07

Human Memory

Encoding

Storage

Retrieval

Forgetting

Physiology of Memory

Systems and Types of Memory

Memory

Memory is defined as the mental processes that enable one to acquire, retain, and retrieve information. Memory involves three fundamental processes of **encoding, storage, and retrieval.**

07 Which is the Correct Penny?

Chapter 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

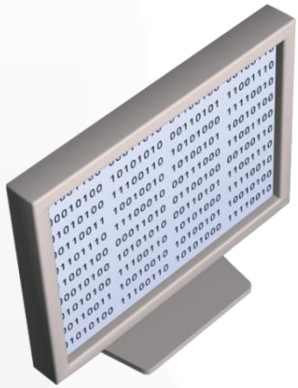
07 Three Key Processes of Memory

Chapter 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Encoding

Storage

Retrieval



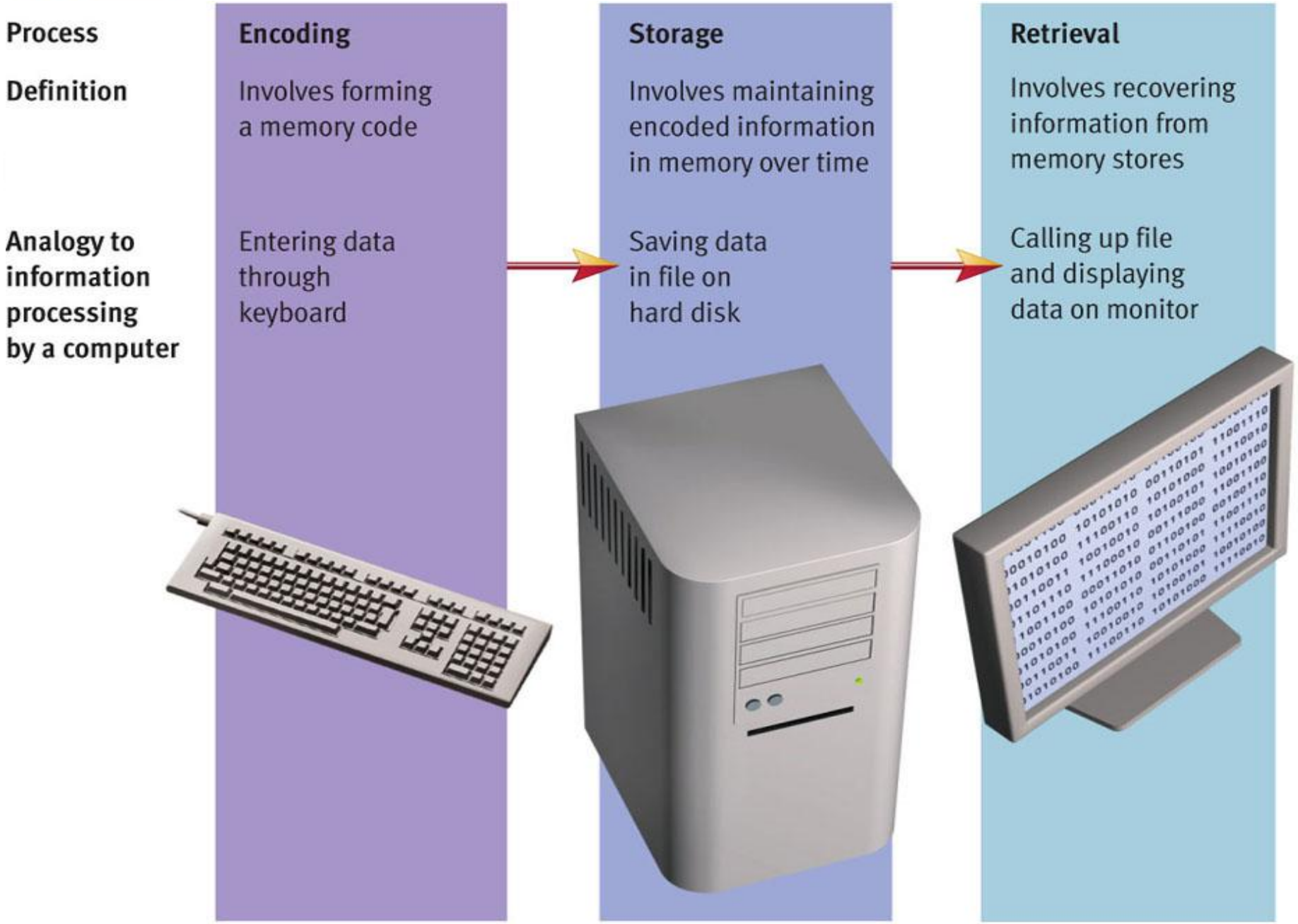


Figure 7.2 Three key processes in memory

The Role of Attention

Encoding

Getting information into memory

Divided Attention and Driving Performance

Levels of Encoding

Structural Encoding

Does the word rhyme with weight?

Phonemic Encoding

Would the word fit in the sentence: "He met a _____ on the street?"

Semantic Encoding

Yes

Visual Imagery

Word	Imagery
Juggler	
Truth	?

Stage Model of Memory

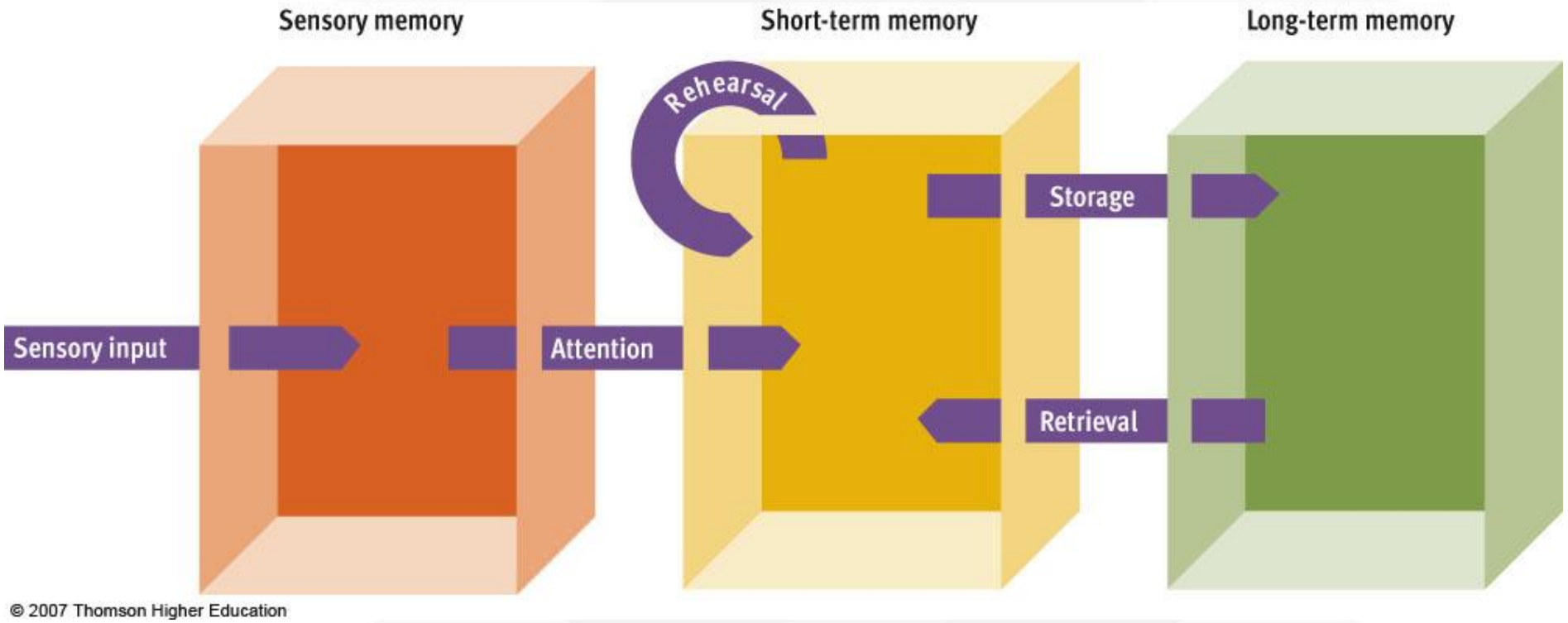
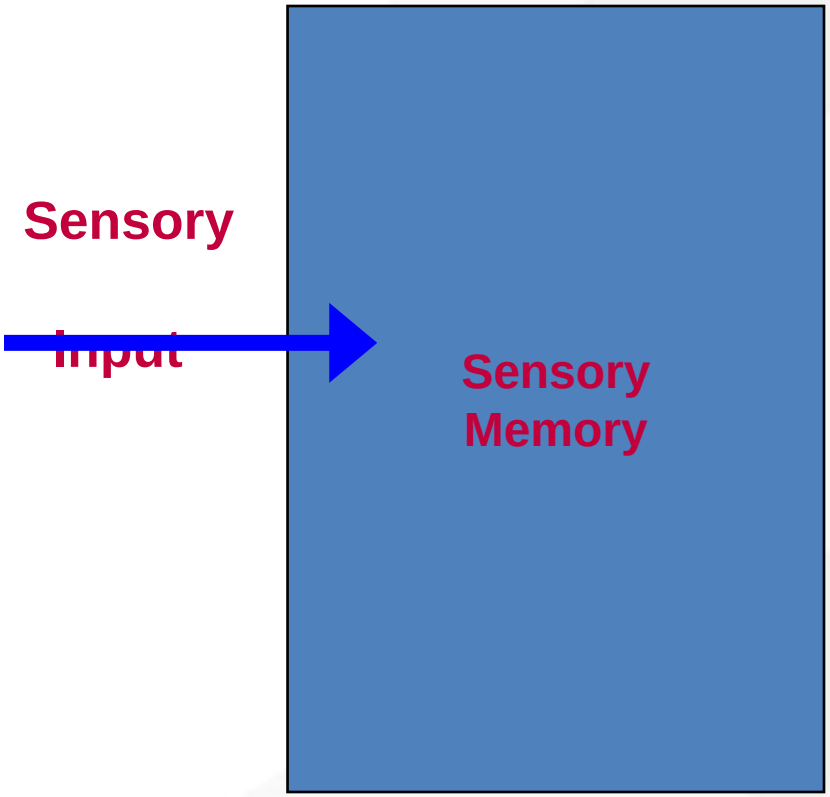


