

we forget because we do not encode the information into long-term memory. If you don't encode the information, you cannot remember it. You should be especially wary of this reason when you are preparing for your class exams. You need to study thoroughly to avoid encoding failure on exams. Second, we may forget information that is encoded and stored in long-term memory isn't periodically recalled and refreshed. The information can fade away over time. Think about what you have learned in the various courses that you have taken so far in college. After a course is over, you may sometimes feel like you retained little of that information for very long. If you want to retain more of it for a longer period of time, you need to regularly recall and use it. Third, the information that we are trying to retrieve may still be there, but we forget because other information may interfere with our retrieval of it or we may not have the necessary retrieval cues available to find it. Both elaboration during encoding and overlearning will help to reduce these retrieval problems.

The next section concerns the information that we do retrieve. Is it accurate or is it distorted? The answer is that it is often distorted. How does this occur? It occurs because retrieval is reconstructive and not exact. Let's take a look at the retrieval process to see how its reconstructive nature may distort our memories.

The Reconstructive Nature of Retrieval

The act of remembering is an act of reconstruction. Memory does not work like a tape recorder or a video recorder. Retrieval is not like playback. Our memories are far from exact replicas of past events. If you read a newspaper this morning, do you remember the stories that you read in the paper word for word? We usually encode the gist or main theme of the story along with some of the story's highlights. Then, when we retrieve the information from our memory, we reconstruct a memory of the story using the theme and the highlights.

Our retrieval reconstruction is guided by what are called **schemas**—frameworks for our knowledge about people, objects, events, and actions. These schemas allow us to organize our world. For example, what happens when you enter a dentist's office or what happens when you go to a restaurant to eat? You have schemas in your memory for these events. The schemas tell us what normally happens. For example, consider the schema for eating out in a restaurant (Schank & Abelson, 1977). First, a host or hostess seats you and gives you a menu. Then the waitperson gets your drink order, brings your drinks, and then takes your meal order. Your food arrives, you eat it, and the waitperson brings the bill. You pay the bill, leave a tip, and go. These schemas allow us to encode and retrieve information about the world in a more organized, efficient manner.

The first experimental work on schemas and their effects on memory was conducted by Sir Frederick Bartlett in the first half of the twentieth century (Bartlett, 1932). Bartlett had his participants study some stories that were rather unusual. He then tested their memory for these stories at

schemas Frameworks for our knowledge about people, objects, events, and actions that allow us to organize and interpret information about our world.

varying time intervals. When the participants recalled the stories, they made them more consistent with their own schemas about the world. For example, one story did not say anyone was wounded in the battle described, but participants recalled that many men were wounded, fitting their schemas for battles. Unusual details were normalized. For example, participants recalled incorrectly that the men in another story were fishing rather than hunting seals. In addition, the stories were greatly shortened in length when recalled. Strangely, the participants did not even realize that they were changing many of the details of the stories. In fact, the parts that they changed were those that they were most confident about remembering.

Bartlett's participants had reconstructed the stories using their schemas and did not even realize it. The main point to remember is that they distorted the stories in line with their schemas. Why? Schemas allow us to encode and retrieve information more efficiently. It would be impossible to encode and retrieve the exact details of every event in our lives. That's why we need organizing schemas to guide us in this task, even though they do not provide an exact copy of what happened. This seems a small cost given the benefits provided by organizing memory in terms of schemas.

Memory can be further distorted in reconstruction by source misattribution and the misinformation effect. **Source misattribution** occurs when we do not remember the true source of a memory and attribute the memory to the wrong source. Maybe you dream something and then later misremember that it actually happened. You misattribute the source to actual occurrence rather than occurrence in a dream. Source information for memories is not very good. You need to beware of this when writing papers. You may unintentionally use another person's ideas and think they are yours. You have forgotten their source. Even if source misattribution is unintentional, it is still plagiarism. Source misattribution also helps to explain *déjà vu*, that eerie sense that you have been in the exact same situation before, but in actuality you have not (Cleary, 2008). You have a feeling of familiarity because you have previously experienced elements in the situation in other contexts, but you cannot make the correct source attributions for them. Thus, *déjà vu* may result from feelings of familiarity that occur in a new situation without proper identification of their sources.

