Psychology - Memory
Human Memory

- **Encoding** involves forming a memory code.
  - Ex: emphasize how it looks, how it sounds, or what it means.

- **Storage** involves maintaining encoded information in memory over time.
  - Information storage isn’t enough to guarantee that you’ll remember something.

- **Retrieval** involves recovering information from memory storage.
  - Research issues concerned with retrieval include the study of how people search memory and why some retrieval are more effective than others.
Process
Definition

Analogy to information processing by a computer

Encoding
Involves forming a memory code

Entering data through keyboard

Storage
Involves maintaining encoded information in memory over time

Saving data in file on hard disk

Retrieval
Involves recovering information from memory stores

Calling up file and displaying data on monitor
Getting Information into Memory

• Have you ever been introduced to someone and then realized only 30 seconds into your interaction that you had already “forgotten” his or her name?

• This results in a failure to form a memory code.

• You don’t remember them because they aren’t encoded for storage into memory.
• **Attention** involves focusing awareness on a narrowed range of stimuli or events.

- Ex: Attention is often linked to a *filter* that screens out most potential stimuli while allowing a select few to pass through into conscious awareness.

• The cocktail party phenomenon—
Claudia is at a party where many conversations are taking place. She is speaking with a friend filtering out other conversations. But if someone mentions her name, Claudia will notice it.
Levels of Processing

- Craik and Lockhart ('72) argue that different rates of forgetting occur because some methods of encoding create more durable memory codes than others.
- Phonemic encoding- what a word sounds like.
- Semantic encoding- the meaning of verbal input; it involves thinking about the objects and actions the words represent.
<table>
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<th>Level of processing</th>
<th>Type of encoding</th>
<th>Example of questions used to elicit appropriate encoding</th>
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<tr>
<td>Shallow processing</td>
<td>Structural encoding: emphasizes the physical structure of the stimulus</td>
<td>Is the word written in capital letters?</td>
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<td>Intermediate processing</td>
<td>Phonemic encoding: emphasizes what a word sounds like</td>
<td>Does the word rhyme with weight?</td>
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<td>Deep processing</td>
<td>Semantic encoding: emphasizes the meaning of verbal input</td>
<td>Would the word fit in the sentence: “He met a ____________ on the street”?</td>
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• **Levels-of-processing theory** proposes that deeper levels of processing result in longer-lasting memory codes.

• Craik and Tuving ('75) compared the durability of structural, phonemic, and semantic encoding.

• They directed subjects’ attention to particular aspects of briefly presented stimulus words by asking them questions about various characteristics of the words.
Enriching Encoding

- The are other dimensions to encoding, dimensions that can enrich the encoding process and thereby improve memory.
- **Elaboration** is linking a stimulus to other information at the time of encoding.
- Ex: Let’s say you read that phobias are often caused by classical conditioning, and you apply this idea to your own fear of spiders. In doing so, you are engaging in elaboration.
Visual Imagery & Self Referent Encoding

- Allan Paivio (‘69)- points out that it is easier to form images of concrete objects than of abstract concepts.

- Dual-coding theory holds that memory is enhanced by forming semantic and visual codes, since either can lead to recall.

- Paivio (‘86)- imagery facilitates memory because it provides a second kind of memory code, and two codes are better than one.
• People’s recall of information tends to be slanted in favor of material that is personally relevant.

• **Self-referent encoding** involves deciding how or whether information is personally relevant.

- Self-referent encoding appears to enhance recall by promoting additional elaboration and better organization of information.
Maintaining information in memory

- **Sensory memory** preserves information in its original sensory form for a brief time, usually only a fraction of a second.
- Allows the sensation of a visual pattern, sound, or touch to linger for a brief moment after the sensory stimulation is over.
- In the case of vision, people really perceive an *afterimage* rather than the actual stimulus.
• **Short-term memory** is limited capacity storage that can maintain unrehearsed information for up to about 20 seconds.

• **Long-term memory** is unlimited capacity storage that can hold information over lengthy periods of time. Permanent???

• **Rehearsal** is the process of repetitively verbalizing or thinking about the information.(Ex. Look up a phone number, recite it over and over until you can dial it.)
• You can increase the capacity of your short-term memory by combining stimuli into larger, possibly higher-order units.

• **Chunking** - grouping of familiar stimuli stored as a single unit.
- **Flashbulb memories**, which are vivid and detailed recollections of momentous events.
- Ex. Older adults in the US can remember exactly where they were, what they were doing and how they felt when they learned that John F. Kennedy had been shot or most of us can remember 9/11.
• **Clustering** is the tendency to remember similar or related items in groups.
- You would tend to remember them in bunches that belong in the same category.

