FIGURE 7.7 The Serial Position Curve.
Most psychologists believe that the primacy and recency effects in this curve are the telltale signs of two different memory systems: long-term and short-term memory, respectively.

Factoid

There's even a serial position curve for U.S. presidents. If given the chance to name as many presidents as they can, most people list early presidents, like Washington, Jefferson, and Adams, and recent presidents, like Clinton, Bush, and Obama more than middle presidents, with good old Abe Lincoln being a striking exception (Roediger & Crowder, 1976). The same effect holds for recall of Canadian prime ministers (Neath & Saint-Aubin, 2011).

? During a 2009 rock concert in Michigan, Bruce Springsteen referred repeatedly to being in Ohio (and even greeted the audience by yelling "Hello Ohio!"). **"The Boss" committed an error in which subtype of long-term memory?** (See answer upside down on bottom of page.)

serial position curve
graph depicting both primacy and recency effects on people's ability to recall items on a list

semantic memory
our knowledge of facts about the world

episodic memory
recollection of events in our lives

explicit memory
memories we recall intentionally and of which we have conscious awareness

implicit memory
memories we don't deliberately remember or reflect on consciously

Answer: Semantic memory

we tend to remember stimuli that are distinctive in some way (Neath & Surprenant, 2003; Radvansky, Gibson, & McNerny, 2011).

If we averaged your results along with those of a few hundred other participants, we'd end up with the graph depicted in **FIGURE 7.7**, called the **serial position curve**. As we can see, this curve clearly displays the primacy and recency effects.

Most researchers agree that primacy and recency effects reflect the operation of different memory systems. Because the last few words in the list were probably lingering in your short-term memory, you were probably especially likely to recall them. So, the recency effect seems to reflect the workings of short-term memory.

What explains the primacy effect? This one is trickier, but there's good evidence that you were more likely to recall the earlier words in the list because you had more opportunity to rehearse them silently—and perhaps even to chunk them. As a consequence, these words were more likely to be transferred from short-term memory into long-term memory. So the primacy effect seems to reflect the operation of long-term memory.

Types of Long-Term Memory. As we mentioned earlier, some psychologists argue that there are actually more than three memory systems. In particular, they claim that long-term memory isn't just one system, but many.

To find out why, try your hand at the following four questions.

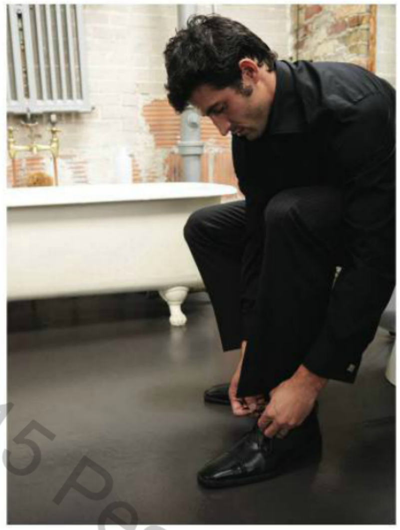
1. In what year did the United States become independent from Great Britain?
2. What Republican candidate for president did Barack Obama defeat in the 2012 U.S. election?
3. How old were you when you first tried to ride a bicycle?
4. Where did you celebrate your last birthday?

According to Endel Tulving (1972) and many other memory researchers (Renoult et al., 2012), our answers to the first two questions rely on different memory systems than our answers to the last two. Our answers to the first two questions (1776 and Mitt Romney) depend on **semantic memory**, our knowledge of facts about the world. In contrast, our answers to the last two questions, which are unique to us, depend on **episodic memory**, our recollection of events in our lives. A. J., whom we discussed at the beginning of the chapter, experiences remarkably accurate episodic memories. There's good evidence that these two types of memory are housed in different brain regions. Semantic memory tends to activate the left frontal cortex more than the right frontal cortex, and vice versa for episodic memory (Cabeza & Nyberg, 1997).

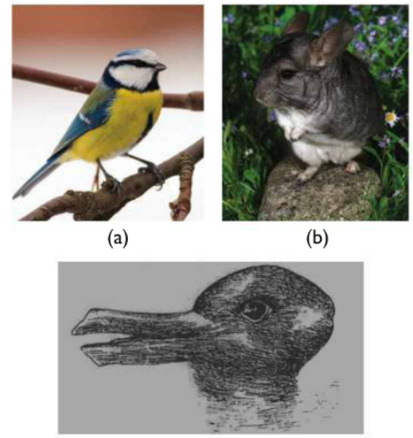
Still, semantic and episodic memory both require conscious effort and awareness. Whether we're trying to recall the definition of "chunking" from earlier in this chapter or our first kiss, we *know* we're trying to remember. Moreover, when we recall this information, we have a conscious experience of accessing it. That is, both semantic and episodic memory are examples of **explicit memory**, the process of recalling information intentionally. (Some researchers refer to the information recalled by explicit memory as *declarative memory*.)

