Knowledge Is Essential to Reading Comprhension

Background knowledge helps you understand what someone is talking about or writing. In the last section I gave a couple of rather obvious examples: if a vocabulary word (for example, *yegg*) or a concept (for example, *marine organic compound*) is missing from your long-term memory, you'll likely be confused. But the need for background knowledge is deeper than the need for definitions.

Suppose a sentence contains two ideas—call them A and B. Even if you know the vocabulary and you understand A and B, you still might need background knowledge to understand the sentence. For example, suppose you read the following sentence in a novel:

> "I'm not trying out my new barbecue when the boss comes to dinner!" Mark yelled.

You could say that idea A is Mark trying out his new barbecue, and idea B is that he won't do it when his boss comes to dinner. To understand the sentence, you need to understand the *relationship* between A and B, but not provided here are the two pieces of information that would help you bridge A and B: that people often make mistakes the first time they use a new appliance and that Mark would like to impress his boss. Putting these facts together would help you understand that Mark is afraid he'll ruin the food the first time he uses his new barbecue, and he doesn't want that to be the meal he serves to his boss.

Reading comprehension depends on combining the ideas in a passage, not just comprehending each idea on its own. And writing contains gaps—lots of gaps—from which the writer omits information that is necessary to understand the logical flow of ideas. Writers assume that the reader has the knowledge to fill the gaps. In the example just given, the writer assumed that the reader would know the relevant facts about new appliances and about bosses.

Why do writers leave gaps? Don't they run the risk that the reader *won't* have the right background knowledge and so will be confused? That's a risk, but writers can't include all the factual details. If they did, prose would be impossibly long and tedious. For example, imagine reading this:

> "I'm not trying out my new barbecue when the boss comes to dinner!" Mark yelled. Then he added, "Let me make clear that by *boss* I mean our immediate supervisor. Not the president of the company, nor any of the other supervisors intervening. And I'm using *dinner* in the local vernacular, not to mean 'noontime meal,' as it is used in some parts of the United States. And when I said *barbecue*, I was speaking imprecisely, because I really meant grill, because *barbecue* generally refers to slower roasting, whereas I plan to cook over high heat. Anyway, my concern, of course, is that

my inexperience with the barbecue (that is, grill) will lead to inferior food, and I hope to impress the boss."

We've all known someone who talks that way (and we try to avoid him or her), but not many; most writers and speakers feel safe omitting some information.

How do writers (and speakers) decide what to omit? It depends on whom they're writing for (or speaking to). Have a look at Figure 4. What would the woman pictured there say if someone asked her, "What are you doing?"

If she were talking to a two-year-old she might say, "I'm typing on a computer." But that would be a ridiculous answer for an adult. Why? Because the typist should assume that the adult knows she's typing. A more appropriate response might be, "I'm filling out a form." Thus we calibrate our answers, providing more or less (or different) information depending on our judgment of what the other person knows, thereby deciding what we can safely leave out and what needs to be explained.*

FIGURE 4:
What would this woman say if someone asked her, "What are you doing?" The answer depends on who asked.

What happens when the knowledge is missing? Suppose you read the following sentence:

I believed him when he said he had a lake house, until he said it's only forty feet from the water at high tide.

If you're like me, you're confused. When I read a similar passage, my mother-in-law later explained to me that lakes don't have appreciable tides. I didn't have that bit of background knowledge that the author assumed I had, so I didn't understand the passage.

