Effects of a Reciprocal Questioning Intervention on the Question Generation and Responding of Children with Autism Spectrum Disorder

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Abstract: A multiple baseline design across participants was used to investigate the effects of reciprocal questioning strategy instruction delivered in cooperative pairs on the question generation and responding of children with autism spectrum disorder. Three children with autism spectrum disorder and nine general education peers participated in the study. Following intervention, children with autism increased frequency of question generation and responding using a story map framework. Social validity data indicated children with autism spectrum disorder and their general education peers found the intervention helpful, and parents perceived a change in their child’s reading and language skills.

“Learning to read builds on cognitive, linguistic, and social skills that have developed from the earliest age” (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001, p. 34). Basic to reading development is a child’s proficiency in language (Rayner et al.). For children with autism spectrum disorder (ASD), however, the reliance on language development to facilitate reading skills is problematic, as children with ASD typically experience difficulty in acquiring the linguistic skills needed for effective reading (Myles et al., 2002; Norbury & Bishop, 2002). Because of the variability in acquisition of cognitive, linguistic and social skills, it is likely that learning to read will present a range of challenges for children with ASD.

In comparison to typically developing peers, children with autism generally acquire speech late, and “a substantial minority” fail to develop fluent speech by adolescence or adulthood (Lord & Paul, 1997, p. 204). Children with ASD that develop speech, typically demonstrate good mechanics of language (Minshew, Goldstein, & Siegel, 1995) with accurate articulation, and phonological development similar to that of their general education peers (Tager-Flusberg, Paul, & Lord, 2005), yet have difficulty with more complex syntax and semantics as well as pragmatic aspects of language (Tager-Flusberg & Joesph, 2003). Some children with ASD appear to only have difficulties with social aspects of language rather than syntactic or semantic difficulties, and others may make gains in social aspects of language but continue to have limited spoken language (Tager-Flusberg et al.).

The scale of difficulties children with ASD experience with language can potentially impact the reading process. Evidence suggests that we can only comprehend text to the degree we comprehend language (Rayner et al., 2001). Although many children with ASD can develop average or better decoding skills, these decoding strengths generally accompany problems with reading comprehension (Frith, 2003; Mayes & Calhoon, 2003a; 2003b; Calhoon, 2001; Lord & Paul, 1997; Minshew, Goldstein, Taylor, & Seigel, 1994; Nation, Clarke, Wright, & Williams, 2006); however, extreme variability has been noted in reading development across the autism spectrum (Nation et al., 2006). Despite variability in reading...
ability, studies have consistently shown that students with ASD frequently have difficulty comprehending text (Mayes & Calhoun, 2003a; 2003b; Nation et al.; Minshew et al.; Wahlberg & Magliano, 2004).

Promoting Reading Skills of Learners with Autism

Research regarding how to promote effective reading skills among children with ASD is minimal. Although the research targeting reading development is limited, children with ASD with varying levels of language and cognitive ability have successfully developed reading skills following the implementation of a variety of intervention methods including behavioral (Rosenbaum & Breiling, 1976), cooperative learning/peer tutoring (Kamps, Barbetta, Leonard, & Delquadri, 1994; Kamps, Leonard, Potucek, & Garrison-Harrell, 1995), incidental teaching (McGee, Krantz, & McClannahan, 1986), computer assisted instruction (Heiman, Nelson, Tjus, & Gillberg, 1995; Tjus, Heimann, & Nelson, 1998; Williams, Wright, Callaghan, & Coughlan, 2002), and anaphoric cuing (O’Connor & Klein, 2004). Many of the studies focused on sight word identification (Heiman et al.; McGee et al.; Rosenbaum & Breiling, 1976; Tjus et al.; Williams et al.), two targeted reading comprehension (Kamps et al.; O’Connor & Klein.), and one reading fluency (Kamps et al., 1994).

Reading comprehension. This scarce literature base of reading intervention studies consists of only two studies emphasizing reading comprehension (Kamps et al., 1995; O’Connor & Klein, 2004). Kamps and colleagues targeted the reading comprehension skills of one child identified as having “high functioning autism” and two children with autism and a moderate cognitive disability along with their general education peers in an in the context of cooperative groups (Kamps et al.). Classroom instruction included direct instruction of vocabulary, story concepts, main idea, sequencing, and story mapping. In the cooperative learning condition, groups of four students, one with ASD, completed 3 activities: (1) a peer tutoring of vocabulary words, (2) responding to wh comprehension questions following reading, (3) comprehension game of characters, and facts from stories read in class. All participants, including general education peers, showed increased levels of academic engagement and social interaction following the intervention, but the authors reported greater variability in reading results associated with the participant’s level of cognitive ability. Distinctly, participants described by the authors as having autism and a moderate cognitive disability did not produce as many gains in the area of reading comprehension as the student described as having high functioning autism and general education counterparts.

The second study focused on increasing reading comprehension of children with ASD (O’Connor et al., 2004) through the use of procedural facilitation. Procedural facilitation consisted of four different conditions in which the researcher provided prompting to facilitate processes needed for comprehension during reading. That is, the researcher set up the task/materials to facilitate the processes needed to comprehend the text. Specifically, participants were asked to read 5 stories aloud in 4 conditions: (1) one in a prereading condition, (2) one in an anaphoric cuing condition, (3) one in a cloze condition, and (4) two in a control condition. Following each condition, a researcher made test consisting of 12 items that included free retelling, identifying incongruous sentences from the story, inference why and how questions, and factual who, what, where, when questions was administered. Following the anaphoric cuing condition, performance on the comprehension measure of more than half of the participants resulted in medium effect size gains, whereas gains from prereading questions and cloze conditions were not statistically significant. Also, in both the anaphoric cuing and cloze conditions the participants completed the task with approximately 80% accuracy, but only anaphoric cuing facilitated comprehension of text.

