Memory

Brief Chapter Outline

I. Three-Stage Model of Memory
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   B. Short-Term Memory
   C. Long-Term Memory

II. Encoding Information into Memory
   A. How We Encode Information
   B. How to Improve Encoding

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   B. Why We Forget
   C. The Reconstructive Nature of Retrieval

Detailed Chapter Outline

Worth Video Anthology for Introductory Psychology: Clive Wearing: Living Without Memory (6:00)

This video provides an excellent introduction to the information in this text chapter. The clip shows footage of the life of a man who has almost no ability to form new memories. It describes and displays how he functions by making diary entries that serve as his memory. There is moving footage showing how such simple things as knowing what year it is or one’s own age depend on memory and how frustrating it can be when such information cannot be remembered. Of course, a failure of memory can occur for a variety of reasons, as discussed in the text, and this clip provides an opportunity to apply the textual information. If students want to know more about Clive Wearing, you may suggest that they conduct an Internet search. Any search will likely turn up several articles from the popular press that describe his current status and provide a more detailed description of his life and struggles. One such article, available at http://www.newyorker.com/reporting/2007/09/24/070924fa_fact_sacks, was written by the neurologist Oliver Sacks, a professor of clinical neurology and clinical psychiatry at Columbia University Medical Center, and the author of popular books such as Awakenings and The Man Who Mistook His Wife for a Hat. The BBC also included the story of Clive Wearing in a documentary on memory. Again, a search for this BBC content will likely turn up an approximately 10-minute segment with more recent interviews with Clive and demonstrations of how short his memory actually is. In one scene, Clive’s wife returns to the room Clive is sitting in and Clive, over and over again, acts as though it’s the first time he’s seen her in years. In another scene, Clive is unable to remember what he’s just been told about his children and family.
PsychInvestigator: Gist of Memory
This interactive video resource provides a brief overview of the history and theories of memory along with an experiment students participate in to understand how memories can be forgotten or constructed. The video resource, Creating False Memories (3:54), is imbedded in the resource. Results of the experiment are related to issues with eyewitness testimony and other problems in everyday life.

Worth Video Anthology for Introductory Psychology: Living Without a Memory (10:00)
This video provides an interesting contrast to the Clive Wearing story. Although George also suffered from viral encephalitis that led to a loss of long-term memory, he lives at home with his wife. George also is capable of completing tasks such as returning CDs to the library and mailing a letter. The clip illustrates how a special pager is helping George regain a modicum of independence.

I. Three-Stage Model of Memory

When introducing this section, use Figure 5.1 and refer to it as you detail each stage. The three-stage model has guided memory research since the late 1960s. The three relatively distinct stages (each of which is discussed in detail on the following pages) are sensory memory, short-term memory, and long-term memory.

A. Sensory Memory
Sensory memory consists of a set of five registers (temporary storage places, one for each sense) that very briefly stores incoming sensory information from the physical environment until people attend to that information, before proceeding to the next stage of memory (short-term memory).

Iconic memory is an exact copy of visual information of less than a second in duration, with a very large capacity. Two experimental procedures test iconic memory.

1. The temporal integration procedure involves presenting two random meaningless dot patterns sequentially at the same visual location with a brief time delay between the two presentations. When the two patterns are integrated, a meaningful pattern is produced. We suggest using Figure 5.2 to help in presenting the temporal integration procedure.

   For a meaningful pattern to be perceived, the two patterns must be integrated somewhere in the memory system. However, if the time delay between the two presentations is greater than 1 second, no meaningful pattern can be perceived because the image from the first pattern has faded from iconic memory.

2. Sperling’s full-report and partial-report procedures present participants with different 3 X 3 matrices of unrelated consonants (a total of 9) for 50 milliseconds across numerous experimental trials. The following is an example experimental trial:

   H   T   V
   D   M   J
   F   C   W

   a. In the full-report procedure, participants report the entire matrix. Participants said they sensed the entire matrix but that it had faded from memory before they could report all 9 letters.

   b. In the partial-report procedure, participants report only one row of the matrix, a row indicated by an auditory cue on each trial. When the auditory cue is given immediately after the brief presentation of the letter matrix, participants recall the indicated row 100 percent of the time. When there is a 1-second delay between presentation of the matrix and the auditory cue, participants’ recall of the cued row worsens.
PsychSim 5 Tutorial: Iconic Memory

This module walks students through Sperling’s experiments and gives them the chance to participate in his work. It also provides explanations for their performance on the various reporting tasks. The module is a good way to introduce the notion of iconic memory as one part of sensory memory, along with echoic (auditory sensory) memory that lasts perhaps 4-5 seconds. The module also provides a visual depiction of the three stages of memory presented in the text.

