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# Cognition

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## I. MEMORY

### A. BASIC DEFINITION

1. Memory
  - ▶ *Mental processes involved in acquiring, storing, and recovering knowledge.*
  - ▶ *Memory creates an internal record of an experience.*

### B. BASIC TASKS

1. Encoding—acquiring information into the memory system
2. Storage—retaining information over time
3. Retrieval—recovering information from memory storage

## II. STAGE ONE—SENSORY MEMORY

### A. FUNCTION

1. Everything that our senses hear, see, taste, touch, and smell enters our sensory memory.
2. Sensory memories give a sense of flow and continuity to experiences that would otherwise seem to be a confusing barrage of sounds, sights, tastes, textures, and odors.

### B. CAPACITY AND DURATION

1. Sensory memory's capacity is large but not unlimited.
2. Sensory memory holds visual images for up to one-half second and auditory messages for up to 2 to 4 seconds.

### C. TYPES

1. There is a sensory register for each sense.
2. Iconic memory records visual information.
3. Echoic memory records auditory information.

## III. STAGE TWO—SHORT-TERM MEMORY

### A. FUNCTION

1. The temporary storage site where sensory information is processed, evaluated, and analyzed. The information can be forgotten or added to long-term memory.
2. Short-term memory also accesses and retrieves information from long-term memory.

### B. CAPACITY AND DURATION

1. Short-term memory has a limited capacity. Research indicates that the working capacity of short-term memory is typically seven pieces of information.
2. Short-term memory holds information for approximately 30 seconds.

### C. EXTENDING THE CAPACITY AND DURATION OF SHORT-TERM MEMORY

1. Chunks and chunking
  - ▶ *A chunk is a single unit of information.*
  - ▶ *The capacity of short-term memory can be extended by grouping separate chunks of information into a new unit or chunk. For example, the four digits 2-0-1-0 can be combined to form the date 2010 and thus remembered as one chunk of information.*
2. Maintenance rehearsal
  - ▶ *Maintenance rehearsal is the process of repeating information to keep it in short-term memory.*
  - ▶ *Most students use maintenance rehearsal as a way of “cramming” information before a test. While*

*maintenance rehearsal will keep information fresh in your short-term memory, it is not an efficient method of transferring information to your long-term memory.*

- ▶ *Rehearsal is a vital process. Without rehearsal, information cannot be transferred to long-term memory.*

### 3. Elaborative rehearsal

- ▶ *The depth of processing determines how well information will be remembered.*
- ▶ *Elaborative rehearsal is a process by which new information is actively reviewed and related to information already stored in long-term memory. For example, a student trying to learn the SAT vocabulary word *vivacious* might try repeating the definition “full of life” over and over again. An alternative and much more effective strategy would be to relate the English word *vivacious* to the Spanish word *vivir*, “to live.” This active process of elaborative rehearsal will greatly facilitate transferring the meaning of *vivacious* into long-term memory.*
- ▶ *Elaborative rehearsal has a number of advantages. It improves the organization of the material, encourages thinking about the meaning of the material, and increases connections between the material and prior knowledge.*

## IV. LONG-TERM MEMORY

### A. FUNCTION

1. Long-term memory serves as a storehouse of information.
2. When properly organized and integrated, information is readily available for retrieval.

### B. CAPACITY AND DURATION

1. The capacity of long-term memory is unlimited.
2. The duration of long-term memory can be permanent.

### C. PROCEDURAL MEMORY

1. Procedural memory includes motor skills, habits, and other memories of how things are done.
2. Remembering how to roller skate, ride a bicycle, and tie a shoe are all examples of procedural memory.
3. Procedural memory also includes classically conditioned responses to conditioned stimuli. For example, phobias and attitudes toward a variety of groups are part of procedural memory.

