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Comprehension Tools for Teachers: Reading for Understanding from Prekindergarten through Fourth Grade

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Abstract

This paper describes the theoretical framework, as well as the development and testing of the intervention, Comprehension Tools for Teachers (CTT), which is composed of eight component interventions targeting malleable language and reading comprehension skills that emerging research indicates contribute to proficient reading for understanding for prekindergarteners through fourth graders. Component interventions target processes considered largely automatic as well as more reflective processes, with interacting and reciprocal effects. Specifically, we present component interventions targeting cognitive, linguistic, and text-specific processes, including morphological awareness, syntax, mental-state verbs, comprehension monitoring, narrative and expository text structure, enacted comprehension, academic knowledge, and reading to learn from informational text. Our aim was to develop a tool set composed of intensive meaningful individualized small group interventions. We improved feasibility in regular classrooms through the use of design-based iterative research methods including careful lesson planning, targeted scripting, pre- and postintervention proximal assessments, and technology. In addition to the overall framework, we discuss seven of the component interventions and general results of design and efficacy studies.

Keywords

Reading comprehension; Elementary school; Preschool; Literacy; Instruction; Intervention; Tier 2; Small group intervention; Academic language; Oral language; Children; Students; Early childhood; Middle childhood

Although there are many factors that contribute to students' success in learning to read with understanding, including genetics, home literacy environment, health, poverty, stress, preschool experiences, parenting, and peers (Bronfenbrenner and Morris 2006; Duncan et al. 2008; Pianta et al. 2007; Skibbe et al. 2012; Taylor et al. 2010), how we teach students to read for understanding and what we teach them impacts their learning. New policies, and particularly the Common Core State Standards (http://www.corestandards.org) and the focus

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on college and career readiness will make increasing demands on students' abilities to read more difficult informational and expository text in addition to narrative text. The most recent 2013 NAEP results (http://nationsreportcard.gov/reading_math_2013/files/Results_Appendix_Reading.pdf) reveal that more than 30 % of fourth graders attending public schools were unable to able to make simple inferences, locate information in text, identify supporting detail, describe characters' motivations and mood, and describe the problem in narrative text (i.e., basic reading level). In informational text, they were unable to find the topic sentence or main idea, supply supporting details, identify the authors' purpose, and make simple inferences. There continues to be an achievement gap between students living in poverty (i.e., eligible for free/reduced-price lunch (FRL)) and their more affluent peers. Only 53 % of students who qualified for FRL achieved at or above basic levels compared with 83 % of students who were not eligible. This achievement gap has narrowed somewhat since 1998 but not to acceptable levels and remains a complex and challenging situation. The Reading for Understanding Network initiative was developed and funded, in large part, to address the achievement gap and to investigate ways to improve students' reading comprehension skills. The purpose of this article is to provide information on the development and testing of Comprehension Tools for Teachers (CTT), a collection of language and literacy interventions that represents the work of multiple investigators from different disciplines with the common thread of improving literacy outcome for elementary students by focusing primarily on linguistic and cognitive processes and component skills associated with reading for understanding.

Based on our work and others (e.g., Landscape, Lexical Quality Hypothesis, and Simple View), to develop CTT, we conceptualized reading comprehension as a complex activity that requires the reader (in this case, the student) to call on the coordination of cognitive, regulatory, linguistic, and text-specific processes, including decoding of text, which are developing over time and that have reciprocal and interacting bootstrapping effects on one another. We refer to this as the "lattice model" for short because these interacting effects resemble a lattice when they are drawn (see Fig. 1) (Gough and Tunmer 1986; Kintsch 1998; Perfetti 2008; Rapp and van den Broek 2005). The framework also considers that the extent to which students successfully read for understanding is further influenced by their purpose for reading and characteristics of the text itself (Snow 2001). CTT was developed to accommodate individual student differences and specificity of learning (see below) and to target malleable sources of influence on reading comprehension, which may be on a continuum from largely automatic and unconscious (e.g., application of oral language) to more reflective and metacognitive (e.g., examining text structure).

Individual Student Differences

Students bring different strengths and aptitudes to the process of learning to read for understanding and the effect of specific types and amount of literacy instruction generally depends on these differences (Connor et al. 2011, 2013; Reis et al. 2008, 2011; Torgesen 2000). The need to target language development for instruction is particularly salient for students from families living in poverty and those with lower parental education levels. Studies indicate that parental language models include (in addition to less varied vocabulary) fewer complex sentence structures, more concrete language, and fewer

opportunities for extended conversations (Hoff 2013; Huttenlocher et al. 2007). Students experiencing such reduced and restricted language input are often less likely to develop extensive vocabularies and background knowledge, complex morphological and syntactical knowledge, or text structure knowledge (Dymock 2007; van Kleeck 2008). Students from lower socioeconomic backgrounds were a population of particular focus for our work because they are frequently at risk for academic underachievement. Each of the component interventions is designed to target specific skills and aptitudes that, research suggests, contribute to proficient reading comprehension.

Specificity of Learning

Students seem to learn best what it is they are explicitly taught (e.g., Adolph 2000), and, thus, an intervention that focuses on text structure, for instance, may be unlikely to impact syntax directly. We do hypothesize bootstrapping and reciprocal effects. Therefore there may be indirect and change effects that, in turn, further support successful reading comprehension.

In reviewing the research on reading comprehension, we identified potentially malleable components in our model, which appear to be related to successful comprehension. These likely candidates included: (1) *linguistic processes*, specifically morphological awareness, syntactic knowledge, dialect awareness, word knowledge, and academic knowledge; (2) *cognitive processes*, specifically comprehension monitoring, enacted comprehension, and inferencing; and (3) *text-specific processes*, specifically understanding narrative and expository text structure. This is with the understanding that all of the processes are overlapping (see Fig. 1). Following the Simple View (Hoover and Gough 1990), which is among the best supported theories of reading comprehension, we recognize the importance of decoding and encoding instruction (Melby-Lervåg and Lervåg 2013; Weiser and Mathes 2011). Moreover, some of the processes for which we developed interventions might arguably be considered code focused as well as meaning-focused interventions, for example, morphological awareness. However, given the numerous evidence-based options already available, none of our newly developed interventions were specifically designed to target decoding or encoding. As can be seen in Fig. 1, we include code-based skills as part of text-specific processes.

The aim of CTT is to support students' development of the key components that enable successful reading for understanding through the development of targeted component interventions. Each component was developed by a lead researcher and in coordination with the other investigators and teachers, who were part of the research team. All studies, design, and efficacy, were conducted in schools where at least 40 % (and often closer to 75 %) of the students qualified for FRL, a frequently used indicator of poverty. To illustrate, we present seven of the component interventions—Morphological Awareness Training (MAT), Dialect Awareness instruction (DAWS), Language in Motion (LIM), Comprehension Monitoring and Providing Awareness of Story Structure (COMPASS), Teaching Expository Text Structures (TEXTS), Enacted Reading Comprehension (ERC), and Content Area Literacy Instruction (CALI). Each described intervention has been developed for two to five grade levels between prekindergarten and fourth grade. The eight intervention, called the

Word Knowledge e-book, designed to improve third through fifth graders' word learning strategies and comprehension monitoring, is still in the iterative design phase of development and so is not reported here.

