Top Lang Disorders
Vol. 36, No. 4, pp. 368–389

Effects of a Text-Processing Comprehension Intervention on Struggling Middle School Readers

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Purpose: We examined the effects of a text-processing reading comprehension intervention emphasizing listening comprehension and expressive language practices with middle school students with reading difficulties. **Method:** A total of 134 struggling readers in grades 6–8 were randomly assigned to treatment ($n = 83$) and control conditions ($n = 51$) using a 2:1 ratio (two students randomized to treatment for every one student randomized to control). Students in the treatment condition received 40 min of daily instruction in small groups of four to six students for approximately 17 hr. **Results:** One-way analysis of covariance models on outcome measures with the respective pretest scores as a covariate revealed significant gains on proximal measures of vocabulary and key word and main idea formulation. No significant differences were found on standardized measures of listening and reading comprehension. **Discussion:** Results provide preliminary support for integrating listening comprehension and expressive language practices within a text-processing reading comprehension intervention framework for middle-grade struggling readers. **Key words:** *listening comprehension*, *reading comprehension*, *struggling middle-grade readers*

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This research was supported in part by the Institute of Education Sciences, U.S. Department of Education, through Grant R305F100013 to the University of Texas-Austin as part of the Reading for Understanding Research Initiative as well as K08 HD068545-01A1 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NICHD, the National Institutes of Health, or the Institute of Education Sciences, U.S. Department of Education.

The authors have indicated that they have no financial and no nonfinancial relationships to disclose.

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DOI: 10.1097/TLD.0000000000000101

READING COMPREHENSION, which has been defined as gaining understanding of written text through a process of translating print into meaning (Snow, 2002), is a critically important academic skill (Nash & Snowling, 2006; National Institute of Child Health and Human Development, 2000). Yet, national and international studies reveal that a significant number of adolescents do not adequately understand complex texts. That, in turn, impedes their success in school, access to postsecondary learning, and opportunities for competitive employment (Biacarosa & Snow, 2004; Kamil et al., 2008). Nationally, recent National Assessment of Educational Progress (NAEP) data indicated that approximately 22% of middle-grade readers performed below basic levels of literacy, suggesting they are not able to connect ideas, form inferences, and make generalizations

when reading grade level texts (National Center for Education Statistics, 2013).

THEORETICAL EXPLANATIONS FOR READING FAILURE

The simple view of reading (SVR) provides one explanation of poor reading comprehension among middle-grade struggling readers (Gough & Tunmer, 1986; Hoover & Gough, 1990). The SVR hypothesizes that reading comprehension is the *product* of word reading efficiency and linguistic comprehension skills. Within this model, reading comprehension can be negatively impacted by a deficit in either skill (i.e., decoding or linguistic comprehension). The SVR does not deny that reading is a complex cognitive process, but rather makes clear that proficient reading comprehension cannot occur unless both decoding skills and language comprehension abilities are strong (Catts, Herrera, Nielsen, & Bridges, 2015). For middle school students with reading difficulties, Cirino et al. (2013) reported that approximately 85% of students who performed poorly on nationally standardized measures of comprehension also had difficulties in decoding or fluency. More specifically, 40% of struggling middle-grade readers exhibited difficulties in decoding, 39% in fluency, 52%–57% in comprehension depending on the type of reading assessment, and 67% in comprehension/fluency (Cirino et al., 2013).

The complexity of reading comprehension is also captured in theoretical models that describe the cognitive and linguistic processes involved *during* reading (Kintsch, 1988; McNamara & Magliano, 2009; Van den Broek, 2005). These models share a central idea that reading comprehension involves the construction of an integrated, coherent mental representation of the situation described in the text (Gernsbacher, Varner, & Frost, 1990; Graesser, Singer, & Trabasso, 1994; Kendeou, Van den Broek, Helder, & Karlsson, 2014; Kintsch, 1988). This mental representation of text comprises relevant information from text and associated prior knowledge that are interconnected in the readers' memory via causal, referential, and spatial semantic relations. Semantic relationships between concepts or meanings are formed through passive, memory-based, associative processes as well as active or strategic inferential processes (Kintsch, 1988; Van den Broek, 2005).

These process-oriented models of reading comprehension suggest that the cognitive and linguistic processes that form semantic relationships between concepts or meanings generally fall into two broad categories: (a) lower-level processes that support the translation of print into meaningful units, and (b) higher-level processes that support the integration of these meaningful units into a coherent mental representation of the situation described in text (Kendeou et al., 2014). Lower-level processes involve the domains of decoding, grammar, and vocabulary and are used to establish a literal representation of text (Perfetti & Stafura, 2014). Higher-level processes are connection-forming processes that help readers organize and interpret ideas in text (Cain, Oakhill, & Bryant, 2004; Sesma, Mahone, Levine, Eason, & Cutting, 2009), integrate ideas in text with prior knowledge (Van den Broek, 1997), and monitor their comprehension (Oakhill, Hartt, & Samols, 2005; Perfetti, 2007). Process-oriented theories and models of reading comprehension suggest that linguistic comprehension skills are not only essential for understanding the basic message of a text but are also necessary for conducting deep levels of text analysis (e.g., scrutinizing the validity of claims and understanding the author's purpose) (Cain, Oakhill, & Lemmon, 2004; Graesser, 2007; Nation & Snowling, 1998a, 1998b, 1999).

LANGUAGE AS A MECHANISM FOR IMPROVING READING COMPREHENSION

The important role assigned to linguistic processes (i.e., language) is further supported by recent research demonstrating that language and reading comprehension are highly interrelated skills among adolescents (Adlof, Catts, & Little, 2006). In addition, research has consistently reported a reciprocal

relationship among listening, speaking, reading, and writing across development (Bradley & Bryant, 1983; Cain & Oakhill, 2011; Catts & Kamhi, 2005; Gillon & Dodd, 1995), with foundational language skills underlying each of these processes (Ehren, Murza, & Malani, 2012). This body of research suggests that lack of experience with school-based language in meaningful contexts underpins reading failure among older struggling readers (Griffin, Burns, & Snow 1998; Kamhi, 2014; Nippold, 2014; Scott, 2014). Further, adolescents who struggle with academic literacy may either lack the foundational language skills (i.e., grammar, vocabulary, and background knowledge) necessary to fully access and understand the lectures delivered in content-based classes (e.g., listening comprehension) (Catts & Kamhi, 1999; Griffin et al., 1998; Nippold, 2014; Scott, 2014) or lack the foundational reading comprehension skills (i.e., inference-making, understanding of text structure, comprehension monitoring, and strategies for maintaining and repairing comprehension breaks) required to fully understand the genres, registers, and instructional methods that are specific to different disciplines (e.g., science, history, and algebra) (Barth, Barnes, Francis, Vaughn, & York, 2015; Barnes, Ahmed, Barth, & Francis, 2015; Ehren et al., 2012). In either case, a focus on language is warranted (Ehren et al., 2012) because listening and reading comprehension rely on similar, general, language-based, comprehension processes and strategies (Adlof et al., 2006). Thus, significant improvements in reading comprehension will likely result in significant gains in listening comprehension and vice versa (Clarke, Snowling, Truelove, & Hulme, 2010; Gilliam, Gilliam, & Reece, 2012; Hulme & Snowling, 2011; Stuart, Stainthorp, & Snowling, 2008).

