Making Inferences

WHAT IS INFERENCE MAKING?

The process of comprehending text often requires the reader to make inferences. For example, consider the sentence "Our neighbor unlocked the door." An inference you might make is that the instrument used to unlock the door was a key (Paris & Lindauer, 1976). As another example, consider the sentence "She slammed the door shut on her hand." An inference you might make is that she hurt her finger (Paris, Lindauer, & Cox, 1977).

Overall, inference making is so important to reading comprehension that "the ability to draw inferences is a cornerstone of reading competence" (Winne, Graham, & Prock, 1993, p. 53). For example, Weaver and Kintsch (1991) estimate that as many as a dozen implicit inferences may be required to understand every explicit statement in a passage fully. Yet, an important educational issue is that young readers are notoriously poor at making inferences during reading (Oakhill & Yuill, 1996).

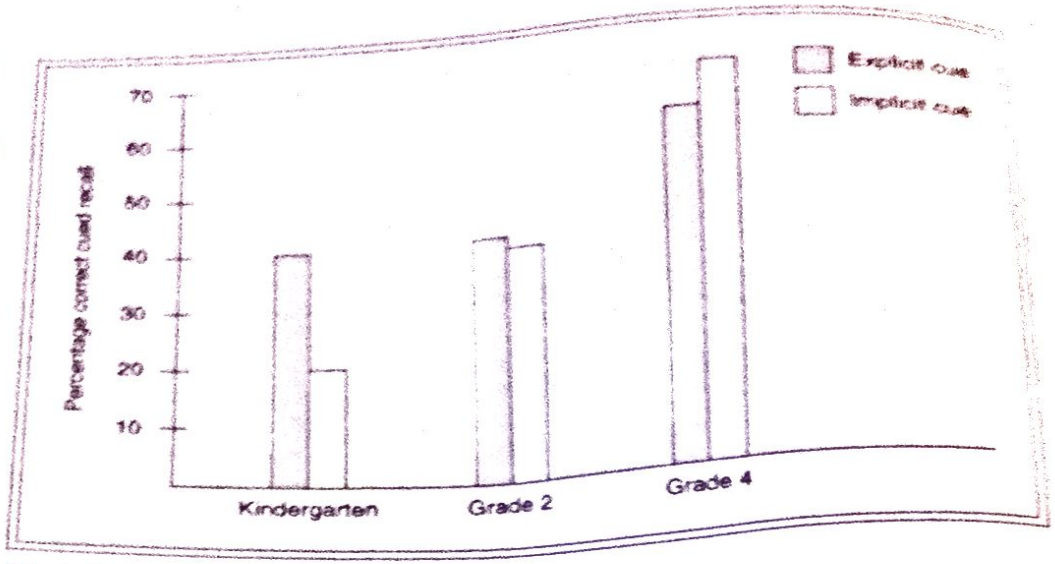
If making inferences during reading is an important component process in reading comprehension, then measures of inference making should correlate strongly with measures of reading comprehension. For example, Hannon and Daneman (2001) asked college students to take a battery of reading tests, including a general test of reading comprehension and a test of inference making while reading. The correlation ranged from .40 to .48, indicating a strong positive relation. In fact, among a large set of cognitive process measures, inference making was among the strongest predictors of reading comprehension.

RESEARCH ON INFERENCE MAKING

Development of Children's Inference Making Paris and his colleagues (Myers & Paris, 1978; Paris et al., 1977, Paris & Lindauer, 1976; Paris & Upton, 1976) found evidence of a developmental trend in which younger readers are less likely to make inferences during reading than are older readers. For example, kindergartners, second graders, and fourth graders listened to eight sentences. The sentences each suggested an implicit inference about the instrument used to carry out the action mentioned in the sentence. For example, "Our neighbor unlocked the door" implies that the instrument is a key. Students were given a cued recall test in which for each sentence the experimenter gave either an explicit cue (the subject, verb, or object of the sentence) or an implicit cue (the instrument). For example, an explicit cue for the preceding sentence is "neighbor," "unlocked," or "door," whereas an implicit cue is "key." Figure 3–19 shows the percentage of correctly recalled sentences when the cue was explicit versus implicit for each age group. For the kindergartners, performance was much better with the explicit cue, but for the second and fourth graders implicit cues were just as useful as explicit ones. Apparently, the younger children do not spontaneously go beyond the information given to make and use inferences as well as the older children. Paris et al. (1977) obtained a similar developmental trend using inferences about consequences such as the "door slamming" sentence given earlier.

