Language

Findings from this study suggest that students who participated in the intervention showed significant improvement on several measures of oral language ability. Students who received the intervention showed a significant difference in pretest and posttest scores on expressive vocabulary, while the control group did not. These results are supported by previous research studies on typically developing children that have observed generalized expressive vocabulary gains following explicit instruction in story vocabulary (e.g., Walsh and Blewitt 2006; Zevenbergen et al. 2003). Children demonstrate increased production of novel words and expressive knowledge when target words are taught both directly and indirectly and when students have multiple experiences in hearing and using the word (NICHD 2000). The findings from this study are promising, as vocabulary is often an indicator of generalized oral language abilities and is important for reading development (Zevenbergen et al. 2003).

Second, results indicated that the experimental group showed significant growth in narrative retell ability in comparison to the control group. This suggests that this intervention was effective in improving students' abilities to accurately remember narrative details. Several components of the intervention may have fostered growth in narrative retelling ability. First, the intervention taught each book in a sequence of five lessons. The first and last lessons associated with each book included a full read aloud of the text, but the second, third and fourth lessons were partial read-throughs

of the story. Therefore, students became familiar with the process of remembering details in sequence from the story and applying this knowledge to create a full mental representation of the text. Additionally, students received direct instruction in partitioning the story into its beginning, middle and end components and reviewing important elements of the story (e.g., setting, main characters). Engaging with these component parts allowed students to develop strategies for recollecting essential details of the story. These results are especially encouraging for students with ASD, who have a tendency to focus on disconnected details in stories rather than the overall "gist" or main idea (Capps et al. 2000).

Effects of the Intervention on Listening Comprehension

On average, students who participated in the intervention showed significant growth compared to the control group in measures of listening comprehension. The core instruction in this intervention focused on explicit teaching of four listening comprehension strategies: (1) direct recall of textual information, (2) making connections to characters and events in the story, (3) narrative retell and (4) making inferences. These strategies have been shown to be beneficial for students with ASD and are all essential in creating a coherent mental representation of text (e.g., Kintsch 1988; van den Broek et al. 2005). For example, a good comprehender will need to recall the details of the story and activate relevant aspects of the text base and integrate them with background knowledge. This intervention included explicit instruction in these key comprehension strategies and also prevented decay of previously-learned strategies by asking students to utilize these skills during read-alouds and writing activities.

Books in this curriculum also included instructor prompts for think-aloud and questioning procedures. Therefore, the instructor was not required to continually consult a teacher manual during instruction or to determine the appropriate timing and language for these questions. These accessible features of the curriculum allowed for a more naturalized and engaging environment for students as they gained experience with the comprehension strategies and may have contributed to generalization of these strategies on the standardized measure of listening comprehension. The written expression component of the intervention also provided an opportunity for individual practice with these skills and kept students engaged with drawing activities and partner work. These activities also allowed the teacher to ask follow-up questions and provide differentiated scaffolding to support comprehension.

Additionally, the skill of making inferences, or "filling in the gaps" of the story left by the author, can be one of the most difficult skills for individuals with ASD. These difficulties have been associated with the social phenotype of ASD,

as many narrative texts contain social plots and/or characters that engage with socially or emotionally complex issues (e.g., Mar and Oatley 2008). In fact, children's storybooks reference a social event or a character's emotion about once every three sentences (Dyer et al. 2000). Therefore, social understanding is distinctly important in discerning causal links in narrative stories and in improving the mental representation of story events.

This intervention broke down the skill of making inferences into its component parts—integrating the details and clues from the book with background knowledge to make an inference. This allowed teachers to provide appropriate scaffolding for students if there was a misconception about what a character might be feeling, or how he or she might react to another character's actions. Children with ASD may be better able to integrate information to derive meaning from text when confounding social task demands are decreased (van den Broek and Kendeou 2008). Incorporating this instruction in perspective-taking may have improved the inferring abilities of students who participated in the intervention, thereby improving their listening comprehension abilities.