A clinical implication is that increasing language proficiency is an essential part of "building up" listening and reading comprehension. This notion of specifically targeting language is supported by a limited body of literature that has directly examined the effect of oral language intervention (i.e., interventions targeting vocabulary, figurative language, spoken narrative comprehension, and independent speaking) on listening and reading comprehension outcomes among beginning readers. Clarke et al. (2010) demonstrated that 20 weeks of oral language training was more effective than text-comprehension training or combined text comprehension and oral language training at improving later reading comprehension performance of 8- to 9-year-olds with specific reading comprehension difficulties. The oral language intervention targeted spoken language and listening comprehension through dialogue between children and an interventionist. The dialogue provided a means to model appropriate use of vocabulary and figurative language, fluent reading of texts, and the generation of spoken narratives. Fricke, Bowyer-Crane, Haley, Hulme, and Snowling (2013) demonstrated that oral language training significantly improved the oral language and spoken narrative skills among preschool children with poor oral language skills following 30 weeks of intervention and led to significant improvements on a standardized assessment of reading comprehension administered 6 months later. Yet, a more recent adaptation of this oral language training program failed to show significant effects on oral language and reading comprehension among 6-year-old children at-risk for dyslexia and/or having preschool language impairment following 9 weeks of intervention (Duff et al., 2014). Thus, oral language interventions examined at or before school entry (i.e., preschool—grade 2) have been associated with positive gains on measures of listening comprehension and reading comprehension following 20 to 30 weeks of instruction among children with reading or language comprehension difficulties but not for 9 weeks of instruction among preschool children at-risk for dyslexia and/or having language impairment.

To date, no study has longitudinally examined the effect of early oral language intervention on later listening *and* reading comprehension development or examined whether oral language interventions can lead to improved listening *and* reading comprehension

among adolescent struggling readers. Among readers in the secondary grades, interventions utilizing content approaches and text-processing approaches provide a rationale for interventions that promote listening and reading comprehension among middle-grade struggling readers.

CONTENT AND TEXT-PROCESSING APPROACHES

Content approaches use oral discussion to focus students' attention on the content of what they are reading and model for students how to work through text to build a coherent representation of the situation (McKeown, Beck, & Blake, 2009). This is accomplished through activities that build background knowledge and vocabulary through preteaching and meaning-based questions about text as well as through small group collaborative discussions of content that are designed to facilitate problem-solving and perspective taking (McKeown & Beck, 2006; Beck, McKeown, Sandora, Kucan, & Worthy, 1996; McKeown et al., 2009; Vaughn et al., 2013, 2015). In general, results suggest that content approaches lead to significant gains in knowledge acquisition (Vaughn et al., 2013, 2015) and narrative and expository recall (McKeown et al., 2009), but they have not consistently impacted standardized measures of reading comprehension among students in grades 5–8 (Scammacca, Roberts, Vaughn, & Stuebing, 2015).

Text processing studies have consistently demonstrated that explicitly teaching students how to identify and effectively communicate (i.e., orally or in writing) the main idea or summarize major points of a text significantly improves reading comprehension among middle-grade students with learning disabilities or difficulties (Berkeley, Matropeori, & Scruggs, 2011; Gajria, Jitendra, Sood, & Sacks, 2007; Jitendra, Hoppes, & Zim, 2000; Mason, Meadan, Hedan, & Corso, 2006; Solis et al., 2012). The majority of interventions have utilized strategy instruction related to main idea or summarization as a means for increasing engagement with text, organization of information, integration of information in text with prior knowledge, and monitoring of comprehension. This body of literature consistently demonstrates significant gains on proximal measures aligned with the intervention and also report small to moderate gains on standardized measures of reading comprehension (Scammacca et al., 2015; Solis et al., 2012; Swanson & Deshler, 2003).

MASTERY OF DISCIPLINARY LITERACY

Yet for struggling readers to achieve the requisite level of proficiency needed to be academically successful in the middle-grades, they must be able generalize and use the literacy and language skills acquired in intervention across a number of academic content areas (e.g., math, science, geography, and English-language arts) (Ehren et al., 2012). This requires mastery of listening and reading comprehension, vocabulary, general knowledge, and higher-level reasoning processes that are specific to particular academic disciplines (Heller & Greenleaf, 2007) because each discipline uses language in different ways and for different purposes (Ehren et al., 2012). In addition, academic disciplines have their own expectations for the text structures students must read and write as well as the language skills required for active listening and independent speaking.

This has led researchers to identify the specific literacy demands of history, science, math, and literature (e.g., Fang, Schleppegrell, & Cox, 2006; Graesser, León, & Otero, 2002; Monte-Sano, 2010; Perfetti, Britt, & Georgi, 2012; Wallach et al., 2014; Yore & Treagust, 2006), which has influenced teachers' content area expectations for reading, writing, listening, and speaking and their teaching pedagogy (Draper, 2008; McKenna & Robinson, 1990; Vacca, Vacca, & Mraz, 2005). As an example, history teachers are now encouraged to provide instruction in how to evaluate evidence for bias so as to determine the authenticity of historical events, facts, figures, and timelines (Fang et al., 2014). As another

example, science teachers are encouraged to help students translate information from various sources (texts, charts, graphs, etc.) and integrate this information with prior knowledge to apply new ideas to new contexts (Fang et al., 2014). This focus on disciplinary literacy is often aimed at improving complex syntax, general language production and comprehension, and ultimately, reading comprehension and written expression within the content areas. Such interventions are designed for students performing below grade level who may or may not qualify officially for the limited supplemental services provided at the secondary level (Ehren et al., 2012).

