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Teaching Emotion Vocabulary to Children With Autism Spectrum Disorder

Seyma Intepe-Tingir, PhD[1], and Kelly Whalon, PhD[2]

Abstract

Research suggests that reading for understanding, especially narrative text, is difficult for children with autism spectrum disorder (ASD); yet research on how to effectively teach skills associated with reading comprehension is limited and has generally deemphasized vocabulary interventions. This single case research design study (i.e., a multiple probe across behaviors design) examined the effectiveness of teaching emotion vocabulary words to children with ASD ages 6 to 7 years. Vocabulary knowledge was taught explicitly during the repeated reading of storybooks illustrating the target emotion words. Results showed all participants increased their ability to label and define the target emotion words. Moreover, the classroom teacher indicated the intervention improved participant understanding of emotion words. Implications and future research are discussed.

Keywords

autism spectrum disorder, emotion vocabulary, technology

Several studies investigating the reading profiles of learners with autism spectrum disorder (ASD) suggest heterogeneity in reading development (e.g., Brown et al., 2013; McIntyre et al., 2017b; Nation et al., 2006). Despite the variability, many learners with ASD score below expected levels on reading comprehension measures but in the average range on decoding subtests (e.g., Brown et al., 2013; McIntyre et al., 2017b; Nation et al., 2006). Unfortunately, the challenges learners with ASD experience related to comprehension tend to persist throughout their schooling (Grimm et al., 2018; Solari et al., 2019), and gaps on measures of comprehension may even expand over time (Wei et al., 2014).

Emerging research suggests that the skills influencing the reading comprehension of typically developing children are similar to those impacting the reading comprehension of learners with ASD. According to the Simple View of Reading, reading for understanding requires both effective decoding skills and language comprehension (Gough & Tunmer, 1986). Consistent with this model, Nation et al. (2006) found that among participants with ASD and intact decoding skills, scores on vocabulary and language comprehension predicted performance on reading comprehension measures. There is also evidence that vocabulary is the strongest predictor of reading comprehension among learners with ASD (Davidson et al., 2018; Lucas & Norbury, 2015). Moreover, learners with ASD often struggle to make inferences (Lucas & Norbury, 2015; Norbury & Nation, 2011; Solari et al., 2019), and vocabulary knowledge is predictive of their ability to generate inferences about text (Lucas & Norbury, 2015).

Despite the links between vocabulary knowledge and comprehension, very few studies have explicitly targeted the vocabulary knowledge of school-age children with ASD in the context of reading instruction (Bailey & Arciuli, 2019). Studies that have addressed vocabulary knowledge are generally part of a larger reading program/curriculum designed to teach reading broadly or comprehension specifically. For example, Grindle and colleagues (2013) measured the impact of MimioSprout Early Reading (i.e., a computer-based comprehensive early reading program) on the early reading skills of 4- to 6-year-old children with ASD. MimioSprout includes direct instruction of verbs as children receptively identify pictures that represent action words. During the course of intervention (80 lessons), children with ASD improved their scores on the DIBELS Word Use Fluency Subtest, which assessed the ability to accurately use a target word.

[1]University of Maryland, College Park, USA
[2]Florida State University, Tallahassee, USA

Corresponding Author:
Seyma Intepe-Tingir, Assistant Clinical Professor, University of Maryland, 3942 Campus Dr., College Park, MD 20742, USA.
E-mail: seyma.intepe@gmail.com

Other studies have embedded vocabulary instruction in the context of comprehensive comprehension interventions for elementary (ages 4–11; Henry & Solari, 2020; Roux et al., 2015a; Solari et al., 2020) and secondary (ages 12–14; Solis et al., 2021) learners with ASD. These interventions targeted 3 to 8 words that were considered important to understanding the content (Henry & Solari, 2020; Solari et al., 2020; Solis et al., 2021) and/or high utility words that are often encountered in a text (i.e., Tier 2 words; Roux et al., 2015b; Solari et al., 2020). Words were taken from fiction (Henry & Solari, 2020; Roux et al., 2015b; Solari et al., 2020) and nonfiction texts (Solis et al., 2021) that were read aloud by an adult (Henry & Solari, 2020; Roux et al., 2015b; Solari et al., 2020) or independently by participants with support (Solis et al., 2021). These studies all included explicit instruction of target vocabulary words but varied in terms of when explicit instruction was applied. For example, while reading text aloud, definitions of target words were provided when encountered in the text (Henry & Solari, 2020; Roux et al., 2015b; Solari et al., 2020) but activities to address the depth of understanding either occurred before (Roux et al., 2015b; Solis et al., 2021) or after (Henry & Solari, 2020; Solari et al., 2020) reading.

In these studies, explicit vocabulary instruction was designed to provide a deeper understanding of the target words. Interventions consistently provided (a) a clear, short definition of the word that students were expected to repeat verbally and/or in writing, (b) multiple examples of the words through images depicting the meaning and clear examples of the words in sentences/text, and (3) several opportunities to use/engage with the words (Henry & Solari, 2020; Roux et al., 2015b; Solari et al., 2020; Solis et al., 2021). Visuals were provided and explained to further understanding of word meanings. For example, asking students if an image is an example or non-example of a target word (Henry & Solari, 2020) or to select the word represented in an image (Solari et al., 2020). Participants were also expected to demonstrate their understanding of the word by using the word (Roux et al., 2015b; Solis et al., 2021), acting out the word (Henry & Solari, 2020), or drawing pictures of word meanings (Solari et al., 2020).

Following explicit instruction, learners with ASD made gains on researcher-made and standardized vocabulary measures. Researcher-made measures monitored depth of understanding by requiring participants to define (i.e., "What does X mean?") target words (Roux et al., 2015b; Solari et al., 2020; Solis et al., 2021), provide a synonym ("What is another word for X?") of the target word (Solis et al., 2021), or use the word in a sentence (Solari et al., 2020; Solis et al., 2021). This ability to provide definitions and synonyms of words indicates a greater depth of understanding than labeling (Oakhill et al., 2015). In group design studies, participants outperformed control groups (Roux et al., 2015b; Solari et al., 2019) on researcher-developed measures, and in a single case design study, variability was noted, but participants did increase their performance on vocabulary knowledge probes (Solis et al., 2021). In one study, participants outperformed the control group on a standardized measure of expressive vocabulary (Expressive Vocabulary Test 2nd edition; Henry & Solari, 2020). This is a promising finding as gains on standardized measures of vocabulary not explicitly taught in the intervention are often difficult to achieve (Elleman et al., 2009).

In addition to decoding and language comprehension (i.e., vocabulary and listening comprehension), the social cognition of learners with ASD is linked to reading comprehension with higher scores on measures of autism symptomatology associated with lower scores on measures of reading comprehension (e.g., McIntyre et al., 2017a; McIntyre et al., 2018; Ricketts et al., 2013). Recent investigations also indicate a relationship between performance on measures of reading comprehension and Theory of Mind or the ability to infer others' perspectives, predict behaviors, and understand the feelings of self and others (e.g., McIntyre et al., 2018; Ricketts et al., 2013). Causal inferences in narrative text often involve interpreting the thoughts, feelings, intentions of others, and linking those to causal events (Guajardo & Cartwright, 2016; Losh & Capps, 2003), and learners with ASD generally have trouble making causal inferences about internal states (Capps et al., 2000). Further evidence suggests learners with ASD find making inferences related to emotion particularly challenging, and this difficulty does not decline over time or when language improves (Bodner et al., 2015). Therefore, to improve comprehension of narrative text, some direct instruction of vocabulary terms associated with emotion will likely be required by drawing the attention of learners with ASD to the mental states of the characters (Randi et al., 2010) and scaffolding causal connections between character mental states and actions (Frith & Happé, 1999).

