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ORIGINAL PAPER

The Effects of a Shared Reading Intervention on Narrative Story Comprehension and Task Engagement of Students with Autism Spectrum Disorder

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Abstract
The purpose of this study was to investigate the effects of a shared reading intervention on narrative story comprehension and task engagement of students with autism spectrum disorder (ASD). A single-case multiple baseline design was used, and three elementary-aged students with ASD participated in this study. The shared reading intervention included before, during, and after reading strategies (i.e., topic anticipation, dynamic reading, story retelling). Results of this study indicated that all participants demonstrated noticeable improvements in reading comprehension. Despite the longer duration of intervention sessions as compared to baseline sessions, participants showed similar or better task engagement with intervention. Improved reading outcomes were maintained at follow up for all participants. Implications for practical implementation and future research were discussed.

Keywords Autism · Reading · Narrative story · Comprehension · Engagement

Introduction

The number of school-aged children diagnosed with autism spectrum disorder (ASD) is greater than ever before (Centers for Disease Control and Prevention 2012). Much of the research on interventions for students with ASD have focused on addressing core features of the disorder including social-communication skills and restrictive and repetitive behaviors (e.g., Brodhead et al. 2014; Mason et al. 2014; Neely et al. 2015). Though the diagnostic criteria of ASD does not directly imply difficulties in reading, core features of ASD may contribute to challenges in the development of literacy skills (Estes et al. 2011). For example, social communication deficits in individuals with ASD may impact comprehension of written contents, leading to delayed literacy development (Ricketts et al. 2013). As such, individuals with ASD may require additional intervention to develop age-appropriate reading skills. Additionally, the push for access to the general education curriculum supports that all students, including students with ASD, should receive instruction that aligns with grade-level standards (Individuals with Disabilities Education Improvement Act 2004; No Child Left Behind 2001). Unfortunately, the relatively small research base on reading intervention for students with ASD may limit educators' knowledge base in selecting and providing effective reading instruction for students with ASD (Finnegan and Mazin 2016).

Previous studies on reading skills for students with ASD have indicated discrepancies between decoding and comprehension skills (Minshew et al. 1994; Nation et al. 2006). One unique difficulty students with ASD have in reading comprehension is in making inferences about social situations (Baron-Cohen et al. 1985; Williamson et al. 2015). Due to impairments in social interaction and communication, students with ASD may struggle to understand the perspectives of others (e.g., belief, intention, feeling, desire). This difficulty may compromise reading comprehension, especially when students with ASD read narrative stories.

Narratives share a relatively stable story grammar (Reutzel 1984) including a problem, solutions, and resolution (Dimino et al. 1995). These story lines require readers to understand what happened to the characters, what the characters did to solve a problem, and what the result of this action was, by following each character's stance. Due to

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social impairments, students with ASD may have difficulty taking on character perspectives in order to understand the narrative story line. For instance, Garcia-Perez et al. (2008) stated that individuals with ASD encounter difficulties in story retelling through the perspectives of the characters. Dodd et al. (2011) compared reading performances of 18 students with ASD in two language programs. Participants of the first language program received education services that emphasized traditional types of story elements and semantics, whereas participants in the second program engaged in activities that emphasized character-perspective taking. As a result, the participants in the second program showed a better understanding of characters' emotional status and possible factors that influenced the characters' emotional status.

One of the instructional strategies that promotes students' reading comprehension is shared reading (Hudson and Test 2011). The shared reading strategy requires active interaction between a student and the reading partner (e.g., teacher, therapist, parent). During shared reading, the reading partner would involve the student in the process of reading by directing the student's attention to the text, explaining meanings of target vocabulary, and asking comprehension questions (Spooner et al. 2014). Common features of shared reading are attention getters, repeated story lines, picture symbols paired with words, and summarized text (Browder et al. 2007; Spooner et al. 2014).

The shared reading intervention has been used to encourage language and literacy development in early education settings (Fleury et al. 2014; Mucchett 2013), and has been reported to have a moderate level of evidence for students with extensive support needs (Hudson and Test 2011). Shared reading intervention have been successfully implemented for students without disabilities (e.g., Justice 2002; Robert 2013) and with disabilities (e.g., Browder et al. 2008; Spooner et al. 2014). Considering that students with ASD may require intensive guidance to understand characters' feelings and narrative storyline within a text, shared reading with an adult reading partner can be a promising strategy to promote their narrative comprehension skills. Some prior studies have investigated the use of shared reading intervention for students with ASD (e.g., Fleury et al. 2014; Golloher 2017; Mucchetty 2013; Spooner et al. 2014; Skoto et al. 2004). Mucchetty (2013) evaluated the effects of a teacher-led adapted shared reading intervention on engagement and comprehension of minimally verbal children with ASD. The results indicated that all four participants demonstrated increased story comprehension and engagement during the intervention phase. Fleury et al. (2014) implemented dialogic reading for young children with ASD. Dialogic reading is one method of shared reading in which adults pose various questions to encourage children to actively participate in reading. Findings of this study indicated that children with ASD showed increased participation. Recently, Golloher (2017) implemented an adapted shared storybook reading intervention for children with ASD in home settings. Results of this study indicated that children with ASD demonstrated improved engagement in shared reading and the outcomes generalized to shared reading with their parents. However, the research base is still relatively limited compared to other student populations. Moreover, Finnegan and Marzin (2016) reported in their systematic literature review that no study investigated the effectiveness of using shared reading intervention to teach reading comprehension skills to students with ASD.