The text provides other examples of iconic memory in the “real world.” In addition, you may remind students that a filmed cartoon is a series of still drawings flashed in rapid succession. It is our iconic memory that allows us to perceive motion in the drawings.

B. Short-Term Memory

Short-term memory is the memory stage in which the information that people attend to in sensory memory enters consciousness. In other words, it is where people consciously process information. People use short-term memory to rehearse information for transfer to long-term memory and to retrieve information from long-term memory when they need to recall the information. If information in short-term memory is not rehearsed, it is lost in less than 30 seconds.

1. The capacity of short-term memory can be tested by the memory span task. A person is presented a series of items one at a time and must remember the items in the order in which they were presented.

Memory span is the average number of items that can be remembered across a series of memory span trials. Humans have a memory span of $7 \pm 2$ (5 to 9) chunks of information. A chunk is a meaningful unit of information. An expert in a given domain tends to have larger chunks for information in that domain.

Class Activity: Memory Span and Chunking

Timothy Bender from Missouri State University has developed an excellent series of computerized memory-related demonstrations, available at http://courses.missouristate.edu/TimothyBender/mem/mydemos.html. You may download these demonstrations prior to use or may use them directly on the site. The Recent Demonstrations link includes a demonstration of Memory Span that also highlights the values of meaningful connections and chunking. The demonstration includes six tasks, all of which require students to remember items in the order in which they were presented. The items to be remembered include a list of 10 unrelated words, a list of 10 related words, a list of numbers, the same numbers in meaningful chunks, a 15-word list in random order, and the same 15-word list in meaningful order. Items are presented at the rate of approximately 1 item per second. At the end of each list, students are asked to recall the items; be sure each student has a pencil and paper available.

2. The duration of short-term memory—how long information can stay in short-term memory without concentrating on it—is estimated to be 30 seconds and is measured using the distractor task. A person is given a small amount of information (three unrelated consonants, such as CWZ), is immediately distracted from concentrating on the information for a brief time (through counting backward aloud by threes), and is then asked to recall the information.

To keep information in short-term memory, people use maintenance rehearsal, which is the repetition of information in short-term memory to keep it from fading away.
PsychSim 5 Tutorial: Short-Term Memory
This module provides hands-on activities that reinforce many of the notions discussed in the chapter. After a visual review of the three major stages of memory presented in the text, Alan Baddeley’s (1992) model of working memory is introduced, with particular emphasis on the phonological loop. The module includes demonstrations of the capacity of short-term memory, the chunking of information in short-term memory, and the duration of information in short-term memory.

C. Long-Term Memory
Long-term memory allows storage of information for a long period (perhaps permanently), and its capacity is essentially unlimited.

1. Long-term memories are classified as one of two types.
   a. **Explicit memory** (also called **declarative memory**) is long-term memory for factual knowledge and personal experiences and requires conscious recall. There are two types of explicit memories. (1) **Semantic memories** are memories of factual knowledge that are common to everyone (e.g., the name of the current president of the United States). (2) **Episodic memories** are memories of personal life experiences (e.g., senior prom night).
   b. **Implicit memory** (also called **nondeclarative memory**) is long-term memory that influences behavior but does not require conscious awareness or declarative statements (for most adults, driving a car and walking are examples).

Some implicit memories are procedural memories because they have a physical procedural aspect (the execution of an ordered set of movements). For a tennis expert such as Serena Williams, the movements in playing the game are implicit procedural memories, whereas for the average player, the movements require conscious recall and more semantic memories.

Other implicit memories become automatic responses to certain stimuli (e.g., people feeling tense when the lights of a police car are flashing behind them).

**Priming** is also an example of implicit memories that are not procedural. Even if people are not consciously aware of seeing a stimulus and do not recognize it, the stimulus may still increase the likelihood that people will identify a related item. For example, if a person reads a list of words including the word money, and is later asked to complete a word starting with mon, the probability that they will answer money is greater following priming.

2. **Amnesia** is the loss of long-term memories. **Amnesics** are people with severe memory deficits following brain surgery or injury. Researchers study people with amnesia to discover distinctions between types of memory and to learn how memories are processed in the brain.