Thematically, most of our interventions address one or more aspects of linguistic ability. Oral language comprehension is one of the essential and necessary foundational skills for reading comprehension (Kendeou et al. 2009; Storch and Whitehurst 2002). Language comprehension draws on a highly complex set of skills and knowledge (e.g., vocabulary, syntax, inference making, working memory, comprehension monitoring, and story knowledge; Cain 1996; Dickinson et al. 2010; Kendeou et al. 2009; Kim, under review). Whereas aspects of oral language such as vocabulary, syntax, and listening comprehension often are considered separate components, increasing evidence suggests that they represent a common underlying ability (e.g., Lonigan and Schatschneider 2013). However, in the interest of maximizing instructional focus and intensity, each intervention primarily targets just one or two elements within the oral language system.

Although separately conceptualized, we designed all of these interventions, with the exception of CALI, to be primarily delivered as targeted, tier 2 instruction for students who qualified-in on the basis of learning need. Each intervention, regardless of length, was delivered 4 days/week to small groups of three to five students for approximately 20 min/session. The structured format of all interventions, the embedded professional development, including semiscripting, and differentiated instruction, was a universal design feature intended to support their ease of implementation by professionals with a range of experience and credentials, from paraprofessionals to veteran teachers. Moreover, although the interventions were designed for multiple grades, all were explicitly developed to have consistent structure but novel content in each grade, providing teachers with flexibility to use materials from a lower or higher grade to differentiate instruction.

The methods used to develop and assess the promise of these interventions were consistent to the extent possible using the following protocols: A research team that included teachers developed a prototype of the intervention. The teachers were certified teachers with classroom experience who were employed by the university and were part of the research team. The prototype was then implemented in classrooms by interventionists who were part of the research team and, frequently, included the teachers who helped develop the intervention. In addition to developing the interventions, all teams designed proximal assessments of the specific content embedded in lesson plans; these and near-transfer standardized distal ("distimal") assessments were conducted prior to and after implementation. For example, LIM developers created multiple-choice, cloze, and free response assessments of targeted syntactical features while COMPASS developers created assessments of text structure knowledge and inconsistency detection. Results were then analyzed and the intervention revised based on these results. This iterative procedure was followed until the intervention was effective in promoting gains on the proximal and distimal measures. The specific measures and number of iterations varied across the interventions. Only once an intervention met the criteria for promise was an efficacy trial conducted, with students within classrooms randomly assigned to the intervention or a business-as-usual control group. Studies were powered to find minimally detectable effect

sizes (d) of 0.20. Again, to the extent possible, the protocol was consistent across studies and included, in addition to proximal and near-transfer measures, standardized measures of vocabulary, listening comprehension, and reading comprehension. As of the writing of this paper, all of the interventions showed promise, but not all had been tested in randomized controlled field trials. Where efficacy trials have been conducted, results are summarized. For the others, efficacy studies have just been conducted (or are ongoing) and the results are being analyzed. We describe each intervention below.

Morphological Awareness Training

Morphological awareness, a linguistic process in our model (see Fig. 1), refers to the ability to consider and manipulate the smallest units of meaning in language, including base words and affixes (e.g., Apel and Lawrence 2011; Carlisle 2000; Wolter et al. 2009). Morphological awareness skills relate to and influence students' word reading, reading comprehension, and spelling abilities, even when other linguistic awareness skills are considered simultaneously (e.g., Apel et al. 2012; Carlisle and Stone 2005; Kirby et al. 2012). Two recent reports, a systematic review (Bowers et al. 2010) and a meta-analysis (Goodwin and Ahn 2013), provided evidence that morphological awareness interventions lead to moderate improvements in morphological awareness skills across a range of student ages and abilities, although most investigations involved students in third grade or above. Improvements in literacy skills attributed to the morphological awareness interventions varied by report, but there also appeared to be some improvement for word-level reading (small to medium effect sizes) and reading comprehension (small effect sizes).

Few morphological awareness intervention studies have been conducted with students below the third grade, perhaps because of a misunderstanding that morphological awareness instruction may not be appropriate in the primary grades. The studies included in the systematic review and meta-analysis also did not include children from low socioeconomic neighborhoods, a population known to be at risk for reading difficulties (e.g., Craig and Washington 2004a, b). To address the address the paucity of information for morphological awareness interventions with young children, particularly those known to be at risk for difficulties learning to read, we designed an intervention, the MAT, that could be delivered to students in kindergarten, first, and second grade. We then examined both its feasibility and its efficacy across two investigations with students from high-poverty schools (Apel et al. 2013; Apel and Diehm 2014).

In a design study with approximately 20 students in each of kindergarten, first and second grade, students were provided the MAT intervention for 9 weeks (Apel et al. 2013). Twelve lessons were taught across those 9 weeks, targeting specific inflectional (plural, s; third person, s; present progressive, ing; and past tense, ed) and derivational affixes (un-, re-, dis-, -er, -ly, ness, -y, and -–est). In general, the students were encouraged to discover rules or facts about the affixes by becoming "Word Detectives," using magnifying glasses as they inspected words presented by the interventionist. Throughout every lesson, they were encouraged to identify the target affix and discover the meaning of words based on the affix. To accomplish this objective, each lesson contained four main elements: an introduction/ listening activity, a word sort or story, a game focused on the affix or a writing activity, and

a summary. For the introductory/listening activity, the interventionist defined and provided examples of the affix to be learned and then the students listened for examples of that affix in spoken sentences produced by the interventionist. Word sorts required the students to separate pictures or word cards representing items contrasting words with or without the target affix. In one writing activity, the students were encouraged to find and circle the target affixes in written words that did or did not contain the affix. Finally, all lessons included a summary of the day's target affix, its meaning, and brainstorming on words that contained that particular affix.

Interspersed after every two lessons (4 days), was a review lesson that included a general discussion of the affixes learned previously. Games incorporating the affixes in review (i.e., dice games) were included to increase the students' interest and to contrast the affixes in review. Additionally, there was a focus on words and their "relatives" (i.e., derived and inflected forms of base words). The students were taught to think about how words are related by meaning and that they could think about multiple relatives of a base word (e.g., act—actor, acting, and action) or listen for relatives within a story.

Results of the design studies were highly promising (Apel et al. 2013). Therefore, we conducted an efficacy trial in the three grades, with approximately 25 students from each grade in the treatment and control conditions (Apel and Diehm 2014). The students received the MAT intervention described above; however, the intervention lasted 8 weeks and 11 lessons were provided. All other aspects of the intervention, including the format and content of the lessons, remained the same as implemented in the design study (Apel et al. 2013).

