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Sequence text structure intervention during interactive book reading of expository picture books with preschool children with language impairment

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Abstract
This study explores the outcomes of an interactive book reading intervention featuring expository picture books. This small-group intervention was delivered by four practitioners (two early childhood special education teachers and two speech-language pathologists) three times per week for 8 weeks to 6 preschool-age children (3 years 1 month to 4 years 9 months) identified with language impairment. The intervention included use of language facilitation strategies during interactive book reading and extension activities after reading for promoting children's understanding of signal words related to the sequence text structure (e.g. first, next, then, finally), academic vocabulary, and science topic knowledge related to plants (how plants grow, plant parts, plant needs). Outcomes indicated that practitioners increased their use of language facilitation strategies over the course of the intervention in both contexts of interactive book reading and extension activities. Children with language impairment made significant improvements in their receptive understanding of sequence signal words, vocabulary, and science topic knowledge from pre-test to post-test. These findings suggest the promise of a sequence text structure intervention implemented in the contexts of interactive book reading of expository picture books and extension activities for supporting the syntax, vocabulary, and content knowledge of preschool children with language impairment.

Keywords
early intervention, expository texts, language impairment, preschool, text structure, vocabulary

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I Introduction

Knowledge of the text structures and language of expository texts is critical to later reading achievement. In fact, research indicates positive and significant relations between the completeness and complexity of text structure and language use in children's informational tellings/retellings in the preschool years and performance on measures of reading ability in the school-age years (e.g. Griffin et al., 2004). For example, preschool children's ability to produce well-organized, informative, and detailed informational picture descriptions has been shown to account for 23% of the variance in reading comprehension scores at 8 years of age (Griffin, et al., 2004). Therefore, the preschool years represent a critical period for employing targeted interventions for young children (Snow et al., 1998), particularly those with language impairment (LI), who are at increased risk of reading failure (Catts et al., 2002). Despite this fact, few language and literacy interventions for preschool-age children have focused on developing expository text knowledge and language.

A lack of expository text interventions may be attributed to the limited exposure and access to expository books in early childhood classrooms. For example, a recent observational study indicated that narrative texts dominate the structural environments of early childhood special education (ECSE) classrooms. Of the 54 ECSE classrooms in the study, only about half included more than four expository books in the classroom environment whereas close to 90% of the classrooms included four or more narrative books in the their environment (Guo et al., 2013). Access and exposure to expository books at a young age is paramount to establishing the foundation for learning and subsequent performance on standardized assessments in the upper elementary grades. Interestingly, young typically developing children and at-risk school-age children have been shown to be capable of comprehending expository text structures (Culatta et al., 2010; Duke and Kays, 1998; Williams et al., 2009). Therefore, it is necessary to expose preschool children with and without disabilities to a variety of text structures as part of a school-readiness curriculum.

The purpose of the present study was to examine the influence of an interactive book reading intervention targeting the language and organization of the sequence text structure on the expository text and language skills of preschool-age children with LI. Because research demonstrates that young children with impaired language are six times more likely to be identified with a reading disability at school age than non-impaired children (Catts et al., 2002), it is especially important to develop and test language and literacy interventions that might be effective for this population. An intervention utilizing expository texts offers an especially rich context for developing children's language skills such as vocabulary and syntax. In particular, expository texts that provide facts and information on science concepts include opportunities for practitioners and children to relate vocabulary to real-life experiences. In addition, expository texts offer children opportunities to practice understanding and using higher-level language and syntax through explanations, hypotheses, and predictions. Relating vocabulary concepts to real-life and using higher-level syntax are important skills to develop in children with LI who characteristically exhibit weaknesses in these areas despite intact cognitive skills (Tomblin et al., 1997).

1 Sequence text structure

Text structure refers to the organizational pattern of a text. Whereas fictional narratives follow a predictable pattern of a character engaging in some goal-directed behavior, expository texts reflect a variety of text patterns and related language. Predominant expository text patterns include: description, sequence/procedure, cause–effect, problem–solution, and compare–contrast (Meyer and Ray, 2011; Moss, 2004; Young and Moss, 2006). Expository texts may include any combination of text structures within a single text. Often, they include multiple text structures rather than one singular text structure within a passage or text. As a result of the variety of text structures found

within a single expository text, children tend to have more difficulty navigating and comprehending this type of text compared to fictional narratives that have a story grammar text structure (Best et al., 2008).

Within expository text patterns, some structures are more easily recalled than others (Bohn-Gettler and Kendeou, 2014; Meyer and Freedle, 1984). For example, due to the orderly nature of the sequence text pattern (e.g. first something happens, next another thing happens, finally the last thing happens), understanding, recall, and use of a sequence of events develops earlier and is more salient to children than other expository text structures (Lundine and McCauley, 2016; Piccolo, 1987). This is likely because children are often familiar with narrative text structures, which generally follow a chronological pattern (Englert and Hiebert, 1984; Pentimonti et al., 2011). Cause–effect and problem–solution text structures also rely on a temporal ordering as well as understanding of higher order causal relationships between two events, thus making these structures more difficult than sequence to comprehend and recall but easier than the description and compare–contrast text structures. In particular, descriptive text structures tend to be less salient for children to identify and recall (Englert and Hiebert, 1984) given that they are often embedded within other text structures and represent a collection of ideas that are not explicitly organized (Wylie and McGuinness, 2004). A compare–contrast text structure is one of the more complex organizational patterns because it is not organized on the basis of temporality; rather this text structure is organized according to similarities and differences (Meyer and Freedle, 1984; Ray and Meyer, 2011). Therefore, instruction of text structures may progress with those patterns in which the information is easiest to recall starting with the sequence text structure (Meyer et al., 1980; Piccolo, 1987; Ray and Meyer, 2011).