Explicit memory differs from **implicit memory**, the process of recalling information we don't remember deliberately. Implicit memories don't require conscious effort on our part (Gopie, Craik, & Hasher, 2011). For example, each of us can go through the steps of unlocking our front doors without consciously recalling the sequence of actions required to do so. In fact, we probably can't tell without reenacting it in our heads or actually standing in front of our doors which way the key turns in the lock and how we hold the key in our hands while unlocking the door.

Studies of people with brain damage provide remarkable *existence proofs* (see Chapter 2) for the distinction between implicit and explicit memory. Antonio Damasio (2000) has studied a patient named David, whose left and right temporal lobes were largely obliterated by a virus. David has virtually no explicit memory for anyone he's met; when Damasio shows him photographs of people with whom he's recently interacted, he can't recognize any of them. Yet when Damasio asks David which of these people he'd ask for help if he needed it, he points to those who've been kind to him, utterly clueless of who they are. David has no explicit memory for who's helped him, but his implicit memory remains intact.



Procedural memory is memory for how to do things, even things we do automatically without thinking about how to do them.



Is the drawing at the bottom a duck or a rabbit? This illusion, originally concocted by psychologist Joseph Jastrow around the turn of the century, affords a good illustration of priming you can try on your friends. Show some of your friends only Photograph A (covering up Photograph B; then show other friends only Photograph B (covering up Photograph A). Ask them what they see in the drawing below. Your friends primed with Photograph A will be more likely to "see" the related image of a duck, and your friends primed with Photograph B will be more likely to "see" the related image of a rabbit (see Chapter 4).

To make matters still more complicated, there are several subtypes of implicit memory. We'll discuss two here: procedural memory and priming. However, according to most psychologists, implicit memory also includes habituation, classical conditioning, and other forms of learning we've encountered in Chapter 6.

One subtype of implicit memory, **procedural memory**, refers to memory for motor skills and habits. Whenever we ride a bicycle or open a soda can, we're relying on procedural memory. In contrast to semantic memory, which is "know what" memory, procedural memory is "know how" memory. Our procedural and semantic memories for the same skills are sometimes surprisingly different. For those of you who are avid typists, find a computer or smart phone keyboard and type the word *the*. That's a breeze, right? Now turn away from the keyboard for a moment, and try to remember where the *t, h,* and *e* are located, but without moving your fingers. If you're like most people, you'll draw a blank. You may even find that the only way to remember their location is to use your fingers to type the imaginary letters in midair. Although your procedural memory for locating letters on a keyboard is effortless, your semantic memory for locating them is a different story.

A second subtype of implicit memory, **priming**, refers to our ability to identify a stimulus more easily or more quickly when we've previously encountered similar stimuli. Imagine that a researcher flashes the word *QUEEN*, interspersed with a few hundred other words, very quickly on a computer screen. An hour later, she asks you to perform a task that requires you to fill in the missing letters of a word. In this case, the stem completion task is K _______. Research shows that having seen the word *QUEEN*, you're more likely to complete the stem with *KING* (as opposed to *KILL* or *KNOW*, for example) than are participants who haven't seen *QUEEN* (Neely, 1976). This is true, incidentally, even for participants who insist they can't even remember having seen the word *QUEEN* (Bargh, 1994). This memory is implicit because it doesn't require any deliberate effort on our part. (Yeh, He, & Cavanagh, 2012).

If you're having a hard time keeping all of these subtypes of long-term memory straight, **FIGURE 7.8** summarizes the major subtypes of explicit and implicit memory.

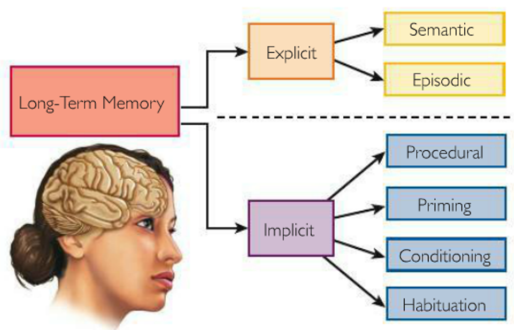


FIGURE 7.8 The Many Subtypes of Memory. A summary of the subtypes of explicit and implicit memory.

procedural memory
memory for how to do things, including motor skills and habits

priming
our ability to identify a stimulus more easily or more quickly after we've encountered similar stimuli

Study and **Review** in **MyPsychLab**

Assess Your Knowledge — FACT or FICTION?