Source misattribution can also lead to other problems. A famous case of source misattribution involved noted developmental psychologist Jean Piaget (Loftus & Ketcham, 1991). For much of his life, Piaget believed that when he was a child, his nursemaid had thwarted an attempt to kidnap him. He remembered the attempt, even remembered the details of the event. When the nursemaid finally admitted to making up this kidnapping story, she said that she did so with the hopes of being rewarded for saving Piaget. Actually, she was rewarded. Piaget's parents gave her a gold Swiss watch, which she returned 13 years later with a letter explaining that she had made up the attempted kidnapping story. She had joined the Salvation Army and decided to come clean with Piaget's parents. Piaget couldn't believe that the kidnapping attempt had not happened. He had reconstructed the

source misattribution Attributing a memory to the wrong source, resulting in a false memory.



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Dr. Elizabeth Loftus has conducted research on eyewitness testimony and the inaccuracies in memory retrieval for over 30 years. Because of her expertise in this area, she has testified as an expert witness in hundreds of court cases, including many high-profile cases such as the trial of serial killer Ted Bundy (Neimark, 1996).

event from the many times the nursemaid recounted the incident and had misattributed the source to actual occurrence. This is like thinking that something we dreamed really occurred. The source of the memory is misattributed. Source misattribution results in what is called a **false memory**, an inaccurate memory that feels as real as an accurate memory. False memories can also be the result of imagination and observation inflation and the misinformation effect.

Imagination inflation is increased confidence in a

false memory of an event caused by repeatedly imagining the event. For example, imagining performing an action often induces a false memory of having actually performed it (Garry, Manning, Loftus, & Sherman, 1996; Goff & Roediger, 1998). Repeated imagining inflates the confidence the person has that she actually performed the action, the imagination inflation effect. What might cause this disconcerting memory failure? Several factors likely contribute to the formation of these false memories. First, actually perceiving something and imagining it activate the same brain areas, leading to similar neural events that when tested might cause confusion as to whether the event was imagined or real (Gonsalves et al., 2004). Second, repeatedly imagining an event makes it seem increasingly familiar. This sense of familiarity can then be misinterpreted as evidence that the event actually occurred (Sharman, Garry, & Beuke, 2004). Lastly, the more vividly we are able to imagine events, the more likely it is that the imagined events feel like real events (Loftus, 2001; Thomas, Bulevich, & Loftus, 2003).

There is now evidence for a similar false memory effect in which a false memory of self-performance of an action is induced by merely observing another person's actions (Lindner, Echterhoff, Davidson, & Brand, 2010). It has been named the observation inflation effect because of its similarity to the imagination inflation effect. What could account for this effect? The controversial mirror neuron systems that we discussed in Chapter 4 may be involved. Some mirror neuron

research suggests that observation of another person's action may trigger a covert simulation of the action and thus activate motor representations similar to those produced during actual self-performance of the action (Iacoboni, 2009). Other

false memory An inaccurate memory that feels as real as an accurate memory.

evidence suggests that the neural correlates for such mirrored motor representations are similar to those for self-performed actions (Senfor, Van Petten, & Kutas, 2002). Thus, when a person is tested about actually performing the observed action, the mirrored action representations could erroneously be reactivated, leading to the observation inflation effect (Lindner et al., 2010).