More recently this focus on disciplinary literacy has led to the evaluation of discipline-specific instructional models that are tailored to build domain knowledge and comprehension skills that are specific to the types of texts and tasks used in secondary grade content area classrooms (e.g., English-language arts and social studies) (Swanson, Wanzek, McCulley, Stillman-Spisak, & Vaughn, 2016; Vaughn et al., 2013, 2015, 2016). Across studies, results suggest that a focus on disciplinary literacy is associated with improved outcomes in reading comprehension (Vaughn et al., 2013), content acquisition and vocabulary (Vaughn et al., 2013, 2015), and sustained content knowledge and vocabulary over the course of the school year (Vaughn et al., 2015). Missing from this limited body of literature are interventions specifically designed for struggling readers in the middle-grades who focus on building requisite content knowledge and vocabulary knowledge for science, developing the types of comprehension strategies required to understand informational science texts, and methods for orally communicating scientific ideas.

STUDY PURPOSE

The purpose of this study was to examine the effectiveness of a text-processing reading comprehension intervention that targeted language-based skills through text-based discussions of *grade-level, informational science texts* on the vocabulary, inferencing, listening comprehension, and reading comprehension performance of middle-grade struggling readers. The intervention operationalized principles outlined by Nippold (2014): (a) break large pieces of informational text into manageable sections; (b) provide students with a unifying strategy for deciphering the meaning of unknown words and understanding the gist of text; and (c) provide students frequent opportunities to formulate the central idea for manageable sections of information texts. In this way, adolescents with language and reading comprehension difficulties can learn to employ general comprehension practices required to comprehend and discuss informational texts that are written for the purpose of transmitting science knowledge (Dole, Duffy, Roehler, & Pearson, 1991; Kamhi, 2014; Pressley, Brown, El-Dinary, & Allferbach, 1995; Swanson & Deshler, 2003). The intervention emphasized how to manage the technical terms that are frequent in informational texts by teaching students how to integrate new information with what they already know about key concepts and ideas. Methods included explicit instruction, modeling, and repeated exposure through a variety of informational sources (Dole et al., 1991; Fang & Wei, 2010). Finally, the intervention provided students feedback on oral responses to questions, formation of main idea statements, and synthesis of information across larger text sections. The purpose of the feedback loop is to improve the accuracy of oral responses as well as expand students' oral production as a mechanism for applying these same procedures when reading text independently.

We hypothesized that this instructional approach would build up both the lower level and higher level language processes that restrict middle-grade struggling readers' ability to synthesize the central idea of connected text. Additionally, this approach would improve inferencing, and ultimately, listening and reading comprehension, by helping students form a more coherent representation of the situation described. We also hypothesized

that repeated practice of synthesizing information to form a main idea and using target vocabulary in context-appropriate ways would improve students' performance on proximal measures of main idea and vocabulary.

METHODS

Participants

Schools

This study was conducted in three middle school sites from three different school districts in the Midwest of the United States. These schools were public schools located in rural, working-class communities. The mean enrollment of the three school sites was 387 students (ranging from 310 to 512 students). Across the school sites, the mean percentage of students eligible for free or reduced lunch was 52% (range = 35%–67%). Student ethnicity varied slightly across the school sites; however, each school site included a high percentage (at least 80%) of White students.

Students

Students in grades 6–8 were recruited to participate based on their prior school year's performance on the standardized state test for reading. Specifically, students who scored at below basic or basic on the reading test of the Missouri Assessment Program (MAP; Missouri Department of Elementary and Secondary Education, 2014) were recruited by the school for participation in the study. The MAP reading test is used to assess students' ability to apply reading skills to narrative and informational texts (i.e., key ideas and details, craft and structure, integration of knowledge and ideas in text and between text, and general knowledge of the topic). The test includes three item formats: (a) multiple choice; (b) open response; and (c) technology enhanced. Students who performed at the basic level are described as using some strategies to comprehend and interpret narrative and informational texts and demonstrate a partial understanding of literary forms, but to apply this limited repertoire of strategies inconsistently for accessing and summarizing important information in grade level, content-based texts (Missouri Department of Elementary and Secondary Education, 2014).

Students were included in the study if they met three criteria. That is, they performed below basic or basic on the MAP, they returned signed parental consent forms approved by the University of Missouri Institutional Review Board and their respective school district boards, and they assented to participate. The resulting participants ($N = 180$ students in grades 6–8) were randomly assigned within schools using a 2:1 ratio to treatment ($n = 120$) and a business-as-usual comparison condition ($n = 60$). We provided a 2:1 ratio of treatment to comparison to meet the school's request for providing treatment to as many students as possible.

After randomization, parents for 46 of the 180 students requested their child not participate in the study ($n = 35$ treatment and $n = 11$ control) because intervention conflicted with elective classes (e.g., band, choir, and art). We did not find differential attrition between students who remained in the study and those who dropped in terms of demographics (χ^2 ranged from 0.06 to 0.73, ps $> .05$) or performance on most of the academic assessments administered at pretest (Fs ranged from 0.11 to 2.55, ps $> .05$). Differential attrition was detected on the researcher-developed vocabulary measure, $F(1, 176) = 5.29$, $p < .05$, and Test of Listening Comprehension-2-Detail subtest (TLC-2; Bowers, Huisingh, & LoGuidice, 2009), $F(1, 158) = 4.46$, $p < .05$. Among students who opted out ($n = 11$), those assigned to the control condition scored lower ($M = 8.18$, $SD = 8.65$) than the treatment condition ($M = 13.37$, $SD = 6.98$) on the vocabulary measure, but the opposite pattern was found on TLC-Detail (control $M = 105.33$, $SD = 6.59$; treatment $M = 93.03$, $SD = 12.41$).

The final sample consisted of 83 students in the treatment condition and 51 students in the comparison condition. Of the 134 students in the final sample, 46% were female, 77% of

the students were eligible for free or reduced lunch, and 31% of students received special education services. The racial/ethnic composition of the final sample was 84% White, 9% African American, 3% Hispanic, and 5% other. The final sample included a mix of students from grades 6 to 8, with higher numbers of students in grades 6 ($n = 51$) and 7 ($n = 55$). There were 42 students with disabilities in the final sample. The most prevalent special education classification in the sample was learning disability ($n = 19$). See Table 1 for a breakdown of additional student demographic data.

Table 1. Demographics of the participants

Variables	Control ($n = 51$)	Treatment ($n = 83$)
Grade		
Sixth	19	32
Seventh	20	35
Eighth	12	16
Gender		
Male	22	49
Female	28	33
School (district)		
Boonville	16	33
Centralia	12	18
Moberly	23	32
Free/reduced lunch		
No	12	19
Reduced	4	4
Free	34	59
Race		
White	45	67
African American	5	7
Hispanic	2	2
Other	1	6
Special education		
No	40	50
Yes	10	32
Special education classification		
Emotional disturbance	1	1
Learning disability	4	15
Speech/language impairment	1	6
Other (OHI, autism, multiple disabilities)	4	10

Note. OHI = other health impairment.

