HOW WE LEARN

ASK THE COGNITIVE SCIENTIST

ILLUSTRATION BY ROBERT BARKIN

The Usefulness of *Brief* Instruction in Reading Comprehension Strategies

How does the mind work—and especially how does it learn? Teachers' instructional decisions are based on a mix of theories learned in teacher education, trial and error, craft knowledge, and gut instinct. Such gut knowledge often serves us well, but is there anything sturdier to rely on?

Cognitive science is an interdisciplinary field of researchers from psychology, neuroscience, linguistics, philosophy, computer science, and anthropology who seek to understand the mind. In this regular American Educator *column, we consider findings from this field that are strong and clear enough to merit classroom application.*

By Daniel T. Willingham

Question: In a recent column* you said that background knowledge is essential for reading comprehension. What about reading comprehension strategies? Isn't it important to teach children comprehension strategies to help them get everything out of what they read?

The effectiveness of teaching reading comprehension strategies has been the subject of over 500 studies in the last 25 years. The simple conclusion from this work is that strategy instruction improves comprehension. Much more difficult to answer are the interesting questions that follow: How much do strategies help? How do they work? Do all students benefit? How much time should be spent on them? The answers are not yet clear, but combining what cognitive scientists know about reading with patterns of data from experiments conducted in classrooms allows us to draw some tentative conclusions. It appears that reading strategies do not build reading skill, but rather are a bag of tricks that can indirectly improve comprehension. These tricks are easy to learn and require little practice, but students must be able to decode fluently before these strategies can be effective.

Let's begin by considering what cognitive scientists know about the process of reading comprehension, because that will help us understand what strategies might do for the student. Reading comprehension actually overlaps quite a bit with the comprehension of spoken language. Children

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*See "How Knowledge Helps" in the Spring 2006 issue: **www.aft.org/pubs-reports/american_educator/issues/spring06/willingham.htm**.

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come to school having already learned the complex process of using grammatical rules to extract meaning from strings of words, and they use these same processes to enable reading comprehension. The contention that listening comprehension contributes to reading comprehension is supported by data showing that there is a very strong relationship between adults' reading comprehension and listening comprehension abilities (e.g., Gernsbacher, Varner, and Faust, 1990). Children's reading comprehension and listening comprehension are also correlated, but not as strongly because they vary in their decoding ability (e.g., Curtis, 1980). It might seem, then, that teaching children to read should just be a matter of teaching them to decode letter strings into words fluently; and that once they have decoded the words, they can understand them by using listening comprehension processes that are already in place. (This generalization assumes that they know the vocabulary in the sentence, and have some familiarity with the subject matter, issues that I'll take up later.)

Listening comprehension processes greatly aid reading comprehension, but most speaking and reading situations differ in an important way. Speakers monitor their listeners' comprehension. For example, when a friend tells you a story, she does not just plow through from beginning to end. Periodically she asks a question, the purpose of which is to ensure that you understand what she's saying. The question might check your understanding directly (e.g., "You know what I mean?") or indirectly ("And so we took the subway, you know, the blue line?"). You, the listener, signal comprehension by answering these questions affirmatively, and by nodding and acknowledging comprehension ("right, uh huh") even when the speaker has not posed a question. If you signal that you're confused, the speaker will describe the confusing material in another way. Speakers do not typically continue until they are sure that the listener understands (Clark and Schaefer, 1989). In addition, listeners typically monitor their own comprehension, even if they are not prompted by the speaker. Although this ability becomes more sophisticated as children grow, even kindergartners show that they know when they do or do not understand (Flavell, Speer, Green, August, and Whitehurst, 1981).