There were statistically significant differences in favor of the intervention group postintervention at each grade level on at least two or three morphological awareness tasks. For each grade, effect sizes for morphological awareness tasks were small to large with most being large. There was a small effect of the intervention on reading comprehension in first-grade students and on pseudoword reading in second-grade students. There was a small, negative effect size on pseudoword reading in first grade, indicating the control group scored higher at posttest than did the intervention group. The remaining effect sizes for the other reading measures were not significantly different than zero, suggesting the intervention did not have an observable effect. A secondary analysis suggested that students characterized as having low morphological awareness abilities did not differ in the gains made during intervention from those characterized as having average morphological awareness abilities. Thus, our findings suggested that students who presented with varying abilities benefitted equally from the intervention.

After a relatively short amount of time (8–9 weeks), MAT appears to contribute to significant gains in morphological awareness abilities, which are known to contribute to and predict reading skills (e.g., Apel et al. 2012; Carlisle and Stone 2005; Kirby et al. 2012). The intervention also showed some promise for increasing reading abilities, even though reading itself was not targeted directly during the intervention. What remains to be determined is the long-term effects of MAT, the effects of the length and frequency of instruction, and whether the more direct links between morphological awareness instruction and reading

(and writing) might increase postintervention performance on measures of reading and writing. With questions such as these answered in the future, clinical and educational professionals will be well prepared to provide instruction that is evidence based and leads to students' successful literacy development and academic achievement.

Dialect Awareness Study

Spoken dialect variations of Mainstream American English (MAE) such as African American English (AAE) and Southern White English (SWE), have long been discussed as potential factors contributing to the achievement gap (Charity et al. 2004; Craig et al. 2009; Wolfram 1971). Major research findings over the last 15 years regarding these varieties of nonmainstream American English (NMAE) and the achievement gap demonstrate a strong, predictive relationship between dialect usage in students, and various language and literacy skills (Charity et al. 2004; Connor and Craig 2006; Craig and Washington 2004a, b; Craig et al. 2009; Terry et al. 2010). Furthermore, students with more dense dialect usage demonstrate poorer performances on standardized measures of language and literacy (Charity et al. 2004; Craig and Washington 2004a, b), and, yet, dialect speaking students who are able to dialect shift (from NMAE varieties to MAE varieties) in specific school contexts, such as written language tasks, perform better on measures of language and literacy (Craig and Washington 2004a, b; Craig et al. 2009; Terry et al. 2012), including reading comprehension tasks.

Returning to our model in Fig. 1, we consider dialect shifting to be a metalinguistic skill that represents an understanding of the differences in the morphological and syntactic structure of NMAE and MAE and when the use of each is more appropriate. Thus, there are metacognitive aspects to dialect shifting as well. As can be seen in Fig. 1, linguistic and cognitive processes overlap and may work together to predict reading for understanding. Whether dialect shifting is less conscious and thus more automatic or more conscious, and hence more malleable, was unclear based on our reading of the current research literature. Therefore, the first version of DAWS was designed specifically to be used in an experiment to investigate whether dialect shifting was malleable, and, if so, whether it was enough to teach children how to edit writing to conform more closely to MAE standards or whether there was an advantage to explicitly contrasting MAE and NMAE features. To directly test this question, we developed two overlapping interventions that addressed dialect usage in both oral and written formats. The interventions were the same—focusing on editing text—but in the explicit version, the idea of formal and informal language was explicitly taught. The analogy of dress (e.g., formal for church or a wedding; informal for playing with friends) was used to teach the pragmatics of dialect shifting from Home English (NMAE) to School English (MAE). Students in the implicit instruction group were taught the same grammatical features but without the contrastive focus on NMAE and MAE and without focus on the context of usage. The general framework for both interventions was an introduction to the grammatical forms on day 1 of each week, receptive language activities on day 2 to build a foundation for the new knowledge, and expressive language activities on day 3 to practice using the forms. On day 4, participants were given a task where they had to write a brief story or edit sentences using the target grammatical features of the week. The targeted features were zero plural (two apple), zero past tense (yesterday he call), and zero

copula (e.g., he going). For example, in one activity, students were given sentences that contained Home English (e.g., He plant the flowers last spring) and they were taught how to edit the sentences so that they were written using School English. In the implicit condition, no mention was made of Home and School English, they were simply taught to edit the sentences. In the explicit condition, students identified Home English and changed it to School English.

The study included 116 second through fourth grade students, all of whom demonstrated NMAE usage on either Part 1 of the Diagnosis of Language Variation—Screening (DELV-S) or on a writing task. Students were randomly assigned within classroom to one of three 4-week conditions including no treatment control and the explicit and implicit conditions. Students in both intervention groups demonstrated increased usage of MAE grammatical forms in writing and on an editing task, suggesting that dialect shifting is malleable. NMAE-speaking students learned how to shift their language usage to MAE in written language. However, students in the explicit-shifting intervention group demonstrated greater dialect shifting than did the students in the implicit instruction group. Both intervention groups performed better on shifting tasks than did students in the control group.

Based on the positive results of the experiment described above, DAWS was expanded into an 8-week intervention, covering six grammatical features. The 8-week intervention focused on usage of past-tense, -ed; plurals, -s/-es; subject–verb agreement; copula/auxiliary; possessives; and preterite had in their writing. The intervention used the same daily format as described in the feasibility study. The editing task, a measure of how well students could recognize and revise sentences in home language into school language, was given at pre-, mid-, and postassessment to assess progress.

Students qualified for the study if they used at least one feature of NMAE in a written language sample or as measured by the DELV-ST. These students (n=374 second, third, and fourth graders) were randomly assigned within classrooms to either the treatment or control group.

Analyses of postassessments revealed that students in the DAWs intervention used more MAE forms and fewer NMAE forms compared with students in the control group (i.e., dialect shifting to a greater extent). Mean performance on the editing task increased by grade level; fourth graders outperformed second and third grades at all three assessment points. Structural equation models revealed that dialect shifting predicted reading comprehension directly as well as indirectly through improved morphological awareness (see MAT above for measures) (Thomas-Tate and Connor 2013).

Language in Motion

Many students with disadvantaged backgrounds enter schooling less familiar with the decontextualized language features present in academic language used by teachers and found in written texts (see Fig. 1, linguistic processes). As such, the literate language features of text can be a substantial roadblock to comprehension (Botting, Simkin, & Conti-Ramsden 2006). Furthermore, students whose own expressive language is not syntactically complex (i.e., not using embedded clauses and conjunction-adjoined phrases) may be more

likely to overlook or misunderstand such features when found in written text (Bishop and Snowling 2004; van der Lely and Marshall 2010).