1. Most of us can accurately recognize thousands of faces we've seen only a few days earlier. **True / False**
2. Memory is more reconstructive than reproductive. **True / False**
3. The major reason for forgetting information from short-term memory appears to be the decay of memories. **True / False**
4. Chunking can permit us to greatly increase the number of digits or letters we hold in our short-term memories. **True / False**
5. Information in long-term memory often lasts for years or decades. **True / False**

Answers: **1.** T (p. 247); **2.** T (p. 248); **3.** F (p. 251); **4.** T (p. 253); **5.** T (p. 255)

The Three Processes of Memory

7.4 Identify methods for connecting new information to existing knowledge.

7.5 Identify the role that schemas play in the storage of memories.

7.6 Distinguish ways of measuring memory.

7.7 Describe how the relation between encoding and retrieval conditions influences remembering.

How do we get information into our long-term memories? Memory psychologists agree that there are three major *processes* of memory: *encoding, storage,* and *retrieval.* By the way, we shouldn't confuse these three processes with the three *systems* of memory we just discussed (sensory, short-term, and long-term). Whereas the three systems refer to the *what* of memory, the three processes we're about to discuss refer to the *how* of memory. They explain how information gets transferred into long-term memory and gets back out again when we need it (see **FIGURE 7.9**).

To understand these three processes of memory, picture yourself working as a librarian at your college or university library. When a new book arrives, you first give it a number to identify it; that's encoding. Then you file it away on the bookshelf; that's storage. Then, when you want to find the book a few weeks, months, or even years later, you go to the shelves and fetch it; that's retrieval. Of course, like all metaphors, this one is an oversimplification, because the memories we retrieve are rarely identical to those we

FIGURE 7.9 Three Processes of Memory.
The process of remembering is similar in some ways to the process of filing and fetching a library book.

Process 1 Encoding: Using a computer, a librarian enters the cataloguing information for a book into the library's database. In the process, the librarian finds out where the book needs to be shelved. The computer prints out a label (what we might think of as an encoding label) that the librarian affixes to the book's spine so that everyone will know where the book should be stored.

Process 2 Storage: The librarian puts the books in the proper section of the library, according to how they've been catalogued.

Process 3 Retrieval: When the librarian wants to access the book, he looks up the cataloguing information and then goes to the appropriate shelf with his computer printout showing the catalogue location of the book to retrieve it.

initially encoded. Some of the "books" in our mental library may become yellow with age; others become marked up or even damaged beyond recognition.

Encoding: The "Call Numbers" of the Mind

Encoding refers to the process of getting information into our memory banks. To remember something, we first need to make sure the information is in a format our memories can use. To a far greater extent than we realize, many of our memory failures are actually failures of encoding. To go back to our library analogy, imagine that the librarian assigns an identification number to some of the books that come in for processing but later decides to toss some of them in the trash instead. These books never make it to the shelves. Once we lose the chance to encode an event, we'll never remember it. No encoding, no memory.

THE ROLE OF ATTENTION. To encode something, we must first attend to it. Have you ever had the embarrassing experience of going to a party and being introduced to several people at the same time and then realizing that you'd immediately forgotten all of their names? Odds are high you were so nervous or distracted that you never encoded their names in the first place.

That principle helps to explain why the popular belief that our brains preserve a record of every event we've ever encountered (Alvarez & Brown, 2001) can't be right. Most events we've experienced are never encoded, and almost all events we do encode include only some of the details of the experience. Much of our everyday experience never gets into our brain in the first place. For instance, consider this example of an everyday object we've seen hundreds, even thousands, of times. Take a look at **FIGURE 7.10**, where you'll see an array of six pennies. Which of these pennies is the real one?

If you flunked this miniature test of "common cents," don't feel too bad. When two researchers conducted a similar version of this test about three decades ago, they found that fewer than half of 203 Americans identified the correct penny (Nickerson & Adams, 1979). We see pennies almost every day, yet how often do we actually pay attention to the details of them?

Encoding also helps to explain the familiar *next-in-line effect*. You've experienced this phenomenon if you've ever been in a class when the instructor called on several students in a row to answer a question or say their names. You probably found that your memory was especially poor for what the person immediately before you said (Bond, Pitre, & van Leeuwen, 1991; Innes, 2011). That's because you were so preoccupied with what you were going to say that you weren't paying much attention to what the person right before you was saying.

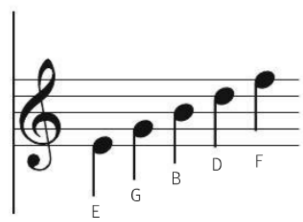
MNEMONICS: VALUABLE MEMORY AIDS. What do the following strange passages have in common?

1. Please Excuse My Dear Aunt Sally.
2. Thirty days hath September, April, June, and November. All the rest have 31, except for February, which has 28, and you probably think it's great. Or maybe it's when fine, on leap year, it has 29.
3. Every Good Boy Does Fine.