Purpose

The purpose of this study was to examine the effects of shared story reading on narrative story comprehension and task engagement of three children with ASD. Specifically, this study sought to answer the following research questions: (1) Does shared reading intervention improve narrative story comprehension of children with ASD? (2) Does shared reading intervention improve reading task engagement of children with ASD? and (3) Can intervention outcomes maintain 3 weeks after the completion of intervention?

Method

Participants

Three male students with ASD aged 6, 7, and 8 years participated in this study. Participants received behavior therapy services in an autism clinic and all study procedures were conducted at the clinic. The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) (Lord et al. 2012) was administered to participants by an independent physician or psychologist prior to enrollment in the autism clinic. Due to institutional restrictions, raw ADOS-2 scores were not available for review. A director of the autism clinic was asked to nominate children who met the following criteria, using ADOS-2 results and the most current scores from behavioral assessments (e.g., Verbal Behavior Milestones Assessment and Placement Program, Sundberg 2014): (a) diagnosed with ASD, (b) communicated primarily using spoken language, (c) had the ability to read aloud short sentences composed of three to five words, (d) required additional support in reading comprehension, (d) had difficulties engaging in reading tasks for more than 30 min, and (e) did not have prior experience with shared story reading intervention. Approval for this research was obtained from parents/guardians through signed consent forms.

Ryan was a 7-year-old White male. He received behavior therapy services in the clinic 7 h per day, 5 days per

week. Ryan could verbally communicate with others, and he was able to read aloud sentences composed of three to five words. Based on his individualized treatment plan, he was expected to learn more sight words and engage in reading tasks for a longer duration. His behavior therapist reported that Ryan engaged in various types of challenging behaviors during instruction, such as non-compliance, aggression, scripting, and inappropriate comments.

Noah was a 6-year-old Asian-American male. He received behavior therapy at the autism clinic 2 h in the morning 5 days per week, and attended public school the rest of the day. He was able to verbally communicate with others. Noah could read aloud short sentences composed of three to five words. Based on the therapist's report, he had some behavior problems (e.g., non-compliance, tantrum, finger flicking) but they occurred infrequently.

David was an 8-year old White male. He received behavior therapy 7 h per day, 5 days per week at the clinic. David could communicate with others through spoken language. He had the ability to read aloud short sentences if the sentence included several sight words he knew (e.g., I, you, was, home, television). His individualized treatment plan included matching words to pictures and pictures to words. His behavior therapist reported that during instruction, David often engaged in challenging behaviors such as non-compliance, aggression, self-injury, and inappropriate comments.

Setting

This study took place in an empty classroom at an autism clinic in the Midwest of the United States. The classroom contained a large desk and chairs. A video camera was set up for the purpose of data collection. During the study, each participant's behavior therapist sat in the classroom but was not involved in any sessions except when the student engaged in challenging behaviors (e.g., yelling, refusing to read, throwing instructional materials). If any challenging behaviors occurred for more than 5 min, the researcher terminated the reading session.

Reading Materials

One grade-level narrative storybook was selected for this study based on the following criteria: (a) the storybook included age- and gender-matched main character (not an animal or an imaginary character), (b) the story was written in diary or essay format, (c) the setting of the story was daily living (e.g., school, home), (d) the whole storybook could be divided into shorter chapters, and (e) the storybook included pictures.

There were two reasons for using one storybook in this study. The first reason was to control the level of difficulty of reading materials across all sessions. Instead of using different storybooks, one book that could be divided into shorter chapters was chosen based on the book selection criteria. No chapters were repeated, and a new chapter was introduced for each session. The second reason was to increase experimental control. If different storybooks were introduced across sessions, variables such as the level of difficulty, contextual knowledge of story, or personal interests of each participant may impact comprehension and engagement outcomes. For these reasons, we selected *Nate the Great Talks Turkey* (Sharmat and Sharmat 2007), which has a reading level of J (appropriate ages: 6–8), and Lexile® of 520L (appropriate ages: 6–9). This reading level was appropriate for all three participants of this study (i.e., 6, 7, and 8 years).

A researcher of this study adapted the storybook into a series of shorter chapters. Each chapter included four paragraphs and three original pictures from the storybook. In every chapter, a new event occurs that is different from the previous chapter. The adapted reading materials included a three-ring binder with two adapted story pages. For the intervention sessions, two types of visual cues were added to the adapted books. First, at the end of each paragraph, a 'STOP' sign was inserted to encourage the participant to stop reading and think about the contents of the paragraph. The 'STOP' sign was a red octagon 15-mm traffic sign, which was inserted next to the end punctuation of the last sentence of a paragraph. Second, the keywords were highlighted in yellow. These highlighted keywords were used to help the participant attend to important information and find answers from relevant text. No additional adaptations were made to the content or difficulty level (e.g., changing difficult words, shortening sentences).

Measurement and Data Collection Procedures

To determine the effectiveness of shared story reading, the following two dependent variables were measured across all phases. The primary dependent variable was narrative story comprehension. After reading, participants were asked to answer ten multiple-choice questions by circling their best answers. Those comprehension questions required participants to answer: (a) what happened, (b) when it happened, (c) where it happened, (d) who was related to the problem/complication, (e) why it happened, and (f) how the problem/complication was resolved. To prevent the comprehension questions from measuring memory-recall rather than actual comprehension, questions were based on the unique events that occurred in the specific chapter used for that section. Additionally, no comprehension questions were repeated throughout this study. Only independent and correct responses were recorded. If the researcher provided any prompts (i.e., verbal, gesture, physical prompt), the response would not be considered independent. Examples of

prompted and unprompted answers are presented in Table 1. Narrative story comprehension was calculated by the number of unprompted and correct answers divided by the total number of comprehension questions and multiplied by 100.

