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The Science of Reading Comprehension Instruction

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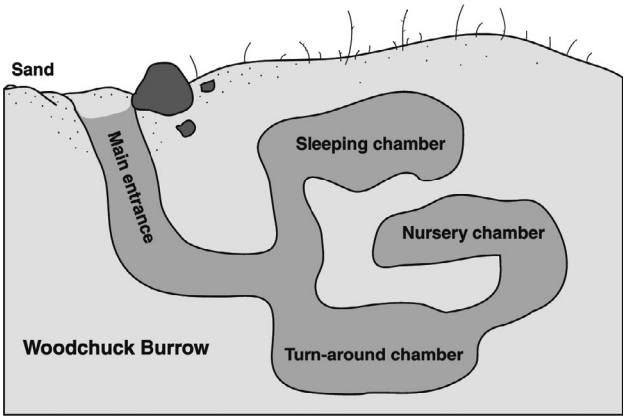
What have decades of research told us about the nature of comprehension and how to develop students' comprehension in schools?

Consider the beginning of an article by Elizabeth C. McCarron (2000/2005) from California's third-grade English Language Arts Standards Test, originally published in *Highlights for Children* magazine:

Not Just a Hole in the Ground
by Elizabeth C. McCarron



The woodchuck sits up on its hind legs, chewing a strawberry. Looking around, the chuck freezes when it spies the farmer's dog. The dog sniffs the air, spots the chuck, and charges toward it. The woodchuck watches the enemy coming closer and closer, then POOF! The chuck disappears from sight, and the dog is left puzzled. The woodchuck has dropped into its burrow to escape.

A woodchuck burrow is more than just a hole in the ground. It is a complex system of entrances, tunnels, and rooms called chambers. Burrows give woodchucks a place to sleep, raise young, and escape enemies. When a woodchuck hibernates (sleeps through the winter), it makes a simple burrow and plugs the entrance with sand.

A woodchuck uses its strong claws to dig its own burrow. In soft soil, a woodchuck can dig an entire burrow in one day.

Each summer burrow usually has several entrances. This lets the woodchuck roam and still have a safe hole nearby in case danger comes along. (p. 16)

(The text continues for five more paragraphs.)

How does a student learn to comprehend an article such as this? Researchers from many disciplines, such as developmental psychology, cognitive science, education, and linguistics, have been working on that question for decades (e.g., Pearson & Cervetti, 2017). Research has revealed a great deal about what goes on in the mind when readers comprehend oral and written text and how instruction and other experiences can affect that development. In this piece, we share some key findings from research on reading comprehension and instructional practices that positively impact its development.

A mind-set to bring to this piece is that fostering reading comprehension development across a wide range of readers requires a multifaceted

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approach. Scientific research has revealed many individual instructional practices and combinations of practices that foster reading comprehension development. Some conversations about reading comprehension engage an either/or approach, such as these two statements, respectively: (1) Don't teach strategies; build knowledge. (2) Don't focus on comprehension; focus on word reading. This tendency does not reflect research findings and does not maximize the likelihood that we will meet the needs of all developing readers.

A metaphor from public health may be helpful. Good health requires good nutrition, ample physical activity, adequate sleep, low levels of stress, and so forth. Advocates of one aspect of public health, such as greater physical activity, do not argue that it should come at the cost of another, such as adequate sleep. One might argue that more time on physical activity must lead to less time for sleep, but in reality, there are synergies in which, for example, adequate physical activity leads to higher quality sleep. As a field, we can advocate for particular research-supported instructional practices without denigrating other research-supported instructional practices. Also, we can be looking for synergies. Later in this piece, we present a model of reading comprehension instruction that capitalizes on potential synergies in instructional practices.

Teaching Foundational Word-Reading and Bridging Skills Supports Reading Comprehension Development

Reading comprehension relies on the ability to read most or all of the words in a text. Word reading is a necessary, although not sufficient, condition for reading comprehension.

Foundational Word-Reading Skills

Developing foundational word-reading skills—phonological awareness, print awareness, phonics, and word recognition instruction—is critical to developing reading comprehension. For example, with respect to "Not Just a Hole in the Ground," students who have experienced high-quality phonics instruction regarding the sound that *aw* typically represents and high-quality phonemic awareness instruction that enables them to blend that sound with others in the word will have an easier time in decoding *strawberry* and *claws*. Both words contribute to understanding the article.

