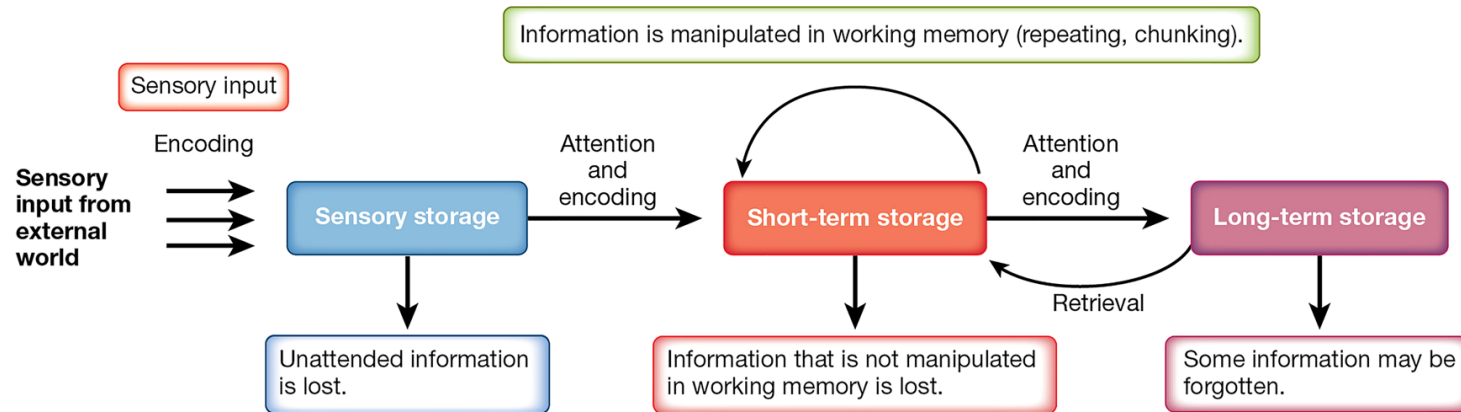


## You Maintain Information in Three Memory Stores



**FIGURE 7.4**

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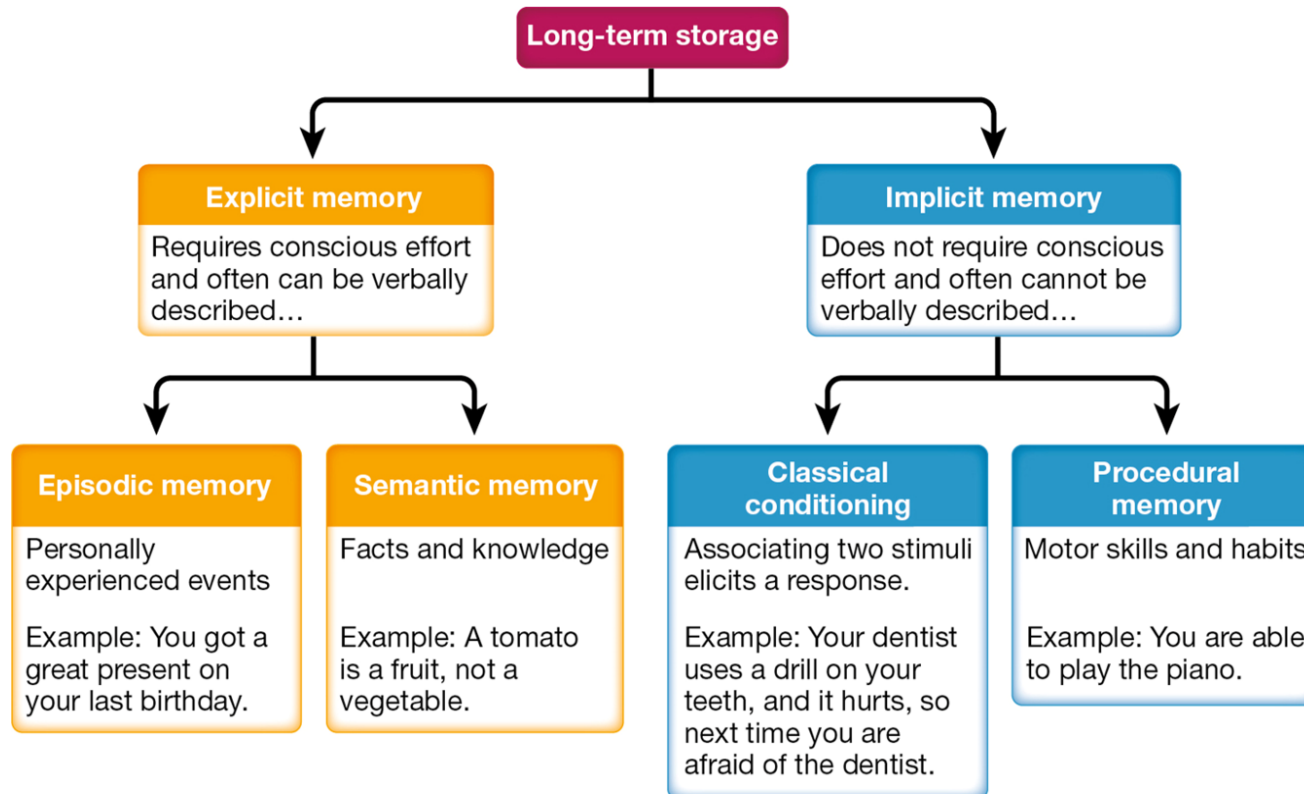
**TABLE 7.1 Four Features of the Three Memory Stores**

