which knowledge and text are compared explicitly, may be as important as making the prediction.

These studies suggest a variety of productive ways of encouraging students to engage their knowledge and experience prior to reading. They also suggest that in nearly all cases, the impact on story understanding is positive, at least for narrative texts in which themes and topics are likely to be highly familiar. The situation may be quite different in reading expository texts, especially if students' existing knowledge is riddled with misconceptions about matters of science and prejudices in the realm of human experience (see, for example, Guzzetti, Snyder, Glass, & Gamas, 1993).

Think-aloud. Another proven instructional technique for improving comprehension is think-aloud. As its name implies, think-aloud involves making one's thoughts audible and, usually, public—saying what you are thinking while you are performing a task, in this case, reading. Think-aloud has been shown to improve students' comprehension both when students themselves engage in the practice during reading and also when teachers routinely think aloud while reading to students.

Teacher think-aloud. Teacher think-aloud is typically conceived of as a form of teacher modeling. By thinking aloud, teachers demonstrate effective comprehension strategies and, at least as importantly, when and when not to apply them. For example, in the following teacher think-aloud, the teacher demonstrates the use of visualization and prediction strategies:

> That night Max wore his wolf suit and made mischief of one kind and another.... Boy, I can really visualize Max. He's in this monster suit and he is chasing after his dog with a fork in his hand. I think he is really starting to act crazy. I wonder what made Max act like that...Hm-m-m...I bet he was getting a little bored and wanted to go on an adventure. I think that is my prediction. (Pressley et al., 1992, p. 518)

Studies typically have not examined the effect of teacher think-aloud by itself, but rather as part of a package of reading comprehension strategies. Therefore, although we cannot infer directly that teacher think-aloud is effective, it is clear that as part of a package, teacher think-aloud has been proven effective in a number of studies. For example, teacher think-aloud is part of the Informed Strategies for Learning (ISL) program (Paris, Cross, & Lipson, 1984), the reciprocal teaching approach (see later discussion), and the SAIL program (see later discussion), all of which have been shown to be effective at improving student comprehension. It is also an important part of the early modeling stages of instruction in many comprehension training routines, for example, the QAR work of Raphael and her colleagues (Raphael, Wonnacott, & Pearson, 1983) and the inference training work of Gordon and Pearson (1983). These studies suggest that teacher modeling is most effective when it is explicit, leaving the student to intuit or infer little about the strategy and its application, and flexible, adjusting strategy use to the text rather than presenting it as governed by rigid rules. Teacher think-aloud with these attributes is most likely to improve students' comprehension of text.

Student think-aloud. Instruction that entails students thinking aloud themselves also has proven effective at improving comprehension (see Kucan & Beck, 1997, for a review). A classic study by Bereiter and Bird (1985) showed that students who were asked to think aloud while reading had better comprehension than students who were not taught to think aloud, according to a question-and-answer comprehension test. A compelling study by Silven and Vauras (1992) demonstrated that students who were prompted to think aloud as part of their comprehension training were better at summarizing information in a text than students whose training did not include think-aloud.

Several scholars have theorized about why student think-aloud is effective at improving comprehension. One popular theory is that getting students to think aloud decreases their impulsiveness (Meichebaum & Asnarow, 1979). Rather than jumping to conclusions about text meaning or moving ahead in the text without having sufficiently understood what had already been read, think-aloud may lead to more thoughtful, strategic reading. A study conducted with third-grade students provides some empirical support for this theory. Baumann and his colleagues found that training in think-aloud improved children's ability to monitor their comprehension while reading (Baumann, Seifert-Kessel, & Jones, 1992). Third-grade children trained to think aloud as they used several comprehension strategies were better than a comparison group at detecting errors in passages, responding to a questionnaire about comprehension monitoring, and completing cloze items. One student trained in think-aloud explained, "When I read I think, is this making sense? I might...ask questions about the story and reread or retell the story" (Baumann et al., p. 159). This and other student comments suggested a thoughtful, strategic approach to reading through think-aloud.

Text structure. Beginning in the late 1970s and extending throughout the 1980s into the early 1990s, we witnessed an explosion of research about the efficacy of teaching children to use the structure of texts, both narrative and expository, to organize their understanding and recall of important ideas. Most of the research emphasized the structural aspects of text organization rather than the substance of the ideas, the logic being that it was structure, not content, that would transfer to new texts that students would meet on their own.