To our knowledge, there are no studies explicitly teaching emotion vocabulary words encountered in narrative text. Therefore, the purpose of this study was to investigate the effects of explicit instruction of emotion vocabulary on the emotion vocabulary knowledge of young children with ASD (6- to 7-year-olds). The following research question was explored:

> **Research Question 1:** What is the effect of direct emotion vocabulary instruction on the emotion vocabulary knowledge of 6- to 7-year-old students with ASD?

Method

Participants and Setting

Participants were recruited from a private school in the southeastern United States that serves students with

Table 1. Student Demographics Information.

			PPVT-4		EVT-2		GARS-3	TEC		
Students	Age	Gender	SS	PR	SS	PR	Probability of ASD	Autism Index	Pre-Raw	Post-Raw
Al	6.10	M	88	21	81	10	Very Likely	74	14	17
By	7.5	M	88	21	95	37	Very Likely	80	11	18
Ct	6.10	M	91	27	81	10	Very Likely	78	11	12
Li	6.3	F	85	16	92	30	Probable	59	14	16

Note. PPVT-4 = Peabody Picture Vocabulary Test, Fourth Edition; EVT-2 = Expressive Vocabulary Test, Second Edition; SS=Standard Score; PR=Percentile Rank; GARS-3 = Gilliam Autism Rating Scale, 3rd edition; TEC = Test of Emotion Comprehension; ASD = autism spectrum disorder.

disabilities in kindergarten through 12th grade. The teacher was asked to identify potential participants who met the following criteria: (a) diagnosis of ASD, (b) the ability to answer questions verbally in short phrases (2- to 3-word combinations) or sentences, (c) enrolled in kindergarten, first or second grade. One teacher identified three males and one female with a diagnosis of ASD. The classroom teacher was a Hispanic female with more than 5 years of teaching experience in early elementary grades. She had a bachelor's degree and was certified in special education. All participants received their education in the same classroom with another four students with disabilities.

To determine the child's current receptive and expressive vocabulary knowledge, the researchers administered (a) the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) and (b) the Expressive Vocabulary Test, Second Edition (EVT-2). The Test of Emotion Comprehension (TEC) was also administered to assess participant understanding of emotions. This test measures nine components of emotion understanding including recognizing facial emotions and interpreting emotions in different contexts/situations. All participants received their ASD diagnosis from a medical professional (i.e., psychologists/pediatricians). To confirm an ASD diagnosis, the teacher completed the Gilliam Autism Rating Scale, 3rd edition (GARS-3). See Table 1 for scores on all measures.

Al was a 6-year-old White male diagnosed with ASD. Al received speech/language and occupational therapy services. His Individualized Education Program (IEP) goals included improving reading comprehension and understanding emotions. His teacher and therapists used a token economy to keep him motivated during reading instruction. **By** was a 7-year-old White male with ASD. He received speech/language, physical, and occupational therapy at school. By easily got upset with small routine changes and responded by yelling, kicking, and/or crying. His teacher and behavior therapists used a token economy system to reinforce engagement in academic instruction by earning small breaks outside, playing with his favorite toys, and so on. His IEP goals included identifying and regulating his emotional state and working on reading comprehension. **Ct** was a 6-year-old White male with ASD. He received speech/language, physical and occupational therapy at school. His IEP objectives targeted improving his reading skills and regulating his emotions. **Li** was a 6-year-old White female. She received speech/language and music therapy at school. Li had difficulty controlling her emotions and became upset quickly. Teachers and therapists used a token economy to encourage her to engage in instruction.

Intervention and probe conditions were delivered in a one-on-one format. Most sessions were conducted in a quiet room at the participant's school. If this room was occupied, a private table in the common area of the library was used.

Dependent Variable

Baron-Cohen's developmental survey of emotion words (Baron-Cohen et al., 2010) was used to determine the target emotion vocabulary words. This survey study identified 336 emotion words. Teachers and parents rated whether children of a specific age (ages 4–16) "clearly understood," "possibly understood," " or "not understood" each word. Target emotion words included words (a) that parents and teachers rated as being understood by 75% of 4- to 8-year-old children and (b) were also found in the storybooks.

Prior to baseline, research assistants administered a pre-test of five storybooks that each included three vocabulary words identified in the survey of emotion words (Baron-Cohen et al., 2010). The pre-test required children to (a) define the target word and (b) provide contextual examples. To be included, participants had to score a 0 on all 3 target words in four of the five storybooks (see Table 2). All participants met these criteria. Storybooks were randomly assigned to conditions. A list of storybooks, target vocabulary words, and definitions are in Table 3.

The primary dependent variable was the percentage of correct responses on vocabulary probes. For each target word, two questions were asked to determine whether participants could (a) define the word (e.g., "What does excited mean?") and (b) provide examples of the word (e.g., "What makes you feel excited?"). Verbal responses were recorded and coded using the scoring system in Table 2. Participants could score a maximum of 9 points on each probe.

Table 2. Scoring System for Expressive Vocabulary.

Points	Criteria	Sample response for "excited"
3	Complete knowledge and examples	
	Child provides a definition and an example(s)	Looking forward to something good.
	Child provides a synonym for the word and an example(s)	Having a new baby, birthday, candy (any examples make sense to be excited). Thrilled or delighted
2	Complete knowledge	
	Child gives multiple examples (more than one)	Having a new baby/friends, going to a party, Disneyworld
	Child provides a definition or a synonym	Looking forward to something Thrilled, Delighted
1	Partial knowledge	
	Child provides proper use of the word or only one example	Feel good, jumping Birthday cake
	Child clearly demonstrates the target word	Demonstrate excited face or behavior such as jumping up and down
0	No knowledge	
	Child provides no response or an inaccurate response Child repeats the target word	Falling down, sad, laughing

Table 3. Target Emotion Words and Definitions by Storybooks.

Storybooks	Words	Definitions
Little Tiger's Big Surprise	Excited	Happily look forward to something
	Upset	Feeling sad and mad
	Pleased	Feeling happy
Knuffle Bunny Free	Brave	Feeling not afraid
	Thankful	Feeling good or happy about something that happened
	Proud	Happy about something you or someone has done
Shark Detective	Lonely	Want to be with other people when you are by yourself
	Love	Liked something or someone a lot
	Grateful	Feeling happy about what you have
The Monster of the Wood	Scared/Frightened	To be afraid of something or someone
	Safe	Free from getting hurt
	Calm	Feeling good and not worried
Franklins' Bad Day	Grumpy	When someone get easily mad at something
	Furious	Really really angry
	Puzzled	To not understand something

Interobserver Agreement

The first author and a research assistant (RA) coded all data. The RA was a master's student in special education. The first author and RA watched videos from a prior share book reading study that also targeted vocabulary knowledge until they reached a minimum of 90% agreement on three of five consecutive videos. Once reliable, the first author served as the primary coder, and the RA coded a randomly selected 30% of sessions from each study phase (probe, intervention, and control conditions). All probe responses were recorded verbatim and double scored. For Al, interobserver agreement (IOA) was 93.4% (91%–100%) in intervention, 95.6% (3%–100%) in control, and 100% in probe conditions. For By, IOA was 95.2% (93%–100%) in intervention, 96.8% (94%–100%) in probe, and 100% in control conditions. For Ct, IOA was 97.3% (86.2%–100%) in intervention, 97% (93%–100%) in probe, and 100% in control conditions. For Li, IOA was 100% in intervention, 98.2% (95%–100%) in probe, and 97% (91%–100%) in control conditions. Coders reached 100% agreement after discussion.