Reading is different in two ways. First, the burden of monitoring comprehension is entirely on the reader. The author cannot monitor your comprehension the way a speaker does when you are listening. Surely you have had the experience of reaching the bottom of a page and realizing that you weren't really following what the author was saying, or that you were thinking about something other than the book entirely, even though your eyes had passed over the words. In either case, you would start reading the passage again. In so doing, you are monitoring your comprehension, finding that it is incomplete, and trying to correct it. The second important difference between reading and conversational speech lies in what can be done when you're confused. In reading, you are stuck with the one description that the author wrote. You cannot (as you could when listening) ask for a different phrasing or easily find out the definition of a word.[†]

So how do students understand what they read? Understanding individual sentences can usually be supported by listening comprehension processes and, therefore, does not pose a problem for a proficient decoder, provided he knows the vocabulary and has sufficient background knowledge. But, relating sentences to one another does pose a challenge, and it is essential for reading comprehension. There are two levels at which the effective reader will relate sentences: a textbase, which is derived from the text, and a situation model, which relies on both the text and the reader's background knowledge. Let's look at examples of each, beginning with the textbase. A textbase is a web of connected ideas created from what you've read. Ideas are linked when sentences refer to the same people or things, or if a causal connection can be drawn between them. Consider these three sentences:

> Bill came to my house yesterday. He dropped a cup of coffee. My rug is a mess.

The first two sentences would be connected in a textbase because both refer to the same object—Bill. The third sentence doesn't share a referent with either of the first two sentences, but it can be related causally to the second. You

[†]There are exceptions to these generalizations. For example, when one listens to a speech, or to radio broadcast, the speaker does not monitor the listener's comprehension, and comprehension checks do take place for some written communications, e.g., instant messaging conversations.

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assume that Bill's spilled coffee created the mess.

Building a textbase is necessary, but it's not sufficient for real comprehension—that requires a situation model. Consider these three sentences:

> Logistic regression allows one to predict a discrete outcome such as group membership from a set of variables that may be continuous, discrete, dichotomous, or a mix. Because of its popularity in the health sciences, the discrete outcome in logistic regression is often disease/no disease. For example, can presence or absence of hay fever be diagnosed from geographic area, season, degree of nasal stuffiness, and body temperature? (Tabachnick and Fidell, 2007)

Each of these sentences shares referents, so you could build a textbase. You could use that textbase representation to answer some questions about the paragraph, even if you didn't understand the meaning very well. For example, if I asked you, "What does logistic regression do?" you could use the textbase to answer, "Predict a discrete outcome, such as group membership." But unless you have some background in statistics, you won't feel that you have a rich understanding of the paragraph's meaning.

How does one get a rich understanding? By relating what you are reading to other material that you already know. For example, if you don't know what a "discrete outcome" is, you don't really know what logistic regression is good for. You know it's good for predicting group membership, which is provided as an example of a discrete outcome, but you can't generalize beyond that example. When you are able to relate what you read to information that you already know, you can develop a situation model. As the name implies, it describes your understanding of all the component ideas, coalesced into a grander model of the situation. Consider this set of sentences:

> I approached the carnival game hesitantly. The goal was to throw a ping pong ball toward a table on which sat dozens of small bowls. If your ball landed in a bowl, you won one of the enormous stuffed bears that lined the top of the booth. Three throws for a dollar. The bowls seemed close together—how could I lose? The man working the booth was old, and had uneven, tobacco-stained teeth. When he noticed me lingering nearby, he winked and said, "Come along. You look like a winner."

The textbase for this paragraph would include the interrelations of the ideas in the sentences. The situation model would include more, for example, the idea that if I play, I'm likely to lose. Although that information is not in the text, it would be in long-term memory—possibly from having been to a carnival and tried this game yourself—and would be relevant to your full understanding of the text. As I will discuss further at the end of this article, this is why it is so essential to build students' background knowledge. The more information they have stored in long-term memory, the more likely they are to be able to develop a situation model, and the better their reading comprehension.