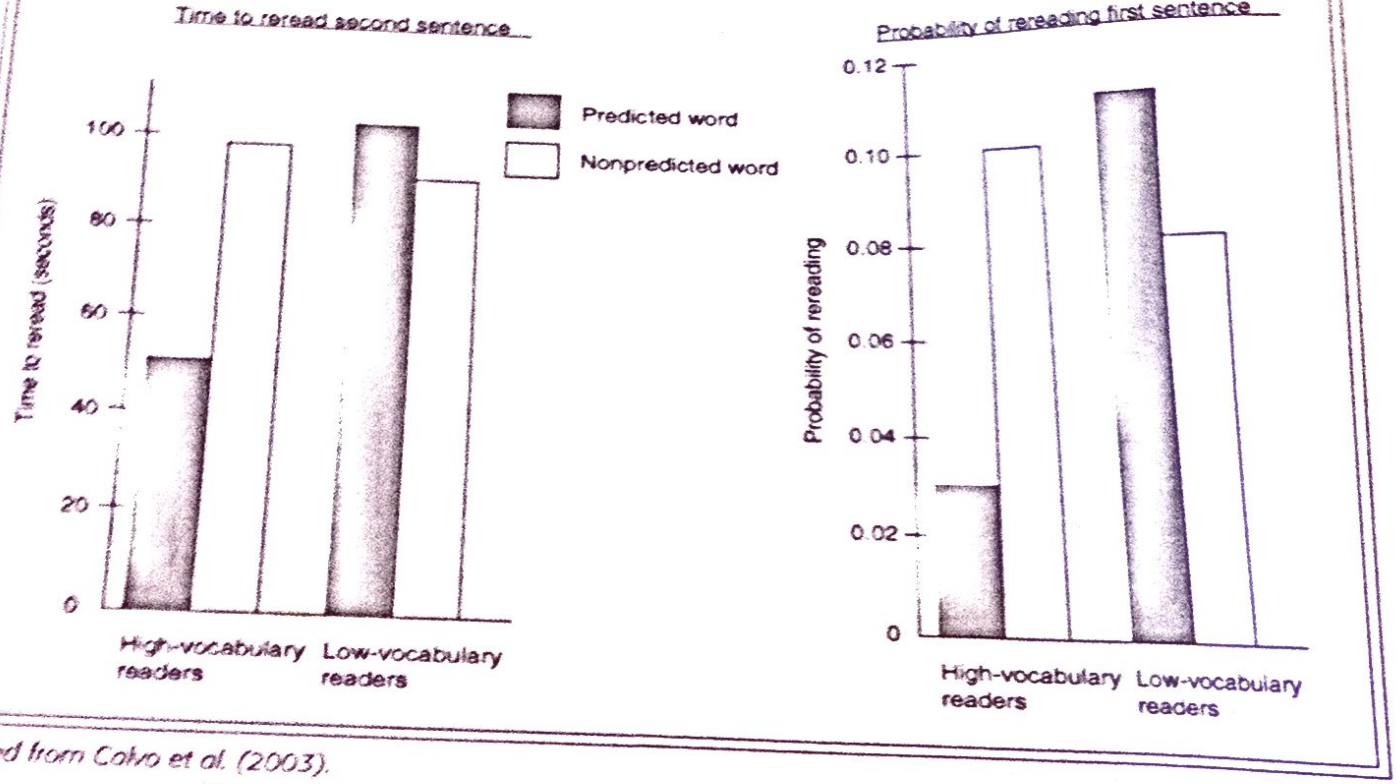
FIGURE 3–19

Age-related differences in children's use of inference



Adapted from Paris and Lindauer (1976).

FIGURE 3–20 High-vocabulary readers make inferences while reading



Adapted from Calvo et al. (2003).

In a related series of studies, Paris and Upton (1976) examined developmental changes in children's inference making for short paragraphs. Students in each Grade K–5 listened to six stories, including the following:

> Chris waited until he was alone in the house. The only sound he heard was his father chopping wood in the barn. Then he pushed the red chair over to the sink, which was full of dishes. Standing on the edge of the sink, he could just barely reach the honey jar. The jar was behind the sugar and he stretched until his fingers could lift the lid. Just as he reached inside, the door swung open and there was his little sister.

Students were asked eight questions about each passage. Half of the questions concerned verbatim memory, such as "Was the jar heavy?" or "Was the chair brown?" The other half concerned inferences, such as "Was Chris's father using an ax?" or "Was Chris caught in the act of doing something he was not supposed to do?" Performance on both verbatim and inferential questions improved with age, but there was a larger increase in inference performance. In addition, ability to make inferences was highly correlated with overall amount recalled. These results suggest that as children develop, they become more able to make inferences that give meaning to their reading of the passage.

Role of Vocabulary in Making Inferences Suppose you read the sentence "The woman went into the church, spoke with the priest for a few minutes, and afterward knelt down in front of the altar." What do you think the woman is going to do? If you said "pray," you have made a reasonable inference. Suppose the next sentence says "The woman prayed." If you have already made the inference about praying, then reading this sentence should be easy—that is, you will not need much time to read it and you probably will not need to go back and reread the previous sentence.

In contrast, suppose the next sentence says "The woman wrote." This sentence conflicts with your inference based on the previous sentence, that is, that the woman went to church to pray. If you have already made an inference about praying, then reading this sentence should be hard; that is, you will need extra time to read it and you are likely to go back and reread the previous sentence.