The purpose of this study is to extend the research base on reading comprehension of children with ASD to include direct comprehension strategy instruction. The National Reading Panel (NPR) acknowledged that within comprehension research, “the strongest scientific evidence was found for the effectiveness of asking readers to generate questions during reading” (NICHD, 2000, pp.
Because the No Child Left Behind Act (NCLB, 2002) calls for evidence-based strategies identified by the NRP to teach reading and children with disabilities have access to the general education curriculum through the Individuals with Disabilities Education Act (IDEA) (34. C.F.R. & 300.26(b)(3)(ii)), research on how to facilitate the learning of children with ASD using strategies appropriate for the general population is needed.

In a review of the question generation literature, Rosenshine, Meister, and Chapman (1996) determined that studies providing procedural checklists, visual cues, signal words and generic questions or question stems as prompts produced positive effects (Rosenshine et al.). These are strategies deemed effective for teaching a variety of skills. Specifically, the use of visuals (Krantz, MacDuff, & McClannahan, 1993; MacDuff, Krantz, & McClannahan, 1993; Pierce & Schreibman, 1994), scripts (Krantz & McClannahan, 1993, 1998; Matson, Sevin, Box, Francis, & Sevin, 1993; Sarokoff, Taylor, & Poulson, 2001; Stevenson, Krantz, & McClannahan, 2000), and self-monitoring (Koegel & Frea, 1993; Koegel, Koegel, Hurley, & Frea, 1992; Mancina, Tankersley, Kamps, Kravits, & Parrett, 2000) have been effective in increasing independence, social communication, and prosocial behaviors of children with ASD.

The availability of self-monitoring, visuals, and scripts during reading comprehension instruction may elicit gains in reading achievement for the general education population, children with effective decoding but limited comprehension skills, and potentially children with ASD. Hence, it is not surprising that researchers have encouraged teachers of children with ASD to use visual cues and checklists to augment receptive and expressive communication (Mirenda & Erikson, 2000; Quill, 1995) and promote independence (Koegel, Koegel, & Parks, 1995; Quill). What remains unclear is whether the use of these instructional practices will prove successful in interventions focusing on the reading comprehension of children with ASD.

In this study, we used an adapted guided reciprocal questioning intervention (See King, 1994; King & Rosenshine, 1993) coupled with self-monitoring and visual cues to teach children with ASD to ask and respond to questions using a story map framework while taking turns reading with a general education peer. The following research questions were addressed.

**Question 1:** What is the functional relationship between guided reciprocal questioning strategy instruction delivered in cooperative pairs and question generation and responding of children with autism spectrum disorder?

**Question 2:** To what extent are children with autism spectrum disorder, general education peers, and parents of children with autism satisfied with the intervention?

**Method**

**Participants**

Three elementary aged boys with ASD (as defined by the DSM IV) participated in the study. They were administered the Peabody Picture Vocabulary Test-III (PPVT-III), the Expressive One-Word Picture Vocabulary Test (EOWPVT), and the Oral Reading Fluency (ORF) and Retell Fluency (RF) subtests of the Dynamic Indicators of Basic Early Literacy (DIBELS) prior to initiation of the study. Table 1 presents the results of this testing along with IQ scores taken from participant cumulative folders.

Scores of all three participants on the PPVT-III were at least one standard deviation below the mean, indicating difficulty with receptive vocabulary. Scores on the EOWPVT were greater than one standard deviation below the mean for two participants, demonstrating difficulty with both receptive and expressive language, and in the average range for the one participant indicating a discrepancy between receptive and expressive language. In addition, participants were administered the DIBELS ORF subtest paired with the RF subtest. The RF is considered a “comprehension check” to determine whether the ORF score reflects overall reading proficiency to include comprehension. The RF score should be approximately half of the ORF score to be considered a good indicator of overall reading ability. Scores of participating students with ASD were considerably less than half their...
ORF scores suggesting a reading comprehension concern (Good & Kaminski, 2003).

**Austin.** Austin was 7 years 5 months old at the onset of the study. He is an Asian/Hispanic male with Asperger syndrome. Austin received his reading instruction in a self-contained classroom setting. In a review of his cumulative folder, Austin's reported strengths included determining relationships between abstract figures, as well as detecting patterns. He has greater difficulty with tasks that involve defining words and stating similarities between words. On the Differential Ability Scales (DAS), Austin received a general conceptual ability score of 101. His score on nonverbal reasoning subtests was significantly higher at 133 than his verbal reasoning score, 73. Further, Austin’s scores on the PPVT-III was over one standard deviation below the mean, 83, yet his score on the EOWPVT was in the average range for his chronological age, 92, indicating a discrepancy between expressive and receptive language. On the ORF subtest, Austin read 78 words per minute, which is above benchmark for his age (i.e., 40 words per minute). Yet, on the RF subtest when asked to tell about what he just read, his retell consisted of five words related to the story.