A man called H. M. by researchers had his hippocampus and surrounding temporal lobe area removed at age 27 (to reduce epileptic seizures). Before the operation, H. M.’s short-term and long-term memories were normal. After the operation, H. M. didn’t seem to be able to store any new information in long-term memory; he suffered from **anterograde amnesia**, which is the inability to form long-term memories for events following brain surgery or trauma. **Retrograde amnesia** is the inability to remember events before, especially just before, the surgery or trauma.
H. M. could, however, form new implicit procedural memories; thus, the anterograde amnesia appeared to be only for explicit memories. H. M.’s puzzle-solving abilities improved, even though he claimed not to recognize a puzzle he had solved before. Furthermore, H. M. demonstrated implicit memory on a mirror-tracing task, in which a person must trace a pattern that can be seen only in its mirror image; the person’s tracing hand is shown to move in the direction opposite to its actual movement. H. M.’s performance showed a normal practice effect, even though he did not remember ever having done the task and had to have the instructions repeated at the start of each session.

If your students are interested in attempting a simulation of the difficulties of mirror drawing, the Online Psychology Lab (http://opl.apa.org/) offers an interesting opportunity for them to do so. Rather than using a mirror, students doing the OPL demonstration are asked to trace a star using the mouse; first with one hand and then with the other. Right-handed students will most likely take longer to complete the task when using their left-hand, simulating some of the difficulty in mirror drawing. Another site, Puzzle Playground (http://www.puzzles.com/PuzzlePlayground/MirrorDrawing/MirrorDrawing.htm) offers a free download of a tracing task that students can attempt to complete using a mirror.

Worth Video Anthology for Introductory Psychology: Memory Loss: A Case Study (7:28) This video presents the case study of E. P., an 82-year-old man who suffered an acute virus infection in 1992 that destroyed his hippocampus, which is critical to memory. Although his fluid thinking skills appear to be intact, E. P. has difficulty remembering what he has just said and will repeat the same story several times within a short period. Interestingly, E. P. has quite good memory for events that occurred before he suffered damage to his hippocampus, suggesting that new memories may be processed in the hippocampus but they are not stored in this brain structure.

The cerebellum seems to be important for formation of implicit memories, whereas the hippocampus seems to be important for formation of explicit memories. Our hippocampus does not fully develop until about the age of 3, which explains why, as adults, we cannot remember events that occurred prior to this age (called infantile/child amnesia).

   a. The cases of H. M. and E. P. suggest such a distinction. For example, whereas H. M.’s short-term memory did not suffer any substantial damage after the operation, he was unable to form new explicit long-term memories.
   b. Free recall performance has also been interpreted to suggest a short-term versus long-term memory distinction. In a free recall task, participants are given a list of words one at a time and then asked to recall them in any order they wish. Compared with recall of items in the middle of the list, participants are more apt to recall items at the start of the list (called the primacy effect) and items at the end of the list (called the recency effect). The recency effect is caused by recall from short-term memory, whereas the primacy effect is the result of superior recall from long-term memory of the first few words in the list. The first few words get proportionately more attention and rehearsal than the words in the middle of the list and can be transferred into long-term memory. The last few words are still in short-term memory at the time of recall. Figure 5.6 is a graph highlighting this distinction.
   c. Recent fMRI neuroimaging data indicates that both short-term and long-term memory are involved in serial position effects.
Class Activity: The Serial Position Effect
John H. Krantz has developed a Java-based demonstration of the serial position effect for which participants can adjust many of the parameters (e.g., how long a stimulus is shown or how many words in a list). The serial position demonstration is available via a link to Serial Position Effect on the Cognition Laboratory Experiments home page (http://psych.hanover.edu/JavaTest/CLE/Cognition/Cognition.html). In this demonstration, students view a list of words and then indicate which words they recognize by clicking on the appropriate items in a matrix.

Prior to asking students to complete the demonstration, decide how you will instruct them to set the variables. There are several options available. Choices include the type of list (long words, short words, two-digit numbers, or four-digit numbers), the number of trials, the number of items in the list, the duration of exposure to each item, the delay between the end of the list and the appearance of the words for the recognition test, and the time allotted for the recognition test.