Story structure. The research on story structure uses a few consistent heuristics to help students organize their story understanding and recall. Usually, these are organized into a story grammar (see Mandler, 1978; Stein & Glenn, 1979), or as it is commonly called in instructional parlance, a story map (see Pearson, 1981), which includes categories such as setting, problem, goal, action, outcome, resolution, and theme. Instruction typically consists of modeling, guided practice, and independent practice in recognizing parts of the stories under discussion that instantiate, or "fill," each category. Although there are situations, texts, and populations in which this sort of instruction does not appear helpful, in the main, story structure instruction shows positive effects for a wide range of students, from kindergarten (Morrow, 1984a, 1984b) to the intermediate grades (Gordon & Pearson, 1983; Nolte & Singer, 1985) to high school (Singer & Donlan, 1982) to special populations (Idol, 1987), and to students identified as struggling readers (Fitzgerald & Spiegel, 1983). Regarding transfer, although the effects are complex and sometimes subtle, it appears the effects are most stable for the texts in which the instruction has been embedded (Singer & Donlan, 1982), and they do transfer to new, independently read texts (Gordon & Pearson, 1983; Greenewald & Rossing, 1986).

Informational text structure. Most of the research establishing the positive impact of helping students learn to use the structural features of informational texts as aides to understanding and recall has been conducted since the appearance of elaborate text analysis schemes in the late 1970s (e.g., Kintsch & Van Dijk, 1978; Meyer, 1975; see also Meyer & Rice, 1984, for a complete review of this early work). The early work documented the significance of attention to text structure, pointing out that students—for whatever reasons, including the fact that they are simply better readers—who are more knowledgeable about text structure recall more textual information than those who are less knowledgeable (Bartlett, 1978; Meyer, Brandt, & Bluth, 1980). The work also suggested that knowledge is not enough. Students must actually follow the text's structure in building their recall for the effect to be realized; not surprisingly, more good than poor readers are inclined to do so (Bartlett, 1978; Taylor, 1980).

The approaches to teaching text structure have exhibited substantial variability, beginning with general attempts to sensitize students to structural elements (e.g., Bartlett, 1978; Davis, Lange, & Samuels, 1988; Slater, Graves, & Piche, 1985) and extending to hierarchical summaries of key ideas (e.g., Taylor & Beach, 1984) and to visual representations of key ideas, such as conceptual maps, semantic networks, charts, and graphs (e.g., Armbruster & Anderson, 1980; Armbruster, Anderson, & Ostertag, 1987; Gallagher & Pearson, 1989; Geva, 1983; Holley & Dansereau, 1984). In general, the research suggests that almost any approach to teaching the structure of informational text improves both comprehension and recall of key text information. One plausible explanation is that systematic attention to the underlying organization, whether intended by the authors of texts or not, helps students relate ideas to one another in ways that make them more understandable and more memorable. Another plausible explanation is that it is actually knowledge of the content, not facility with text structure, that children acquire when they attend to the structural features of text. In other words, text structure is nothing more than an alias for the underlying structure of knowledge in that domain.

Only a few of the studies in this area have evaluated these competing hypotheses. The results of the Gallagher and Pearson (1989) work suggest that both content and structural features contribute to the salutary effects of "text structure" instruction. Over a series of several weeks, Gallagher and Pearson taught fourth-grade students, mainly poor readers, to apply a consistent structural framework, instantiated as a set of matrix charts and flowcharts, to their reading and discussion of short books about different social insects (ants, bees, and termites). The outcome measures included several independently read passages, each passage successively more distant from the original social insect books. They read, in order, a passage about a fourth social insect, the paper wasp, a passage about a human society, and a passage about geographic formations such as gulfs, capes, peninsulas, and the like. As the conceptual distance between the original set of books and the testing passages increased, the effect of the intervention (compared with a group who read the same texts and answered questions and with a group that only read the texts) decreased in magnitude, but was still statistically significant, suggesting that students

were learning something about (a) insect societies, (b) social organization in general, and (c) how to unearth the structure of an informational text. From a classroom teacher's perspective, there is some comfort in knowing that content knowledge and text structure are naturally intertwined; after all, either or both represent legitimate curricular goals.