The sequence text structure in expository texts compares to the story grammar of narrative texts in a variety of ways. First, sequence text structure and story grammar present ideas or events in a temporal order. As organizational patterns, they both relate information according to time as: first something happens, then another thing follows, next something else happens, and finally there is a conclusion. Second, both the sequence text structure and story grammar are marked via signal words that cue the reader or listener to the syntactic organization of the text (Breit-Smith et al., 2015). Well-organized expository and narrative texts include signal words such as *first*, *then*, *next*, and *last*. Third, both a sequence text structure and story grammar can be easily organized visually with graphic organizers that include boxes as steps or events and arrows leading from the first event to the second and so on.

Although the sequence and story grammar text structures have similarities, there are significant differences. The primary difference lies in genre. In expository text, temporality is often expressed in specific steps such as ‘how plants grow’ rather than in a series of actions a character takes to solve a problem as in narrative texts (Meyer and Rey, 2011). Second, story grammar is chronological in nature and often displayed in illustrations as it relates to story characters, whereas the sequence text structure is related to real-life steps that may include headings, diagrams, and photographs (Breit-Smith et al., 2015). Third, the sequence text structure in expository texts is often written in the present tense, while story grammar is written in the past tense; for children with LI, this can present language challenges. Because of these similarities and differences, young children, particularly those with LI, may have both successes and difficulties navigating and comprehending expository text structures without repeated, guided exposure. One way to provide young children with repeated, guided exposure is through interactive book reading.

2 Interactive book reading

According to Vygotsky’s (1978) sociocultural framework, language and thought develop reciprocally. Therefore combining instruction on language structure with expository texts may help

children with LI to further develop thought and language skills. Expository texts include factual information about topics or phenomena that children may experience every day. This information may be more concrete for children with LI than information from narrative texts. Simply exposing children to expository texts, however, is likely not enough to impact children's language skills. Thus Vygotsky stresses the importance of social interactions in the learning process; and interactive book reading of expository texts provides an engaging context for the social interaction necessary to learn language structure and academic content, as long as children are provided the ideal supports.

One way to support children's understanding and use of the language structures and academic content found within expository texts is through language facilitation strategies. Language facilitation strategies during interactive book reading may broadly include adults' use of questions and feedback to engage the child in the book reading (Lonigan and Whitehurst, 1998; Milburn et al., 2014). Adults implementing these strategies during book reading of narrative texts have been shown to positively impact children's language and literacy skills with significant and moderate effects ($d = 0.35$) (National Early Literacy Panel, 2009). Hypothetically, these language facilitation strategies might also be implemented during interactive book reading with expository texts with some considerations or adaptations given the differences between these two genres.

Unique aspects of expository text structures provide opportunities to use language facilitation strategies such as literal and inferential questioning. Questioning focused on literal aspects of the text can be adapted to the features of expository text by asking children to label or describe what is in the photograph rather than illustration (as in narrative texts) or explain the next step in the sequence of how a plant grows compared to the sequence of a character's actions. This type of literal questioning may facilitate children's understanding of the overall text structure found within the book. Although inferential questioning tends to be more cognitively demanding because it requires children to provide information beyond the text (Zucker et al., 2010), the factual nature of expository texts may make it easier for children who have pertinent background knowledge to draw upon it as well as use the visual cues from books to answer questions that are not explicitly addressed within the text. As a result, adults' use of inferential questioning can facilitate children's understanding and use of higher-level language during interactive book reading of expository texts.

In addition to questioning, adults facilitate children's understanding and use of language during interactive book reading through providing feedback and support to children (Notari-Syverson et al., 2001). Providing positive feedback involves active listening and being responsive to children's behavior and utterances. Specific techniques for providing positive feedback include modeling ('*First* you put the seed in dirt, and *then* you have to water it'), extensions of children's utterances (Practitioner: 'What should you do after you put the seed in the dirt?' Child: 'Water' Practitioner: 'Yes! You have to put water on the seed to make it grow'), and encouraging children to construct responses to questions. Practitioners can encourage responses by summarizing the text ('Here the book said that plants need water and sunlight to grow'), providing hints via think-alouds ('I want to know about plant parts. I will look for pictures in this book'), using visual cues ('Look here at the pictures of the roots'), or asking children to locate and label characteristics of the book ('Look at this picture. Show me the leaves'). Positive feedback is particularly important to use with children with LI to facilitate their understanding and use of language found within books as well as to build their skills with answering literal and inferential questions (Ford and Milosky, 2008).

Further support of children's understanding and use of the language structures and academic content found within expository texts can also occur in planned activities that extend beyond the book reading. For example, pictures or objects demonstrating relationships found within expository text can be organized on visual maps or graphic organizers. Research on the use of visual mapping has shown it to be an effective activity to extend understanding of the structure and content of science texts for school-age students (Roman et al., 2016) and preschool-age students

(Culatta et al., 2010). In addition, dramatization as an extension activity of the content in books has been a long-held early childhood education practice in the classroom, particularly with narrative texts (Rao et al., 2016). Thus, extension activities that include mapping and dramatization of expository texts for preschool children represent effective and developmentally appropriate practices for supporting children's understanding and use of language structures and science content.

