Chapter 7

Human Memory

Human Memory: Basic Questions

- How does information get **into** memory?
- How is information **maintained** in memory?
- How is information pulled **back out** of memory?

Figure 7.2

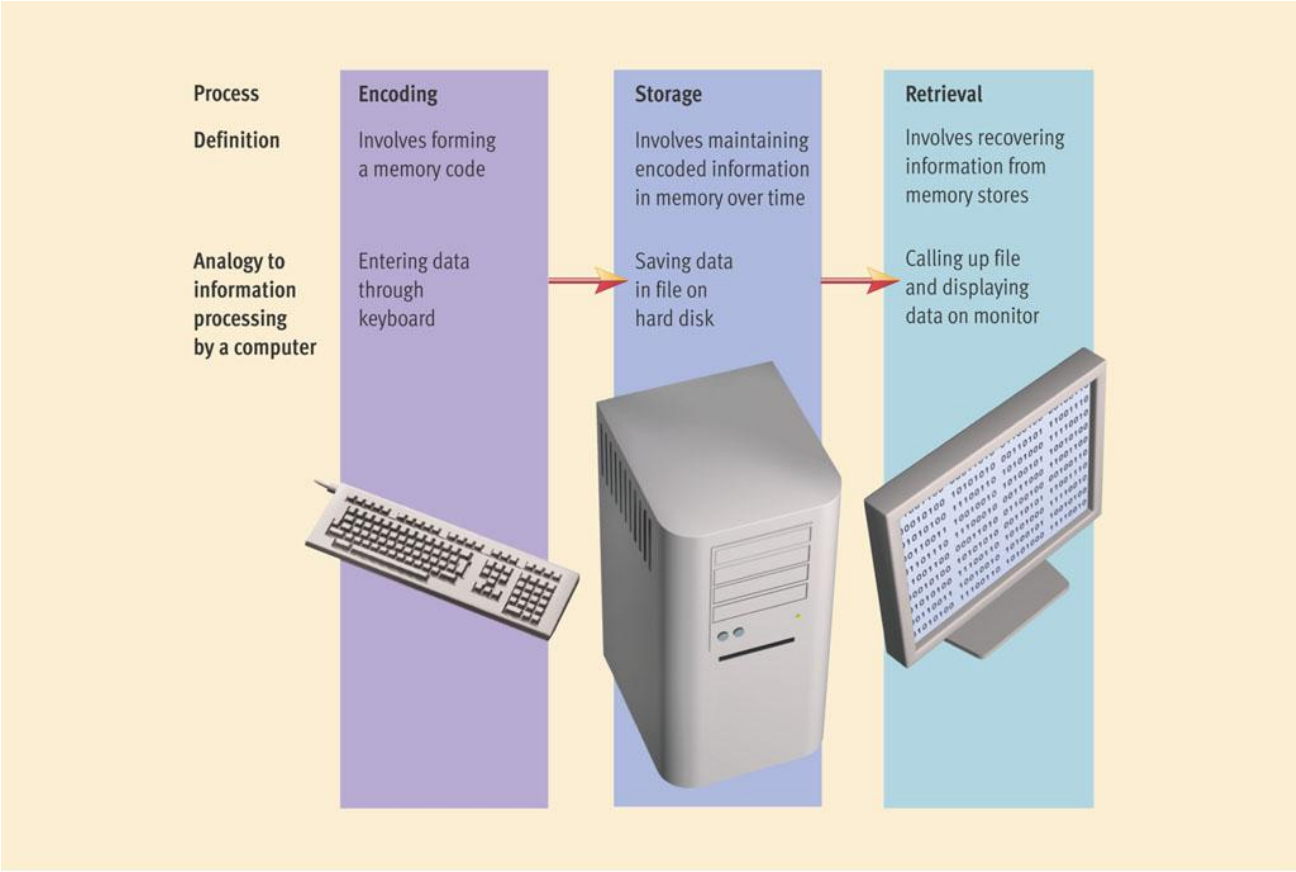


Figure 7.2 Three key processes in memory. Memory depends on three sequential processes: encoding, storage, and retrieval. Some theorists have drawn an analogy between these processes and elements of information processing by computers as depicted here. The analogies for encoding and retrieval work pretty well, but the storage analogy is somewhat misleading. When information is stored on a hard drive, it remains unchanged indefinitely and you can retrieve an exact copy. As you will learn in this chapter, memory storage is a much more dynamic process. Our memories change over time and are rough reconstructions rather than exact copies of past events.

- Craik and Lockhart: incoming information is processed at different levels
- Levels of processing:
  - **Structural** = shallow
  - **Phonemic** = intermediate
  - **Semantic** = deep
- Deeper processing = longer lasting memory codes