Figure 7.6 The Atkinson and Schiffrin model of memory storage

Sensory Memory

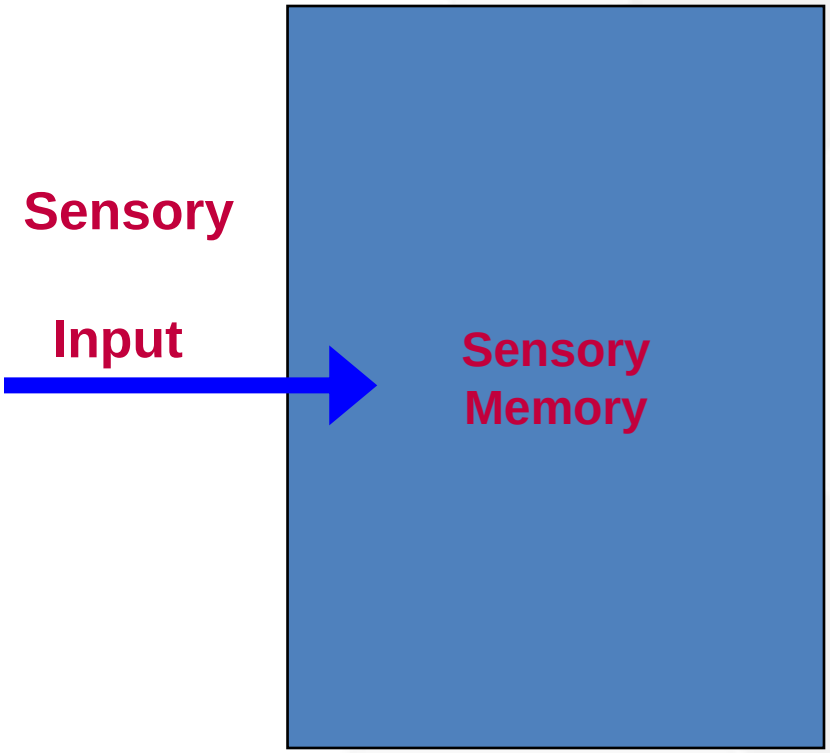


- **Function**—holds information long enough to be processed for basic physical characteristics
- **Capacity**—large
  - can hold many items at once
- **Duration**—very brief retention of images
  - .3 seconds for visual info
  - 2 seconds for auditory info

07 Sensory Memory

- Sensory memory is the 1st of 2 temporary storage buffers that information must pass before reaching long-term storage. There is sensory memory for each of the 5 senses

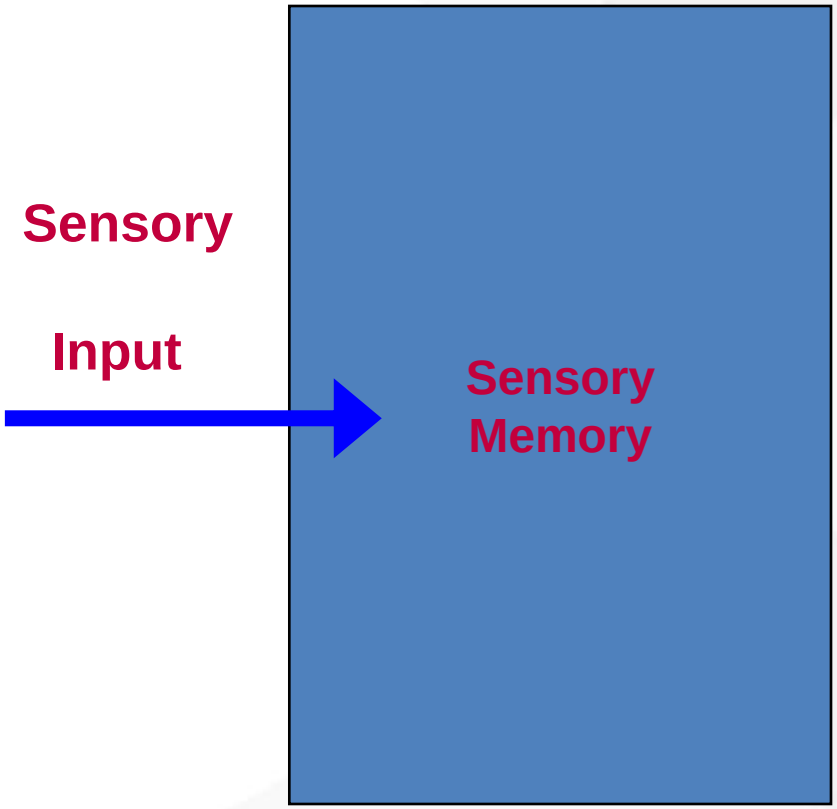
Sensory Memory



Although we receive info from all 5, we are going to discuss the main 2 we use a humans

- iconic memory: visual information
- echoic memory: auditory information

Sensory Memory

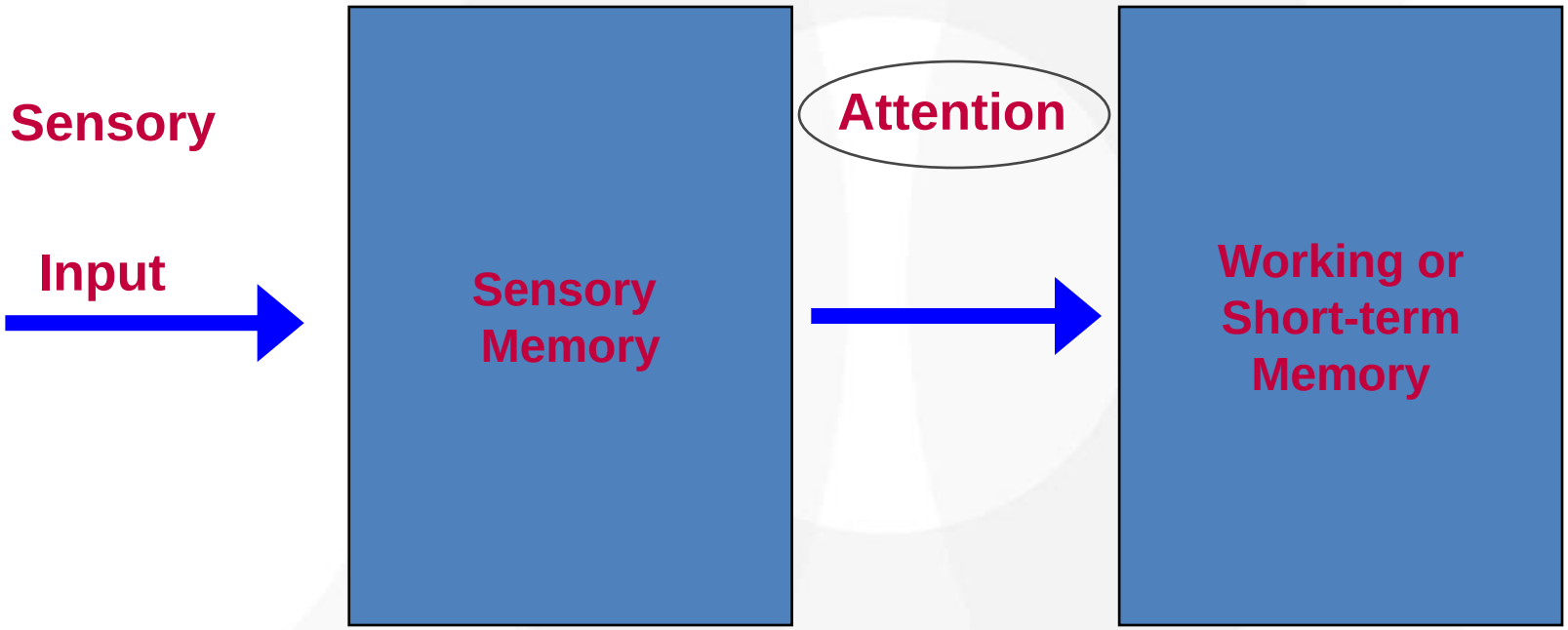


- Sensory memory forms automatically, without attention or interpretation
- **Attention** is needed to transfer information to working memory

Sensory Memory

- **Visual sensory memory**—brief memory of an image or icon. Also called iconic memory.
- **Auditory sensory memory**—brief memory of a sound or echo. Also called echoic memory.
- Auditory sensory memories may last a bit longer than visual sensory memories.

Short term or working memory



07 Short-term Memory

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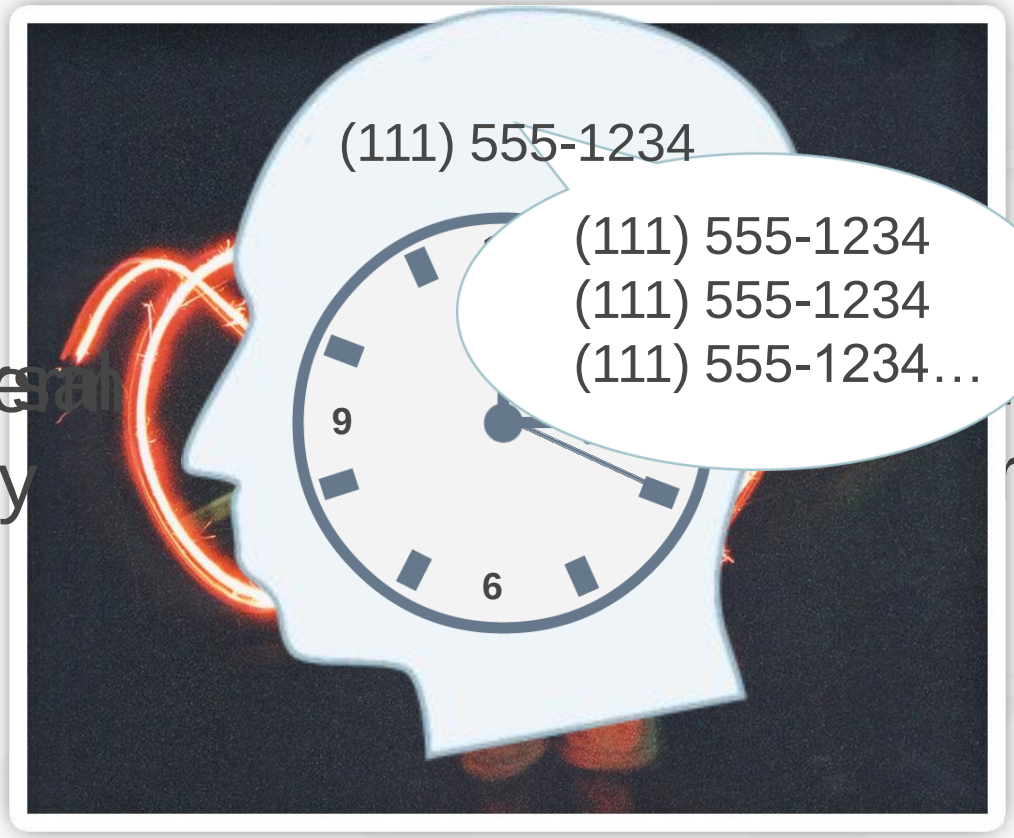