To review, I've named three factors that are important in reading comprehension: monitoring your comprehension, relating the sentences to one another, and relating the sentences to things you already know. The key question is this: Can we instruct students to do these things? Most of the strategies that educational researchers have tried to teach to developing readers target one of these three processes. The table (on page 43) shows 16 strategies that have been tested in classroom experiments between 1980 and 1998. Fifteen of these strategies are distinct; the remaining one, called "multiple strategy instruction," combines several strategies (usually summarization, prediction, question generation, and clarification of confusing words or passages). These categories of strategies were distilled from 481 studies evaluated by the National Reading Panel (2000), a group of outstanding researchers gathered by the National Institutes of Health. The panel spent two years evaluating different methods of teaching reading. As part of that effort, they evaluated research on teaching students reading comprehension strategies. I've organized their list of 16 strategies to emphasize the cognitive process that each one targets. As the table indicates, most of the strategies that reading researchers have tested target one of the three cognitive processes that I've said are important to reading with understanding: monitoring your comprehension,

Three factors are important in reading comprehension: monitoring your comprehension, relating the sentences to one another, and relating the sentences to things you already know.

relating the sentences to one another, or relating the text to what you already know. So, do these strategies help students?

Evidence That Strategy Instruction Helps

The National Reading Panel conducted a comprehensive review of all of the 481 studies on reading strategies published between 1980 and 1998. The Panel set stringent criteria as to which studies to consider in drawing their conclusions: The studies had to 1) be peer-reviewed and published in a scientific journal, and 2) show a causal relationship. Many studies that showed that better readers are more likely than poor readers to use reading comprehension strategies were not considered by the panel because they did not meet the second criterion. One cannot conclude a causal relationship (i.e., strategies make you a better reader) from the correlation (better readers tend to use strategies).‡ Ultimately, the NRP deemed 205 of the studies worthy of consideration as they tried to determine the effectiveness of reading comprehension strategies. As the table indicates, some strategies have been studied much more often than others. Across all of these studies, there was a range of student ages, but the majority ranged from grade three to grade six.

The Panel concluded that eight of the 16 strategies "appear to have a firm scientific basis for concluding that they improve comprehension in normal readers." Those eight are indicated in the table. Just how much do the strategies help? Unfortunately, at this point we can only answer that question for two of the eight effective strategies—question generation and multiple strategy instruction. Here's why: Statisticians measure the size of an effect with a metric called "effect size," signified as *d*. It's basically a measure of how much a treatment (e.g., training students to use a reading strategy versus not training them) affects an outcome (e.g., performance on a reading test). The advantage of *d* is that it's independent of the particular measure used, so you can compare the size of an effect even if experimenters used different tests. Most of the 205 studies did not provide enough detail for the Panel to calculate d, but they could do so for studies on question generation and multiple strategy instruction.

The important finding from those two groups of studies is that the apparent helpfulness of a strategy depends on how reading comprehension is measured. In virtually all of the studies, the experimenter selected the reading material and designed the comprehension test. In some experiments, the authors also used a standardized reading test, often the Gates-MacGinitie (Gates-MacGinitie, 1989). A consistent finding was that the *d* for the experimenter-written tests was much larger than for the standardized reading tests. For the studies on question generation, *d* averaged about 0.90 for experimenter-written tests, which is an enormous effect—comparable to a student moving from the 50th to the 82nd percentile. For standardized tests, *d* was a still-respectable 0.36—comparable to a student moving from the 50th to the 64th percentile. The pattern was very similar for the multiple strategy instruction experiments (experimenter-written tests, $d = 0.88$; standardized tests, $d = 0.32$). Even though the Panel was unable to calculate effect sizes for the six other effective strategies, it did note that for those experiments too, statistically significant effects were more often observed when an experimenter-designed test was used than when a standardized test was used. Studies that have been published since the Panel review and that used different instruction strategies show a strikingly similar pattern in effect sizes for experimenter-designed versus standardized tests (e.g., Alfassi, 2004; Johnson-Glenberg, 2005; McNamara, 2004; VanKeer, 2004).