So, background knowledge in the form of vocabulary is not only necessary in order to understand a single idea (call it A), but it's also necessary in order to understand the connection between two ideas (A and B). In still other situations, writers present multiple ideas at the same time—A, B, C, D, E, and F—expecting that the reader will knit them together into a coherent whole. Have a look at this sentence from Chapter Thirty-Five of *Moby-Dick:*

Now, it was plainly a labor of love for Captain Sleet to describe, as he does, all the little detailed conveniences of his crow's-nest; but

> though he so enlarges upon many of these, and though he treats us to a very scientific account of his experiments in this crow's-nest, with a small compass he kept there for the purpose of counteracting the errors resulting from what is called the "local attraction" of all binnacle magnets; an error ascribable to the horizontal vicinity of the iron in the ship's planks, and in the Glacier's case, perhaps, to there having been so many broken-down blacksmiths among her crew; I say, that though the Captain is very discreet and scientific here, yet, for all his learned "binnacle deviations," "azimuth compass observations," and "approximate errors," he knows very well, Captain Sleet, that he was not so much immersed in those profound magnetic meditations, as to fail being attracted occasionally towards that well replenished little case-bottle, so nicely tucked in on one side of his crow's-nest, within easy reach of his hand.

Why is this sentence so hard to understand? You run out of room. It has a lot of ideas in it, and because it's one sentence, you try to keep them all in mind at once and to relate them to one another. But there are so many ideas, you can't keep them all in mind simultaneously. To use the terminology from Chapter One, you don't have sufficient capacity in working memory. In some situations, background knowledge can help with this problem.

To understand why, let's start with a demonstration. Read the following list of letters once, then cover the list and see how many letters you can remember.

X C N
N P H
D F B
I C I
A N C
A A X

Okay, how many could you remember? If you're like most people, the answer would perhaps be seven. Now try the same task with this list:

X
C N N
P H D
F B I
C I A
N C A A
X

You probably got many more letters correct with this second list, and you no doubt noticed that it's easier because the letters form acronyms that are familiar. But did you notice that the first and second lists are the same? I just changed the spacing to make the acronyms more apparent in the second list.

This is a working memory task. You'll remember from Chapter One that working memory is the part of your mind in which you combine and manipulate information—it's pretty much synonymous with consciousness. Working memory has a limited capacity (as discussed in Chapter One), so you can't maintain in your working memory all of the letters from list one. But you can for list two. Why? Because the amount of space in working memory doesn't depend on the number of letters; it depends on the number of meaningful objects. If you can remember seven individual letters, you can remember seven (or just about seven) meaningful acronyms or words. The letters *F, B,* and *I* together count as only one object because combined they are meaningful.

The phenomenon of tying together separate pieces of information from the environment is called *chunking*. The advantage is obvious: you can keep more stuff in working memory if it can be chunked. The trick, however, is that chunking works only when you have applicable factual knowledge in long-term memory. You will see *CNN* as meaningful only if you already know what CNN is. In the first list, one of the three-letter groups was *ICI*. If you speak French, you may have treated this group as a chunk, because *ici* is French for "here." If you don't have French vocabulary in your long-term memory, you would not treat *ICI* as a chunk. This basic effect—using background knowledge to group things in working memory—doesn't work only for letters. It works for anything. Bridge players can do it with hands of cards, dancing experts can do it with dance moves, and so forth.

So factual knowledge in long-term memory allows chunking, and chunking increases space in working memory. What does the ability to chunk have to do with reading comprehension? Well, I was saying before that if you read ideas A, B, C, D, E, and F, you would need to relate them to one another in order to comprehend their meaning. That's a lot of stuff to keep in working memory. But suppose you could *chunk* A through E into a single idea? Comprehension would be much easier. For example, consider this passage:

> Ashburn hit a ground ball to Wirtz, the shortstop, who threw it to Dark, the second baseman. Dark stepped on the bag, forcing out Cremin, who was running from first, and threw it to Anderson, the first baseman. Ashburn failed to beat the throw.

If you're like me this passage is hard to comprehend. There are a number of individual actions, and they are hard to tie together. But for someone who knows about baseball, it's a familiar pattern, like *CNN*. The sentences describe a double play.