This is exactly the pattern of results that Calvo, Estevez, and Dowens (2003) found when they asked high-vocabulary college students to read sentences like these (although the students were Spanish speaking and the material was in Spanish). As you can see in Figure 3–20, high-vocabulary students spent about half as much time rereading the second sentence when it was predictable (i.e., involved praying) than when it was not (i.e., involved writing), and were less than half as likely to go back and reread the first sentence. However, low-vocabulary students did not show any evidence of making inferences while reading the first sentence. Unlike the high-vocabulary students, they did not spend less time reading the second sentence when it was predictable, nor did they reread the first sentence less often when the second sentence was predictable. Calvo et al. (2003) propose that readers with larger vocabularies are more likely to find the inferred word (e.g., pray) in their long-term memory within the short time available, whereas readers with smaller vocabularies need more time to search for an appropriate word in their long-term memory. In this way, a higher order comprehension skill (inference making) depends on a lower level reading skill (accessing word meaning).

IMPLICATIONS FOR INSTRUCTION: INFERENCE TRAINING

Inference training is a central feature of most basal reading programs (Pressley, 1990; Rosenshine, 1980) and of many traditional reading programs. However, until recently there has been little empirical research concerning the effectiveness of inference training. For example, Hansen (1981) developed a 5-week classroom program for second graders. Some students were given practice in answering inference questions for each of several practice passages; other students used the same practice passages in class but followed the normal instructional program. On a posttest, all students read new passages and answered some literal and inference questions about the passages. The question-trained group performed 12% better than the control group on literal questions and 26% better on inference questions. However, a group that received training in the use of prereading strategies, such as trying to predict what would happen or relating the story to their own experiences, did not show strong posttest advantages over the control group. Apparently, an effective way to teach students how to answer inference questions is to give them direct instruction and practice in answering inference questions.

In a follow-up study, Hansen and Pearson (1983) provided 5 weeks of inference training to poor and good fourth-grade readers. The training included prereading strategies such as discussing the readers' own experiences and making predictions about the story. For example, the script for prereading strategies was as follows:

TEACHER: What is it that we have been doing before we discuss each story?
DESIRED RESPONSE: We talk about our lives and we predict what will happen in the stories.
TEACHER: Why do we make these comparisons?
DESIRED RESPONSE: These comparisons will help us understand the stories.
TEACHER: Last week I asked you to think about a social studies lesson on Japan. Today, pretend that you are reading a science article about conservation. What might you be thinking about while you are reading the article?
DESIRED RESPONSE: [Students relate personal experiences with conservation and explain how the experiences would be related to the text. For example, students talk about how their families heat with wood to conserve oil and state that they want to find out how the Japanese conserve oil.]

Training for a story on a man who is embarrassed by his appearance focused on understanding the main ideas:

TEACHER: Sometimes people are embarrassed by their personal appearance. Tell us about a time you were embarrassed about the way you looked.
TYPICAL RESPONSES: I got a short haircut. I wore short pants. I'm too short.
TEACHER: In the next story there is an old man who is embarrassed about the way he looks. What do you think is the thing that embarrasses him?
TYPICAL RESPONSES: Ragged clothes. Cane. Gray hair. Wrinkles.

These prereading scripts led to discussions that lasted approximately 20 minutes. Then students read the passage independently. Students in the control group did not engage in the prereading activities. After reading the story, the class

10 questions. For the trained group, all the questions required inferences. For example, in a discussion of a basal version of *Charlotte's Web*, the teacher asked, "What kind of person do you think Templeton [the rat] would be if he were human?" The control group discussion involved questions using the ratio of four literal questions for each inference question. This ratio corresponds to the normal pattern of reading discussions. Following the training program, students were tested by asking them to read a passage appropriate for their reading level and to answer both literal and inference questions. Figure 3–21 shows that the training seems to have had no effect on the good readers, presumably because they already possessed good inference strategies. However, Figure 3–21 also indicates that the training greatly enhanced the performance of the poor readers on both inference and literal questions.

Does inference training affect students' reading comprehension performance? To help answer this question Yuill and Oakhill (1988; Oakhill & Yuill, 1996) provided seven 30-minute training sessions to 7- and 8-year-olds who had scored either low or high on a test of reading comprehension. In the training, students read short stories, performed several inference-inducing tasks with them, and then received feedback and discussed their answers. One task was to generate questions based on a short passage, such as shown in Figure 3–22. Some possible questions that students could generate for this story are "Where was Lucy?" "Why was she there?" and "Why couldn't she move?" A second task was to identify words in the story that suggested what a character was like, where the story takes place, and the like. In a third task, part of the text was covered, and students were asked to guess at what was missing.

Students were given a reading comprehension test before and after the training period. For those who had done poorly on the pretest, scores increased greatly for the trained group but not for a control group that received practice in decoding. For those who had done well on the pretest, the trained group did not show large gains, nor did it gain more than the control group. Overall, these results show that inference training has a strong effect on students who score low in reading comprehension, suggesting that the ability to make inferences is a key component in skilled comprehension.

