Module 33

Forgetting, Memory Construction, and Memory Improvement


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Module Learning Objectives

33-1 Explain why we forget.

33-2 Explain how misinformation, imagination, and source amnesia influence our memory construction, and describe how we decide whether a memory is real or false.

33-3 Describe the reliability of young children's eyewitness descriptions, and discuss the controversy related to claims of repressed and recovered memories.

33-4 Describe how you can use memory research findings to do better in this and other courses.

Forgetting

33-1 Why do we forget?

"Amnesia seeps into the crevices of our brains, and amnesia heals." -Joyce Carol Oates, "Words Fail, Memory Blurs, Life Wins," 2001

Amid all the applause for memory—all the efforts to understand it, all the books on how to improve it—have any voices been heard in praise of forgetting? William James (1890, p. 680) was such a voice: "If we remembered everything, we should on most occasions be as ill off as if we remembered nothing." To discard the clutter of useless or out-of-date information—last year's locker combination, a friend's old phone number, restaurant orders already cooked and served—is surely a blessing. The Russian memory whiz S, whom we met at the beginning of Module 31, was haunted by his junk heap of memories. They dominated his consciousness. He had difficulty thinking abstractly—generalizing, organizing, evaluating. After reading a story, he could recite it but would struggle to summarize its gist.

A more recent case of a life overtaken by memory is "A. J.," whose experience has been studied and verified by a University of California at Irvine research team (Parker et al., 2006). A. J., who has identified herself as Jill Price, compares her memory with "a running movie that never stops. It's like a split screen. I'll be talking to someone and seeing something else. . . . Whenever I see a date flash on the television (or anywhere for that matter) I automatically go back to that day and remember where I was, what I was doing, what day it fell on, and on and on and on and on and on. It is nonstop, uncontrollable, and totally exhausting." A good memory is helpful, but so is the ability to forget. If a memory-enhancing pill becomes available, it had better not be *too* effective.

More often, however, our unpredictable memory dismays and frustrates us. Memories are quirky. My own memory can easily call up such episodes as that wonderful first kiss with the woman I love, or trivial facts like the air mileage from London to Detroit. Then it abandons me when I discover I have failed to encode, store, or retrieve a student's name, or where I left my sunglasses.

FYI

Cellist Yo-Yo Ma forgot his 266-year-old, $2.5 million cello in a New York taxi. (He later recovered it.)

Forgetting and the Two-Track Mind

English novelist and critic C. S. Lewis described the forgetting that plagues us all. We are

> bombarded every second by sensations, emotions, thoughts . . . nine-tenths of which [we] must simply ignore. The past [is] a roaring cataract of billions upon billions of such moments: Any one of them too complex to grasp in its entirety, and the aggregate beyond all imagination. . . . At every tick of the clock, in every inhabited part of the world, an unimaginable richness and variety of 'history' falls off the world into total oblivion.

For some, memory loss is severe and permanent. Consider Henry Molaison (known as "H. M.," 1926–2008). For 55 years after having brain surgery to stop severe seizures, Molaison was unable to form new conscious memories. He was, as before his surgery, intelligent and did daily crossword puzzles. Yet, reported neuroscientist Suzanne Corkin (2005), "I've known H. M. since 1962, and he still doesn't know who I am." For about 20 seconds during a conversation he could keep something in mind. When distracted, he would lose what was just said or what had just occurred. Thus, he never could name the current president of the United States (Ogden, 2012).

AP® Exam Tip

Retrograde amnesia acts backward in time, just like when you choose a "retro" look for a party and wear clothes from an earlier time.

Molaison suffered from **anterograde amnesia**—he could recall his past, but he could not form new memories. (Those who cannot recall their past—the old information stored in long-term memory—suffer from **retrograde amnesia.**)

anterograde amnesia an inability to form new memories.

retrograde amnesia an inability to retrieve information from one's past.

Neurologist Oliver Sacks (1985, pp. 26–27) described another patient, Jimmie, who had anterograde amnesia resulting from brain damage. Jimmie had no memories—thus, no sense of elapsed time—beyond his injury in 1945.

When Jimmie gave his age as 19, Sacks set a mirror before him: "Look in the mirror and tell me what you see. Is that a 19-year-old looking out from the mirror?"

Jimmie turned ashen, gripped the chair, cursed, then became frantic: "What's going on? What's happened to me? Is this a nightmare? Am I crazy? Is this a joke?" When his attention was diverted to some children playing baseball, his panic ended, the dreadful mirror forgotten.

Sacks showed Jimmie a photo from *National Geographic*. "What is this?" he asked.

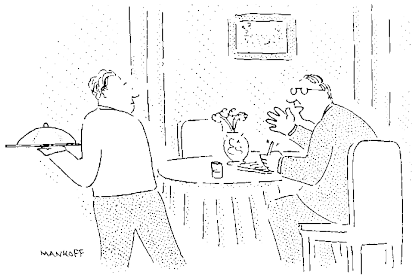
"It's the Moon," Jimmie replied.

"No, it's not," Sacks answered. "It's a picture of the Earth taken from the Moon."

"Doc, you're kidding? Someone would've had to get a camera up there!"

"Naturally."

"Hell! You're joking—how the hell would you do that?" Jimmie's wonder was that of a bright young man from nearly 70 years ago reacting with amazement to his travel back to the future.



"Waiter, I'd like to order, unless I've eaten, in which case bring me the check."

Careful testing of these unique people reveals something even stranger: Although incapable of recalling new facts or anything they have done recently, Molaison, Jimmie, and others with similar conditions can learn nonverbal tasks. Shown hard-to-find figures in pictures (in the *Where's Waldo?* series), they can quickly spot them again later. They can find their way to the bathroom, though without being able to tell you where it is. They can learn to read mirror-image writing or do a jigsaw puzzle, and they have even been taught complicated job skills (Schacter, 1992, 1996; Xu & Corkin, 2001). They can be classically conditioned. However, *they do all these things with no awareness of having learned them.*

Molaison and Jimmie lost their ability to form new explicit memories, but their automatic processing ability remained intact. Like Alzheimer's patients,

whose *explicit* memories for new people and events are lost, they can form new *implicit* memories (Lustig & Buckner, 2004). They can learn *how* to do something, but they will have no conscious recall of learning their new skill. Such sad cases confirm that we have two distinct memory systems, controlled by different parts of the brain.

For most of us, forgetting is a less drastic process. Let's consider some of the reasons we forget.


San Diego Union-Tribune/Newscom

Studying a famous brain Jacopo Annese and other scientists at the University of California, San Diego's Brain Observatory are preserving Henry Molaison's brain for the benefit of future generations. Their careful work will result in a freely available online brain atlas.

Encoding Failure

Much of what we sense we never notice, and what we fail to encode, we will never remember (**FIGURE 33.1**). Age can affect encoding efficiency. The brain areas that jump into action when young adults encode new information are less responsive in older adults. This slower encoding helps explain age-related memory decline (Grady et al., 1995).

But no matter how young we are, we selectively attend to few of the myriad sights and sounds continually bombarding us. When texting during class, students may fail to encode details that their more attentive classmates are encoding for next week's test. Without effort, many potential memories never form.