The secondary dependent variable was reading task engagement. We operationally defined on-task and off-task behaviors (see Table 2). Reading task engagement data were collected throughout each session using 30-s momentary time sampling. An electronic cueing application was used to signal each interval. Percentage of on-task behaviors of each observational period was calculated by the number of on-task intervals divided by the total number of intervals and multiplied by 100. All sessions were video recorded for data collection purposes. The researcher or a trained research assistant viewed each video recorded session independently and recorded data on narrative story comprehension and on-task behavior.

Inter-Observer Agreement

Inter-observer agreement (IOA) for each dependent variable was obtained for at least 30% of sessions for each participant (i.e., 41% for Ryan, 31% for Noah, 31% for David). These sessions were proportionately distributed across baseline, intervention, and maintenance phases (i.e., 35% for baseline, 36% for intervention, and 40% for maintenance). Secondary data collectors included one doctoral student in a special education program and one undergraduate student in a speech and hearing sciences program. The first author provided direct instruction to the secondary data collectors on observing and measuring each dependent variable before collecting IOA data. Then, the first author conducted practice sessions with the secondary data collectors using sample video recordings. If agreement was not satisfactory (i.e., below 80%), the secondary observers participated in more practice sessions. IOA data was calculated by the total number of agreements divided by the total number of agreements plus the total number of disagreements and multiplied by 100 (Kennedy 2004). The mean IOA was 100% (range 100–100%) for narrative story comprehension and 100% (range 98–100%) for reading task engagement.

Table 1 Examples of prompted and non-prompted answers

Prompted answers	Non-prompted answers
• Paraphrasing the comprehension questions	• Reading the question and the options
• Asking the participant to rethink about the answer (e.g., "Do you really think so?")	• Asking the participant to read the question and the options one more time
• Pointing a specific keyword or sentence in the text	• Pointing to the question and options
• Asking the participant to reread a specific keyword or sentence in the text	• Asking the participant to draw a circle on the best answer
	• Asking the participant what the best answer is when it is unclear which option the participant circled
	• Reminding the participant to refer to the text to find the answer (e.g., "You can find the answer in the text.")
	• Reminding the participant that he can ask the interventionist reread the question and options anytime

Table 2 Operational definition of on-task and off-task behavior

	Definition	Examples
On-task behavior	Meaningfully participate in reading activities	Answering questions
		Asking questions
		Reading aloud
		Writing
		Pointing a picture or word
		Listening the interventionist's talk
		Staring at the interventionist or texts
Off-task behavior	Do not participate in reading activities	Making a noise
		Do not stare at the interventionist or texts
		Out-of-seat
		Doodling

Procedural Fidelity

Procedural fidelity data was collected across at least 30% of baseline, intervention, and maintenance sessions (i.e., 35% for baseline, 36% for intervention, 40% for maintenance) to ensure that all the necessary procedures were implemented as intended. The same graduate student and undergraduate student were trained to observe whether the interventionist completed each necessary step based on the task-analysis checklist. Two different checklists were used for the baseline/maintenance and intervention sessions (see Appendix). The fidelity checklist for the baseline/maintenance sessions included nine items (e.g., the interventionist presented one reading material and one worksheet on the table). For the intervention phase, 18 items were measured (e.g., the interventionist presented one picture from the last session and summarized how the story was finished). The observers documented whether each step was implemented accurately, and the intervention fidelity was calculated by the number of accurately implemented steps divided by the total number of steps and multiplied by 100 (Kennedy 2004). Procedural fidelity was 100% (range 100–100%) for the baseline, 99% (range 94–100%) for intervention, and 100% (range 100–100%) for maintenance.

Experimental Design

A single-subject multiple baseline design across participants was implemented to evaluate the effects of the shared reading intervention on narrative story comprehension and task engagement. Each child was exposed to baseline, intervention, and maintenance conditions.

Procedures

The first author of this study implemented all sessions with each participant in a one-on-one session. For each participant, sessions in all phases were conducted once per day, three times per week. The mean duration of sessions was 9 min for baseline (range 5–17 min), 28 min for intervention (range 25–40 min), and 10 min for maintenance (range 7–17 min). The sessions were terminated either (a) when the participant indicated that they completed the reading comprehension worksheet, or (b) when the participant continuously engaged in off-task behaviors (see the definition in Table 2) for 5 min. During the intervention sessions, the reading comprehension worksheet was provided after the shared reading procedures were completed. The mean duration of the intervention sessions was approximately 20 min longer than the baseline and maintenance sessions. Across all phases, the interventionist asked the participant to answer the comprehension questions on the worksheet. To ensure participants understood the question, the interventionist read or reread the questions and response options. The interventionist did not paraphrase or rephrase any questions or options.

Baseline

The interventionist presented two pages of reading materials on the desk and provided an initial instructional cue (e.g., "Whenever you are ready, you can start to read and answer the questions"). No further prompting, error correction, or feedback was provided. When the participant did not read the text aloud, the researcher waited 5 min without prompting (i.e., verbal, gesture, physical prompt) and then asked if the participant had completed the reading. If the participant indicated that he had completed reading, the researcher asked the participant to answer the comprehension questions on the worksheet. The session was terminated when the participant answered the all questions or engaged in off-task behaviors for 5 min (i.e., 10 intervals) continuously. At least five data were collected for the baseline, and the intervention was introduced when the last three primary data (i.e., comprehension) of the baseline showed either a stable or decreasing trend. The level or trend of the secondary variable (i.e., engagement) was not considered for changing phases because the engagement data was primarily used to demonstrate that lack of engagement was not a reason for poor comprehension.