Although many students develop reading comprehension competence in elementary school, some do not. These students are often labeled as "learning disabled" and receive special pull-out instruction during the academic year. Will inference training help these young readers? Winne et al. (1993) tackled this question by providing nine sessions of inference training to a group of students in Grades 4 through 6 who had poor comprehension skills. During the sessions, students worked individually with an adult tutor on answering inference questions about short texts.

For example, in one session the tutor read the summer camping passage in Figure 3–23 and then asked the student to answer a series of questions aimed at promoting inference making, such as those in the bottom of Figure 3–23. The correct answer to the first question is that the boys camped near the pond; this answer can be derived by noting that "the boys decided that their campsite should be near some water" and that only one of the available sites was near water. After each answer, some students received feedback on the correct answer and were shown where in the text it was found (abbreviated feedback group), whereas others received the same feedback along with explanations of how the answer could be derived from the relevant portion of the text (explanatory feedback group). As expected, students in the explanatory feedback group showed more

FIGURE 3–23 An inference-training exercise based on answering questions

Read this passage:

It was summer at last! John and Peter were going camping. They wanted to find a really good campsite this year. Last summer they were almost two kilometers from the store and ice cream stand.

Both the boys loved camping. John had been a Boy Scout for five years. Peter and his mother had camped in the woods every summer when he was younger. This year, the boys decided that their campsite should be near water.

When they arrived at the campground, the park ranger told them that only two campsites were left. "One site is close to a Dairy Queen store," he said. "There are many beautiful wild flowers nearby. The other site is by a small pond. It is a peaceful camping spot away from other campers. However, there are lots of insects there."

Answer these questions:

1. Where did the boys camp?
   (Answering this question requires making an inference, namely, that the boys camped near a pond.)
2. Why?
   (Answering this question requires remembering a rule—"their campsite should be near some water"—and a critical fact—"the other site . . . by a small pond" was the only available site near water.)
3. What did John and Peter want to find?
   (The answer is "a really good campsite." The reader must notice that this is the problem statement, that is, the main problem in the story.)
4. What sort of a campsite had the boys decided they wanted this year?
   (The answer is one "near some water." The reader must note that it is a rule, that is, a major constraint in the story.)
5. What campsites did the ranger give the boys to choose from?
   (The answer is "one site is close to a Dairy Queen" and "the other site is by a small pond." The reader must determine that these are the important relevant facts in the story.)
6. What was wrong with the campsite by the pond?
   (Although the answer is that "there are lots of insects there," the reader must also realize that this information is not relevant to the boys' decision.)

Adapted from Winne et al. (1993).

improvement in their inference making than did those in the abbreviated feedback group. The results suggest that students with poor comprehension skills need practice not only in inference making but also in explaining how the inferences are made.

Using Metacognitive Knowledge

WHAT IS METACOGNITIVE KNOWLEDGE?

Metacognition is knowledge and awareness of one's own cognitive processes. Brown et al. (1981) pointed out that although metacognitive skills are particularly difficult to teach to readers, they are crucial for effective reading. For example, one kind of metacognitive knowledge related to reading is *comprehension monitoring*, which we focus on in this section.

How can we evaluate a student's level of metacognitive awareness of reading strategies? Mokhtari and Reichard (2002) developed a questionnaire containing 30 statements such as listed in Figure 3–24, and asked students in Grades 6–12 to circle 1 for "I never or almost never do this," 2 for "I do this only occasionally," 3 for "I sometimes do this (about 50% of the time)," 4 for "I usually do this," and 5 for "I always or almost always do this." A factor analysis—which calculates which items tend to go together—was used to sort the items into three categories: global reading strategies, which involved global analysis of the text; problem-solving strategies, which involved addressing difficulties in reading; and support reading strategies, which involved specific learning strategies. Examples of items that measure each these categories are shown in Figure 3–24. As you can see, comprehension

FIGURE 3–24 Examples of items intended to measure students' metacognitive awareness of reading strategies

GLOBAL READING STRATEGIES

I have a purpose in mind when I read.
I skim the text first by noting characteristics like length and organization.
I decide what to read closely and what to ignore.
I think about whether the content of the text fits my purpose.

PROBLEM-SOLVING STRATEGIES

I try to get back on track when I lose concentration.
I stop from time to time to think about what I'm reading.
I adjust my reading speed according to what I am reading.
When text becomes difficult, I reread to increase my understanding.

SUPPORT READING STRATEGIES

monitoring falls within the second category (problem-solving strategies) and is the focus of this section. In addition, the third category is addressed in Chapter 11 on learning strategies.

Is comprehension monitoring related to reading comprehension? To answer this question, Cain, Oakhill, and Bryant (2004) asked 100 students to take a series of tests during academic years when they were 8, 9, and 11 years old. The tests included a reading comprehension test, a word reading test, and a comprehension monitoring test. Reading comprehension was measured by asking students to read passages and answer questions about them; word reading involved reading words aloud in sentences; and comprehension monitoring was measured by giving students a story that contained conflicting statements and then asking them to underline any parts that did not make sense and explain why they did not make sense.