Experimental Design

A multiple probe across word sets was used to determine the impact of the intervention on participant vocabulary knowledge. A multiple probe design allows the researcher to collect baseline data intermittently over the course of the study, thereby limiting participant fatigue associated with long-baseline conditions. In this study, the multiple probe design

was presented in phases to form their own condition (Gast et al., 2018, p. 246). This design is appropriate as academic skills are more likely irreversible (Ledford & Gast, 2018). The independent variable was introduced following an initial probe phase consisting of at least three data points. Then, intervention on the first set of target words was implemented until the participant reached the criteria. To meet the criteria, the participants scored at least 3 points (see Table 2) for each vocabulary word on the last two consecutive days of intervention. After reaching the criteria, vocabulary probes were administered in a second probe phase. These procedures continued for the third and fourth word sets.

Procedures

The interventionists included a doctoral candidate and three undergraduate assistants with prior experience serving students with disabilities. All undergraduate students were part of a university undergraduate research opportunity program. To develop child-friendly definitions (Beck et al., 2002), children's dictionaries and English language learner online dictionaries (e.g., Merriam-Webster, Learners dictionary) were used. Definitions of emotion words were kept short. Faculty with expertise in vocabulary development and intervention and elementary teachers reviewed the definitions to determine whether the definition was representative, child-friendly, and whether the word is important for children in kindergarten through second grade to learn/know. Reviewers agreed that "the definition is kid-friendly," "the definition is representative (culturally sensitive)," and "the word is important to teach in K to 2 grade." Based on recommendations, four definitions were revised. The intervention was delivered 5 days a week for 10 weeks. Each session took approximately 25 min.

Materials

Five age-appropriate storybooks of high interest for children in kindergarten through second grade with three developmentally appropriate emotion words selected (see Table 3). The Go Book app was used to pre-teach words during the intervention. Example materials are available upon request. All sessions were video recorded for coding purposes.

Probe Condition

The researcher administered probes, and all administration and scoring procedures followed those outlined in the dependent variable section. In all probe sessions, participants were asked to define the target word and the function of the word. If the participant provided no response after 5 s or incorrect response, the researcher moved to the next item without providing any feedback or error correction.

Intervention

The intervention is a package consisting of (a) a pre-teaching activity, (b) reading aloud with questioning, and (c) systematic instruction. The same book was used repeatedly until participants reached the criteria. The Go Book app was programmed with 5 prompts for each target word to provide several opportunities to experience the target word. Specifically, the app asked participants to (a) identify the target word, (b) repeat the target word, (c) provide a definition of the target word, (d) identify the target word among three visual options, (e) watch a video depicting the target word in context and model the target word (e.g., Show me your happy face), (f) repeat the definition of the target word, and (g) select the correct illustration of the target word among visual options (e.g., "Which picture shows looking forward to something?"). The pre-teaching activity was repeated at the beginning of each intervention session.

Following the pre-teaching activity, the interventionist read the story aloud. During the reading, the interventionist asked 12 scripted questions corresponding to storybook pages containing the target vocabulary (e.g., "How does mother tiger feel?"). Two questions about each target word were asked twice on different pages (four questions total per word) in the storybook. After asking a question, the interventionist evaluated the response and confirmed a correct response (e.g., "Yes, mother tiger is excited.") or provided a direct model and followed no or an incorrect response (e.g., "Mother tiger is excited. Say, excited."). Regardless of the level of prompting, the interventionist expanded correct responses by providing an example (e.g., "I am excited because I am going on vacation."). The intervention continued until participants reached the mastery criteria (i.e., scoring 3 points for each vocabulary word for 2 consecutive days).

Control condition/repeated reading. The control condition included a repeated reading of the storybook without the pre-teaching activity. The only difference between the control and intervention condition was the instructional procedures (no pre-teaching of vocabulary words, no feedback on responses for the questions, and no expansion for the questions). The same storybooks were repeatedly read, and interventionists asked the same questions during reading. The repeated reading phase ended once the data were stable or descending for at least 3 consecutive days.

Comprehension test/generalization. The interventionist asked five comprehension questions after the book reading. The questions included one about the character (e.g., "Who was excited?"), one about an event (e.g., "What happened when little tiger tried to find someone to play with?"), one about a problem or solution (e.g., "Why could no one play with little tiger?"), one or two questions about the cause of a target

Table 4. Comprehension Scores for Four Storybooks.

	Participants' comprehension scores			
Books	Al	By	Ct	Li
Book Set 1	3.5	2.6	2.8	3
	87% F 58% I	58% F 50% I	70% F 46% I	50% F 66% I
Book Set 2	3.6	3.5	1.8	3.4
	83% F 66% I	90% F 56% I	60% F 20% I	90% F 53% I
Book Set 3	3	3.3	2.6	4.1
	81% F 41% I	66% F 66% I	78% F 33% I	78% F 85% I
Mean Sets 1–3	3.4	3.1	2.4	3.5
Control Book	3.2	2.2	1.2	2.4
	80% F 53% I	90% F 13% I	30% F 20% I	60% F 33% I

Note. F = Fact Questions; I = Inference Questions.

emotion (e.g., "Why was Little Tiger upset?"). Following an incorrect or no response within 5 s, the researcher moved to the next item. Questions answered correctly within 5 s were coded as independent, and no or incorrect responses were coded as incorrect.

Procedural fidelity. Prior to the study, interventionists reached 90% accuracy twice on fidelity checklists. Fidelity checklists for each condition included procedures to ensure the interventionist conducted the study as intended. All coders received training until they reached a minimum of 90% agreement on three out of five consecutive mock videos. A randomly selected 30% of the sessions from each condition for each participant was coded. For Al, the procedural fidelity was 100% for intervention, control, and probes. For By, the mean was 98.25% (96%–100%) for the intervention and 100% for the probe and control. For Ct, the mean was 99.6% (97%–100%) for the intervention and 100% for the control and probes. For Li, the mean was 96.5%(94%–100%) for the intervention and 100% for the probe and control.

Social validity. A Likert-type scale based on the Reichow's criteria for social validity (Reichow et al., 2008) was developed. The scale (i.e., strongly disagree, disagree, neutral, agree, and strongly agree) included questions that asked the classroom teacher about the usefulness, importance, and feasibility of the intervention (see Table 4). In addition, elementary school teachers and faculty with a background in vocabulary intervention rated the selected vocabulary to determine if the definitions were student-friendly and important to teach children in grades K–2.

Results

Figures 1 to 4 present data from all conditions by target word set (a total of four word sets) for each participant. The graphed data represent the percentage of correct responses on the expressive vocabulary knowledge probe (probe conditions) and vocabulary knowledge questions (intervention conditions) by target word set.

Al

Al's correct responses in the first Word Set 1 probe phase ranged from 0% to 11% (mean 4%). Once intervention was introduced, Al immediately answered questions correctly and reached criterion after seven sessions. In the second probe condition, Al's percentage of correct responses increased ranging from 66% to 88% (mean 73%) demonstrating a shift in level. In the remaining 3 probe phases, Al's percentage of correct responses decreased but remained higher than the initial probe condition ranging from 55% to 100% (mean 76%). There was no overlap between probe phases prior to and following intervention.

In the initial Word Set 2 probe condition, Al demonstrated a decreasing trend with scores ranging from 0% to 44% (mean 12%). Al immediately answered questions correctly when the intervention was introduced, reaching criterion after six sessions. In the probe phase following intervention, Al's percentage of correct responses increased ranging from 55% to 88% (mean 77%). Data on the remaining probes reflects variability with scores ranging from 44% to 100% (mean 72%). Although some overlap is noted, the majority of data points exceed the initial probe.