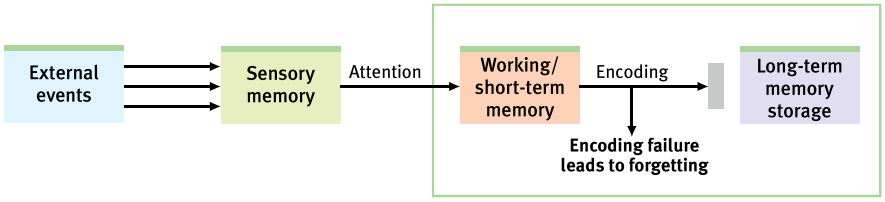


Figure 33.1
Forgetting as encoding failure We cannot remember what we have not encoded.

Storage Decay

Even after encoding something well, we sometimes later forget it. To study the durability of stored memories, Hermann Ebbinghaus (1885) learned more lists of nonsense syllables and measured how much he retained when relearning each list, from 20 minutes to 30 days later. The result, confirmed by later experiments, was his famous forgetting curve: *The course of forgetting is initially rapid, then levels off with time* (**FIGURE 33.2;** Wixted & Ebbesen, 1991).

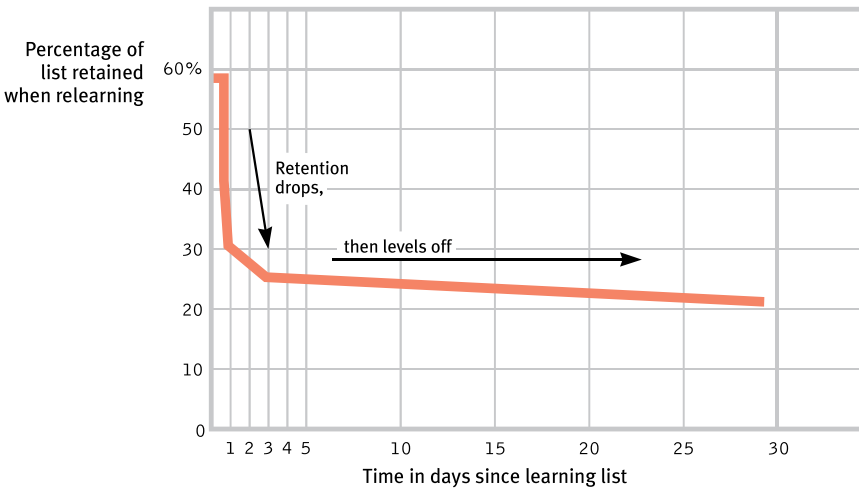
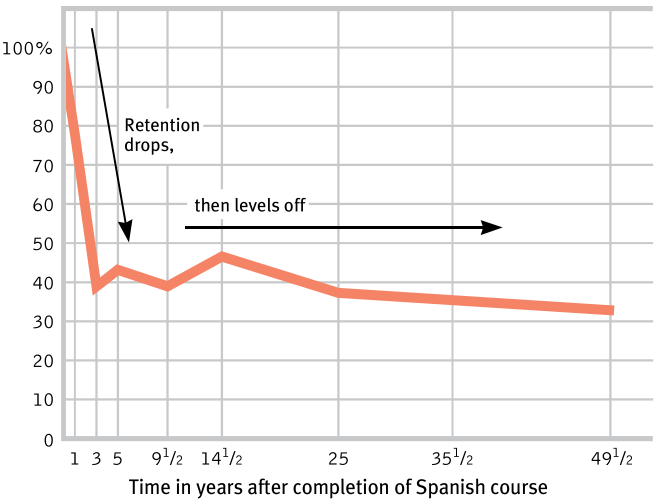


Figure 33.2
Ebbinghaus' forgetting curve After learning lists of nonsense syllables, such as YOX and JIH, Ebbinghaus studied how much he retained up to 30 days later. He found that memory for novel information fades quickly, then levels out. (Adapted from Ebbinghaus, 1885.)



Bill Aron/Photo Edit

Figure 33.3
The forgetting curve for Spanish learned in school Compared with people just completing a Spanish course, those 3 years out of the course remembered much less. Compared with the 3-year group, however, those who studied Spanish even longer ago did not forget much more. (Adapted from Bahrick, 1984.)

Harry Bahrick (1984) found a similar forgetting curve for Spanish vocabulary learned in school. Compared with those just completing a high school or college Spanish course, people 3 years out of school had forgotten much of what they had learned (**FIGURE 33.3**). However, what people remembered then, they still remembered 25 and more years later. Their forgetting had leveled off.

One explanation for these forgetting curves is a gradual fading of the physical memory trace. Cognitive neuroscientists are getting closer to solving the mystery of the physical storage of memory and are increasing our understanding of how memory storage could decay. Like books you can't find in your high school library, memories may be inaccessible for many reasons. Some were never acquired (not encoded). Others were discarded (stored memories decay). And others are out of reach because we can't retrieve them.

Retrieval Failure

FYI

Deaf persons fluent in sign language experience a parallel "tip of the fingers" phenomenon (Thompson et al., 2005).

Often, forgetting is not memories faded but memories unretrieved. We store in long-term memory what's important to us or what we've rehearsed. But sometimes important events defy our attempts to access them (**FIGURE 33.4**). How frustrating when a name lies poised on the tip of our tongue, just beyond reach. Given retrieval cues *("It begins with an M")*, we may easily retrieve the elusive memory. Retrieval problems contribute to the occasional memory failures of older adults, who more frequently are frustrated by tip-of-the-tongue forgetting (Abrams, 2008).

Do you recall the gist of the sentence I asked you to remember in Module 32's discussion of making information personally meaningful? If not, does the word *shark* serve as a retrieval cue? Experiments show that *shark* (likely what you visualized) more readily retrieves

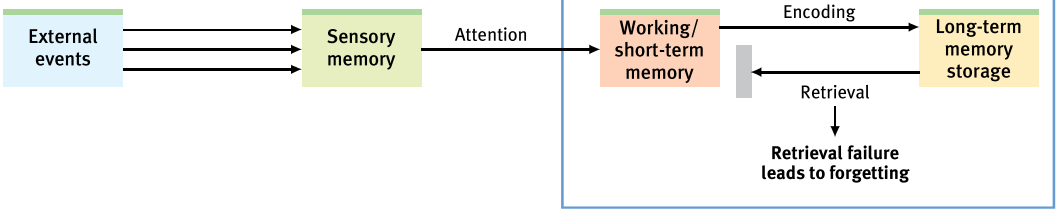


Figure 33.4
Retrieval failure Sometimes even stored information cannot be accessed, which leads to forgetting.

the image you stored than does the sentence's actual word, *fish* (Anderson et al., 1976). (The sentence was *"The fish attacked the swimmer."*)

But retrieval problems occasionally stem from interference and, perhaps, from motivated forgetting.

proactive interference the disruptive effect of prior learning on the recall of new information.

retroactive interference the disruptive effect of new learning on the recall of old information.

INTERFERENCE

As you collect more and more information, your mental attic never fills, but it surely gets cluttered. Sometimes the clutter interferes, as new learning and old collide. **Proactive** *(forward-acting)* **interference** occurs when prior learning disrupts your recall of new information. Your well-rehearsed Facebook password may interfere with your retrieval of your newly learned copy machine code.

Retroactive *(backward-acting)* **interference** occurs when new learning disrupts recall of old information. If someone sings new lyrics to the tune of an old song, you may have trouble remembering the original words. It is rather like a second stone tossed in a pond, disrupting the waves rippling out from the first.

AP® Exam Tip

Here's the prefix "retro" again and it means exactly the same thing with interference that it did for amnesia. In both cases, they're exerting an influence back in time.