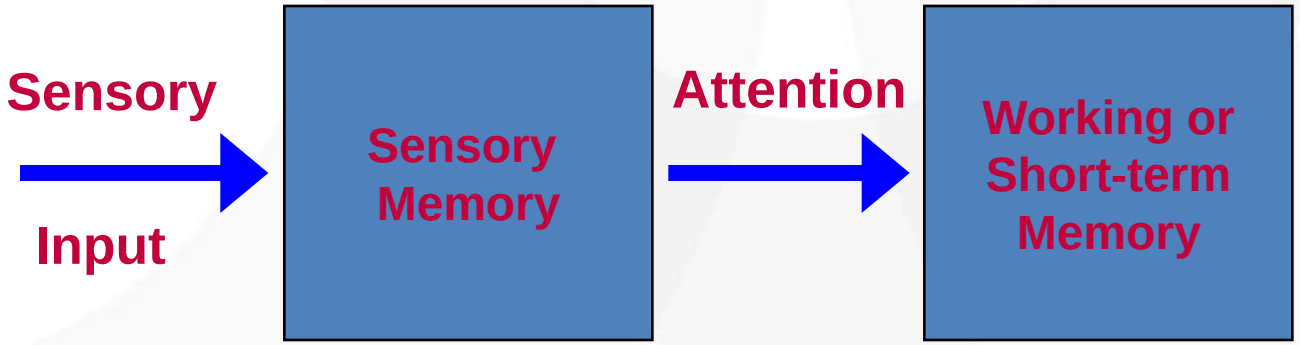
Short-term Memory

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 (between 5 and 9 items generally)**
  - **Chunking** – grouping familiar stimuli for storage as a single unit

Short-term Memory

- Function—conscious processing of information
  - where information is actively worked on
- Capacity—limited (holds 7 +/- 2 items)
- Duration—brief storage (about 20-30 seconds)



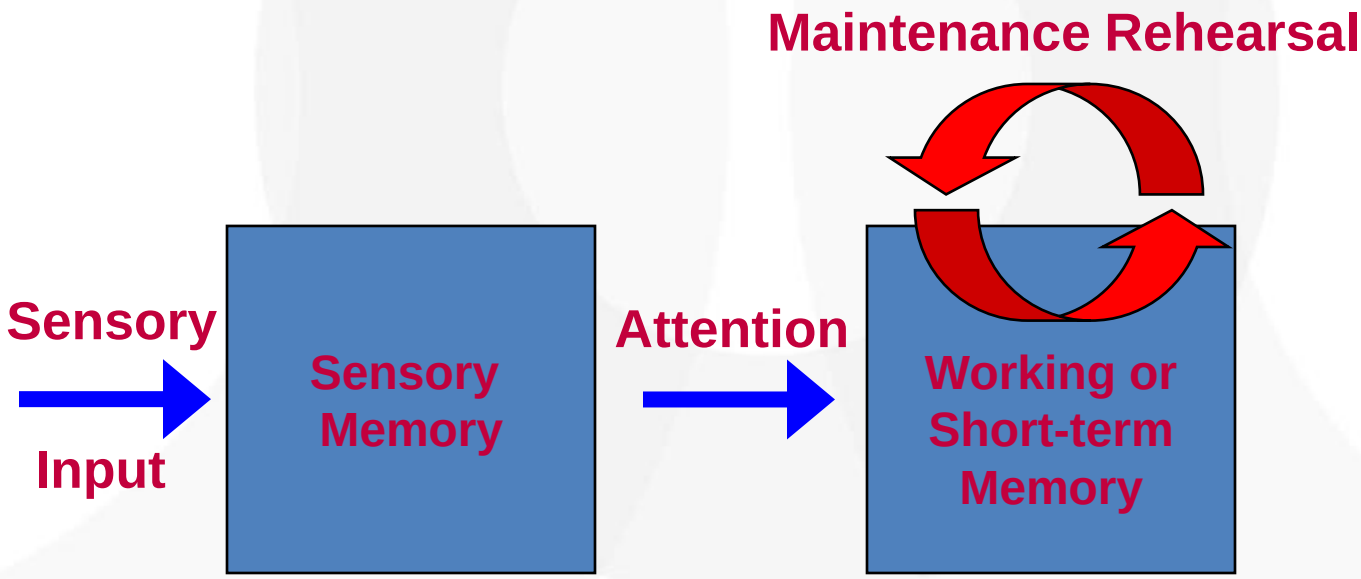
Chunking

Chunking

- Grouping small bits of information into larger units of information
  - expands working memory load
- Which is easier to remember?
  - 4 8 3 7 9 2 5 1 6
  - 483 792 516

Maintenance Rehearsal

- Mental or verbal repetition of information allows information to remain in working memory longer than the usual 30 seconds



Short-Term Memory as "Working Memory"

- STM not limited to phonemic encoding
- Loss of information not only due to decay
- **Baddeley (1986)** – 3 components of working memory
  - **Phonological rehearsal loop**
  - **Visuospatial sketchpad**
  - **Executive control system**

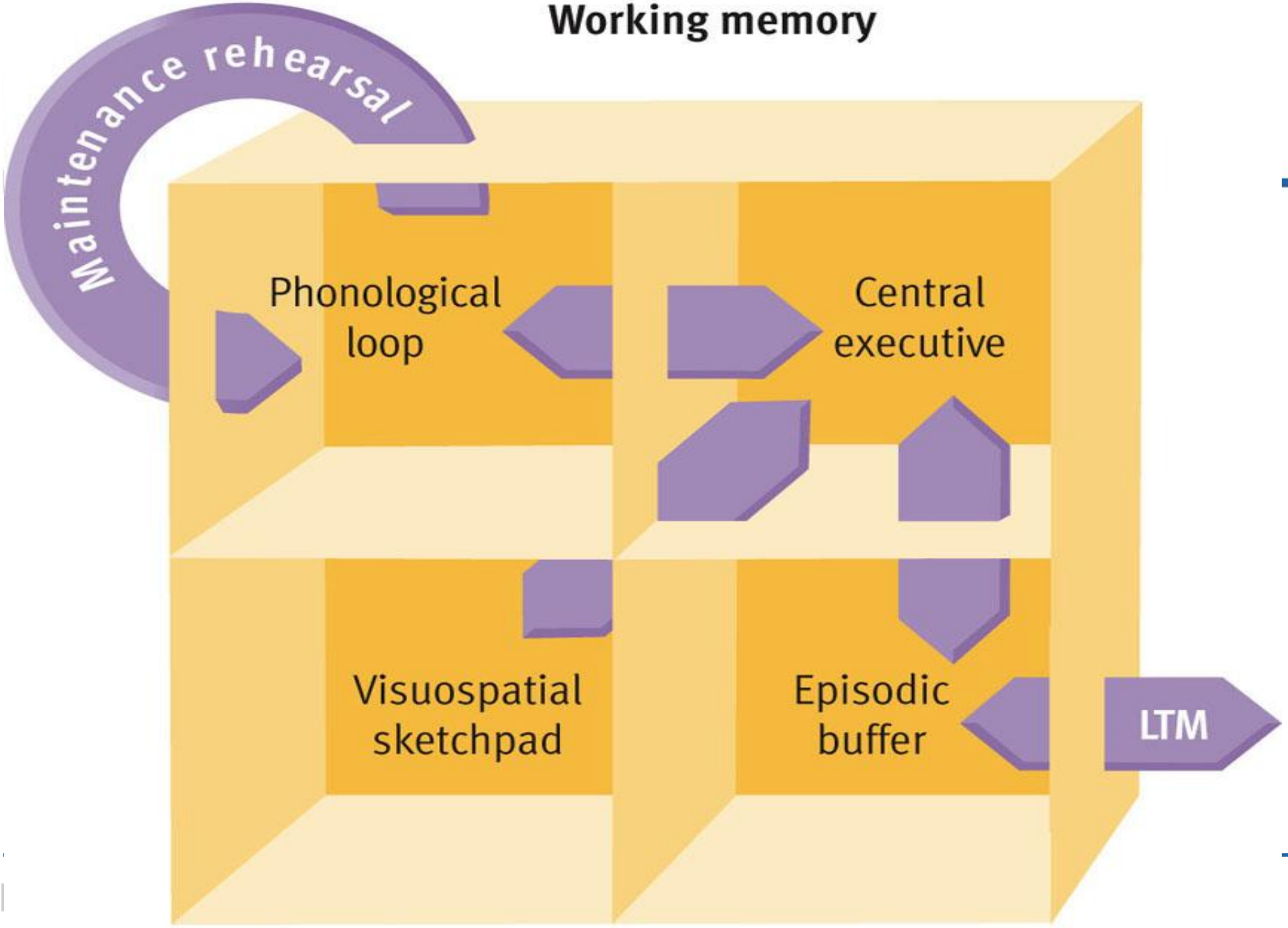
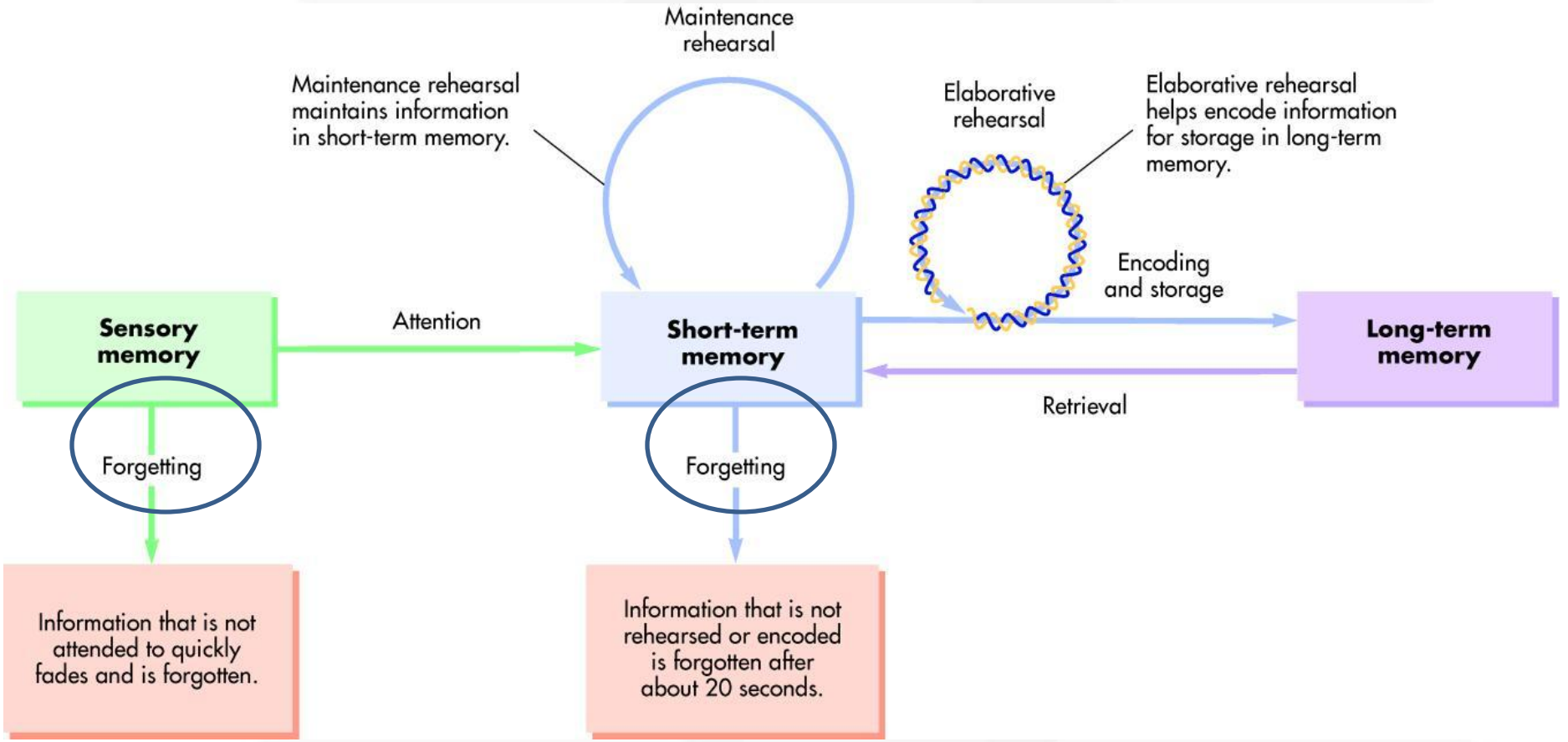