|                             | Sensory storage   | Short-term storage   | Long-term storage   |
|-----------------------------|---|--|---|
| <b>Function of storage</b>  | <ul style="list-style-type: none"> <li>Lets perceptions appear to be unified wholes</li> </ul>                          | <ul style="list-style-type: none"> <li>Maintains information for immediate use</li> </ul>  | <ul style="list-style-type: none"> <li>Stores information for access and use at a later time</li> </ul>   |
| <b>Encoding for storage</b> | <ul style="list-style-type: none"> <li>In the sense it is experienced: visual, auditory, taste, smell, touch</li> </ul> | <ul style="list-style-type: none"> <li>Primarily auditory</li> <li>Also visual and semantic</li> </ul>                           | <ul style="list-style-type: none"> <li>Primarily semantic</li> <li>Also visual and auditory</li> <li>Dual coding provides richest encoding</li> </ul> |
| <b>Duration of storage</b>  | <ul style="list-style-type: none"> <li>Visual: under 1 second</li> <li>Auditory: 3-4 seconds</li> </ul>                 | <ul style="list-style-type: none"> <li>Under 20 seconds</li> <li>Indefinite with working memory manipulation of items</li> </ul> | <ul style="list-style-type: none"> <li>Probably unlimited</li> </ul>  |
| <b>Capacity of storage</b>  | <ul style="list-style-type: none"> <li>Vast due to huge amount of sensory input</li> </ul>                              | <ul style="list-style-type: none"> <li>About 7 items, plus or minus 2</li> <li>Using working memory aids capacity</li> </ul>     | <ul style="list-style-type: none"> <li>Probably unlimited</li> </ul>  |



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## Types of Long Term Memories (page 279)