3 Language in expository science books

Expository texts and books focused on science content offer children an array of opportunities to engage with different types of text structures and content. For instance, the syntax found within expository science books provides children the opportunity to hear and use a variety of syntactic structures. Compound and complex sentences often are used for explaining the causes and effects of science concepts, comparing and contrasting information, and/or describing real-world problems and their potential solutions. Therefore, exposure to various syntactic structures via the language found in expository texts may be useful for children with LI to build their understanding and use of more sophisticated language structures (Bishop and Donlan, 2005; Rice et al., 2010).

Expository science texts also include academic vocabulary words such as 'sprout' and 'blossoms' which are important words for children to learn, yet not typically heard in natural interactions and conversations. As a result, expository texts provide a great medium to broaden children's vocabulary. This is important for children with LI who often demonstrate more limited vocabularies than their peers (McGregor et al., 2002; Oetting, 1999) thus making explicit and direct instruction on individual vocabulary words necessary (Neuman and Wright, 2013). Practitioners using expository texts during interactive book readings may identify specific vocabulary words to be taught during readings and provide opportunities for children to practice using these words. Extended activities such as dramatic play or hands-on experiences that follow up on the content of expository texts offer opportunities for children to use the academic vocabulary while engaged in other classroom activities.

Exposure and instruction with individual academic vocabulary words also facilitates children's language comprehension of the science concepts presented in expository texts. When reading an expository picture book related to the life cycle of a sunflower, children might have opportunities to learn content or topic knowledge associated with sunflower plants such as how sunflowers grow, the parts of a sunflower plant, and what sunflower plants need in order to grow. This type of topic knowledge begins to build the background knowledge that children need in order to understand the more complex life science concepts they will encounter later on in school.

Although expository texts offer opportunities to facilitate syntactic structures, academic vocabulary, and content or topic knowledge, there is limited research on their use in preschool settings. A few published studies to date have investigated the use of interactive book reading using expository texts with preschoolers. Pollard-Durodola et al. (2011) determined that 12 weeks of daily medium-sized group (9–10 children) interactive book readings of informational (2 days per week) and narrative (2 days per week) social studies and science texts were efficacious for teaching vocabulary to typically developing at-risk preschoolers. Gonzalez et al. (2014) examined teachers' use of questions before, during, and after reading during 18 weeks of daily small-group book readings of informational (2 days per week) and narrative (2 days per week) texts on at-risk preschoolers' receptive and expressive vocabulary. Gonzalez and colleagues found that questions and talk after reading and duration and frequency of teachers' making connections with words significantly related to children's expressive vocabulary. Only the duration of teachers' making connections with words significantly related to children's receptive vocabulary. Culatta et al. (2010) found significant gains for typically developing preschool children's comprehension of

compare–contrast and problem–solution text structures following 16 weeks of supplemental expository text activities (e.g. presenting expository texts aloud, relating text to children's prior knowledge, dramatizing texts). This evidence supports the notion that expository text instruction via interactive book reading is developmentally appropriate for preschool children; yet no studies to date that we are aware of have focused on children with LI.

Because the use of appropriate supports is fundamental to acquiring new skills, instruction using expository texts for preschoolers with LI must be planned carefully. Within interactive book reading for expository texts, instruction may target text structure, signal words, academic vocabulary, and topic knowledge (Breit-Smith et al., 2015). Therefore, the primary purpose of the present study was to test the feasibility and potential effects of a newly developed interactive book reading intervention using expository texts with preschool children with LI. The specific research questions were:

1. To what extent do practitioners use language facilitation strategies with preschool children with language impairments during an 8-week sequence text structure intervention delivered during interactive book reading of expository science books?
2. To what extent does an 8-week sequence text structure intervention delivered during interactive book reading of expository science books with preschool children with language impairments influence their receptive understanding of expository text structure and content?

II Method

1 Classrooms

This study was conducted as a one-group, pre-test, post-test design. Two ECSE classrooms participated in this study. The two classrooms were located within one public school district in the Midwest. Both classrooms provided half-day (morning session and afternoon session), 9-month, four-day-a-week programs. Children received preschool education and care for approximately 2 hours and 30 minutes each half-day session. Children enrolled in the ECSE classrooms consisted of a mix of eight preschool children identified with disabilities and eight children identified as typically developing.

2 Participants

A total of four practitioners and six children identified with language impairment took part in this study. Of the four practitioners, two were ECSE teachers and two were speech language pathologists (SLPs). One ECSE and one SLP served as a team per classroom (i.e. two ECSE classrooms with two teams with a total of four practitioners). Each team worked with three children identified with language impairment on the SLP's caseload in a small group. Thus three children per classroom participated in this study for a total of six children.

a Practitioners. Inclusionary criteria for practitioners in this study included holding appropriate credentials (Master's degree for SLPs; Bachelor's degree for ECSE teachers) and current licensure. In addition, the SLP had to have three children on his or her caseload identified with language impairment and receiving services in the ECSE classroom.

All practitioners self-identified as White/Caucasian females. Three of the four practitioners' reported Master's degrees as their highest level of education (two SLPs and one teacher). All

practitioners reported having licenses and/or certificates in their respective fields. Both ECSE teachers possessed Early Childhood licenses and certification as an Early Childhood Intervention Specialist. Both SLPs possessed state licenses as well as American Speech-Language-Hearing Certificates of Clinical Competence in Speech-Language Pathology. Both ECSE teachers' experience included 6–7 total years spent teaching. One SLP reported 31 total years of experience providing speech-language services whereas the other SLP had five years SLP experience.

b Children. Children in this study were identified with language impairment via a two-step process. First, participating SLPs completed a brief questionnaire on preschool children receiving direct speech-language services on his or her caseload. The questionnaire served as an initial screening to determine the presence of language impairment in the absence of autism, cognitive impairment, hearing impairment, or English as a second language. On the basis of this initial screen, the second step in the process included research team members administering three eligibility assessments to the children: bilateral hearing screening, nonverbal cognitive testing, and language testing. Research team members were trained on each assessment via a protocol of familiarization, practice, and reliability (90% or greater on test procedures during observed administration in the field). We used the combination of results obtained from the initial screening and assessments to identify our sample of six children with LI.