Interventionist characteristics and training

The intervention was provided by 30 interventionists who were hired and trained by the research team to provide instruction in the treatment condition. All of the interventionists were undergraduate students seeking degrees in education or speech language pathology, except for two interventionists who held undergraduate degrees. Each interventionist received 12 hr of training on key instructional elements and procedures, features of effective instruction and behavior management, and strategies for supporting student engagement. In addition, the research team led weekly meetings with the interventionists to provide ongoing instructional support and supplied scripted lessons for each instructional session.

Intervention

Students in the treatment condition received 40 min of small group instruction (four to six students per group) four times per week for approximately 8 weeks. The treatment was delivered in mixed-grade groups within schools. Interventionists used semiscripted lessons and grade-level science texts organized around four, 2-week thematic units (i.e., natural disasters, ecosystems, human body, and space exploration). Research staff created the instructional texts and analyzed the Lexile levels to ensure the text difficulties ranged from grades 6 to 8. Each instructional lesson was centered on the reading of a new text.

Interventionists utilized explicit instructional routines, provided quality feedback, and supported the gradual release of responsibility to students. Interventionists initially modeled all instructional components for students through think-alouds, and then provided students guided practice opportunities and instructional supports until students showed increased proficiency. Over time, the amount of teacher support and feedback diminished as students practiced

understanding informational texts independently. In addition, interventionists provided specific corrective feedback throughout the lesson sequence. Each instructional lesson consisted of three components: (1) identifying key words and main ideas through text-based discourse, (2) synthesizing information within a single text for summarization and making inferences, and (3) integrating information across multiple texts (see Appendix A). Each of these components is explained further in the sections that follow.

Component 1: Identifying key words and main ideas through text-based discourse

During the first component, students read along as the interventionist read a section of text aloud. The amount of text per section gradually increased over the lesson sequence from one paragraph (four to five sentences) to multiple paragraphs (up to 12–14 sentences). After reading a section of text, the interventionists briefly checked for understanding of target vocabulary by asking students to define these words. Target vocabularies were identified in the instructional scripts because they represented words that appeared across multiple texts and were important for understanding the specific text being read. Once interventionists checked students' understanding of target vocabulary, each student was responsible for identifying key words central to the meaning of the text section and discussing their key words with the rest of the group. Key words frequently included targeted vocabulary as well as other words that were important for understanding the text. At first, interventionists explicitly taught students how to identify key words by modeling think alouds and using guided practice. After identifying key words, interventionists asked students to utilize their key words to create a gist statement, which is similar to a main idea sentence. Once students had written their gist statements, the group shared their main idea sentences and recorded a group main idea sentence on a large easel for all to see. The instructional group repeated this step for each section of text (three to four text sections per lesson). As with all of the instructional components, the amount of modeling and guided support diminished as students showed improved proficiency in comprehending the texts. When student responses were inaccurate, interventionists directed students back to specific text sections until students identified the appropriate information.

Component 2: Synthesizing information within a single text for summarization and making inferences

The second instructional step focused on explicitly teaching students to synthesize information across text sections within a single text. Interventionists modeled through think alouds how to summarize using the gist statements from each text section to develop an overall main idea for the entire passage. Interventionists provided students multiple opportunities to practice summarizing text while receiving interventionist and peer feedback during discussions. Student feedback focused on directing students back to the gist statements for text sections to help them repair their overall main idea statements.

Component 3: Integrating information across multiple texts

The goal of the last instructional component for students was to integrate knowledge gained from the day's text with prior knowledge gained in the intervention or the student's original background knowledge. Each 2-week unit included a big question (e.g., "How do human body systems function to keep us alive?"). At the end of each lesson, the instructional group would reread the unit's big question and discuss how the knowledge gained in the day's lesson helped them to better answer the big question. As with the other instructional components, interventionists modeled how to integrate information across texts. They also focused the group's attention on strong student responses and directed students back to the texts and their notes when they struggled with the task.

Intervention fidelity

Interventionists audio-recorded instructional lessons each day. The research team then randomly selected a subset of audio recordings ($n = 45$; 10% of the total number of instructional sessions) to code for fidelity. Three members of the research team were assigned to code these audiotapes ($n = 15$) for fidelity. Before fidelity coding, the three fidelity coders received a 2-hr training and independently coded a randomly chosen audio recording. In adherence to the gold standard method (Gwet, 2001), the three coders met to discuss discrepancies in scores and receive feedback from another member of the research team who served as the gold standard. This process was repeated until comparison of code sheets reached agreement of 90% or higher to the gold standard.

Fidelity was coded for each of the three components of the intervention (i.e., understanding, synthesizing, and integrating) using a 4-point Likert-type scale ranging from 1 (low), 2 (mid-low), 3 (mid-high), to 4 (high). A score of 4 (high) was coded when the interventionist completed all of the required elements and procedures. A score of 3 (mid-high) was coded when nearly all of the required elements and procedures were completed, and a score of 2 (mid-low) when more than half (but not nearly all) of the required elements and procedures were completed. A score of 1 was coded if less than half of the required elements and procedures were completed for a given component of the lesson. If a component was not expected during the lesson, a score of N was coded indicating that the component was not expected during that particular lesson and was not included in the fidelity score calculation. The mean implementation score across components and across interventionists was 3.88 ($SD = 0.07$, range = 3.82–4.00).

Fidelity data also were collected related to overall quality of implementation and dosage. Quality of overall implementation was also rated on a 4-point Likert-type scale. Considerations for global observations were overall quality, group management, and student engagement. The mean quality score across components and across interventionists was 3.69 ($SD = 0.09$, range = 3.58–3.78). Dosage data were collected using interventionist-recorded student attendance records. The mean total amount of instruction students in the treatment condition received was 17.3 hr ($SD = 2.6$, range = 8–21 hr). Across the three school districts the number of intervention sessions students received varied significantly ($p < .001$).

Business as usual condition

All students (i.e., treatment and business as usual) continued to participate in core content area classes (e.g., math, science, English-language arts, and social studies). Students participating in response to intervention time continued to receive this supplemental instruction offered by the school while receiving the experimental treatment. Students receiving special education services continued to receive all services documented in their individualized educational plans while participating in the study. The experimental intervention was offered during elective classes (e.g., band, choir, and art) to ensure that students did not miss core instruction, supplemental instruction, or special education services. No additional literacy instruction was provided by elective teachers.