Intervention

The shared story reading intervention included: (1) before reading, (b) during reading, and (c) after reading strategies. A framework of the shared reading process is described in Fig. 1. *Before reading*, the interventionist presented two pictures on the desk. One picture was from the previous session, and the other picture was from the current session. The participant was asked to describe what happened in the previous chapter, using the picture from that session as a visual prompt. Then, using the picture from the current session, the participant was asked to predict how the story

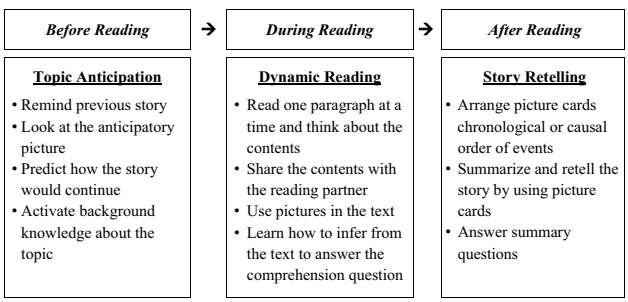

Fig. 1 A framework of the shared reading intervention

would continue. The interventionist provided prompts if necessary (e.g., "Do you remember her name? Why did Nate visit her?").

During reading, each participant was asked to stop reading aloud when he saw a 'STOP' sign at the end of the paragraph. When the participant was reading aloud, the interventionist provided immediate prompts if the student struggled to decode certain words. However, to prevent the participant from focusing too much on decoding rather than comprehending, the interventionist did not require the participant to read the text fluently. After the participant read one paragraph, the interventionist guided the participant to share the story by asking WH-questions (e.g., "Who was in Olivia's turkey search team?"), directing them to think about characters' narratives (e.g., "No one wanted to join her team. How did Olivia feel?"), and providing examples (e.g., "When do you feel lonely? I feel lonely when I am eating a large pizza alone"). Also, if the participant did not comprehend story details, the interventionist instructed the participant to reread a certain sentence or make inferences from the text by pointing to highlighted keywords. This process was repeated when the participant read the second, third, and fourth paragraph.

After reading, the interventionist presented three picture cards that were included in the reading material and then she shuffled them. The participant was asked to order the picture cards in chronological or causal order of events. Then, the interventionist guided the participant to retell the story by modeling (e.g., showing how to order the picture cards), prompting (e.g., "See this picture. What is Nate doing in this picture?"), and providing feedback (e.g., "You are right. Tell me what happened next").

In the intervention condition, all reading materials included highlighted keywords. Those keywords were used as visual cues to prompt participants to infer from the text throughout shared reading time. Specifically, the interventionist taught the participants to find answers from the text by pointing to highlighted keywords and reminded the student that he should focus more on those highlighted keywords to answer the questions. The intervention phase was completed when each participant met two criteria: (a) the participant continuously attended at least six sessions of shared reading intervention (i.e., 2 weeks), and (b) the last three primary data (i.e., comprehension) were above 80% consecutively and did not show a decreasing trend.

Maintenance

Three weeks after the intervention was completed, maintenance data were collected. Procedures in the maintenance condition was identical to the baseline condition. Two pages of reading materials without any highlighted keywords or stop signs were presented in a 3-ring binder on the desk. Since activating prior knowledge from previous chapters of a narrative was a part of the shared reading intervention (i.e., before reading strategy), a different chapter of the same storybook was introduced in each session of the maintenance phase. The interventionist provided verbal instruction to start reading and answer comprehension questions, and the participants were expected to independently use their content knowledge from previous chapters to comprehend the narrative story without shared reading with the interventionist. All participants were exposed to a minimum of three maintenance sessions, and the maintenance phase was completed when the participant demonstrated either a stable or increasing trend in comprehension.

Effect Size Calculation

To supplement visual analysis of intervention effects, a nonparametric statistical analysis of effect size, Tau-U, (Parker et al. 2011) was calculated. Tau-U provides a flexible effect size index by incorporating level and trend of data (Parker et al. 2011). Tau-U is also suitable for data with any distribution shape, for any type of type of scale, and for short data series (Parker and Vannest 2012). The calculated Tau-U scores can be interpreted as either the "percentage of nonoverlap between phases" or "percentage of data showing improvement between phases" (Parker et al. 2011, p. 291). Tau-U scores have a range from 0 to 1 and can be interpreted based on the following criteria: (a) small effects: 0–0.65, (b) medium effects: 0.66–0.92; and (c) large effects: 0.93–1.0 (Parker and Vannest 2009). For example, if a Tau-U score was 0.88, this indicates that 88% of data between two phases (e.g., baseline and intervention) and shows a medium effect size.

Social Validity

One factor affecting future replication of this researcher-implemented shared reading intervention would be the social validity of the intervention (Horner et al. 2005). It is critical for applied researchers to recommend effective interventions that are socially valid in practical settings (Gerow et al. 2017). To evaluate social validity, two questionnaires were developed and given to the participants and their individual behavior therapists. For the behavior therapists, researchers modified the Treatment Acceptability Rating Form-Revised ([TARF-R], Reimers and Wacker 1988). This modified TARF-R questionnaire included eight *Likert* type questions (i.e., 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) regarding acceptability, cost-efficiency, feasibility, and generalizability of this intervention. At the end of the study, each therapist was asked to complete this questionnaire honestly.

For the participants, the researchers developed a simple questionnaire with four *Likert* type questions, and the three *Likert* scale options (i.e., 1 = No, 2 = I do not know, 3 = Yes) were presented with picture symbols. At the end of this study, the interventionist met with each participant individually to obtain their perspectives on the procedures and outcomes of the shared reading intervention. The interventionist read the questions and asked each student to pick the best picture symbol that described their feeling. The questions were related to: (a) whether they enjoyed the reading sessions, (b) whether the reading intervention was helpful in understanding the story better, (c) whether they perceived improvement in their reading skill, and (d) whether they wanted to read more storybooks.