The **misinformation effect** occurs when a memory is distorted by subsequent exposure to misleading information (Loftus, 2005). Elizabeth Loftus and her colleagues have provided numerous demonstrations of the misinformation effect, involving thousands of subjects, over the past 4 decades (Frenda, Nichols, & Loftus, 2011). These studies usually involve witnessing an event and then being tested for memory of the event but being given misleading information at the time of the test. Let's consider an example. Loftus and John Palmer (1974) showed participants a film of a traffic accident and then later tested their memory for the accident. The test included misleading information for some of the participants. For example, some participants were asked, "How fast were the cars going when they smashed into each other?" and others were asked, "How fast were the cars going when they hit each other?" Participants who were asked the question with the word *smashed* estimated the speed to be much higher than those who were asked the question with the word *hit*. In addition, when brought back a week later, those participants who had been questioned with the word *smashed* more often thought that they had seen broken glass in the accident when in fact there was none. The key theme of this line of research is that our memories for events are distorted by exposure to misinformation. The resulting false memories seem like real memories.

False memories have important implications for use of eyewitness testimony in criminal cases and for the controversy over memories of childhood sexual abuse that have supposedly been repressed but then are "recovered" in adulthood. The Loftus and Palmer research example shows us that eyewitness testimony is subject to error and manipulation by misleading information. Between 1989 and 2007, for example, 201 prisoners in the United States were freed because of DNA evidence; and 77% of these prisoners had been mistakenly identified by eyewitnesses (Hallinan, 2009). Many of these overturned cases rested on the testimony of two or more mistaken eyewitnesses. Eyewitnesses not only often misidentify innocent people as criminals but they also often do so with the utmost confidence, and jurors tend to heavily weigh an eyewitness's confidence when judging their believability.

Clearly, certain types of interrogation, including the way questions are worded, could lead to false memories. With respect to the repressed memory controversy, many memory researchers are skeptical and think that these "recovered" memories may describe events that never occurred (like the kidnapping attempt on Piaget as a child). Instead, they may be false memories that have been constructed and may even have been inadvertently implanted by therapists during treatment sessions. In fact, researchers have demonstrated that such implanting is possible (Loftus,

misinformation effect The distortion of a memory by exposure to misleading information.

Coan, & Pickrell, 1996; Loftus & Ketcham, 1994). We must remember, however, that demonstrating the possibility of an event does not demonstrate that it actually happened. So, are all memories of childhood sexual abuse false? Absolutely not. Sexual abuse of all kinds is unfortunately all too real. The important point for us is that the research on false memory has provided empirical evidence to support an alternative explanation to the claims for recovered memories, and this will help to sort out the true cases from the false.

Section Summary

In this section, we considered the three ways to measure retrieval—recall, recognition, and relearning. In recall, the information has to be reproduced, but in recognition it only has to be identified. In relearning, the time one saves in relearning information is the measure of memory. For all three retrieval measures, forgetting from long-term memory levels off after a rapid initial burst of forgetting.

There are four major theories that address the question of why we forget. Encoding failure theory assumes that the information is never encoded into long-term memory, so it is not there to be retrieved. The storage decay theory assumes that the information is encoded but that it decays during storage so that it is no longer available to be retrieved. The other two theories assume that the information is still available in long-term memory but cannot be accessed. Interference theory assumes that the retrieval failure is due to other information blocking our retrieval. This interfering information could be older information interfering with the retrieval of new information (proactive interference) or new information interfering with the retrieval of older information (retroactive interference). The other theory, cue-dependent theory, assumes that the cues necessary to retrieve the information are not available, meaning that the information cannot be located in long-term memory.

Memory is a reconstructive process guided by our schemas—organized frameworks of our knowledge about the world. The use of schemas along with source misattribution problems, imagination and observation inflation, and the misinformation effect can lead to false memories, inaccurate memories that feel as real as accurate memories. Such false memories create questions about the accuracy of eyewitness testimony and the validity of supposed repressed memories of childhood abuse.

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Explain the difference between recall and recognition as methods to measure retrieval.

Explain how the four major theories of forgetting differ with respect to the availability versus accessibility of the forgotten information.

Explain how schemas help to create false memories.

Explain how source misattribution and the misinformation effect lead to false memories.