Figure 7.7 Short-term memory as working memory


Maintenance rehearsal
Maintenance rehearsal maintains information in short-term memory.
Elaborative rehearsal
Elaborative rehearsal helps encode information for storage in long-term memory.
Encoding and storage
Sensory memory
Attention
Short-term memory
Long-term memory
Retrieval
Forgetting
Forgetting
Information that is not attended to quickly fades and is forgotten.
Information that is not rehearsed or encoded is forgotten after about 20 seconds.

07 Short-term Memory as Working Memory

Chapter 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Eposodic Buffer
Prepares short-term memory information for long-term memory

07 Long-term Memory

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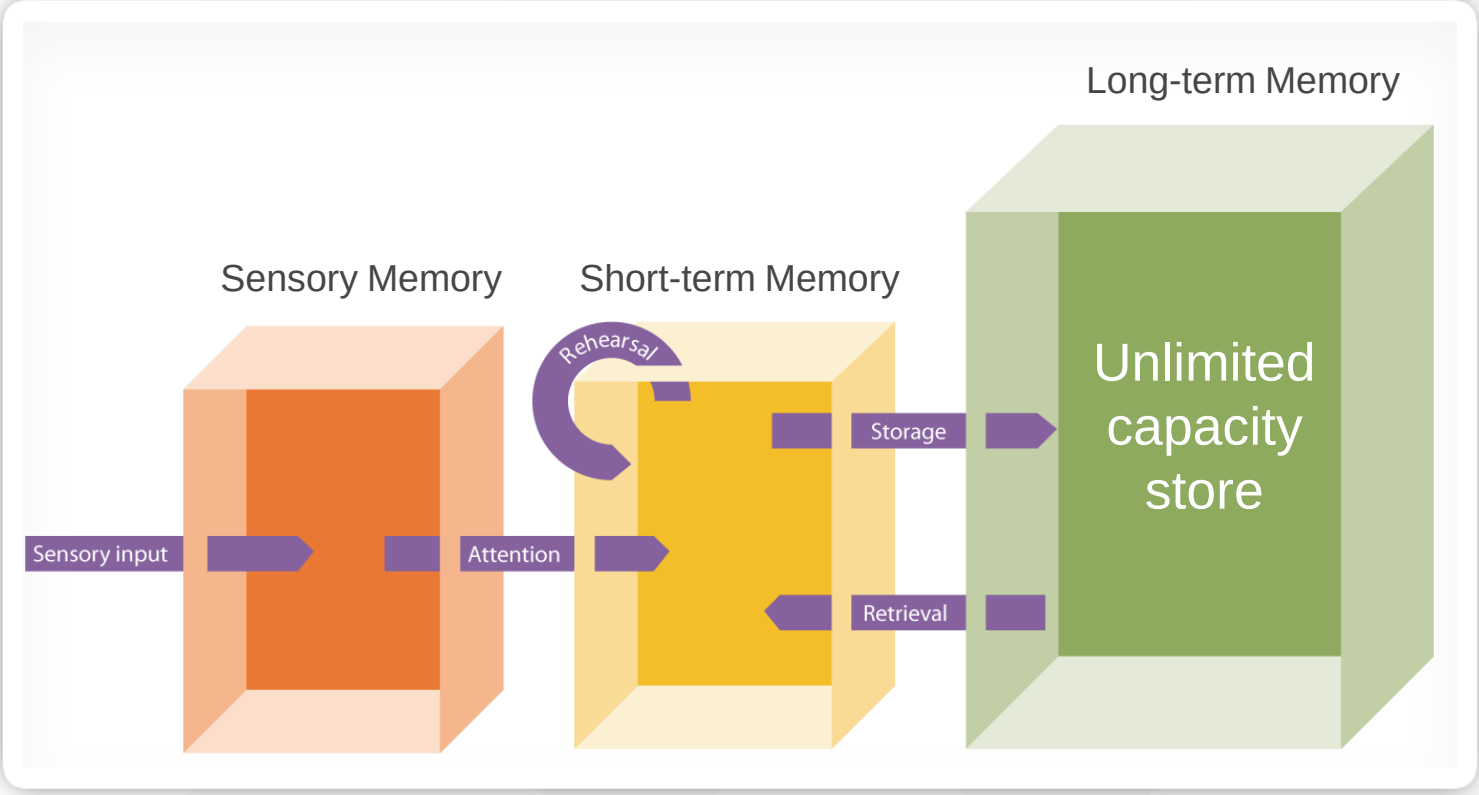
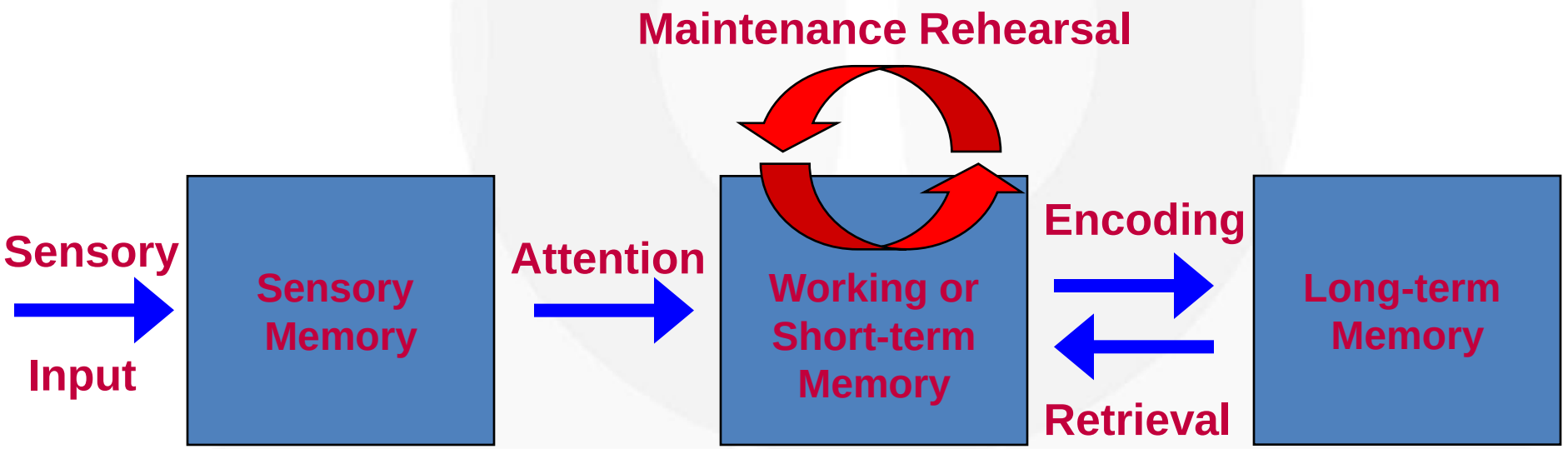


Long-Term Memory

- **Encoding**—process that controls movement from working to long-term memory store
- **Retrieval**—process that controls flow of information from long-term to working memory store



Long-Term Memory

- Unlimited Capacity
- Permanent storage?
  - Flashbulb memories
- How is knowledge represented and organized in memory?
  - Schemas and Scripts
  - Semantic Networks
  - Connectionist Networks and PDP (parallel distributed processing) Models

Flashbulb Memory

Flashbulb Memories

Do you remember where you were when this occurred?

Flashbulb Memory

*The recall of very specific images or details surrounding a vivid, rare, or significant personal event; details may or may not be accurate (e.g., 9/11, wedding day, high school graduation, Hurricane Ike)

Semantic Network Model

- Mental links between concepts
  - common properties provide basis for mental link
- Shorter path between two concepts = stronger association in memory
- Activation of a concept starts decremental spread of activity to nearby concepts

07 How is Knowledge Represented and Organized in Memory?

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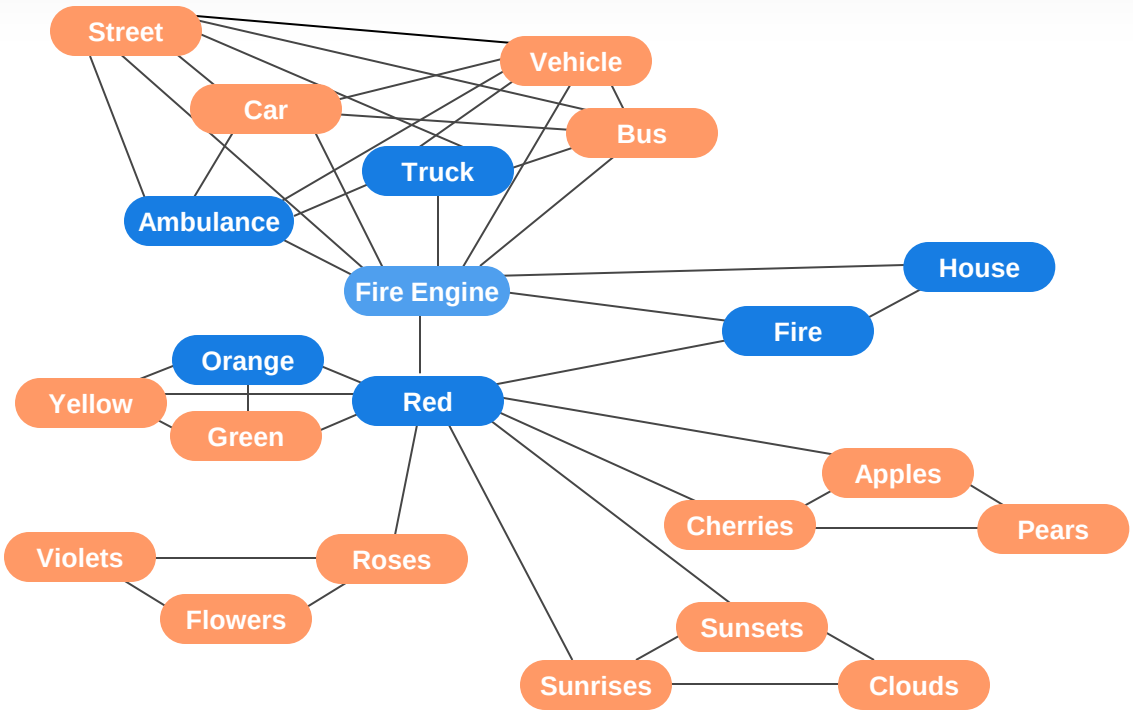


Schemas and Scripts

- **Schema**—mental representation of an object, scene, or event
  - Example: schema of a countryside may include green grass, hills, farms, a barn, cows, etc.
- Often fit memories into existing beliefs or schemas
- Recall not an exact replica of original events
- Recall is a *construction* built and rebuilt from various sources

Automatic Versus Effortful Encoding

- Automatic processing
  - Unconscious encoding of information
  - Examples:
    - What did you eat for lunch today?
    - Was the last time you studied during the day or night?
    - You know the meanings of these very words you are reading. Are you actively trying to process the definition of the words?