A number of studies have shown that people understand what they read much better if they already have some background knowledge about the subject. Part of the reason is chunking. A clever study on this point was conducted with junior high school students.[2] Half were good readers and half were poor readers, according to standard reading tests. The researchers asked the students to read a story that described half an inning of a baseball game. As they read, the students were periodically stopped and asked to show that they understood what was happening in the story by using a model of a baseball field and players. The interesting thing about this study was that some of the students knew a lot about baseball and some knew just a little. (The researchers made sure that everyone could comprehend individual actions, for example, what happened when a player got a double.) The dramatic finding, shown in Figure 5, was that the students' knowledge of baseball determined how much they understood of the story. Whether they were "good readers" or "bad readers" didn't matter nearly as much as what they knew.

Thus, background knowledge allows chunking, which makes more room in working memory, which makes it easier to relate ideas, and therefore to comprehend.

Background knowledge also clarifies details that would otherwise be ambiguous and confusing. In one experiment illustrating this effect,[3] subjects read the following passage:

> The procedure is actually quite simple. First, you arrange items into different groups. Of course one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities, that is the next step; otherwise, you are pretty well set. It is important not to overdo things. That is, it is better to do too few things at once than too many.

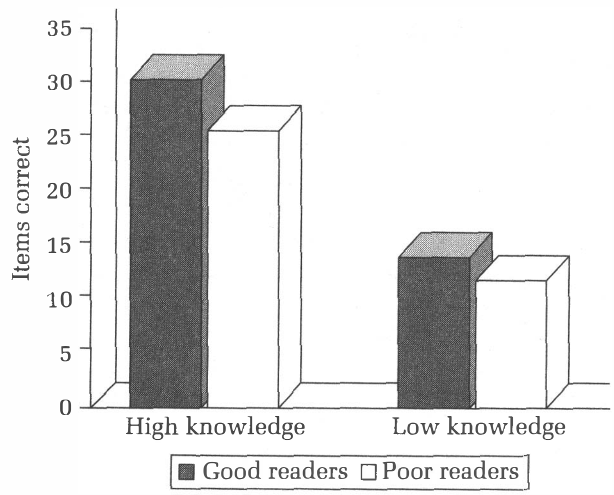

FIGURE 5: Results from a study of reading. As you would predict, the good readers (shaded bars) understood more than the poor readers (unshaded bars), but this effect is modest compared to the effect of knowledge. The people who knew a lot about baseball (leftmost columns) understood the passage much better than the people who didn't know a lot, regardless of whether they were "good" or "poor" readers, as measured by standard reading tests.

The passage went on in this vein, vague and meandering, and therefore very difficult to understand. It's not that you're missing vocabulary. Rather, everything seems really vague. Not surprisingly, people couldn't remember much of this paragraph when asked about it later. They remembered much more, however, if they had first been told that the passage's title is "Washing Clothes." Have another look at the passage now that you know the title. The title tells you which background knowledge is relevant, and you recruit that knowledge to clarify ambiguities. For example, "Arrange items into groups" is interpreted as sorting darks, bright colors, and whites. This experiment indicates that we don't take in new information in a vacuum. We interpret new things we read in light of other information we already have on the topic. In this case, the title, "Washing Clothes," tells the reader which background knowledge to use to understand the passage. Naturally, most of what we read is not so vague, and we usually know which background information is relevant. Thus, when we read an ambiguous sentence, we seamlessly use background knowledge to interpret it, and likely don't even notice the potential ambiguities.

I've listed four ways that background knowledge is important to reading comprehension: (1) it provides vocabulary; (2) it allows you to bridge logical gaps that writers leave; (3) it allows chunking, which increases room in working memory and thereby makes it easier to tie ideas together; and (4) it guides the interpretation of ambiguous sentences. There are in fact other ways that background knowledge helps reading, but these are some of the highlights.

It's worth noting that some observers believe that this phenomenon—that knowledge makes you a good reader—is a factor in the fourth-grade slump. If you're unfamiliar with that term, it refers to the fact that students from underprivileged homes often read at grade level through the third grade, but then suddenly in the fourth grade they fall behind, and with each successive year they fall even farther behind. The interpretation is that reading instruction through third grade focuses mostly on decoding—figuring out how to sound out words using the printed symbols—so that's what reading tests emphasize. By the time the fourth grade rolls around, most students are good decoders, so reading tests start to emphasize *comprehension*. As described here, comprehension depends on background knowledge, and that's where kids from privileged homes have an edge. They come to school with a bigger vocabulary and more knowledge about the world than underprivileged kids. And because knowing things makes it easier to learn new things (as described in the next section), the gap between privileged and underprivileged kids widens.