Table 3–2 shows that comprehension monitoring was highly correlated with reading comprehension (that is, the focus of advanced reading instruction above Grade 3) for each of the three age levels, but as expected, comprehension monitoring was not strongly correlated with word reading (i.e., the focus of beginning reading instruction in Grades K–3). In addition, when the effects of word reading, vocabulary, verbal ability, and working memory capacity were statistically removed, comprehension monitoring still contributed strongly to the children's reading comprehension scores at each of the three age levels. For example, individual differences in comprehension monitoring scores accounted for about 5% to 10% of the variance in reading comprehension scores, beyond the effects of the other tests.

RESEARCH ON DIFFERENCES IN METACOGNITIVE KNOWLEDGE

Comprehension Monitoring Comprehension monitoring is an awareness of whether you understand what you are reading. In essence, a reader with good comprehension monitoring skills is continually asking, "Does this make sense?" To study comprehension monitoring, Markman (1979) read three short essays to third, fifth, and sixth graders. Each story contained either an explicit or an implicit inconsistency as shown in italics in Figure 3–21. For example, the inconsistency in the fish essay is that there is not enough light at the bottom of the ocean to see colors and that fish see the color of their food at the

BLE 3–2

rrelations ing com- ehension toring at ree age levels

Age Level	Comprehension Monitoring and Reading Comprehension	Comprehension Monitoring and Word Reading
8 years	.49	.10
9 years	.48	.25
11 years	.39	−.14

From Cain, Oakhill, and Bryant (2004).

Did the children respond to these prompts by referring to the inconsistency in the passage? Figure 3–25 lists the percentage of students at each grade level who recognized the inconsistency in at least two out of three essays. As you can see, about half the students found the explicit inconsistencies in at least two essays, whereas almost none found the implicit inconsistencies. Apparently, it is difficult for students to recognize spontaneously that the text they are reading is incomprehensible, especially when inconsistencies are implicit.

Can Children Be Induced to Monitor Their Comprehension? To test this question, Markman (1979) conducted a follow-up study on third and sixth graders using the same texts described above. However, this time half the children were told, "There is something funny about each of the essays. Something which does not make any sense. Something which is confusing. I would like you to try and spot the problem with each essay, and tell me what it was that did not make any sense." These instructions did not greatly influence the ability of the third graders to find either implicit or explicit inconsistencies, but it did greatly improve the ability of the sixth graders to find both. Apparently, the older children are capable of comprehension monitoring but do not engage in this activity spontaneously.

Myers and Paris (1978) interviewed second and sixth graders concerning their metacognitive knowledge about reading. Some of the questions focused on comprehension monitoring, such as "Do you ever have to go back to the beginning of a paragraph or story to figure out what a sentence means? Why?" About 60% of the sixth graders were able to explain why they reread (e.g., to get context cues); in comparison, less than 10% of the second graders were able to explain why they reread. Apparently, younger readers are less aware of the role of comprehension monitoring in reading.

These results suggest that skilled readers are able to focus on inconsistencies in text. To examine this idea, Baker and Anderson (1982) asked college students to read short expository passages, some of which contained inconsistencies. The passages were presented on a computer terminal screen with only one sentence on the screen at a time. The reader pressed the "Next" button to see the next sentence, the "Back" button to see the previous sentence, and the "Lab" button to start over at the beginning of the passage. The results indicate that readers spent much more time reading a sentence that conflicted with previously presented information compared to reading the same sentence in a consistent passage. In addition, skilled readers were far more likely to look back to an inconsistent sentence than to the same sentence when it was in a consistent passage. These results suggest that comprehension monitoring is a characteristic of skilled readers.

Why Do Children Fail to Recognize Inconsistencies in a Passage? There are two major explanations as to why children fail to detect inconsistencies in passages. According to a representational theory, students fail to adequately represent and retain the two inconsistent statements in their working memory. According to a processing theory, students adequately represent the two conflicting statements in working memory but fail to compare them adequately. To test these two theories, Vosniadou, Pearson, and Rogers (1988) asked first, third, and fifth graders to listen to (or read) stories, such as the one partially shown in Figure 3–26. As you can see, the stories contain contradictions, such as the sentence in Figure 3–26 stating "When you pour spaghetti and water into a strainer, the water passes through the holes and the spaghetti stays in the strainer," and another sentence stating that when Georgette poured the spaghetti and water into the strainer, "the

Then, each child was asked to recall the story, to say what about it did not make sense, and to justify the answer.

The left panel of the table in Figure 3–20 shows a developmental trend in which younger readers tended to miss the inconsistencies, whereas older readers were more likely to catch them. In addition, third graders were more likely to notice the inconsistencies when they listened to the story than when they read it themselves, presumably because they had less attentional capacity available when they had to do the reading. The right panel of the table shows a developmental trend in which younger readers were less successful at remembering the conflicting statements than were older students. The recall data show that younger readers' difficulties in detecting inconsistencies occurred mainly because younger readers were more likely than the older readers to forget the inconsistent information. Vosniadou et al. (1988) concluded that "greater attention should be paid to how children's mental representations of text affect inconsistency detection and comprehension monitoring" (p. 36). According to this view, an important factor in comprehension monitoring is the prior knowledge of the reader, because inconsistent statements are more easily represented (and therefore compared) when they are familiar to the reader.

