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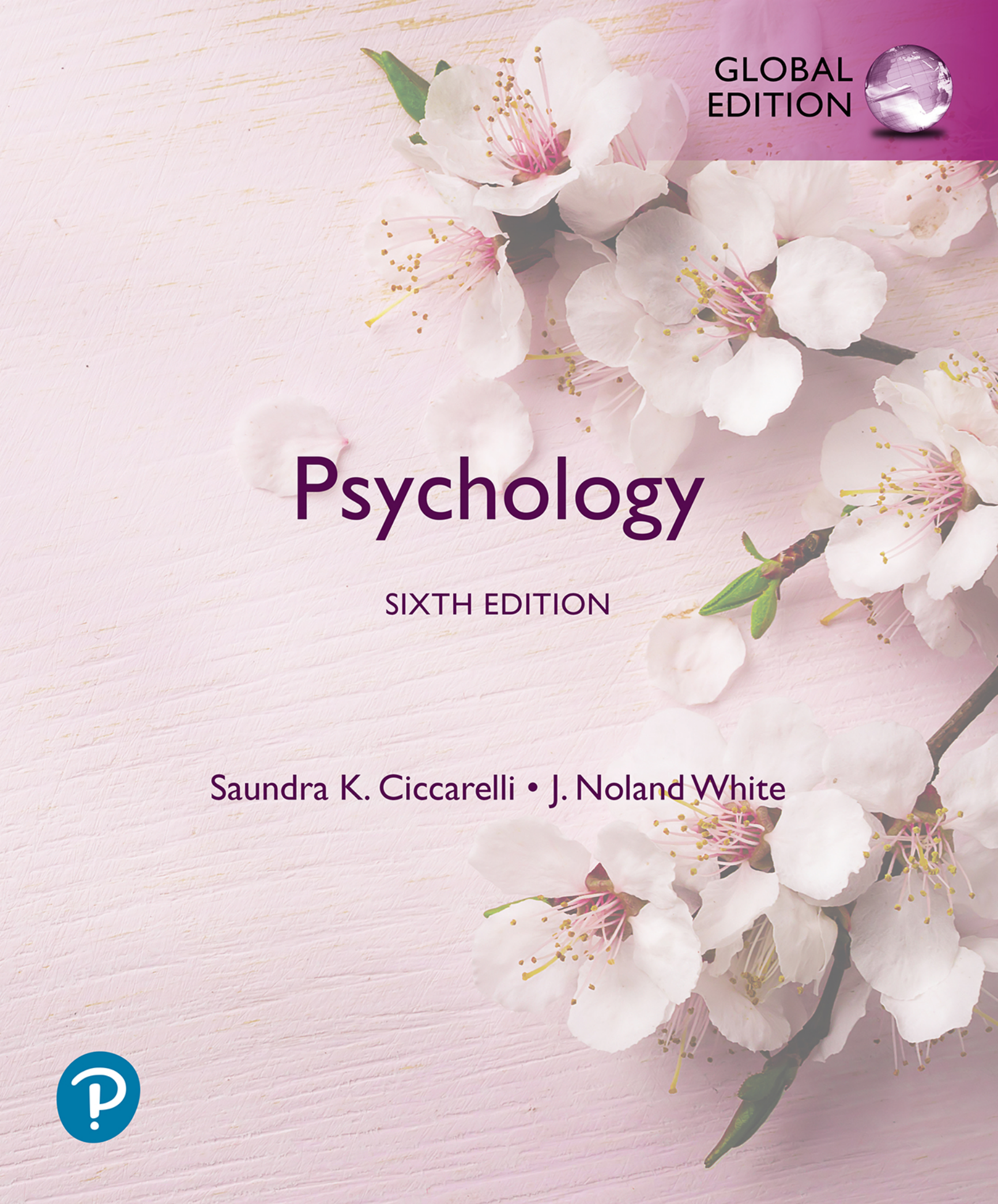