Automatic Versus Effortful Encoding

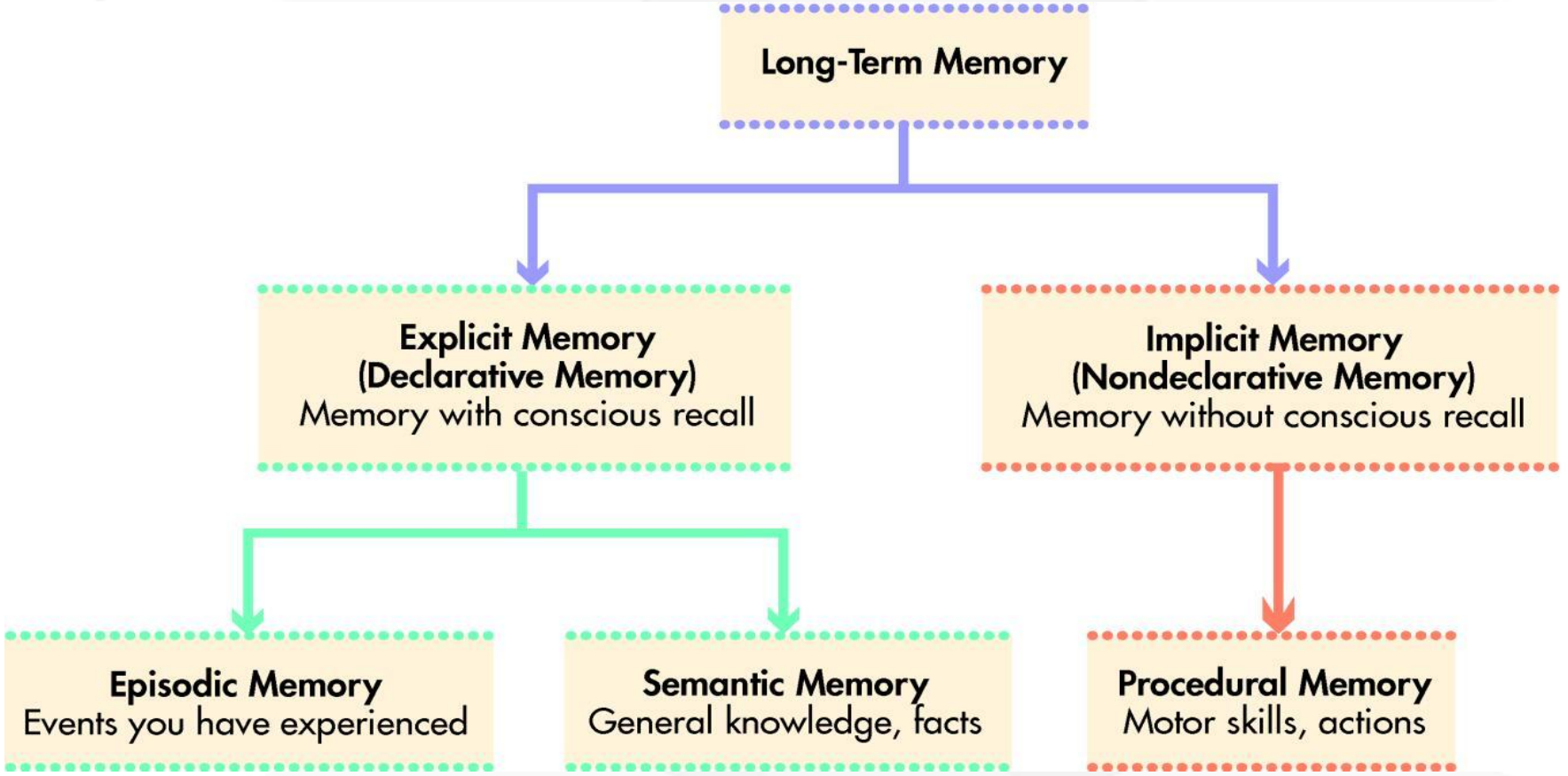
- Effortful processing
  - Requires attention and conscious effort
  - Examples:
    - Memorizing your notes for your upcoming Introduction to Psychology exams
    - Repeating a phone number in your head until you can write it down

Types of Long-term Memory

- **Explicit memory**—memory with awareness; information can be consciously recollected; also called declarative memory
- **Implicit memory**—memory without awareness; memory that affects behavior but cannot consciously be recalled; also called nondeclarative memory

07

Chapter 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15



Explicit Memory

- Declarative or conscious memory
- Memory consciously recalled or declared
- Can use explicit memory to directly respond to a question
- Two subtypes of explicit memory

Episodic Memory

- Memory tied to your own personal experiences
- Examples:
  - What is your birthdate?
  - Do you like to eat caramel apples?

Q: Why are these explicit memories?

A: Because you can actively declare your answers to these questions

Semantic Memory

- Memory not tied to personal events
- General facts and definitions about the world
- Examples:
  - How many tires on a car?
  - What is a cloud?
  - What color is a banana?

Semantic Memory

Q: Why are these explicit memories?

A: Because you can actively **declare** your answers

- *Important note: Though you may have had personal experiences with these items, your ability to answer the questions does NOT depend on tying the items to your past
  - i.e., you do not have to recall the time last week when you ate a banana to say that bananas are yellow

Implicit Memory

- Nondeclarative memory
- Influences your thoughts or behavior, but does not enter consciousness
- Three subtypes—we will look only at one (procedural, the other 2 are emotional, and unconscious memories)

Procedural Memory

- Memory that enables you to perform specific learned skills or habitual responses
- Examples:
  - Riding a bike
  - Using the stick shift while driving (driving a standard)
  - Tying your shoe laces

Q: Why are these procedural memories implicit?

A: You don't have to consciously remember the steps involved in these actions to perform them

  - Try to explain to someone how to tie a shoelace without using visual cues

Retrieval: Getting Information Out of Memory

- The tip-of-the-tongue phenomenon – a failure in retrieval
  - Retrieval cues
- Reinstating the context
  - Context cues
- Reconstructing memories
  - Misinformation effect
- Source monitoring

Tip-of-the-Tongue (TOT) Experience

- TOT—involves the sensation of knowing that specific information has been stored in long-term memory but being unable to retrieve it
- Can’t retrieve info that you absolutely know is stored in your LTM

Context cues

- *Memories can also be reinstated by context cues. It is easier to recall long-forgotten events if you return after a number of years to a place where you used to live*

Encoding Specificity

- When conditions of retrieval are similar to conditions of encoding, retrieval is more likely to be successful
- You are more likely to remember things if the conditions under which you recall them are similar to the conditions under which you learned them

Encoding Specificity

- Contextual effects—environmental cues that help one recall the information
- **State dependent retrieval**—physical, internal factors (i.e. study under the influence- recall information better in same state but still **not** as much as sober) *NOTE: **Best** method to learn and recall information- study sober and take the test sober!
- Mood congruence—factors related to mood or emotions

Retrieval Cues

Word Definition
Favoritism shown or patronage granted by persons in high office to relatives or close friends

Retrieval Cue 1: Begins with “N”

Retrieval Cue 2: Ends in –ism

Retrieval Cue 3: First syllables rhymes with pep

Source Monitoring

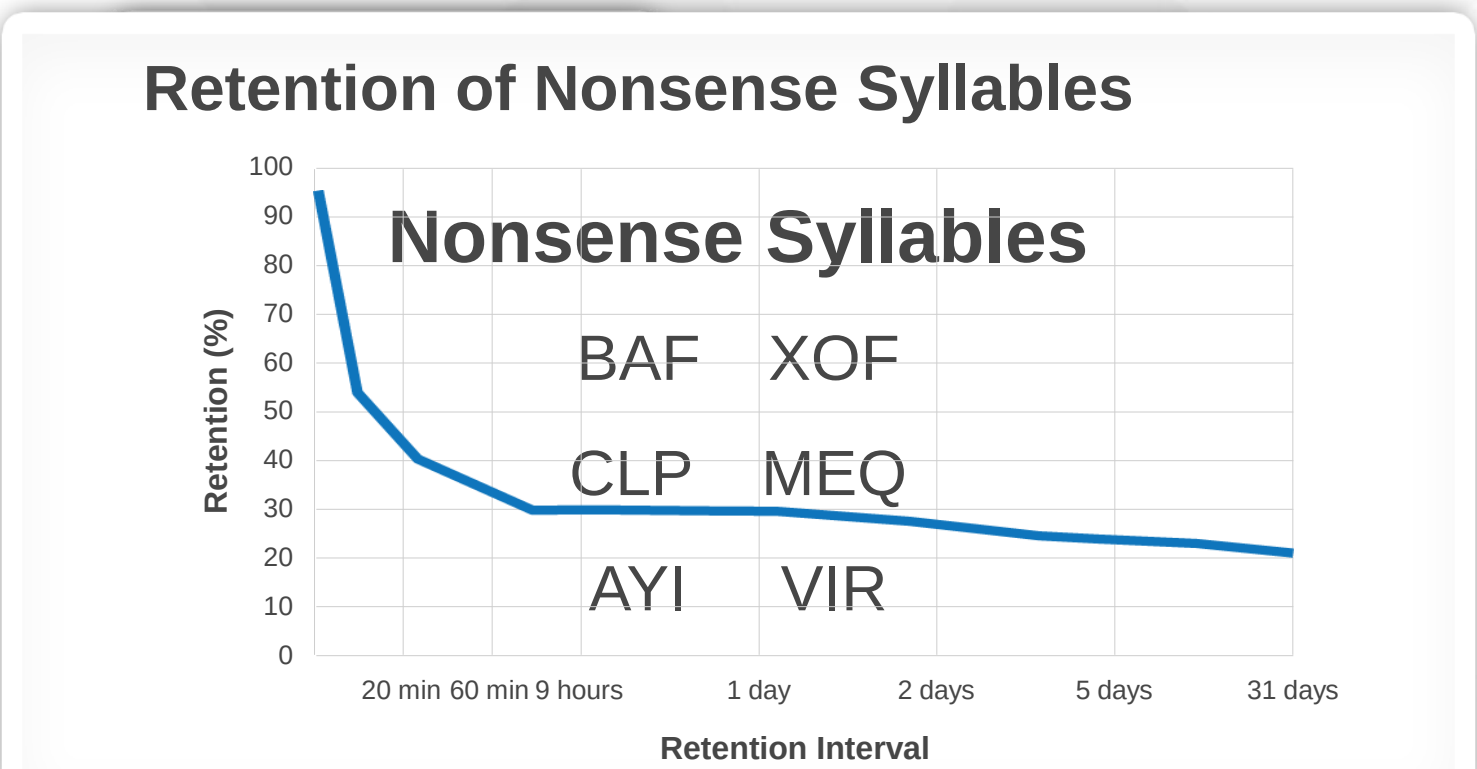
The process of making inferences about the origins of memories