### D. DECLARATIVE MEMORY

1. Episodic memory
  - ▶ *A subdivision of declarative memory that stores memories of personal experiences and events.*
  - ▶ *Episodic memories include your first romantic kiss, your "sweet sixteen" birthday party, and your first time taking the SAT or ACT.*
2. Semantic memory
  - ▶ *A subdivision of declarative memory that stores memories of facts and general knowledge.*
  - ▶ *Semantic memories include the Pythagorean theorem, the names of the three branches of government, and the functions of short-term memory.*

## **V. RETRIEVAL AND LONG-TERM MEMORY**

### A. THE SERIAL-POSITION EFFECT

1. The primacy effect—information from the beginning of a list is remembered better than material in the middle.
2. The recency effect—information from the end of a list is remembered better than material in the middle.
3. Examples
  - ▶ *You remember the first and last people you meet at a party better than those you meet in-between.*
  - ▶ *You remember America's first and last presidents better than those who served in the late 1800s.*

## B. RETRIEVAL CUES

### 1. Recall

- ▶ *The use of a general cue to retrieve a memory.*
- ▶ *For example, your AP Psychology teacher asks you to write down everything you remember about yesterday's lesson on long-term memory without referring to your notes.*

### 2. Recognition

- ▶ *The use of a specific cue to retrieve a memory.*
- ▶ *For example, your language arts teacher asks you to define the term allusion by saying, "It's like in Taylor Swift's song 'Love Story' when she says, 'Cause you were Romeo, I was a scarlet letter.'"*

## VI. FORGETTING

### A. THE FORGETTING CURVE

1. Hermann Ebbinghaus (1850–1909) was a German psychologist who conducted pioneering research on forgetting.
2. Ebbinghaus invented three-letter nonsense syllables such as TIX and ZEL. He then tested his recall of them after varying amounts of time.
3. Ebbinghaus' famous forgetting curve shows two distinct patterns. First, memories of relatively meaningless information are lost shortly after they have been learned. Second, following this initial plunge, the rate of forgetting levels off and then slowly declines.
4. The Ebbinghaus forgetting curve can be applied to such common experiences as learning names at a party or cramming facts before an exam. Most of the names and facts are then quickly forgotten.

### B. INTERFERENCE THEORY

1. According to the interference theory, forgetting takes place when one memory must compete with another similar memory. The similarity between the two memories creates interference and forgetting.

## 2. Proactive interference

- ▶ Occurs when old information interferes with recalling new information.
- ▶ For example, you learn and perform a dance routine for your fall school play. You then experience trouble remembering a new dance routine for the winter play because of proactive interference from the prior fall routine.

## 3. Retroactive interference

- ▶ Occurs when new information interferes with recalling old information.
- ▶ For example, you learn how to drive on a car with a manual transmission (“stick shift”). Your parents then buy you a new car with an automatic transmission. On a family vacation, your parents rent a car with a “stick shift.” You have trouble driving the rental car because of retroactive interference from driving your new automatic car.



AP Psychology test writers know that students often confuse proactive and retroactive interference. Don't be confused. Proactive interference means that an old memory is moving forward (“pro”) to interfere with a new memory. For example, your memory of the combination to your old locker reaches forward and interferes with remembering the combination to your new locker. Retroactive interference means that a new memory moves backward (“retro”) to interfere with an old memory. For example, your team learns a new set of plays that now interfere with your performance of the old plays.

## C. ENCODING FAILURE

1. Encoding failure occurs when poorly encoded information is passed from the short-term memory to the long-term memory.
2. As your teachers have no doubt repeated, paying attention is vital to retention. Your teachers are right. Divided attention is one of the most common causes of encoding failure. Studies show that when we try to perform multiple tasks, the information is not properly encoded into long-term memory.

3. For example, text-messaging a friend while parking your car at the mall. By dividing your attention between texting and parking, you created an encoding failure that might come back to haunt you a few hours later when you try to find your car.

#### D. RETRIEVAL FAILURE

1. An encoding failure takes place when information is not properly stored in long-term memory. In contrast, a retrieval failure takes place when information stored in long-term memory is available, but momentarily inaccessible.
2. Interference, faulty cues, and emotional states such as test anxiety, can all cause retrieval failure.
3. The “tip-of-the-tongue” phenomenon is a common example of retrieval failure. It describes the feeling that at any moment a name or place you are trying to remember is just out of reach but will soon pop out from the “tip of your tongue.”