Measures

Listening comprehension

Listening comprehension was measured using the Woodcock Johnson-III Oral Comprehension subtest (WJ-III; Woodcock, McGrew, & Mather, 2001) and Test of Listening Comprehension Test-2 (TLC-2; Bowers et al., 2009). The individually administered WJ-III Oral Comprehension subtest requires students to listen to short read-aloud passages and provide the missing word from the passage using syntactic or semantic cues (Woodcock et al., 2001). The Oral Comprehension test has a test-retest reliability of 0.80 in the age range of 5 to 19 (Woodcock et al., 2001). Student's listening comprehension skills also were measured using the TLC-2 by having students listen to stories and answer

questions. Each question evaluates a particular aspect of listening comprehension and falls within one of the five subtests: reasoning, main idea, details, vocabulary and semantics, and understanding messages. For students aged 12–14 years, internal consistency estimates of reliability range from 0.61 to 0.74 for each subtest and 0.92 for the total test.

Reading comprehension

Reading comprehension was assessed with the Gates-MacGinitie Reading Test–Fourth Edition (MacGinitie, 2000), the WJ-III Passage Comprehension subtest (WJ-III; Woodcock et al. 2001), and the Bridge-IT (Barnes, Faulkner, Wilkinson, & Dennis, 2004). The Gates-MacGinities Reading Comprehension subtest is a timed (35 min), group-administered assessment consisting of expository and narrative passages ranging in length from 3 to 15 sentences. Students read each passage silently and answer multiple-choice questions. Internal consistency reliability ranges from 0.91 to 0.93, and alternate form reliability is reported as 0.80 to 0.87 (MacGinitie, 2000). The WJ-III Passage Comprehension is an individually administered, cloze-based subtest that requires students to read a passage and answer questions by filling in the missing word. Test-retest reliabilities for children aged 8–13 years range from 0.76 to 0.86 (Woodcock et al., 2001). The Bridge-IT is an individually administered task designed to measure the effect of textual distance on bridging inferences ability. The Bridge-IT comprises of 10, five-sentence, narrative passages that were presented to students in paper–pencil format. Passages began with a statement sentence followed by four sentences of intervening text. After reading the passage, students were presented four continuation sentences and were asked to identify which continuation sentence represented a "consistent" continuation of the passage. Each five-sentence story consisted of two opposing mental models. In the first sentence the model that needed to be integrated was presented first, leaving the need for the second model to be suppressed in order to correctly identify the correct continuation sentence. In previous work, which has computerized this task, average reliability coefficients (Kuder-Richardson 20) ranged from 0.52 to 0.69 for students in grades 6–12 (Barth et al., 2015).

Word reading fluency

Word reading fluency was assessed with the Test of Word Reading Efficiency-2 (TOWRE-2; Torgesen, Wagner, & Rashotte, 2012) Sight Word Efficiency and Phonemic Decoding Efficiency subtests. For the Sight Word Efficiency subtest, the participant is given a list of 104 words and asked to read them as accurately and as quickly as possible; the number of words read correctly within 45 s is recorded. For the Phonemic Decoding Efficiency subtest, the participant is given a list of 63 nonwords and is asked to read them as accurately and as quickly as possible within 45 s. Alternate forms and test-retest reliability coefficients exceed 0.90 for students in the middle grades.

Proximal measures

Two group-administered, researcher-developed measures were administered to measure vocabulary acquisition and the identification of key words and main ideas (see Appendix B).

The key word and main idea proximal measure called for students to read a short science passage, identify two key words from the passage, and write a main idea. The measure was administered in a paper–pencil format, in groups of approximately 15 students. Students in both the treatment and control conditions were not exposed to the grade-level science passages used in the proximal measure during treatment. Student samples were scored using a 12-point rubric based on the accuracy of the key words and main ideas, yielding a maximum raw score of 12 points for each proximal measure. Prior to the administration of the proximal measure, the research team created a scoring key that identified appropriate key words and main idea statements. Utilizing the gold standard method (Gwet, 2011), two members of the research team blind to group membership were trained on the scoring of the key words

and main idea rubric. Agreement of 90% or higher to the gold standard was established with 10 student samples (i.e., a total of 120 points) before scoring.

The vocabulary assessment required the students to match vocabulary words taught in the treatment condition with a brief definition. For example, "tissue" should be matched to the definition of "a group of similar cells working together." There were a total of 24 vocabulary words presented to students in four sets of six vocabulary words with eight possible definitions per set (two definitions did not match with vocabulary words). The vocabulary measure was administered in a paper–pencil format, in groups of approximately 15 students. Students first practiced vocabulary matching with a small set of highly knowledgeable practice items, and then proceeded to the test items.

RESULTS

Preliminary analyses

Because of the high attrition rate prior to the initiation of intervention, we used all available pretest and demographics variables to create 1000 imputed data sets with MPLUS v7 (Muthén & Muthén, 1998–2012). Averaging results across all the imputed data sets resulted in the identical pattern of results to the actual final sample, and thus we report the latter.

Demographic comparisons and descriptive data

A summary of demographics and descriptive statistics for the pretest measures is presented in Tables 1 and 2, respectively. No significant differences in demographics were

Table 2. Descriptive statistics at pretest

	Control			Treatment		
	M	*SD*	*N*	*M*	*SD*	*N*
Listening comprehension						
WJ-III-OC	93.39	7.58	51	93.40	10.02	80
TLC-Reasoning	98.37	14.08	49	93.78	14.56	79
TLC-Main Idea	107.18	11.51	49	100.71	14.64	79
TLC-Detail	88.88	11.06	49	88.79	12.56	78
TLC-Vocabulary & Semantics	93.80	10.99	49	93.56	11.18	78
TLC-Understanding Messages	90.86	13.79	49	89.28	13.98	79
Reading comprehension						
WJ-III-PC	87.65	8.74	51	87.35	9.79	80
GMRT	88.18	8.44	49	86.60	10.35	79
Bridge-IT	4.22	1.62	51	4.07	1.56	81
Proximal measures						
Vocabulary	12.61	5.29	51	12.33	5.83	83
Key word and main idea	6.67	2.50	51	6.69	2.28	81
Word reading fluency						
TOWRE-SWE	90.29	9.24	51	84.81	10.36	80
TOWRE-PDE	85.84	11.17	51	83.12	12.89	80

Notes. GMRT = Gates-MacGinites Reading Test; TLC = Test of Listening Comprehension Test—Adolescent; TOWRE-PDE = Test of Word Reading Efficiency-Phonemic Decoding Efficiency; TOWRE-SWE = Test of Word Reading Efficiency-Sight Word Efficiency; WJ-III-OC = Woodcock Johnson-III Oral Comprehension; WJ-III–PC = Woodcock Johnson-III Passage Comprehension.

found between treatment and control groups. Treatment and control groups did not differ in listening and reading comprehension measures at pretest, except for the TLC-Main Idea, F (1, 126) = 6.923, p = .01. On the TLC-Main Idea, the control group (M = 107.18, SD = 11.51) performed significantly higher than the treatment group (M = 100.71, SD = 14.64). Also noteworthy, participants performed approximately 1 SD below the mean on standardized measures of comprehension and 2/3 to 1 SD below the mean on measures of word and nonword reading fluency, indicating that participants were struggling middle-grade readers in both key aspects of the SVR.