Information presented in the hour before sleep is protected from retroactive interference because the opportunity for interfering events is minimized (Diekelmann & Born, 2010; Nesca & Koulack, 1994). Researchers John Jenkins and Karl Dallenbach (1924) first discovered this in a now-classic experiment. Day after day, two people each learned some nonsense syllables, then tried to recall them after up to 8 hours of being awake or asleep at night. As **FIGURE 33.5** shows, forgetting occurred more rapidly after being awake and involved with other activities. The investigators surmised that "forgetting is not so much a matter of the decay of old impressions and associations as it is a matter of interference, inhibition, or obliteration of the old by the new" (1924, p. 612).

The hour before sleep is a good time to commit information to memory (Scullin & McDaniel, 2010), though information presented in the *seconds* just before sleep is seldom remembered (Wyatt & Bootzin, 1994). If you're considering learning *while* sleeping, forget it. We have little memory for information played aloud in the room during sleep, although the ears do register it (Wood et al., 1992).

Old and new learning do not always compete with each other, of course. Previously learned information (Latin) often facilitates our learning of new information (French). This phenomenon is called *positive transfer.*

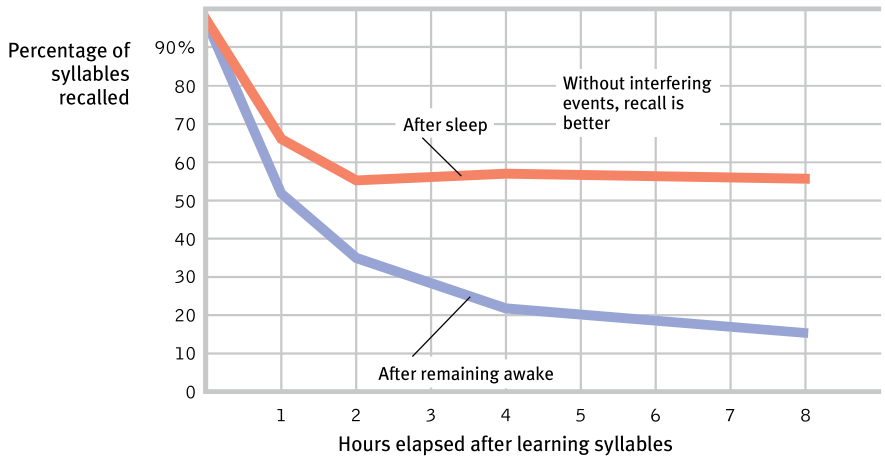


Figure 33.5
Retroactive interference More forgetting occurred when a person stayed awake and experienced other new material. (From Jenkins & Dallenbach, 1924.)

MOTIVATED FORGETTING

To remember our past is often to revise it. Years ago, the huge cookie jar in our kitchen was jammed with freshly baked chocolate chip cookies. Still more were cooling across racks on the counter. Twenty-four hours later, not a crumb was left. Who had taken them?


Fuse/Thinkstock

During that time, my wife, three children, and I were the only people in the house. So while memories were still fresh, I conducted a little memory test. Andy admitted wolfing down as many as 20. Peter thought he had eaten 15. Laura guessed she had stuffed her then-6-year-old body with 15 cookies. My wife, Carol, recalled eating 6, and I remembered consuming 15 and taking 18 more to the office. We sheepishly accepted responsibility for 89 cookies. Still, we had not come close; there had been 160.

Why do our memories fail us? This happens in part because, as Carol Tavris and Elliot Aronson have pointed out, memory is an "unreliable, self-serving historian" (2007, p. 6). Consider one study, in which researchers told some participants about the benefits of frequent toothbrushing. Those individuals then recalled (more than others did) having frequently brushed their teeth in the preceding 2 weeks (Ross et al., 1981).

FIGURE 33.6 reminds us that as we process information, we filter, alter, or lose much of it. So why were my family and I so far off in our estimates of the cookies we had eaten? Was it an *encoding* problem? (Did we just not notice what we had eaten?) Was it a storage problem? (Might our memories of cookies, like Ebbinghaus' memory of nonsense syllables, have melted away almost as fast as the cookies themselves?) Or was the information still intact but not *retrievable* because it would be embarrassing to remember?[1]

Sigmund Freud might have argued that our memory systems self-censored this information. He proposed that we **repress** painful or unacceptable memories to protect

repression in psychoanalytic theory, the basic defense mechanism that banishes from consciousness anxiety-arousing thoughts, feelings, and memories.

AP® Exam Tip

There are many references to Sigmund Freud in the text. Most of your knowledge of Freud probably came from popular culture, and it often conflicts with the discoveries of modern researchers. The AP® exam may test your understanding of researchers' views of Freud.

[1] One of my cookie-scarfing sons, on reading this in his father's textbook years later, confessed he had fibbed "a little."

"Someday we'll look back at this time in our lives and be unable to remember it."

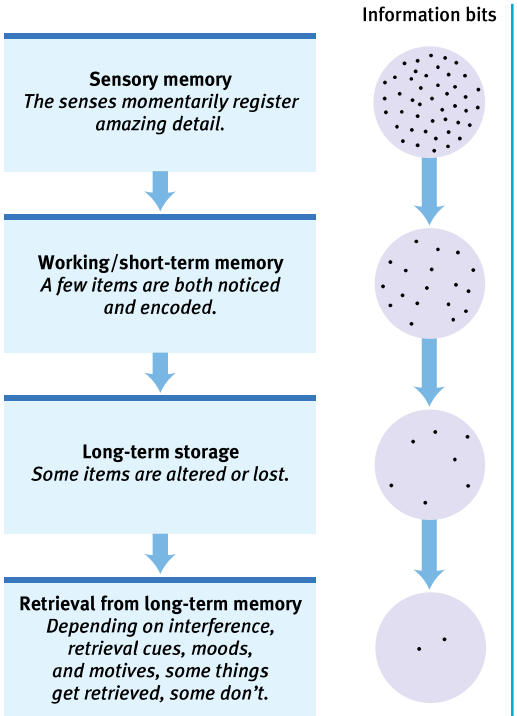


Figure 33.6
When do we forget? Forgetting can occur at any memory stage. As we process information, we filter, alter, or lose much of it.

our self-concept and to minimize anxiety. But the repressed memory lingers, he believed, and can be retrieved by some later cue or during therapy. Repression was central to Freud's psychoanalytic theory (more on that in Module 55) and was a popular idea in mid-twentieth-century psychology and beyond. In one study, 9 in 10 university students agreed that "memories for painful experiences are sometimes pushed into unconsciousness" (Brown et al., 1996). Some therapists assume it. Today, however, increasing numbers of memory researchers think repression rarely, if ever, occurs. People succeed in forgetting unwanted neutral information (yesterday's parking place), but it's harder to forget emotional events (Payne & Corrigan, 2007). Thus, we may have intrusive memories of the very traumatic experiences we would most like to forget.

Before You Move On

▶ ASK YOURSELF

Most people, especially as they grow older, wish for a better memory. Is that true of you? Or do you more often wish you could better discard old memories?

▶ TEST YOURSELF

Can you offer examples of proactive and retroactive interference?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Memory Construction Errors

33-2 How do misinformation, imagination, and source amnesia influence our memory construction? How do we decide whether a memory is real or false?