In Word Set 3, Al's percentage of correct responses in probe phases prior to intervention ranged from 0% to 11% (mean 4%). When the intervention was introduced, Al immediately answered questions correctly with correct responses ranging from 42% to 100% (mean 66%). He reached criteria after eight sessions. In the following probe condition, Al's percentage of correct responses was variable ranging from 44% to 88% (mean 62%) and remained variable in the final probe condition ranging from 55% to 88% (mean 73%). Although variable, data in probe conditions remained higher than phases prior to intervention with no

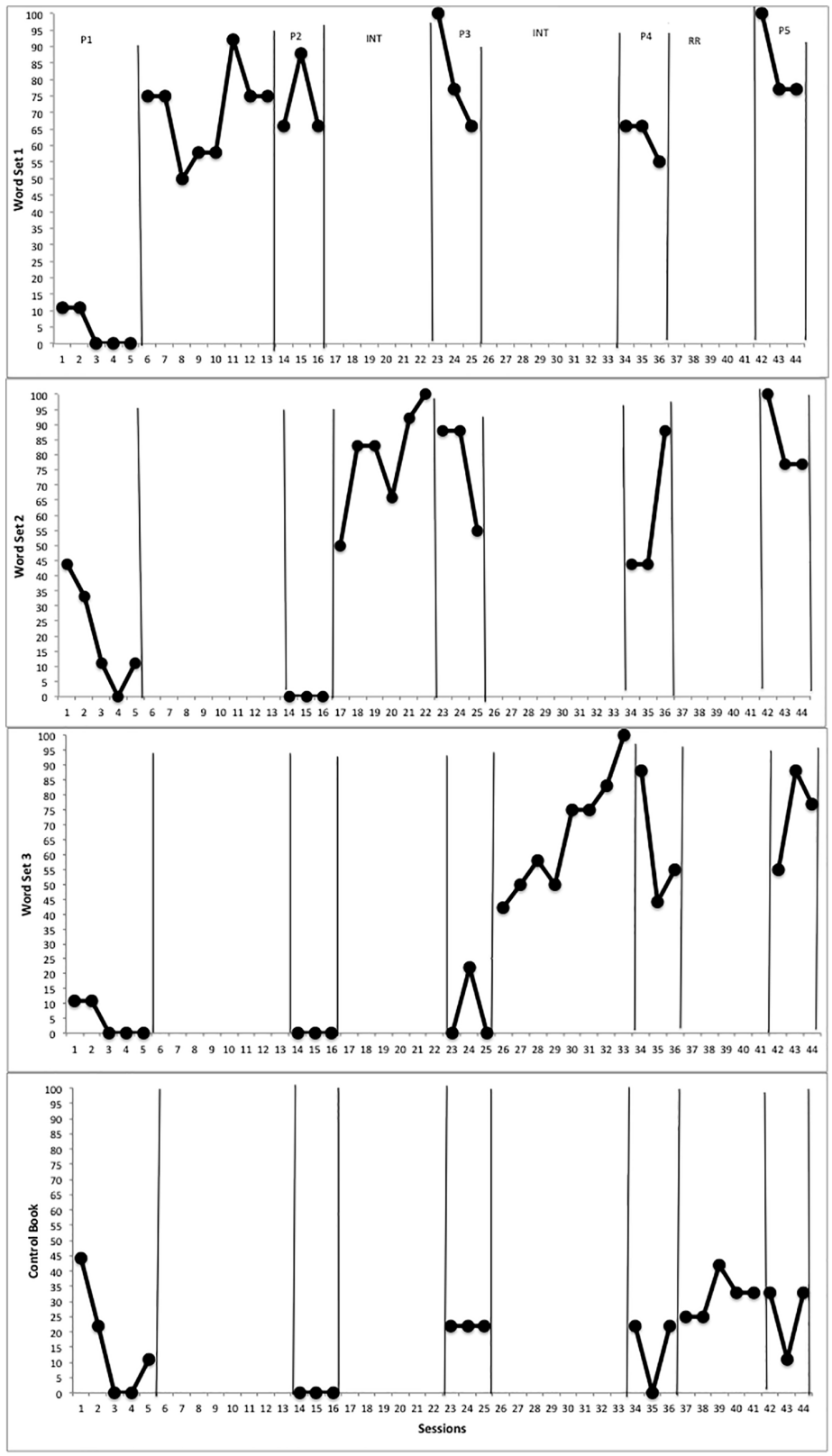

Figure 1. Percentage of correct responses for AI.

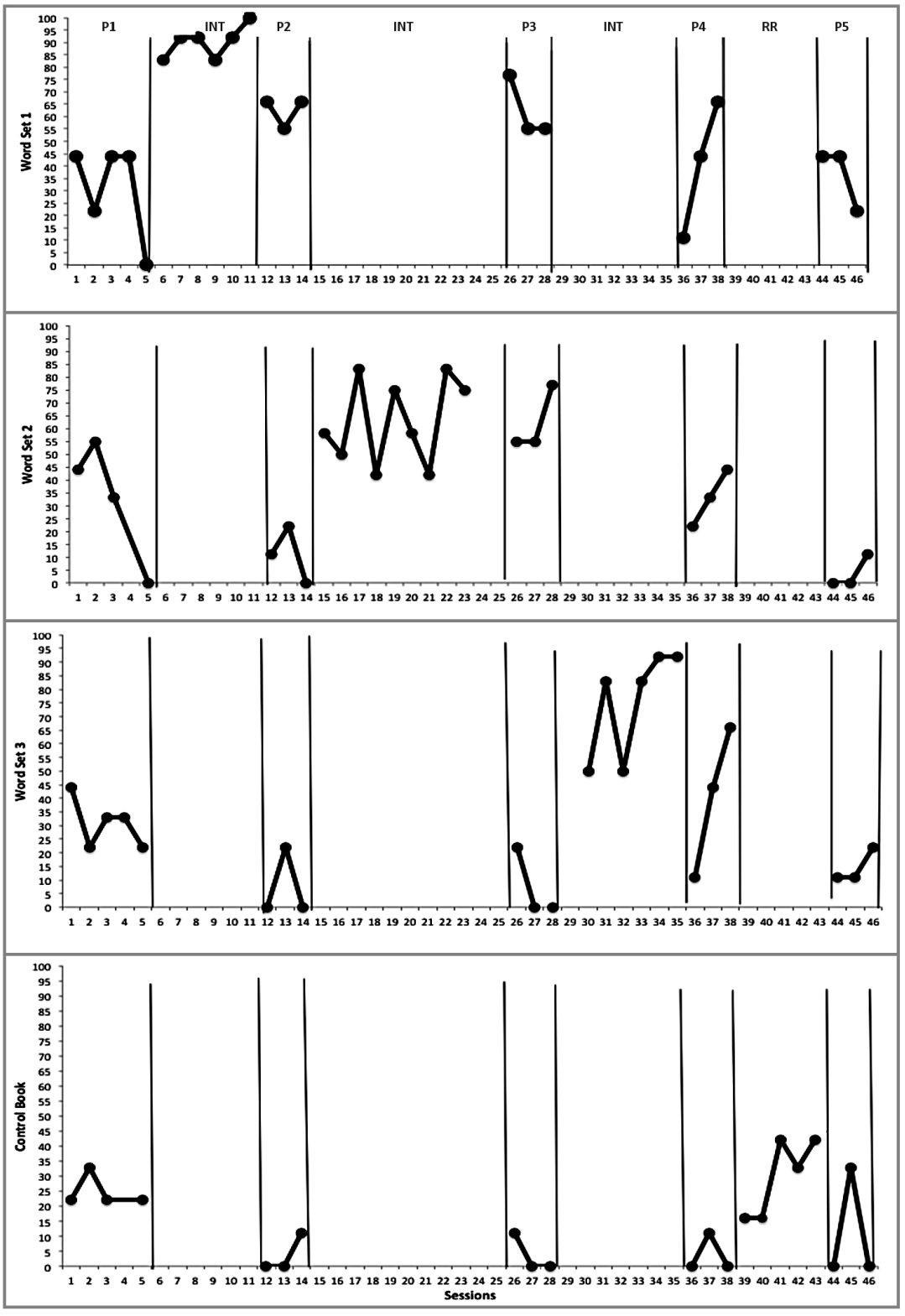

Figure 2. Percentage of correct responses for By.