Psychology

SIXTH EDITION

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Psychology

Sixth Edition
Global Edition

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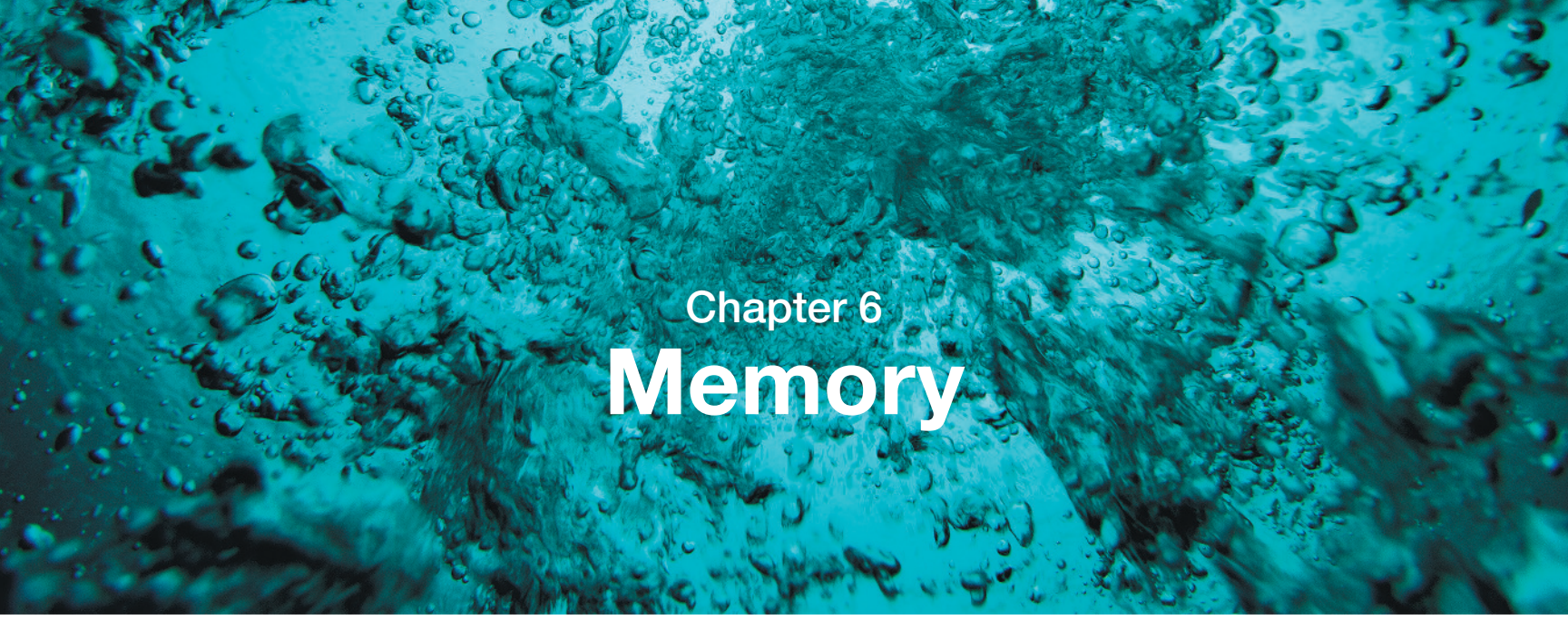


Chapter 6

Memory

In your words

How is your memory of events? Do you find that you remember events from your past differently than others who were also present at that time?

After you have thought about these questions, watch the video to see how other students would answer them.

Why study memory?

Without memory, how would we be able to learn anything? The ability to learn is the key to our very survival, and we cannot learn unless we can remember what happened the last time a particular situation arose. Why study forgetting? If we can learn about the ways in which we forget information, we can apply that learning so that unintended forgetting occurs less frequently.

Learning Objectives

6.1 Identify the three processes of memory.

6.2 Explain how the different models of memory work.

6.3 Describe the process of sensory memory.

6.4 Describe short-term memory, and differentiate it from working memory.

6.5 Explain the process of long-term memory, including nondeclarative and declarative forms.

6.6 Identify the effects of cues on memory retrieval.

6.7 Differentiate the retrieval processes of recall and recognition.

6.8 Describe how some memories are automatically encoded into long-term memory.

6.9 Explain how the constructive processing view of memory retrieval accounts for forgetting and inaccuracies in memory.

6.10 Describe the "curve of forgetting."

6.11 Identify some common reasons people forget things.

6.12 Explain the biological bases of memory in the brain.

6.13 Identify the biological causes of amnesia.

6.14 Describe ways in which you can use elaborative rehearsal to make information easier to remember.

6.1–6.2 What Is Memory?

Is memory a place or a process? The answer to that question is not simple. In reading through this chapter, it will become clear that memory is a process but that it also has a "place" in the brain as well. Perhaps the best definition of **memory** is an active system that receives information from the senses, puts that information into a usable form, organizes it as it stores it away, and then retrieves the information from storage (adapted from Baddeley, 1996, 2003).

6.1 Three Processes of Memory

6.1 Identify the three processes of memory.

Although there are several different models of how memory works, all of them involve the same three processes: getting the information into the memory system, storing it there, and getting it back out.