After students complete the demonstration, a summary screen appears illustrating the proportion of correct recognition for the items in each serial position. Students should examine this data to determine if their recall demonstrated a primacy or recency effect (with the proportion correct being higher for the first and last positions than for the middle positions). Students may also examine their trial-by-trial data if they are interested in determining which words they missed. Depending on class size, you may opt to ask students to submit their results to you for compilation to determine the performance of the class as a whole, which you might discuss in a subsequent class.

PsychSim 5 Tutorial: When Memory Fails
This module reviews the basic structure of the human memory system and then distinguishes between short-term and long-term memory storage. Focus then turns primarily to long-term memory, including information about long-term potentiation and types of long-term memory (a good review of information covered in this part of the text). The module then extends textual information by discussing the roles of the medial temporal area, the hippocampus, the occipital lobe, the cerebellum, and the frontal lobe in the memory process. Information about retrograde and anterograde amnesia is presented, with information on tools (PET scans and MRI scans) used to study memory physiologically. Information about the patients Clive Wearing and H. M. are included, as is information on the development of Alzheimer’s disease.

Worth Video Anthology for Introductory Psychology: An Amazing Memory (9:45)
This is an interesting video that follows a savant who set the world record for memorizing the most digits of pi, some 20,000+ digits. Narration is combined with interviews of prominent neuroscientists describing the brain science behind these unique individuals.

PsychInvestigator: Levels of Processing
There is an interactive video (13:47) followed by an experiment to highlight the levels of processing discussed in the text. Results are shown prior to an analysis and review of the material covered. Once complete, students can take a quiz to determine their comprehension of memory encoding. Further, students are given tips on how to improve their study habits. This is an excellent resource to assign prior to discussing the next section of the text.

Scientific American Introductory Psychology Video: Models of Memory (13:45)
This program provides an overview of the complex process of memory encoding, storage, and retrieval. The human capacity for emotion is what distinguishes the memory system of the human brain from the memory system of a computer. Memories that are linked to emotions are more likely to be kept for future retrieval.
The three stages of memory, as outlined in the stage model of memory, are categorized by the duration of time the memory is stored in the brain and how we interact with it. Daniel Schacter describes three components of working memory—the phonological loop, the visual-spatial sketchpad, and the central executive. The field of cognitive neuroscience has contributed much of our current understanding about the relationship between cognition and memory. However, there is still much more to learn about this complex and fascinating system.

II. Encoding Information into Memory

There are three essential processes in our memory system. **Encoding** is the process of transferring information from one memory stage to the next. **Storage** is the process of maintaining information in a particular stage. **Retrieval** is the process of bringing information stored in long-term memory to the conscious level in short-term memory.

A. How We Encode Information

Automatic processing is processing that occurs subconsciously and does not require attention. Effortful processing is processing that occurs consciously and requires attention. For a particular type of effortful processing, much practice is needed.

1. **Levels-of-processing theory** describes what types of encoding lead to better retrieval. It contains three levels of processing: physical (how information appears), acoustic (how the information sounds), and semantic (what the information means). As seen in Figure 5.7), long-term memory is best for information encoded semantically, next best for information encoded acoustically, and worst for information encoded physically.

2. **Elaborative rehearsal** is the rehearsal of information by relating new information to information already in long-term memory. Elaborative rehearsal provides more retrieval cues than maintenance rehearsal to facilitate retrieval.

   A good way to elaborate on new material is for people to relate the material to themselves, which leads to the **self-reference effect**: It is easier for a person to remember information that is related to him- or herself because the connection provides more retrieval cues and lends more meaning to the new information.

*PsychInvestigator: Levels of Processing*

This interactive video (13:47) described above is followed by an experiment to highlight the levels of processing discussed in the text. This is an excellent resource to connect students with information contained within this section of the text.