**Barry.** When the study began, Barry was 8 years 7 months old. Barry is a Hispanic male with autism. He received reading instruction in both his self-contained and mainstream settings. His reported IQ score in his cumulative folder of 112 was obtained from the Leiter-R test of nonverbal intelligence, and is considered average for his chronological age. On language measures, Barry’s scores were suggestive of difficulty with both expressive and receptive language. Specifically, Barry’s performance on the EOWPVT was over one standard deviation below the mean, and his score on the PPVT-III was two standard deviations below the mean for his age. On the DIBELS ORF subtest, Barry read 87 words per minute, just below the 2nd grade benchmark of 90 words; however, on the RF subtest he was able to retell three words related to the story.

**Chris.** Chris was 7 years 8 months at pretesting. He is a Caucasian male with pervasive developmental disorder. He receives his reading instruction in both a self-contained and mainstream classroom setting. On the Leiter-R nonverbal intelligence test, Chris received an IQ score of 92, an average score for his age. Strengths noted in his cumulative folder included performance on visual matching tasks, and his ability to discriminate information and complete concrete tasks. On preliminary descriptive measures, Chris demonstrated difficulty on both expressive and receptive assessments. Chris scored more than one standard deviation below the mean on the PPVT-III, and greater than two standard deviations below the mean on the EOWPVT. On the DIBELS ORF subtest, Chris read 66 words per minute, which is below the 2nd grade benchmark of 90 words a minute. When asked to tell everything he remembered about what he read on the RF subtest, Chris did not respond.

Nine general education peers participated in the study. Peers attended the same school and grade level as the student with ASD, and were students with whom the children with ASD had the opportunity to interact during a typical school day. General education students were recruited because of their effective interpersonal skills as determined by each participant’s mainstream teacher.

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**TABLE 1**

<table>
<thead>
<tr>
<th>Participants’ Test Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PPVT-III</strong></td>
</tr>
<tr>
<td>Austin</td>
</tr>
<tr>
<td>Barry</td>
</tr>
<tr>
<td>Chris</td>
</tr>
</tbody>
</table>

1 Reported in words per minute
2 Reported in words related to the story
Setting

All three students with ASD received their education in a self-contained special education classroom. Each participant was mainstreamed in a general education classroom setting for at least one class, approximately 60 minutes each day. The intervention occurred in a small room located outside the general and special education classrooms. The classroom was used for parent pick-up and drop-off, occupational therapy, special area activities, etc. The setting was familiar to all participants with ASD.

Experimental Design

A single-subject multiple baseline design across participants was employed to clearly establish the effects of the intervention on each participant’s ability to generate and respond to questions related to a reading selection. Further, the multiple baseline design is well-suited to the practical requirements of applied research and does not require the withdrawal of intervention procedures (Neuman & McCormick, 1995).

Dependent Measures

To formulate a question about text, the reader must process the information read and create a question that reflects content (Palinscar & Brown, 1984; Rosenshine et al., 1996; Slavin, Hurley, & Chamberlain, 2003). Forming questions in direct relation to content requires the responder to interpret meaning from the text (Palinscar & Brown). Question generation has also demonstrated improvements in student ability to respond to questions focusing on the main idea (NICHD, 2000). Therefore, dependent measures focused on the participants’ ability to generate and respond to questions related to the content of reading material. The frequency of student-generated questions was coded as related or unrelated to the book and as prompted or unprompted. Table 2 provides a description of each of the codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Code Definition</th>
<th>Subcategories and Subcategory Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Generated Question</td>
<td>A student generated question directed toward peer</td>
<td>Related: A question in direct reference to the story that contains a question word (who, what, when, where, why, how) and an element of the story (character, setting, event, problem, solution)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unrelated: A question containing an appropriate question word and information unrelated to the story</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prompted: A related question formed following a researcher prompt (i.e., verbal prompt, modeling, or corrective feedback)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unprompted: A related question formed without a preceding researcher prompt (i.e., verbal prompt, modeling, or corrective feedback)</td>
</tr>
<tr>
<td>Student Responses</td>
<td>Any communicative act in response to a peer question that is unprompted</td>
<td>Related response: Any communication act directly related to the story in response to a question that does not follow corrective feedback/modeling from the researcher</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unrelated response: Any communication act unrelated to the story in response to a question</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Echoic: Any imitation of an utterance in response to a question</td>
</tr>
</tbody>
</table>

Table 2: Codes of Student Question Generation and Responding
Data Collection

All sessions were videotaped using a digital camcorder and downloaded to a computer for analysis. The researcher transcribed, then coded and graphed the data to include the frequency of student generated questions and responses, and researcher prompting.

Procedure

Pre-Baseline. A 2-session pre-baseline phase was included to determine the impact of pre-instruction procedures on participant question generation and responding. In pre-baseline, each child with ASD and one general education peer took turns reading a storybook aloud. One book was read each session of pre-baseline, taking approximately 20 minutes. The general education peer was selected randomly each day from a consistent group of three general education peers for each child with ASD. Before reading, the researcher prompted the students to ask their friend questions, “It is time to read with your friend. Remember to ask each other questions while you read.” The researcher provided no guidance or prompts related to question generation.

Elements of a story instruction. Elements of a story instruction occurred after pre-baseline and seven school days prior to baseline. This instruction ensured that participants had a preliminary understanding of the setting, characters, events, problem and solution of a story. To be eligible to begin baseline, students were required to accurately match 80% of note cards to the appropriate element of a story card. All students met criteria by the second day of instruction. Details on teaching the elements of a story follow.