Whereas language interventions addressing morphosyntax (e.g., verb conjugation and plurals) and sentence-level syntax (e.g., conjunctions, passive sentences, and elaborated phrases) may be common in language therapy for students with significantly impaired language development (e.g., Law et al. 2004), this is a less common instructional feature for students who fall in between the clinically identified and average groups. Our goal was to develop a supplemental language instruction program, LIM, that would be appropriate and effective in improving both targeted syntax, general language production and comprehension abilities, and ultimately, reading comprehension, for students with a range of below-average abilities, who may or may not officially qualify for specific language impairment.

LIM has been developed for grades prekindergarten to third, in both 12- and 9-week versions. The intervention is organized into four units that are unique to each grade level.

Each unit has a specific syntactical target around which the entire series of lessons are focused. For instance, prekindergarten unit 3 addresses adverbs of form and manner (e.g., quickly and tightly). These syntactical targets are woven through the stories written specifically for the intervention that form the centerpiece of each unit. Targets are woven through all activities during the unit, which move from a focus on modeling and receptive responses to increasingly challenging expressive responses being asked of the students. Developmental distinction across grades is found in the level of expressive language expected from the students rather than in the broad activity structure itself (e.g., in all grade levels, every fourth day includes a board or card game presenting cumulative unit and grade-level review questions that vary by difficulty).

An important instructional design goal was to maximize both student engagement and opportunities to hear and produce the syntactical targets in authentic oral contexts. In other words, we prioritized giving the students and instructor a meaningful content focus in which the syntax instruction would be seamlessly embedded. To enhance the hands-on, participatory nature of the intervention, and to provide a rich context for vocabulary and conceptual development, we selected science concepts of motion (e.g., rolling, friction, sound waves, etc.) and integrated motion props and visuals into all grades' materials and activities. Thus, for example, the first grade students conduct activities each unit with a marble run prop, and the stories they hear and discuss relate to the adventures of Molly and her family and friends at an amusement park roller coaster, watching the circus' trapeze artists, on the ski slopes, and on a water slide. Specifically designed illustrations and carefully selected photographs support both the science and syntactical understanding, and provide an additional hands-on feature with which the students can interact (e.g., in third grade, the large picture scenes of a spooky mystery house provide visual context in which to demonstrate Newton's laws of motion with moveable furniture props, and in prekindergarten students move a ball above and below equipment on a playground scene).

Our highest instructional design priority was differentiation. Thus, included in the lessons for each day's activities were scaffolding options that allowed interventionists to provide extra support to those students having difficulty with a concept, and to challenge those demonstrating some mastery. For example, in the second grade unit addressing elaborated verb phrases (e.g., "I am gradually climbing the inclined plane"), more advanced students were asked to provide responses that required them to add multiple adverbs to their comments or to change the tense of a modeled elaborated phrase, whereas struggling students were asked to provide just the adverb–verb pair and then provided a modeled expansion (e.g., "yes, silently entered, the thief silently entered the pyramid").

Use of mental-state verbs (e.g., wonder and decide) is correlated with complex complement usage, one exemplar of elaborated sentence structure (Lee and Rescorla 2008). Therefore, we embedded instruction and modeling to support students' understanding of and use of these words within their own expressive sentence structure. For prekindergarten through first grade, we taught two words per unit, with child-friendly definitions, multiple examples of sentences including these terms within the core stories and expressive activities. For second and third grades, the lessons also included a more challenging focus on comparing and contrasting sets of these terms for the degree of "sureness" they convey (e.g., know is a stronger statement of confidence than think).

The initial design studies (Phillips 2014) for each grade involved an iterative cycle of implement, revise, re-implement in which 64 students per grade (screened-in based on standardized syntax assessments using a 50th percentile cut-point) were provided intervention in small groups. In subsets of 16, each student received two 3-week units, such that each unit was tested in both initial and revised forms with unique students. Pre- and postassessments utilized the two curriculum-based measures we developed. Overall, across all five grades, results yielded significant, and in some cases, large changes on both types of measures (e.g., effect sizes ranging from occasionally nonsignificant to over 2.00). On average, revised versions yielded larger effect sizes than did initial versions, as we modified the difficulty and intensity of lessons and added additional explicit scaffolding.

Building off these promising but preliminary results, we conducted separate randomized-efficacy trials with the full 12-week interventions in prekindergarten through first grade. Again, students qualified at or below the 50th percentile on the syntax assessments, and we screened over 100 students per grade to achieve 82 qualified students who were then equivalently randomized to business-as-usual or intervention conditions. Pre- and post-assessments now included both our two grade-specific proximal assessments and near-transfer standardized syntax measures (e.g., Sentence Structure from the CELF-4 or CELFP2), plus more distal listening comprehension, vocabulary, and for first grade, reading comprehension measures. Results indicated trends or (in two of three grades) significant findings on proximal syntax and listening comprehension measures in all grades, and favorable trends for standardized syntax or listening comprehension measures in two of three grades (Phillips et al. 2014). Overall, results suggest that students receiving LIM make gains in the specific syntactic skills targeted for instruction, and, particularly for the younger grade levels, on more distal language skills. Ongoing efforts to further focus and intensify the intervention are aimed at increasing the impact on generalized oral language skills.

Comprehension Monitoring and Providing Awareness of Story Structure

Although many prior studies focus on vocabulary as a means of improving oral language (e.g., Coyne et al. 2010; Silverman and Hines 2009), attention to other language and cognitive skills merits attention (see Fig. 1). COMPASS focuses on two more novel aspects, comprehension monitoring (metacognitive process) and narrative text structure (text-specific process). Comprehension monitoring is the ability to evaluate one's own comprehension of text (Baker 1984; Cain et al. 2004; Kim, under review; Kim and Phillips, under review; Kinnunen et al. 1998; Ruffman 1999). For instance, when children listen to the following short story, individual differences are found in their ability to detect that there is inconsistency in the story.

> *Johnny loves to play outside. It is nice and warm today. When Johnny asked his mother if he could go out and play, his mother said it is too cold to play outside.*

Studies have shown that many students, particularly struggling readers, fail to understand what they read and are not aware of their failure (Gersten et al. 2001). Thus, comprehension monitoring has been promoted to resolve confusion or failure to understand in the context of reading comprehension (e.g., Block and Pressley 2002; Garner and Anderson 1981/1982; Griffin et al. 1995; Pressley et al. 1989). Whereas less attention has been given to comprehension monitoring in pre-readers, evidence indicates that comprehension monitoring is also an oral language skill (Kim and Phillips, under review; Markman 1977, 1979), which makes a unique contribution to listening comprehension (Kim, under review; Kim and Phillips, under review). Therefore, we conjectured that there is no need to wait for comprehension monitoring instruction until children develop reading skills. Instead, training in oral language monitoring may improve students' listening comprehension, an important foundational skill for reading comprehension.