*Class Activity: Self-Reference Effect*

As an alternative, you may opt to include a similar activity that also includes questions to stimulate self-referenced processing. In our experience, results consistently demonstrate that relating material to personal experience is an effective memory aid, a point that instructors often emphasize. Timothy Bender has included a self-reference activity among his demonstrations, available at (http://courses.missouristate.edu/TimothyBender/mem/mydemos.html#recent). The Astound demonstration is based on an incidental learning paradigm used by Rogers, Kuiper, and Kirker (1977).
To prepare for the demonstration, students take out a blank sheet of paper and write down the numbers 1 to 30 on it. (These instructions are presented on the screen.) They are then asked to answer “Yes” or “No” to three types of questions about each of 30 words flashed on the screen for 2 seconds each. Ten questions ask, “Does the word mean the same as ___?”, 10 ask “Does the word contain the letter ___?”, and 10 ask “Does the word describe you?” After answering the 30 questions, students are given 2 minutes to recall as many words as they can. Students are then shown the words in each category (letter, meaning, and self-reference) and asked to total how many words they remembered from each. Typically, the number of words remembered from the “letter” category is minimal and notably fewer than the number of words remembered from the “meaning” and “self-reference” categories. The demonstration concludes with coverage of the consistency effect (suggesting that people tend to have better memories for words linked to questions answered by “yes” than for questions answered by “no”). You may opt to have the students turn in their totals for each category and then calculate the mean, median, and mode for the class, reinforcing the material in Chapter 1.


3. Environmental effects influence encoding.
   a. The **encoding specificity principle** proposes that the cues present during encoding serve as the best cues for retrieval. It explains why the various concepts and examples that people relate to a new concept during elaborative rehearsal help them remember the concept.
   b. **State-dependent memory** is memory that depends on the relationship of people’s physiological state at the time of encoding and their physiological state at the time of retrieval. Suggesting students not skip their morning coffee on the day of an exam in their morning class is one way to relate the material to coffee-drinking students in morning classes.
   c. **Mood-dependent memory effects** attest to the fact that memory is better when a person’s mood is the same during encoding and retrieval. For example, if people are happy during the encoding of information, it is easier for them to retrieve the information when they are happy.
   d. The **mood-congruence effect** refers to the fact that memory is better for experiences that are congruent with a person’s current mood (e.g., when people are sad, it is easier for them to retrieve memories of negative events). So should students come to class anxious every day if they are anxious when they take tests?

B. How to Improve Encoding

1. **Mnemonics** are memory aids that require elaborative rehearsal. Among the types of mnemonic devices are the following:
   a. In the **method of loci**, the sequential pieces of information to be remembered are first associated with sequential locations in a very familiar room or other location. When retrieving the information, people merely mentally go around the room (or other location) and retrieve the item stored at each sequential location. Obviously, the method of loci uses elaborative mental imagery.
   b. In the **peg-word system**, people visually associate the items to be remembered to items in a jingle that they first memorize.
   c. The **first-letter technique** involves composing a word, acronym, or sentence from the first letters of the words people want to remember. This mnemonic may be less effective than other memory techniques for complicated information.
## Class Activity/Teaching Suggestion—Variation of Peg-Word System

Russell Carney and Joel Levin suggested a variation on the peg-word system. Students learn terms (of which there are many in introductory psychology) by creating a mental picture associated with each term. Carney and Levin give a specific example of how this system can be used with information in the neuroscience chapter (see the accompanying table). However, having students create their own mental pictures for terms in this and other chapters is probably more useful for applying the peg-word system and learning information throughout the course.

<table>
<thead>
<tr>
<th>Term</th>
<th>Keyword</th>
<th>Meaning</th>
<th>Your Mental Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medulla</td>
<td>Medal</td>
<td>Controls heart rate</td>
<td>Imagine the winner of a race.</td>
</tr>
<tr>
<td>Pituitary glands</td>
<td>Pit</td>
<td>Regulates growth</td>
<td>Imagine a young child down in a pit (pituitary). The child grows and grows (growth) until he’s big enough to climb out.</td>
</tr>
<tr>
<td>Reticular formation</td>
<td>Re-tickle</td>
<td>Attention</td>
<td>Imagine tickling someone to get her attention. Then she loses interest again so you have to re-tickle (reticular) her.</td>
</tr>
<tr>
<td>Parasympathetic nervous system</td>
<td>Parachute</td>
<td>Calms the body</td>
<td>Imagine the peace and calming effect of watching a parachute (parasympathetic) drift slowly downward.</td>
</tr>
<tr>
<td>Sympathetic nervous system</td>
<td>Symphony</td>
<td>Excites the body</td>
<td>Imagine a symphony (sympathetic) playing loudly in the room next door! The music excites you and you can’t sit still.</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>Cereal bell</td>
<td>Facilitates movement</td>
<td>Imagine someone hearing the cereal bell (cerebellum), the signal to move to the breakfast table and begin moving the cereal to the mouth with a spoon.</td>
</tr>
<tr>
<td>Thalamus</td>
<td>Thermos</td>
<td>Relay station for incoming information</td>
<td>Imagine a relay race. The first runner hands an incoming thermos (thalamus) instead of a baton to the next runner.</td>
</tr>
</tbody>
</table>