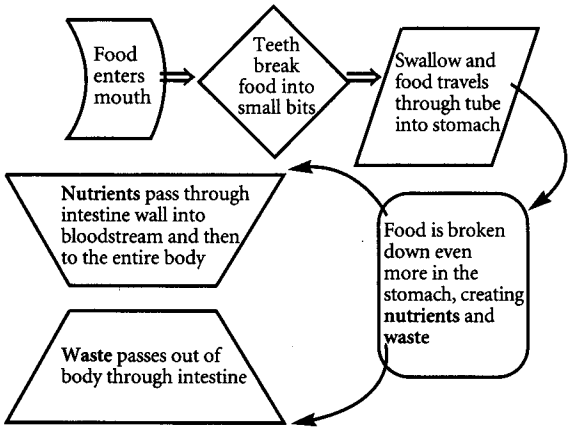
Visual representations of text. There is an old saying that a picture is worth a thousand words. When it comes to comprehension, this saying might be paraphrased, "a visual display helps readers understand, organize, and remember some of those thousand words." Compare the short text on digestion to the flow chart in Figure 10.2. The text is verbal, abstract, and eminently forgettable; by contrast, the flowchart is visual, concrete, and arguably more memorable.

Figure 10.2. Text versus visual representation

Text describing the digestive process:

When you eat, you use your teeth to break food apart into tiny particles. These pieces mix with saliva to become a kind of mush. When you swallow, the food goes through a tube into your stomach, where it is digested. During digestion, your body breaks down the food into smaller and smaller bits. The food contains things your body needs, which we call nutrients. As the food passes from the stomach into the intestine, the nutrients pass through the walls of intestine into your bloodstream. Your bloodstream carries these nutrients to all parts of your body. The part of the food that is not digested, which we call waste, passes out of the body through the intestine.

Flowchart of the digestive process:

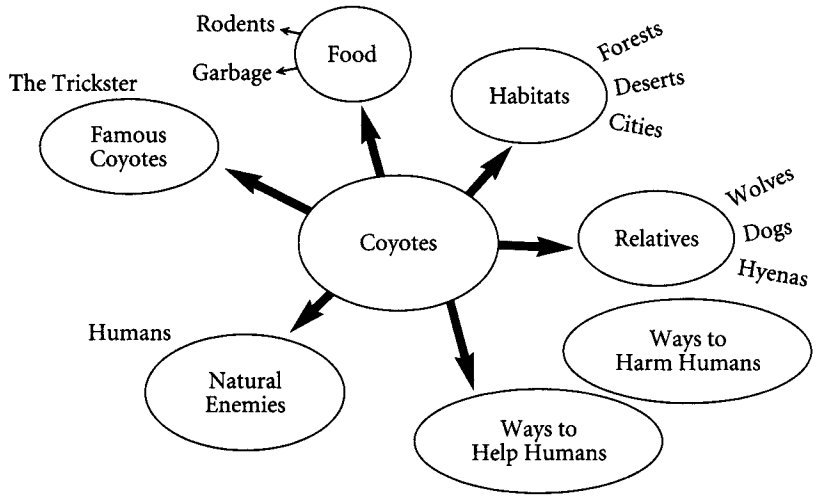


That said, we readily admit that when it comes to the use of visual representations of text, it is difficult, perhaps impossible, to specify exactly what it is that students attend to and learn when teachers use them as heuristic devices to aid in comprehension and recall. The ubiquitous use of semantic maps and webs reveals this ambiguity. Consider, for example, the web in Figure 10.3.

This could be a graphic summary of an article about coyotes. Or, it could be a map of an individual's (or a whole class's collective) knowledge about coyotes. Or, it could be a heuristic device used by a teacher to teach key vocabulary in a unit on scavenging animals. In a practical sense, as we pointed out in discussing text structure instruction, it does not really matter. To the contrary, we would expect tools and activities that improve comprehension to also enhance knowledge of text structure and vocabulary acquisition. The point about visual representations is that they are *re*-presentations; literally, they allow us to present information *again.* It is through that active, transformative process that knowledge, comprehension, and memory form a synergistic relationship—whatever improves one of these elements also improves the others.