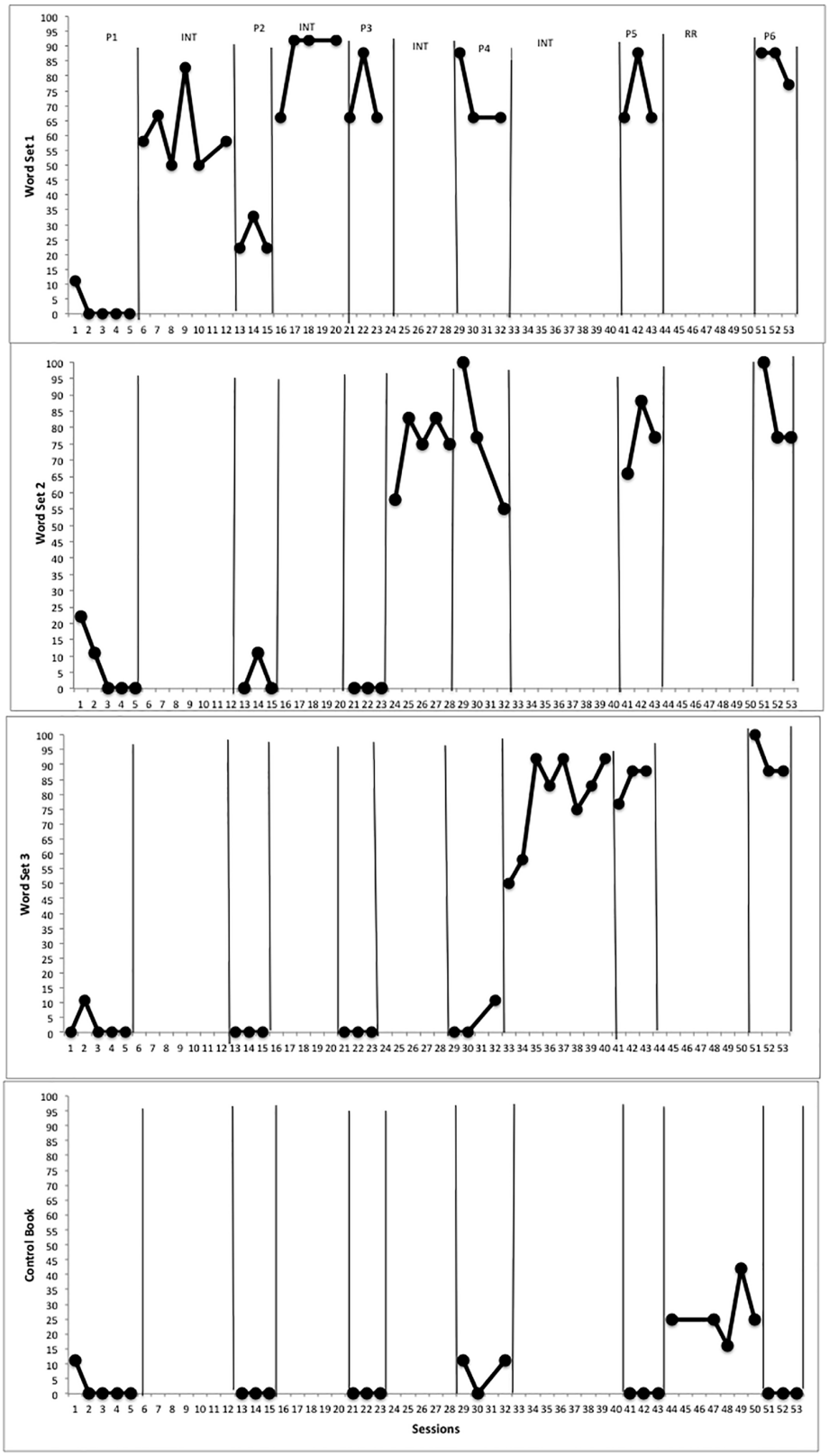

Figure 3. Percentage of correct responses for Ct.

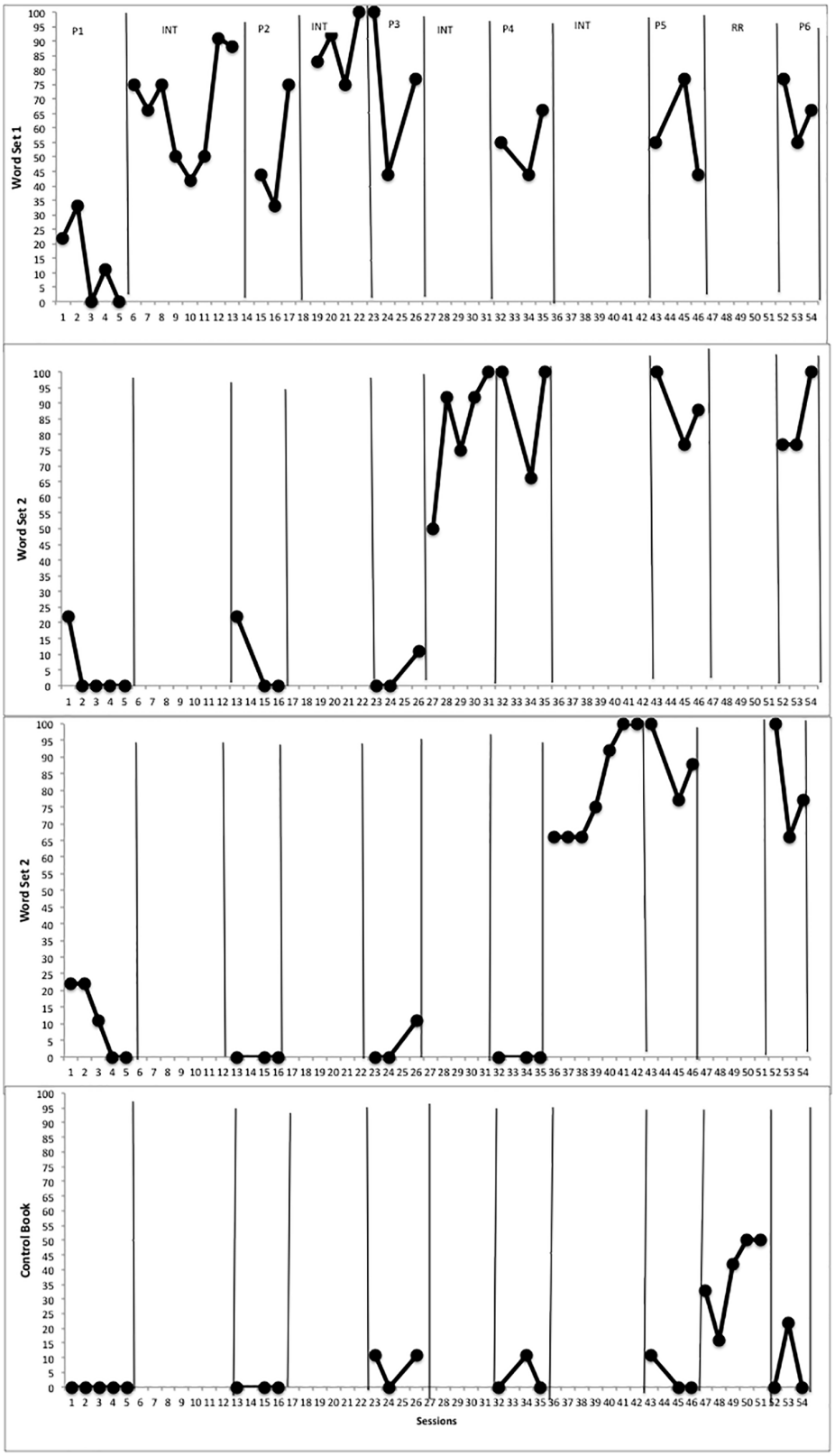

Figure 4. Percentage of correct responses for Li.

overlap. An error analysis indicates Al's errors reflected his inability to supply definitions of some words consistently, but he consistently gave an example of the word in context.