Of the six children with language impairment participating in this study, caregiver report of race/ethnicity and gender identified all children to be White/Caucasian and 50% male. Children's average age included 48 months ($SD = 7$ months) with a range of 37 to 57 months. Caregiver report of the average highest education of children's mothers consisted of two mothers holding Master's degrees, one mother completing some courses beyond a Bachelor's degree, one mother holding a Bachelor's degree, and two mothers completing some education beyond high school. Annual household incomes as reported by children's caregivers ranged from $50,000 to $85,000 or more.

In regards to the bilateral hearing screening, research team members screened each child's bilateral hearing in accordance with the hearing screening guidelines provided by the American Speech-Language Hearing Association (American Speech-Language-Hearing Association, 1997; 20 dB at the following frequencies: 1,000 Hz, 2,000 Hz, and 4,000 Hz). All children passed the bilateral hearing screening. Each child's non-verbal cognitive skills were assessed using the nonverbal matrices of the norm-referenced assessment, *Kaufman Brief Intelligence Test-2* (KBIT-2; Kaufman and Kaufman, 2004). Five children demonstrated non-verbal cognitive skills greater than −1.25 *SD* of the mean ($M = 100$; $SD = 15$) for their chronological age (standard scores ranged from 80 to 101). However one child received a nonverbal cognitive standard score of 63 ($M = 100$; $SD = 15$). To determine language level, research team members administered three subtests (sentence structure, word structure, expressive vocabulary) of the norm-referenced assessment, *Clinical Evaluation of Language Fundamentals Preschool-2* (CELF-P2; Semel et al., 2004), to each child to derive a core language score. Core language standard scores across the six children ranged from 59 to 92 ($M = 100$; $SD = 15$). With parent consent, SLPs also provided a copy of each child's Individualized Education Program (IEP). Each of the six children's IEPs included at least one annual goal or objective related to increasing children's language skills.

3 Sequence text structure intervention

Practitioners implemented a text structure intervention during interactive book reading sessions of expository texts with a small group of three children with language impairment. Children attended preschool four days a week. Practitioners read the same expository picture book three times per week, on different days, to the same small group of children. ECSE teachers read the book two

times and SLPs read the book one time. Each week the practitioners read a new expository picture book. The total duration of the text structure intervention was 8 weeks. Practitioners focused on exposing children to the sequence text structure for weeks 1 through 5, compare–contrast text structure during week 6, cause–effect text structure during the week 7, and all three text structures (sequence, compare–contrast, and cause–effect) during the week 8. Although compare–contrast and cause–effect text structures were included in the intervention, the primary focus and outcomes of the intervention centered on the sequence text structure. The content over the 8 weeks involved life science, and, specifically, plants. We chose to focus on life science rather than other science content areas (e.g. earth and space science or physical science) given the ways topics in life science can lend themselves to studying sequences and cycles such as the life cycle of a butterfly or how a plant grows. Furthermore, life science is a frequent topic of read-alouds among teachers teaching preschool to grade 3 (Yopp and Yopp, 2012). Each expository picture book discussed a different plant's growth. For example, the first book explained how sunflowers grow while week 2 explained how carrots grow (for the Scope and Sequence of the 8-week intervention, see Table 1). Criteria used to select the books for the intervention included the following: (1) the topic must be of interest to most preschool-age children, (2) the books must have an informational format such as headings, captions, and glossaries that help to signal the book's genre as nonfiction, and (3) the books' illustrations must be realistic photographs (Duke and Kays, 1998).

Each text structure intervention session included interactive book reading followed by interactive extension activities each of the three days the book was read. The interactive extension activities were the same each week; however, the content changed along with the content of the new book each week. Thus, one day per week following the book reading, the practitioner modeled the sequence of how a plant grows using a graphic organizer and then dramatized with the children how plants grow. In particular, the children took on different roles in the steps of a growing plant (e.g. seed, sun, waterer) during the dramatization. Another day during the week the interactive extension activity involved the practitioner and children building the sequence of how a plant grows using picture cards representing each step and a graphic organizer, and then covering a step on the graphic organizer and asking the children to talk about and describe the covered step. And, finally, one day during the week the extension activity included the practitioner and children building the sequence of how a plant grows using picture cards representing each step and a graphic organizer and then taking away a step on the graphic organizer and asking the children to figure out which step was missing. The practitioners decided as a team who would implement each day of the interactive extension activities, but both teams implemented all three days each week following interactively reading the book for the week.

During both the interactive book reading and interactive extension activities practitioners were required to talk about and define the following targets: text structure (e.g. the book is organized to tell the steps of how plants grow, compare–contrast plants, causes–effects of too much/not enough water for plants), signal words (e.g. first, next, then, last, different, but, because, so), academic vocabulary words (e.g. seeds, bud), and topic knowledge (e.g. plants need water, sunlight, and air to grow). Practitioners talked about these targets using primarily two language facilitation strategies: (1) asking questions that focused children's attention on the expository structure (e.g. for text structure and signal words; 'First you plant the seed. Then what happens?') or asking children to make inferences (e.g. for topic knowledge; 'If it doesn't rain, what will happen to a plant?'), and (2) providing support to children through extending utterances and helping children construct responses to questions. Procedurally, each session included the practitioners setting the purpose for reading first (e.g. 'This book tells the steps for growing plants. The steps are called a sequence. We will learn the steps or sequence'), interactively reading the expository picture book next (e.g. engaging children in conversation during the book reading), and finally engaging the children in

Table 1. Scope and sequence of interactive, expository book reading intervention.