Results

To evaluate the effects of the shared reading intervention, we measured narrative story comprehension and reading task engagement of three children with ASD. The obtained data are presented in Fig. 2, and the mean, range, and Tau-U scores are displayed in Table 3.

Visual Analysis

Ryan

During the baseline phase, although Ryan engaged in reading tasks 89.1% of intervals (range 76–100%), he demonstrated a low level of reading comprehension ($M = 23.3\%$, range 10–30%). After the intervention was introduced his reading comprehension score showed an increasing trend. In the first and the second intervention sessions, his reading comprehension score increased to 40 and 50%. In the third intervention session, he exhibited a rapid increasing trend and reached 90% independent and correct answers. In the seventh intervention session, Ryan independently and correctly answered all comprehension questions. Compared to the last five data points of intervention (range 80–100%), his comprehension score decreased to between 60–90% at the beginning of the maintenance phase. However, he reached 100% of reading comprehension again in the fourth maintenance session. Although mean session duration increased from 8 min for baseline to 26 min for intervention, on-task behavior of Ryan increased ($M = 92\%$, range 88–96%). 3 weeks after the intervention was completed, Ryan showed a high and stable level of reading task engagement ($M = 100\%$, range 100–100%).

Noah

Noah engaged in reading tasks 70.4% of intervals (range 66–77%) during baseline but demonstrated a low level of reading comprehension ($M = 27.1\%$, range 10–40%). Upon the introduction of intervention, immediate positive effects on both reading comprehension and task engagement were demonstrated. From the first intervention session, he independently responded to the reading comprehension questions 70% correctly. Noah's comprehension scores showed a stable increasing trend and reached 100% of comprehension in the sixth intervention session. The mean score of reading comprehension was 92.2% (range 89–95%) during the intervention. The mean duration of the sessions increased from 12 min in baseline to 33 min in intervention, and Noah demonstrated a higher level of reading task engagement during the intervention ($M = 92.2\%$, range 89–95%) as compared to baseline ($M = 70.4\%$, range 66–77%). The discrepancies between reading comprehension and task engagement decreased during the intervention sessions. 3 weeks after the completion of the intervention, Noah maintained improved reading comprehension ($M = 80\%$, range 80–90%) and task engagement ($M = 98.7\%$, range 96–100%).

David

During the baseline, David showed a high level of engagement ($M = 88.4\%$, range 83–100%), but he answered the reading comprehension questions 22.9% correctly. With the introduction of the intervention phase, David demonstrated immediate increase in both reading comprehension and reading task engagement. His reading comprehension score increased from 20% in the last baseline session to 70% in the first intervention session. David showed a stable increasing trend until he scored 100% independent and correct responses in the fifth and sixth intervention sessions. Though the mean duration of sessions increased from 8 min in baseline to 28 min in intervention, David's task engagement remained high ($M = 96.7\%$, range 94–100%). 3 weeks after the completion of the intervention, David maintained his improvement in reading comprehension ($M = 83.3\%$, range 80–90%) and task engagement ($M = 96.3\%$, range 89–100%).

Effect Size

Since the baseline data on both reading comprehension and task engagement of all three participants did not show increasing trends with an exception of Noah's engagement data, we did not need to correct baseline. For Noah's task engagement data, we used corrected baseline and Tau-U. The calculated Tau/Tau-U scores were presented in Table 3. Tau scores of all participants suggested large effects for