## VII. AMNESIA

#### A. BASIC DEFINITION

1. Amnesia is a severe memory loss.

#### B. RETROGRADE AMNESIA

1. People who suffer from retrograde amnesia are unable to remember some or all of their past. Retrograde amnesia especially affects episodic memories for recent events.
2. Automobile and motorcycle accidents are leading causes of retrograde amnesia.
3. For example, on August 31, 1997, Diana, Princess of Wales, her companion Dodi Fayed, and driver Henri Paul were all killed in a car accident in Paris. Fayed’s bodyguard, Trevor Rees-Jones, was the only survivor. Because of severe head injuries, Rees-Jones suffers from retrograde amnesia and cannot recall particulars of the accident.

### C. ANTEROGRADE AMNESIA

1. People who suffer from anterograde amnesia are unable to form new memories.
2. The best-known and most extensively studied case of anterograde amnesia is that of Henry Molaison (1926–2008), better known as H.M.
3. H.M. suffered from severe epileptic seizures. In 1953, his surgeon removed portions of H.M.'s medial temporal lobes, including his hippocampus. The experimental surgery successfully controlled H.M.'s epilepsy. However, doctors soon discovered the H.M could not commit new events to long-term memory. Known as "The Man Who Couldn't Remember," H.M. lived in an eternal present.
4. Psychologists Brenda Milner and Suzanne Corkin worked with H.M. for over 30 years. Their exhaustive studies revolutionized understanding of the organization of human memory and helped establish the field of neuropsychology.

## VIII. MEMORY DISTORTION

### A. INTRODUCTION

1. The human memory is far from perfect. Important details can be changed, exaggerated, and even deleted.
2. Elizabeth Loftus (b. 1944) is an American psychologist who is a renowned expert on memory distortion.

### B. THE MISINFORMATION EFFECT

1. A memory distortion phenomenon in which a person's existing memories can be altered if a person is exposed to misleading information.
2. In a classic study, Loftus showed her subjects a film of an automobile accident. The subjects recorded what they saw and answered a series of questions including, "About how fast were the cars going when they contacted each other?" Loftus then varied the question by substituting the verbs "hit," "bumped," "collided," and "smashed" for the word

“contacted.” The choice of words significantly influenced the subjects’ estimate of how fast the cars were traveling. For example, the word “contacted” elicited an average speed estimate of 32 miles per hour. In contrast, “smashed” produced an average speed estimate of 41 miles per hour.

3. Loftus’ use of suggestive questions provides compelling evidence of how the information a person receives after an event can lead to memory distortion.

## **IX. STRATEGIES FOR MEMORY IMPROVEMENT**

### **A. MNEMONICS**

1. Strategies for improving memory.
2. The most effective mnemonic strategies make connections between new material and information already in long-term memory.

### **B. THE METHOD OF LOCI**

1. First developed by ancient Greek and Roman orators to help them remember key points in their speeches.
2. In this technique, the speaker first memorizes the layout of a building, street, garden, or any geographic entity with a number of discrete loci (plural of Latin *locus* for place or location). The speaker then attaches key items to each place. The speaker retrieves the information by “walking” through the loci and allowing each place to cue the desired items.
3. For example, as part of an AP Psychology class project on memory, you need to give a brief oral report on the types of long-term memory. You might use the method of loci by attaching procedural memory to the bicycle in your garage, episodic memory to family pictures in the den, and semantic memory to the computer in your room.

### **C. ACRONYMS**

1. The acronym method involves creating a code word from the first letters of the items you want to remember.

2. For example, Roy G. Biv is a well-known acronym for remembering the sequence of hues (red, orange, yellow, green, blue, indigo, and violet) in a rainbow or any visible spectrum.

## X. LANGUAGE

### A. DEFINITION

1. Language is a form of communication using spoken and written words and gestures that are combined according to specific rules.
2. Language allows us to communicate and preserve thoughts, ideas, feeling, and experiences.