Week	*Book* (Author)	Text structure	Signal words	Science topic knowledge: Plants		Academic Vocabulary
1	*The life cycle of a sunflower* (Linda Tagliaferro)	Sequence	first, before, next, last	Grow Parts Needs	seeds, sprouting seed, flower buds, sunflowers stems, leaves, branches, seeds sunlight, soil, water, warmth	seeds, buds
2	*The life cycle of a carrot* (Linda Tagliaferro)	Sequence	start, then, after, finally	Grow Parts Needs	seeds, sprouting seed, young plants, carrots, flowers roots, thin stems, leaves, carrot soil, water, warmth	stems, warmth
3	*The life cycle of an oak tree* (Linda Tagliaferro)	Sequence	first, before, next, last	Grow Parts Needs	acorns sprout, seedling, young tree, adult tree, flowers roots, trunk, branches, leaves, acorns water, sunlight, soil, warmth, wind	sprout, trunk, seedling
4	*Blueberries grow on a bush* (Mari Schuh)	Sequence	start, then, after, finally	Grow Parts Needs	seeds, bushes, bees pollinate flowers, blueberries branches, leaves, berries moist soil, bright sun, lots of sun	pollinate, moist
5	*From seed to apple* (Anita Ganeri)	Sequence	first, before, next, last	Grow Parts Needs	seed, shoot and leaves, sapling, apple blossoms, apples root, leaves, trunk, branches, apples ground/soil, water, air/gas, sunlight	blossoms, air/gas
6	*Fruits* (C. Guillain)	Compare–contrast	different, same	Grow Parts Needs	seeds, new plant, flower, spiky fruit roots, stem, leaf air, water, sunlight	roots, spiky
7	*What plants need to grow* (Allison Breit-Smith and Jo-Anne Prendeville)	Cause–effect	because, so	Grow Parts Needs	seed, seedling, flowers, fruit roots, stems grew spindly, leaves sun, water carries nutrients, soil, air	spindly, nutrients
8	*How do plants grow?* (Louise and Richard Spilsbury)	Sequence, Compare–contrast, Cause–effect	start, then, after, finally, different, same, because	Grow Parts Needs	seed, shoot, young plant, flowering plant root, bulbs, stem, leaves use energy, leaf buds, trunks, branches soil, water, light, air	energy, leaf bud

interactive extension activities based on the book after reading. To support practitioners' use of the targets, language facilitation strategies, and procedures of the intervention, they were provided a target-technique card each week for each book they read during the intervention.

4 Practitioner training

Before beginning the 8-week text structure intervention, practitioners received instruction in expository texts and how to focus children's attention on the structure and content of expository texts during interactive book reading. Practitioner training included one, one-hour pre-intervention face-to-face meeting with the practitioners to provide background knowledge on the difference between narrative and expository texts, why reading expository texts is important, the needs of children with language impairment as they relate to expository texts, and how to implement the targets and techniques of the text structure intervention. Two one-hour reflection discussion sessions during weeks 1 and 3 were also conducted face-to-face with the practitioners to provide further training on implementation of the intervention targets and techniques as well as feedback. In addition one, one-hour face-to-face mid-study training session was conducted during week 5 to train practitioners how to implement the compare–contrast and cause–effect text structures in weeks 6, 7 and 8 of the intervention. Practitioners received written feedback via email two times on videos they submitted. Two of the project investigators watched the videos with the target-technique card and made notes in three areas related to the practitioners: implementation of the targets, language facilitation strategies use, and adherence to the procedures of the intervention. Email feedback then related to practitioners' implementation of these three areas with comments on what was done well and comments on areas to work on such as asking more inferential questions.

5 Fidelity of implementation

The Fidelity Observation Scale (FOS) is an observational tool developed to measure practitioners' fidelity of intervention implementation. The FOS includes a coding sheet and accompanying manual that captures procedural and pedagogical fidelity. In this study, procedural fidelity refers to practitioners' adherence regarding the session procedures prescribed in the training. Fidelity to the procedures during interactive book reading included practitioners setting the purpose for the session (e.g. 'This book is about plants. It tells the steps for growing plants. The steps are called a sequence. The book tells the sequence from planting a seed to the plant growing'), interactively discussing and reading the book, and addressing the text structure, signal words, academic vocabulary, and topic knowledge of the book. Fidelity to procedure for the interactive extension activities included practitioners modeling the sequence of how a plant grows with a graphic organizer and picture cards and engaging children in an interactive reproduction of the text through dramatization or manipulating the graphic organizer and picture cards (i.e. covering a step and removing a step). . Procedural fidelity was coded for the presence or absence of implementing the procedures during interactive book reading and interactive extension activities. Pedagogical fidelity refers to the practitioners' use of the targets as prescribed in the practitioner training and implemented during the intervention session and is coded continuously. Each time a practitioner addresses a target (text structure, signal words, academic vocabulary words, topic knowledge) coders make a tally.