In the control condition, Al's percentage of correct responses in the initial probe phases was variable ranging from 0% to 44% (mean 13%), a decreasing trend. During the repeated reading phase, Al answered some vocabulary knowledge questions correctly with scores ranging from 25% to 42% (mean 32%). His performance remained relatively stable with a rate of correct responses much lower than intervention phases. When the probe phase was reintroduced, Al's scores ranged from 11% to 33% (mean 26%) overlapping with previous probe phases.

By

By's percentage of correct responses in the initial probe condition for Word Set 1 ranged from 0% to 44% (mean 31%). He immediately responded correctly to questions when the intervention was introduced. During the intervention, his scores ranged from 83% to 100% (mean 90%). He reached the criteria after the sixth session. His scores on the probe following intervention ranged from 55% to 66% (mean 62%) which demonstrates a shift in level from the first probe. In the remaining three probe phases, By's percentage of correct responses ranged from 11% to 77% (mean 46%). However, in the last two probes (Probe 5 and 6), he started to refuse to answer questions responding to only one or two questions. Data indicate By did not maintain his gains following intervention; however, it is unclear because of his refusal to answer questions.

For Word Set 2, the initial probes before intervention ranged from 0% to 55% (mean 21%). When the intervention was introduced, By immediately began to correctly answer questions about vocabulary ranging from 42% to 75% (mean 63%). He reached the criteria after nine sessions. On the probe following the intervention, By's percentage of correct responses ranged from 55% to 77% (mean 62%) with 2 points overlapping with initial probes. Data in the remaining probe conditions were variable ranging from 0% to 44% (mean 18%). By refused to answer questions, hence it is unclear whether he maintained his knowledge of the target words.

Initial probes on Word Set 3 ranged from 22% to 44% (mean 18%). After the intervention, By's scores ranged from 50% to 92% (mean 75%). He reached the criteria after six sessions. Scores on the probe immediately increased following intervention ranging from 11% to 66% (mean 40%). In the remaining probe conditions, By refused to respond to questions and his percentage of correct responses decreased ranging from 11% to 33% (mean 15%) with data points in probe conditions 4 and 5 overlapping with the initial probe. An error analysis indicates that By consistently provided a definition and examples of the target words. His incorrect responses reflected his refusal to respond to questions.

In the control condition, By's percentage of correct responses in the initial probe phases showed a decreasing trend with scores ranging from 0% to 33% (mean 9%). During repeated reading, By answered some questions correctly but his scores were lower in this condition than the previous intervention conditions. His scores ranged from 16% to 42% (mean 30%). The probe immediately following repeated reading ranged from 0% to 33% (mean 11%). There was an overlap between the initial probes and the probe following the repeated readings.

Ct

Word Set 1 data were stable in the first probe phase ranging from 0% to 11 (mean 2%). When the intervention was introduced, Ct immediately responded to questions correctly meeting criteria after 6 sessions. His performance on the second probe increased ranging from 22% to 33% (mean 26%) but was considerably lower than his performance during reading. Coders noted a decline in treatment fidelity as the interventionists failed to ask Ct to repeat a direct model following an incorrect response. The interventionists were retrained by the first author until they reached 100% integrity on the checklist. After the booster training session, treatment integrity remained above 95%, and Ct's percentage of correct responses in the intervention condition improved ranging from 66% to 92% (mean 85%). In the remaining probe conditions, Ct's scores remained consistent with scores ranging from 66% to 88% (mean 73%). There was no overlap between initial probe phases and probe phases following the intervention.

Initial Word Set 2 probe phases showed a declining trend with scores ranging from 0% to 22% (mean 6%). Ct immediately answered questions correctly when the intervention was introduced reaching criteria after the fifth session. His scores on the probe following intervention ranged from 58% to 83% (mean 75%). Ct's scores maintained ranging from 55% to 100% (mean 77%) and 66% to 88% (mean 77%) in the final probe conditions. There was no overlap between probes prior to and following intervention.

Ct's Word Set 3 probe phases data prior to intervention ranged from 0% to 11% correct (mean 2%). Once intervention was introduced, Ct immediately answered questions correctly reaching the criteria on the eighth session and his percentage of correct responses ranged from 50% to 92% (mean 78%). Following the intervention, a clear shift in level occurred in the probe phase with scores ranging from 77% to 88% (mean 88%). There was no overlap. Ct maintained his scores ranging from 88% to 100% (mean 92%) in subsequent probe conditions. Error analysis indicates that Ct consistently provided a definition of the target words. If he missed an item, he was unable to give an example.

In the fourth/control phase, Ct's scores in the probe conditions prior to repeated reading ranged from 0% to 11% (mean 2%). Ct answered some questions correctly ranging from 16% to 42% (mean 26%). When the probe phase was reintroduced, Ct consistently scored a 0 on the probe indicating overlap with previous probe phases.

Li

Word Set 1 initial probe data were variable with the percentage of correct responses ranging from 0% to 33% (mean 13%). When the intervention was introduced, Li immediately increased her percentage of correct responses and her scores ranged from 42% to 91% (mean 64%). Once she reached the criterion after 7 days, her performance on the second probe was higher than initial probe levels ranging from 33% to 88% (mean 55%) but considerably lower than her performance during reading. Coders noted a lack of treatment fidelity as interventionists failed to ask Li to repeat direct models and expand. The interventionists were retrained by the first author until they reach 100% on the integrity checklist. After the booster training session, treatment integrity remained above 93%. Li's scores during intervention ranged from 75% to 100% (mean 85%), and she reached the criteria after 12 sessions. On the probe immediately following the intervention, Li's scores ranged from 44% to 100% indicating variability, but in her percentage of correct responses, there was no overlap with the initial probe phase. Li maintained similar levels of correct responses on the vocabulary knowledge probe in later probes, with scores ranging from 44% to 77% (mean 63%) correct on the vocabulary knowledge across final phases.

Initial Word Set 2 probe conditions demonstrated a decreasing trend with Li's scores ranging from 0% to 22% (mean 5%) correct on the vocabulary knowledge probe. However, she started to answer questions correctly when the intervention was introduced. Li reached criterion during intervention after seven sessions with scores ranging from 50% to 100% (mean 81%). In the probe condition following the intervention, Li's scores ranged from 66% to 100% (mean 87), and there was a change in level. The remaining probe conditions reflect variability with scores ranging from 66% to 100% (mean of 86.5%), but she maintained higher levels of correct responses after the intervention. There was no overlap between probes before and following the intervention.

For Word Set 3, the probes before intervention ranged from 0% to 22 (mean 6%) and show a decreasing trend. When the intervention was introduced, Li immediately started to respond to questions correctly. She reached the criteria after seven sessions and her scores ranged from 66% to 100% (mean 81%). The next probe after intervention ranged from 77% to 100% (mean 88%), and her final probe phase is consistent ranging from 66% to 100% (mean 81%) correct. There was no overlap between initial probes and probes following the intervention. Error analysis indicates that Li occasionally was unable to provide a definition for a target word, but she consistently gave examples of words in context.

In the control phase, Li's percentage of correct responses in probe conditions prior to repeated reading ranged from 0% to 11% (mean 6%) and demonstrated stability. During the repeated reading phase, she answered some of the vocabulary knowledge questions correctly but her scores were lower than previous intervention conditions and highly variable ranging from 16% to 50% (mean 38%). In probe phases following the intervention, Li's percentage of correct responses ranged between 0% and 22% (mean 7%). Li's scores in the probe conditions following intervention indicated overlap between baseline and probes following repeated reading.