### B. BUILDING BLOCKS OF LANGUAGE

#### 1. Phonemes

- ▶ *The smallest distinctive units of sound used in a language.*
- ▶ *English speakers use approximately 44 phonemes. For example, the p in “party” and the ng in “ping” are both phonemes.*

#### 2. Morphemes

- ▶ *The smallest units of meaning in a language.*
- ▶ *Morphemes can be words, such as “I” and “a,” or they can be parts of words such as the prefix un and the suffix able. For example, the word “unbreakable” consists of three morphemes—the prefix un, the root word break, and the suffix able.*



*It is very easy to overlook phonemes and morphemes. Remember that a phoneme is the smallest unit of sound and a morpheme is the smallest unit of meaning. One mnemonic device for remembering these terms is to attach them to the familiar PM part of the day. The P comes before the M just as phonemes precede morphemes.*

### 3. Syntax

- ▶ Grammatical rules for putting words in correct order.
- ▶ Sentences are sequences of words constructed according to the rules of syntax. Each language has its own syntax.

### 4. Overregulation of grammar rules

- ▶ Overregulation occurs when children apply a grammatical rule too widely and therefore create incorrect forms.
- ▶ The following sentence by a three-year-old contains two examples of overregulation: "I holded the window closed, daddy, and now the mouses can't get out." Note that the child used "holded" instead of "held" and "mouses" instead of "mice."

## C. NOAM CHOMSKY (B. 1928) AND LANGUAGE DEVELOPMENT

1. Noam Chomsky is a renowned linguist who argues that young children possess an innate capacity to learn and produce speech.
2. Chomsky notes that children in widely different cultures progress through the same stages of language development at about the same ages.
3. Chomsky hypothesized that humans learn language because of innate speech-enabling structures called the language acquisition device or LAD.

## D. BENJAMIN WHORF (1897–1941) AND THE EFFECT OF LANGUAGE ON THOUGHT

1. Benjamin Whorf was a linguist who believed that a language does more than describe a person's culture. Whorf argued that a person's language may also shape a person's thoughts and perceptions. This proposal is called the linguistic relativity hypothesis.
2. Whorf illustrated his hypothesis by pointing out that Eskimos (Inuits) have many different words for snow. In contrast, English has the one word—"snow." According to Whorf, "We have the same word for falling snow, snow on the ground, snow packed hard like ice, slushy snow, wind-driven flying

snow—whatever the situation may be. To an Eskimo, this all-inclusive word would be almost unthinkable; he would say that falling snow, slushy snow, and so on are sensuously and operationally different...he uses different words for them and for other kinds of snow.”

3. Contemporary researchers now challenge Whorf’s hypothesis. They point out that the English language contains a number of words to describe various forms of snow, including “sleet,” “slush,” and “powder.”
4. Linguists now believe that language influences, but does not determine, thought.

## **XI. BUILDING BLOCKS OF THOUGHT**

### **A. MENTAL IMAGES**

1. A mental picture of a previously stored sensory experience.
2. Images can be visual, such as imagining what a rainbow looks like. However, images are not strictly limited to visual pictures. For example, you can probably create a mental representation for the sound of a roaring race car, the smell of barbecued chicken, or the feel of a warm breeze blowing through your hair.

### **B. CONCEPTS**

1. A mental category formed to group objects, events, or situations that share similar features and characteristics.
2. Artificial or formal concepts are defined by a specific set of rules or features. Geometric shapes, such as triangles, squares, and rectangles, are all formal concepts.
3. Natural concepts are formed by everyday experience. Vehicles, birds, and fruit are all natural concepts.
4. A prototype is the most typical instance of a particular concept. For example, a car would be the prototypical example of a vehicle, a robin would be the prototypical example of a bird, and an apple would be the prototypical example of a fruit.

## C. SCHEMAS AND SCRIPTS

1. A schema is an organized mental framework about a particular topic, event, object, idea, setting, or group of people. For example, to a student the word “high school” probably conjures up a schema that includes classrooms, cafeterias, science labs, band rooms, and athletic fields.
2. A script is a type of schema that involves the typical sequence of behavior expected at an everyday event. For example, we have scripts for riding a school bus, attending a class, going to a Christmas party, and taking a date to a movie.
3. Schemas play an important role in how we learn to categorize different groups of people. For example, children learn different schemas for racial groups that can include stereotypes and prejudices.