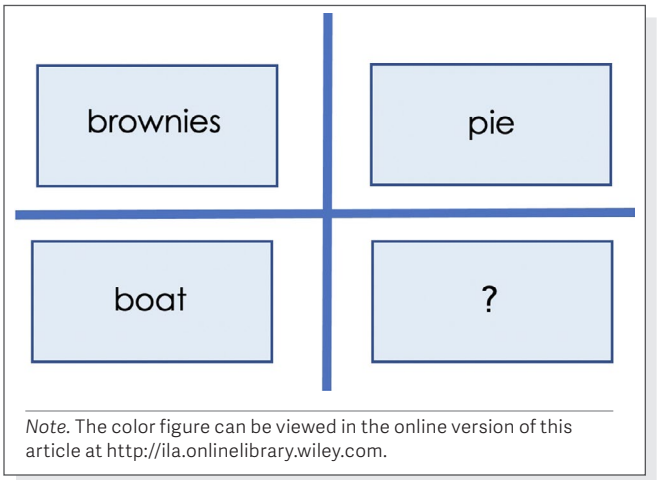
Students who have previously experienced repeated connecting of graphemes, phonemes, and meanings of words in "Not Just a Hole in the Ground" (i.e., orthographic mapping; Ehri, 2014), including orthographically complex words such as *usually* and *through*, will be able to devote less attention to word reading and more to comprehension. As one might expect given these examples, instruction aimed at improving students' word reading, including through phonemic awareness and phonics instruction, often has a positive impact on reading comprehension (e.g., Suggate, 2016).

Bridging Skills

Graphophonological Semantic Cognitive Flexibility. Also important to reading comprehension are knowledge and skills that bridge word reading and comprehension. One such skill is graphophonological semantic cognitive flexibility (GSF), a form of executive function (and a fancy label for a down-to-earth skill). GSF is the ability to simultaneously attend to, and flexibly switch between, the letters and sounds in words (graphophonological) and the meanings of words (semantic). Research has found a relation between readers' GSF and their reading comprehension, so researchers have examined whether there are ways to bolster students' GSF.

Figure 1 is a matrix that crosses letter–sound relations and word meanings. Readers need to consider both to complete the matrix with a word that begins with /p/ and is a mode of transportation

Figure 1
A Matrix to Promote Graphophonological Semantic Cognitive Flexibility



Note. The color figure can be viewed in the online version of this article at http://ila.onlinelibrary.wiley.com.

(e.g., *plane*). Cartwright et al. (2020) found that interventions including completing matrices such as this raise reading comprehension in comparison with a control group that did not receive the matrix instruction. In "Not Just a Hole in the Ground," GSF enables readers to switch their attention flexibly between the complex word-decoding and meaning construction processes needed to understand the text.

Morphological Awareness. Morphological awareness, or attention to the smallest meaningful parts of words (e.g., roots, affixes, words in compound words), also bridges decoding and comprehension. In "Not Just a Hole in the Ground," morphological knowledge would help students recognize and interpret inflectional affixes, as in the many *-ed* and *-ing* words and also derivational affixes, as in *dis-* in *disappears* and *-er* in *farmer* (meaning *one who*). Morphological awareness likely would also help students with this passage from the article, in which *woodchuck* is shortened to *chuck*: "The woodchuck watches the enemy coming closer and closer, then POOF! The chuck…" (McCarron, 2000/2005, p. 16).

Instruction in morphological awareness affects many contributors to reading comprehension, and more intensive morphological awareness instruction positively affects reading comprehension directly (e.g., Goodwin & Ahn, 2013). Morphological awareness instruction is appropriate for younger and older children. In fact, one study of morphological awareness instruction in preschool showed positive impacts on reading comprehension in grade 6 (Lyster, Lervåg, & Hulme, 2016).