The second component in COMPASS is text structure knowledge for narratives, widely known as story grammar (Pressley et al. 1989). In narrative stories, important elements of a story (i.e., text structure) typically include main characters, the setting, an initiating event, a problem, attempts to solve the problem, and the resolution (Baker and Stein 1981; Fitzgerald 1989). Text structure knowledge appears to help spoken language and reading comprehension because it provides schemas to organize and understand new information (Stevens et al. 2010; Williams et al. 2009), process meaning construction (Anderson et al. 1977; Bransford and Johnson 1972), analyze stories (Trabasso 1981), and support inference generation (Tompkins and McGee 1989; Trabasso and Wiley 2005).

COMPASS has been developed for five grades from prekindergarten to third grade, in both 8- and 10-week versions. Each lesson has a scaffolded learning format of I do, we do, and you do (Pearson and Gallagher 1983). Overall, the lesson is sequenced such that each component's instruction increased progressively in difficulty over time. The lesson plan is highly scripted to support teacher fidelity to the intervention.

The comprehension monitoring part of the COMPASS lesson involved novel short stories and required the child to identify whether any parts of the story are silly or do not make sense. Students are also provided with sentences that are not silly or that do make sense.

Initially, all stories are supplemented with illustrations, but these are progressively removed in the second 4 weeks. At the end of each comprehension monitoring portion of the session, students are told that when they listen to a story, things have to make sense to them, and if they do not, they have to stop and ask questions.

Text structure lessons were developed around eight unique stories that we created for each grade. These stories were developed to provide a clear text structure in terms of characters, setting, leading events, problem, and resolution. The stories included characters to whom participating students could relate in terms of age, gender, and racial backgrounds. In addition, these stories were developed around specific themes per grade. For instance, the theme for prekindergarten was home and food, and for third grade, it was multiculturalism and community. Each story had illustrations showing the sequence of events. One story was used each week (days 1 to 4) with various activities around it including reading aloud, dialogic reading questions, and retell. Students were explicitly taught about text structure using visual aids as well as a song. Narrative retell was modeled by interventionists first, followed by opportunity for students to practice retell using story illustrations.

To examine the feasibility of the COMPASS intervention, a series of design studies were conducted with students in prekindergarten to third grade. There were a total of 8 weeks of intervention, and this 8-week intervention was divided into 2 units (4 weeks/unit), which underwent an iterative process of development and evaluation. That is, each 4-week unit was developed and evaluated and revised and reevaluated. Each design study group included approximately 16 children per grade with a total of 303 students from prekindergarten to third grade.

Students were assessed on experimental measures of comprehension monitoring and their narrative comprehension and retell. In the comprehension monitoring tasks, the student heard a story that was similar to the example above and was asked to identify whether the story made sense or not, adapted from Baker (1984). If the child said the story did not make sense, he was asked to explain why. Children heard narrative stories, and were asked to retell the story. Children's retell was transcribed and coded for inclusion of story structure elements (e.g., main characters, setting, events, problem, and resolution). Results showed that after 4 weeks of instruction, students in COMPASS made gains in inconsistency detection (d=0.31–1.69) and in text structure knowledge (d=0.20 to 1.60).

In the subsequent efficacy study, 232 children in prekindergarten through first-grade students from eight schools participated in an 8-week trial with students randomly assigned within classrooms to treatment or business-as-usual control. The proximal comprehension monitoring, and text structure knowledge assessments, and the Test of Narrative Language (Gillam and Pearson 2004) were administered at pre- and posttest on the same was assessed using experimental stories and the Test of Narrative Language (Gillam and Pearson 2004).

In this more rigorous test of the intervention, students exposed to the COMPASS intervention achieved significantly greater scores in comprehension monitoring (d=0.24–0.60 across grade levels) compared with students in the control group. The intervention had no significant effect on text structure knowledge. There are a number of potential reasons for

the latter finding. First, the intervention might not have been intensive enough to make a difference on the text structure knowledge and listening comprehension. Alternatively, oral retell might not be the best way to assess children's text structure knowledge. For older children who are readers, a task such as a story anagram (the child reads sentences and rearranges them) has been used (e.g., Cain et al. 2004). Nevertheless, the positive effect on comprehension monitoring in the study indicates that children can be taught to identify inconsistency in short stories with only about 5 min of explicit instruction in this skill per day for 8 weeks.

Teaching Expository Text Structures

Teaching Expository Text Structures (TEXTS) was developed to improve understanding and use of expository text structure (see Fig. 1, text-specific processes) to aid comprehension for children in kindergarten, first, and second grade who had below-average listening or reading comprehension. As noted previously, prior research has shown that understanding the features of narrative text structure helps children form a better understanding of the whole story (e.g., Englert et al. 1988; Rapp et al. 2007). However, expository text is not always organized in an explicit or obvious manner (Mesmer et al. 2012). Meyer and Poon (2004) described the following major types of text structures: (1) Sequencing, which emphasizes a numerical or chronological order to describe items or events; (2) cause/effect, which delineates one or more causes and then describes the ensuing effects; (3) compare/contrast, which compares and contrasts two or more similar events, topics, or objects; and problem/solution, which poses a problem or question and then gives the answer.

Cain and Nash (2011) demonstrated that 8-year olds had a less developed understanding of the sequencing text structure than did ten year olds, who in turn, had less understanding than adults. Their findings supported our selection of kindergarten through second grade as a potential developmental window for when the knowledge and comprehension of connectives might be malleable and therefore important to teach directly. Previously, the youngest students participating in empirical studies of expository text structure were second graders, and they were trained only in cause and effect (Hall et al. 2005; Reutzel et al. 2005; Williams et al. 2005, 2009). Notably, Williams et al. found that text structure training for second graders was more powerful when it involved completion of graphic organizers and brief paragraphs. However, we found no empirical studies with kindergarten or 1st grade and no studies that focused on sequence or cause/effect.

Following the Simple View of Reading, the theory of change, which guided the design of TEXTS, was that the more a beginning reader was aware of how expository text was organized or connected through causal connective words, the easier it would be for him or her to understand the causal, temporal, or comparative links across and within sentences or information. TEXTS specifically targets early readers who had not implicitly grasped the story structure inherent in many narrative or expository texts to which they had been exposed orally or in writing. Given research showing that students benefit from direct and explicit instruction, we planned instructional routines that incorporated modeling, guided, and individual practice.

For example, with regard to sequencing text structure, we hypothesized that beginning readers might understand the temporal nature of a sequence of events better when (1) they could read or be read to using text that explicitly used temporal language, (2) they were directly taught relevant connectives (e.g., first, next, and last), and (3) when they were directly taught to use a graphic organizer as a scaffold for retelling the text. We used the more child-friendly term of “clue words” to characterize the relevant connectives and developed graphic organizers for each text structure type. Brief initial trials of books and materials, assessments, and scripted lessons provided an opportunity to test feasibility, grouping structures, and amounts of scripting.