2. Other tips for improving encoding
   a. The **spacing** (or **distributed study**) effect suggests that students will retain information better if they study for an exam for an extended period (spaced studying) rather than studying for just a few days before the exam.
   b. **Overlearning** is studying material past the point of initial learning. Overlearning tends to facilitate subsequent retrieval of information.
   c. Regularly self-test by taking publishers’ quizzes imbedded in the text and online to identify what information is difficult or impossible to retrieve. Without self-testing, it’s easy to focus on what you know and ignore what you don’t.
Worth Video Anthology for Introductory Psychology: Enhancing Memory: The Role of Emotion (7:38)

Narrated by Alan Alda, this video examines the role of emotion in memory formation and recollection. A laboratory experiment is depicted, in which scenes of varying emotional content are displayed to a participant. After viewing the scenes, the participant’s arm is immersed in cold water, and she is asked to hold it there as long as she can. The hypothesis is that the immersion will trigger a stress-hormone response that, in turn, will enhance memory of the scenes. Indeed, a week after the experiment, participants who had their arms immersed had better memory for the scenes than did participants who did not have their arms immersed. The role of stress hormones and the limbic system, including the amygdala, in memory formation is discussed. Additionally, potential sex differences in the processing of emotional events are presented.

III. Retrieving Information from Memory

PsychSim 5 Tutorial: Memory—Trusting Your Memory

Because the module introduces issues surrounding the reliability of memories, you may opt to ask students to complete it prior to discussion of this section of the text. First, the module presents and demonstrates the difference between memory recall and memory recognition. The serial position effect is also introduced and demonstrated. Most of the module covers false memories and the reasons why people have them, including misattribution (source confusion) and suggestibility (misinformation effect). The module concludes with a presentation of Loftus’ work on reconstructive memory and the reliability of eyewitness testimony.

Once information is encoded into and stored in long-term memory, it will usually be necessary to retrieve, or get that information out of long-term memory as it is needed.

A. How to Measure Retrieval

Researchers use three methods for measuring retrieval of memories.

1. **Recall** is a measure of retrieval that requires the reproduction of the information with essentially no retrieval cues.

2. **Recognition** is a measure of retrieval that requires only the identification of the information in the presence of retrieval cues.

3. **Relearning**, also called the savings method, is a measure of the amount of time saved when learning the information for a second time. Ebbinghaus conducted the first experimental studies on human memory more than 100 years ago using the relearning method. He studied a list of nonsense syllables until he could correctly recite the complete list without any hesitations. He then put the list aside, waited some time, and then relearned the list to the same criterion. To get a measure of learning, he computed a savings score—the reduction in the number of trials it took him to reach criterion. As seen in Figure 5.8, the “forgetting curve” reveals that most forgetting occurs in the first two days after learning material.

B. Why We Forget

Four theories explain why people forget (summarized in Table 5.2).

1. **Encoding failure theory** says that at times forgetting is not really forgetting. Rather, a failure to remember something occurs because the information never entered long-term memory in the first place.

2. **Storage decay theory** suggests that forgetting occurs because of a problem in the storage of the information. The biological trace of the memory gradually decays over time because it has not been used. Periodic use of the information helps to maintain it in storage. Figure 5.8 provides an example of the forgetting curve for long-term memory.

3. **Interference theory** proposes that other similar information interferes and makes the forgotten information inaccessible (refer to Figure 5.10).
a. **Proactive interference** occurs when already-known information interferes with retrieval of newly learned information. For example, think about changing a phone number after having a certain number for many years. When asked for the new phone number, people’s memory for their old number interferes with their retrieving the new one.

b. **Retroactive interference** occurs when just-learned information interferes with retrieval of old information. For example, think about being at a party with many unfamiliar people. Suppose you meet a woman you like, but before getting a chance to talk with her, you are introduced to many more people. Later, you cannot remember the name of the woman you liked.

**PsychSim 5 Tutorial: Forgetting**
This module presents information primarily about interference, with numerous examples of both proactive and retroactive interference. We find that students tend to have trouble with these two types of interference and that this module, with its hands-on demonstrations of both types of interference using a series of paired-associates tests, helps students learn them.