During the first day, the researcher taught the elements of a story to each child with ASD in a group with three general education peers. The researcher reviewed the elements of a story (i.e., setting, characters, event, problem and solution) using the familiar story, Goldilocks and the Three Bears. Participants were asked questions about each element using the tag board materials and story cards shown in Figure 1. Table 3 includes examples of questions related to each story element. If students had difficulty answering any of the questions, the researcher modeled looking up the answer in the storybook.

Next, each participant was given five note-
cards with statements specific to one of the elements of a story from *Goldilocks and the Three Bears*. With assistance from the researcher, students matched the notecards with the appropriate element by placing the Velcro notecard on the tagboard. For example, “Goldilocks” is placed next to the characters story card on the tag board, and “Goldilocks tasted the porridge” next to the events card. After all of the notecards were placed on the tagboard, the researcher and students reviewed the story elements.

On the second day, using the note cards from the previous lesson and the tag board story cards shown in Figure 1, the researcher asked students to independently match the note card on the tag board next to the appropriate element of a story card. Following the review, the researcher read *Cloudy with a Chance of Meatballs* to the students. Each student had a copy of the story, his or her own story cards containing the element of a story, a small individual tag board/story board and 10 note cards with statements specific to each of the elements of the story read. The researcher asked students to match their notecards to the appropriate element of a story on their own tagboard. During the task, the researcher provided corrective feedback. For example, if a student placed a note card describing the problem on the tag board next to event, the researcher asked the student to look at the story card. Then, the researcher read the generic question on the story card: “What does the character do in the story?” “On your note card it says that the food falling from the sky is too large and destroying the town of Chewandswallow.” “Is that something the character did in the story?” “Let’s look at the problem card.” “It says, What is the problem in the story?” “If the food is destroying the town, is that a problem?”

**SCORE instruction.** The SCORE curriculum was introduced after elements of a story instruction and one week prior to baseline. Each day for one week, the researcher provided direct instruction of cooperative behaviors using the SCORE curriculum with each participant and 3 general education cooperative partners in small groups of 4 students (Vernon, Schumaker, & Deshler, 1996). This curriculum has been used successfully in previous studies teaching academic content to students with ASD in cooperative groups (Dugan, Kamps, & Leonard, 1995; Kamps et al., 1995; 2002). SCORE includes the following cooperative learning behaviors: Share ideas, Compliment others, Offer help or encouragement, Recommend changes nicely, and Exercise self-control. At the end of each lesson, students applied the skill during role play. After the role play session, the researcher and students discussed examples of skill application. To reach criterion, all students defined and provided an example of the skill at the end of the lesson and each consecutive lesson until the SCORE curriculum ended. Lessons lasted approximately 30 minutes each day.

**Baseline.** Baseline conditions were the same as pre-baseline except that baseline followed *Elements of a Story* and SCORE instruction. That is, each child with ASD and one
general education peer took turns reading one storybook aloud during each session. Before reading, the researcher prompted the students to ask their friend questions, “It is time to read with your friend. Remember to ask each other questions while you read.” The researcher provided no guidance or prompts related to question generation. Also, throughout baseline, the researcher provided students with stickers on a SCORE chart as cooperative behaviors were observed.

**Intervention.** On the first day of the cooperative pairs intervention condition, the researcher randomly assigned the child with ASD to one of the three typical peers participating in the study. On each successive day, general education participants were rotated. Participants had access to the following materials: (a) copies of a storybook from Marc Brown’s Author series for each participant, (b) laminated self-monitoring checklist and vis-à-vis pen, (c) story cards containing elements of a story, corresponding picture, and generic question (d) question word cards (i.e., who, what, when, where, why and how), and (e) a manipulative velcro storyboard (see Figures 1-3). Also, the researcher continued to provide students with stickers on the SCORE chart after students demonstrated a behavior consistent with the SCORE curriculum. Sessions took place four days a week for approximately 40 minutes.

The researcher began instruction by verbally “walking” the students through each mental process used to construct a question during reading. When generating a question, the researcher placed the story card illustrating the relevant element of a story on the Velcro storyboard followed by the appropriate question card (see Figure 3). After reading four pages of the book, the researcher asked the children, “Who wants to ask a question?” At that point, questioning was alternated between the two children and the researcher. The following is a detailed description of the initial intervention session as it distinctly related to reciprocal questioning (i.e., the During Reading step on the checklist in Figure 2).

1. The researcher explained: “Good questions start with a question word such as who, what, when, where, why, and how. Also, a good question asks about important elements of the story such as, setting, characters, events, a problem, or a solution” while pointing to the story cards shown in Figure 1. The researcher then read the generic question from story cards aloud.

2. The researcher presented the story cards containing the elements of a story, corresponding picture and generic questions as well the removable question words (See Figure 3).

3. The researcher read the story, stopping to ask questions before turning each page.

4. The researcher asked questions by picking the question word, looking at the book, and restating what was read. For example, “I just found out what Arthur has for homework, so I can ask a question about an event because it is something the character has to do [the researcher placed the event card on the storyboard] (see Figure 3). Because I want to ask about ‘what’ Arthur has for homework, I will start my question with ‘what’ [researcher placed the word card on the storyboard]. So, my question is ‘What does Arthur have for homework?’” Or, if restating what was read would lead to a response, the researcher made a generic statement followed by a question such as “Wow, Arthur has a problem. What is Arthur’s problem?” Table 4 provides examples of researcher dialogue related to all five elements of a story including questions, question words, and think aloud discussions.