PUTTING IT IN: ENCODING The first process in the memory system is to get sensory information (sight, sound, etc.) into a form that the brain can use. This is called **encoding**. Encoding is the set of mental operations that people perform on sensory information to convert that information into a form that is usable in the brain's storage systems. For example, when people hear a sound, their ears turn the vibrations in the air into neural messages from the auditory nerve (*transduction*), which make it possible for the brain to interpret that sound. See Learning Objective 3.1.

> It sounds like memory encoding works just like the senses—is there a difference?

Encoding is not limited to turning sensory information into signals for the brain. Encoding is accomplished differently in each of three different storage systems of memory. In one system, encoding may involve rehearsing information over and over to keep it in memory, whereas in another system, encoding involves elaborating on the meaning of the information—but let's elaborate on that later.

KEEPING IT IN: STORAGE The next step in memory is to hold on to the information for some period of time in a process called **storage**. The period of time will actually be of different lengths, depending on the system of memory being used. For example, in one system of memory, people hold on to information just long enough to work with it, about 20 seconds or so. In another system of memory, people hold on to information more or less permanently.

GETTING IT OUT: RETRIEVAL The biggest problem many people have is **retrieval**, that is, getting the information they know they have out of storage. Have you ever handed in an essay test and *then* remembered several other things you could have said? Retrieval problems are discussed thoroughly in a later section of this chapter.

memory
an active system that receives information from the senses, puts that information into a usable form, and organizes it as it stores it away, and then retrieves the information from storage.

encoding
the set of mental operations that people perform on sensory information to convert that information into a form that is usable in the brain's storage systems.

storage
holding on to information for some period of time.

retrieval
getting information that is in storage into a form that can be used.

6.2 Models of Memory

6.2 Explain how the different models of memory work.

Exactly how does memory work? When the storage process occurs, where does that information go and why? Memory experts have proposed several different ways of looking at memory. The model that many researchers once felt was the most comprehensive* and has perhaps been the most influential over the last several decades is the **information-processing model**. This approach focuses on the way information

information-processing model
model of memory that assumes the processing of information for memory storage is similar to the way a computer processes memory in a series of three stages.

*comprehensive: all-inclusive, covering everything.

is handled, or processed, through three different systems of memory. The processes of encoding, storage, and retrieval are seen as part of this model.

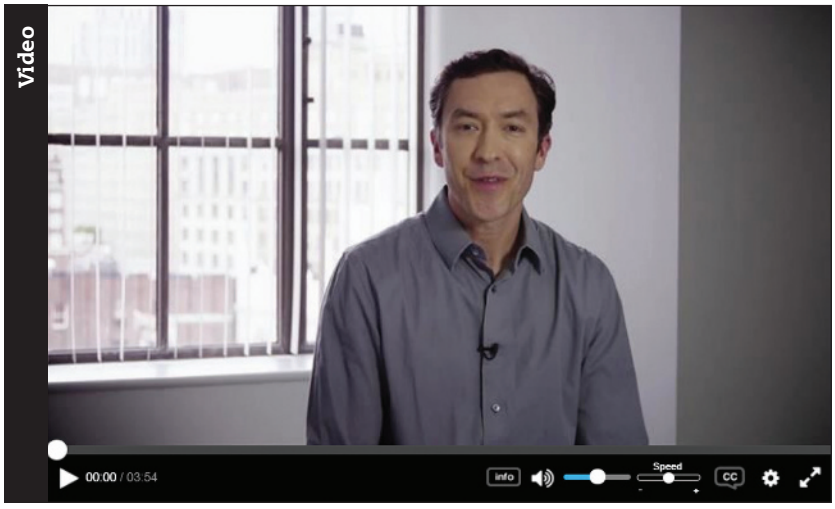
While it is common to refer to the three systems of the information-processing model as *stages* of memory, that term seems to imply a sequence of events. While many aspects of memory formation may follow a series of steps or stages, there are those who see memory as a simultaneous* process, with the creation and storage of memories taking place across a series of mental networks "stretched" across the brain (McClelland & Rumelhart, 1988; Plaut & McClelland, 2010; Rumelhart et al., 1986). This simultaneous processing allows people to retrieve many different aspects of a memory all at once, facilitating much faster reactions and decisions. This model of memory, derived from work in the development of artificial intelligence (AI), is called the **parallel distributed processing (PDP) model**. In the AI world, PDP is related to *connectionism*, the use of artificial neural networks to explain the mental abilities of humans (Bechtel & Abrahamsen, 2002; Henderson & McClelland, 2011; Marcus, 2001; Schapiro & McClelland, 2009).

parallel distributed processing (PDP) model
a model of memory in which memory processes are proposed to take place at the same time over a large network of neural connections.