4. **Cue-dependent theory** says that people forget because the cues necessary for retrieval are not available. The information is in memory, but people cannot access it. This theory is analogous to knowing that a book is in the library but cannot be found because the library lacks call numbers. An example of forgetting due to a lack of cues is the tip-of-the-tongue phenomenon, in which we struggle to recall something we’re sure we know.

**Worth Video Anthology for Introductory Psychology: Aging and Memory (4:00)**
This is an excellent resource for summarizing information about prospective memory; that is, people need to perform an action (for example, talking to a colleague) and need to remind themselves to do the action. This video describes an experimental procedure for testing age differences in prospective memory recall ability. Specifically, adults answering a series of questions on a computer keypad had to press the F12 key every 5 minutes with no external time cues available to them (no environmental support was available). Other adults were asked to press F12 whenever they were asked a question about the presidency of the United States (environmental support was available). Large differences in prospective memory among ages were found when no environmental support was available, but the differences disappeared when environmental supports were present. In addition to using this title to accompany this section of the text, we recommend using it in Chapter 1 to illustrate experimental and quasi-experimental designs.

C. **The Reconstructive Nature of Retrieval**
When reading a newspaper article, people usually code the gist or main theme of the story, along with some of the story’s highlights. Then when people retrieve the information from memory, they reconstruct a memory of the story using the theme and highlights. Retrieval reconstruction is guided by **schemas**—organized frameworks of knowledge about people, objects, and events that indicate what normally happens in a given situation. They allow people to encode and retrieve information more efficiently.
Schemas can lead people to “misremember” information in ways that are more consistent with their schemas. Frederick Bartlett (1932) had people read unusual stories and subsequently recall details from the stories. When the participants recalled the stories, they made them more consistent with their schemas about the world. Bergman and Roediger (1999) have replicated Bartlett’s results using a similar repeated reproduction paradigm, in which they tested participants 15 minutes, 1 week, and 6 months after reading a story called “War of the Ghosts.” As the delay prior to test increased, participants distorted the original material and introduced rationalizations that had not been present in the stimulus story.

Class Activity: Misremembering
To illustrate how easily material may be distorted, you can ask students to engage in a simple classroom demonstration based on a childhood game that has been called “Telephone.” First, ask one or two students to create a brief story (three or four sentences should suffice) and to write it down for subsequent reference. Second, ask one of the story’s authors to whisper it to his or her neighbor. Third, ask this person to whisper it to his or her neighbor. Continue this “whispering to a neighbor” until approximately 10 students have heard the story. To conclude the activity, simply ask the last student to repeat the story aloud. Verify the accuracy of the last student’s rendition by asking the authors to read the original version aloud.

Source misattribution occurs when people do not remember the true source of a memory and attribute the memory to the wrong source. Source misattribution results in false memories, which are inaccurate memories that feel as real as accurate memories.

Student Video Activity: Creating False Memories: A Laboratory Study (4:45)
This video provides an interesting example of source misattribution. The video illustrates how researchers created false memories in a sample of college students who were shown pictures from their childhoods. Each student viewed four photographs, three of which had been obtained from the participants’ families. The fourth photograph, however, was digitally altered to show the participant taking a hot-air balloon ride. After four interviews spanning a week, many participants tended to “remember” being on a hot-air balloon ride, often “recalling” details of the ride that extended beyond what was shown in the photograph. Many participants considered the source of their memories to be an actual experience, rather than the photographs and their imagination. To expand on the topic of creating childhood memories in the laboratory, you may ask students to read “Creating Childhood Memories,” an article published by Elizabeth Loftus.


PsychSim 5 Tutorial: Trusting Your Memory
This 22-slide tutorial reviews phenomenon such as the serial position effect and issues of recall versus recognition before honing in on false memories and their possible causes. Issues of suggestibility and the problems with eyewitness testimony are highlighted at the end.
Class Activity: False Memory

As a false memory activity, you may simply read a list of words to your students, using a word list from Roediger and McDermott (1995). These researchers compiled lists of 16 associated words (e.g., “tired,” “dream,” and “wake”), all of which were related to a word that was not included on the list (e.g., “sleep”), called a critical lure. Researchers read each list of words to participants at a rate of 1 word every 1.5 seconds. After hearing the words, participants were asked to recall them. Recall results indicated that people tended to recall the critical nonpresented words about as often as they correctly recalled presented words from the middle of the lists. In contrast, inaccurate recall of other nonpresented words was very infrequent.