Each is a **mnemonic** (pronounced "nee-MAH-nik"): a learning aid, strategy, or device that enhances recall. Mnemonics help us encode memories in a way that makes them easier to recall. From time to time, virtually all of us use recall boosters, like making lists or writing appointments on a calendar, cell phone, or portable computer (Intons-Peterson & Fournier, 1986; McCabe, Osher, Roche, & Susser, 2011). Nevertheless, mnemonics differ from these "external" memory aids in that they rely on internal mental strategies, namely, strategies we use during encoding that help us later retrieve useful information. Item 1 specifies the proper order of mathematical operations (parentheses, exponents, multiplication, division, addition, subtraction) by having each

"In one ear and out the other," so the saying goes. If you have met someone and forgotten his or her name a minute later, you probably never encoded it in the first place.

FIGURE 7.10 **Penny Array from Nickerson and Adams (1979). Which of these pennies is the real one?** Try to guess before pulling one out of your pocket. (*Source:* Based on Nickerson & Adams, 1979)



Music students use the mnemonic "Every good boy does fine" to remember the names of the lines (E, G, B, D, F) in the treble clef.

encoding
process of getting information into our memory banks

mnemonic
a learning aid, strategy, or device that enhances recall

Answer: The correct answer is (b).

FIGURE 7.11 Pegword Method. The pegword method can be a useful mnemonic for helping us recall lists of objects in order. See the text for an explanation of this fanciful illustration.

word start with the same letter as the mathematical operation. Item 2 is a rhyme that's a handy way of remembering the number of days in each month. Item 3 stands for the notes on the lines of the treble clef in musical notation (E, G, B, D, F).

Mnemonic devices share two major features. First, we can apply them to just about anything and everything: the names of planets, the elements of the periodic table, the bones of the hand, the order of geological time periods, and the colors of the rainbow (the last being ROY G. BIV for red, orange, yellow, green, blue, indigo, and violet). Second, most mnemonics depend on our having a store of knowledge to begin with. We need to know something about mathematical operations for the mnemonic about Aunt Sally to make any sense. So in general, mnemonics are most helpful as mental shortcuts for recalling lists of information we've already learned. There are many other mnemonic approaches in addition to those we've discussed: We'll review three here.

Pegword Method. By elementary school age, most of us were well acquainted with the exploits of Jack and Jill, Little Bo Peep, and Little Jack Horner. Songs ranging from "Twinkle, Twinkle Little Star" to the hip-hop songs of the Black Eyed Peas are easy to remember because they contain rhymes.

Rhyming is a key component of the *pegword method*, often used to recall ordered lists of words. To master this mnemonic, first associate each number in a list with a word that rhymes with the number, such as "One is a bun." The word associated with the number is a "pegword." It's essential to memorize a list like the one that follows, but the fact that the numbers and words rhyme makes it easy to do so: (1) One is a bun, (2) Two is a shoe, (3) Three is a tree, and (4) Four is a door.

Suppose you need to learn four words associated with memory concepts for your psychology class (don't you wish there were only four new terms in this chapter?) and that you need to recall them in the following order: chunking, elaboration, hippocampus, and decay. After you've memorized the pegword associated with each number (such as "one is a bun"), create an image that associates the word you want to remember with the pegword (such as *bun*). For the first word, *chunking*, you could imagine a bun (the pegword) with a chunk missing or broken up into chunks. For two—*elaboration*—you might imagine a shoe with elaborate beading, sequins, and bows. For three—*hippocampus*—imagine a tree with a hippo camping under it. For number four, *decay*, you might picture a rotting, decaying door on an old house. When you need to remember the third item on your list, for example, you'd say to yourself that three is a tree, which would prompt recall of the hippo camping under it, and you'd know that the third word on the list is hippocampus (see **FIGURE 7.11**). Researchers have found that repeated use of the pegword method enhanced students' delayed recall for ordered lists of unfamiliar terms, suggesting that the method may be a useful study strategy for improving vocabulary (Carney & Levin, 2011).

Method of Loci. The *method of loci* (pronounced "low-sigh") relies on imagery of places, that is, *locations,* hence the name of the mnemonic (Bellezza, 1999; Foer, 2011). The method is straightforward: Think of a path with which you're familiar and can imagine vividly. Perhaps it's the route from your dorm to the cafeteria or a stroll through the rooms in your apartment. Think of the path you take and the things that you encounter in a set order. For example, to get to the cafeteria, first you get in the elevator, then you walk under a huge tree before you pass by a fountain, and so on. If you need to remember five words in a particular order, think of five things you'll encounter on your way to the cafeteria; if you need to recall ten words, imagine ten locations along your route. If you were trying to remember the list of memory terms with the method of loci, you might imagine chunks of rock or glass on the floor of the elevator.