AP® Exam Tip

Read this entire section particularly carefully. Many people harbor misconceptions about how memory works, and a lot of the misconceptions are dealt with in the next few pages. Memory does *not* function like a video recorder!

Memory is not precise. Like scientists who infer a dinosaur's appearance from its remains, we infer our past from stored information plus what we later imagined, expected, saw, and heard. We don't just retrieve memories, we reweave them, noted Daniel Gilbert (2006, p. 79): "Information acquired after an event alters memory of the event." We often construct our memories as we encode them, and every time we "replay" a memory, we replace the original with a slightly modified version (Hardt et al., 2010). (Memory researchers call this *reconsolidation*.) So, in a sense, said Joseph LeDoux (2009), "your memory is only as good as your last memory. The fewer times you use it, the more pristine it is." This means that, to some degree, "all memory is false" (Bernstein & Loftus, 2009b). Let's examine some of the ways we rewrite our past.

Misinformation and Imagination Effects

misinformation effect
incorporating misleading information into one's memory of an event.

In more than 200 experiments, involving more than 20,000 people, Elizabeth Loftus has shown how eyewitnesses reconstruct their memories after a crime or an accident. In one experiment, two groups of people watched a film of a traffic accident and then answered questions about what they had seen (Loftus & Palmer, 1974). Those asked, "About how fast were the cars going when they *smashed* into each other?" gave higher speed estimates than those asked, "About how fast were the cars going when they *hit* each other?" A week later, when asked whether they recalled seeing any broken glass, people who had heard *smashed* were more than twice as likely to report seeing glass fragments (**FIGURE 33.7** on the next page). In fact, the film showed no broken glass.

In many follow-up experiments around the world, others have witnessed an event, received or not received misleading information about it, and then taken a memory test. The repeated result is a **misinformation effect:** Exposed to misleading information, we tend to

"Memory is insubstantial. Things keep replacing it. Your batch of snapshots will both fix and ruin your memory. . . . You can't remember anything from your trip except the wretched collection of snapshots." -Annie Dillard, "To Fashion a Text," 1988

Figure 33.7

Memory construction In this experiment, people viewed a film of a car accident (left). Those who later were asked a leading question recalled a more serious accident than they had witnessed. (From Loftus & Palmer, 1974.)

misremember. A yield sign becomes a stop sign, hammers become screwdrivers, Coke cans become peanut cans, breakfast cereal becomes eggs, and a clean-shaven man morphs into a man with a mustache (Loftus et al., 1992). So powerful is the misinformation effect that it can influence later attitudes and behaviors (Bernstein & Loftus, 2009).

Just hearing a vivid retelling of an event can implant false memories. One experiment falsely suggested to some Dutch university students that, as children, they became ill after eating spoiled egg salad (Geraerts et al., 2008). After absorbing that suggestion, a significant minority were less likely to eat egg-salad sandwiches, both immediately and 4 months later.

Even repeatedly *imagining* nonexistent actions and events can create false memories. American and British university students were asked to imagine certain childhood events, such as breaking a window with their hand or having a skin sample removed from a finger. One in four of them later recalled the imagined event as something that had really happened (Garry et al., 1996; Mazzoni & Memon, 2003).

Digitally altered photos have also produced this *imagination inflation.* In experiments, researchers have altered photos from a family album to show some family members taking a hot-air balloon ride. After viewing these photos (rather than photos showing just the balloon), children reported more false memories and indicated high confidence in those memories. When interviewed several days later, they reported even richer details of their false memories (Strange et al., 2008; Wade et al., 2002).

In British and Canadian university surveys, nearly one-fourth of students have reported autobiographical memories that they later realized were not accurate (Mazzoni et al., 2010).

DOONESBURY

I empathize. For decades, my cherished earliest memory was of my parents getting off the bus and walking to our house, bringing my baby brother home from the hospital. When, in middle age, I shared that memory with my father, he assured me they did *not* bring their newborn home on the Seattle Transit System. The human mind, it seems, comes with built-in Photoshopping software.

"It isn't so astonishing, the number of things I can remember, as the number of things I can remember that aren't so." -Mark Twain (1835–1910)

Source Amnesia

Among the frailest parts of a memory is its source. We may recognize someone but have no idea where we have seen the person. We may dream an event and later be unsure whether it really happened. We may misrecall how we learned about something (Henkel et al., 2000). Psychologists are not immune to the process. Famed child psychologist Jean Piaget was startled as an adult to learn that a vivid, detailed memory from his childhood—a nursemaid's thwarting his kidnapping—was utterly false. He apparently constructed the memory from repeatedly hearing the story (which his nursemaid, after undergoing a religious conversion, later confessed had never happened). In attributing his "memory" to his own experiences, rather than to his nursemaid's stories, Piaget exhibited **source amnesia** (also called *source misattribution*). Misattribution is at the heart of many false memories. Authors and songwriters sometimes suffer from it. They think an idea came from their own creative imagination, when in fact they are unintentionally plagiarizing something they earlier read or heard.

Debra Poole and Stephen Lindsay (1995, 2001, 2002) demonstrated source amnesia among preschoolers. They had the children interact with "Mr. Science," who engaged them in activities such as blowing up a balloon with baking soda and vinegar. Three months later, on three successive days, their parents read them a story describing some things the children had experienced with Mr. Science and some they had not. When a new interviewer asked what Mr. Science had done with them—"Did Mr. Science have a machine with ropes to pull?"—4 in 10 children spontaneously recalled him doing things that had happened only in the story.

Source amnesia also helps explain **déjà vu** (French for "already seen"). Two-thirds of us have experienced this fleeting, eerie sense that "I've been in this exact situation before." It happens most commonly to well-educated, imaginative young adults, especially when tired or stressed (Brown, 2003, 2004; McAneny, 1996). Some wonder, "How could I recognize a situation I'm experiencing for the first time?" Others may think of reincarnation ("I must have experienced this in a previous life") or precognition ("I viewed this scene in my mind before experiencing it").

The key to déjà vu seems to be familiarity with a stimulus without a clear idea of where we encountered it before (Cleary, 2008). Normally, we experience a feeling of *familiarity* (thanks to temporal lobe processing) before we consciously remember details (thanks to hippocampus and frontal lobe processing). When these functions (and brain regions) are out of sync, we may experience a feeling of familiarity without conscious recall. Our amazing brains try to make sense of such an improbable situation, and we get an eerie feeling that we're reliving some earlier part of our life. After all, the situation is familiar, even though we have no idea why. Our source amnesia forces us to do our best to make sense of an odd moment.

Try This

In the discussion of mnemonics in Module 31, I gave you six words and told you I would quiz you about them later. How many of these words can you now recall? Of these, how many are high-imagery words? How many are low-imagery? (You can check your list against the six inverted words below.)

Bicycle, void, cigarette, inherent, fire, process

"Do you ever get that strange feeling of vujà dé? Not déjà vu; vujà dé. It's the distinct sense that, somehow, something just happened that has never happened before. Nothing seems familiar. And then suddenly the feeling is gone. Vujà dé." -Comedian George Carlin (1937–2008), in *Funny Times*, December 2001

Discerning True and False Memories

Because the misinformation effect and source amnesia happen outside our awareness, it is nearly impossible to sift suggested ideas out of the larger pool of real memories (Schooler et al., 1986). Perhaps you can recall describing a childhood experience to a friend and filling in memory gaps with reasonable guesses and assumptions. We all do it, and after more retellings, those guessed details—now absorbed into our memories—may feel as real as if we had actually experienced them (Roediger et al., 1993). Much as perceptual illusions may seem like real perceptions, unreal memories feel like real memories.

source amnesia attributing to the wrong source an event we have experienced, heard about, read about, or imagined. (Also called *source misattribution*.) Source amnesia, along with the misinformation effect, is at the heart of many false memories.

déjà vu that eerie sense that "I've experienced this before." Cues from the current situation may unconsciously trigger retrieval of an earlier experience.