Figure 7.3

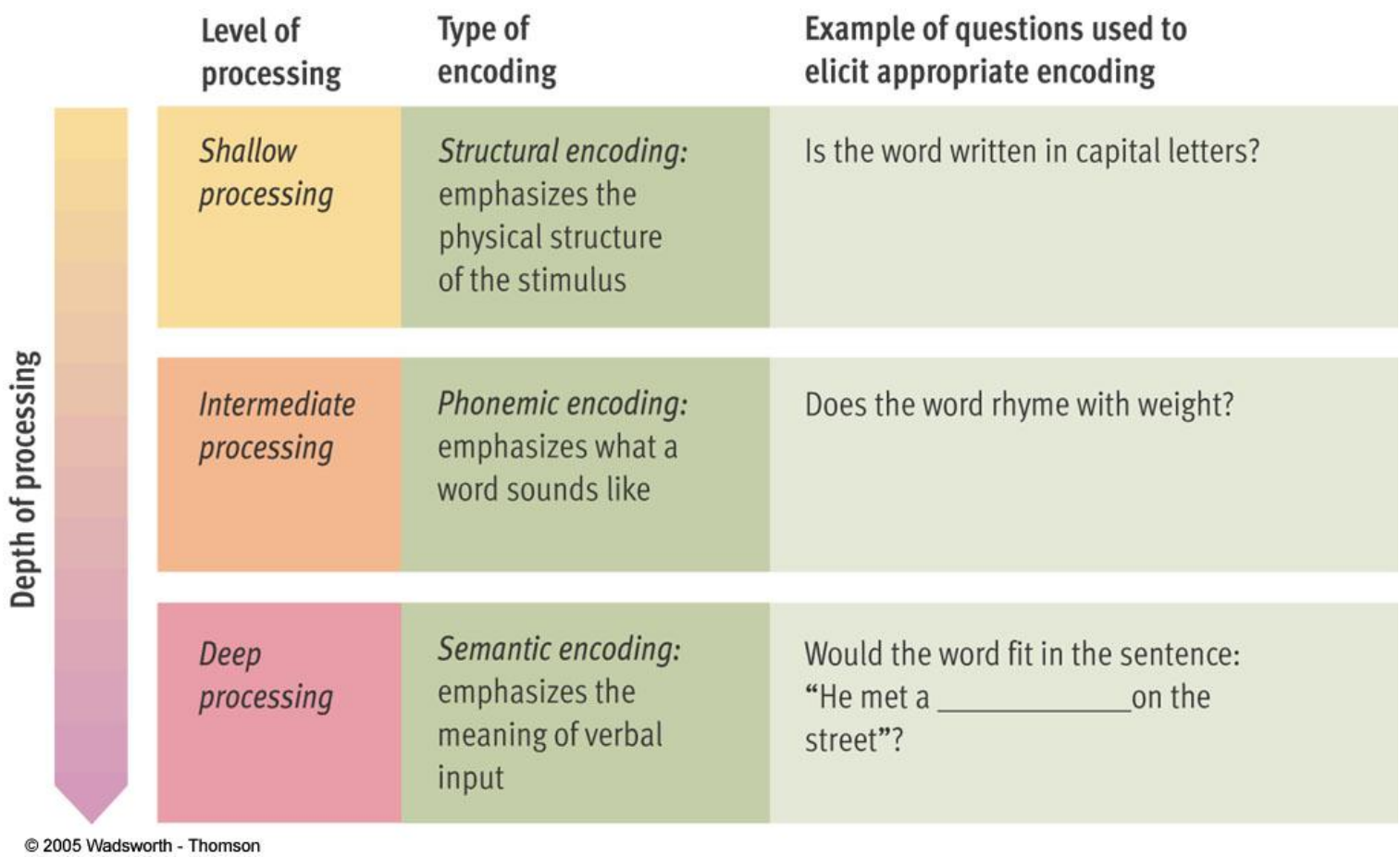


Figure 7.3 Levels-of-processing theory. According to Craik and Lockhart (1972), structural, phonemic, and semantic encoding—which can be elicited by questions such as those shown on the right—involve progressively deeper levels of processing, which should result in more durable memories.

- **Elaboration** = linking a stimulus to other information at the time of encoding
  - Thinking of examples
- **Visual Imagery** = creation of visual images to represent words to be remembered
  - Easier for concrete objects: Dual-coding theory

- Analogy: information storage in computers ~ information storage in human memory
- **Information-processing theories**
  - We can divide memory into **3 different stores**
    - **Sensory, Short-term, Long-term**