Reading Fluency. Reading fluency—reading with accuracy, automaticity, and prosody—also serves as a bridge between decoding and reading comprehension. Reading words accurately supports comprehension because it helps readers build an accurate base understanding of the text. Reading words with automaticity allows readers to devote more cognitive attention to comprehension. Reading with prosody (e.g., appropriate expression, phrasing) both reflects and supports comprehension. In "Not Just a Hole in the Ground," whether readers pause between "air" and "spots," for example, is important to meaning making, lest they wonder what "air spots" are.

Instructional practices, such as Readers Theatre and choral, echo, and paired reading, that are aimed at improving prosody and other aspects of reading fluency have been shown to positively impact reading comprehension in a number of studies (e.g., Kuhn, 2020; Turner, 2010).

Reading Comprehension Is Not Automatic Even When Fluency Is Strong

As important as foundational word-reading and bridging skills are to reading comprehension, research has shown that they are not sufficient for strong comprehension. For example, just because a reader can fluently read the words in "Not Just a Hole in the Ground" does not mean that the reader will glean from the article the characteristics of summer and winter woodchuck burrows. That understanding requires a broader range of knowledge, strategies, and dispositions.

A key piece of evidence that foundational word-reading and bridging skills alone are not sufficient for reading comprehension is the existence of students who have poor reading comprehension despite strong decoding and reading fluency. Researchers have observed and investigated such cases for decades (e.g., Oakhill, 2020), and research has suggested that they are a substantial portion of students who are not proficient on state reading tests (e.g., Koon, Foorman, & Galloway, 2020). Comprehension-focused interventions can foster reading comprehension in students who have specific difficulty with reading comprehension (Lee & Tsai, 2017).

Comprehension Instruction Should Begin Early

Given the absolute necessity of foundational word-reading skills, it is tempting to think that instruction should begin with a focus on developing those and later turn to comprehension. However, research has supported a simultaneous, rather than sequential, model of reading instruction. Along with the development of phonological awareness, print concepts, and alphabet knowledge, young learners in preschool and early elementary school benefit from efforts to develop oral language comprehension, including efforts to develop oral comprehension of written language (i.e., through read-alouds; e.g., Cervetti, 2020; Swanson et al., 2011).

As young learners begin to read texts themselves, comprehension instruction, alongside phonics and

other foundational skills instruction, has an important place. For example, comprehension monitoring provides a form of feedback to readers as to whether they have read a word accurately. While reading the sentence "I can get a dog," a young reader might understandably pronounce *get* as *jet* (i.e., pronouncing *g* as in *gem* rather than *g* as in *got*). It is comprehension monitoring that would alert readers that *jet* is not correct, so they may reread, try a different sound for *g*, and thus be left with a correct orthographic mapping for the word. Some students monitor comprehension as they read without instructional support, but others do not (Kinnunen, Vauras, & Niemi, 1998), and researchers have long concluded that teaching comprehension monitoring is effective (National Institute of Child Health and Human Development, 2000). The relation between word-reading instruction and reading comprehension instruction is more synergistic than competitive.

Teaching Text Structures and Features Fosters Reading Comprehension Development

One reason why strong decoding and listening comprehension alone are not sufficient for good reading comprehension is that there are many features of written text not found in a purely oral language environment. Punctuation marks are one such feature. Another is the graphical elements of text. "Not Just a Hole in the Ground" includes a cross-section diagram that requires its own comprehension skills, as does comprehending the diagram in relation to the written words.

Discerning the structure of the text also aids comprehension. Of course, oral texts have structures, but with written language, the reader may preview the text in advance of reading it to begin to ascertain the structure. Attention to the structure of the text during reading may provide a helpful scaffold for the syntactic complexity and conceptual density that are characteristic of many written texts. For example, in "Not Just a Hole in the Ground," recognizing when the author is moving into comparing/contrasting a summer burrow and a winter burrow can support processing the information-dense descriptions.

A huge amount of research has examined the impact of text structure instruction. We have long known that students benefit from instruction in common structures and elements of narrative or story text (e.g., identifying characters, setting, goal, problem, events, resolution, and theme; e.g., Fitzgerald & Spiegel, 1983). With respect to informational text, meta-analyses (quantitative studies of many studies) have also documented positive impacts (Hebert, Bohaty, & Nelson, 2016; Pyle et al., 2017).