Keyword Method. If you've taken a foreign language course, you may be familiar with the *keyword method.* This strategy depends on your ability to think of an English word (the keyword) that reminds you of the word you're trying to remember. Take the Spanish word *casa*, which means "house" in English. Think of an English word, like *case*, that sounds like or brings to mind *casa*. Now think of an image that combines *case* (or another word of your choice) and *house*. Perhaps you can picture a case of soda on the roof of your house. When you think of this image, it should help you retrieve the meaning of *casa*. People who learn foreign vocabulary benefit from the keyword strategy compared with more traditional methods, such as rote memorization (Beaton et al., 2005; Gruneberg & Sykes, 1991). Likewise, researchers have found that the keyword strategy was effective for third-graders, including students with learning disabilities, in mastering new vocabulary words (Uberti, Scruggs, & Mastropieri, 2003).

Music. Can putting material-to-be-learned to a familiar melody like "Pop Goes the Weasel" or "Yankee Doodle Dandy" assist in learning? That's what one pair of researchers set out to determine (Rainey & Larson, 2002). They included lists of names in the two songs, and participants either listened to one or the other tune or heard the words in the lists spoken. The researchers found no initial recall advantage for people who learned the names with musical accompaniment. However, those who heard the sung version required fewer trials to relearn the names a week later, suggesting that learning information put to a melody improves long-term retention.

Generally speaking, mnemonics can be helpful if we're motivated to practice them on a regular basis. Mnemonics require training, patience, and even a dash of creativity.

psychomythology

SMART PILLS

The next time you're in your local drugstore, stop by the aisle containing herbal remedies. There you'll find a virtual museum of so-called smart pills designed to enhance memory: ginkgo; vitamin E; and even drugs with unpronounceable, but scientific-sounding, names like phosphatidylserine, citicoline, and piracetam. Can any of them help us remember where we mislaid our keys this morning, memorize the names of the ten people we met at last night's party, or recall how to spell *phosphatidylserine*?

Ginkgo and other supposed memory-enhancing drugs are a multimillion-dollar industry in the United States. These pills are popular, but do they work?

Probably the best-known herbal remedy for memory is ginkgo (whose scientific name is *Ginkgo biloba*), an ancient Chinese medicine extracted from the leaves of the ginkgo tree. Although it might be tempting to assume that ginkgo is effective because it's been used for many centuries, this would be an example of the *argument from antiquity fallacy* (see Chapter 1), the error of concluding that something must be effective because it's been around for a long time. The manufacturers of ginkgo claim that it can markedly improve normal people's memory in as little as four weeks. Like many other memory boosters, ginkgo presumably works in part by increasing the level of the brain's acetylcholine, a neurotransmitter that plays a key role in memory (see Chapter 3).

Ginkgo is remarkably popular; Americans spend $249 million on it per year (DeKosky et al., 2008). Yet controlled studies comparing ginkgo with a placebo show that its effects on memory in normal individuals are minimal, even nonexistent (Gold, Cahill, & Wenk, 2002; Elsabagh et al., 2005). If ginkgo produces any effects on normal memory at all, they appear to be about equal to those of drinking a glass of lemonade or any sugary liquid (as you'll recall from Chapter 3, sugar is the brain's fuel). Ginkgo's effects on memory in people with Alzheimer's disease or other forms of dementia are slight (Gold et al., 2002) and perhaps even nonexistent (DeKosky et al., 2008; Vellas et al., 2012). There's no good evidence that it can reverse severe memory loss or stave off age-related cognitive decline (Snitz et al., 2009). Moreover, like many herbal remedies, ginkgo can be harmful in certain cases; it can interfere with the effects of blood-thinning medicines and thereby cause excessive bleeding. As for the other smart pills we mentioned with fancy names, the evidence for their effects on memory is too preliminary to draw strong conclusions (McDaniel, Maier, & Einstein, 2002).

Finally, what about pills designed to boost attention and keep us awake, perhaps just long enough to study for that dreaded final exam? Not surprisingly, some of these drugs are becoming popular on college campuses. Surveys show that up to 30 percent of college students have used Ritalin, Adderall, and similar stimulants, widely prescribed for attention-deficit/hyperactivity disorder (see Chapter 15), to help them concentrate while studying or taking exams (Greely et al., 2008; Garnier-Dykstra et al., 2012). One team of investigators compared students taking the SAT, some of whom believed they were ingesting Ritalin and some whom believed they were ingesting a dummy pill. The former students reported better mental functioning and attention—but their SAT scores weren't any higher. Yet *both* groups had actually received a dummy pill, suggesting that Ritalin's "impact" on test taking may be due to a placebo effect (Gowin, 2009; see Chapter 2). Still other evidence suggests that stimulants may be helpful in consolidating declarative memories, like memories of facts, but the evidence is too preliminary to draw firm conclusions (Smith & Farah, 2011).