Figure 7.6

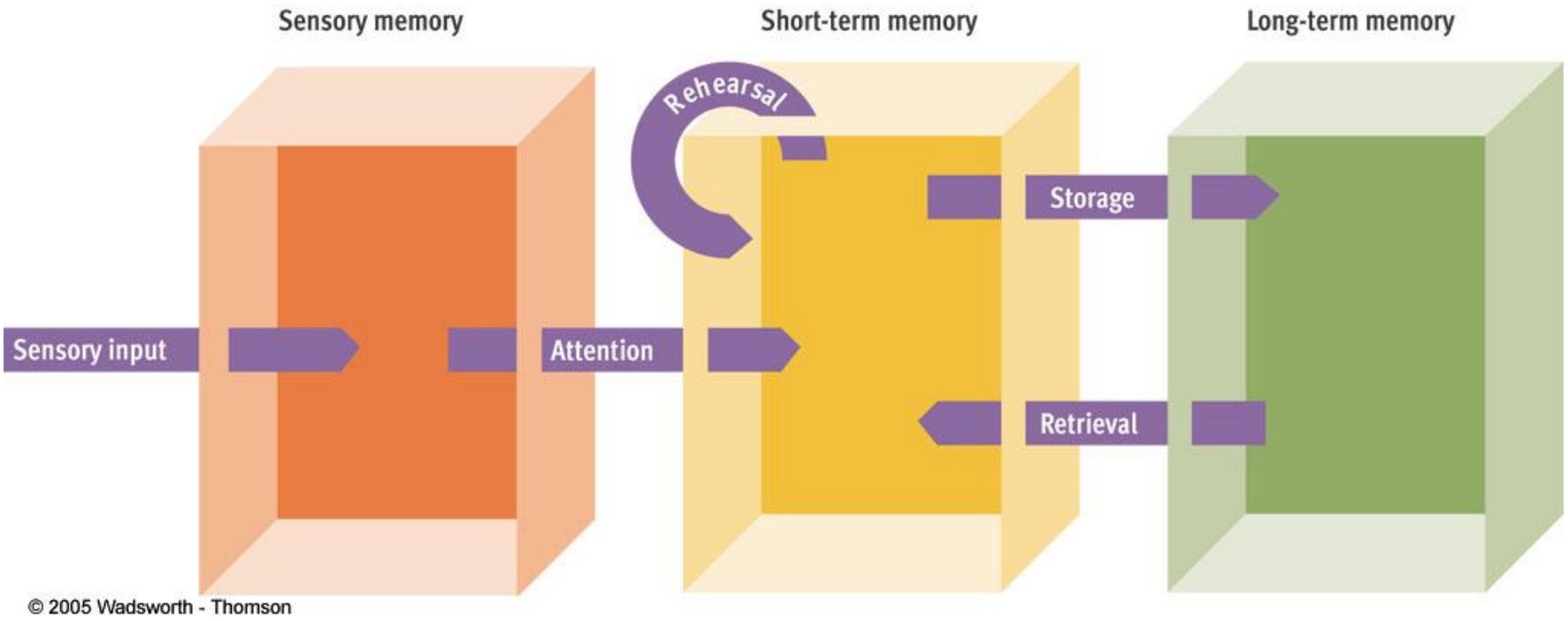
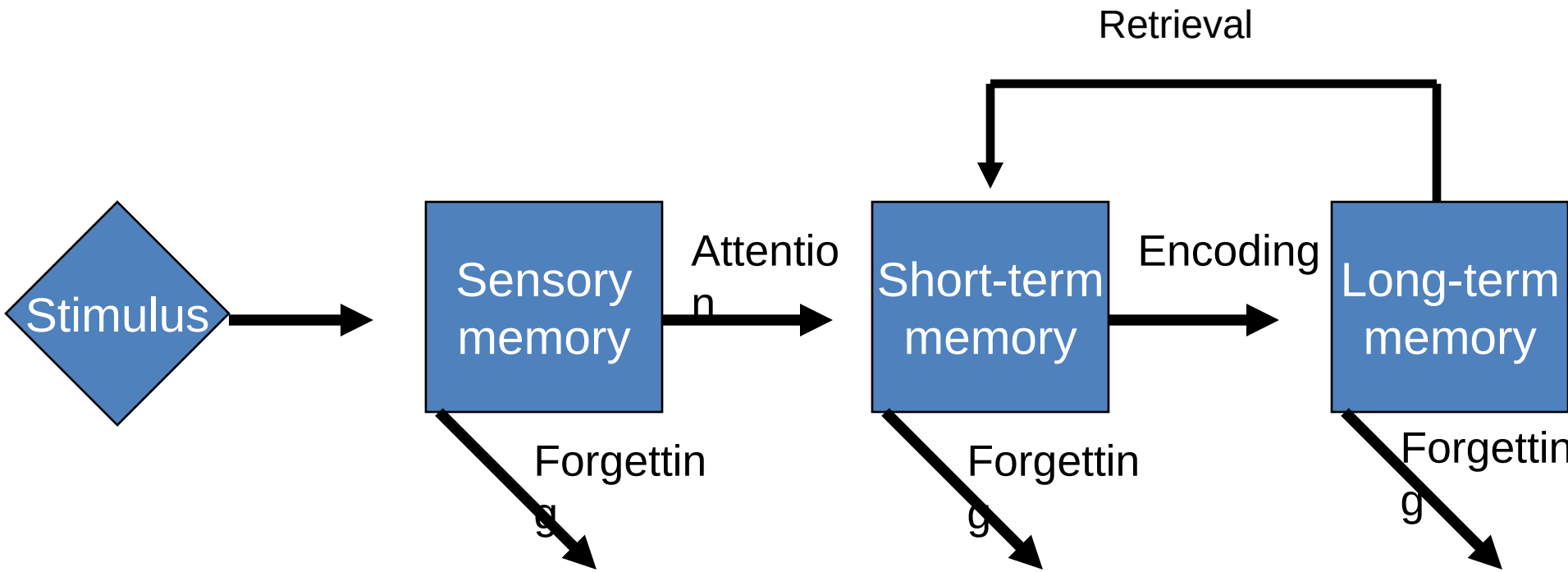


Figure 7.6 The Atkinson and Shiffrin model of memory storage. Atkinson and Shiffrin (1971) proposed that memory is made up of three information stores. *Sensory memory* can hold a large amount of information just long enough (a fraction of a second) for a small portion of it to be selected for longer storage. *Short-term memory* has a limited capacity, and unless aided by rehearsal, its storage duration is brief. *Long-term memory* can store an apparently unlimited amount of information for indeterminate periods.

Information-Processing Model of Memory



- SENSORY MEMORY
- Brief preservation -in original sensory form
- Afterimage
- Auditory/Visual – approximately ¼ second

Short Term Memory (STM)

- **Limited duration** – about **20 seconds** without rehearsal
  - **Rehearsal** – the process of repetitively verbalizing or thinking about the information
- **Limited capacity** – magical number **7 plus or minus 2**
  - **Chunking** – grouping familiar stimuli for storage as a single unit

- **LONG TERM MEMORY**
- Unlimited capacity store that can hold information over lengthy periods of time
  - Permanent storage?
    - **Flashbulb memories**