Comprehension Processes Vary by What and Why One Is Reading

Reading comprehension is very much affected by what one is reading and the purpose for which one is reading it. In a review, Duke and Roberts (2010) identified at least 18 differences between narrative and informational reading processes. Recent neuroimaging research also has found differences in brain activity depending on text genre (Jacoby & Fedorenko, 2020). Notice that "Not Just a Hole in the Ground" is complex because it begins with a narrative and moves to an informative/explanatory approach.

One's purpose for reading also affects comprehension, with both printed and online texts (e.g., Narvaez, van den Broek, & Ruiz, 1999; Zhang & Duke, 2008). Purpose is shaped by many facets of the context in which one is reading. Is it a school assignment or a book voluntarily read for pleasure? Is it a piece of literature or a description of a scientific process? What one does with the fruits of comprehension also matters. Duke (2020) coined the term *compreaction*, from the words *comprehension* and *action*, to refer to doing something with meaning that has been constructed, such as to learn something that one has become interested in, to be entertained by the antics of a funny character, to follow the steps to make something, to critique an argument, or to understand an issue in one's community. Some research on effective approaches to developing reading comprehension discussed later in this piece has situated instruction in contexts in which students are expected to do something with their understanding of texts.

Vocabulary and Knowledge Building Support Reading Comprehension Development

"Not Just a Hole in the Ground" contains many words that are likely to be in some third graders' working vocabulary and not others', such as *complex*, *entrance*,

hind, *roam*, and *system*. As one might guess, research has found that teaching students the meanings of words in text supports their comprehension of that text, although there is little evidence that doing so improves comprehension overall (Wright & Cervetti, 2017). Being able to figure out the likely meanings of words one encounters in text and attend to vocabulary-building opportunities the author offers (e.g., "hibernates (sleeps through the winter)" in "Not Just a Hole in the Ground") is also supportive of comprehension.

The likelihood that a student knows the words in the article about woodchucks is likely affected by how much the student knows about other wild animals. For example, a student who has learned a lot about wild animals is more likely to know the words *enemies*, *burrows*, and *hibernates*. For that and other reasons, a student who knows more about wild animals is likely to be able to comprehend the article better. For many decades, research has established that one's knowledge, including one's academic content knowledge and the cultural knowledge developed through day-to-day activities in one's family and community, affects one's reading comprehension (e.g., Hwang & Duke, 2020; Pritchard, 1990).

Surprisingly little research has focused on the impact of content instruction on reading comprehension. However, research to date has suggested positive effects of content knowledge building on comprehension development (e.g., Cabell & Hwang, 2020; Cervetti, Wright, & Hwang, 2016; Connor et al., 2017, although this study incorporated some strategy instruction as well). Further, as explained in the next section, many effective approaches to comprehension strategy instruction are set in the context of content knowledge building, suggesting the efficacy, and perhaps synergy, of simultaneously building content knowledge and improving students' metacognition.

Comprehension Strategy Instruction Improves Reading Comprehension

Research has long shown that proficient comprehenders engage in particular mental activities to support their understanding of what they are reading (e.g., Pressley & Afflerbach, 1995). Some young students learn to use these processes seemingly naturally, but many benefit from explicit instruction in how to think before, during, and after reading; how to monitor their understanding; and how to help themselves when meaning breaks down (e.g., Shanahan et al., 2010).

Sometimes comprehension strategy instruction is relatively narrowly focused and short term. For example, a number of studies have focused on the impact of teaching only self-questioning (e.g., stopping to ask oneself why woodchucks' summer and winter burrows differ). A meta-analysis of these studies found that instruction occurred over a mean of 8.4 sessions over a mean of 1.6 months. Still, the instruction was "effective for improving reading comprehension performance across a range of diverse learners and across various educational settings" (Joseph, Alber-Morgan, Cullen, & Rouse, 2016, p. 152; for similar findings in inference instruction, see Elleman, 2017).

