Chapter 6: Memory

Three Stages of Memory

Three memory stores that differ in function, capacity, and duration

Sensory Memory
- Function—holds information long enough to be processed for basic physical characteristics
  - Capacity—large
  - Duration—very brief retention
  - of images
- .3 seconds for visual info
- 2 seconds for auditory info
Sensory Memory

• Divided into two types:
  – iconic memory: visual information
  – echoic memory: auditory information
• George Sperling studied iconic memory.

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
**Short-term Memory**

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

**Working Memory**

- The active, conscious manipulation of temporarily stored information—sometimes used interchangeably with short-term memory.
- Used when problem solving, reasoning, comprehending language, and mental comparisons.
- Short-term memory is more likely to be used when the focus is on simpler memory processes (rehearsing lists of syllables, words, or numbers).
- Best-known model of working memory developed by British psychologist Alan Baddeley.

**Working Memory**

- **Three main components, each of which can function independently:**
  - The phonological loop is specialized for verbal material, such as lists of numbers or words.
  - The visuospatial sketchpad is specialized for spatial or visual material, such as remembering the layout of a room or city.
  - The central executive, which controls attention, integrates information, and manages the activities of the phonological loop and the visuospatial sketchpad.

**Maintenance Rehearsal**

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

Long-term Memory

Once information passes from sensory to working memory, it can be encoded into long-term memory

- Function—organizes and stores information
  - more passive form of storage than working memory
- Unlimited capacity
- Duration—thought by some to be permanent

Maintenance Rehearsal

- Sensory Memory
  - Input
- Attention
  - Working or Short-term Memory
  - Encoding
  - Long-term Memory
  - Retrieval
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

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?

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
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

Explicit Memory

- Episodic information—information about events or "episodes"
- Semantic information—information about facts, general knowledge, school work

Episodic Memory

- Memory tied to your own personal experiences.
- Examples:
  - What month is your birthday?
  - 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?

Q: Why are these explicit memories?
A: Because you can actively declare your answers.

Important note: Though you may have personal experience with these items, your ability to answer does NOT depend on tying the item 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)

Procedural Memory

- Memory that enables you to perform specific learned skills or habitual responses
- Examples:
  - Riding a bike
  - Using the stickshift while driving
  - 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.
Culture and Early Memory

• Cross-cultural research has shown how culture helps shape one's sense of self.
• Research has shown that Americans' first memories focused on themes of self-awareness and individual autonomy.
• Asians' first memories often include other people, centering on collective activities.

How are memories organized?

• Hierarchical organization
• Associations

Hierarchical Organization

• Related items clustered together to form categories
• Related categories clustered together to form higher-order categories
• Remember list items better if list presented in categories
  – poorer recall if presented randomly
• Even if list items are random, people still organize information in some logical pattern.

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.
Semantic Network Model

- Car, Truck
- Fire Engine, Ambulance
- Rose, Red, Hot, Stove
- Violet, Flower, Apple, Cherry, Pot, Pan, Pie
- Bus, House

Review of Long-term Memory

- Retrieval transfers info from LTM to STM
- Forgetting—incapability to retrieve previously available information
- Why do people forget?

Why Do We Forget?

- Forgetting can occur at any memory stage

Forgetting as Retrieval Failure

- Retrieval—process of accessing stored information
- Sometimes info is encoded into LTM, but we can’t retrieve it
Tip-of-the-Tongue (TOT) Experience

• TOT—involves the sensation of knowing that specific information is stored in long-term memory but being unable to retrieve it
• Can’t retrieve info that you absolutely know is stored in your LTM.
• Shown also among American Sign Language (ASL) users

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.

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

• Context effects—environmental cues to recall
• State dependent retrieval—physical, internal factors
• Mood congruence—when a given mood tends to evoke memories that are consistent with that mood
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).

The Forgetting Curve

Hermann Ebbinghaus first began to study forgetting by using nonsense syllables. Nonsense syllables are three-letter combinations that look like words but are meaningless (ROH, KUF).