5. The researcher directed the question (generated in step 4 immediately above) to one of the students. If the student responded to the question correctly, the researcher praised the student. If the student responded incorrectly, the researcher provided corrective feedback by putting the student’s response in context and then modeling the appropriate answer by locating the answer in the text. If the student failed to respond in five seconds or repeated the question, the researcher rephrased for clarity or used restated using binary choice. If the student did not respond or responded inappropriately, the researcher provided corrective feedback and put the response in context, and then explained the correct answer. The scaffolding procedures are outlined in Table 5.
Before Reading

1

☐ Ask each other: “Why is it important to ask questions when we read?”
☐ Look at the cover
☐ Read the title
☐ What do you think the story is going to be about?

During Reading

☐ After each page Ask Questions
  ▪ Use an element of the story and a question word
☐ Respond to Your Partners
☐ Help your Partners
  ▪ Help your partner but do not give them the answer

Half Way Through Reading

☐ Predict
  ▪ What do you think will happen next?

After Reading

Ask each other these questions

☐ Who was your favorite character? ➞ ☐ Why?
☐ What was your favorite event in the story? ➞ ☐ Why?

Figure 2. Self-monitoring checklist
6. After the researcher asked three questions (as outlined in step 4 above), she verbally prompted a participant to ask a question: “Who would like to ask a question?”

   • If the student did not ask a question in five seconds, the researcher provided a verbal prompt: “What did we learn about on this page?” Did we just learn about a character or an event?”

   • If the student failed to ask a question in 5 seconds, the researcher modeled question generation.

7. The researcher and participants rotated around the table asking each other questions during this initial session.

After session 2, the researcher no longer generated questions with participants and provided scaffolding to include verbal prompting, modeling and corrective feedback as needed (see Table 5). Scaffolding was used when children with ASD and/or their general education peers had difficulty forming/responding to questions. Students had access to all needed materials during each session, including the self-monitoring checklist (Figure 2).

**Interrater Reliability**

A special education graduate student was taught to code student and researcher behavior for reliability purposes. To learn coding procedures, the researcher and student assistant watched videotapes taken during a pilot study of storybook reading using the same procedure but in a one-to-one situation with a researcher and student. The graduate student and researcher watched the videos and coded researcher and student behaviors until 80% agreement was reached for three out of five consecutive coding sessions. Agreement was reached by session 3. At this time, the graduate student began coding intervention data for reliability.

Interrater reliability was calculated by divid-
ing the number of agreements by the number of agreements plus disagreements and multiplying by 100. In addition, a Kappa coefficient was calculated. Interrater reliability was assessed for 30% of all collected student data. Reliability of prompted and unprompted student generated questions was 85% with a Kappa value of .62, considered “good” agreement (Cooper & Hedges, 1994). Reliability of unprompted and prompted student responses was 90% with a Kappa value of .68, also considered “good” agreement (Cooper & Hedges).

Data Analysis
To gain a better understanding of the intervention effects on individual performance, all data obtained are presented graphically (Parsonson & Baer, 1992). The data were graphed and visually inspected by investigating the degree as well as variability of change to determine intervention effects (Barlow & Hersen, 1984; Kamil, 1995).

Treatment Fidelity
A graduate student coded a randomly selected 30% of all intervention and baseline sessions to document the specified intervention procedures (see procedures section for a description). Data collection consisted of frequency counts of researcher prompting, instructional steps completed, and presence of needed materials. The researcher adhered to procedures during all baseline and intervention segments viewed 100% of the time. Further, appropriate materials were presented in 100% of all baseline sessions, and 92% of the time during intervention.

Results
Visual inspection of the data (presented in Figures 4 and 5) reveals a functional relationship between the implementation of a reciprocal questioning intervention delivered in cooperative pairs and question generation and responding of the three children with ASD. That is, once intervention began, all three children increased frequency of unprompted question generation and responding during reading.

Question Generation
Figure 4 illustrates the frequency of unprompted and prompted questions generated

<table>
<thead>
<tr>
<th>Story Element</th>
<th>Question Word</th>
<th>Think Aloud</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting</td>
<td>Where</td>
<td>“I just learned something new about the setting. I am going to ask a question using ‘where’ because ‘where’ is a good question word when asking about setting.”</td>
<td>“Where did Arthur have his pet business?”</td>
</tr>
<tr>
<td>Character</td>
<td>Who</td>
<td>“We just found out about a character. ‘Who’ is a good question word when asking a character question.”</td>
<td>“Who is helping Arthur write his story?”</td>
</tr>
<tr>
<td>Event</td>
<td>Why</td>
<td>“We found out that Arthur did something. He borrowed books from the Brain. So I can ask a question about an event.”</td>
<td>“Why did Arthur borrow books from the Brain?”</td>
</tr>
<tr>
<td>Problem</td>
<td>Why</td>
<td>“Oh, Arthur is not sleeping well. I am going to ask a question about the problem using why.”</td>
<td>“Why is Arthur not sleeping well?”</td>
</tr>
<tr>
<td>Solution</td>
<td>What</td>
<td>“We just found out that Mr. Ratburn helped solve Arthur’s problem. I am going to ask a question about the solution, using what.”</td>
<td>“What did Mr. Ratburn do to help Arthur solve his problem?”</td>
</tr>
</tbody>
</table>
by all three participants with ASD. Because participants did not ask any questions unrelated to the story, the graph consists of the frequency of unprompted versus prompted question generation only. The change in frequency of unprompted question generation was immediate for Austin and Barry. Chris also showed an increase in the number of unprompted questions asked, but with greater variability. The frequency of unprompted questions increased from 0–1 at baseline to a range of 1–6, 1–4, and 0–4 during intervention for Austin, Barry, and Chris respectively. Prompting decreased as children began generating questions independently.