Two coders, a doctoral-level graduate student in speech-language pathology and full-time project staff member with a master's degree in early childhood education, participated in FOS training to become reliable using the tool. Coder training involved familiarization with the coding scheme, practice coding videos using the FOS, and coding videos for reliability. To be reliable, coders must

have 85% of their codes match master FOS codes. We also calculated inter-reliability of the FOS as a tool. Twenty percent of the videos were selected for double coding. As a tool, the FOS demonstrates adequate inter-rater reliability for procedural fidelity (Cohen's kappa = 1.00 for book reading and .65 for interactive extension activity) and pedagogical fidelity (Intra-class coefficient = .97 for book reading and .96 for interactive extension activity).

In regards to practitioners' fidelity to the procedures of the intervention, coders coded 30 videos of the sequence text structure intervention sessions submitted weekly by the practitioners for the first five weeks of the intervention (ECSE teachers read two times per week, SLPs read one time per week). On average, interactive book reading lasted a duration of 11 minutes and interactive extension activities lasted an average duration of 10 minutes 45 seconds. Practitioners on average demonstrated 98% adherence to the interactive book reading procedures and 93% adherence on average to the interactive extension activities procedures after reading. In regards to pedagogical fidelity, practitioners demonstrated between 96.7% to 100% adherence to addressing the targets (text structure, signal words, academic vocabulary words, topic knowledge) during the context of interactive book reading, and between 86.7% to 100% adherence to addressing the targets (text structure, signal words, academic vocabulary words, topic knowledge) during interactive extension activities after reading. As a result, practitioners demonstrated high fidelity to the procedures and targets of the intervention as prescribed.

6 Measures

a Practitioners' language facilitation strategy use. To examine the extent to which practitioners used language facilitation strategies with preschool children with language impairment during interactive book reading of expository science books, practitioners' weekly videos were coded for their use of questions and provision of support using the pedagogical fidelity portion of the FOS. Specifically, four strategies were coded as they pertained to practitioners' utterances to the three children as a group (not individually): (1) practitioner asks an expository text structure question (e.g. 'The plant grows flowers. When does that happen?'), (2) practitioner asks a question requiring inferencing (e.g. 'If seeds need water and warmth to sprout, what happens when it's cold?'), (3) practitioner provides support to children through extending utterances, and (4) practitioner helps children construct responses to questions through summarizing, thinking aloud, listing information, or asking a direct question. A total of 30 videos across the four practitioners were coded for practitioners' use of language facilitation strategies in two contexts: during interactive book reading and during the interactive extension activity after reading. In each context, a strategy received a tally each time it was used. Tallies were summed and averaged across practitioners for each context for an average language facilitation use score for interactive book reading and a language facilitation use score for the interactive extension activity after reading.

b Children's receptive understanding of expository text structure and content. Children were assessed at pre- and post-intervention using an intervention-based assessment closely aligned to the intervention. This assessment examined children's understanding of the targets of the intervention and included three subscales: sequence signal words, academic vocabulary, and topic knowledge. The signal words subtest included a sequence map consisting of four pictures with arrows in between showing the four steps of how a sunflower (seed to sprouting seed to flower bud to sunflower), oak tree (acorn sprout to seedling to young tree to adult tree), blueberry bush (seeds to bushes to flowers to blueberries), and carrot (seeds to young plants to carrots to flowers) grow. Children were told, 'Look at all of the pictures. A sunflower grows in many steps. What happens first? What happens last?' Children then selected one of the pictures in the sequence. Children received one point

if they answer the question correctly and a zero otherwise. Eight signal word items were assessed per sequence for a total of 32 items; thus total scores range from 0 to 32. Initial field testing on children with and without disabilities shows excellent reliability for the signal word subtest (Cronbach's alpha = .94).

The academic vocabulary subscale, modeled after standardized assessments of vocabulary (e.g. Peabody Picture Vocabulary Test), included 18 items in which children were given a choice of four pictures and asked to select the picture that matched the vocabulary word said by the examiner. The vocabulary words assessed were those taught and targeted in the intervention. Children received one point if they answered the question correctly and a zero otherwise. Total scores on this subscale range from 0–18. Reliability for the academic vocabulary subtest is good with a Cronbach's alpha of .63.

The topic knowledge subscale consisted of three sections: plant parts, how plants grow, and needs of living things. Practitioners discussed and targeted these three areas of topic knowledge during their intervention sessions. The plant parts section of the topic knowledge subscale included 12 items in which children were shown a picture of a whole plant with certain parts of the plants boxed and asked to select the box that matched the plant part said by the examiner (e.g. 'Here is a picture of a carrot plant. Each red box shows a different plant part. Show me stem.'). The how plants grow section included eight items in which children were shown two and three, two or three step sequences from how a plant grows and asked to select the correct sequence (e.g. How do sunflowers grow?). The plant needs section included six items in which children were shown a picture of a girl and her mother planting a tree and pictures of plant needs below. Children were told, 'Julie and her mom planted a tree in the ground. Look at these boxes and point to everything a plant needs to grow.' Children received one point if they answered the question correctly and a zero otherwise. Total scores on the topic knowledge subtest range from 0 to 26. Initial reliability testing shows good reliability for the topic knowledge subtest (Cronbach's alpha = .80).