Why was the effect so much smaller on standardized tests? The likely explanation concerns the reading material that would be used on each test. Researchers have found that the strategies that students learn are not equally applicable to every text that they read (Magliano, Trabasso, and Graesser, 1999; Narvaez, van den Broek, and Ruiz, 1999). Some texts have a lot of details (e.g., a description of a trip to Hawaii) and are well suited to students asking themselves questions. Other texts are organized rather obviously around a single, main idea (e.g., a text about the first settlement of Hawaii by Polynesians). Laboratory tests also show that asking readers to use different strategies leads them to make different inferences (Narvaez et al., 1999). If I ask you to generate questions as you read (who, what, why, where, when, how) you might not stop to think about what the main idea of the text is.

When creating a reading test, an experimenter might unconsciously select passages that are well-suited to the strat-

Strategy	Number of studies	Evidence of effectiveness	Strategy description
Strategies designed to encourage students to monitor their comprehension:			
Comprehension monitoring	22	Yes	Readers are taught to become aware of when they do not understand, for example by formulating what exactly is causing them difficulty.
Listening actively	4	Research inconclusive	Students learn to think critically as they listen and to appreciate that listening involves understanding a message from the speaker.
Strategies designed to encourage students to relate sentences to one another:			
Graphic organizer	11	Yes	Students learn how to make graphic representations of texts, for example, story maps.
Question answering	17	Yes	After students read a text, the teacher poses questions that emphasize the information students should have obtained from the text.
Question generation	27	Yes	Students are taught to generate their own questions, to be posed during reading, that integrate large units of meaning.
Summarization	18	Yes	Students are taught techniques of summarizing, e.g., deleting redundant information and choosing a topic sentence for the main idea.
Mental imagery	7	Research inconclusive	Students are instructed to create a mental visual image based on the text.
Cooperative learning	10	Yes	Students enact comprehension strategies—for example, prediction and summarization—in small groups, rather than with the teacher.
Story structure	17	Yes	Students are taught the typical structure of a story and learn how to create a story map.
Multiple strategy instruction	38	Yes	Multiple strategies are taught, often summarization, prediction, question generation, and clarification of confusing words or passages.
Strategies designed to encourage students to relate sentences to things they already know:			
Prior knowledge	14	Research inconclusive	Students are encouraged to apply what they know from their own lives to the text, or to consider the theme of the text before reading it.
Vocabulary-Comprehension relationship	3	Research inconclusive	Students are encouraged to use background knowledge (as well as textual clues) to make educated guesses about the meaning of unfamiliar words.
Other strategies:			
Curriculum	8	Research inconclusive	Instruction is carried to the curriculum beyond reading. Thus, students might study story structure during reading time, apply the structure themselves during writing time, and look for story structure during social studies.
Mnemonic	2	Research inconclusive	Students are taught to associate a keyword with some aspect of the text to help memory for that aspect; it is designed for use with very unfamiliar texts.
Psycholinguistic	1	Research inconclusive	Students are taught language conventions that will help comprehension; for example, how to find the antecedent of a pronoun like "she."
Teacher preparation	6	Research inconclusive	Teachers learn techniques by which to teach reading strategies.

Source: National Reading Panel (2000). Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction. *Washington, D.C.: National Institute of Child Health and Human Development.*

egy that students are learning. The texts that appear on standardized reading tests, however, are more unpredictable and varied. That probably explains why reading strategies look so much more effective when experimenters' tests are used as the measure. But make no mistake, when standardized reading tests are used, there is still a positive effect of teaching students reading strategies, and the effect is not trivial.

A Deeper Look at What Reading Comprehension Strategies Do

Most research has evaluated whether or not teaching reading comprehension strategies is effective; it has not evaluated which strategies are most effective, or what type of student

‡ In fact, it's known that poor readers may fail to use strategies (e.g., monitor their comprehension) because their other reading processes don't work well (Otero and Kintsch, 1992).

Reading strategy programs that were relatively short (around six sessions) were no more or less effective than longer programs that included as many as 50 sessions.

benefits most from learning them. Still, patterns in existing data provide clues about what reading strategies do and, therefore, how they should be taught.