Feasibility

In order to determine feasibility for daily use, it is important to gauge whether instructors can implement instructional components with fidelity. If an intervention is overly complex or is difficult to administer, there is a greater likelihood that components could be rushed or skipped altogether, and teachers may not continue to use the intervention on a regular basis in their classroom. Fidelity of intervention implementation was monitored through direct observation, and there was a high rate of fidelity for quality of implementation, use of scaffolding and feedback and adherence to the script and curriculum components. Additionally, teachers rated the feasibility and acceptability of this intervention as exceptionally high. This suggests that this curriculum is appealing to educators and is well-organized and easy to implement. These results may be partially due to the study design, as the intervention was delivered in groups. Group instruction allows for more efficiency and the increased likelihood for observational learning to occur (Ledford et al. 2008). Teacher ratings on appropriateness were slightly lower than other scales. This suggests that the intervention is appropriate for use with school-aged children with ASD, but there may be room to tailor the intervention to better suit these students' needs.

Limitations

There are several limitations in this study that should be addressed in future studies investigating these constructs. First, the sample size for this study was small, which may

have impacted the power of statistical analyses. Future studies should consider larger cohorts to better understand potential mediators and moderators of intervention outcomes. Second, the age range in this study was quite large. Although this is not uncommon in samples of children with disabilities, the reading and oral language skills targeted in this intervention may have been differentially impacted by these developmental stages, and more stringent age brackets may help to better understand growth in these areas. Third, potential contamination issues must be considered in interpreting these results. Teachers may have inadvertently exposed control students to concepts contained within the curriculum, though it should be noted that research team controlled for contamination effects by instructing teachers to conceal curricular materials when not engaged in small group instruction and to ensure that control students did not participate in the lessons or activities. Additionally, the statistically significant differences between students in the experimental and control conditions on several key measures suggests that contamination did not affect the results of this study. Furthermore, though teachers demonstrated adequate procedural fidelity, there may have been instructor characteristics that differentially affected student outcomes. This study did not include observations of typical classroom instruction or additional interventions that the students may have been receiving in school. Students were randomized across classrooms to mitigate these issues, but this instructional time may have differentially affected the language and comprehension variables that were measured in this study.

Summary and Future Directions

Reading comprehension is a much-needed skill for academic success and vocational outcomes (Spooner and Browder 2015) and the heterogeneity of learners with ASD creates an explicit need for teachers to use individualized instructional approaches. Teachers, however, report a lack of time and knowledge to seek out research-based practices and believe that specialized training, resources and skills are needed to address these unique student needs (Accardo and Finnegan 2019; Busby et al. 2012) Therefore, the intervention used in this study fulfills a gap in current educational practice, as it is a multicomponent curriculum that targets both oral language and comprehension rather than focusing on one specific factor (e.g., vocabulary) and is feasible for use in the classroom on a regular basis. The results of this study converge with a growing line of research showing the positive impact of shared reading interventions for students with ASD, and further demonstrate that these types of interventions are effective in the classroom as supplemental instruction.

The data indicate that this curriculum was successful in improving several important contributors to reading

comprehension. This suggests that a skill that is well-known to be a deficit for students with ASD may be ameliorated by small group intervention. Intervening in the area of listening comprehension provides students with clear, explicit strategies to navigate texts without having to consider word-reading or decoding constraints. As there is good evidence that a single comprehension system underlies comprehension for both oral and written language (Stuart et al. 2008), improvement in listening comprehension is likely to transform directly to improved reading comprehension when coupled with instructional supports in word-reading and reading fluency (e.g., Garner and Bochna 2004; Solari et al. 2017). Many general education teachers of early elementary grades include read-alouds or other oral narratives in their typical classroom instruction. Therefore, a reading intervention that incorporates known classroom routines and is beneficial for typically developing students *and* students with ASD may be a strong option for teachers who are unsure about best practices to support the diverse needs of students in their classroom.

There is a need for additional research on the potential benefits of interventions involving narrative texts for both comprehension and social development in school-aged children with ASD. Fictional stories contain complex social relationships with characters that are driven by unique goals and emotions (Frith and Frith 2003). By providing instruction in extricating these social processes or in following the intentions and feelings of the characters within the story, we may also be targeting core social-cognitive skills that are essential for social communication. Fiction may also assist readers in building their social knowledge by exposing them to social rules and contingencies presented in the context of a story. Including additional instruction and visual aids to support understanding the distinct perspectives of characters within a story, or to consider social skills and their role within the story, may be a way to target these social-cognitive skills for young students with ASD. Future research examining these important questions can continue to build on the promising findings from this study to help educators maximize positive outcomes for students with ASD in the crucial areas of reading and language.

Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

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