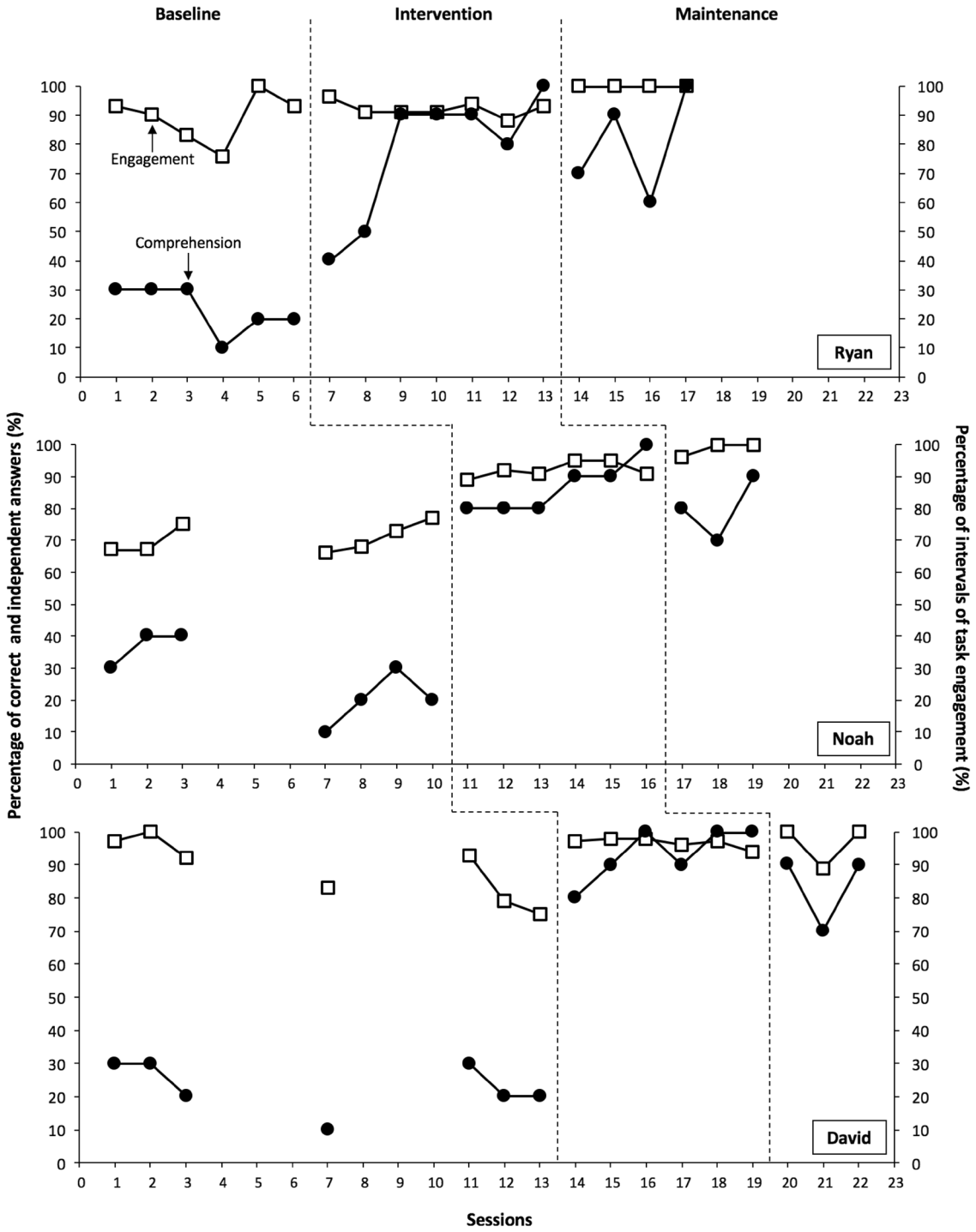

Fig. 2 Results of the shared reading intervention

reading comprehension. All three participants' Tau for reading comprehension were 1.00. This result indicates that 100% of data showed improvement between baseline and intervention, and there was no overlapping data between adjacent phases. The Tau/Tau-U for task engagement was 0.19, 0.76, 0.57 for Ryan, Noah, David respectively (see Table 3). This result suggested that all three participants demonstrated positive improvement between two phases. Specifically, 19% of Ryan's data, 76% of Noah's data, and 57% of David's data demonstrated improvement between two phases. This result indicates small effects for Ryan and David, and medium effects for Noah.

Table 3 Mean, range, and tau scores for comprehension and engagement

	Baseline	Intervention	Maintenance	Tau/Tau-U
Ryan				
Comprehension	23.3% (10–30%)	77.1% (40–100%)	80% (60–100%)	1.00[b]
Engagement	89.1% (76–100%)	92% (88–96%)	100% (100–100%)	0.19
Noah				
Comprehension	27.1% (10–40%)	86.7% (80–100%)	80% (80–90%)	1.00[b]
Engagement	70.4% (66–77%)	92.2% (89–95%)	98.7% (96–100%)	0.76[a]
David				
Comprehension	22.9% (10–30%)	93.3% (80–100%)	83.3% (80–90%)	1.00[b]
Engagement	88.4% (83–100%)	96.7% (94–100%)	96.3% (89–100%)	0.57

[a]Medium effects

[b]Large effects

Social Validity

Each participant's behavior therapist completed the social validity questionnaire. The overall mean score across the three therapists was 4.83 out of 5 (i.e., 1 = strongly disagree, 5 = strongly agree). Two of the therapists strongly agreed with all questions ($M = 5$, range 5–5), and the other therapist answered all questions positively with a mean score of 4.5 (range 3–5). All therapists indicated that the shared reading intervention was appropriate and effective for their clients, and there was no disadvantage following the reading intervention. Also, they reported that the intervention was easy to generalize across different settings/subjects. In terms of feasibility, all therapists indicated that the shared reading intervention was cost-effective, and they were willing to apply the intervention for the target children after the end of this study. One therapist responded neutrally to one of the questions regarding whether the reading intervention promoted the student's level of independence in reading. Except for this question, all therapists responded positively.

Child participants completed the modified rating scale by circling the picture icons that represented their thoughts best. All participants reported that they enjoyed the reading sessions and the intervention helped them understand the story better. They indicated that their reading skills improved through the intervention and wanted to read more storybooks. Ryan and David responded to all four questions positively. Noah responded positively to three questions and neutrally to one question. He reported that he did not know whether the reading strategies used in the reading intervention (e.g., using pictures, highlighted keywords, story retelling) was helpful for understanding the story. There were no negative responses.

Discussion

The purpose of this study was to evaluate the effects of the shared reading intervention on narrative story comprehension and task engagement of three students with ASD. The findings of this study indicated that all participants demonstrated improvements in narrative reading comprehension through the shared reading intervention package. Due to high levels of task engagement during both baseline and intervention phases (i.e., above 70%), only one of three participants demonstrated a functional relationship between the shared reading intervention and the percentage of intervals with on-task behavior. However, all three participants exhibited similar or better levels of engagement in reading despite the increased duration of the intervention sessions. In addition, maintenance data indicated that all participants with ASD were able to maintain improved reading comprehension skills over time. Overall, this study extended the literature base of shared reading by demonstrating positive effects on comprehension skills and task engagement of participants with ASD.