First, the evidence for the effectiveness of reading strategies is weak for students in the third grade or earlier. The National Reading Panel claimed that positive results could be observed at all grade levels, which is true, but it's also true that the results are more consistently positive in grades four and later. Furthermore, the data for grades three and earlier look much weaker when one limits the analysis to experiments that used standardized test scores. Data published since the Panel's report support this pattern: Effects for third-graders are weak or absent (e.g., Johnson-Glenberg, 2000; Janzen, 2003; Vaughn et al., 2000). This finding seems sensible in light of the cognitive processes necessary to implement reading strategies. Strategies require attention and space in working memory (e.g., Cain, Oakhill, and Bryant, 2004; Calvo and Castillo, 1998). Students who are still learning to decode fluently do not have enough working memory space available to implement strategies. Their working memory is occupied by decoding. A natural conclusion is that there is not much point in teaching reading strategies before students have gained that fluency—for most students, that will be in the third or fourth grade.

A second important finding from studies of reading strategies concerns how much time students should spend practicing them. In two meta-analyses, Rosenshine and his colleagues (Rosenshine and Meister, 1994; Rosenshine, Meister and Chapman, 1996) reported that spending a lot of time practicing the strategies did not have an effect. Reading strategy programs that were relatively short (around six sessions) were no more or less effective than longer programs that included as many as 50 sessions. How can it be that practice doesn't add to the effectiveness of reading strategies? Practice is usually essential for the development of a skill.

Based on my reading of the research and my knowledge of cognitive science, I think that the answer may be that successfully implementing a reading comprehension strategy is not a skill at all. It may be more like a trick in that it's easy to learn and use, and the only difficulty is to consistently remember to apply it. An analogous process may be checking one's work in mathematics. There is not a lot to learn in checking your work; it's not a skill that requires practice. But you do have to remember to do it. Checking your work is analogous to reading strategies in another way. Checking your work will make it more likely that you get a problem right, but it doesn't tell you how to solve the problem. Similarly, reading strategies don't get reading comprehension done. They encourage the student to apply reading comprehension processes. If the comprehension processes can't do the job, reading strategies won't help much. For example, in order to "summarize," you need to comprehend enough to differentiate the main idea from subordinate ideas. For "comprehension monitoring" to be useful, not only do you need to recognize that you don't understand a passage, but also to be able to comprehend the material when you reread it.

If reading comprehension strategies are quickly learned tricks, that has another implication for the studies I've discussed here. The studies may well underestimate how much reading strategies actually help. When a teacher presents a reading strategy to students, we can assume that there are three types of students in the class: students who have already discovered the strategy (or something similar) on their own, students who are not fluent enough decoders to use the strategy, and students who are good decoders but don't know the strategy. Only the last group of students will benefit from reading strategy instruction. When a researcher finds an average effect size of $d = 0.33$ for teaching students the strategy, that effect is probably actually composed of many students who showed no benefit and a smaller number of students who showed a large benefit. To evaluate whether or not this is true, reading researchers would have to conduct studies designed to evaluate the progress of each child, rather than the average progress. To my knowledge, such a study hasn't been done.

There is another way in which published studies may have underestimated the impact of teaching one reading strategy in particular: comprehension monitoring. The point of this strategy is to get students to recognize when they do and do not understand something and to realize that if they do not understand, they need to reread the passage. But standardized reading tests present students with questions immediately after they read a passage.

Teaching reading strategies is a low-cost way to give developing readers a boost, but it should be a small part of a teacher's job. Acquiring a broad vocabulary and a rich base of background knowledge will yield more substantial and longer-term benefits.

These questions make it evident to the student whether or not she understands. Thus, students in the control condition of a study (who have not been taught to monitor their own comprehension and normally would not do so) have their comprehension monitored for them—the test questions make it evident to the student if they do not understand a passage. Thus, reading tests may underestimate how much it helps to teach students to monitor their own comprehension.

Reading Strategies in the Classroom

We can summarize what we know from the last 25 years of research on reading comprehension strategies fairly concisely:

- Teaching children strategies is definitely a good idea.
- The evidence is best for strategies that have been most thoroughly studied; the evidence for the less-studied strategies is inconclusive (not negative) and, therefore, there is not evidence that one strategy is superior to another.
- Strategies are learned quickly, and continued instruction and practice does not yield further benefits.
- Strategy instruction is unlikely to help students before they are in the third or fourth grade.