Forgetting Theories

- Encoding failure
- Interference theories
- Motivated forgetting
- Decay

Forgetting as Encoding Failure

Info never encoded into LTM
Which Is the Real Penny?

A  B  C  D  E  
F  G  H  I  J  
K  L  M  N  O  

Answer

A  B  C  D  E  
F  G  H  I  J  
K  L  M  N  O  

Encoding Failures

Even though you’ve seen thousands of pennies, you’ve probably never looked at one closely enough to encode specific features.

Déjà Vu

• A brief but intense feeling of remembering a scene or an event that is actually being experienced for the first time.
• French for “already seen.”
Decay Theories

- Memories fade away or decay gradually if unused
- Time plays critical role
- Ability to retrieve info declines with time after original encoding

Interference Theories

- “Memories interfering with memories”
- Forgetting NOT caused by mere passage of time
- Caused by one memory competing with or replacing another memory
- Two types of interference

Decay Theories

- Biology-based theory
- When new memory formed, it creates a memory trace
  - a change in brain structure or chemistry
- If unused, normal brain metabolic processes erode memory trace
- Theory not widely favored today

Two Types of Interference

- Types of Interference
  - Retroactive Interference
  - Proactive Interference
Retroactive Interference

• When a NEW memory interferes with remembering OLD information
• Example: When new phone number interferes with the ability to remember old phone number

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

Motivated Forgetting

• Undesired memory is held back from awareness
  – Suppression—conscious forgetting
  – Repression—unconscious forgetting (Freudian)
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?

Loftus Results

<table>
<thead>
<tr>
<th>Word Used in Question</th>
<th>Average Speed Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>smashed</td>
<td>41 mph</td>
</tr>
<tr>
<td>collided</td>
<td>39 mph</td>
</tr>
<tr>
<td>bumped</td>
<td>38 mph</td>
</tr>
<tr>
<td>hit</td>
<td>34 mph</td>
</tr>
<tr>
<td>contacted</td>
<td>32 mph</td>
</tr>
</tbody>
</table>

Eyewitness Testimony

Scripts—type of schema

- Mental organization of events in time.
- Example of a classroom script: Come into class, sit down, talk to friends, bell rings, instructor begins to speak, take notes, bell rings again, leave class, etc.

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.
The Misinformation Effect

• A memory-distortion phenomenon in which a person’s existing memories can be altered if the person is exposed to misleading information.

Source Confusion

• 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 Distortions

• 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.

Forming False Memories

A person can actually believe an event occurred by imagining the event; called “imagination inflation.”
Recovered vs. False Memories

• Accuracy of memory recovered in therapy difficult to determine.

• Types of therapies for memory:
  - Repressed memory therapy
  - Recovery therapy
  - Recovered memory therapy
  - Trauma therapy

Recovered vs. False Memories

• Research with thousands of participants has intentionally distorted a significant portion of the subjects’ memories.

• The mechanism by which people are convinced that they were lost, frightened, and crying in a mall is not so different than the mechanism by which therapists might unwittingly encourage memories of sexual abuse.

Biological Basis of Memory

• Karl Lashley searched for a localized memory trace or engram.
  • Found that maze-learning in rats was distributed throughout the brain.

Richard Thompson found that memory for simple classically conditioned responses was localized (in the cerebellum).
New Memories in a Snail

Aplysia—a sea snail used to study how memories can change neurons.

Biological Basis of Memory

- Amnesia—severe memory loss
- Retrograde amnesia—inability to remember past episodic information; common after head injury; need for consolidation
- Anterograde amnesia—inability to form new memories; related to hippocampus damage (demonstrated with much research on patient H.M.)

Brain Structures Involved in Human Memory

- 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
Biology of Alzheimer’s Disease

- *Plaques* interfere with the ability of neurons to communicate
- *Tangles* are twisted fibers that build up inside the neuron and interrupt the flow of nourishment to the neuron
- Both result in the death of the neuron

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