Figure 7.8

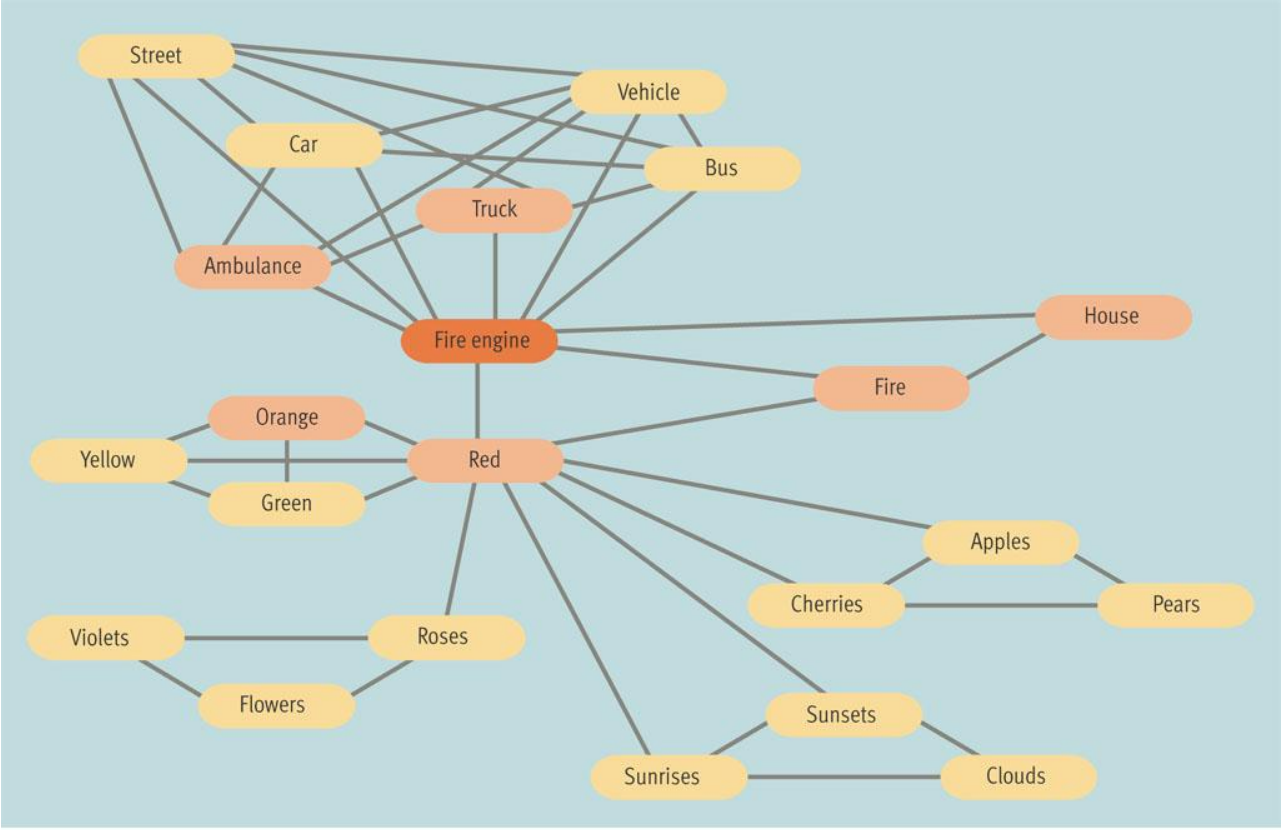


Figure 7.8 A semantic network. Much of the organization of long-term memory depends on networks of associations among concepts. In this highly simplified depiction of a fragment of a semantic network, the shorter the line linking any two concepts, the stronger the association between them. The coloration of the concept boxes represents activation of the concepts. This is how the network might look just after a person hears the words *fire engine.* Source: Adapted from Collins, A. M., & Loftus, E. F. (1975). A spreading activation theory of semantic processing. *Psychological Review, 82,* 407–428. Copyright © 1975 by the American Psychological Association. Adapted by permission of the authors.

Factors which affect Memory

- Transience (passage of time)
- Absentmindedness (lack attention; divided attention; failure to remember to do things in future -> **cues**
- Blocking
- Memory misattribution (source errors)
- Suggestibility - http://www.youtube.com/watch?v=QgkRLnXFR74 (example p. 27; loftus car crash, lost in mall, lima bean studies)

Factors which affect memory

- Bias-
- Persistence - intrusive recollections we would prefer to forget.

- Failures of retrieval
  - Tip of the tongue phenomenon
  - Retrieval cues
- Recalling an event
  - Context cues
- Reconstructing memories
  - Misinformation effect
    - Source monitoring