These facts, along with what we know about the cognitive processes of reading, give us a broader view of what strategy instruction might do for the young reader. In my view, the main effect of strategy instruction may be to push the reader toward a new understanding of reading. It is not just a matter of decoding words, but is more a matter of comprehending a meaningful message that the author is trying to communicate, and the student hasn't truly "read" the material until he or she understands the message. This new view of reading leads the student to engage different processes when she reads—for example, rereading material that is not understood and seeking clues in the text to help comprehend difficult material. It is likely that the student would eventually come to this understanding of the purpose of reading on her own, but it confers a significant advantage to comprehension, and should certainly be taught, rather than waiting for the student to stumble on it.

I suggest that the main effect of reading comprehension strategies is to encourage a new view of reading because I don't believe that students continue using these strategies into adulthood. Literate adults do not construct story maps as they read the morning paper, nor do they pose and answer questions for themselves. They do, however, understand that the goal of reading is to obtain meaning, and they monitor their own comprehension; that understanding is likely what remains with the tenth-grader who was taught a set of reading strategies in fourth grade.

This view of reading strategies leads to straightforward suggestions for classroom application. Students must have achieved some level of fluency for reading strategies to be effective, so there is little point in teaching them before the third or fourth grade. Students will, of course, vary in fluency, so some students will be ready when others are not. Therefore, it may be sensible to teach one reading strategy in each of the fourth, fifth, and sixth grades (or later for students who are slow to develop fluency). Doing so should be feasible because strategy instruction need not be lengthy—five or six sessions will do—and teachers can avoid repetition by teaching different strategies each year. Teaching reading strategies is worthwhile, but we should bear in mind that knowledge of strategies is only a small part of what makes an effective reader. A good reader also decodes fluently, has a broad vocabulary, and has wide-ranging background knowledge.

The need for a broad vocabulary should be self-evident. It's hard to understand the meaning of a sentence if you don't know the meaning of the constituent words. There are times when you can deduce the meaning of an unknown word from the context, but you need to understand most of the text to be able to puzzle out the meaning of the unknown word. Your ability to do so drops rapidly, however, as the number of unfamiliar words increases (Laufer, 1997).

Background knowledge also has profound effects on reading comprehension. Have another look at the three classes of strategies in the table—two of them rely on or are facilitated by background knowledge. Encouraging students to relate the text they are reading to background knowledge won't help much if the students don't have the relevant background knowledge. Less obvious is the fact that relating sentences to

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one another also often requires background knowledge. That's because authors often do not spell out how sentences relate—the author assumes that the reader can do that work. In one of the examples discussed earlier, it's assumed that the reader knows that spilled coffee makes a mess.

The writer cannot specify every last detail or the text would become impossibly long. The writer must make assumptions about what the reader knows. If the level of knowledge that the writer assumes does not match the level of knowledge that the reader actually has, the reader won't comprehend the text. By the same reasoning, an individual with background knowledge on a wide variety of subjects will less often be confused when reading than an individual with limited background knowledge in long-term memory. Indeed, general world knowledge is a strong predictor of reading ability (Kosmoski, Gay and Vockell, 1990). Thus, two of the three categories of reading strategies depend on background knowledge for their successful application.

In the final analysis, how should we think about reading strategies? Teaching reading strategies is a low-cost way to give developing readers a boost, but it should be a small part of a teacher's job. Happily, students can learn them quickly and they are effective, but they appear to deliver a one-time boost. Acquiring a broad vocabulary and a rich base of background knowledge will yield more substantial and longer-term benefits, but doing so is more difficult and time consuming. This knowledge must be the product of years of systematic instruction as well as constant exposure to high quality books, films, conversations, and so on, which provide students with incidental exposure to a great deal of new vocabulary and knowledge. □

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