Why Do Some Readers Fail to Engage in Comprehension Monitoring? Why do some students fail to use metacognitive strategies during reading? A recent study by Linderholm and van den Broek (2002) suggests that students who have more working memory capacity use different reading strategies than those with low working memory capacity. Working memory capacity is the amount of cognitive processing that a person can engage in at any one time, and was measured by a reading span task (Daneman & Carpenter, 1980). Students are given a stack of index cards with a sentence on each, and divided into sets of two to six cards each. They are asked to read each sentence aloud and after two to six cards are asked to recite the last word in each of the previous sentences in the set. The total number of words recalled indicates *reading span*, which is a measure of working memory capacity relevant to reading.

Linderholm and van den Broek (2002) asked college students to read articles from *Scientific American* titled "Origins of the Moon" or "Why Songbirds Are Vanishing." They were told to read as if they were preparing for an essay exam in a class. They were told to read the article aloud, one sentence at a time, and to verbally reflect on their understanding of the sentence. Table 3–3 shows that high-working-memory students made many

TABLE 3–3 Number of comments per sentence during reading by low- and high-working-memory readers

	Type of Comment		
	Monitor Comprehension	**Reread Text**	**Express Opinion**
Low-working-memory capacity	0.26	0.07	0.09
High-working-memory capacity	0.42	0.01	0.01

Adapted from Linderholm and van den Broek (2002).

more metacognitive comments (i.e., comments about how well they comprehended the sentence) than did low-working-memory students. In contrast, low-working-memory students were more likely to reread a sentence or express a puzzle or misunderstanding than were high-working-memory students. Apparently, having more working memory capacity enables students to allocate more attention to demanding reading strategies, such as comprehension monitoring, rather than less demanding ones, such as rereading or expressing an opinion.

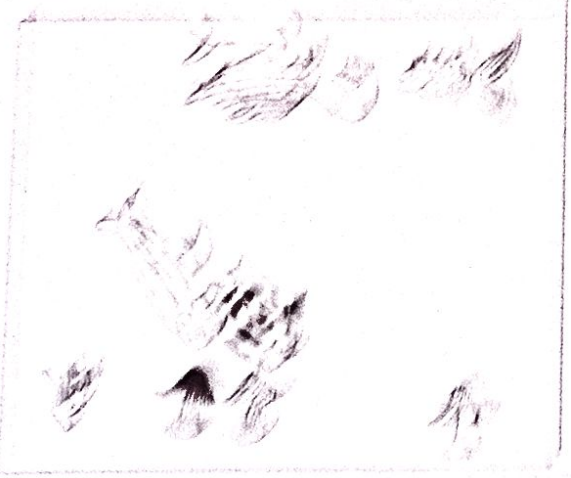
IMPLICATIONS FOR INSTRUCTION: COMPREHENSION MONITORING TRAINING

When low-skill readers in the third grade were asked to read stories containing inconsistencies, they detected only 13% of the inconsistencies (Rubman & Waters, 2000). What can we do to increase their comprehension monitoring performance? Rubman and Waters asked third and sixth graders to read a story that had an inconsistency such as the fish story used by Markman (1979) in Figure 3–25. Then, some students were asked to read the story again while placing cutouts (such as red fungus plants and fish with big eyes) on a magnetic board. The top of Figure 3–27 shows an example of the pictures constructed for the fish story. Other students simply read the story a second time. After the second reading, all students were explicitly asked, "Did everything in the story make sense?" and "Was there anything wrong with the story?" as well specific questions such as "What color is food the fish eat?" "How can fish tell what color their food is?" "Is it light or dark at the bottom of the ocean?" and "Do you think that the fish can see the color of their food in the dark?" The bottom of Figure 3–27 shows the percentage of high-skill readers and low-skill readers in Grades 3 and 6 who detected inconsistencies in the storyboard construction and read only treatments. As you can see, students detected more inconsistencies when they constructed a pictorial version of the story, and this effect was particularly strong for the low-skill readers in the third grade.

Why did storyboard construction produce such strong improvements in inconsistency detection? Rubman and Waters (2000) propose that low-skill readers may view their task as decoding the words rather than making sense of the passage (that is, as learning to read rather than reading to learn). Accordingly, the storyboard construction task "encouraged the less skilled readers to pay attention to the meaning of the text" and "changed the focus of the less skilled readers from pure decoders to more meaningful text processors" (p. 510). Thus, an important step in the promotion of comprehension monitoring strategies is to help students learn how to make sense of text passages.