Other approaches to comprehension strategy instruction are tested over a longer period of time (e.g., a school year) and involve teaching many strategies to be used in concert. For example, when reading "Not Just a Hole in the Ground," students might apply a strategy cluster that involves previewing the text, monitoring comprehension, ascertaining the gist of what they are reading, summarizing what they have learned, and posing questions for future reading. Examples of such multiple-comprehension-strategy instructional approaches are reciprocal teaching (e.g., Palincsar & Brown, 1984), collaborative strategic reading (e.g., Klingner & Vaughn, 1999), transactional strategies instruction (e.g., Pressley et al., 1992), and Concept-Oriented Reading Instruction (Guthrie, McRae, & Klauda, 2007).

A relatively recent meta-analysis included multiple-strategy instructional approaches in examining the effectiveness of comprehension strategy instruction in regular classroom settings in grades 3–12 (Okkinga et al., 2018). The researchers found positive effects on both standardized and researcher-developed tests of reading comprehension. Reviews of the impact of comprehension strategy instruction with younger students have also found positive effects (e.g., Mahdavi & Tensfeldt, 2013).

Research has found that comprehension strategy and/or text structure instruction need not detract from content learning or knowledge building. For example, Williams et al. (2014) compared social studies instruction with or without embedded text structure instruction (with some strategy elements). Those who experienced the text structure instruction had higher comprehension and learned an equal amount of social studies content. Further, many effective approaches to comprehension strategy instruction are actually set in a knowledge-building context (for an example in science, see Cervetti, Barber, Dorph, Pearson, & Goldschmidt, 2012).

Another concern expressed about comprehension strategy instruction has been how it is implemented in classrooms, such as presented more as the end goal rather than as providing tools to be used for the goal of learning from text. However, just as poor implementation of phonics instruction (e.g., Duke & Mesmer, 2018) does not justify not teaching phonics, poor implementation of comprehension strategy instruction does not justify abandoning it.

Supporting Engagement With Text Fosters Comprehension Development

Engaging with text—whether through reading widely and in volume, discussing and analyzing texts read, or writing about or in response to texts read—is central to developing students' reading comprehension.

Volume Reading

A great deal of experience in reading is another necessary, but certainly not sufficient, condition for reading comprehension proficiency. Reutzel, Fawson, and Smith (2008) collaborated with educators to redesign the practice of sustained silent seading to respond to criticisms and a lack of experimental evidence that it supports reading achievement. The redesigned technique, called scaffolded silent reading (ScSR), to be used with students once they are able to read without immediate teacher support, includes the following: explicit instruction in book selection strategies, individual reading conferences in which students read aloud and answer questions about the text, and setting and monitoring goals related to reading widely across a variety of genres, in a specified amount of time. A yearlong controlled experiment of ScSR with third graders found no significant differences between ScSR and the evidence-based control condition of guided repeated oral reading except on one fluency measure that favored ScSR. In other words, ScSR represents a practice that is at least as good as the established alternative and that readers can engage in while the teacher is with other students providing valuable, targeted individual and small-group reading instruction. The researchers recommended using both ScSR and guided repeated oral reading in classrooms.

Increasing students' reading volume outside of school can also support comprehension. Studies of summer reading programs have shown that they can have a positive effect on comprehension (e.g., Allington et al., 2010). Importantly, simply allowing students to choose their own books without guidance (Kim & Guryan, 2010), or even matching books to readers based on their interests (Kim, 2007), is not always enough to significantly impact comprehension. Scaffolding the experience (e.g., by complementing book options with lessons in fluency and comprehension strategies) increases the likelihood of success (Kim & White, 2008).

Text Discussion and Analysis

Engaging in discussion can also positively affect students' comprehension. A meta-analysis found that many approaches to discussion successfully boosted students' literal or inferential comprehension. Those approaches focused on reading to acquire particular information (i.e., Questioning the Author, Instructional Conversations, Junior Great Books Shared Inquiry) had particularly strong effects on students' high-level comprehension of text (Murphy, Wilkinson, Soter, Hennessey, & Alexander, 2009).