The first design study was a pilot test of three 4-week text structure intervention components (sequencing, compare and contrast, and cause and effect). Students qualified for the intervention if they scored at or below grade level for reading comprehension and if they missed half of the items on an expository text structure screener (roughly half of kindergarten children and about a third of second graders qualified). Students were randomly assigned within classrooms to one of the three text structure interventions with each highlighting a particular text structure (e.g., cause/effect, compare/contrast, and sequencing). The instructional framework of the intervention provided students with explicit teaching, guided practice, followed by independent practice. During explicit teaching, students and interventionists read expository text together that exemplified the clue words associated with the structure, introduced and taught the clue words (e.g., first, next, and last; same and different; and because) associated with that structure, and demonstrated the expository concepts through the use of graphic organizers. Guided practice allowed students the opportunity do the same activities that were modeled during explicit teaching and to practice oral retelling of the clue word story. During independent practice, kindergarten students used pictures to complete the graphic organizers independently while first- and second-grade students created their own graphic organizers.

Results of the design studies revealed that TEXTs was feasible with children as young as kindergarten through second grade (Al Otaiba et al., in preparation). Two proximal assessment measures involved students reading a story (or listening to a story for kindergarten) containing clue words and were asked to identify the clue word; they earned one point for each possible word. Then, the book was closed and students were asked to tell the clue words they heard in the story and could earn one point for each correct word. Students performed significantly better at identifying and retelling clue words in the text structure they were taught than on a counterfactual untaught text structure (problem and solution). Effect sizes ranged from 1.70 to 3.94 for identification and from 3.24 to 9.87 for retell. Furthermore, students demonstrated significant growth on a standardized measure of oral language. Most students, with the exception of second graders in the sequencing, and compare and contrast condition also demonstrated significant growth in listening comprehension after the 4-week intervention. Overall, these results suggest that we can teach expository text structure to children as young as kindergarten and that this may have direct and indirect effects on students’ oral language and reading comprehension.

Enacted Reading Comprehension

Embodied approaches to reading comprehension are based on the idea that meaning is grounded (at least in part) in internal sensorimotor simulations of the content described in the linguistic input—cognitive and linguistic processes (see Fig. 1). The interpretation of a sentence such as, “John gave you a pen,” would therefore involve the use of the systems involved in motor planning to simulate the action that is being described (e.g., Glenberg and Kaschak 2002), and the interpretation of a sentence such as, “The car approached you,” would involve the use of the perceptual system to simulate the appearance of an approaching vehicle (e.g., Kaschak et al. 2005). The claim that systems of perception, action planning, and emotional responding play a role in language comprehension is supported by numerous studies involving behavioral (e.g., Glenberg and Kaschak 2002; Meteyard et al. 2007; Havas et al. 2007) and neuroimaging (e.g., Hauk et al. 2004) methods (see Fischer and Zwaan 2008, for a review).

The simulation view of comprehension most naturally explains the understanding of concrete situations (such as performing an action), but there is evidence that the same kind of process plays a role in understanding abstractions. Lakoff and Johnson’s (1980) seminal work advanced the claim that abstractions such as time and power are grounded in concrete experience (e.g., the passage of time is understood as motion through space; see Casasanto and Boroditsky 2008). Lakoff and Johnson’s (1980) analysis has been confirmed in experimental work showing that the understanding of power (e.g., Schubert 2004), time, and quantity (Sell and Kaschak 2011, 2012) is grounded in motor system activity. Thus, it appears that perceptual and motor simulations serve to ground the understanding of abstract concepts and situations.

Glenberg et al. (2004) developed an intervention for beginning readers based on the embodied approach to comprehension. The inspiration for the intervention was the idea that some beginning readers may be expending so much effort on recovering words from the printed page that they are not creating internal simulations of the content of the text that they are reading. These readers may be decoding the text adequately but the lack of simulation impairs their ability to comprehend the situation that is being described. To remedy this problem, Glenberg et al. (2004) asked kindergarten and 1st grade students to act out the situations described in the text using a set of toys. For example, students reading a text about a farm would be provided with a toy farm (including a barn, animals, tractor, and so on) that could be used to enact the plot of the story. In this and subsequent studies, Glenberg et al. (2004) found that the enactment helped students focus on the simulation aspects of the comprehension process. Enactment thus resulted in better comprehension of the text, better memory for the text, and increased ability to draw inferences from the text.

The ERC intervention described here is an extension of Glenberg et al.’s (2004) approach. We had two broad goals in designing this intervention. First, whereas Glenberg and colleagues have largely focused on the comprehension of language about concrete situations (such as events occurring on a farm) in short narrative texts, we sought to develop an intervention that both targeted the understanding of abstract situations (such as the opposing forces in a debate) and could be used with a broader range of texts, including novels.

ERC is an intervention targeted at third- and fourth-grade students. The central idea of the intervention was to use bodily movement as a vehicle to aid students in construction simulations of the content of the texts they were reading. Unlike Glenberg's work, however, we did not ask students to manipulate real objects. Rather, students simply used the motion of their hands and arms in the space around their body to simulate text content. Using the hands and arms in this manner to represent linguistic and conceptual content is a widespread human behavior (e.g., Hostetter and Alibali 2008), and, thus, our intervention trades on a behavior that should already be familiar to students. The students were trained to use particular actions to represent important elements of the abstract content of the texts. ERC had three phases. The first phase of the intervention involved the comprehension of two science texts—Seymour Simon's Earthquakes, and either Hurricanes (for students in grade 3) or Tornadoes (for students in grade 4). In this phase of the study, students were taught to use their hands and arms to simulate the action of opposing forces. All students began by reading about earthquakes. Hand and arm actions were used to simulate the motion of tectonic plates, and to illustrate how pressure and force build and release to cause earthquakes (e.g., pressing the hands together and moving them against each other). The dynamics of an earthquake were used to introduce students to the basic idea of the intervention with a fairly concrete situation. Students then transitioned to reading about hurricanes or tornadoes. The same hand and arm movements were used to illustrate a more abstract idea—the way that air masses push against each other, and the way that changes in atmospheric pressure contribute to the development of storms.

The second phase of ERC involved the comprehension of persuasive texts. In this phase of the intervention, we asked students to apply what they had learned about using their hands and arms to represent opposing forces (tectonic plates or air masses) to representation of the opposing forces in a debate. The students were then taught to use this idea to understand the dynamics of a persuasive text. We were specifically interested in the idea that authors present arguments for and against their position within each text, and that specific arguments and counterarguments push against each other with one set of arguments winning out over the other. The students were asked to use hand and arm gestures to keep track of the arguments that were presented in the text, and to track which side was the winning argument.