Can children learn to be more effective comprehension monitors? In a classic study, Markman and Gorin (1981) provided encouraging evidence that students more accurately detect inconsistencies in text when they are given some instruction in how to do so. Eight- and 10-year-olds listened to a series of short stories that either did or did not contain inconsistencies, and then indicated after each story whether it was easy to understand or if they had some problem understanding it. For example, the following story has an inconsistency between the second and final sentences:

> Corn can be served in many ways. I've never met anyone who didn't consider corn, in one form or another, one of their favorite foods. Corn can be steamed and served with melted



Group	[illegible]	[illegible]
Low-skill third graders	[illegible]	[illegible]
High-skill third graders	[illegible]	[illegible]
Low-skill sixth graders	[illegible]	[illegible]
High-skill sixth graders	[illegible]	[illegible]

Other students did not receive these examples (control group).

Figure 3–28 shows the percentages of 8- and 10-year-old students in each group who correctly detected inconsistencies. Those who had received instructions on how to detect inconsistencies performed better than did those who had not. The instructions were particularly helpful for the 10-year-olds, suggesting that they had known the strategy but detecting inconsistencies but had not been fully aware that they should use it in this task before instruction. Markman and Gorin (1981) concluded that "when children are given examples of what types of problems to look for, they are capable of adjusting their standards of evaluation" (p. 325).

In an important extension of this study, Elliot-Faust and Pressley (1986) asked third graders to listen to four stories, two of which contained inconsistencies such as the following:

> The sea horse is a fascinating fish. Sea horses are found in oceans and seas. Sea horses are very small. Sea horses grow to be twelve centimeters long. The sea horse's head looks like a tiny horse's head. The sea horse has a small body and a long tail. When the sea horse swims it looks like it's standing on its tail. It moves through the water by moving its fins on its head and back. The sea horse is not a very fast swimmer. It makes jerky movements as it swims. The sea horse moves slowly through the water. The sea horse escapes enemy fish by swimming quickly away. That is how the sea horse keeps from being eaten by other fish. That's the story about sea horses. (p. 28)

After listening to each story the students were asked, "Did the story make sense?" If they answered no, the experimenter asked, "Why?" and "What part didn't make sense?" In this example, the correct answer is to point out the contradiction between "the sea horse is not a very fast swimmer" and "the sea horse escapes enemy fish by swimming quickly away."

Some students were given examples of inconsistent sentences (instructed group), whereas others received no training (control group), as in the Markman and Gorin (1981) study. In addition, some students (strategy group) received the same training as the

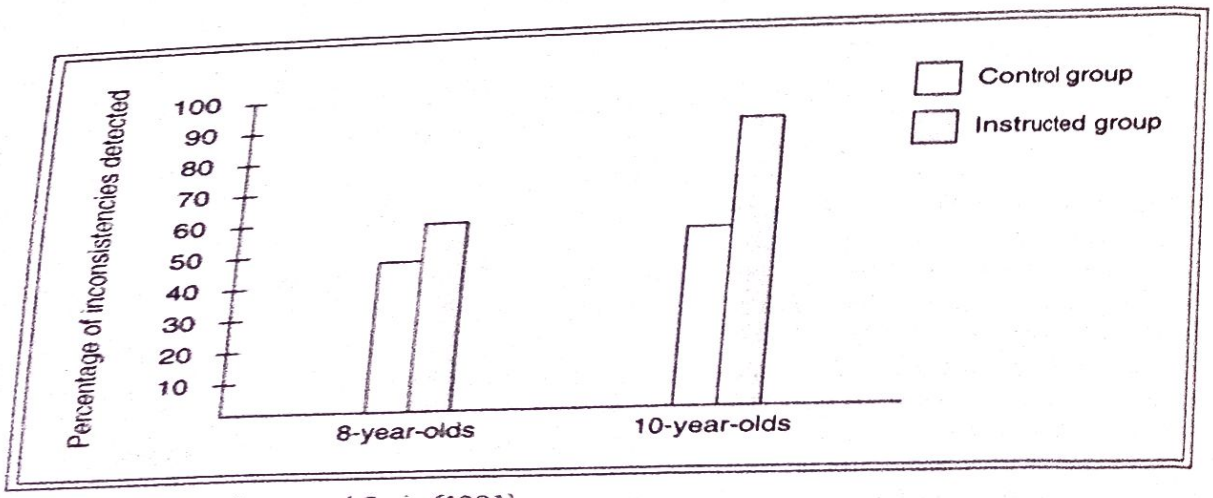


FIGURE 3–28

Percentage of inconsistencies detected by four groups

Adapted from Markman and Gorin (1981).

instructed group as well as explicit training in how to use comprehension monitoring strategies for detecting contradictions between sentences. The strategy training included practice in controlling one's use of comprehension monitoring strategies by asking questions such as "What is my plan?" "Am I using my plan?" and "How did I do?" As in the Markman and Gorin study, the instructed group detected more inconsistencies (73%) than the control group (37%). In addition, the strategy group detected more inconsistencies (91%) than either of these groups. These results demonstrate that extended strategy training can greatly improve the comprehension monitoring skills of young readers.