• **Conceptual hierarchy**—is a multilevel classification system based on common properties among items.
- According to Gordon Bower ('70), organizing information into a conceptual hierarchy can improve recall dramatically.
If you were to memorize the list of presidents, your recall of the list at a later time would demonstrate how the mind spontaneously organizes information stored in memory.

Washington  Taylor  Harrison  Eisenhower
J.A. Adams  Fillmore  Cleveland  Kennedy
Jefferson  Pierce  McKinley  L. Johnson
Madison  Buchanan  T. Roosevelt  Nixon
Monroe  Lincoln  Taft  Ford
JQ Adams  A. Johnson  Wilson  Carter
Jackson  Grant  Harding  Reagan
Van Buren  Hayes  Coolidge  Bush
Harrison  Garfield  Hoover  Clinton
Tyler  Arthur  FD. Roosevelt  Bush Jr.
Polk  Cleveland  Truman  Obama
• **Schema** is an organized cluster of knowledge about a particular object or event abstracted from previous experience with the object or event.

• Ex. College students have schemas for what professors’ offices are like.
• **Semantic network** consists of nodes representing concepts, joined together by pathways that link related concepts.

• **Connectionist or parallel distributed processing (PDP)**, models assume that cognitive processes depend on patterns of activation in highly interconnected computational networks that resemble neural networks.
Getting Information Out of Memory

• Some theorists maintain that understanding retrieval is the key to understanding human memory.

• **Tip-of-the-tongue phenomenon** - the temporary inability to remember something you know, accompanied by a feeling that it’s just out of reach.
- **Source monitoring** is the process of making attributions about the origins of memories.

- According to Johnson, memories aren't tagged with labels that specify their sources.

- Did I read that in the New York Times or Rolling Stones?
• **Source-monitoring error** occurs when a memory derived from one source is misattributed to another source.

- Ex. Might attribute something that your roommate said to your psychology professor, or something you heard on Oprah to your psychology textbook.
• **Reality monitoring** refers to the process of deciding whether memories are based on external sources (one’s perceptions of actual events) or internal sources (one’s thoughts and imagination.)

- Ex. People engage in reality monitoring when they reflect on whether something actually happened or they only though about it happening.

- Did I pack the umbrella or only think about packing it??
When Memory Lapses

- The **forgetting curve** is a graph that shows the graphs retention and forgetting over time.
- Ebbinghaus’s forgetting curve shows a precipitous drop in retention during the first few hours after the nonsense syllables were memorized.
- He concluded that most forgetting occurs very rapidly after learning something.
Measures of Forgetting

- **Retention** refers to the proportion of material retained.
  - The results may be reported in terms of the amount forgotten or the amount retained.
- **Retention interval** is the length of time between the presentation of materials to be remembered and the measurement of forgetting.
3 principle methods used to measure forgetting are recall, recognition, and relearning.

- A **recall** measure of retention requires subjects to reproduce information on their own without any cues.
- A **recognition** measure of retention requires subjects to select previously learned information from an array of options.
- Ex. Multiple-choice, true-false, and matching questions are recognition measures.
- A **relearning** measure of retention requires a subject to memorize information a second time to determine how much time or how many practice trials are saved by having learned it before.
Why we forget?

• Measuring forgetting is only the first step in the long journey toward explaining why forgetting occurs.

• **Decay theory** proposes that forgetting occurs because memory traces fade with time.

- According to the decay theory, the mere passage of time produces forgetting.
• **Interference theory** proposes that people forget information because of competition from other material.

- Interference is assumed to be greatest when intervening material is most similar to the test material.

• 2 types of interference: retroactive interference and proactive interference.
• **Retroactive interference** occurs when new information impairs the retention of previously learned information.
  - Occurs between the original learning and the retest on that leaning during the retention interval.

• **Proactive interference** occurs when previously learned information interferes with the retention of new information.
  - Rooted in learning that comes before exposure to the test material.
Retrieval Failure

• Why does an effort to retrieve something fail on one occasion and succeed on another?

• One theory is that retrieval failures may be more likely when a mismatch occurs between retrieval cues and the encoding of the information you’re searching for.

• **Encoding specificity principle** states that the value of a retrieval cue depends on how well it corresponds to the memory code. ABC’s Doe a Deer
• **Transfer-appropriate processing** occurs when the initial processing of information is similar to the type of processing required by the subsequent measure of retention.

