MODULE 28

Storage: Retaining Information

Module Preview

With the modified Atkinson-Shiffrin three-stage processing model, information first enters the memory through the senses. We register visual images via iconic memory and sound via echoic memory.

Although our memory for information just presented is limited to about seven items, our capacity for storing information permanently is essentially unlimited. The search for the physical basis of memory has focused on the synapses and their neurotransmitters and on brain circuits. The hippocampus processes explicit (declarative) memories; even more ancient brain regions—for example, the cerebellum—process implicit (nondeclarative) memories.

Module Guide

Sensory Memory

➤ Exercise/Project: Iconic Memory
➤ PsychSim 5: Iconic Memory

28-1. *Contrast two types of sensory memory.*

Information first enters the memory system through the senses. ***Iconic memory*** is a momentary sensory memory of visual stimuli, a photographic or picture-image memory lasting for a few tenths of a second. ***Echoic memory*** is a momentary sensory memory of auditory stimuli. Even if attention is elsewhere, sounds and words can still be recalled within 3 or 4 seconds.

Working/Short-Term Memory

➤ Exercise: Memory Capacity
➤ Feature Film: *Memento*
➤ PsychSim 5: Short-Term Memory

28-2. *Describe the duration and capacity of working/short-term memory.*

Our working/short-term memory span for information just presented is very limited—a seconds-long retention of up to about seven items, depending on the information and how it is presented. Short-term recall is slightly better for random digits than for random letters, and slightly better for what we hear than what we see. Without rehearsal, most of us retain in short-term memory only about four information chunks.

Long-Term Memory and **Storing Memories in the Brain**

➤ Lecture: Rajan Mahadevan's Amazing Memory
➤ Video: Module 20 of *The Brain* Series, 2nd ed.: *A Super-Memorist Advises on Study Strategies*

28-3. *Describe the capacity and duration of long-term memory, and discuss the biological changes that may underlie memory formation and storage.*

Although we know that our capacity for storing information permanently is essentially unlimited, we are not sure how and where we store it. Research has shown that memories do not reside in a single place, and the so-called *memory trace* is difficult to find.

➤ Videos: Modules 16, 18, and 17 of *The Brain* Series, 2nd ed.: *The Locus of Learning and Memory, Living with Amnesia: The Hippocampus and Memory,* and *Learning as Synaptic Change;* Segment 16 of the Scientific American *Frontiers* Series, 2nd ed.: *Remembering What Matters*
➤ PsychSim 5: When Memory Fails

The search for the physical basis of memory is now focused on the synapses and their neurotransmitters and on the ***long-term potentiation (LTP)*** of brain circuits. In response to increased activity in neural pathways, neural interconnections form or strengthen. Studies of the sea slug indicate that when learning occurs, the slug releases more of the neurotransmitter *serotonin* at certain synapses, and these synapses become more efficient at transmitting signals. In experiments, rapidly stimulating certain memory-circuit connections has increased their sensitivity for weeks to come. This LTP appears to be a neural basis for learning and remembering associations. Drugs that block LTP interfere with learning. Scientists are developing and testing drugs that enhance long-term memory. One approach is to develop drugs that enhance the production of the protein CREB. Another is to develop drugs that boost *glutamate*.

➤ Exercise: Flashbulb Memory
➤ Video: Module 14 of *Psychology: The Human Experience: Flashbulb Memories*

The naturally stimulating hormones that we produce when excited or stressed make more glucose energy available to fuel brain activity, signaling the brain that something important has happened. The amygdala, two emotion-processing clusters in the brain's limbic system, arouses brain areas that process emotion. These emotion-triggered hormonal changes help explain our ***flashbulb memories*** of surprising, significant events. Emotionless events mean weaker memories.

➤ Lecture: Explicit-Implicit Memory and Clive Wearing
➤ ActivePsych: Scientific American *Frontiers,* 3rd ed.: *Aging and Memory: Studying Alzheimer's Disease; Enhancing Memory: The Role of Emotion;* and *Memory Loss: A Case Study*
➤ Instructor Video Tool Kit: *Brain Fingerprinting: Memory, Recognition, and Lie Detection; A Pill for Forgetting*

28-4. *Distinguish between implicit and explicit memory, and identify the main brain structure associated with each.*

Studies of brain-damaged patients who suffer from ***amnesia*** reveal two types of memory. ***Implicit memory*** (nondeclarative memory) is retention without conscious recollection. ***Explicit memory*** (declarative memory) is the memory of facts and experiences that one can consciously know and "declare."

Brain scans of people recalling words and autopsies of people who had amnesia reveal that the ***hippocampus,*** a limbic system structure, plays a vital role in the gradual processing of our explicit memories into long-term memory. The hippocampus is not the permanent storehouse, but a loading dock that feeds new information to the cortex for permanent storage. Implicit memories are processed by the cerebellum. Research with rabbits in which different parts of the neural pathway were temporarily deadened during eyeblink training pinpointed implicit memory in the cerebellum at the back of the head. Our dual-memory system helps explain *infantile amnesia.*