False memories can be very persistent. Imagine that I were to read aloud a list of words such as *candy, sugar, honey,* and *taste*. Later, I ask you to recognize the presented words from a larger list. If you are at all like the people tested by Henry Roediger and Kathleen McDermott (1995), you would err three out of four times—by falsely remembering a nonpresented similar word, such as *sweet.* We more easily remember the gist than the words themselves.

Memory construction helps explain why 79 percent of 200 convicts exonerated by later DNA testing had been misjudged based on faulty eyewitness identification (Garrett, 2008). It explains why "hypnotically refreshed" memories of crimes so easily incorporate errors, some of which originate with the hypnotist's leading questions *("Did you hear loud noises?").* It explains why dating partners who fell in love have overestimated their first impressions of one another *("It was love at first sight"),* while those who broke up underestimated their earlier liking *("We never really clicked")* (McFarland & Ross, 1987). How people feel today tends to be how they recall they have always felt (Mazzoni & Vannucci, 2007; and recall from Module 4 our tendency to *hindsight bias*). As George Vaillant (1977, p. 197) noted after following adult lives through time, "It is all too common for caterpillars to become butterflies and then to maintain that in their youth they had been little butterflies. Maturation makes liars of us all."

Children's Eyewitness Recall

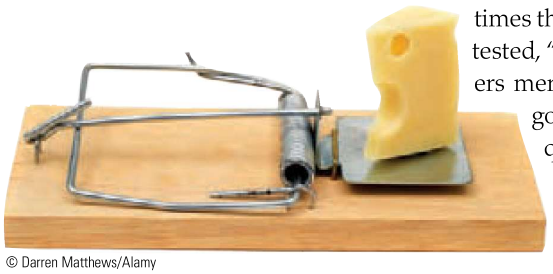
33-3 How reliable are young children's eyewitness descriptions, and why are reports of repressed and recovered memories so hotly debated?

If memories can be sincere, yet sincerely wrong, might children's recollections of sexual abuse be prone to error? "It would be truly awful to ever lose sight of the enormity of child abuse," observed Stephen Ceci (1993). Yet Ceci and Maggie Bruck's (1993, 1995) studies of children's memories have made them aware of how easily children's memories can be molded. For example, they asked 3-year-olds to show on anatomically correct dolls where a pediatrician had touched them. Of the children who had not received genital examinations, 55 percent pointed to either genital or anal areas.

In other experiments, the researchers studied the effect of suggestive interviewing techniques (Bruck & Ceci, 1999, 2004). In one study, children chose a card from a deck of possible happenings, and an adult then read the card to them. For example, "Think real hard, and tell me if this ever happened to you. Can you remember going to the hospital with a mousetrap on your finger?" In interviews, the same adult repeatedly asked children to think about several real and fictitious events. After 10 weeks of this, a new adult asked the same question. The stunning result: 58 percent of preschoolers produced false (often vivid) stories regarding one or more events they had never experienced (Ceci et al., 1994). Here's one of those stories:

> My brother Colin was trying to get Blowtorch [an action figure] from me, and I wouldn't let him take it from me, so he pushed me into the wood pile where the mousetrap was. And then my finger got caught in it. And then we went to the hospital, and my mommy, daddy, and Colin drove me there, to the hospital in our van, because it was far away. And the doctor put a bandage on this finger.

Given such detailed stories, professional psychologists who specialize in interviewing children could not reliably separate the real memories from the false ones. Nor could the children themselves. The above child, reminded that his parents had told him several times that the mousetrap incident never happened—that he had imagined it—protested, "But it really did happen. I remember it!" In another experiment, preschoolers merely overheard an erroneous remark that a magician's missing rabbit had gotten loose in their classroom. Later, when the children were suggestively questioned, 78 percent of them recalled actually seeing the rabbit (Principe et al., 2006). "[The] research leads me to worry about the possibility of false allegations. It is not a tribute to one's scientific integrity to walk down the middle of the road if the data are more to one side," said Ceci (1993).



Does this mean that children can never be accurate eyewitnesses? *No.* When questioned about their experiences in neutral words they understood, children often accurately recalled what happened and who did it (Goodman, 2006; Howe, 1997; Pipe, 1996). And when interviewers used less suggestive, more effective techniques, even 4- to 5-year-old children produced more accurate recall (Holliday & Albon, 2004; Pipe et al., 2004). Children were especially accurate when they had not talked with involved adults prior to the interview and when their disclosure was made in a first interview with a neutral person who asked nonleading questions.

Repressed or Constructed Memories of Abuse?

The research on source amnesia and the misinformation effect raises concerns about therapist-guided "recovered" memories. There are two tragedies related to adult recollections of child abuse. One happens when people don't believe abuse survivors who tell their secret. The other happens when innocent people are falsely accused.

Some well-intentioned therapists have reasoned with patients that "people who've been abused often have your symptoms, so you probably were abused. Let's see if, aided by hypnosis or drugs, or helped to dig back and visualize your trauma, you can recover it." Patients exposed to such techniques may then form an image of a threatening person. With further visualization, the image grows more vivid. The patient ends up stunned, angry, and ready to confront or sue the remembered abuser. The accused person (often a parent or relative) is equally stunned and devastated, and vigorously denies the accusation.

Critics are not questioning most therapists' professionalism. Nor are they questioning the accusers' sincerity; even if false, their memories are heartfelt. Critics' charges are specifically directed against clinicians who use "memory work" techniques, such as "guided imagery," hypnosis, and dream analysis to recover memories. "Thousands of families were cruelly ripped apart," with "previously loving adult daughters" suddenly accusing fathers (Gardner, 2006). Irate clinicians have countered that those who argue that recovered memories of abuse never happen are adding to abused people's trauma and playing into the hands of child molesters.

In an effort to find a sensible common ground that might resolve psychology's "memory war," professional organizations (the American Medical, American Psychological, and American Psychiatric Associations; the Australian Psychological Society; the British Psychological Society; and the Canadian Psychiatric Association) have convened study panels and issued public statements. Those committed to protecting abused children and those committed to protecting wrongly accused adults have agreed on the following:

- ***Sexual abuse happens.*** And it happens more often than we once supposed. Although sexual abuse can leave its victims at risk for problems ranging from sexual dysfunction to depression (Freyd et al., 2007), there is no characteristic "survivor syndrome"—no group of symptoms that lets us spot victims of sexual abuse (Kendall-Tackett et al., 1993).
- ***Injustice happens.*** Some innocent people have been falsely convicted. And some guilty people have evaded responsibility by casting doubt on their truth-telling accusers.
- ***Forgetting happens.*** Many of those actually abused were either very young when abused or may not have understood the meaning of their experience—circumstances under which forgetting is common. Forgetting isolated past events, both negative and positive, is an ordinary part of everyday life.
- ***Recovered memories are commonplace.*** Cued by a remark or an experience, we all recover memories of long-forgotten events, both pleasant and unpleasant. What many psychologists debate is twofold: Does the unconscious mind sometimes *forcibly repress* painful experiences? If so, can these experiences be retrieved by certain therapist-aided techniques? (Memories that surface naturally are more likely to be verified [Geraerts et al., 2007].)