Forgetting: When Memory Lapses

- **Ebbinghaus's Forgetting Curve**
- Retention – the proportion of material retained
  - **Recall**
  - **Recognition**
  - **Relearning**

07 Ebbinghaus' Curve

Chapter 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15



Why We Forget

- **Ineffective Encoding**
- **Decay**
- **Interference**
  - Proactive
  - Retroactive
- Retrieval failure
- **Repression**
  - Authenticity of repressed memories?
  - Memory illusions
  - Controversy

Ineffective Encoding

Memories never stored due to lack of attention

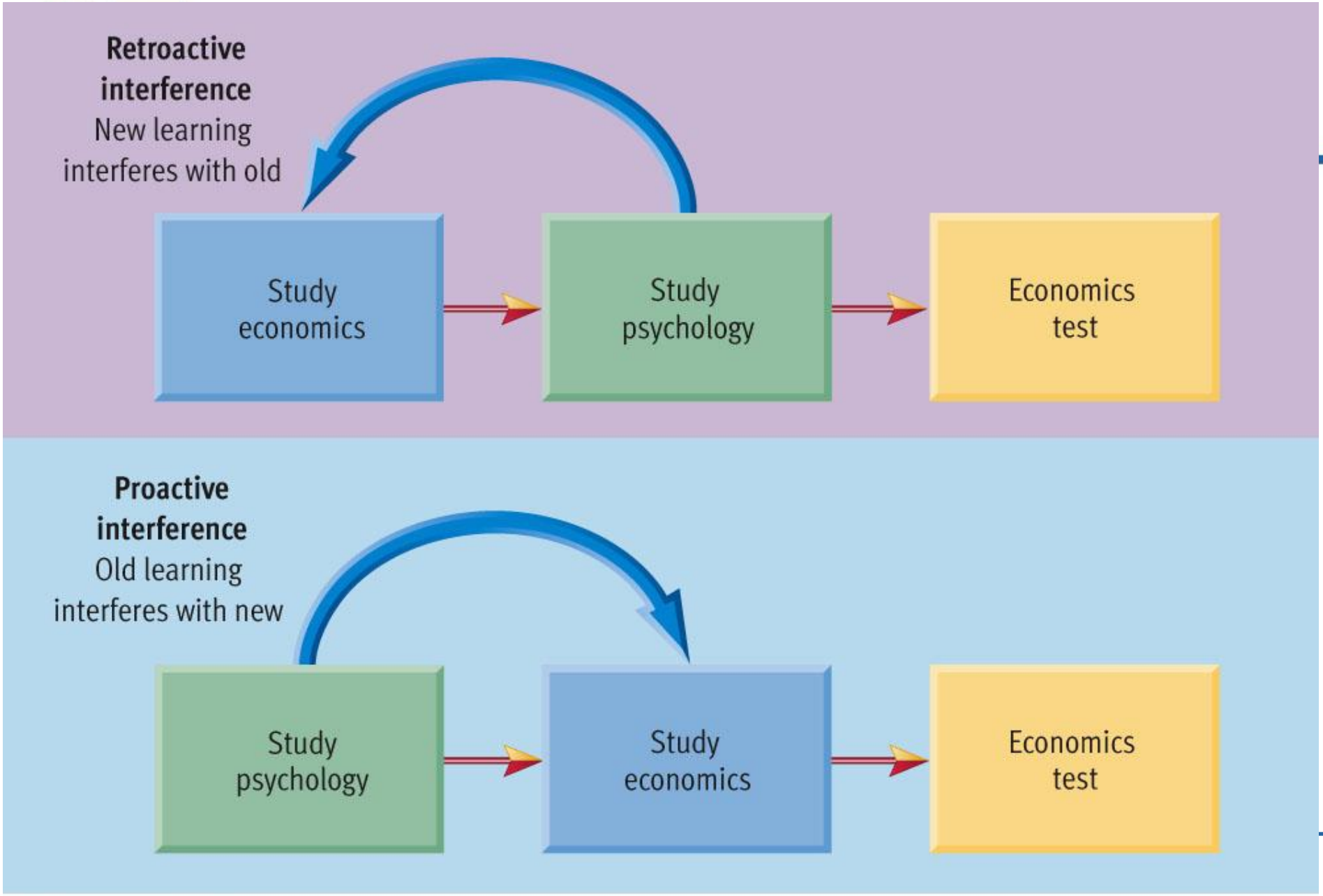
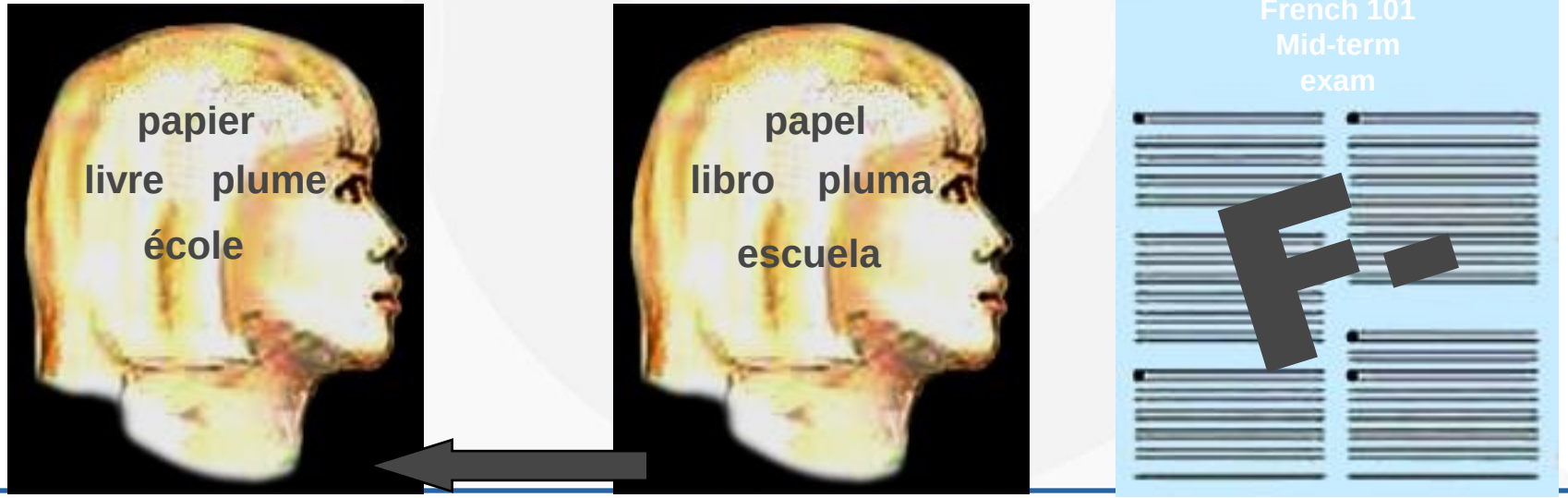


Figure 7.12 Retroactive and proactive interference

Retroactive Interference

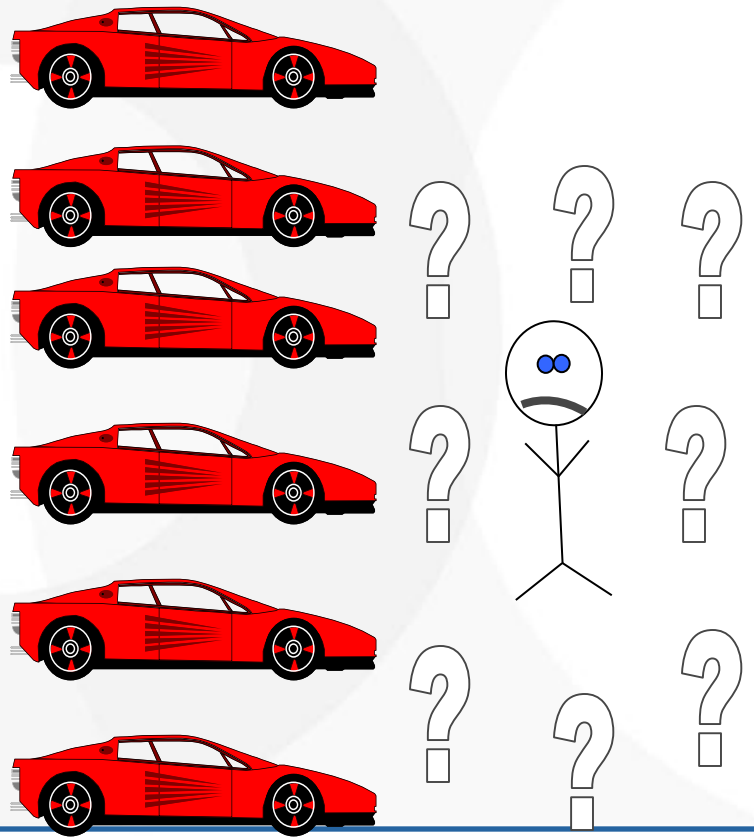
Example: Learning a new language interferes with ability to remember old language



retroactive interference

Proactive Interference

- Opposite of retroactive interference
- When an OLD memory interferes with remembering NEW information
- Example: Memories of where you parked your car on campus the past week interferes with ability find car today (or speaking German and Spanish comes out)



Ways to Measure Forgetting

Three Measures of Retention:

Recall Measure
Recognition Measure
Retention Measure

Measures of Retrieval

- Recall—test of LTM that involves retrieving memories without cues; also termed free recall
- Cued recall—test of LTM that involves remembering an item of information in response to a retrieval cue
- Recognition—test of LTM that involves identifying correct information from a series of possible choices.
- Serial position effect—tendency to remember items at the beginning and end of a list better than items in the middle.