Figure 7.9

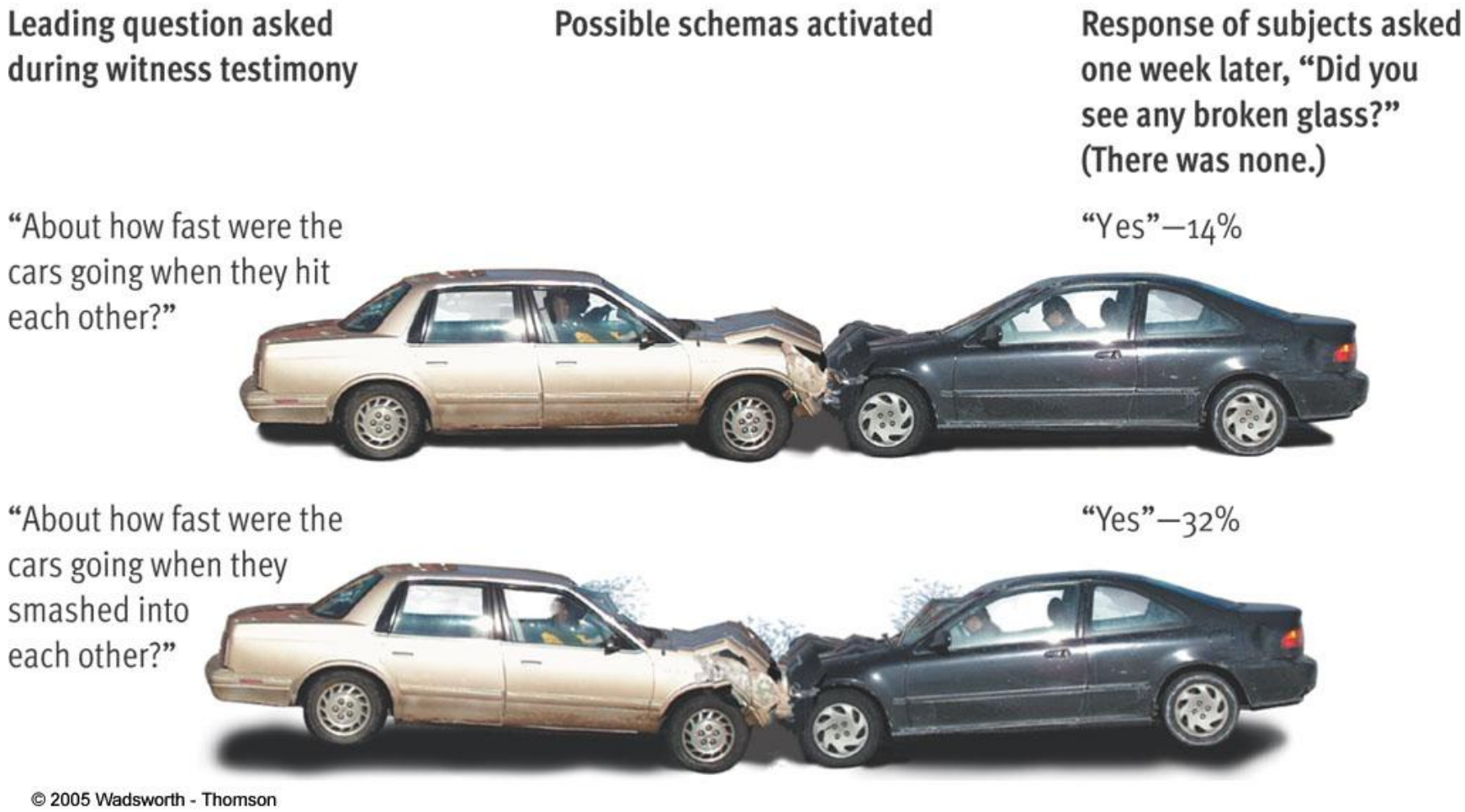


Figure 7.9 The misinformation effect. In an experiment by Loftus and Palmer (1974), participants who were asked leading questions in which cars were described as *hitting* or *smashing* each other were prone to recall the same accident differently one week later, demonstrating the reconstructive nature of memory.

Figure 7.10

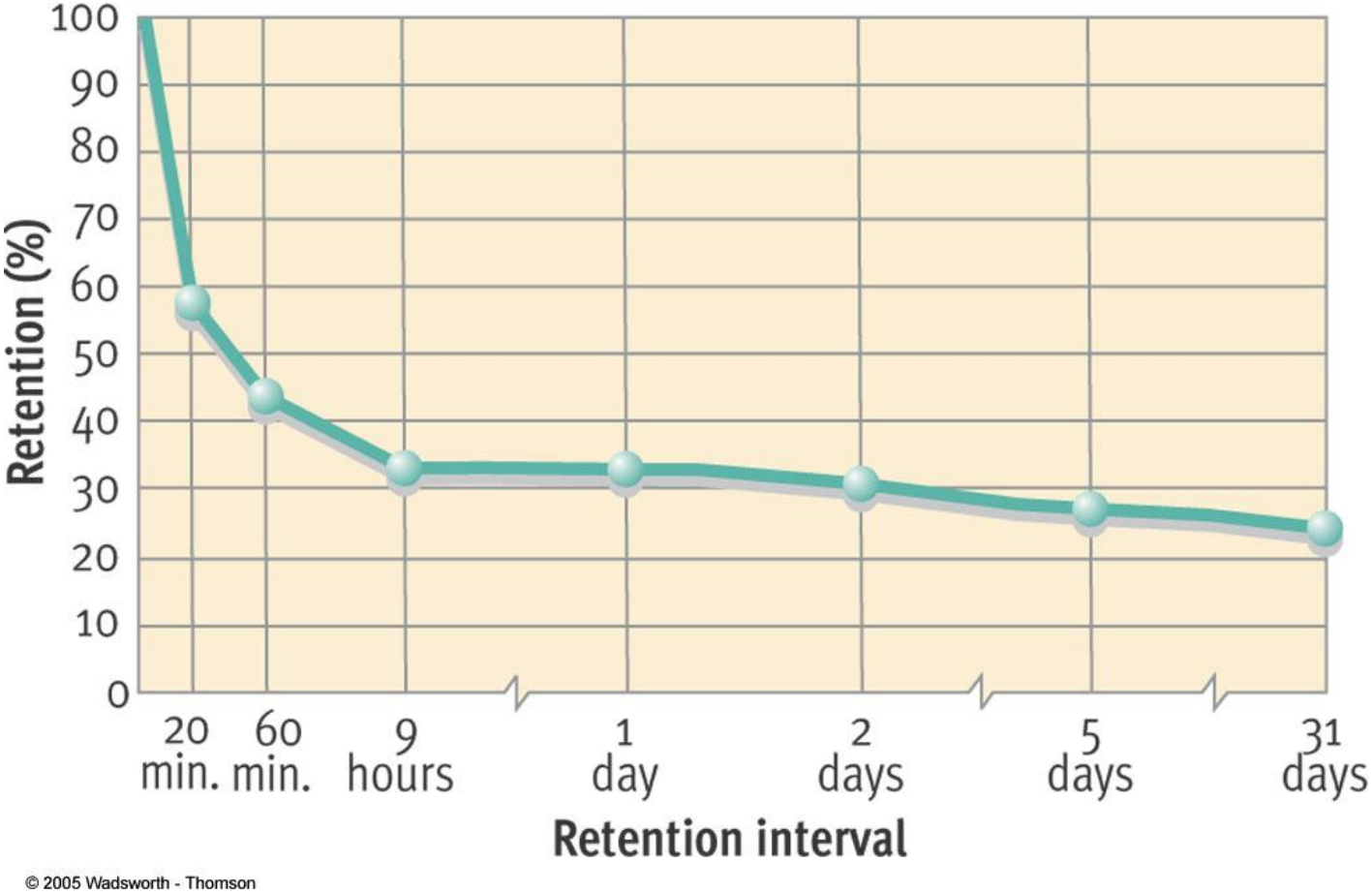


Figure 7.10 Ebbinghaus's forgetting curve for nonsense syllables. From his experiments on himself, Ebbinghaus concluded that forgetting is extremely rapid immediately after the original learning and then levels off. Although this generalization remains true, subsequent research has shown that forgetting curves for nonsense syllables are unusually steep. (Data from Ebbinghaus, 1885)