Much of the research cited in the previous section on text structure applies to the use of visual displays. Most notable, because of their

Figure 10.3. A semantic map of the concept, coyotes



consistent use of visual displays over an extended time period, is the work of Armbruster, Anderson, and Ostertag (1987) and Gallagher and Pearson (1989). Armbruster and colleagues (1987) employed the heuristic of a general frame to assist students in learning from expository text. For example, in history, a conflict frame is useful in organizing many historical phenomena: One side wants X, the other wants Y, their desires collide in some sort of conflict (war, debate, political battle), and some sort of resolution, often tentative, is reached. In their approach to teaching frames, Armbruster and her colleagues (Armbruster et al., 1987; Armbruster, Anderson, & Meyer, 1990) have identified and successfully taught students, usually at the middle school level, to use several generic frames as tools for organizing what they are learning from their reading, among them frames for depicting conflicts, cause-effect relations, descriptions, explanations, and procedures. The effects in this work are usually quite dramatic in improving understanding and recall for the texts in which the instruction is embedded; transfer effects to new passages read without assistance or without the requirement that the frames be used is much less impressive.

An exception to the transfer effect finding is the work of Gallagher and Pearson (1989), described earlier in conjunction with text structure instruction. Recall that although transfer decreased as a function of conceptual distance from the original information domain (insect societies), it was nonetheless significant even for passages on unrelated topics. What may be central in this sort of instruction, besides consistent and persistent guidance in how and why to use the visual displays, is direct involvement in constructing the visual display along with compelling feedback to the students in the form of evidence that the arduous effort involved in *re*-presenting information pays off in terms of learning and, in the case of older students, better grades.

Summarization. Teaching students to summarize what they read is another way to improve their overall comprehension of text. Dole, Duffy, Roehler, and Pearson (1991) describe summarizing as follows:

> Often confused with determining importance, summarizing is a broader, more synthetic activity for which determining importance is a necessary, but not sufficient, condition. The ability to summarize information requires readers to sift through large units of text, differentiate important from unimportant ideas, and then synthesize those ideas and create a new coherent text that stands for, by substantive criteria, the original. This sounds difficult, and the research demonstrates that, in fact, it is. (p. 244)

Indeed, most people with relevant experience will agree that summarizing is a difficult task for many children. Many children require instruction and practice in summarizing before they are able to produce good oral and written summaries of text. Interestingly, research suggests that instruction and practice in summarizing not only improves students' ability to summarize text, but also their overall comprehension of text content. Thus, instruction in summarization can be considered to meet dual purposes: to improve students' ability to summarize text and to improve their ability to comprehend text and recall.

There are at least two major approaches to the teaching of summarization. In rule-governed approaches, students are taught to follow a set of step-by-step procedures to develop summaries. For example, McNeil and Donant (1982) teach the following rules, which draw from the work of Brown, Campione, and Day (1981) and Kintsch and Van Dijk (1978):

> Rule 1: Delete unnecessary material.
>
> Rule 2: Delete redundant material.
>
> Rule 3: Compose a word to replace a list of items.
>
> Rule 4: Compose a word to replace individual parts of an action.
>
> Rule 5: Select a topic sentence.
>
> Rule 6: Invent a topic sentence if one is not available.

Through teacher modeling, group practice, and individual practice, students learn to apply these rules to create brief summaries of text.

Other approaches to summarizing text are more holistic. One that has been the subject of research is the GIST procedure (Cunningham, 1982). In GIST, students create summaries of 15 or fewer words for increasingly large amounts of text, beginning with single sentences and working incrementally to an entire paragraph. As Cunningham describes it, GIST is conducted first as a whole class, then in small groups, and finally on an individual basis.

Working with sixth-grade students, Bean and Steenwyk (1984) studied the effectiveness of McNeil and Donant's set of rules procedure and Cunningham's GIST procedure. They found that versions of both approaches were effective not only in improving students' written summaries of text, but also in improving their comprehension of text as

measured by a standardized test. Despite being markedly different, the two approaches were roughly equal in their effectiveness, and both were superior to a control technique that involved only practice in writing summaries based on the main ideas in text.

Perhaps one of the reasons why both McNeil and Donant's and Cunningham's summary procedures are effective is that they are both consistent with an overall model of text processing that itself has stood the test of validation: Kintsch and Van Dijk's (1978) model of text comprehension posits that text is understood through a series of identifiable mental operations. These operations are necessary for understanding both the local and the more global meaning of text within the constraints of working memory, the reader's goals, and the structure of the text. Although a thorough description of these operations is beyond the scope of this chapter, they essentially involve a series of deletions, inferences, and generalizations, much like those required by the summarizing procedures later used by McNeil and Donant.