Background Knowledge Is Necessary for Cognitive Skills

Not only does background knowledge make you a better reader, but it also is necessary to be a good thinker. The processes we most hope to engender in our students—thinking critically and logically—are not possible without background knowledge.

First, you should know that much of the time when we see someone apparently engaged in logical thinking, he or she is actually engaged in memory retrieval. As

I described in Chapter One, memory is the cognitive process of *first* resort. When faced with a problem, you will first search for a solution in memory, and if you find one, you will very likely use it. Doing so is easy and fairly likely to be effective; you probably remember the solution to a problem because it worked the last time, not because it failed. To appreciate this effect, first try a problem for which you *don't* have relevant background knowledge, such as the one shown in Figure 6.[4]

The problem depicted in Figure 6 is more difficult than it first appears. In fact, only about 15 or 20 percent of college students get it right. The correct answer is to turn over the A card and the 3 card. Most people get A—it's clear that if there is not an even number on the other side, the rule has been violated. Many people incorrectly think they need to turn over the 2 card. The rule does not, however, say what must be on the other side of a card with an even number. The 3 card must be flipped because if there is a vowel on the other side, the rule has been violated.

Now let's look at another version of the problem, shown in Figure 7.[5]

If you're like most people, this problem is relatively easy: you flip the beer card (to be sure this patron is over twenty-one) and you flip the 17 card (to be sure this kid isn't drinking beer). Yet logically the 17 card has the same role in the problem that the 3 card did in the previous version, and it was the 3 card that everyone missed. Why is it so much easier this time? One reason (but not the only one) is that the topic is familiar. You have background knowledge about the idea of a drinking age, and you know what's involved in enforcing that rule. Thus you don't need to reason logically. You have experience with the problem and you remember what to do rather than needing to reason it out.

In fact, people draw on memory to solve problems more often than you might expect. For example, it appears that much of the difference among the world's best chess players is *not* their ability to reason about the game or to plan the best move; rather, it is their memory for game positions. Here's a key finding that led to that conclusion. Chess matches are timed, with each player getting an hour to complete his or her moves in the game. On occasion there are so-called blitz tournaments in which players get just five minutes to make all of their moves in a match (Figure 8). It's no surprise that everyone plays a little bit worse in a blitz tournament. What's surprising is that the best players are still the best, the nearly best are still nearly best, and so on.[†] This finding indicates that whatever makes the best players better than everyone else is still present in blitz tournaments; whatever gives them their edge is *not* a process that takes a lot of time, because if it were they would have lost their edge in blitz tournaments.

It seems that it is memory that creates the differences among the best players. When

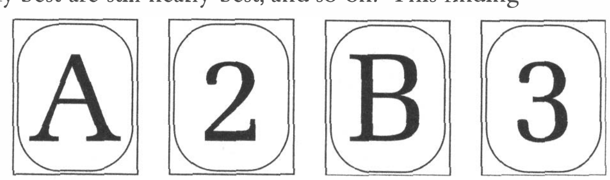

FIGURE 6: Each card has a letter on one side and a digit on the other. There is a rule: *If there is a vowel on one side, there must be an even number on the other side.* Your job is to verify whether this rule is met for this set of four cards, and to turn over the minimum number of cards necessary to do so. Which cards would you turn over?