- **Ineffective Encoding**
- **Decay theory**
- **Interference theory**
  - Proactive
  - Retroactive
- **Encoding specificity principle**

Figure 7.11

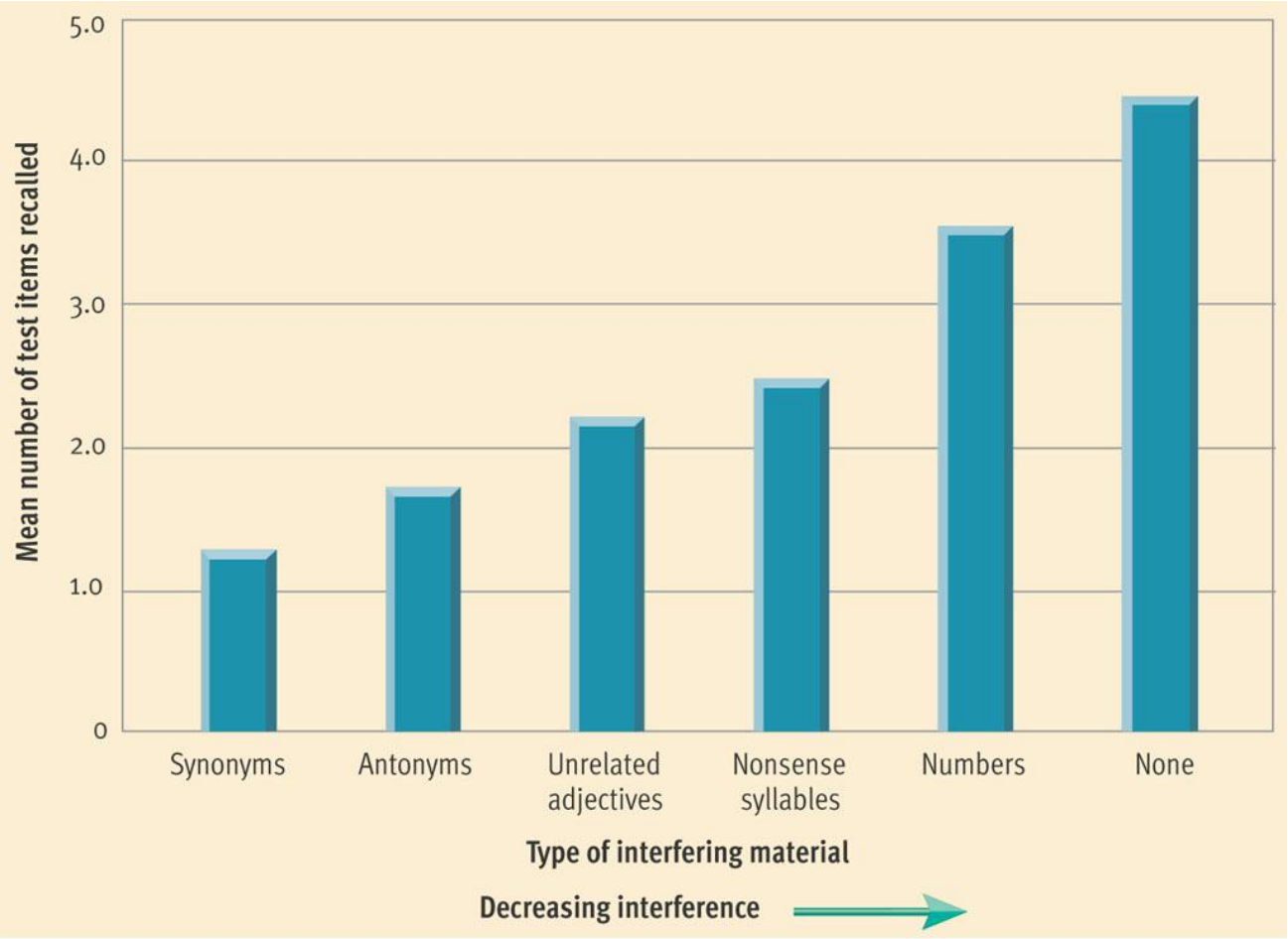


Figure 7.11 Effects of interference. According to interference theory, more interference from competing information should produce more forgetting. McGeoch and McDonald (1931) controlled the amount of interference with a learning task by varying the similarity of an intervening task. The results were consistent with interference theory. The amount of interference is greatest at the left of the graph, as is the amount of forgetting. As interference decreases (moving to the right on the graph), retention improves. (Data from McGeoch & McDonald, 1931)