Another way for students to engage deeply in text is to analyze it, namely, for the relations at play both within and across sentences. A student reading the woodchuck passage and encountering the sentence "It is a complex system of entrances, tunnels, and rooms called chambers" (McCarron, 2000/2005, p. 16), for example, might need support to analyze the sentence and understand that "chambers" refers just to the rooms, not to the entrances, tunnels, and rooms as a group. Teaching students to recognize and analyze certain sentence structures, such as anaphora, or "when one word or group of words replaces another within a sentence or across sentences" (Mesmer & Rose-McCully, 2018, p. 452), has been shown to improve students' ability to answer related comprehension questions about both narrative and expository texts (Baumann, 1986). Instruction in sentence combining, a common practice in writing instruction, has also shown some significant effects on students' performance on standardized tests of reading achievement (Wilkinson & Patty, 1993).

Writing

Finally, students can engage deeply in texts by writing about them. A meta-analysis that compared the effects of different kinds of writing activities on reading comprehension found that engaging students in extended writing activities improved their reading comprehension more than question-answering

activities did when assessed by an extended writing task and that writing summaries improved their comprehension more than question answering did when students were asked to write down everything they could remember about the text they had read (Hebert, Simpson, & Graham, 2013). A more recent meta-analysis found that literacy instruction that balanced reading and writing (i.e., taught the subjects together, with no subject dominating more than 60% of instructional time) significantly improved students' reading comprehension (Graham et al., 2018).

Instructional Practices That Kindle Reading Motivation Improve Comprehension

In considering the science of reading, many researchers cite the National Reading Panel's (National Institute of Child Health and Human Development, 2000) review and analysis of research related to reading instruction, which identified five key concepts in reading: phonemic awareness, phonics, fluency, vocabulary, and comprehension. Although these "big five" are certainly important, and each has received attention in this piece, they do not represent an exhaustive list of contributors to reading that teachers should consider when designing literacy instruction. Scientific research has shown that motivation for reading is another important determinant of reading comprehension, one that we ignore at our peril.

One can imagine that a student who is more interested in woodchucks is likely to expend more effort to comprehend the article "Not Just a Hole in the Ground," experience greater success in reading it, and be more motivated to engage in similar reading in the future. In research, the relation between proficient reading and motivation is synergistic. According to theory, motivation activates engaged reading behavior, which in turn affects the degree to which instruction leads to greater achievement (Guthrie & Wigfield, 2000).

Here's the good news: Because motivation is inherently social, the social context of the classroom can be adapted and leveraged to better support reading motivation (Hruby et al., 2016). In fact, a recent systematic review and meta-analysis found that motivational reading interventions, such as fostering reading interest through hands-on activities, offering choices, and providing process-oriented feedback, produced significant, positive effects on students' reading motivations and reading comprehension (McBreen & Savage, 2020).

A Layered Model of Effective Comprehension Instruction

Figure 2 presents a visual representation of effective reading comprehension instruction that reflects findings presented in this piece and in other relevant research. The model incorporates many instructional practices that scientific research has found to positively impact reading comprehension development. The model presents these practices as layered. We do not show a balance scale, for example, in which knowledge building is on one side and comprehension strategy instruction on the other. Rather, comprehension strategy instruction is depicted as occurring in the context of knowledge building and language development. Similarly, reading motivation is not presented as a construct to address in isolation but rather as a set of practices that can be infused in or contextualize other aspects of reading comprehension instruction. The model also illustrates that we can adjust the amount of instruction provided based on students' strengths and needs (e.g., providing additional comprehension strategy instruction as needed). As we look across the research literature and across the realities of daily classroom instruction, we conclude that this differentiated and layered approach to reading comprehension instruction is the most scientifically advisable way forward.