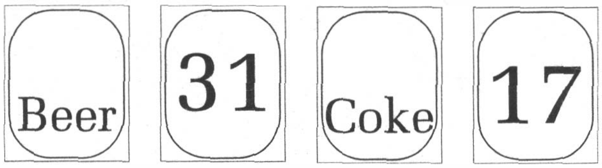

FIGURE 7: You are to imagine that you are a bouncer in a bar. Each card represents a patron, with the person's age on one side and their drink on the other. You are to enforce this rule: *If you're drinking beer, then you must be twenty-one or over.* Your job is to verify whether this rule is met for this set of four people. You should turn over the minimum number of cards necessary to do so. Which cards would you turn over?

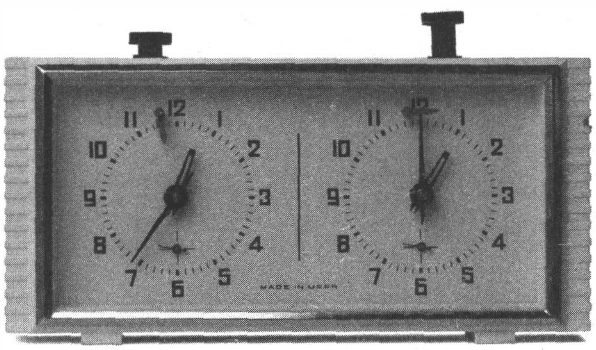

FIGURE 8: A device used to time a chess match. The black hand on each clock counts down the minutes remaining. After making a move, the player pushes the button above his clock, which stops it and causes his opponent's clock to restart. Players set identical amounts of time to elapse on each clock—just five minutes in a blitz tournament—representing the total time the player can take for all moves in the game. The flag near the twelve on each clock is pushed aside by the black hand as it approaches twelve. When the flag falls, the player has exceeded his allotted time, and so forfeits the match.

tournament-level chess players select a move, they first size up the game, deciding which part of the board is the most critical, the location of weak spots in their defense and that of their opponents, and so on. This process relies on the player's memory for similar board positions and, because it's a memory process, it takes very little time, perhaps a few seconds. This assessment greatly narrows the possible moves the player might make. Only then does the player engage slower reasoning processes to select the best among several candidate moves. This is why top players are still quite good even in a blitz tournament. Most of the heavy lifting is done by memory, a process that takes very little time. On the basis of this and other research, psychologists estimate that top chess players may have fifty thousand board positions in long-term memory. Thus background knowledge is decisive even in chess, which we might think is the prototypical game of reasoning.

That's not to say that all problems are solved by comparing them to cases you've seen in the past. You do, of course, sometimes reason, and even when you do, background knowledge can help. Earlier in this chapter I discussed chunking, the process that allows us to think of individual items as a single unit (for example, when *C, N,* and *N* become *CNN*), thereby creating more room in working memory. I emphasized that in reading, the extra mental space afforded by chunking can be used to relate the meaning of sentences to one another. This extra space is also useful when reasoning.

Here's an example. Do you have a friend who can walk into someone else's kitchen and rapidly produce a nice dinner from whatever food is around, usually to the astonishment of whoever's kitchen it is? When your friend looks in a cupboard, she doesn't see ingredients, she see recipes. She draws on extensive background knowledge about food and cooking. For example, have a look at the pantry in Figure 9.

FIGURE 9: Suppose you were at a friend's house and she asked you to make dinner with some chicken and whatever else you could find. What would you do?

A food expert will have the background knowledge to see many recipes here, for example, wild rice cranberry stuffing or chicken with salsa over pasta. The necessary ingredients will then become a chunk in working memory, so the expert will have room in working memory to devote to other aspects of planning, for example, to consider other dishes that might complement this one, or to begin to plan the steps of cooking.

Chunking applies to classroom activities as well. For example, take two algebra students. One is still a little shaky on the distributive property, the other knows it cold. When the first student is trying to solve a problem and sees $a(b + c)$, he's unsure whether that's the same as $ab + c$, or $b + ac$, or $ab + ac$. So he stops working on the problem and substitutes small numbers into $a(b + c)$ to be sure he's got it right. The second student recognizes $a(b + c)$ as a chunk and doesn't need to stop and occupy working memory with this subcomponent of the problem. Clearly the second student is more likely to complete the problem successfully.