Figure 7.12

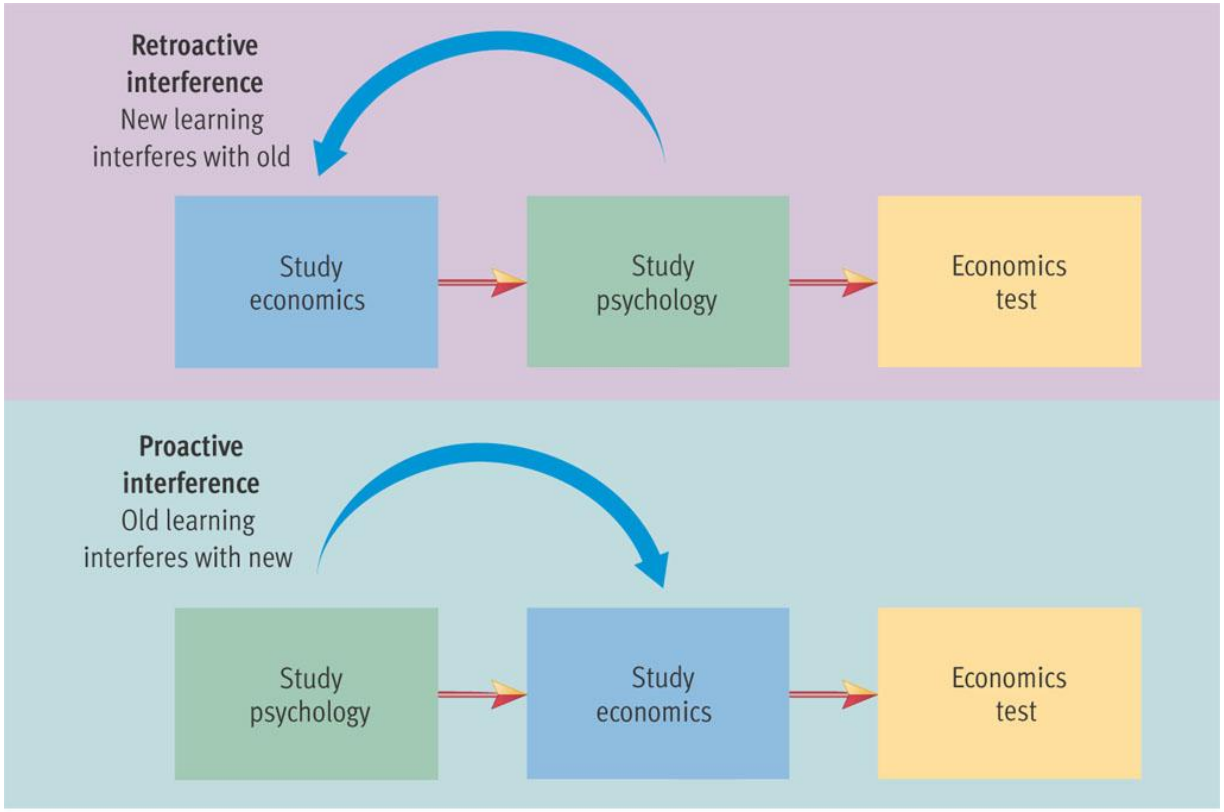


Figure 7.12 Retroactive and proactive interference. Retroactive interference occurs when learning produces a "backward" effect, reducing recall of previously learned material. Proactive interference occurs when learning produces a "forward" effect, reducing recall of subsequently learned material. For example, if you were to prepare for an economics test and then study psychology, the interference from the psychology study would be retroactive interference. However, if you studied psychology first and then economics, the interference from the psychology study would be proactive interference

- Repression
- Authenticity of repressed memories?
  - Memory illusions
  - Controversy