Modafinil (its brand name is Provigil), commonly prescribed for narcolepsy, sleep apnea, and other sleep disorders (see Chapter 5), is also popular as an aid for maintaining wakefulness and alertness. Nevertheless, research suggests that although Modafinil may be about as effective as caffeine for enhancing attention in sleep-deprived people, at least some of its effects on fatigue may not exceed those of a placebo (Drabiak-Syed, 2011; Kumar, 2008). Because the Food and Drug Administration (FDA) no longer regulates diet supplements and herbal remedies, including those intended to enhance memory, it's anybody's guess whether they work, or even whether any might be harmful (Bent, 2008). As is so often the case in pop psychology, the best advice for those of us hoping to become memory whizzes overnight is *caveat emptor:* Let the buyer beware.

Storage: Filing Away Our Memories

Once we've filed away a library book on the shelf, it sits there, often for years at a time, collecting dust and cobwebs. We've stored it, perhaps to be retrieved one day by a student or professor who needs it for a writing project. **Storage** refers to the process of keeping information in memory.

Yet where in the library we choose to file this book depends on our *interpretation and expectations* regarding the book's content. Let's imagine a new book entitled *The Psychology of Dating* has just arrived in the library. Should we file this book in the psychology section, along with books on personality, emotion, and social psychology, or in the relationships section, along with books on dating, attraction, and marriage? The answer depends on what we think is most important or relevant about the book's content. Similarly, how we store our experiences in memory depends on our interpretations and expectations of these events.

Our interpretation of ambiguous events in everyday life, like an animated conversation on the street, depends in part on our schemas.

storage
process of keeping information in memory

schema
organized knowledge structure or mental model that we've stored in memory

THE VALUE OF SCHEMAS. Consider this scenario. You and your friends go to a brand new sit-down restaurant. Although this is your first visit, you've got a pretty good idea of what's in store. That's because you possess a schema for eating at a nice restaurant. A **schema** is an organized knowledge structure or mental model that we've stored in memory. Our schema for restaurants is characterized by a set order of events, sometimes called a *script* (Schank & Abelson, 1977). You're seated at a table, given menus from which you order food, wait while your food is prepared, eat the food, get the check, and pay for the food before leaving. And don't forget the tip! There's even a standard sequence in ordering, at least in U.S. culture. We order drinks first, followed by appetizers, soup or salad, entrees, and finally dessert and coffee.

Schemas serve a valuable function: They equip us with frames of reference for interpreting new situations. Without schemas, we'd find some information almost impossible to comprehend (Bransford & Johnson, 1972). For example, if you've ever switched suddenly to a new computer system or smart phone, you know how confusing doing so can be at first. You may not have an understanding of how the keyboard is arranged, of what buttons are in which places, or perhaps even in which order you're supposed to type different instructions.

SCHEMAS AND MEMORY MISTAKES. Valuable as they are, schemas can sometimes create problems, because they can lead us to remember things that never happened. Schemas simplify, which is good because they help us make sense of the world. But schemas sometimes *oversimplify*, which is bad because they can produce memory illusions. Schemas provide one key explanation for the paradox of memory: They enhance memory in some cases, but lead to memory errors in others.

For example, Mark Snyder and Seymour Uranowitz (1978) presented participants with a case study of the life of a woman, Betty K. After reading this case study, some participants learned that Betty was now living a heterosexual lifestyle; others learned that she was living a homosexual lifestyle. Snyder and Uranowitz then gave participants a recognition test for the details in the passage. They found that participants distorted their memories of the original information, such as her relationship with her father and past dating habits, to be in line with their schema—their beliefs about her current lifestyle. For example, participants who believed Betty to be homosexual mistakenly recalled her as never having dated men in high school. If we're not careful, our schemas can lead us to overgeneralize, painting all members of a category with the same broad brush (see Chapter 13).

Answers are located at the end of the text.

MEMORY BOOSTERS

evaluating **CLAIMS**

Many of us would love to improve our memories—to perform better in our courses or at work; remember birthdays, anniversaries, and other important dates; or just remember where we left our keys. Scores of products on the market purport to improve our memories and overall brain function. Let's evaluate some of these claims, which are modeled after actual ads for memory-enhancing supplements.

"Never misplace your keys again! Use our product and *cure your absentmindedness!*"

The claim that this product is a cure is extraordinary. What kind of evidence is needed to support this claim?

"*Scientifically proven* to improve your memory."

The claim talks of "proof," yet scientific knowledge is rarely, if ever, conclusive. What information would you need to evaluate whether the studies were conducted properly?