"When memories are 'recovered' after long periods of amnesia, particularly when extraordinary means were used to secure the recovery of memory, there is a high probability that the memories are false." -Royal College of Psychiatrists Working Group on Reported Recovered Memories of Child Sexual Abuse (Brandon et al., 1998)

- ***Memories of things happening before age 3 are unreliable.*** We cannot reliably recall happenings from our first three years. As noted earlier, this infantile amnesia happens because our brain pathways have not yet developed enough to form the kinds of memories we will form later in life. Most psychologists—including most clinical and counseling psychologists—therefore doubt "recovered" memories of abuse during infancy (Gore-Felton et al., 2000; Knapp & VandeCreek, 2000). The older a child was when suffering sexual abuse, and the more severe the abuse, the more likely it is to be remembered (Goodman et al., 2003).
- ***Memories "recovered" under hypnosis or the influence of drugs are especially unreliable.*** Under hypnosis, people will incorporate all kinds of suggestions into their memories, even memories of "past lives."
- ***Memories, whether real or false, can be emotionally upsetting.*** Both the accuser and the accused may suffer when what was born of mere suggestion becomes, like an actual trauma, a stinging memory that drives bodily stress (McNally, 2003, 2007). Some people knocked unconscious in unremembered accidents know this all too well. They have later developed stress disorders after being haunted by memories they constructed from photos, news reports, and friends' accounts (Bryant, 2001).

So, does *repression* of threatening memories ever occur? Or is this concept—the cornerstone of Freud's theory and of so much popular psychology—misleading? In Modules 55 and 56, we will return to this hotly debated issue. For now, this much appears certain: The most common response to a traumatic experience (witnessing a loved one's murder, being terrorized by a hijacker or a rapist, losing everything in a natural disaster) is not banishment of the experience into the unconscious. Rather, such experiences are typically etched on the mind as vivid, persistent, haunting memories (Porter & Peace, 2007). As Robert Kraft (2002) said of the experience of those trapped in the Nazi death camps, "Horror sears memory, leaving . . . the consuming memories of atrocity."

Before You Move On

▶ ASK YOURSELF

Could you be an impartial jury member in a trial of a parent accused of sexual abuse based on a recovered memory, or of a therapist being sued for creating a false memory of abuse? Why or why not?

▶ TEST YOURSELF

How would source amnesia affect us if we were to remember all of our waking experiences as well as all of our dreams?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Improving Memory

33-4 How can you use memory research findings to do better in this and other courses?

Biology's findings benefit medicine. Botany's findings benefit agriculture. So, too, can psychology's research on memory benefit education. Here, for easy reference, is a summary of some research-based suggestions that could help you remember information when you need it. The SQ3R (*S*urvey, *Q*uestion, *R*ead, *R*etrieve, *R*eview) study technique introduced in Module 2 incorporates several of these strategies:

Rehearse repeatedly. To master material, use distributed (spaced) practice. To learn a concept, give yourself many separate study sessions. Take advantage of life's little intervals—riding a bus, walking to lunch, waiting for class to start. New memories are weak; exercise them and they will strengthen. To memorize specific facts or figures, Thomas Landauer (2001) has advised, "rehearse the name or number you are trying to memorize, wait a few seconds, rehearse again, wait a little longer, rehearse again, then wait longer still and rehearse yet again. The waits should be as long as possible without losing the information." Reading complex material with minimal rehearsal yields little retention. Rehearsal and critical reflection help more. It pays to study actively.

©Image Source/Corbis

Thinking and memory Actively thinking as we read, by rehearsing and relating ideas, and by making the material personally meaningful, yields the best retention.

Make the material meaningful. You can build a network of retrieval cues by taking text and class notes in your own words. Apply the concepts to your own life. Form images. Understand and organize information. Relate the material to what you already know or have experienced. As William James (1890) suggested, "Knit each new thing on to some acquisition already there." Restate concepts in your own words. Mindlessly repeating someone else's words won't supply many retrieval cues. On an exam, you may find yourself stuck when a question uses phrasing different from the words you memorized.

Activate retrieval cues. Mentally re-create the situation and the mood in which your original learning occurred. Jog your memory by allowing one thought to cue the next.

Use mnemonic devices. Associate items with peg words. Make up a story that incorporates vivid images of the items. Chunk information into acronyms. Create rhythmic rhymes *("i before e, except after c")*.

Minimize interference. Study before sleep. Do not schedule back-to-back study times for topics that are likely to interfere with each other, such as Spanish and French.

Sleep more. During sleep, the brain reorganizes and consolidates information for long-term memory. Sleep deprivation disrupts this process.

Test your own knowledge, both to rehearse it and to find out what you don't yet know. Don't be lulled into overconfidence by your ability to recognize information. Test your recall using the Test Yourself items found throughout each unit, and the numbered Learning Objective Questions at the end of each module. Outline sections. Define the terms and concepts listed at each unit's end before turning back to their definitions. Try the Multiple-Choice and Practice FRQ questions at the end of each module, and take the AP® Exam Practice Questions at the end of each unit.

Before You Move On

► ASK YOURSELF

Which of the study and memory strategies suggested in this section will work best for you?

► TEST YOURSELF

What are the recommended memory strategies you just read about? (One advised rehearsing to-be-remembered material. What were the others?)

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 33 Review

33-1 Why do we forget?

- *Anterograde amnesia* is an inability to form new memories.
- *Retrograde amnesia* is an inability to retrieve old memories.
- Normal forgetting happens because we have never encoded information; because the physical trace has decayed; or because we cannot retrieve what we have encoded and stored.
- Retrieval problems may result from *proactive* (forward-acting) *interference,* as prior learning interferes with recall of new information, or from *retroactive* (backward-acting) *interference,* as new learning disrupts recall of old information.
- Some believe that motivated forgetting occurs, but researchers have found little evidence of *repression.*

33-2 How do misinformation, imagination, and source amnesia influence our memory construction? How do we decide whether a memory is real or false?

- In experiments demonstrating the *misinformation effect,* people have formed false memories, by incorporating misleading details, either after receiving wrong information after an event, or after repeatedly *imagining* and rehearsing something that never happened.
- When we reassemble a memory during retrieval, we may attribute it to the wrong source *(source amnesia).* Source amnesia may help explain *déjà vu.*
- False memories feel like real memories and can be persistent but are usually limited to the gist of the event.

33-3 How reliable are young children's eyewitness descriptions, and why are reports of repressed and recovered memories so hotly debated?

- Children are susceptible to the misinformation effect, but if questioned in neutral words they understand, they can accurately recall events and people involved in them.
- The debate (between memory researchers and some well-meaning therapists) focuses on whether most memories of early childhood abuse are repressed and can be recovered during therapy using "memory work" techniques using leading questions or hypnosis.
- Psychologists now agree that (1) sexual abuse happens; (2) injustice happens; (3) forgetting happens; (4) recovered memories are commonplace; (5) memories of things that happened before age 3 are unreliable; (6) memories "recovered" under hypnosis or the influence of drugs are especially unreliable; and (7) memories, whether real or false, can be emotionally upsetting.

33-4 How can you use memory research findings to do better in this and other courses?