Figure 7.15

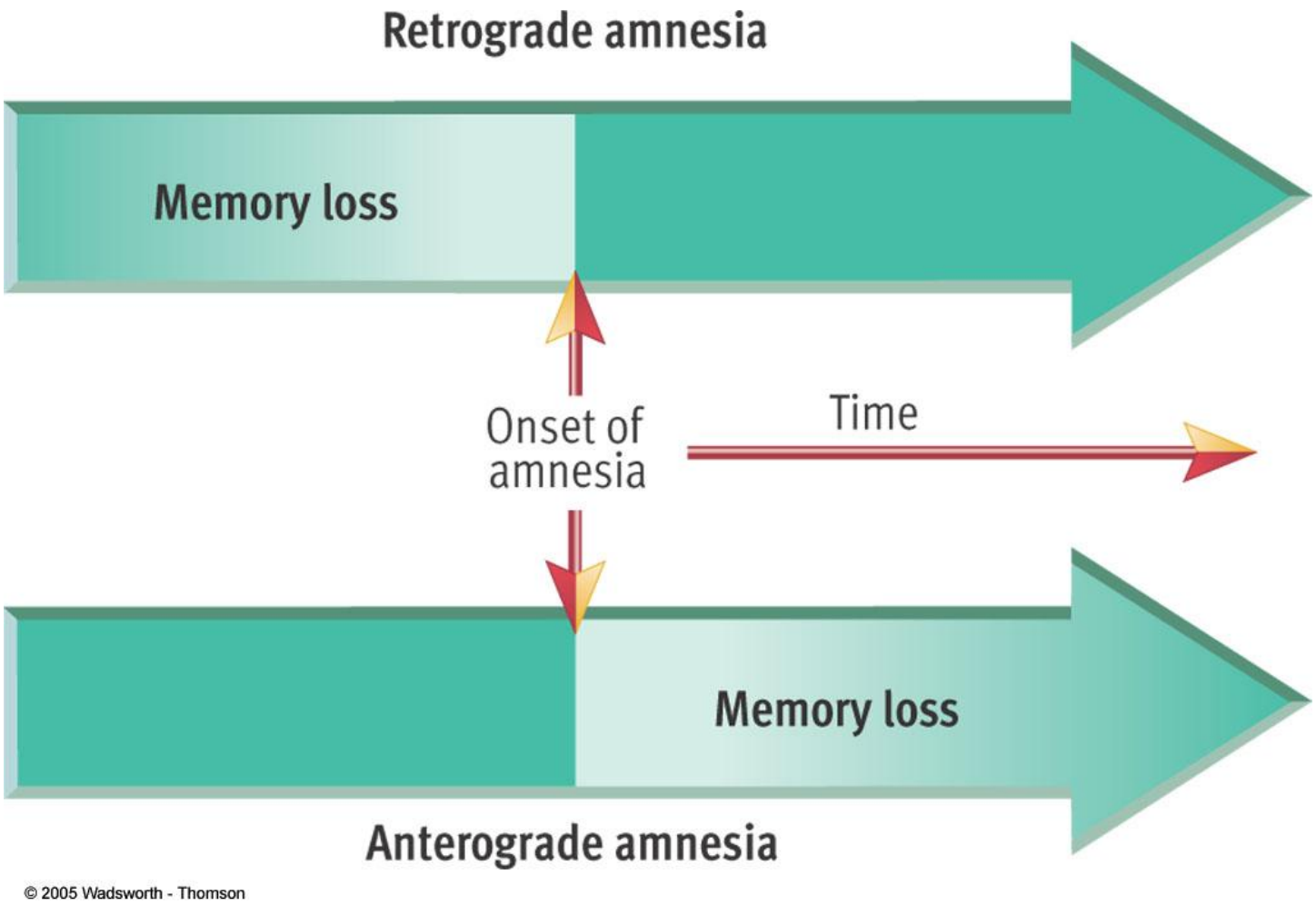


Figure 7.15 Retrograde versus anterograde amnesia. In retrograde amnesia, memory for events that occurred prior to the onset of amnesia is lost. In anterograde amnesia, memory for events that occur subsequent to the onset of amnesia suffers.

- **Anatomy of Memory**
  - Anterograde and Retrograde Amnesia
  - The hippocampus and consolidation
- **Neural Circuitry and Biochemistry**
  - Localized neural circuits
    - Reusable pathways in the brain
- **Biochemistry**
  - Alteration in synaptic transmission
    - Hormones modulating neurotransmitter systems
    - Protein synthesis

Figure 7.16

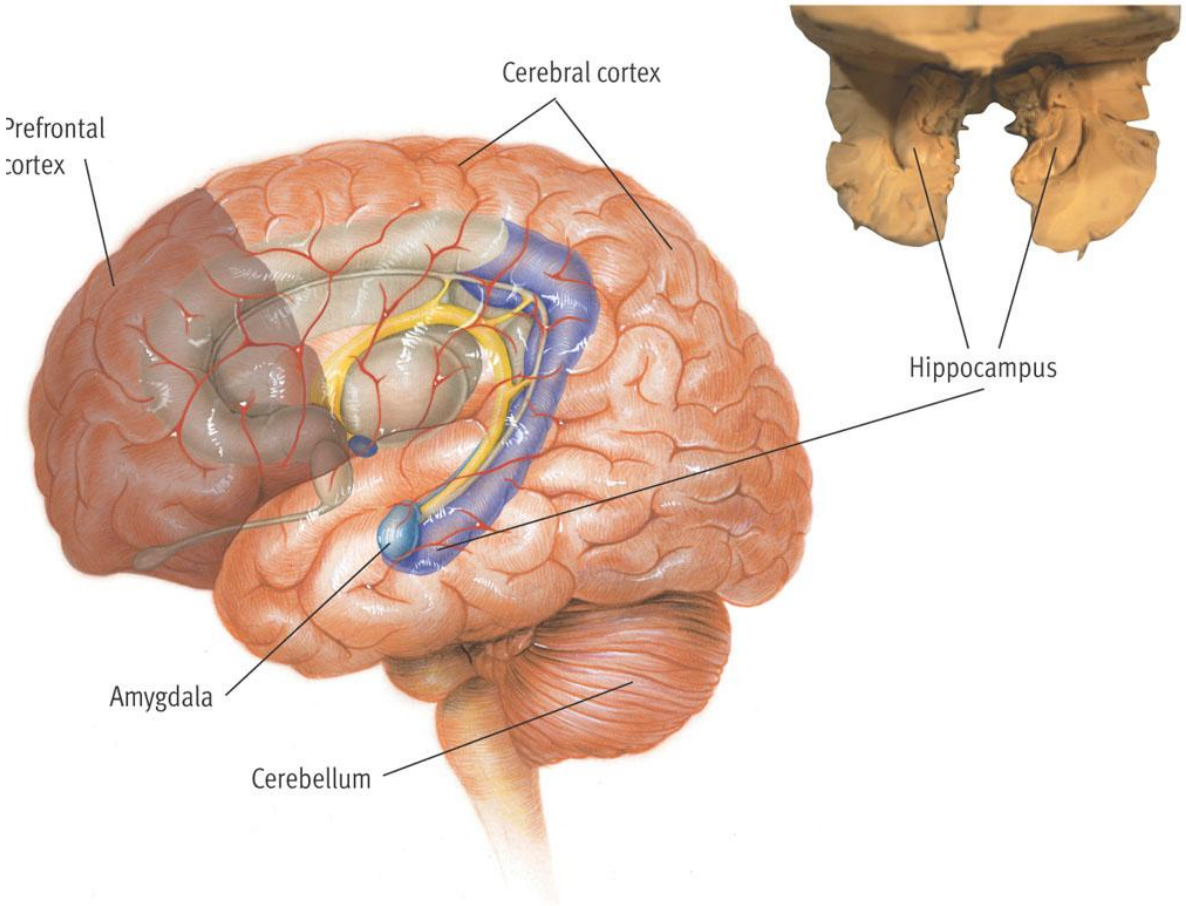


Figure 7.16 The anatomy of memory. All the brain structures identified here have been implicated in efforts to discover the anatomical structures involved in memory. Although its exact contribution to memory remains the subject of debate, the hippocampus is thought to play an especially central role in memory. Photo: Wadsworth collection.

Are There Multiple Memory Systems?

- Implicit vs. Explicit
- Declarative vs. Procedural
- Semantic vs. Episodic