There is a final point to be made about knowledge and thinking skills. Much of what experts tell us they do in the course of thinking about their field *requires* background knowledge, even if it's not described that way. Let's take science as an example. We could tell students a lot about how scientists think, and they could memorize those bits of advice. For example, we could tell students that when interpreting the results of an experiment, scientists are especially interested in anomalous (that is, unexpected) outcomes. Unexpected outcomes indicate that their knowledge is incomplete and that this experiment contains hidden seeds of new knowledge. But for results to be unexpected, you must have an expectation! An expectation about the outcome would be based on your knowledge of the field. Most or all of what we tell students about scientific thinking strategies is impossible to use without appropriate background knowledge. (See Figure 10.)

The same holds true for history, language arts, music, and so on. Generalizations that we can offer to students about how to think and reason successfully in the field may *look* like

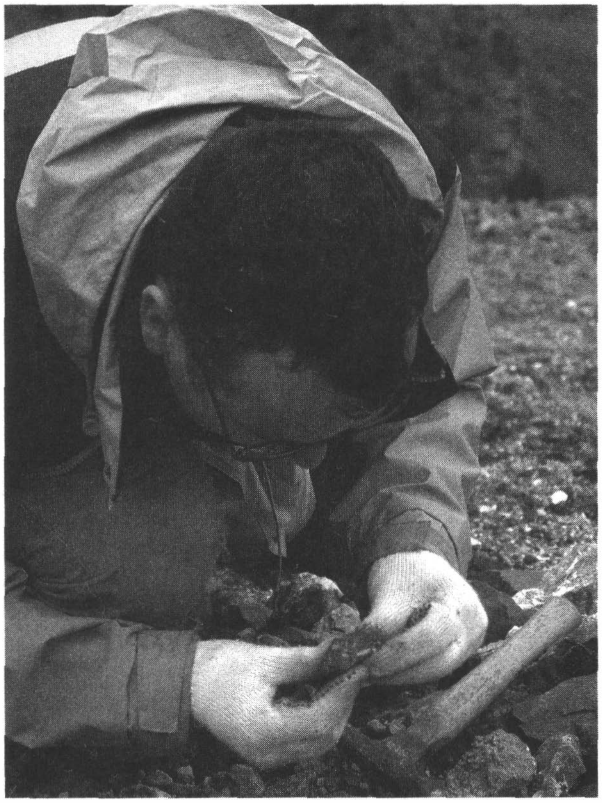

FIGURE 10: Scientists are good at "thinking like scientists," but doing so depends not just on knowing and practicing the thinking strategies, but also on having background knowledge that allows them to use the thinking strategies. This may be why a well-known geologist, H. H. Read, said, "The best geologist is the one who has seen the most rocks."

they don't require background knowledge, but when you consider how to apply them, they actually do.

Factual Knowledge Improves Your Memory

When it comes to knowledge, those who have more gain more. Many experiments have confirmed the benefit of background knowledge to memory using the same basic method. The researchers bring into the laboratory some people who have some expertise in a field (for example, football or dance or electronic circuitry) and some who do not. Everyone reads a story or a brief article. The material is simple enough that the people without expertise have no difficulty understanding it; that is, they can tell you what each sentence means. But the next day the people with background knowledge remember substantially more of the material than the people who do not have background knowledge.

You might think this effect is really due to attention. If I'm a basketball fan, I'll enjoy reading about basketball and will pay close attention, whereas if I'm not a fan, reading about basketball will bore me. But other studies have actually *created* experts. The researchers had people learn either a lot or just a little about subjects that were new to them (for example, Broadway musicals). Then they had them read other, new facts about the subject, and they found that the "experts" (those who had earlier learned a lot of facts about the subject) learned new facts more quickly and easily than the "novices" (who had earlier learned just a few facts about the subject).[6]

Why is it easier to remember material if you already know something about the topic? I've already said that if you know more about a particular topic, you can better