The third phase of ERC involved students reading the novel A Single Shard (Park 2001). We chose this novel because there are many episodes in the plot that involve intra- and interpersonal conflict (e.g., a character is conflicted over whether to share a secret that he has learned about). Students were trained to recognize these episodes, and use the hand and arm motions that were discussed in the previous phase of the intervention to represent the internal and external conflicts of the characters. In sum, we took a natural component of communicative behavior (using the hands and arms to gesture in a way that captures meaning) and taught students to use the behavior to represent key aspects of science texts, persuasive texts, and a novel.

We conducted a series of design studies to develop ERC with 65 third- and fourth-grade students. As the intervention is targeted at students who have acquired decoding skills but lack comprehension skills such as simulation construction, we included only students who

could read on a second grade level. Each intervention phase was preceded by a pretest of the relevant content knowledge (e.g., a pretest on knowledge of earthquakes) and followed by a posttest on specific text content. Students showed significant gains in the posttest in all three phases of the intervention. The results of design studies suggest that ERC is a promising intervention for use with third- and fourth-grade students and a feasible intervention to use with a wide range of text types. An efficacy study has been conducted, but results are not yet available.

Content Area Literacy Instruction

Developed for kindergarten through fourth grade, the purpose of the CALI intervention is to build content area knowledge, support higher-order thinking (making connections, drawing conclusions, and making inferences), automatic use of comprehension strategies to understand information in text, expository writing skills and knowledge acquisition in social studies and science—in essence tapping all three processes (text-specific, cognitive, and linguistic) presented in our model (see Fig. 1). As proficient reading for understanding arguably relies on a solid grasp of academic content knowledge (Cromley and Azevedo 2007; Willson and Rupley 1997) and the semantic knowledge that is an integral part of building content knowledge (Snow 2010), we tested the hypothesis that the teaching of oral and text comprehension skills and strategies in the context of learning academic content knowledge would be effective but might be moderated by students' background knowledge and reading skill (Connor et al. 2010, 2012).

We developed the most recent version of CALI after four iterative design studies. Each CALI topic is divided into two 3-week-related units. Additionally, all instruction is provided in homogenous small flexible learning groups based on students' comprehension skills. Daily lessons are conducted 4 days/week for 20–30 min, depending on the pace at which students in the groups completed the lessons. Each unit has two driving questions that students would be able to understand by the end of the unit (e.g., How do people adapt to their surroundings? Why are soil, water, and rocks important? How do organisms help each other survive?) Discussion is a key part of each lesson and teachers use strategies that encourage students to talk about what they are reading including brainstorming, think-pair-share, asking how and why questions, among other strategies (Connor et al. 2010).

Lessons are organized using a framework of four phases for each 3-week unit—connect, clarify, research, and apply—based on the well documented 5-E learning framework (Bybee and Kennedy 2005). In each unit, the first lesson is always a connect lesson in which the purpose was to connect difficult concepts (e.g., the economy) to things or events that students actually experienced. For example, in studying the economy with fourth graders, in the connect activity they were shown engaging photos of Disney World and various Florida beaches while the interventionist discussed with them how Disney World and beaches help Florida's economy.

The Clarify lessons (at least two per unit and frequently more) used leveled text to teach student show to read and understand informational text with a focus on learning the information in the text and making inferences using information from previous texts or

experiences (e.g., connect activity), as well as students' background knowledge. In order to address individual students' different learning needs, we discovered during the design studies, which leveled books were required to fully mitigate child characteristic X instruction interaction effects on learning. Therefore, we wrote books that differed in difficulty but not in content so that expectations for learning content were the same in the books but text complexity was controlled using Lexiles and Co-metrix (e.g., Graesser et al. 2014). Books were written at three levels: for grade-typical readers, above grade level and below grade level. Results of the design studies indicated that three levels of text difficulty were sufficient and that further differentiation of instruction was feasible through teachers' differentiated levels of scaffolding and support. We also highlighted various text structures in these books. Students kept the books in their Researchers' Notebook.

The Research lessons allowed students to experience what they learned from text. In Science lessons, these were hands-on experimental activities. In social studies, they involved interactions with original source materials (e.g., photographs and letters). Written results from the research activities were kept in the researchers' notebook, and students were encouraged to use the books from the clarify lessons to guide the experiments and interactions with original source materials. The idea was to support students' systematic use of previously presented materials to improve their understanding of new materials in the service of gaining and consolidating new knowledge.

Finally, at the end of each unit were the apply lessons. The purpose of these lessons was to help students synthesize and analyze the information and strategies they had learned during the connect, clarify, and research lessons. For example, in the unit on the economy, students designed a lemonade or juice stand. To do this, they relied on all of the materials used and knowledge gained during the previous lessons, made inferences to the new situation or problem, and worked collaboratively as a small group to complete the project.

The CALI efficacy study (Connor et al., in preparation) included 430 kindergarten through fourth-grade students with approximately 80 per grade who were randomly assigned within classrooms to treatment (received CALI throughout the school year) or control (business as usual) conditions. CALI was provided in small homogeneous learning groups with leveled materials based on students assessed reading skills. Results revealed a significant effect of treatment on students' content knowledge gains, including their responses to open-ended questions, with treatment effects (d) increasing in magnitude and ranging from 1.2 in kindergarten to 3.0 in third grade. Structural equation models revealed a positive direct effect of the treatment on content knowledge (both social studies and science), which directly predicted scores on a composite reading comprehension measure but not on a composite measure of word knowledge (Connor 2013).

CALI did not affect students' oral language skills as anticipated. The language measures used may not have been sensitive to the changes in academic knowledge taught. However, it is also possible that intervening to build students' academic knowledge may have little or no effect on aspects of the language system, such as lexical knowledge and semantics, which are considered more unconscious and automatic processes and so likely to be less malleable. There are a number of studies that suggest that vocabulary interventions may support

reading comprehension without actually improving general vocabulary (Elleman et al. 2009).

The results of CALI did reveal that increasing academic knowledge is malleable and that it can be taught in ways that support students' learning from text regardless of their incoming knowledge and reading skills. Students were able to improve their ability to write in response to higher-level open-ended questions and employ graphic organizers, text structure, and other strategies to facilitate their learning from informational text, which are key skills for the common core state standards. We hypothesized that reflective and thus arguably more malleable systems, such as knowledge acquisition, would be good targets for intervention and this seemed to be the case. As CALI was specifically differentiated to support learning for students with weaker reading skills, including students with reading difficulties, this intervention appeared to have supported the development of academic language and, perhaps, compensatory mechanisms for these students.

Discussion

There is robust evidence supporting the need for strong and broad language skills, as well as the importance of understanding text structure, academic knowledge, and comprehension monitoring in achieving proficient oral and reading comprehension. As such, the primary goal of CTT is to enhance students' linguistic and cognitive abilities, build their academic knowledge, and improve their grasp of text-specific processes. Our vision for these interventions is to provide teachers of students at risk for reading comprehension difficulties with a menu of targeted interventions, and, ultimately, with guidance regarding how to best match them to student profiles in language and comprehension skills.