What can be done to help students develop appropriate metacognitive skills? Based on research on children's comprehension monitoring, Markman (1985) makes the following suggestions:

1. Children should read a "variety of well-organized, tight passages" that involve "simple logical, causal, and temporal relations" (p. 288). Unfortunately, textbooks written for young children often are unstructured, with many paragraphs consisting of lists of descriptive sentences. Thus, they do not offer children practice in determining whether the material makes sense, because the text has often been rewritten to minimize logical, causal, or temporal structure. In addition, children should be asked to predict the next logical event or the actions of a character, to infer the order of events in a causal sequence, to guess the cause of an event, or to infer the motives of a character.
2. Children should be given a set of general questions to ask themselves as they read, such as "Do I understand?" "What is the main point?" "What else do I know that is related?" Self-testing has been successfully used in improving the reading comprehension of developmentally delayed children (Brown, Campione, & Barclay, 1979, cited in Markman, 1985).
3. Children should be exposed to teachers who model appropriate comprehension monitoring techniques.
4. Children should practice evaluating explanations of a passage, such as choosing which of several possible explanations makes the most sense.
5. Children should practice detecting inconsistencies or other problems in text.

In summary, children often fail to use appropriate comprehension monitoring and related skills, even though they are capable of doing so. Instruction in using metacognitive knowledge may improve their comprehension performance. Clearly, research is needed to help determine how to apply these recommendations to the needs of individual children.

Chapter Summary

The research on reading comprehension presented in this chapter demonstrates that progress is being made in identifying the strategies that successful readers use and in teaching these strategies to beginning readers. In particular, this chapter focused on four active cognitive processes in reading that can be taught:

Integrating: Using one's prior knowledge to make sense out of text.
Organizing: Identifying important ideas and the relationships among them.

Elaborating: Making necessary inferences while reading.
Monitoring: Evaluating one's comprehension and adjusting one's reading strategy.

Accumulated research evidence from the past 25 years shows that it is possible to help students learn component skills such as how to write a summary of a passage, how to predict what will come next, how to clarify a sentence, how to generate questions, and how to detect inconsistencies (Pearson & Fielding, 1991; Pressley & Woloshyn, 1995). These findings are consistent with Bartlett's (1932) vision of reading comprehension as an active search for meaning.

The task for any effective reading program is to incorporate successful techniques into an integrated reading program for classroom use. As we observed in this chapter, a large body of scientific research addresses how readers use their prior knowledge, make judgments of importance, draw inferences, and monitor their comprehension process. Because school reading comprehension instruction is shaped by a few major basal reader series (Chall & Squire, 1991; Rosenshine, 1980), it would make sense for such programs to be coordinated with research on reading comprehension. An important trend for the future would be for reading programs to be developed in accord with the research on reading and for theories of reading instruction to be tested within the context of real school reading programs.

This chapter briefly explored the processes by which a reader comes to understand a passage, that is, the processes of reading comprehension. We began by examining Bartlett's (1932) concept of effort after meaning, the view that reading involves trying to make sense out of what is presented. Then, we explored four cognitive processes involved in reading comprehension: using prior knowledge, using prose structure, making inferences, and engaging in comprehension monitoring.

First, this chapter presented examples of the well-documented evidence concerning prior knowledge. For both adults and children, a reader who has appropriate background knowledge comprehends a passage differently from one who lacks such knowledge. In particular, a reader with rich background knowledge is more likely to make inferences that give coherence to the passage.

Second, this chapter presented examples of the well-documented evidence concerning prose structure. For adults and older children, readers are more likely to remember important information than unimportant information from a passage. However, younger readers are less likely to be able to distinguish between important and unimportant information in the text and are less likely to spend their study time focusing on the important information.

Third, this chapter examined examples of research concerning inference making during reading. Younger readers are much less likely than older readers to make inferences spontaneously. Although answering inference questions can be taught, the general effects of inference training on reading comprehension are not yet clear.

Fourth, this chapter examined the research on metacognitive processes such as comprehension monitoring. Again, some evidence indicates that younger readers are less likely than older readers to monitor their performance or to alter their reading strategy for different tasks.

For each of these cognitive processes in reading comprehension, we explored exemplary research studies in which students could be taught to use the process. This chapter points to the crucial contribution of the reader's existing knowledge—content, strategic, and metacognitive—in the reading process. Given the emerging research base on teaching

reading comprehension processes, it may soon be possible to build an integrated reading comprehension program that develops students' content, strategic, and metacognitive knowledge for reading.

SUGGESTED READINGS

Barr, R., Kamil, M. L, Mosenthal, P., Pearson, P. D., & Bar, R. (Eds.). (2000). *Handbook of reading research (Vol. 3)*. New York: Longman. (A collection of papers by leading researchers on reading.)

Bartlett, F. C. (1932). *Remembering*. London: Cambridge University Press. (Presents work that was the forerunner of modern cognitive research on learning from prose.)

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

Paris, S., & Stahl, S. (Eds.). (2005). *Children's reading comprehension and assessment*. Mahwah, NJ: Erlbaum. (Presents up-to-date reviews of research on reading comprehension.)