The information-processing model assumes that the length of time that a memory will be remembered depends on the stage of memory in which it is stored. Other researchers have proposed that a memory's duration** depends on the depth (i.e., the effort made to understand the meaning) to which the information is processed or encoded (Cermak & Craik, 1979; Craik & Lockhart, 1972). If the word *BALL* is flashed on a screen, for example, and people are asked to report whether the word was in capital letters or lowercase, the word itself does not have to be processed very much at all—only its visual characteristics need enter into conscious attention. But if those people were to be asked to use that word in a sentence, they would have to think about what a ball is and how it can be used. They would have to process its meaning, which requires more mental effort than processing just its "looks." This model of memory is called the **levels-of-processing model**. Numerous experiments have shown that thinking about the meaning of something is a deeper level of processing and results in longer retention of the word (Cermak & Craik, 1979; Craik & Tulving, 1975; Paul et al., 2005; Watson et al., 1999). Watch the video *Depth of Processing* for an interactive demonstration of how shallow versus deep processing of information can affect memory.

levels-of-processing model
model of memory that assumes information that is more "deeply processed," or processed according to its meaning rather than just the sound or physical characteristics of the word or words, will be remembered more efficiently and for a longer period of time.

Watch Depth of Processing



So which model is right?

"Which model is right?" is not the correct question. The correct question is, *Which model explains the findings of researchers about how memory works?* The answer to that question is that all of these models can be used to explain some, if not all, research findings. Each of these views of the workings of memory can be seen as speaking to different aspects of memory. For example, the information-processing model provides a "big picture" view of how the various memory systems relate to each other—how the "memory machine" works. The PDP model is less about the

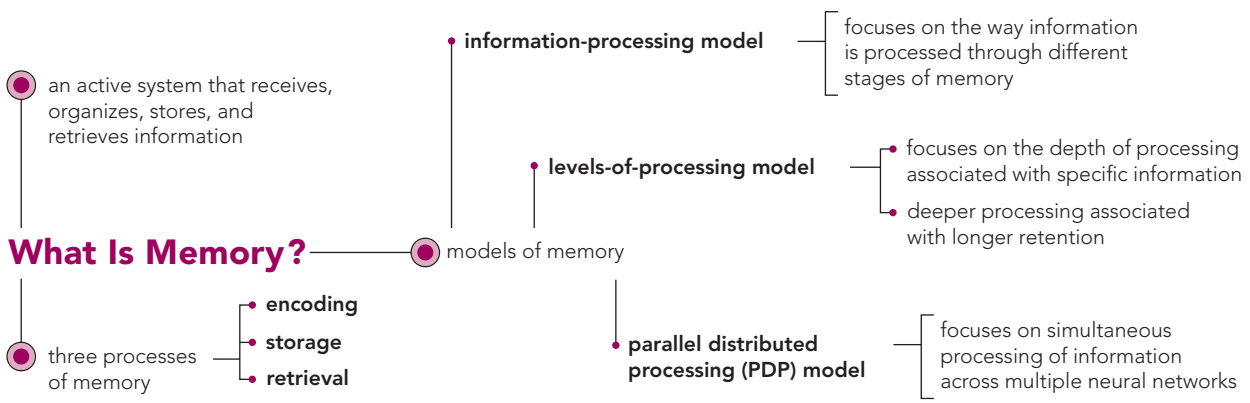
*simultaneous: all at the same time.
**duration: how long something lasts.

mechanics of memory and more about the connections and timing of memory processes. The depth to which information is processed can be seen to address the strength of those parallel connections within each of the three memory systems, with strength and duration of the memory increasing as the level of processing deepens.

While the information-processing model is no longer the primary way current memory researchers view the processes of memory, it is historically important and provides a handy way to talk about how memory seems to work. We're going to explore a lot of memory concepts in this chapter and will look at many of these concepts in the framework of this older model just because it's a little easier to talk about these concepts in these terms—terms many of you have probably heard in daily use. If you should decide to specialize in the study of memory, you'll no doubt have a better grasp of the latest memory theories because you understand the historical view from which they arose. Many of those more current ideas will also be covered in later sections of this chapter as well.

Concept Map L.O. 6.1, 6.2

Interactive



Practice Quiz How much do you remember?

Pick the best answer.

1. Human memory consists of multiple systems that have the ability to store information for periods of time that range from _____ to _____.
   a. seconds, hours
   b. minutes, decades
   c. seconds, our lifetime
   d. hours, our lifetime

2. Elinor met her best friend after a long time and talked a lot with her. After the meeting, she felt that she had more to talk about but could not recall anything at that point. Elinor's problem is in the memory process of
   a. encoding.
   b. storage.
   c. retrieval.
   d. perceiving.