The shared reading intervention package included three key components (i.e., before, during, after reading strategies) that may lead to improvements in narrative reading comprehension of students with ASD. First, as a before reading strategy, participants were asked to recall what they read previously and predict how the story would be continued. Researchers have suggested the use of prior knowledge during reading is beneficial (Kendeou and van den Broek 2007; O'Connor and Klein 2004), but students with ASD may require additional supports to activate prior knowledge to comprehend the text (O'Connor and Klein 2004; Pressley and Afflerbach 1995). The result of this study indicates that supporting the activation of prior knowledge on the topic and prediction of the story helped students with

ASD comprehend the narrative text. Second, during reading, visual cues (i.e., STOP signs, highlighted keywords) were integrated into the texts. Previous articles have indicated that some students with ASD have "hyperlexic" characteristics (i.e., well-developed word recognition skill accompanied by poor reading comprehension), and their reading comprehension difficulties are often associated with word recognition problems (Nation et al. 2006; Perfetti et al. 1996). When students need to dedicate their efforts to decoding words, they are more likely to miss the content (Brown et al. 2013). The comprehension data of this study support providing visual cues to students with ASD to stop decoding and directing them to think about important content, which can help them promote narrative reading comprehension. Third, after reading, students with ASD were asked to retell the story by using three picture cards. Previous research suggests that story retelling is an active procedure that supports comprehension (Louis and Singh 2017; Morrow 1985), and the findings of this study align with past studies which suggested story retelling can promote reading comprehension.

The secondary data of this study indicated that all the students demonstrated similar or higher levels of engagement despite the increased mean duration of intervention sessions. Given that each participant's individual work schedule was typically under 10 min in their daily settings, the high percentages of on-task intervals during short baseline sessions were not entirely surprising. However, it is worthy to note that two participants maintained their high levels of engagement (i.e., Ryan, David) and one participant demonstrated a higher level of engagement (i.e., Noah) during the intervention sessions, which were much longer in duration than the baseline sessions. Problems in task engagement were often considered as an indicator of low academic achievement and reading comprehension. In contrast, all participants in this study showed unique discrepancies between the high task engagement and low reading comprehension. While such a discrepancy is not supported by research in reading comprehension, it helped rule out the possibility that poor reading comprehension of the participants with ASD was due to low task engagement. In fact, this observation implies that despite the participants' ability to engage appropriately in reading, they lacked the skills to comprehend narrative passages and answer comprehension questions correctly. Our shared reading intervention helped participants with ASD develop skills to understand and make inferences from narrative texts.

Practical Implication

Positive reading outcomes of this study would support that the shared reading intervention can be effectively used for students with ASD to promote narrative reading comprehension and task engagement. Additionally, social validity findings from participants and their therapists were mostly positive and indicated that the shared reading intervention is easy to implement, beneficial, and enjoyable. To implement this intervention in practical settings, educators may need to consider the following factors.

First, students with ASD may require additional training on how to answer different types of questions (e.g., multiple-choice questions, matching questions, open-ended questions). For example, Ryan did not answer multiple-choice questions correctly even when he orally responded to the same questions correctly during shared reading time. Therefore, educators may need to check whether they are truly evaluating the student's comprehension with their questions. If low reading scores of students with ASD are due to the mode of answering instead of limited comprehension, educators can consider utilizing different types of comprehension questions to accommodate students' preferred means of answering or providing additional instruction to help students learn to answer specific types of questions.

Second, given the cost-effectiveness and easy implementation procedures, shared reading interventions can be a feasible option for educators. Since the shared reading intervention implemented in this study consisted of multiple components (i.e., before, during, after reading strategy), educators may want to select components to suit their own classrooms. For instance, teachers may want to apply only one of three strategies within a lesson due to time constraints. Teachers may also replace one strategy with another research-based strategy depending on the student's individual needs (e.g., filling out a narrative graphic organizer instead of retelling a story). While some adaptations may allow educators to implement the shared reading intervention more feasibly, caution should be exercised as we are uncertain if deviations from our shared reading intervention would lead to positive outcomes. This current study demonstrated reading improvements as a result of the whole reading intervention package.

Third, different individuals with ASD may prefer different modes of communication. Considering that procedures of our shared reading intervention primarily relied on active interaction between the child and the adult reading partner, educators should consider the preferred means of communication of their students and alter the mode of expression if necessary.

Limitations and Future Research

Despite the positive findings of this study, it is not without limitations. In this section, we will describe the limitations and suggest some research areas that warrant future investigation.

First, all participants had the ability to verbally communicate with others. Given that the shared reading intervention

procedures included verbal discussion as a key component, the effects of this study may not be generalizable across students with ASD who have limited or no verbal communication skills. Future researchers should explore ways to adapt shared reading interventions for students with limited verbal communication skills.

Second, in this study, the current ability and performance of each participant prior to the intervention was described based on the director's report, informed by formalized behavioral assessments (e.g., the VB-MAPP), and confirmed through researcher observation. Also, baseline measures of participant performance provided an additional objective account of skill deficits in all three participants. Therefore, current level of participant performance, prior to intervention, was likely established. However, these measures of participant performance are likely not complete. As differences in cognitive ability and language development of students with ASD may be reflected in a range of difficulties related to reading comprehension, identifying the participants' cognitive and language abilities through standardized measures (e.g., IQ scores) would help generalize the findings of this study to other individuals with similar characteristics. It would also aid educators in deciding whether this intervention can be closely replicated with their students. In addition to evaluating what scores on standardized measures predict success in shared reading interventions, future research should formally evaluate behavioral markers of participant deficits and pre-requisite skills that may also predict successful intervention outcomes.

Third, since the shared reading intervention implemented was a package intervention, conclusions cannot be drawn as to which component was most effective in promoting reading comprehension outcomes of students with ASD. In other words, if only one part of this package intervention is implemented, the positive effects of this study may not be closely replicated. To compare the effectiveness of each component, future researchers may consider conducting component analyses of shared reading intervention package to identify the most critical components that generate positive outcomes.