III Results

The first research question of this study examined practitioners' use of language facilitation strategies with preschool children with language impairment during a sequence text structure intervention delivered during interactive book reading of expository science books. Descriptive results of total use of the four strategies (practitioner asks an expository text structure question, practitioner asks a question requiring inferencing, practitioner provides support to children through extending utterances, and practitioner helps children construct responses to questions through summarizing, thinking aloud, listing information, or asking a direct question) indicated that practitioners increased their overall use of language facilitation strategies during both interactive book reading and interactive extension activities. On average, practitioners asked questions and provided support 18.67 (SD = 11.33) times during week 1 while conducting the interactive book reading while they asked questions and provided support 35.00 (SD = 18.94) times during interactive book reading in week 5. Within the context of interactive extension activities, practitioners on average used language facilitation strategies 39.67 (SD = 9.89) times in week 1, whereas during week 5 they used language facilitation strategies on average 44.50 (SD = 33.89) times. These results suggest that practitioners can be trained to ask more questions and provide more support and feedback to children with language impairment during interactive book reading and extension activities. However, as seen in the standard deviations, there is great variability, particularly during week 5, in practitioners' use of language facilitations strategies during interactive extension activities. One potential source of this variability may be due to the extent to which some children could dramatize, build, and discuss the sequence of how a plant grows using a graphic organizer independently. Children

Table 2. Descriptive results for practitioners' use of language facilitation strategies per week during interactive book reading (n = 4; mean values with *SD* in parentheses).

Language facilitation strategy	Week 1	Week 2	Week 3	Week 4	Week 5
Ask expository text structure question	4.00 (3.74)	4.33 (1.75)	4.50 (3.15)	4.67 (2.16)	2.83 (2.4)
Ask inference question	3.83 (2.99)	4.00 (2.76)	5.33 (2.25)	8.33 (3.33)	8.83 (3.76)
Extend children's utterances	5.33 (2.88)	5.50 (3.94)	9.00 (7.24)	9.67 (2.94)	11.00 (7.40)
Help children construct responses to questions	5.50 (4.23)	7.00 (4.98)	10.67 (7.17)	9.83 (5.57)	12.33 (8.41)
Total	18.67 (11.33)	20.83 (11.50)	29.50 (17.24)	32.50 (10.80)	35.00 (18.94)

Notes. Teachers taught two lessons and speech language pathologists (SLPs) taught one lesson in each week.

who were more independent would potentially evoke fewer language facilitation strategies from practitioners while children who needed more support would evoke more language facilitation strategies from practitioners.

More specifically across the weeks, practitioners steadily increased their use of three of the four language facilitation strategies during interactive book reading. Specifically, during week 1 practitioners asked 3.83 questions requiring inferencing, whereas during week 5 they asked 8.83 questions requiring inferencing during book reading. In regards to support, the practitioners extended children's utterances 5.33 times on average in week 1, while they extended children's utterances 11.00 times on average during week 5. Practitioners were also almost twice as likely to help children construct responses to questions during week 5 as they were during week 1. The only language facilitation strategy that was used with approximately the same frequency across the weeks was asking an expository text structure question. Descriptive statistics for the four language facilitations strategies during interactive book reading are shown in Table 2.

In the context of interactive extension activities, providing children help constructing their response through summarizing, thinking aloud, listing information, or asking a direct question increased from week 1 (11.67) to week 5 (21.50). Asking an expository text structure question during interactive extension activities from week 1 to week 5 demonstrated a somewhat steady decrease from 16.67 questions to 8.83 questions. Asking inference questions showed an upward trend from weeks 1 to 4 and then returned to week 1's frequency during week 5, whereas extending children's utterances showed very little change from weeks 1 to 4 and then increased in frequency during week 5. Descriptive statistics for the four language facilitations strategies during interactive extension activities are shown in Table 3.

The second research question in this study examined the extent to which the sequence text structure intervention influenced the receptive understanding of expository text structure and content in preschool children with language impairment. We compared pre-test and post-test scores on each of the three receptive subscales of our intervention-based assessment and then combined the three subscales to calculate an overall score. We acknowledge that this is not a randomized controlled trial, and instead a one-group pre-test post-test design. Thus, to make this comparison, we employed nonparametric matched-pair Wilcoxon tests for our small sample size of six children. Overall, we found statistically significant growth of 21.67 points on the intervention-based measure with p = 0.016. Looking at the subscales of the intervention-based measure, we found statistically significant growth of 9.84 (p = 0.016), 5.67 (p = 0.029), and 6.17 (p = 0.018) for signal words, academic vocabulary, and topic knowledge respectively, demonstrating some promise of the intervention for children with language impairment. Descriptive statistics for children's performance on the three subscale measures at pre- and post-test are shown in Table 4.

Table 3. Descriptive results for practitioners' use of language facilitation strategies per week during interactive extension activities (n = 4; mean values with *SD* in parentheses).

Language facilitation strategy	Week 1	Week 2	Week 3	Week 4	Week 5
Ask expository text structure question	16.67 (6.28)	9.00 (5.73)	9.00 (5.44)	12.33 (3.93)	8.83 (5.46)
Ask inference question	2.33 (2.34)	3.33 (3.01)	3.00 (2.97)	5.00 (4.18)	2.33 (3.62)
Extend children's utterances	9.00 (2.37)	6.17 (4.88)	9.33 (4.08)	9.00 (3.29)	11.83 (8.91)
Help children construct responses to questions	11.67 (4.08)	6.67 (3.98)	14.83 (17.03)	13.67 (9.52)	21.50 (21.10)
Total	39.67 (9.89)	25.17 (13.57)	36.17 (23.22)	40.00 (16.98)	44.50 (33.89)

Notes. Teachers taught two lessons and speech language pathologists (SLPs) taught one lesson in each week.

Table 4. Descriptive Results for Children's Understanding of Expository Structure and Content (n = 6; mean values with *SD* in parentheses).