Comprehension Scores

Table 4 shows the percentage of correct responses (maximum 5 points) to fact and inference questions. Mean data indicate a range between 2.4 (48%) and 3.5 (70%) correct on the comprehension test in intervention and 1.2 (24%) to 3.2 (64%) in the control condition. Participants responded correctly to fact questions more often than to inference questions.

Social Validity

The teacher strongly agreed with all items on the Likert-type scale (see Table 4). The teacher also remarked that she was impressed with the progress the students' made and that they used emotional vocabulary more often in the classroom. In addition, all participants increased their scores from pre- to post-test on the TEC improving their ability to recognize facial expressions and interpret emotions.

Discussion

This study used a multiple probe across word sets design to investigate the effects of explicit emotion vocabulary instruction on the vocabulary knowledge of four 6- to 7-year-old children with ASD. This is the first study to explicitly teach emotion vocabulary to school-age children with ASD while reading popular trade books aloud. Visual analysis showed that all four participants increased their vocabulary knowledge after intervention suggesting explicit instruction helped learners with ASD define emotion vocabulary words and give examples or synonyms of those words. All participants maintained higher levels of correct responses on the vocabulary knowledge probe after the intervention. The addition of repeated reading as a control condition suggests that repeatedly reading storybooks with emotion vocabulary was insufficient for children with ASD to learn target words.

Findings from this study add to the research base on vocabulary instruction for learners with ASD by adding additional evidence that children with ASD can learn targeted vocabulary from the narrative text when directly taught with few adaptations (Roux et al., 2015b; See Henry & Solari, 2020; Solari et al., 2020). Taken together these findings are important as vocabulary knowledge is linked to reading comprehension (e.g., Davidson et al., 2018; Lucas & Norbury, 2015). This study taught vocabulary knowledge to young children with ASD (ages 6–7) who are still learning to read. Studies in young children with ASD that explicitly target the early reading skills associated with future reading comprehension like vocabulary knowledge may limit some of the challenges they are likely to experience once expected to read for meaning.

Oakhill and colleagues (2015) have described several levels associated with the depth and breadth of knowing a word. The breadth of knowledge requires labeling or recognizing. One indicator of depth is when the child supplies the definition of a word and/or a synonym (Oakhill & Cain, 2017). This study required children to demonstrate the depth of understanding by providing a definition we well as examples and/or a synonym. Although participants often provided the definition taught, they occasionally defined the term in their own words and gave personal examples. For instance, By responded to the definition of "brave" as "you are like a prince fighting a monster." Al reported that " I am very grumpy when I wake up" and "I am furious when someone punches me." Li reported that "I feel safe when daddy drives the new van." Putting the definition in their own words and giving relevant examples from their own lives shows an ability to connect what they learned to their own lives. Well-connected semantic representations of words are helpful to relate not only to a word's meaning in the text but also help connect that meaning of the familiar concepts (Oakhill & Cain, 2017). Among all the words on the age-appropriate emotion word list (Baron-Cohen et al., 2010), some may have been harder for participants to learn depending on prior knowledge, exposure, and so on. When students did not earn a point on the probe, they were typically unable to supply a definition. Children might need more opportunities in different contexts to demonstrate the depth of knowledge of some words.

During reading, participants were also asked to apply their understanding of emotions and take the perspective of others, skills linked to reading comprehension (Atkinson et al., 2017). Comprehending narrative text requires readers to understand how events influence behaviors including emotions (Oakhill et al., 2015), a skill especially difficult for learners with ASD (Bodner et al., 2015). To determine the impact of teaching vocabulary knowledge on listening comprehension, participants were asked questions about the character, events, and the connection between events and emotions after each reading. Although the participating children increased their percentage of correct responses on the vocabulary knowledge probe, this did not transfer to the comprehension measure. Generally, scores on the comprehension measure were higher in intervention conditions than the repeated reading condition (mean 1 point) indicating vocabulary instruction may have had some influence on scores. On this measure, participants often answered more fact than inference questions correctly. For example, although they defined "scared," some of the students were unable to explain why the character was scared or how we can tell the character is scared. This is surprising as participants did answer similar questions during the intervention, but they had trouble generalizing their responses to the probe following the intervention. This may be a reflection of time lapsing as learning the word in context, the removal of scaffolding, and/or the question posed. It may also be that children with ASD need more time and opportunity to make inferences using their newly learned vocabulary.

Implications for Practice

This has implications for instruction as the Common Core State Standards often reference character perspectives (e.g., "Describe characters in a story and explain how their actions contribute to the sequence of events."). Because students with ASD have difficulty taking the perspectives of others and understanding social contexts (Brown et al., 2013), teaching perspective-taking through books may potentially build theory of mind (ToM) (Randi et al., 2010). Teachers might use inexpensive apps and storybooks because they are rich in vocabulary including emotion words and cost-effective.

This study incorporated several evidence-based practices shown to improve a variety of skills for children and youth with ASD. Similar to prior studies (Roux et al., 2015b; Solis et al., 2021), pre-teaching was useful to introduce new words prior to exposure to text. This study also included questioning and making comments, which has increased the word learning of typically developing children (e.g., Coyne et al., 2007) and learners with ASD (e.g., Solis et al., 2021).

There are commercially available curriculum sets including DVD, storybooks, and other materials to teach emotions, but many teachers are unable to purchase these expensive curricula. Teachers can use any storybooks that include context and emotion words to teach emotion vocabulary and perspective-taking. In this study, popular, widely available storybooks that included emotion words were used. The cost of the storybooks is affordable, and most schools are more likely to have storybooks in the library.

Previous research also successfully used technology to create to teach vocabulary to students with ASD (Knight et al., 2015). Flexible apps provide another way to address the individual needs of learners with ASD. This study used the Go Book app, and researchers embedded explicit

instructions. The app is inexpensive and easy to program. Creating materials takes time initially, but teachers can easily share the app once created.

Limitations

Several limitations were encountered. First, because this is an SCRD study with a limited number of participants, the findings are not generalizable. Second, re-training was required of an interventionist, which provided additional exposure to the target words in two conditions. Replication is needed with a more diverse population of learners with ASD including learners with more limited verbal ability. Although students with ASD learned emotion vocabulary, it is unclear if they used newly acquired vocabulary in other contexts. Future research should add measures of word use in a variety of contexts (e.g., playground, lunch).

Future Research

Vocabulary instruction is helpful to increase comprehension scores, but it is not sufficient. Scores on the comprehension measure were variable especially when participants were required to generate an inference. Learners with ASD might benefit from additional inference-making strategies. For children who struggle to make inferences from the text, Oakhill et al. (2015) recommended that shared storybook reading instruction include asking inference questions paired with meaningful discussion. Studies should continue to investigate ways to assist learners with ASD in making causal inferences beginning in the earliest grades as these skills tend to emerge in the preschool years (Cain & Barnes, 2017; Tompkins et al., 2013). Future research should also address the relationship between teaching emotion words and increases in ToM measures. Finally, in the future, teachers or parents familiar to students should deliver the intervention to determine feasibility.

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References

Atkinson, L., Slade, L., Powell, D., & Levy, J. P. (2017). Theory of mind in emerging reading comprehension: A longitudinal study of early indirect and direct effects. *Journal of Experimental Child Psychology*, *164*, 225–238.

Bailey, B., & Arciuli, J. (2019). Reading instruction for children with autism spectrum disorders: A systematic review and quality analysis. *Review Journal of Autism and Developmental Disorders*, *7*, 127–150.

Baron-Cohen, S., Golan, O., Wheelwright, S., & Granader, Y. (2010). Emotion word comprehension from 4 to 16 years old: A Developmental Survey. *Frontiers in Evolutionary Neuroscience*, *2*, Article 109.

Beck, I. L., McKeown, M. G., & Kucan, L. (2002). *Bringing words to life*. Guilford Press.