As demonstrated in Table 6, unprompted and prompted question generation was not consistent among children with ASD, yet they were representative of their general education peers. Similarities among individual children with ASD and their general education counterparts were observed in the percentage of unprompted questions posed.

**Austin.** The proportion of unprompted versus prompted questions was high for Austin when generating questions related to characters, but lower when generating questions pertaining to an event or problem (see Table 6). The content of initial questions generated by Austin were generic, reflective of questions printed on the storycards, and primarily focused on characters and setting. Over time, Austin began asking more specific questions that went beyond character and setting iden-

### TABLE 5

**Researcher Scaffolding Procedure**

<table>
<thead>
<tr>
<th>Teacher Prompt</th>
<th>Situation</th>
<th>Definition</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Prompt</td>
<td>Child fails to initiate a question</td>
<td>&quot;What does your checklist tell you to do?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Child asks for help</td>
<td>&quot;What is a good question word when asking a character question?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Child repeats a generic question</td>
<td>&quot;What elements of the story did you just read about?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Child repeatedly asks a question about the same element of a story</td>
<td>&quot;What did you just read about?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Child does not respond to a peer question</td>
<td></td>
<td></td>
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**Modeling**

**Child Generated Question**

- Child does not respond to a verbal prompt
- After corrective feedback following a child generated question
- The teacher models how to ask an appropriate question by:
  - placing the appropriate story and word card on the storyboard
  - asking a question directly related to the element of the story identified on the story card

**Corrective Feedback**

**Child Response**

- Child gives an incorrect response to a question
- Child asks an unclear or inappropriate question
- Child generated question
  - Child asks an unclear or inappropriate question
  - Child gives an incorrect response to a question

- The teacher uses the child’s response in context, and then provides the correct response
- The teacher explains why the question does not ask something about the chosen part of the story then, models an appropriate question
- The teacher explains why the question does not ask something about the chosen part of the story then, models an appropriate question

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tification to interpretation of events, problems, and solutions. For example, in beginning sessions, Austin asked the following, “Where are they going?” “Who is Arthur telling to go away?” In later sessions, Austin’s unprompted questions were specific and clearly stated, “Why does Arthur have to clean up his room before mommy gets home?” “What did Arthur and Buster fight about?”

Barry posed few character and setting questions, and needed higher levels of prompting when questions targeted an event as opposed to other story elements (see Table 6). Unlike other participants with ASD, Barry effectively asked “why” questions throughout intervention, which most often reflected the problem in the story. However, during initial sessions, Barry started the majority of his questions using the question word “why.” Later, he effectively asked a range of questions using question words other than “why” (e.g., “What did Arthur’s puppy do?”; “What happened to

Figure 4. Frequency of prompted and unprompted student generated questions by children with autism spectrum disorder
the computer?”). By the end of intervention, Barry used a number of question words, and only received prompting when questions did not reflect the element of a story.

Chris. In comparison to other children with ASD, Chris demonstrated the highest percentage of unprompted questions when asking about a problem and the lowest percentage when asking about characters and events (see Table 6). Chris’s difficulty forming character questions was a result of using “who” and “what” question words interchangeably, “Who is mommy doing?” Chris relied primarily on modeling to ask a question during beginning sessions. By session 6, he was consistently asking more unprompted than prompted questions during reading. During initial sessions, Chris used a lot of self-talk, “I can ask an element. Setting is an element.” By the end of session 5, Chris asked his first specific problem question, “Why did Muffy trip the brain?” Throughout the intervention, Chris progressively asked more specific questions reflecting story content, “Why is their house all messy?” Self-talk remained prominent, but instances of failing to ask a question decreased steadily after session eight. At the end of the intervention, Chris continued to use “who” and “what” question words interchangeably.

Unprompted Responses

Figure 5 shows the frequency of unprompted responses by each child. Immediately after intervention began, general education peers increased question generation. Because the intervention involved reciprocal questioning, the responses of the children with ASD were highly dependent on questions posed by general education peers. That is, all three children with ASD show a general pattern of increased unprompted responses with an increase in the questions posed by peers, although with individual variations in relation to consistency. The number of times participants with ASD responded to questions generated by peers without prompting ranged from 2–6, 1–6 and 1–5 for Austin, Barry and Chris respectively.

Participants with ASD and their general education peers had the opportunity to respond to a variety of questions focusing on each of the 5 elements of a story (see Table 7). The proportion of unprompted versus prompted responses was variable. Participants with ASD and their peers received the least amount of prompting when responding to character and setting questions. Responses to problem questions showed greater variability. Further, solution questions were asked very infrequently by participants, making it difficult to note any patterns in responding behavior. Very few participants failed to respond or responded with “I don’t know.”