Findings for proximal measures were generally stronger for each intervention in at least one or two grade levels than more distal measures, and there appear to be both direct and indirect effects on reading comprehension. For example, in the DAWS intervention, dialect shifting predicted greater reading comprehension but it also predicted stronger morphological awareness, which in turn predicted reading comprehension. These findings provide some preliminary evidence supporting our conceptualization of bootstrapping and reciprocal effects in the lattice model (see Fig. 1). This model predicts synergistic effects when the component interventions are combined. It also predicts that improving reading for understanding should, in turn, support developing linguistic, cognitive, and text-specific processes, but these predictions remain to be tested. Other research and some preliminary findings also suggest that the component interventions are more effective for students with specific constellations of skills (i.e., child characteristic × instruction interaction effects).

The collection of design and efficacy studies demonstrates the substantial challenge of remediating longstanding language and comprehension weaknesses with intense but quite brief interventions. The conceptualization of student learning needs as ongoing and requiring sustained instructional efforts (e.g., akin to managing a chronic condition rather than inoculating against a disease (Connor et al. 2013; Konstantopoulos and Chung 2011), appears most appropriate for the students typically included in our studies.

Next Steps

As described for each intervention, we intentionally designed each intervention to be modularly focused on just one or a few of the range of cognitive, linguistic, and text-specific skills posited to be associated with competence in oral and reading comprehension. However, it remains unclear whether targeting instruction to just one or two of these components will improve all elements required for proficient reading for understanding; furthermore, we do not yet know which of these points of leverage will bring about the most improvement. An ongoing set of studies we call “Comparative Efficacy” are intended to investigate just these questions; specifically, which of the modular interventions provides greater benefit to students with below-average language or comprehension skills? We anticipate a complex set of outcomes in which the answers differ by grade level and by individual differences in students’ initial profile of language and reading skills. As noted above, we anticipate potential additive or even synergistic benefits of providing combinations of these interventions to students, particularly in the earliest grade levels; to this end a current study explores the impact of combining two of either COMPASS, LIM, and a version of dialogic reading on oral language comprehension in prekindergarten and kindergarten.

Results of the design and efficacy studies completed to date indicate that we do appear to be successfully improving the proximal skill set targeted by each intervention. We remain committed, however, to the more challenging and potentially more meaningful goal of demonstrating clear progress in students’ more distal oral and reading comprehension abilities, likely through combinations of the component interventions and better understanding of how to match students with interventions that will be most effective for them. With this goal, we will be able to provide to teachers a set of ready-to-use modular interventions, aligned with the common core state standards, which can be utilized flexibly with students at high risk for weak comprehension skills.

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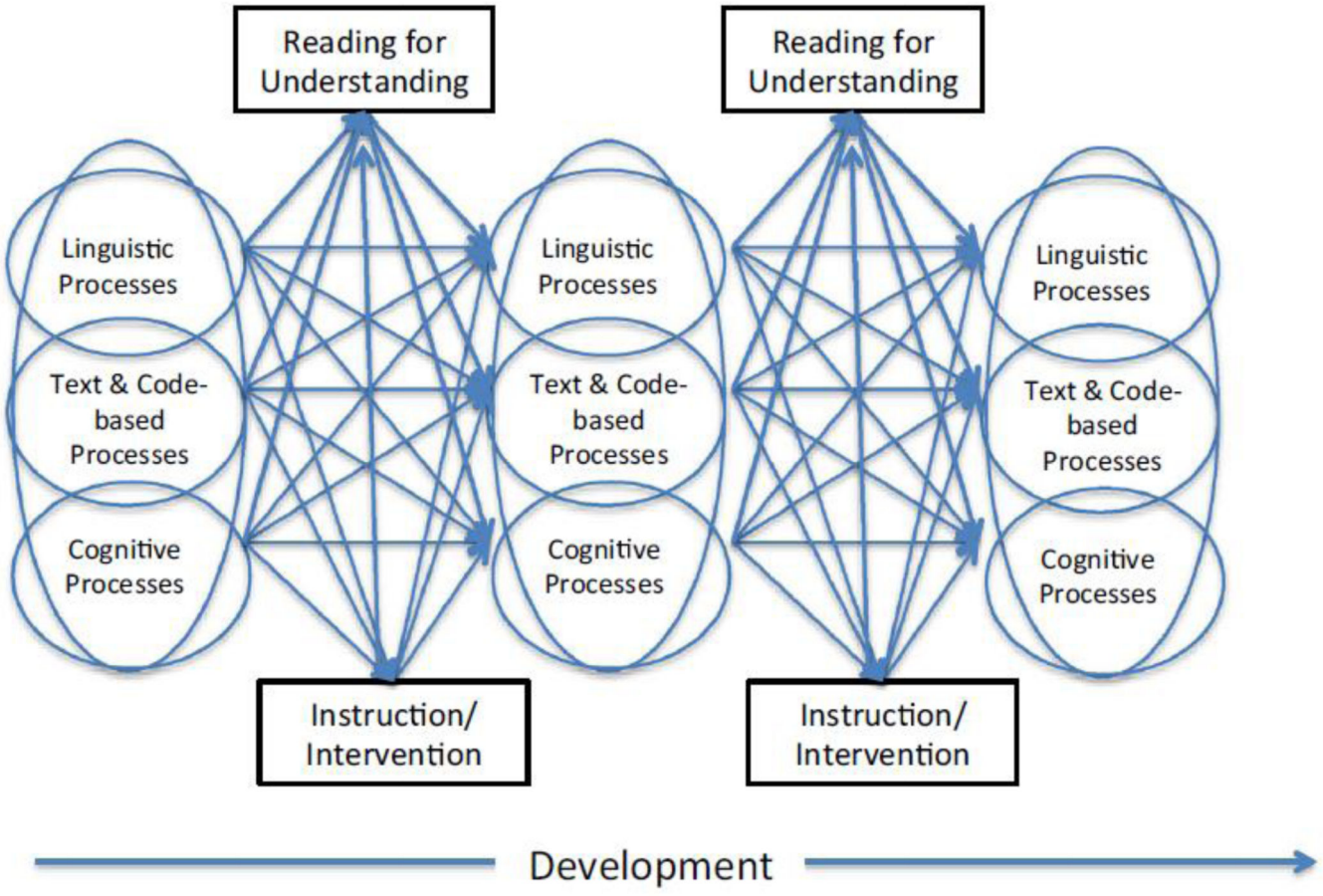

Fig. 1.

Our conceptualization of the bootstrapping and reciprocal effects of interacting linguistic, text and code-based, and cognitive processes, as well as instruction/intervention effects that influence proficient reading for understanding