Bodner, K. E., Engelhardt, C. R., Minshew, N. J., & Williams, D. L. (2015). Making inferences: Comprehension of physical causality, intentionality, and emotions in discourse by high-functioning older children, adolescents, and adults with autism. *Journal of Autism and Developmental Disorders*, *45*, 2721–2733.

Brown, H. M., Oram-Cardy, J., & Johnson, A. (2013). A meta-analysis of the reading comprehension skills of individuals on the autism spectrum. *Journal of Autism and Developmental Disorders*, *43*(4), 932–955.

Cain, K., & Barnes, M. A. (2017). Reading comprehension: What develops and when? In K. Cain, D. L. Compton, & R. K. Parrila (Eds.), *Theories of reading development* (pp. 257–282). John Benjamins.

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

Coyne, M. D., McCoach, D. B., & Kapp, S. (2007). Vocabulary intervention for kindergarten students: Comparing extended instruction to embedded instruction and incidental exposure. *Learning Disability Quarterly*, *30*(2), 74–88.

Davidson, M., Kaushanskaya, M., & Weismer, S. E. (2018). Reading comprehension in children with and without ASD: The role of word reading, oral language and working memory. *Journal of Autism and Developmental Disorders*, *48*, 3524–3541.

Elleman, A. M., Lindo, E. J., Morphy, P., & Compton, D. L. (2009). The impact of vocabulary instruction on passage-level comprehension of school-age children: A meta-analysis. *Journal of Research on Educational Effectiveness*, *2*(1), 1–44.

Frith, U., & Happé, F. (1999). Theory of mind and self-consciousness: What is it like to be autistic? *Mind & Language*, *14*(1), 82–89.

Gast, D. L., Lloyd, B. P., & Ledford, J. R. (2018). Multiple baseline and multiple probe designs. In J. R. Ledford & D. L. Gast (Eds.), *Single case research methodology: Applications in special education and behavioral sciences* (3rd ed., pp. 239–282). Routledge.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education*, *7*(1), 6–10.

Grimm, R. P., Solari, E. J., & Gerber, M. M. (2018). A longitudinal investigation of reading development from kindergarten to grade eight in a Spanish-speaking bilingual population. *Reading and Writing*, *31*, 559–581.

Grindle, C. F., Hughes, J. C., Saville, M., Huxley, K., & Hastings, R. P. (2013). Teaching early reading to children with autism using MimioSprout early reading. *Behavioral Interventions*, *28*, 203–224.

Guajardo, N. R., & Cartwright, K. B. (2016). The contribution of theory of mind, counterfactual reasoning, and executive function to pre-readers' language comprehension and later reading awareness and comprehension in elementary school. *Journal of Experimental Child Psychology*, *144*, 27–45.

Henry, A. R., & Solari, E. J. (2020). Targeting oral language and listening comprehension development for students with autism spectrum disorder: A school-based pilot study. *Journal of Autism and Developmental Disorders*, *50*(10), 3763–3776. https://doi.org/10.1007/s10803-020-04434-2

Knight, V. F., Wood, C. L., Spooner, F., Browder, D. M., & O'Brien, C. P. (2015). An exploratory study using science etexts with students with autism spectrum disorder. *Focus on Autism and Other Developmental Disabilities*, *30*(2), 86–99.

Ledford, J. R., & Gast, D. L. (Eds.). (2018). *Single case research methodology.* New York, NY: Routledge.

Losh, M., & Capps, L. (2003). Narrative ability in high-functioning children with autism or Asperger's syndrome. *Journal of Autism and Developmental Disorders*, *33*(3), 239–251.

Lucas, R., & Norbury, C. F. (2015). Making inferences from text: It's vocabulary that matters. *Journal of Speech, Language, and Hearing Research*, *58*(4), 1224–1232.

McIntyre, N. S., Oswald, T. M., Solari, E. J., Zajic, M. C., Lerro, L. E., Hughes, C., Devine, R. T., & Mundy, P. C. (2018). Social cognition and reading comprehension in children and adolescents with autism spectrum disorders or typical development. *Research in Autism Spectrum Disorders*, *54*, 9–20.

McIntyre, N. S., Solari, E. J., Gonzales, J. E., Solomon, M., Lerro, L. E., & Novotny, S. (2017a). The scope and nature of reading comprehension impairments in school-aged children with higher-functioning autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *47*(9), 2838–2860.

McIntyre, N. S., Solari, E. J., Grimm, R. P., Lerro, L. E., Gonzales, J. E., & Mundy, P. C. (2017b). A comprehensive examination of reading heterogeneity in students with high functioning Autism: Distinct reading profiles and their relation to autism symptom severity. *Journal of Autism and Developmental Disorders*, *47*(4), 1086–1101.

Nation, K., Clarke, P., Wright, B., & Williams, C. (2006). Patterns of reading ability in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *36*(7), 911–919.

Norbury, C., & Nation, K. (2011). Understanding variability in reading comprehension in adolescents with autism spectrum disorders: Interactions with language status and decoding skill. *Scientific Studies of Reading*, *15*(3), 191–210.

Oakhill, J., & Cain, K. (2017). Children with specific text comprehension problems. In K. Cain, D. L. Compton, & R. K. Parrila (Eds.), *Theories of reading development* (pp. 359–379). John Benjamins Publishing.

Oakhill, J., Cain, K., & Elbro, C. (2015). *Understanding and teaching reading comprehension: A handbook*. Routledge.

Randi, J., Newman, T., & Grigorenko, E. L. (2010). Teaching children with autism to read for meaning: Challenges and possibilities. *Journal of Autism and Developmental Disorders*, *40*(7), 890–902.

Reichow, B., Volkmar, F. R., & Cicchetti, D. V. (2008). Development of the evaluative method for evaluating and determining evidence-based practices in autism. *Journal of autism and developmental disorders*, *38*(7), 1311–1319.

Ricketts, J., Jones, C. R., Happé, F., & Charman, T. (2013). Reading comprehension in autism spectrum disorders: The role of oral language and social functioning. *Journal of Autism and Developmental Disorders*, *43*, 807–816.

Roux, C., Dion, E., & Barrette, A. (2015a). Enhancing reading comprehension among students with high-functioning autism spectrum disorder: A randomized pilot study. *Canadian Journal of Education*, *38*(1), Article 1.

Roux, C., Dion, E., Barrette, A., Dupéré, V., & Fuchs, D. (2015b). Efficacy of an intervention to enhance reading comprehension of students with high-functioning autism spectrum disorder. *Remedial and Special Education*, *36*(3), 131–142.

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

Solari, E. J., Henry, A. R., McIntyre, N. S., Grimm, R. P., & Zajic, M. (2020). Testing the effects of a pilot listening comprehension and vocabulary intervention for individuals with autism. *Research in Autism Spectrum Disorders*, *71*, 1–13.

Solis, M., Reutebuch, C. K., Falcomata, T., Steinle, P. K., Miller, V. L., & Vaughn, S. (2021). Vocabulary and main idea reading intervention using text choice to improve content knowledge and reading comprehension of adolescents with autism spectrum disorder. *Behavior Modification*, *45*(1), 66–98. https://doi.org/10.1177/0145445519853781

Tompkins, V., Guo, Y., & Justice, L. M. (2013). Inference generation, story comprehension, and language in the preschool years. *Reading and Writing: An Interdisciplinary Journal*, *26*, 403–429. https://doi.org/10.1007/s11145-012-9374-7

Wei, X., Christiano, E. R. A., Yu, J. W., Wagner, M., & Spiker, D. (2014). Reading and math achievement profiles and longitudinal growth trajectories of children with an autism spectrum disorder. *Autism: The International Journal of Research and Practice*, *19*, 200–210. https://doi.org/10.1177/1362361313516549