Comparison of treatment and business-as-usual groups

To examine the treatment effects, we fit one-way analysis of covariance (ANCOVA) models on outcome measures with the respective pretest scores as a covariate. We confirmed linear relationships between the outcomes and covariates through visual inspection, and Levene's test for equality of variance indicated homogenous variances of outcomes between groups except WJ-III Passage Comprehension (PC). For the WJ-III PC, the larger standard deviation was less than twice as large as the smaller standard deviation and thus deemed practically acceptable to retain all students in the analysis (McDonald, 2009). In addition, assumptions about homoscedasticity and normality of the residuals were met in all of the models.

Pretest adjusted and unadjusted means and standard deviations with the results from ANCOVA are presented in Table 3. In addition, we provide standardized effect sizes calculated for treatment effects using pretest adjusted means and observed standard deviations in Table 3. In terms of listening comprehension, we found significant treatment effects on the TLC-Reasoning, F (1, 119) = 5.34, p = .023, η_p^2 = 0.043. We did not find any statistically significant differences on standardized reading comprehension measures. However, significant treatment effects were found on proximal measures. For the vocabulary measure, treatment students performed better than the control students on the vocabulary, F (1, 131) = 7.00, p = .009, η_p^2 = 0.051, the key word and main idea F (1, 125) = 6.36, p = .013, η_p^2 = 0.048.

We then applied the Benjamini-Hochberg method (BH; Benjamini & Hochberg, 1995), separately for listening and reading comprehension as well as proximal measures, to correct the critical p value to protect against Type I error due to multiple testing. TLC-Reasoning did not yield significant results after the BH correction, but the two proximal measures remained significant.

DISCUSSION

This randomized controlled trial examined the effectiveness of a reading comprehension intervention that emphasized listening comprehension and expressive language practice through text-based discussions. The content and goals of the intervention were chosen to reflect our interest in understanding whether improvements in listening comprehension and expressive language would lead to improved reading comprehension among struggling readers in the middle grades. We found small to moderate effects of the intervention on skills explicitly modeled and practiced in the intervention, but these effects did not transfer to standardized measures of listening comprehension and reading comprehension.

Specifically, we found significant effects on a proximal measure of vocabulary, suggesting that repeated exposure to key vocabulary words in text and in discussion about the passage can lead to significant improvements in students' recall of the target word's meaning. We also found significant effects on a proximal measure of key words and main idea, indicating that the main idea practices implemented in this intervention effectively facilitated struggling middle-grade readers' identification of explicit details in text, determination of details that are most essential, and integration of important information to capture

Table 3. Treatment effects on outcome measures

	Control				Treatment				
	Adjusted *M*	*M*	*SD*	*N*	Adjusted *M*	*M*	*SD*	*N*	Hedge's g
Listening comprehension									
WJ-III-OC	97.66	97.51	9.06	49	97.83	97.92	10.88	79	0.03
TLC-Reasoning	100.09	101.46	13.38	46	104.44	103.62	13.00	76	0.33*
TLC-Main Idea	108.51	110.33	12.95	46	110.22	109.13	13.65	77	0.13
TLC-Detail	92.20	92.18	12.17	45	91.31	91.32	11.86	75	−0.07
TLC- Vocabulary & Semantics	99.67	99.67	13.29	46	97.96	97.96	13.02	75	−0.13
TLC-Understanding Messages	96.73	97.64	14.61	45	96.14	95.61	14.26	77	−0.04
Reading comprehension									
WJ-III-PC	90.72	91.19	8.90	48	90.08	89.80	12.71	79	−0.06
GM	481.35	482.87	23.88	47	481.45	480.54	27.67	79	0.00
Bridge-IT	4.47	4.48	1.57	50	4.54	4.53	1.78	79	0.04
Proximal measures									
Vocabulary	13.29	13.39	5.28	51	15.64	15.58	6.31	83	0.39**,[a]
Key word and main idea	6.74	6.73	2.57	49	7.87	7.86	2.49	81	0.45**,[a]

[a]Statistically significant results after the Benjamini-Hochberg corrected level.

Notes. GMRT = Gates-MacGinites Reading Test; TLC = Test of Listening Comprehension Test—Adolescent; WJ-III-OC = Woodcock Johnson-III Oral Comprehension; WJ-III-PC = Woodcock Johnson-III Passage Comprehension.

*$p < .05$.

**$p < .01$.

the gist of a text. No significant effects were found for standardized measures of inference, listening comprehension, and reading comprehension.

The pattern of significant effects on researcher-developed measures that closely aligned to the intervention, but with no transfer to standardized measures of listening comprehension and reading comprehension, characterizes the majority of recent randomized control trials conducted with middle-grade struggling readers (Vaughn & Wanzek, 2014). This body of literature appears to justify the conclusion that a large subgroup of middle-grade struggling readers are minimally responsive to intensive interventions designed to remediate the numerous and varied difficulties they present. Minimal response following intensive intervention is likely due to the complex nature of language and literacy at this point in development as well as difficulty in reliably and validly measuring the full range of skills that are engaged when listening, speaking, or comprehending text.

The current investigation did show what appeared to be significant effects on The Listening Comprehension Test-Reasoning subtest ($ES = 0.33$, $p < .05$), suggesting that the intervention was leading to practical improvements on a standardized measure that requires the integration of background knowledge with information from the text. It is likely the case that the narrow nature of this task was particularly influenced by students' acquisition of content knowledge during the intervention or learning how to apply relevant knowledge to understand novel texts. However, these practical improvements did not lead to significant differences between the treatment and business as usual conditions that were retained after controlling for Type 1 error. Thus, we are left with the question of why this theoretically derived intervention did not lead to significant effects on standardized measures of listening comprehension and reading comprehension.