"Our formula is a *synergistic blend of antioxidants, gotu kola, brainy aromatics, amino acids, and specific neurotransmitter nutrients* to help maintain *healthy cellular energy production by promoting healthy mitochondrial function, scavenging free radicals, and promoting blood circulation* to the brain."

We should beware of meaningless "psychobabble" that uses scientific-sounding words that are lacking in substance.

"*75% of Americans are turning to complementary and alternative medicine* to improve their memory—by taking our all-natural memory enhancers you can be one of them."

Does the claim that a large number of Americans use complementary and alternative medicines mean this product is effective? Why or why not?

TABLE 7.1 Demonstration of Retrieval Cues. Find a friend and read each category, followed by the word that goes along with it. Then, ask your friend to recall only the words, in any order. For each word your friend forgot, ask whether he or she remembers something from that word's category. As you'll see, this demonstration helps to make a simple point: Many memory failures are actually failures of retrieval.

CATEGORY	WORD
A metal	Silver
A precious stone	Pearl
A relative	Niece
A bird	Canary
Type of reading material	Journal
A military title	Major
A color	Violet
A four-legged animal	Mouse
A piece of furniture	Dresser
A part of the body	Finger
A fruit	Cherry
A weapon	Cannon
A type of dwelling	Mansion
An alcoholic beverage	Brandy
A crime	Kidnapping
An occupation	Plumber
A sport	Lacrosse
An article of clothing	Sweater
A musical instrument	Saxophone
An insect	Wasp

Retrieval: Heading for the "Stacks"

To remember something, we need to fetch it from our long-term memory banks. This is **retrieval**, the third and final process of memory. Yet, as we mentioned earlier, this is where our metaphor of a library begins to break down, because what we retrieve from our memory often doesn't match what we put into it. Our memories are reconstructive, often transforming our recollections to fit our beliefs and expectations.

Many types of forgetting result from failures of retrieval: Our memories are still present, but we can't access them. It's pretty easy to demonstrate this point. If a friend is nearby, try the following demonstration, courtesy of psychologist Endel Tulving (even if you don't have a friend handy, you can still follow along). Read each category in **TABLE 7.1** to your friend, followed by the word that goes along with it. Tell your friend that after you're done reading all of the categories and their corresponding words, you'll ask him or her to recall just the words—in any order—not the categories.

After you read the list to your friend, ask him or her to take a few minutes to write down as many words as he or she can remember. Almost certainly, your friend missed some of them. For those missing words, prompt your friend with the category. So if your friend missed *Finger*, ask, "Do you remember the word that went with 'A part of the body'?" You'll probably find that these prompts help your friend to remember some of the forgotten words. In psychological lingo, the category names serve as **retrieval cues**: hints that make it easier for us to recall information. So your friend's long-term memory contained these missing words, but he or she needed the retrieval cues to remember them.

MEASURING MEMORY. Psychologists assess people's memory in three major ways: recall, recognition, and relearning. Think of them as the three Rs (another mnemonic device, by the way).

Recall and Recognition. What kind of exam do you find the toughest: essay or multiple choice? For sure, we've all taken multiple-choice tests that are "killers." Still, all else being equal, essay tests are usually harder than multiple-choice tests. That's because **recall**, that is, generating previously remembered information on our own, tends to be more difficult than **recognition**, selecting previously remembered information from an array of options (Bahrick, Bahrick, & Wittlinger, 1975). To demonstrate what we mean, try recalling the sixth president of the United States. Unless you're an American history buff, you may be stumped. If so, try this question instead.

The sixth president of the United States was:

(a) George Washington
(b) John Quincy Adams
(c) Bill Clinton
(d) Sarah Palin

With a bit of thought, you probably figured out that (b) was the correct answer. You could safely eliminate (a) because you know George Washington was the first president, (c) because you know Bill Clinton was a much more recent president, and (d) because you know Sarah Palin hasn't been president. Moreover, you may well have recognized John Quincy Adams as an early U.S. president, even if you didn't know he was number six.

Why is recall usually harder than recognition? In part, it's because recalling an item requires two steps—generating an answer and then determining whether it seems correct—whereas recognizing an item takes only one step: determining which item from a list seems most correct (Haist, Shimamura, & Squire, 1992).