Fourth, based on the participant selection criteria, three students with ASD who had decoding skills were included in this study. For this reason, the effects on narrative reading comprehension may not be generalizable to students who do not have adequate decoding skills. Future researchers would need to identify prerequisite skills for teaching reading comprehension and suggest alternative ways to promote comprehension of non-fluent readers with ASD.

Fifth, this study was implemented one-on-one in an autism clinic, and the experimental setting in this study may have impacted their task engagement. Reading is one of the major content areas in school, but in school settings, implementing one-on-one reading interventions may not be a feasible option. Future researchers would need to address how shared reading strategies can be incorporated classroom settings for a group of students with and without disabilities. Findings of this study provide more evidence to support the effectiveness of shared reading interventions by expanding the population of participants to include students with ASD. Shared reading interventions are considered a research-based practice for enhancing early literacy skills (National Early Literacy Panel 2008). A growing body of research has indicated that shared reading interventions can be successfully implemented to teach literacy skills to students with moderate to severe intellectual disabilities (Browder et al. 2011; Hudson and Test 2011). The current study contributes to the literature by demonstrating how shared reading intervention can benefit students with ASD in narrative reading comprehension and task engagement.

Author Contributions SYK conceived of the study, participated in its design, implemented the intervention, collected data, and drafted the manuscript; MR participated in the design and coordination and helped to draft the manuscript; CL collected data and participated in drafting the manuscript; EG collected data and participated in drafting the manuscript; MTB participated in interpretation of data and helped to draft the manuscript. All authors read and approved the final manuscript.

Appendix

Fidelity Checklist (Baseline/Maintenance)

Date:	Student:	Interventionist:	Observer:	Section:

Objective/Activity	Recording		
1. The interventionist presented one reading material and one worksheet on the table.	+	–	N/A
2. The interventionist provided an initial instruction to read the text aloud and answer the question (i.e., "Whenever you're ready, you can read it aloud and answer the questions").	+	–	N/A
3. The interventionist did not provide any error corrections, prompts, and feedback when the participant was reading.	+	–	N/A
4. If the participant did not start to read five minute after the initial instruction was given (Object #2), the interventionist asked if he/she finished reading.	+	–	N/A
5. When the participant indicated that he/she had completed reading, the interventionist asked the participant to start to answer the questions on the worksheet.	+	–	N/A
6. The interventionist ask the student read the question and options aloud before circling on the worksheet.	+	–	N/A
7. The interventionist read aloud the questions and options if necessary.	+	–	N/A
8. When the participant did not answer the question 15 seconds after reading the question, the interventionist reminded the participant answering the question or provided prompts if necessary.	+	–	N/A
9. The interventionist ignored all off-task behaviors.	+	–	N/A
10. The interventionist terminated the session if the participant continuously engaged in off-task behaviors for 5 minutes.	+	–	N/A
TOTAL: ( ) / ( ) = ( )			

Fidelity Checklist (Intervention)

Date:	Student:	Interventionist:	Observer:	Session:

Objective/Activity	Recording		
[BEFORE Reading]			
1. The interventionist presented one picture from the last session and summarized how the story was finished.	+	–	N/A
2. The interventionist presented an anticipatory picture and asked the participant to tell what the story would be.	+	–	N/A
[DURING Reading]			
3. The interventionist asked the participant to read the *first* paragraph aloud. If necessary, the interventionist provided verbal/gesture prompts and error corrections.	+	–	N/A
4. The interventionist guided the participant to share what the participant read in the *first* paragraph and asked comprehension questions. If necessary, the interventionist provided verbal/gesture prompts and feedback.	+	–	N/A
5. The interventionist asked the participant to read the *second* paragraph aloud. If necessary, the interventionist provided verbal/gesture prompts and error corrections.	+	–	N/A
6. The interventionist guided the participant to share what the participant read in the *second* paragraph and asked comprehension questions. If necessary, the interventionist provided verbal/gesture prompts and feedback.	+	–	N/A
7. The interventionist asked the participant to read the *third* paragraph aloud. If necessary, the interventionist provided verbal/gesture prompts and error corrections.	+	–	N/A
8. The interventionist guided the participant to share what the participant read in the *third* paragraph and asked comprehension questions. If necessary, the interventionist provided verbal/gesture prompts and feedback.	+	–	N/A
9. The interventionist asked the participant to read the *fourth* paragraph aloud. If necessary, the interventionist provided verbal/gesture prompts and error corrections.	+	–	N/A
10. The interventionist guided the participant to share what the participant read in the *fourth* paragraph and asked comprehension questions. If necessary, the interventionist provided verbal/gesture prompts and feedback.	+	–	N/A

[AFTER Reading]			
11. The interventionist presented all pictures that were inserted in the reading material.	+	–	N/A
12. The interventionist asked the participant to order the pictures and retell the story. If necessary, the interventionist provided verbal/gesture prompts and feedback.	+	–	N/A
[Reading Comprehension Assessment]			
13. The interventionist presented a worksheet and markers.	+	–	N/A
14. The interventionist asked the participant to read each question aloud and draw a circle on the best answer. If necessary, the interventionist (re)read the questions and options aloud.	+	–	N/A
15. When the participant did not answer the question 15 seconds after reading the question, the interventionist redirect to read the question and options one more time.	+	–	N/A
16. If the participant answered the question incorrectly, the interventionist provided feedback and error correction.	+	–	N/A
[Throughout the session]			
17. The interventionist ignored all off-task behaviors.	+	–	N/A
18. The interventionist terminated the session if the participant continuously engaged in off-task behaviors for 5 minutes.	+	–	N/A
TOTAL: ( ) / ( ) = ( )			

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