- Ex. Morris, Bransford, and Franks (’77) gave subjects a lists of words and a task that required either semantic or phonemic processing.

• **Repression** refers to keeping distressing thoughts and feelings buried in the unconscious.
The Physiology of Memory

- One line of research suggests that memory formation results in alterations in synaptic transmission at specific sites.

- **Long-term potentiation (LTP)** is a long-lasting increase in neural excitability at synapses in a specific neural pathway.

- Memory formation may stimulate neural growth and the emergence of new neural circuits.
The Anatomy of Memory

- **Retrograde amnesia** involves the loss of memories for events that occurred prior to the onset of amnesia.

- **Anterograde amnesia** involves the loss of memories for events that occur after the onset of amnesia.
Consolidation is a hypothetical process involving the gradual conversion of information into durable memory codes stored in long-term memory.

Memories are consolidated in the hippocampal region and then stored in diverse and widely distributed areas of the cortex.

In other words, the hippocampal area may play a key role in organizing neural networks that represent specific memories.
Multiple Memory Systems

• **Implicit memory** is apparent when retention is exhibited on a task that does not require intentional remembering. Incidental, unintentional remembering. (Mandler ’89)

  - How to walk, your name, riding a bike

• **Explicit memory** is contrasted with implicit which involves intentional recollection of previous experiences.

  - Facts
Types of long-term memories

Explicit (declarative) With conscious recall
- Facts—general knowledge ("semantic memory")
- Personally experienced events ("episodic memory")

Implicit (nondeclarative) Without conscious recall
- Skills—motor and cognitive
- Classical and operant conditioning effects
Memory

Declarative memory system (factual information, explicit memories)

Nondeclarative/Procedural memory system (actions, perceptual motor skills, conditioned reflexes, implicit memories)
Example: Riding a bicycle

Semantic memory system (general knowledge, stored undated)
Example: Lincoln gave Gettysburg Address

Episodic memory system (dated recollections of personal experiences)
Example: First kiss
• Many theorists have suggested that people have separate memory systems for different kinds of information.

• **Declarative memory system** handles factual information.
  - Recollections of words, definitions, names, dates, faces, events, concepts and ideas.

• **Nondeclarative or procedural memory system** houses memory for actions, skills, operations, and conditioned responses.
  - Contains memories of how to execute such actions as riding a bike, typing, and tying one’s shoes.
Semantic Versus Episodic Memory

- Endel Tulving (‘86, ‘93) has subdivided declarative memory into episodic and semantic memory.
- **Episodic memory system** is made up of chronological, or temporally dated, recollections of personal experiences.

- Ex. Record of things you’ve done, seen and heard.
• The **semantic memory system** contains general knowledge that is not tied to the time when the information was learned.

- Ex. Such as Christmas is on December $25^{\text{th}}$, dogs have 4 legs etc.

- Like an autobiography while semantic memory is like an encyclopedia.
Prospective Versus Retrospective Memory

- **Prospective memory** involves remembering to perform actions in the future.
  - Ex. Remembering to walk the dog, to call someone, to grab the tickets for the big game, and to turn off your sprinklers.

- **Retrospective memory** involves remembering events from the past or previously learned information.
  - Ex. When you try to recall who won the Super Bowl last year, when you reminisce about your high schools days, or when you try to recall what your professor said in a lecture last week,
Improving Everyday Memory

• **Mnemonic devices** are methods used to increase the recall of information.
  - Ex. Please excuse my dear aunt Sally.

**Overlearning** refers to continued rehearsal of material after you first appear to have mastered it.
  - You should not quit rehearsing material as soon as you appear to have mastered it.

• **Serial-position effect** occurs when subjects show better recall for items at the beginning and end of a list than for items in the middle.
  - If you need to learn a list, allocate extra practice trials to items in the middle of the list and check your memorization of those items very carefully.
Visual Mnemonics

- The **link method** involves forming a mental image of items to be remembered in a way that links them together.
  - To remember items on a list, you might have to visualize the objects into a story.

- The **method of loci** involves taking an imaginary walk along a familiar path where images of items to be remembered are associated with certain locations.

- The **keyword method**, in which you associate a concrete word with an abstract word and generate an image to represent the concrete word.
- **Hindsight bias** is the tendency to mold our interpretation of the past to fit how events actually turned out.

- When you know the outcome of an event, this knowledge slants your recall of how the event unfolded and what your thinking was at the time.