Questions that required a response beyond text recall required prompting more often than responses directly found in text. That is, if a response required interpretation of a character’s behavior or summarizing a character’s actions or events, the need for prompting increased. For example, in the story Arthur Goes to Camp, Rocky (the boy’s camp counselor) is yelling at the boys about their physical shape. Earlier in the story, references were made about sporting competitions between the boys and girls camps, and Rocky is yelling at the

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<th>Participants</th>
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boys about getting in better shape. One participant asked, “Why is Rocky being so mean to the boys?” To answer this question, first, the student must interpret Rocky’s behavior as “mean.” Then, the participant has to link Rocky’s pushing the boys to get into better shape as a reflection of his desire to win the competition. This takes summarizing information from within text and linking it to what the participant already knows about competition.

Social Validity

Social validity data were collected including interviews with parents of children with ASD, interviews of children with ASD, and interviews with 8 of 9 participating general education peers. Parents were interviewed regarding degree of change noticed in their child’s reading and social behavior, and whether or not they felt the intervention was important.
and necessary for their child. Later, parents were shown a video of the first intervention session followed by a video of the last session, and were asked to describe any changes in their child’s reading and language skills. Children with ASD and their general education peers were interviewed separately. Questions pertained to usefulness of the reading intervention. Further, children were asked about relationships established with their reading partners during intervention.

All participants with ASD stated the intervention helped them understand what they read. Barry and Austin reported they still ask questions when they read. When asked what they liked best about the intervention, Austin focused on the books and reading with peers, Barry reported a preference for working with one peer, and Chris enjoyed using the checklist. Austin described positive attributes of all three of his peers, and Barry favored one peer he thought of as “cool.”

All general education peers indicated the intervention was helpful, and they enjoyed participating. General education participants stated they learned new words (n = 3) and how to ask questions (n = 3). Also, one participant noted she was able to take time to read, another mentioned feeling encouraged to read more, and a third thought the book helped him learn. Further, six participants reported they continued to ask questions when reading and reported they talked to the children with ASD more often. When asked what they thought of their peers with ASD, all communicated differences in perception. For example, one of Austin’s peers stated that before intervention he found Austin “a little weird,” but after intervention he thought of Austin as “a good friend.” Similarly, one of Chris’s peers believed Chris was “a nice person” prior to intervention, and after she considered him “nice” and “smart.” In fact she stated: “... he didn’t really need my help at all because he was really smart.” Overall, six of the seven peers would participate in the reading intervention again, and one indicated he might.

Parents of children with ASD were shown a video of the first intervention session followed by a video of the last session and were then asked to describe any changes in her child’s reading and language skills from the first to last session. Austin’s mother reported improvement in Austin’s question formation and attention while reading. Barry’s parents and Chris’s mother acknowledged a positive gain in reading fluency including rate, accuracy and/or expression. Chris’s mother noted forming questions remained difficult for him and stated he had trouble “... coming up with words.” Austin’s mother and Barry’s parents observed a decrease in the level of prompting prior to and following intervention while Chris’s mother noticed less prompting related to initiation of a question.

Overall, Austin and Chris’s mothers, as well as Barry’s parents, agreed that the intervention was valuable. Austin’s mother and Barry’s parents suggested the intervention was important for both reading and language. Moreover, Barry’s parents indicated it improved Barry’s “conversational skills.” Chris’s mother valued the intervention because Chris no longer responded to questions with “I don’t know.” Further, all interviewees would like

### TABLE 7

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their children to participate in a similar intervention again.

Discussion

The purpose of this study was to determine the effect of a reciprocal questioning comprehension strategy delivered in the context of cooperative pairs on the question generation and responding of three children with ASD. All children with ASD were able to learn and effectively utilize a question generation strategy and increased frequency of question generation and responding during reading. In addition, social validity data documented that both children with and without ASD enjoyed participating in the intervention and thought it beneficial. Parents of all three children with ASD also felt the intervention was important and had a positive effect on their child.

Individual Variation in Question Generation

Immediate and consistent gains experienced by Austin may be representative of his language ability. On descriptive receptive/expressive language measures, Austin scored higher than his peers with ASD. Yet, he demonstrated a discrepancy between scores, scoring higher on the expressive than receptive language measure, not uncommon for children with Asperger syndrome (Tantum, 2000). It is possible that Austin had less trouble forming questions initially, resulting in his ability to focus his attention on meaning, i.e., content related to the story rather than on the mechanics of question formation.

In contrast to Austin, Barry and Chris scored at least one standard deviation below the mean on both expressive and receptive language measures given prior to intervention. During beginning intervention sessions, Barry and Chris had greater difficulty forming questions, attending more to the form and function of question generation. From the onset of intervention, Barry was able to generate ‘why’ questions effectively, but had greater difficulty posing questions with an alternate question word. For example, “Elements of a story, because Arthur is doing something in the story.” Similar to Barry, Chris also had trouble forming questions during beginning sessions, “I can ask an element. Setting is an element.” This is consistent with the research on language development of children with ASD, that is, many children with ASD have difficulty understanding how to use language to obtain a specific goal (Wetherby, 1986). Over the course of intervention, Barry began forming questions using various question words, and Chris began generating content specific questions. Therefore, initial intervention effects may reflect an expansion in communicative function for Barry and Chris, specifically, the function of asking and responding to questions interactively during reading.