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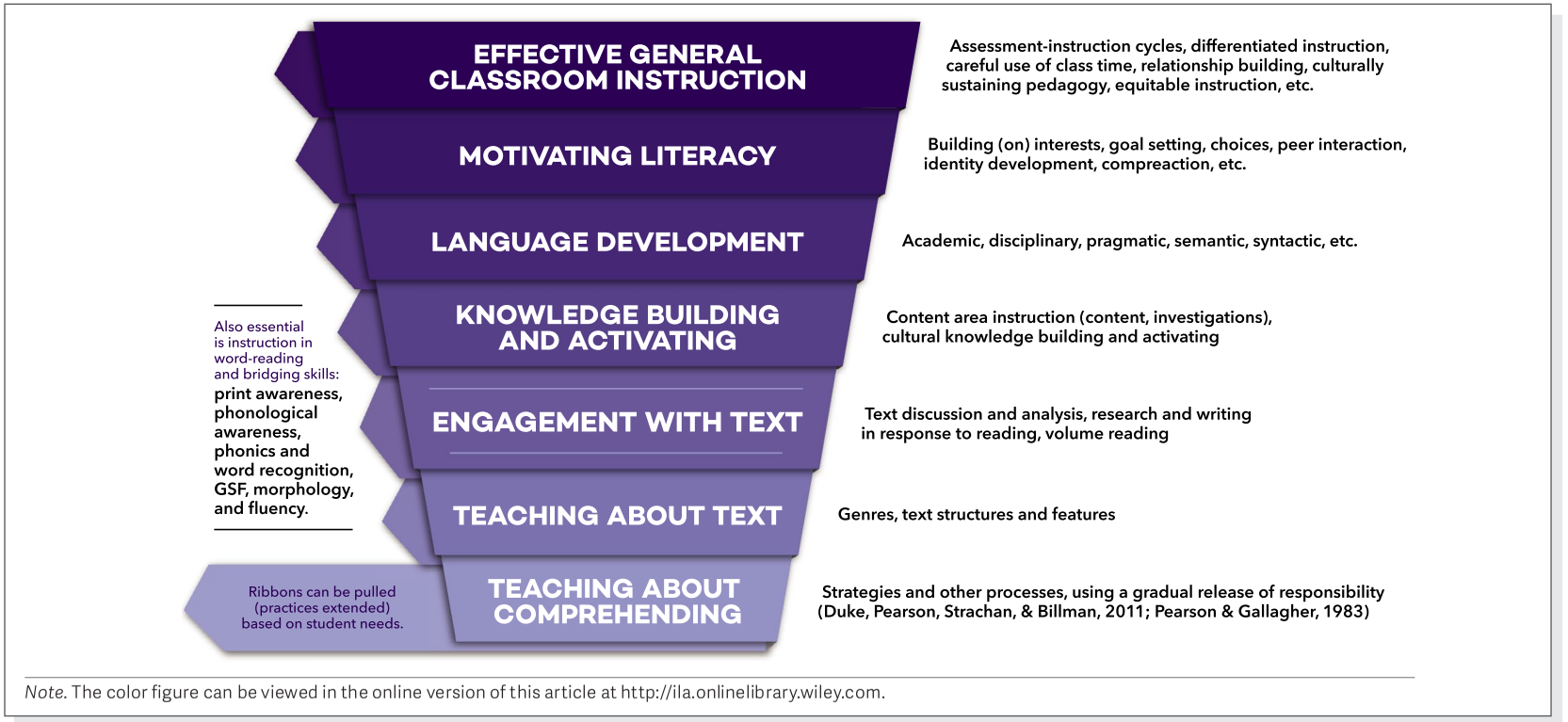
Figure 2
A Layered Model of Effective Comprehension Instruction



Note. The color figure can be viewed in the online version of this article at http://ila.onlinelibrary.wiley.com.

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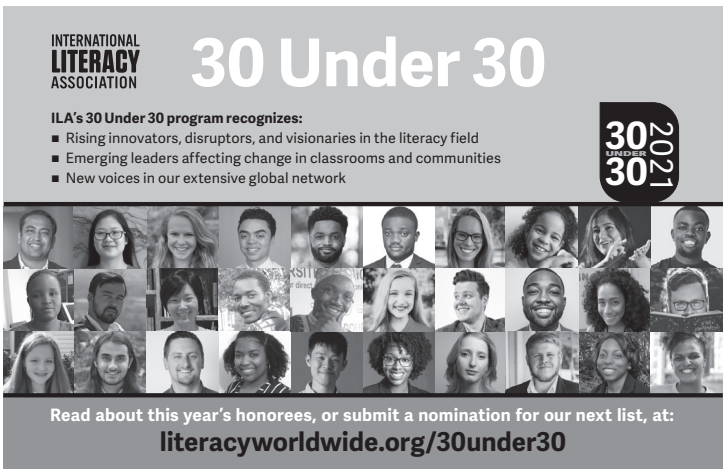
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