- Memory research findings suggest the following strategies for improving memory: Study repeatedly, make material meaningful, activate retrieval cues, use mnemonic devices, minimize interference, sleep more, and test yourself to be sure you can retrieve, as well as recognize, material.

Multiple-Choice Questions

1. Which of the following is an example of anterograde amnesia?

a. Halle has no memories of the first 10 years of her life.
b. William has lost his memory of the 2 weeks before he had surgery to remove a benign brain tumor.
c. Louis can remember his past, but has not been able to form new long-term memories since experiencing a brain infection 4 years ago.
d. Maddie can't remember the details of when she was mugged downtown 6 months ago.
e. Kalund struggles in school because he consistently misremembers what his teachers said in class.

2. Muhammad has been in his school cafeteria hundreds of times. It is a large room, and there are nine free-standing pillars that support the roof. One day, to illustrate the nature of forgetting, Muhammad's teacher asks him how many pillars there are in the cafeteria. Muhammad has difficulty answering the question, but finally replies that he thinks there are six pillars. What memory concept does this example illustrate?

a. Storage decay
b. Retrograde amnesia
c. Proactive interference
d. Retroactive interference
e. Encoding failure

3. What does Hermann Ebbinghaus' forgetting curve show about the nature of storage decay?

a. The rate of forgetting increases as time goes on.
b. The rate of forgetting decreases as time goes on.
c. The rate of forgetting does not change as time goes on.
d. The rate of forgetting varies according to the motivation of the learner.
e. The rate of forgetting varies according to the emotional state of the learner.

4. Which of the following is an example of proactive interference?

a. You can't recall your locker combination from sixth grade because your current locker combination interferes.
b. You can't recall your new cell phone number because your old number interferes.
c. You can't recall what you studied in first period because what you studied in fourth period interferes.
d. You can't recall what you studied on Monday because what you studied on Tuesday interferes.
e. You can't recall who won the state swim meet last year because the winner of this year's meet interferes.

5. The text discusses therapist-guided "recovered" memories. Which of the following statements represents an appropriate conclusion about this issue?

a. Therapists who use hypnosis are likely to help their patients retrieve repressed memories.
b. Statistics indicate that childhood sexual abuse rarely occurs; therefore, recovered memories of such abuse must be false.
c. Memories are only rarely recovered; once you are unable to retrieve a memory you will probably never be able to retrieve it.
d. One indicator of whether a recovered memory is true is the patient's emotional response; only true recovered memories are emotionally upsetting.
e. Since the brain is not sufficiently mature to store accurate memories of events before the age of 3, memories from the first 3 years of life are not reliable.

Practice FRQs

1. Tasnia feels like she encodes material well, but still forgets the material on test day. Explain how her forgetting might be related to problems with each of the following:

- Storage
- Retrieval

Answer

1 point: Forgetting may be related to the decay of stored material.

1 point: Forgetting may be related to interference during retrieval (or motivated forgetting).

2. Your younger sister has asked you for help because she feels she cannot remember class material well enough to get good grades on her tests. Provide three specific pieces of advice that she should consider, making sure that your advice is based on psychological science.

(3 points)

Module 34

Thinking, Concepts, and Creativity

Courtesy Everett Collection

Module Learning Objectives

34-1 Define *cognition*, and describe the functions of concepts.

34-2 Identify the factors associated with creativity, and describe ways of promoting creativity.

In some ways, we humans are, as we will see, dim-witted. We fear the wrong things. We allow the day's hot or cold weather to color our judgments of global climate change. We tend to be overconfident in our judgments and to persevere in clinging to discredited beliefs. Yet we also display remarkable mental powers. Our intelligence, creativity, and language mark us as "little less than the angels."

cognition all the mental activities associated with thinking, knowing, remembering, and communicating.

concept a mental grouping of similar objects, events, ideas, or people.

prototype a mental image or best example of a category. Matching new items to a prototype provides a quick and easy method for sorting items into categories (as when comparing feathered creatures to a prototypical bird, such as a robin).

Thinking and Concepts

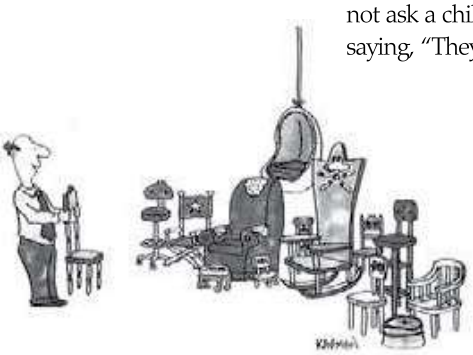
34-1 What is cognition, and what are the functions of concepts?

Let's begin our study of **cognition**—the mental activities associated with thinking, knowing, remembering, and communicating information—by appreciating our human smarts.

Consider, for example, our ability to form **concepts**—mental groupings of similar objects, events, ideas, and people. The concept *chair* includes many items—a baby's high chair, a reclining chair, a dentist's chair—all of which are for sitting. Concepts simplify our thinking. Imagine life without them. We would need a different name for every person, event, object, and idea. We could not ask a child to "throw the ball" because there would be no concept of *throw* or *ball.* Instead of saying, "They were angry," we would have to describe expressions, intensities, and words. Concepts such as *ball* and *anger* give us much information with little cognitive effort.

We often form our concepts by developing **prototypes**—a mental image or best example of a category (Rosch, 1978). People more quickly agree that "a robin is a bird" than that "a penguin is a bird." For most of us, the robin is the birdier bird; it more closely resembles our bird prototype. And the more closely something matches our prototype of a concept—bird or car—the more readily we recognize it as an example of the concept.

Once we place an item in a category, our memory of it later shifts toward the category prototype, as it did for Belgian students who viewed ethnically blended faces. For example, when viewing a blended face in which 70 percent of the features were Caucasian and 30 percent were Asian, the students categorized the



"Attention, everyone! I'd like to introduce the newest member of our family."

face as Caucasian. Later, as their memory shifted toward the Caucasian prototype, they were more likely to remember an 80 percent Caucasian face than the 70 percent Caucasian they had actually seen (Corneille et al., 2004). Likewise, if shown a 70 percent Asian face, they later remembered a more prototypically Asian face. So, too, with gender: People who viewed 70 percent male faces categorized them as male (no surprise there) and then later misremembered them as even more prototypically male (Huart et al., 2005).

Move away from our prototypes, and category boundaries may blur. Is a tomato a fruit? Is a 17-year-old female a girl or a woman? Is a whale a fish or a mammal? Because a whale fails to match our "mammal" prototype, we are slower to recognize it as a mammal. Similarly, when symptoms don't fit one of our disease prototypes, we are slow to perceive an illness (Bishop, 1991). People whose heart attack symptoms (shortness of breath, exhaustion, a dull weight in the chest) don't match their heart attack prototype (sharp chest pain) may not seek help. And when behaviors don't fit our discrimination prototypes—of White against Black, male against female, young against old—we often fail to notice prejudice. People more easily detect male prejudice against females than female against males or female against females (Inman & Baron, 1996; Marti et al., 2000). Concepts speed and guide our thinking. But they don't always make us wise.

Toying with our prototypes It takes a bit longer to conceptualize a Smart Car as an actual car, because it looks more like a toy than our mental prototype for *car*.

Creativity

34-2 What is creativity, and what fosters it?