Retrieval Failure

- **Encoding Specificity**
- **Transfer-Appropriate Processing** (initial processing is similar to the measure of retention)
- **Repression**
  - Authenticity of repressed memories?
  - Memory illusions
  - Controversy

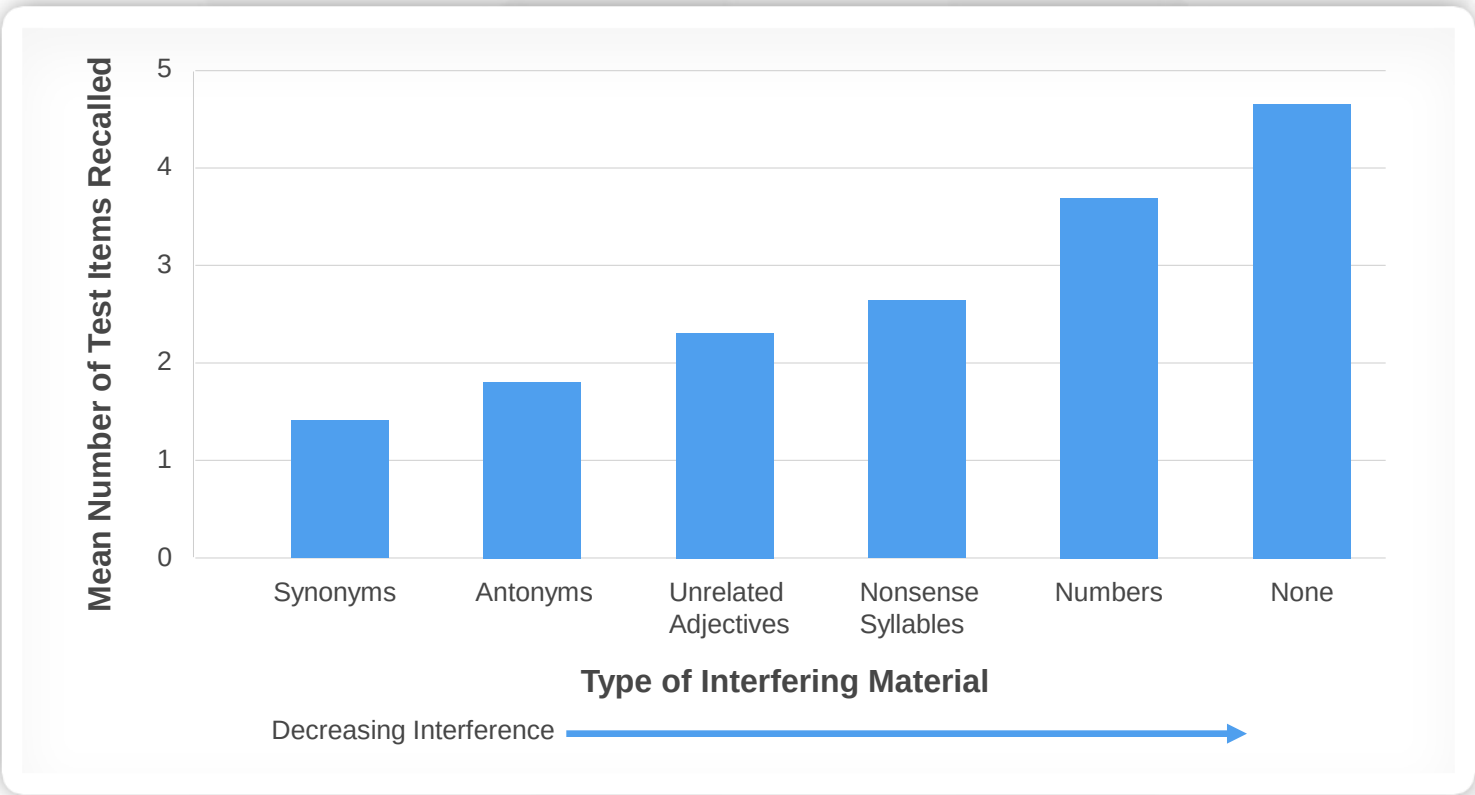
The Difficulty of a Recognition Test Can Vary

Which is the correct answer?

The fourth president of the United States was:

a. Thomas Jefferson
b. John F. Kennedy
c. John Quincy Adams
d. James Madison

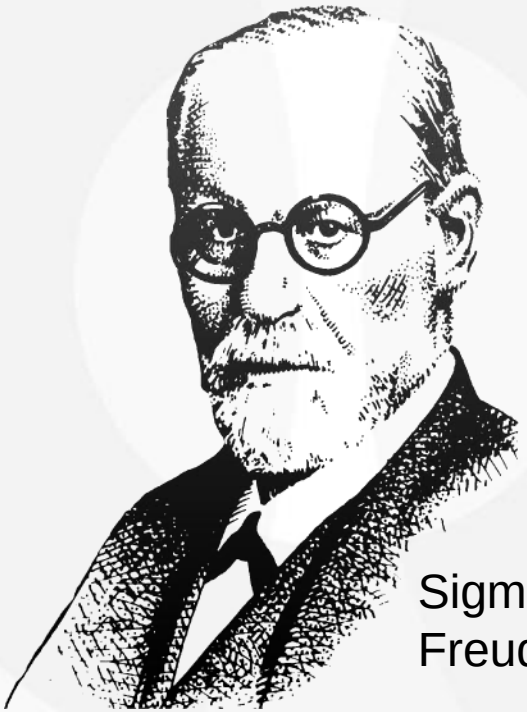
07 Interference



Encoding Specificity Principle

Value of a cue depends on how well it corresponds to the memory code formed during encoding

Repressed Memory



Sigmund Freud

The Controversy of Repressed Memories

Skeptics of Repressed Memory Theory

- Abuse is more common than the
- Therapists may ask leading questions until
- Lab research on implanting memories cannot be
- Computer simulations that is easy to cause
- No direct and empirical evidence
- Some court cases discredit existence of repressed memories
- Misinformation effect, source monitoring, and other researched areas show us that memory is not as reliable as many of us think

Eyewitness Testimony

- Recall not an exact replica of original events
- Recall a *construction* built and rebuilt from various sources
- Often fit memories into existing beliefs or schemas
- Schema—mental representation of an object, scene, or event
  - Example: schema of a countryside may include green grass, hills, farms, a barn, cows, etc.

Source Confusion &Memory distortions

- A memory distortion that occurs when the true source of the memory is forgotten
- Can give rise to a false memory: a distorted or fabricated recollection of something that did not actually occur
- Memory can be distorted as people try to fit new info into existing schemas
- Giving misleading information after an event causes subjects to unknowingly distort their memories to incorporate the new misleading information

Loftus Experiment

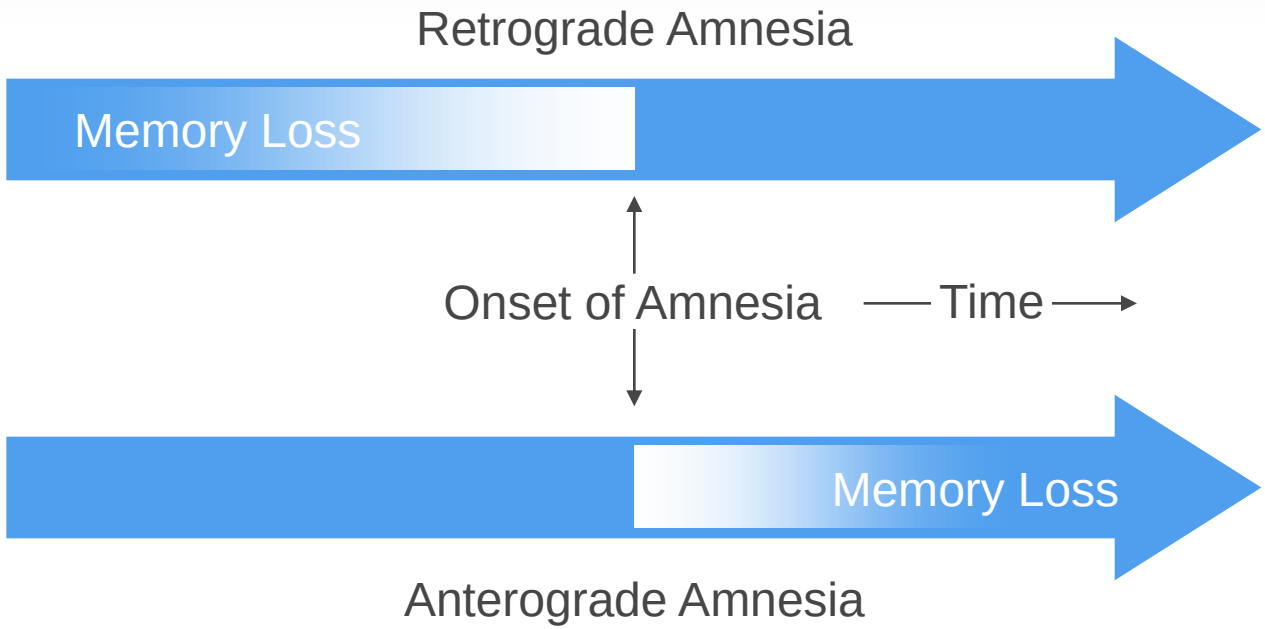
- Subjects shown video of an accident between two cars
- Some subjects asked: How fast were the cars going when they smashed into each other?
- Others asked: How fast were the cars going when they hit each other?

Leading question:
"About how fast were the cars going when they *smashed* into each other?"