Gestalt Learning

Children with autism often begin using language by imitating vocalizations. As children with ASD use these vocalizations in context, they begin to understand their meaning and function. As a result, more inventive language emerges as imitative, rigid vocalizations decrease (Schuler, Prizant, & Wetherby, 1997). This pattern of language development has been described as a Gestalt learning style (Wetherby, Prizant, & Schuler, 2000). The Gestalt learning style has been explained as learning in chunks. When applied to language development, the child interprets a chunk of language as meaning associated with the context in which it was originally heard or learned. Initially, chunks of language are repeated with little comprehension of function, sometimes taking on unconventional forms of language. As the child begins to understand the function or intent to a greater extent, he/she begins personalizing vocalizations by modifying repeated phrases. Through experience using and modifying these phrases, more spontaneous speech occurs (Wetherby et al.).

Both Austin and Chris used story cards to build questions during initial sessions, “What is the problem in the story?”; “What is the character doing in the story?” Later, both participants became more flexible with question generation. For example, Austin asked, “What is Mrs. McGrady, Fern and Binky doing?” and Chris, “Why did Muffy trip the brain?” The initial success of using the story card to form a question could be a reflection of the gestalt learning style associated with autism. That is, participants began using the direct model,
and then modified questions to fit the context of the story, becoming more creative with question generation.

Similarly, Barry initially generated questions using only ‘why.’ This heavy reliance on ‘why’ questions during beginning sessions may signify familiarity with the form and function of these questions. It is conceivable that as Barry became more comfortable with and began to comprehend the purpose and function of generating questions during reading, his creativity with question formation increased by expanding question word use (i.e., who, how, what). Also, all three participants increased the frequency of unprompted responses beyond answering using information directly stated in text or immediate recall to interpretation of events within text.

Results Indicative of Age

All participants with autism as well as their general education peers received variable levels of prompting when questions required interpretation of text beyond factual information. If the participant had to summarize information from the text or use prior knowledge or experience to generate or respond, instances of prompting were greater. For example, both children with ASD and their general education peers had more difficulty with questions and/or responses reflecting a problem in the story. To generate and/or respond to a question concerning a problem, one has to summarize and interpret what was read as a problem for the character(s) in the story often sequencing and summarizing information from within text, and linking it to what the participant already knows about the topic read.

Although lower levels of prompting were recorded for all participants over the course of intervention, the abstract nature of the task may account for existence of prompting at the end of intervention. The ability to independently participate in higher order processing activities that involve abstract thought differs by age. During middle childhood years (ages 6-10) children have more limited capacity for abstract thought, and generally require the assistance of concrete materials and/or adult scaffolding to participate in activities that require abstract processing (Devitt & Ormrod, 2002). Therefore, developmentally all participating children to varying degrees needed concrete supports as well as researcher prompting. Consequently, the intervention established a truly reciprocal relationship in which students with ASD learned alongside typically developing peers.

Typically, question generation strategies including reciprocal teaching are used for students in third grade through adult years (Rosenshine & Meister, 1994; Rosenshine, et al., 1996). This does not mean that question generation is not an important strategy for students in early elementary grades. Children as young as kindergarteners have increased the quality of questioning related to story comprehension (Glaubman, Glaubman, & Ofir, 1997). Moreover, research suggests that students reading/comprehending on grade level by third grade will not necessarily comprehend on grade level in future grades, indicating a need for explicit, systematic comprehension instruction beginning in primary grades (Snow, 2002). Further, results from this study indicate that students began to generate more questions that required respondents to summarize information from within text and link it to independent knowledge and experiences. Over time increased experiences in generating and responding to such questions may increase the student’s ability to independently respond to like questions (Palincsar & Brown, 1984).

Results of this study suggest that direct comprehension strategy instruction in the form of reciprocal questioning intervention has the potential to be a powerful tool for increasing question generation and responding of children with ASD during the context of storybook reading with peers. Results also show that both the children with ASD and their general education peers learned a new strategy simultaneously. Therefore, children with ASD can learn reading comprehension strategies suggested by NRP alongside their typical peers with the typical peers also benefiting from the intervention. Both the children with and without ASD enjoyed learning together, and, as such, the integrated setting may increase motivation for learning.

Limitations

Results of the study, however, should be interpreted with caution. The small sample size

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and lack of random selection makes it impossible to generalize the results to other children. Also, in a multiple baseline design it is preferred to vary the length of the baseline condition across participants (Cooper, Heron, & Heward, 1987). Although baseline sessions were lagged between participants and the number of days spent in the baseline condition varied, the number of baseline sessions was three for all participants. However, data revealed stable or descending baseline behavior across all participants. Further, because the proposed study incorporates a treatment package, when a change in behavior occurs, it is difficult to determine if the entire package or a component of the intervention impacted that change.

Implications for Practice and Further Research

Research replicating the present study and examining the effects of direct comprehension strategy instruction on reading comprehension is needed. Not only should the effects of reciprocal questioning intervention on reading comprehension be studied, but the effects of other NRP strategies on the reading comprehension of learners with ASD should be researched. Outcomes of teaching students with ASD with their typical peers should be conducted. Studies should assess the longitudinal impact of reading comprehension interventions and the generalization of reading comprehension skills to other areas of development (i.e., expressive, receptive, social communication, and cognitive development), to comprehension in curriculum content areas, and to performance on question and answer assessments. Also, future studies should investigate the amount and intensity of instruction required for children with ASD to increase and maintain reading comprehension abilities.

References


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