One possibility is that 21 hr of instruction is not enough instructional time for students to master the skills taught in the intervention at a sufficient level such that they are successfully able to transfer these skills to novel grade-level informational texts or the types of narrative and informational texts found on standardized assessment of comprehension. Although regression models examining whether the number of treatment sessions predicted outcomes controlling for pretest indicated that dosage was not associated with end of treatment performance, this seems to be a valid argument with respect to training listening comprehension, expressive language, and reading comprehension, all of which are complex cognitive processes that are challenging to build even among struggling readers in preschool and the early elementary grades. For example, previous research reports significant effects on a narrative composite and broad oral language composite following 30 weeks of intervention but only on grammar and trained vocabulary (Bowyer-Crane et al., 2008) and after a 20-week intervention (Fricke et al., 2013) but not after a 9-week intervention period (Duff et al., 2014) among beginning, struggling readers. Even though results did not indicate that treatment students significantly outperformed comparison students on standardized measures, it is important to examine how to best teach the language-based comprehension processes that support listening comprehension and reading comprehension among older adolescent struggling readers—students who have well-documented difficulties with language (Ehren et al., 2012). A failure to explore alternative methods of addressing the language difficulties of struggling readers in the middle grades ensures that the literate language features of text, which are a substantial roadblock for comprehension, remain a substantial roadblock (Botting, Simlin, & Coti-Ramsden, 2006).

A second possibility is that the intervention targeted comprehension processes that support listening and reading comprehension (i.e., identification and understanding of key words, formulation of main idea, and synthesizing important information across sections of text) and not basic word decoding skills,

which can also be a major bottleneck for comprehension of text. This is important to note because students in the intervention also presented significant deficits in the area of word reading efficiency. To compensate for these word level difficulties, the interventionists read the passages to students, with students directed to follow along in text, silently read, or whisper read. One might argue that the effectiveness of the intervention may have been enhanced by adding instruction in multisyllabic decoding; however, word reading efficiency did not moderate treatment effects on Woodcock Johnson-III Oral Comprehension or Passage Comprehension outcomes.

Another consideration may be that the identification of key words, formulation of the main idea, and synthesizing information across texts without explicit practice in answering the types of comprehension questions found on standardized assessments of listening comprehension and reading comprehension do not naturally lead to generalization to these assessment formats without explicit practice and feedback. In this study, assessment formats included multiple-choice, open-ended short-answer, recall of text, and cloze procedure. In addition, the types of language and literacy skills employed to answer these question formats vary (Keenan & Meenan, 2014). Although key word and main idea instruction in this study improved students' accuracy in identifying and integrating important information from science texts (as measured by the proximal measures), it may be that intervention also needs to teach students how to activate, retrieve, and integrate relevant background information and information from text into the evolving situation model for the purpose of answering the various types of comprehension questions found on high-stakes assessments.

An additional explanation for the lack of transfer to standardized measures of listening comprehension and reading comprehension may be associated with students' limited vocabulary, domain knowledge, and background knowledge for the passages included on the standardized assessments. Prompting students to use a main idea strategy or any strategy for engaging with text may be challenging for reading or listening tasks for which they have little knowledge. Students with low knowledge may expend large amounts of cognitive resources on basic tasks related to understanding text (e.g., word reading and linking facts), such that they have reduced cognitive resources for inference making or generating and synthesizing main ideas (Ramsay, Sperling, & Dornisch, 2010). For this reason, it may be important to understand how much knowledge is required for general comprehension strategies to be effective as measured by comprehension tests that may assess different aspects of the component skills that make up the complex construct of comprehension. Finally, standardized tests are not designed to capture evidence of change over short periods of intervention. Standardized assessments are designed to be as short as possible while meeting psychometric standards of reliability and validity. For this reason, one or two items can make a critical difference in a student's standardized score but not be enough to produce a statistically significant difference as a measure of progress following a short intervention.

Clinical significance

This study is an example of an early efficacy study. We were interested in blending intervention components previously reported to be effective with middle-grade struggling readers (i.e., main idea, discussions about text, and vocabulary instruction) with new research among beginning readers that demonstrates that improvements in oral language (i.e., vocabulary, spoken comprehension, and independent speaking) may generalize to improvements in reading comprehension (Clarke et al., 2010; Fricke et el., 2013). Because we were interested in assessing the potential benefit of emphasizing listening comprehension and expressive language use within the framework of a text-processing approach, we included multiple standardized measures of listening

comprehension and reading comprehension. Standardized measures control for age-related changes in development and permit rank ordering of students' performance so that a student's score can be reported relative to the norming group. An important next step is to include multiple assessments of proximal measures (i.e., vocabulary, key word and main idea, inferencing, and knowledge acquisition) that closely align with the intervention. Proximal measures are more likely to capture significant learning gains that may not be revealed on standardized assessments, although they could be said to be too close to the instructional tasks, so that one is essentially teaching to the test. On the other hand, they could provide information on the learning process, inform instructional changes, and help to understand how students are progressing. This next step is clinically important because proximal progress probe measures could isolate which language-based skills and general comprehension strategies improve at particular points in the intervention.

Study limitations

This study provides preliminary information about the effectiveness of a text-processing reading comprehension intervention that targets listening comprehension and expressive language practice through text-based discussions of grade-level informational science texts. Although findings support the ongoing inquiry in this area, the preliminary nature of the study revealed a couple of important limitations to consider for future research.

In terms of methodological limitations, four issues are noted that could strengthen the quality of future studies. First, the selection criteria for participants should be refined to better control for unexplained variability in reading and listening comprehension skills. In addition to the state reading assessment, a standardized measure of reading comprehension might be used to identify students with reading comprehension scores that are significantly below grade level. In addition, the inclusionary criteria could include a measure of listening comprehension either to describe the listening comprehension skills of the sample or to exclude students who do not present significant deficits in both listening comprehension and reading comprehension. Unfortunately, districts are exceedingly restrictive in the number of measures allowed for randomized control trials reducing access to outcomes from these valuable measures.

Second, further developing and refining the measures of vocabulary and main idea of text as well as inference making and knowledge acquisition will improve confidence in the proximal findings. The lack of reliable and valid proximal measures is a critical barrier to advancing the understanding of how these text-processing skills develop among adolescent struggling readers. Reliable and valid proximal measures are also important to quantify significant gains in skills that are not captured on standardized measures of listening and reading comprehension.