Relearning. A third way of measuring memory is **relearning**: how much more quickly we learn information when we study something we've already studied relative to when we studied it the first time. For this reason, psychologists often call this approach the method of *savings*: Now that we've studied something, we don't need to take as much time to refresh our memories of it (that is, we've "saved" time by studying it).

retrieval
reactivation or reconstruction of experiences from our memory stores

retrieval cue
hint that makes it easier for us to recall information

recall
generating previously remembered information

recognition
selecting previously remembered information from an array of options

relearning
reacquiring knowledge that we'd previously learned but largely forgotten over time

The concept of relearning originated with the pioneering work of German researcher Hermann Ebbinghaus (1885) well over a century ago. Ebbinghaus used hundreds of "nonsense syllables," like ZAK and BOL, to test his own recollection across differing time intervals. As we can see in **FIGURE 7.12**, he found that most of our forgetting occurs almost immediately after learning new material, with less and less forgetting after that. However, he also found that when he attempted to relearn the nonsense syllables he'd forgotten after a delay, he learned them much more quickly the second time around.

Imagine you learned to play the guitar in high school but haven't played it for several years. When you sit down to strum an old song, you're rusty at first. Although you need to go back to your notes to remind yourself the first couple of times you sit down to play, you'll probably find that it doesn't take you nearly as long to get the hang of the song the second time around. That's relearning. Relearning shows that a memory for this skill was still lurking in your brain—somewhere.

FIGURE 7.12 Ebbinghaus's Curve of Forgetting. This graph from Ebbinghaus's classic memory research shows the percent "savings," or how much faster information he relearned the second time following various delays (plotted in hours).

Relearning is a more sensitive measure of memory than either recall or recognition. That's because relearning allows us to assess memory using a relative amount (how much faster was material learned the second time?) rather than the simple "right" or "wrong" we obtain from recall or recognition (MacLeod, 2008; Nelson, 1985). It also allows us to measure memory for procedures, like driving a car or playing a piano piece, as well as for facts and figures.

When memorizing his nonsense syllables, Ebbinghaus happened on a crucial principle that applies to most forms of learning: the law of **distributed versus massed practice** (Donovan & Radosevich, 1999; Willingham, 2002). Simply put, this law tells us that we tend to remember things better in the long run when we spread our learning over long intervals than when we pack it into short intervals. This principle is probably one of the best-replicated effects in all of psychology (Cepeda et al., 2006). Even infants show it (Cornell, 1980).

Watch in **MyPsychLab** the **Video:** IT Video: Cramming

◀ **REPLICABILITY**
Can the results be duplicated in other studies?

Herein lies another word to the wise. Cramming for an exam helps us remember the information for *that exam*, but it typically produces poor long-term retention. If you want to master the information in your psychology course—or any course, for that matter—you should spread out your review of the material over long intervals. So when one of your teachers nags you to "start studying at least a week before the exam rather than waiting until the last minute," you have Ebbinghaus to thank—or blame.

TIP-OF-THE-TONGUE PHENOMENON. We've all experienced retrieval failure in the form of the frustrating **tip-of-the-tongue (TOT) phenomenon**, in which we're sure we know the answer to a question, but can't come up with it (Brown, 1991; Ecke, 2009; Schwartz, 1999). It's surprisingly easy to generate this phenomenon (Baddeley, 1993). Read the names of the ten U.S. states in **TABLE 7.2**, and try to name their capital cities. Now focus on the states for which you're *unsure* of whether you know the right answer, and keep trying. If you're still stuck, look at the list that follows, which gives you the first letter of the capital of each state: Georgia (A), Wisconsin (M), California (S), Louisiana (B), Florida (T), Colorado (D), New Jersey (T), Arizona (P), Nebraska (L), and Kentucky (F).

TABLE 7.2 TOT Phenomenon. First try to come up with the capital of each state. Then, return to the text for some hints. (Answers are located upside-down at the bottom of the page.)

STATE	CAPITAL
Georgia	
Wisconsin	
California	
Louisiana	
Florida	
Colorado	
New Jersey	
Arizona	
Nebraska	
Kentucky	

Did the first letters help? Research shows when we experience the TOT phenomenon, they often will. The fact that we sometimes experience TOT tells us that there's a difference between something we've forgotten because it didn't get *stored* in memory and something that's in there somewhere that we can't quite *retrieve*.

Two investigators showed that when people believe that something is on the tip of their tongues, they're frequently right (Brown & McNeill, 1966). They presented participants with the definitions of relatively rare words (such as "to give up the throne") and asked them to come up with the word (in this case, *abdicate*). About 10 percent of the time, participants reported a TOT experience; they were pretty sure they "knew" the word, but couldn't generate it. In these cases, the researchers asked participants to guess the first letter of the word or the number of syllables in it. Interestingly, the participants did much better than chance. So participants *did* know something about the word; they just couldn't spit it out whole.

distributed versus massed practice
studying information in small increments over time (distributed) versus in large increments over a brief amount of time (massed)

tip-of-the-tongue (TOT) phenomenon
experience of knowing that we know something but being unable to access it

Answers: Atlanta, Madison, Sacramento, Baton Rouge, Tallahassee, Denver, Trenton, Phoenix, Lincoln, Frankfort