Questions/questioning. No comprehension activity has a longer or more pervasive tradition than asking students questions about their reading, whether this occurs before, during, or after the reading (see Durkin, 1978, for compelling evidence of the ubiquity of this practice). We also know much about the effect of asking different types of questions on students' understanding and recall of text, with the overall finding that students' understanding and recall can be readily shaped by the types of questions to which they become accustomed (the classic review is Anderson & Biddle, 1975, but see also Levin & Pressley, 1981; Pressey, 1926; Rickards, 1976). Thus, if students receive a steady diet of factual detail questions, they tend, in future encounters with text, to focus their efforts on factual details. If teachers desire recall of details, this is a clear pathway to shaping that behavior. If, by contrast, more general or more inferential understanding is desired, teachers should emphasize questions that provide that focus. When students often experience questions that require them to connect information in the text to their knowledge base, they will tend to focus on this more integrative behavior in the future (e.g., Hansen, 1981).

Although the impact of questions on comprehension is important, for our purposes, the more interesting questions are (a) whether students can learn to generate their own questions about text and (b) what impact this more generative behavior might have on subsequent comprehension. The research on engaging students in the process of generating questions about the texts they read, although not definitive, is generally positive and encouraging (see Rosenshine, Meister, & Chapman, 1996, for a review). Raphael and her colleagues (Raphael & McKinney, 1983; Raphael & Pearson, 1985; Raphael & Wonnacott, 1985) carried out perhaps the most elaborate line of work on question generation in the mid-1980s. Using a technique called QARs (Question-Answer-Relationships), Raphael and her colleagues modeled and engaged students in the process of differentiating the types of questions they could ask of text. Students learned to distinguish among three types of questions: (1) *Right There* QARs were those in which the question and the answer were explicitly stated in the text, (2) *Think and Search* QARs had questions and answers in the text, but some searching and inferential text connections were required to make the link, and (3) *On My Own* QARs were those in which the question was motivated by some text element or item of information, but the answer had to be generated from the students' prior knowledge. Through a model of giving students ever-increasing responsibility for the question generation, Raphael and her colleagues were able to help students develop a sense of efficacy and confidence in their ability to differentiate strategies in both responding to and generating their own questions for text.

Later research by Yopp (1988) indicated that when students learn to generate questions for text, their overall comprehension improves. In a variation that wedded the logic of QARs with the work on story schemas (e.g., Singer & Donlan, 1982), Yopp studied three different groups that varied in terms of who was taking the responsibility for question generation. In the first group, the teacher asked the questions; in the second, the students generated their own; in the third, the students generated their own and were provided with a metacognitive routine (in the manner of QAR) for answering their own questions. The second and third groups performed better on posttests given during instruction and after the instruction had ended, suggesting that student control of the questioning process is a desirable instructional goal. Furthermore, although it did not translate into higher performance on the comprehension assessments, the third group, those who received the additional metacognitive routine, were better at explaining the processes they used to answer questions.

Perhaps the most compelling evidence for the efficacy of teaching students to generate their own questions while reading comes from the research cited in the subsequent section in which we move from

individual strategies to comprehension routines. The three routines described—reciprocal teaching, transactional strategies instruction, and Questioning the Author—are all research-based approaches to teaching comprehension that, as a part of their overall approach, teach students how to ask questions about text. That the question-generation strategy works so well as part of a larger and more comprehensive routine suggests that when it is implemented in classrooms, it is probably better to use it not as a steady routine repeated for every text encountered, but as an activity that is regularly but intermittently scheduled into guided or shared reading.

Summary of the six individual comprehension strategies. To summarize, we have identified six individual comprehension strategies that research suggests are beneficial to teach to developing readers: prediction/prior knowledge, think-aloud, text structure, visual representations, summarization, and questions/questioning. Although somewhat different terminology is used, these strategies were also identified by the recent National Reading Panel (NRP) report (2000), commissioned by the U.S. Congress to evaluate research in the area of beginning reading. The NRP report also identified "Comprehension Monitoring" and "Cooperative Learning" as effective comprehension strategies. We address comprehension monitoring to some degree in the section covering think-aloud. We view cooperative learning as an instructional medium rather than a comprehension strategy, and therefore have not included it in our analysis. However, the assumption of collaborative work among students and between the teacher and students is implicit in the overall approach to comprehension we recommend in the first section of this chapter, as well as in the comprehension routines discussed later.

A great deal of research suggests that vocabulary and comprehension are inextricably linked. Thus, strategies related to ascertaining the meaning of unknown words, as well as general vocabulary building, are also essential to a strong program in comprehension instruction.