Third, undergraduate students seeking degrees in education or speech language pathology provided the interventions. Previous studies that have focused on oral language discourse among elementary grade students have delivered the intervention by either speech language pathologists (Gillam et al., 2012) or highly trained interventionists (Clarke et al., 2010). One challenge many interventionists faced was how to provide targeted positive feedback and error correction for main idea statements. To effectively do this, interventionists must determine whether a student's main idea statement was correct or incorrect. For correct main idea statements, the interventionist provides positive reinforcement. For incorrect main idea statements, the interventionist must identify one aspect of that statement to positively reinforce and then instruct the student on how to correct the errors. Next, the interventionist encourages the student to generate a new main idea statement and provides targeted positive reinforcement of the correct aspects of this new main idea. In brief, to execute this feedback loop efficiently and accurately, the interventionist must thoroughly understand the passage and

be able to quickly analyze students' main idea statements to identify areas of reinforcement and areas of correction. This feedback loop was challenging for interventionists as they were using a new set of complex instructional skills, which required ongoing professional development (i.e., weekly) from the research team as well as modifications to the scripting in order to minimize the cognitive processing demands (i.e., examples of frequent errors plus targeted positive feedback for those errors).

Finally, the sample size for this study was small, which may have limited the ability to detect significant differences between the intervention and control groups. One issue that led to the smaller sample size was attrition from the study. Further a priori power analysis did not assume the level of attrition experienced in this study. Attrition from the study was due in large part to the intervention occurring during the period when students were originally scheduled to have an elective class. Given that there is very little student choice in the middle school grades, future research should work closely with middle schools to identify a time during the school day that is amenable for both students and schools.

Future research

Results of this study demonstrate that text-based discussions that support the development of vocabulary and synthesis of main idea statements led to improved performance on measures aligned with the aims of the intervention. The interventionist taught students how to identify key words, form main idea statements, and integrate information across multiple text sections as a method for improving listening comprehension and reading comprehension skills. Because listening and reading comprehension are complex cognitive skills, interventions may need to shift to 1:1 delivery or small groups of two to three students in order to provide sufficient opportunities for students to respond and to receive individualized feedback and instruction (Vaughn & Wanzek, 2014). This study, as well as others with this grade group (see for review, Solis et al., 2012), has not demonstrated significant gains on standardized measures of listening and reading comprehension. Thus, future studies may need to consider providing students with additional time, intensity, or apply different methods for developing comprehension-related outcomes. Future research, for example, might investigate whether collaborative learning opportunities, student selection of additional reading materials, application of general comprehension strategies across content domains (e.g., science, social studies, and English-language arts) or whether instruction delivered by speech language pathologists who have substantial experience in language-based intervention are more effective as methods of increasing independent practice and generalization of strategies that promote comprehension learning.

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Appendix A. Sample Reading Intervention Lesson

Lesson Number: Unit 4, Lesson 5
Unit Big Question: What has space exploration taught us about outer space?

Component 1: Identifying key words and main ideas through text-based discourse (32 min)

1. Read a section of text and check for understanding of key vocabulary
   - After reading a text section (two to three paragraphs long), check for student understanding of difficult vocabulary
   - For instance, an interventionist might say, "There were a couple of difficult words in there that I want to make sure we understand. What is an orbiter?" Students respond, "Right, an orbiter is a part of the shape shuttle that carries passengers and cargo"'
   - *Words for teachers to check: orbiter, telescope, cargo*
2. Students identify key words and receive feedback from peers and interventionist
   - Have students write a few key words that are central to the meaning of the text section
   - Interventionist might say, "Tell me one of the key words you wrote down and why you think it is an important word"
   - *Key words answer key: Challenger, space shuttle, missions, information*
3. Students write gist statements individually and then work as a group (with teacher support) to develop a group gist statement using individual answers
   - Call for students to write a gist statement (one to two sentences) using the previously selected key words
   - After a couple of students have shared their gist statements and the interventionist and/or peers have provided feedback, help the group develop an excellent group gist statement using individual responses discussed
   - *Gist statement answer key: The* Challenger *was a* space shuttle *created to fly many different types of* missions *to gather information*

Repeat for text sections 2–4

Component 2: Synthesizing information within a single text (8 min)

1. Identify key words for the entire passage
   - Have students use the gist statements for each text section to identify overall key words for the whole passage
   - Discuss the key words identified and provide student feedback
   - *Key words answer key: space shuttle, Challenger, explosion, investigation, problems*
2. Students create overall gist statement and the group discusses individual responses.
   - Have students use their overall key words to develop a gist statement for the entire passage, discuss responses as a group, and have students make corrections, as needed

Overall gist statement sample answer: The Challenger space shuttle *was a reusable spacecraft that* exploded *after takeoff. An* investigation *uncovered* problems *that led to changes in the space shuttle program*

Component 3: Integrating information across multiple texts (5 min)

1. Pose "big question" to students and provide feedback on student responses
   - "Today, we learned about the Challenger expedition. Let's think about what we learned today and answer our big question, What has space exploration taught us about outer space?"
2. *New information answer key:*
   - *The space shuttle program was a way of collecting data from outer space*
   - *The Challenger explosion was a reminder of the danger of space exploration*
   - *Because of the danger, safety precautions are very important*

Appendix B. Examples of Proximal Measures

Key Words and Main Idea Proximal Measure

Wildfires

A wildfire is an uncontrolled blaze that is capable of destroying acres of land in just minutes. There are three conditions, known as the fire triangle, that need to be present for a wildfire to burn: fuel, oxygen, and a heat source. Fuel is any flammable material surrounding a fire, such as trees, grasses, brush, and even homes. Air supplies the oxygen that a fire needs to burn. Heat sources help spark the wildfire. Lightning, burning campfires, cigarettes, hot winds, and even the sun can all provide enough heat to spark a wildfire.

Firefighters fight wildfires by removing one or more of the fire triangle conditions. Traditional methods include spraying water and nonflammable materials on the fire to extinguish it. Firefighters also fight wildfires by intentionally starting fires in a process called controlled burning. These fires remove vegetation, brush, and ground litter from a forest, depriving a wildfire of fuel.

1. Write down two key words from the passage.
2. What is this passage mostly about? Write a main idea sentence for the passage you just read.

Vocabulary Proximal Measure

Match each vocabulary term with its definition.

Notice there are two extra definitions that you will not use.

1. tremor _____	a. an animal that hunts other animals
2. predator _____	b. a vibrating or shaking motion
3. tissue _____	c. natural force that causes things to fall toward earth
4. conditions _____	d. a sudden disturbance
5. gravity _____	e. describe the state of something
6. contaminate _____	f. to stain or infect something by contact with something that is dirty or harmful
	g. a large body of ice moving slowly down a slope or spreading outward on a land surface
	h. a group of similar cells