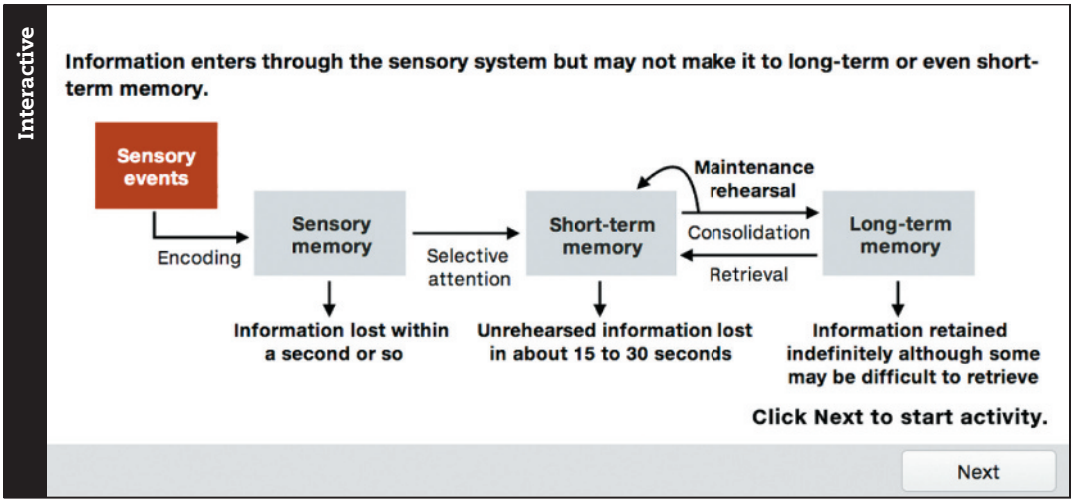
3. Which model of memory suggests that memory processes occur throughout a neural network simultaneously?
   a. parallel distributed processing model
   b. levels-of-processing model
   c. information-processing model
   d. three-stage model

4. Research has demonstrated you can enhance your memory for a specific word if you think about its meaning, how it can be used, and by giving a personal example of its use. This is best accounted for by which model of memory?
   a. parallel distributed processing model
   b. levels-of-processing model
   c. information-processing model
   d. three-stage model

6.3–6.5 The Information-Processing Model: Three Memory Systems

The information-processing theory, which looks at how memory and other thought processes work as part of the cognitive perspective (see Learning Objective 1.3), bases its model for human thought on the way that a computer traditionally functions (Massaro & Cowan, 1993). Data are encoded in a manner that the computer can understand and use. The computer stores that information on a disc, a hard drive, or a memory stick, and then the data are retrieved out of storage as needed. It was also information-processing theorists who first proposed that there are three types of memory systems (see **Figure 6.1**), sensory memory, short-term memory, and long-term memory (Atkinson & Shiffrin, 1968).

Figure 6.1 Three-Stage Process of Memory



Information enters through the sensory system, briefly registering in sensory memory. Selective attention filters the information into short-term memory, where it is held while attention (rehearsal) continues. If the information receives enough rehearsal (maintenance or elaborative), it will enter and be stored in long-term memory.

6.3 Sensory Memory: Why Do People Do Double Takes?

6.3 Describe the process of sensory memory.

Sensory memory is the first system in the process of memory, the point at which information enters the nervous system through the sensory systems—eyes, ears, and so on. Think of it as a door that is open for a brief time. Looking through the door, one can see many people and objects, but only some of them will actually make it through the door itself. Sensory memory is a kind of door onto the world.

Information is encoded into sensory memory as neural messages in the nervous system. As long as those neural messages are traveling through the system, it can be said that people have a "memory" for that information that can be accessed if needed. For example, imagine that Elaina is driving down the street, looking at the people and cars on either side of her vehicle. All of a sudden she thinks, "What? Was that man wearing any pants?" and she looks back to check. How did she know to look back? Her eyes had already moved past the possibly pantless person, but some part of her brain must have just processed what she saw (most likely it was the reticular formation, which notices new and important information). This is called a "double take" and can only be explained by the presence, however brief, of a memory for what she saw. See Learning Objective 2.6.

There are two kinds of sensory memory that have been studied extensively. They are the iconic (visual) and echoic (auditory) sensory systems.

sensory memory
the very first system of memory, in which raw information from the senses is held for a very brief period of time.