This pattern of results is easily replicated in the classroom. Ask your students to take out a piece of paper, but not to write anything down until you instruct them to do so. Ask students to listen carefully as you read a list of words and to write down the words they remember at your request. Then, read the following list of words: BED, REST, AWAKE, TIRED, DREAM, WAKE, SNOOZE, BLANKET, DOZE, SLUMBER, SNORE, NAP, PEACE, YAWN, DROWSY. Immediately ask them to write down as many words as they can remember from that list. When the students are finished writing, ask for a show of hands to indicate how many recalled the first item on the list (“bed”) and how many recalled the last item on the list (“drowsy”). The percentage of students recalling words from each of these serial positions is typically high, demonstrating the primacy and recency effect. Then, ask for a show of hands for a word in the middle of the list (e.g., “blanket”) for which recall is typically lower. Finally, ask students to stand if they recalled the word “sleep.” (Standing is more dramatic than raising hands.) We have done this demonstration multiple times, with a minimum false recall of about 30 percent and a high recall of about 75 percent for the critical lure “sleep.” (Roediger and McDermott’s results were between 40 percent and 55 percent.) Regardless of the actual level of false recall, that it even exists typically surprises many students; some may actually ask to see the list. The demonstration provides a starting point for a possible discussion of eyewitness testimony, involving situations in which people may be too distracted or frightened to concentrate on remembering details.


False memories can also stem from the misinformation effect, which occurs when a memory is distorted by subsequent exposure to misleading information. Loftus and Palmer (1974) showed people a film of a traffic accident and later tested their memory for the accident. Some people were asked, “How fast were the cars going when they smashed into each other?” Others were asked, “How fast were the cars going when they hit each other?” Participants who were asked the first question estimated a higher speed at impact and reported seeing broken glass when in fact there was none.

Research about false memories suggests that eyewitness testimony is subject to error and may be readily manipulated by misleading information. Research also suggests that recovered memories are not necessarily accurate.
**Student Video Activities**

There are two videos in this student activity, *Retrieval: A Journey into Memory* (6:00), followed by *Bias: An Interview with Daniel Schacter* (1:50). The *Journey into Memory* segment offers an artistic rendition of how a father who has not heard from his daughter since she left for an overseas trip remembers their last conversation. The father’s memories of his last interaction with his daughter range from argumentative to warm. Prior to showing this video, instructors should encourage students to pay attention to the opening visual description of the clip, which is not accompanied by audio. Without knowledge of this description, students may have difficulty understanding the purpose of the subsequent video. In the *Bias* segment, renowned memory researcher Daniel Schacter discusses retrieval bias. Specifically, he indicates that people’s current feelings determine how they recollect their relationships. Such belief-colored recollections illustrate one of seven “sins of memory” that Schacter has identified. Each video is followed by a video assessment quiz to test students’ knowledge of the material presented.

**Worth Video Anthology for Introductory Psychology: Retrieval: A Journey into Memory (8:10)**

This video presents the same information as the Video Tool Kit of the same name and has the same interview with Dr. Schacter following the video of a parting conversation.

**Class Activity: Flashbulb Memories**

Mark Sudlow Hoyert and Cynthia O’Dell (2000) describe a simple procedure for examining flashbulb memories. Typically, research has strongly suggested that there are discrepancies between two recollections of a flashbulb memory, regardless of how confident respondents are in their accounts.

In this exercise, ask students on the first day of class what they were doing when they first heard of some major event, such as the attacks on September 11, 2001, or the beginning of the invasion of Iraq by the United States in March 2003. Then, ask for the same information again after you’ve covered the memory information in the course. Following the second memory probe, students can analyze their memory accounts in class. Brown and Kulik (1977) indicate that flashbulb memories tend to contain particular types of information: (a) location where the information was learned, (b) ongoing activity, (c) informant, (d) affect displayed by others, (e) own affect, and (f) actions taken after hearing the news. Students can use these criteria to analyze their own flashbulb memories.

The work of both Hoyert and O’Dell and our own experiences with this activity have found that the accounts of between one-quarter and one-half of the students, depending on the particular class, differ dramatically on at least one and usually more of the criteria. Specific details also tend to change for the majority of students when we use this activity. *(Note: We tend to cover memory about 10 weeks into the semester. If you cover it sooner—as you certainly will, if you are on a quarter or trimester system—students’ discrepancies might not be quite as extreme.)*