Receptive subscale	Pre-test raw score	Post-test raw score
Sequence signal words	7.83 (4.17)	17.67 (5.24)
Academic vocabulary words	6.00 (1.67)	11.67 (2.58)
Science topic knowledge	12.00 (2.37)	18.17 (1.94)
Total	25.83 (6.68)	47.50 (8.22)

Notes. Sequence signal words subscale includes 32 items; academic vocabulary subscale includes 18 items; science topic knowledge subscale includes 26 items.

IV Discussion

The aims of the present study were to examine practitioners' use of language facilitation strategies with preschool children with language impairment during interactive book reading of expository science picture books and to determine the effects of an 8-week interactive book reading intervention targeting the sequence text structure with expository science picture books on children's comprehension of expository text structures and language. Two major findings resulted from this work, each of which are discussed in turn: (1) practitioners on average increased their use of language facilitation strategies across the intervention, and (2) children with language impairment made significant increases in their understanding of expository text and language skills when exposed to the sequence text structure intervention.

The first major finding of this study extends the research on adult's use of language facilitation strategies during interactive book reading (Lonigan and Whitehurst, 1998; Milburn, et al., 2014; National Early Literacy Panel, 2009). In particular, this study demonstrates that it is feasible for practitioners to adapt language facilitation strategies typically used with narrative texts to expository texts. Practitioners provided a great deal of support and feedback to children, which suggests that they were responsive to children's utterances during both the interactive book reading and interactive extension activity contexts. Furthermore, practitioners increased their use of language facilitation strategies overall, indicating their responsiveness to the utterances of children with language impairment. It is likely that providing support to children for constructing responses was the most used language facilitation strategy given the language status of the children. The increase in strategy use may also be due to practitioners' comfort level in reading expository texts as well as more practice with the strategies over time. Of interesting note regarding practitioners' use of

questions is the type of questions asked across both contexts. During interactive book reading, practitioners asked children with language impairment more questions requiring inferencing than literal questions about the expository text structure. This is consistent with prior research demonstrating practitioners' use of higher level language questions during interactive reading of expository texts (Zucker et al., 2010). On the other hand, during the interactive extension activities, which included dramatization or mapping with graphic organizers after reading, practitioners asked more literal questions focused on the sequence text structure rather than inferences. This may be due to the hands-on and more contextualized, concrete nature of these extension activities as compared to the decontextualized nature of the book reading experience.

Concerning the second major finding, the present study provides promising evidence that preschool-age children who are identified with language impairment can participate in and benefit from interactive book reading experiences with expository texts. These findings are consistent with text structure intervention research conducted with at-risk school-age children (Williams et al., 2005, 2007); however, very few studies have yet to explore the influence of text structure interventions at the preschool-age level. Furthermore, our second finding indicates that exposing and teaching children about the structure and content of expository texts can increase children's understanding of syntactic markers such as adverbs (first, next, then, before, after, etc.), academic vocabulary words, and knowledge of science concepts such as plant parts. All three of these language skills comprise common individualized education program goals for children with language impairment, ultimately suggesting that expository texts can provide a rich therapeutic context for addressing the language needs of young children with language impairment.

Last, this study demonstrates the feasibility of ECSE teachers and SLPs teaming together to implement an intervention with children with language impairment. In the current study, teachers engaged in interactive book reading and extension activities with a small group of children two times per week while the SLP engaged in interactive book reading and extension activities with the same small group of children one time a week. Thus, this type of service delivery was feasible for early childhood practitioners in authentic educational settings. Furthermore, this study suggests that practitioners can be trained to implement a supplemental book reading program focused on expository texts and extension of those texts using graphic organizers with preschool children with language impairments.

V Limitations and future research

Two limitations warrant note in the present study. First, this study included four practitioners and six preschool children with language impairment. Given this small sample size, the findings from this study may not be generalizable beyond the participants and classrooms who took part in this research. Additionally, within the sample, nonverbal and language skills varied with one child's nonverbal skills in the below average range and one child's language skills within the normal range. Despite this variability in test results for language impairment, all children were receiving services from speech-language pathologists and had at least one language goal on his or her IEP targeting language. Nevertheless, the fact that the practitioners and children completed the 8-week intervention suggests that interventions targeting expository text structures and content using expository picture books may be feasible for use in ECSE classrooms. Future research in this area should continue to explore interventions targeting the sequence text structure with more classrooms, practitioners, and children with language impairment.

Second, increases in children's understanding of the structure and content of expository books about plants with a sequence text structure should be considered in light of no treatment control group. Although lack of a control group was an intentional design feature given the overall purpose

of this study being to test the intervention's feasibility and promise, without a control group of children with language impairment with which to measure the influence of the intervention on their language skills, we cannot fully attribute children's growth in this study to our specific intervention. Furthermore, although we used measures directly aligned with the intervention, we did not include any standardized measures of children's language or comprehension skills that may have provided additional insight into the effects of the intervention. Nonetheless, the results of this study indicated that the children participating in the intervention grew significantly in their receptive language skills related to plants and the sequence text structure over a brief treatment period (8 weeks).

VI Conclusions

This study served as a preliminary investigation of a sequence text structure intervention for preschool children with language impairment. The results reported in this study are descriptive and not causal. The next step in this line of research might include a cluster-randomized trial in which some practitioners implement the intervention while others conduct their business as usual. Even so, we found that the use of interactive book reading and extension activities with expository texts is feasible with preschool children with language impairment in ECSE classrooms. We also found that children's understanding of expository texts and language improved when exposed to interactive book reading and extension activities focused on this genre. In summary, the preliminary evidence in this study suggests the importance of early childhood practitioners' exposing children with language impairment to expository structures and content at a young age.

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