*AP Psychology test writers have used the concept of schema in both multiple-choice and free-response questions. The multiple-choice questions typically focus on the definition of a schema as a mental construct built up through experience. The free-response questions ask you to apply the concept of schema to an everyday problem or social situation. For example, a 1995 free-response question asked students to explain how schemas contribute to the phenomena of prejudice.*

## XII. PROBLEM-SOLVING STRATEGIES

### A. ALGORITHMS

1. An algorithm is a logical, step-by-step procedure that, if followed correctly, will eventually solve a specific problem.
2. Mathematical formulas are examples of algorithms. For example, the formula for computing the area of a triangle ( $1/2 \text{ base} \times \text{height}$ ) is an algorithm.

## B. HEURISTIC

1. A heuristic is a general rule of thumb or shortcut that is used to reduce the number of possible solutions.
2. High school students interested in attending college can visit all the possible choices (an algorithm). However, this strategy would be impractical. Instead, students use a heuristic by limiting their search to small liberal arts colleges located within 300 miles of their homes.

## **XIII.** OBSTACLES TO SOLVING PROBLEMS

### A. MENTAL SET

1. The tendency to continue using belief systems and problem-solving strategies that worked in the past.
2. President Hoover's response to the Great Depression illustrates how mental sets can be an obstacle to solving problems. Hoover's belief system emphasized rugged individualism, the importance of private charities, and a laissez-faire or "hands off" attitude toward government intervention in the economy. Because of this mental set, Hoover failed to adopt the new Keynesian economic model that stressed massive government spending programs to revive the economy.

### B. FUNCTIONAL FIXEDNESS

1. The tendency to think of an object as functioning only in its usual or customary way. As a result, individuals often do not see unusual or innovative uses for familiar objects.
2. For example, Courtney and his wife Audrey are enjoying a visit to a tropical rainforest. One day while on a canoe trip a summer rainstorm suddenly approaches, catching them by surprise. They are soon soaked because they did not think of cutting holes in their environmentally friendly plastic trash bags and using them as improvised raincoats.

### C. CONFIRMATION BIAS

1. A preference for information that confirms preexisting positions or beliefs, while ignoring or discounting contradictory evidence.
2. Christopher Columbus's famous voyage in 1492 provides one of history's best-known examples of a confirmation bias. Searching for a new water route to the Indies, Columbus in fact bumped into several Caribbean islands. Nonetheless, Columbus was so certain that he had reached the Indies that he called the native peoples Indians.

### D. THE AVAILABILITY HEURISTIC

1. Judging the likelihood of an event based on readily available personal experiences or news reports.
2. Mega Millions is America's largest jackpot game with jackpots starting at \$12 million and reaching up to \$390 million. Mega Millions creates vivid memories by running TV commercials featuring ecstatic winners. By ignoring the millions of losers, the advertisements help create an unrealistic availability heuristic.

### E. THE REPRESENTATIVE HEURISTIC

1. Judging the likelihood of an event based on how well it matches a typical example.
2. Kara is an attractive, fun-loving person who enjoys shopping, tanning at the beach, and attending rock concerts. When asked whether it is more likely that Kara is a model or an elementary school teacher, most respondents chose the former. In reality, there are far more female elementary school teachers than female models. The respondents' choice of a model illustrates the representative heuristic because the description of Kara matched their prototype of how a model should look and behave.

## **XIV. CREATIVITY**

### **A. BASIC DEFINITION**

1. Creativity is a mental process that produces novel solutions to problems.

### **B. DIVERGENT THINKING**

1. A type of thinking in which problem solvers devise a number of possible alternative approaches. Divergent thinking is a major element in creativity.
2. The Great Depression tested the creativity of both President Hoover and President Roosevelt. Hoover failed to improve economic conditions because he was locked into a rigid mental set. In contrast, FDR embraced divergent thinking when he proposed a New Deal based upon “bold, persistent experimentation.”

### **C. CHARACTERISTICS OF CREATIVE THINKING**

1. Creative people are independent thinkers who resist social pressures to conform.
2. Creative people display a willingness to grow, change, and take risks.
3. Creative people are internally motivated and display an ability to focus their full attention on a problem.
4. Creative people are drawn to complex, challenging problems.