Pierre de Fermat, a seventeenth-century mischievous genius, challenged mathematicians of his day to match his solutions to various number theory problems. His most famous challenge—*Fermat's last theorem*—baffled the greatest mathematical minds, even after a $2 million prize (in today's dollars) was offered in 1908 to whoever first created a proof.

Princeton mathematician Andrew Wiles had pondered the problem for more than 30 years and had come to the brink of a solution. One morning, out of the blue, the final "incredible revelation" struck him. "It was so indescribably beautiful; it was so simple and so elegant. I couldn't understand how I'd missed it. . . . It was the most important moment of my working life" (Singh, 1997, p. 25).

Wiles' incredible moment illustrates **creativity**—the ability to produce ideas that are both novel and valuable (Hennessey & Amabile, 2010). Studies suggest that a certain level of aptitude—a score above 120 on a standard intelligence test—supports creativity. Those who score exceptionally high in quantitative aptitude as 13-year-olds are more likely to obtain graduate science and math degrees and create published or patented work (Park et al., 2008; Robertson et al., 2010). Intelligence matters. Yet, there is more to creativity than what intelligence tests reveal. Indeed, the two kinds of thinking engage different brain areas. Intelligence tests, which typically demand a single correct answer, require **convergent thinking.** Injury to the left parietal lobe damages this ability. Creativity tests *(How many uses can you think of for a brick?)* require **divergent thinking.** Injury to certain areas of the frontal lobes can leave reading, writing, and arithmetic skills intact but destroy imagination (Kolb & Whishaw, 2006).

Although there is no agreed-upon creativity measure—there is no Creativity Quotient (CQ) corresponding to an Intelligence Quotient (IQ) score—Robert Sternberg and his colleagues have identified five components of creativity (Sternberg, 1988, 2003; Sternberg & Lubart, 1991, 1992):

1. ***Expertise***—a well-developed base of knowledge—furnishes the ideas, images, and phrases we use as mental building blocks. "Chance favors only the prepared mind," observed Louis Pasteur. The more blocks we have, the more chances we have to combine them in novel ways. Wiles' well-developed base of knowledge put the needed theorems and methods at his disposal.

FYI

After picking up a Nobel Prize in Stockholm, physicist Richard Feynman stopped in Queens, New York, to look at his high school record. "My grades were not as good as I remembered," he reported, "and my IQ was [a good, though unexceptional] 124" (Faber, 1987).

creativity the ability to produce novel and valuable ideas.

convergent thinking narrows the available problem solutions to determine the single best solution.

divergent thinking expands the number of possible problem solutions (creative thinking that diverges in different directions).

2. ***Imaginative thinking skills*** provide the ability to see things in novel ways, to recognize patterns, and to make connections. Having mastered a problem's basic elements, we redefine or explore it in a new way. Copernicus first developed expertise regarding the solar system and its planets, and then creatively defined the system as revolving around the Sun, not the Earth. Wiles' imaginative solution combined two partial solutions.
3. ***A venturesome personality*** seeks new experiences, tolerates ambiguity and risk, and perseveres in overcoming obstacles. Wiles risked much of his time in pursuit of his dream and persevered in near-isolation from the mathematics community partly to stay focused and avoid distraction.
4. ***Intrinsic motivation*** is being driven more by interest, satisfaction, and challenge than by external pressures (Amabile & Hennessey, 1992). Creative people focus less on extrinsic motivators—meeting deadlines, impressing people, or making money—than on the pleasure and stimulation of the work itself. Asked how he solved such difficult scientific problems, Isaac Newton reportedly answered, "By thinking about them all the time." Wiles concurred: "I was so obsessed by this problem that . . . I was thinking about it all the time—[from] when I woke up in the morning to when I went to sleep at night" (Singh & Riber, 1997).
5. ***A creative environment*** sparks, supports, and refines creative ideas. After studying the careers of 2026 prominent scientists and inventors, Dean Keith Simonton (1992) noted that the most eminent were mentored, challenged, and supported by their colleagues. Many had the emotional intelligence needed to network effectively with peers. Even Wiles stood on the shoulders of others and wrestled his problem with the collaboration of a former student. Creativity-fostering environments support innovation, team-building, and communication (Hülsheger et al., 2009). They also support contemplation. After Jonas Salk solved a problem that led to the polio vaccine while in a monastery, he designed the Salk Institute to provide contemplative spaces where scientists could work without interruption (Sternberg, 2006). Google has estimated that nearly half its product innovations have been sparked during the 20 percent of employee time reserved for unstructured creative thinking (Mayer, 2006).

Imaginative thinking Cartoonists often display creativity as they see things in new ways or make unusual connections.

"For the love of God, is there a doctor in the house?"

For those seeking to boost the creative process, research offers some ideas:

- *Develop your expertise.* Ask yourself what you care about and most enjoy. Follow your passion and become an expert at something.
- *Allow time for incubation.* Given sufficient knowledge available for novel connections, a period of inattention to a problem ("sleeping on it") allows for unconscious processing to form associations (Zhong et al., 2008). So think hard on a problem, then set it aside and come back to it later.
- *Set aside time for the mind to roam freely.* Take time away from attention-absorbing television, social networking, and video gaming. Jog, go for a long walk, or meditate.
- *Experience other cultures and ways of thinking.* Living abroad sets the creative juices flowing. Even after controlling for other variables, students who have spent time abroad are more adept at working out creative solutions to problems (Leung et al., 2008; Maddux et al., 2009, 2010). Multicultural experiences expose us to multiple perspectives and facilitate flexible thinking.

A creative environment

Before You Move On

▶ ASK YOURSELF

Imagine patiently waiting your turn at a store, and then having some late-arriving adults served before you. The clerk also checks inside your bag as you leave the store. What is a prototype, and what sort of "teenager" prototype does the clerk seem to have in mind?

▶ TEST YOURSELF

According to Robert Sternberg, what are the five components of creativity?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 34 Review

34-1 What is cognition, and what are the functions of concepts?

- *Cognition* refers to all the mental activities associated with thinking, knowing, remembering, and communicating.
- We use *concepts,* mental groupings of similar objects, events, ideas, or people, to simplify and order the world around us.
- We form most concepts around *prototypes,* or best examples of a category.

34-2 What is creativity, and what fosters it?

- *Creativity,* the ability to produce novel and valuable ideas, correlates somewhat with intelligence, but beyond an intelligence test score of 120, that correlation dwindles.
- Sternberg has proposed that creativity has five components: expertise, imaginative thinking skills; a venturesome personality; intrinsic motivation; and a creative environment that sparks, supports, and refines creative ideas.

Multiple-Choice Questions

1. Which of the following is the best term for mental activities associated with remembering, thinking, and knowing?
   a. Cognition
   b. Concepts
   c. Prototypes
   d. Convergent thinking
   e. Divergent thinking

2. Which of the following is the best phrase for the narrowing of available problem solutions with the goal of determining the best solution?
   a. Allowing for incubation
   b. Divergent thinking
   c. Developing expertise
   d. Convergent thinking
   e. Experiencing other cultures

3. Producing valuable and novel ideas best defines which of the following?
   a. Prototyping
   b. Cognition
   c. Intrinsic motivation
   d. Venturesome personality
   e. Creativity

Practice FRQs

1. Compare the notions of concept and prototype.

Answer

1 point: A concept is a mental grouping of similar objects, events, ideas, and people.

1 point: A prototype is a mental image or best example of a category.

2. Identify and explain four of the five components of creativity mentioned in this module.

(4 points)