Loftus Results

Word Used in Question	Average Speed Estimate
smashed	41 mph
collided	39 mph
bumped	38 mph
hit	34 mph
contacted	32 mph

Retrograde and Anterograde Amnesia



07 Anatomy of Memory

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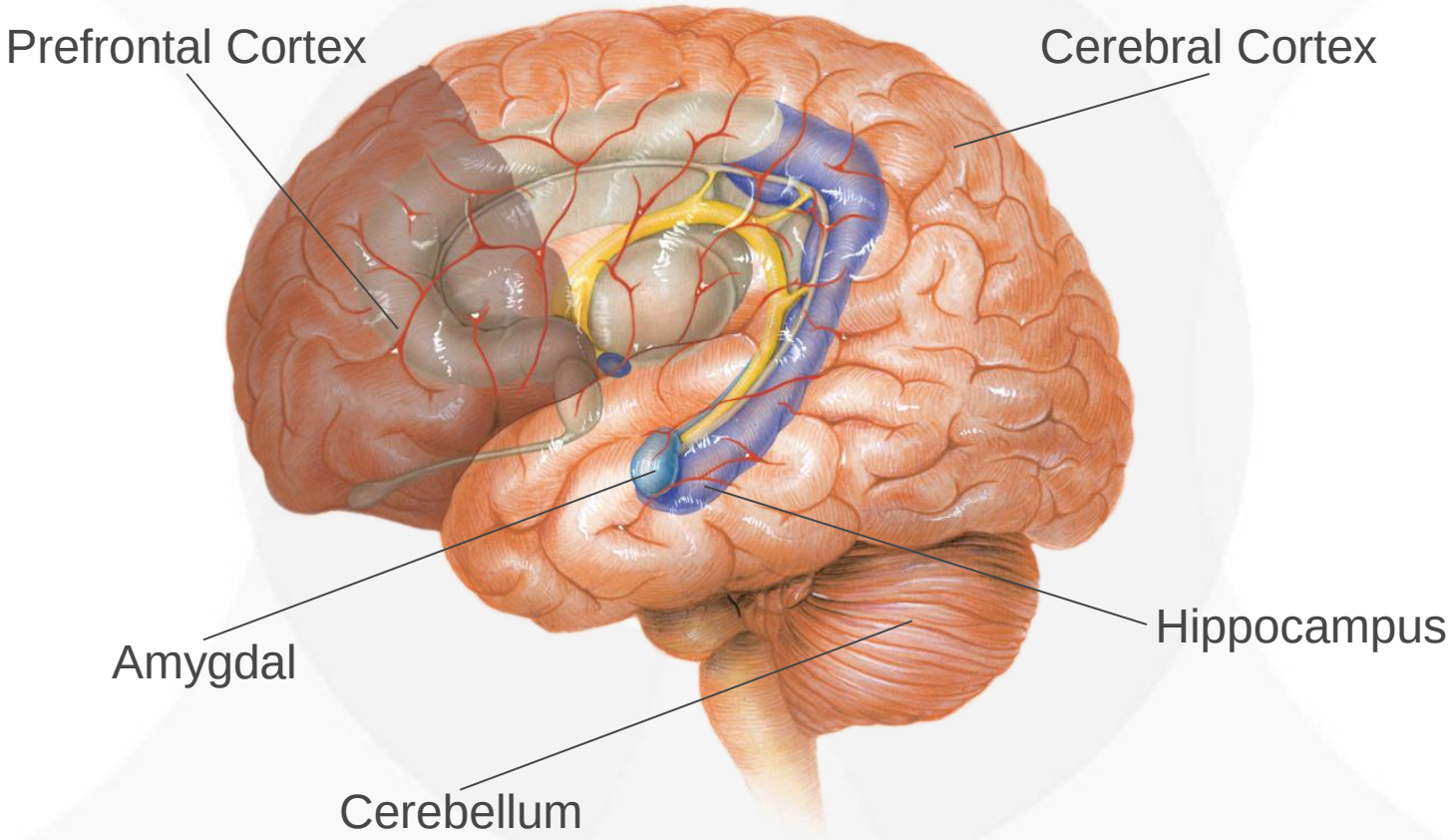

Anatomy of memory

- **Consolidation** refers to a hypothetical process involving gradual conversion of information into durable memory codes for storage in long-term memory. These areas are those around the hippocampus, which comprise the medial temporal lobe.
- Other areas, such as the cortex, are involved in memory, but the search for the anatomy of memory is in its infancy.

Long-term Potentiation
Neurogenesis

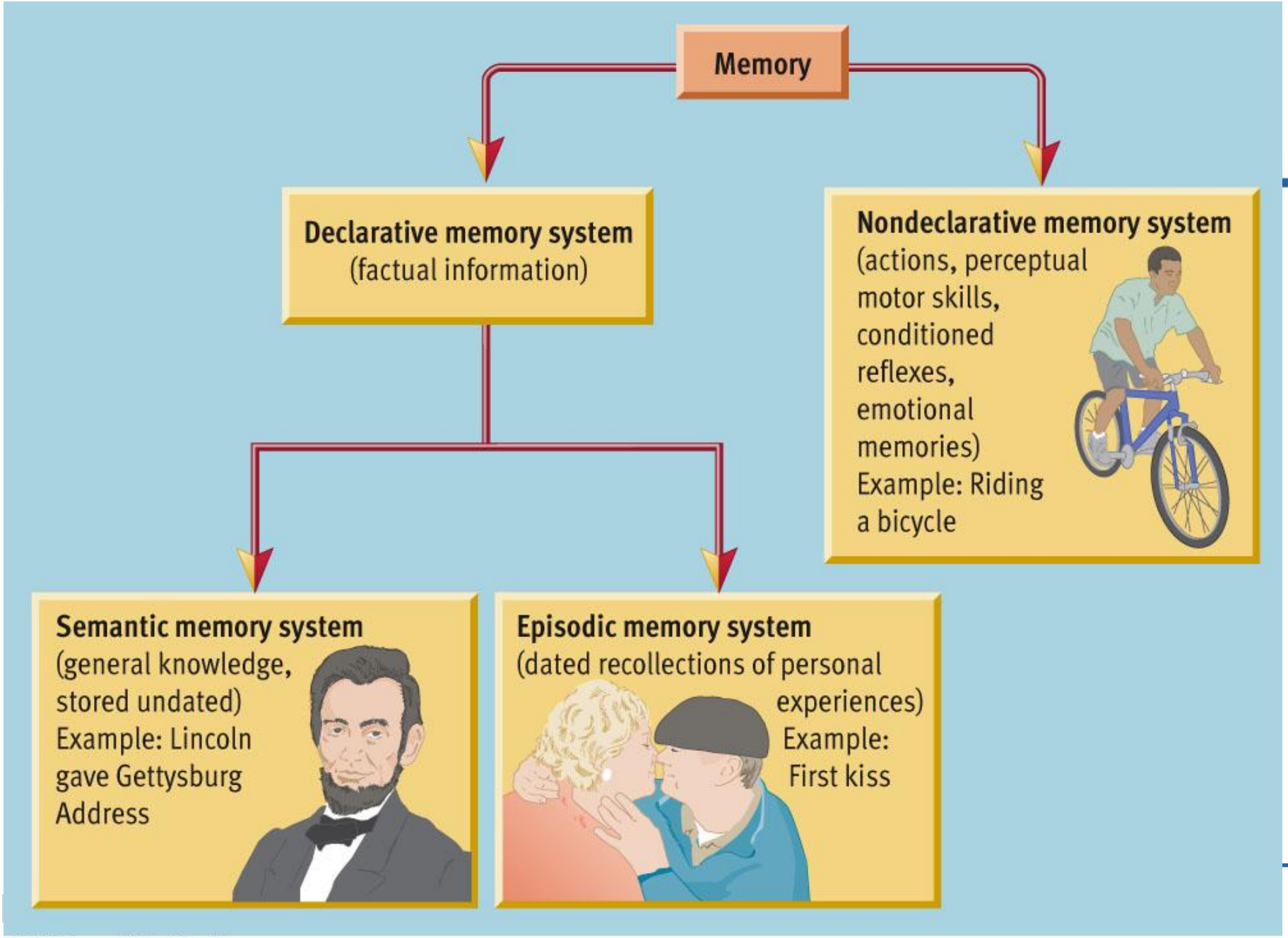

Figure 7.17 Theories of independent memory systems

07 Types of Memory

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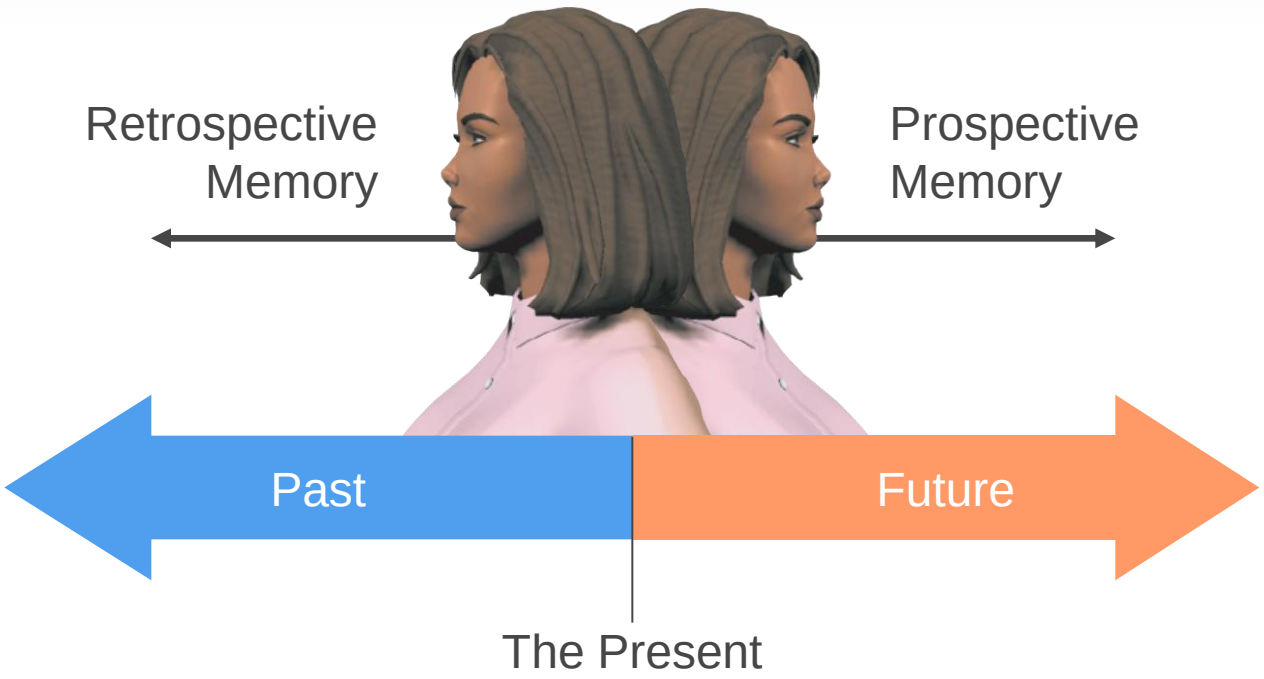

Gradually Losing the Ability to Remember

Dementia: Progressive deterioration and impairment of memory, reasoning, and other cognitive functions occurring as the result of a disease or a condition

Alzheimer's disease (AD): A progressive disease that destroys the brain's neurons, gradually impairing memory, thinking, language, and other cognitive functions, resulting in the complete inability to care for oneself; the most common form of dementia

Strategies for Boosting Memory

- Focus attention
- Commit the time
- Space study sessions
- Organize the information
- Elaborate on the material
- Use visual imagery
- Use a mnemonic device
- Explain it to a friend
- Reduce interference within a topic
- Counteract the serial position effect
- Use contextual clues
- Sleep on it
- Forget the ginkgo biloba

Memory

- Trailer for the movie “Memento”

http://www.youtube.com/watch?v=Rq9eM4ZXRgs/