**FIGURE 7.17**



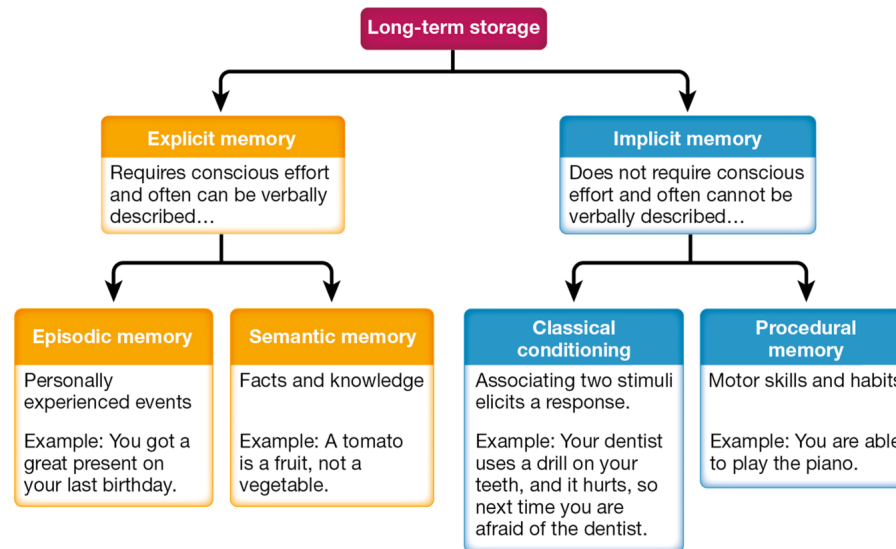





FIGURE 7.17

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| Explicit Memories  |   | Implicit memories  |
|--|---|--|
| Episodic Memory  | Semantic Memory   | Procedural Memory  |
| A type of explicit memory that includes a person's personal experiences.   | A type of explicit memory that includes a person's knowledge about the world, independent of personal experiences.  | A type of explicit memory that involves learning motor skills and behavioral habits and knowing how to do things.  |
|  <p><small>Psychological Science, Fifth Edition<br/>Copyright © 2015 W. W. Norton &amp; Company</small></p> |  <p><small>Psychological Science, Fifth Edition<br/>Copyright © 2015 W. W. Norton &amp; Company</small></p> |  <p><small>Psychological Science, Fifth Edition<br/>Copyright © 2015 W. W. Norton &amp; Company</small></p> |

## **Duration of Long-term Memory**

Baring physical injury, the duration of most long-term memories are believed to be a lifetime. Although it may be difficult to recall specific information, providing retrieval cues help with memory.

## Capacity of Long-term Memory

The capacity of long-term memory is not known and we do not know the limit of how much long-term memory can store. However, many people have the experience that it seems like we cannot store more information.

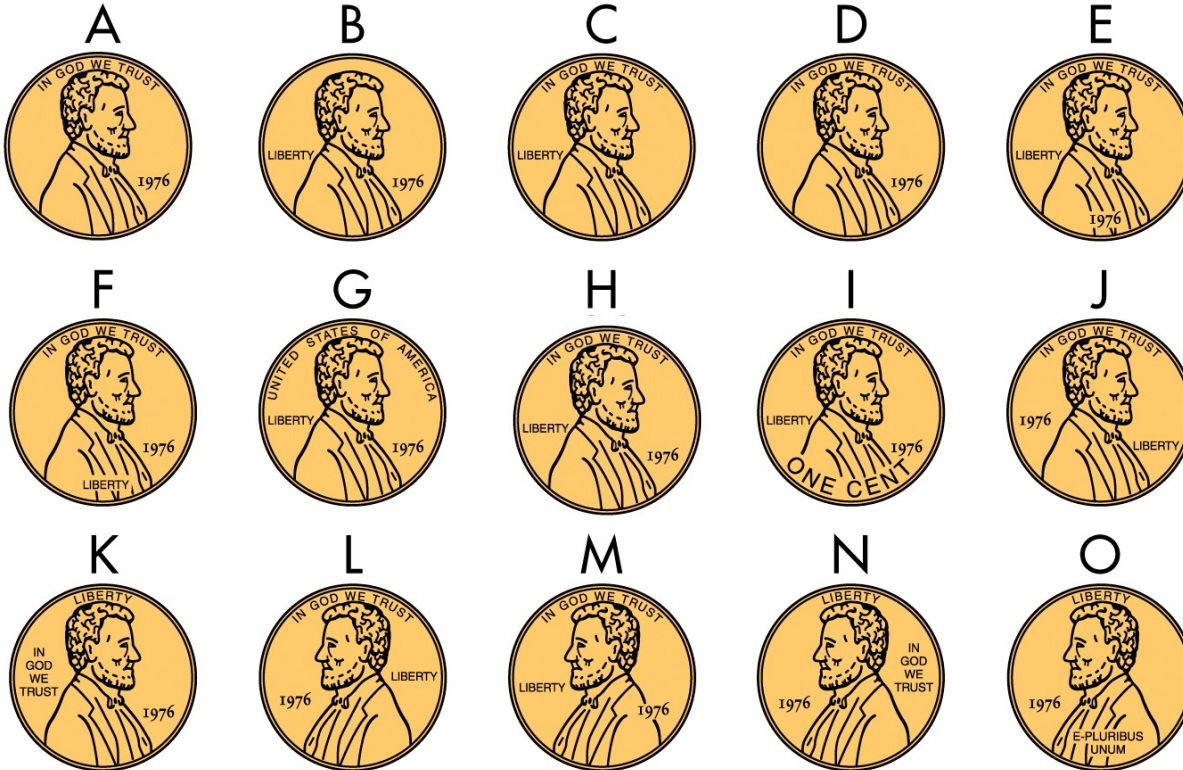
Only a small amount of information that we experience is encoded from sensory memory to short-term memory and finally to long-term memory. One explanation is that it takes time to encode information from short-term storage to long-term storage. I like to imagine that this process is like a funnel. You can only get a small amount information into long-term memory. Any excess information gets lost (spills out over the edges).



This means that you need to spread your study sessions over time to encode and store information.

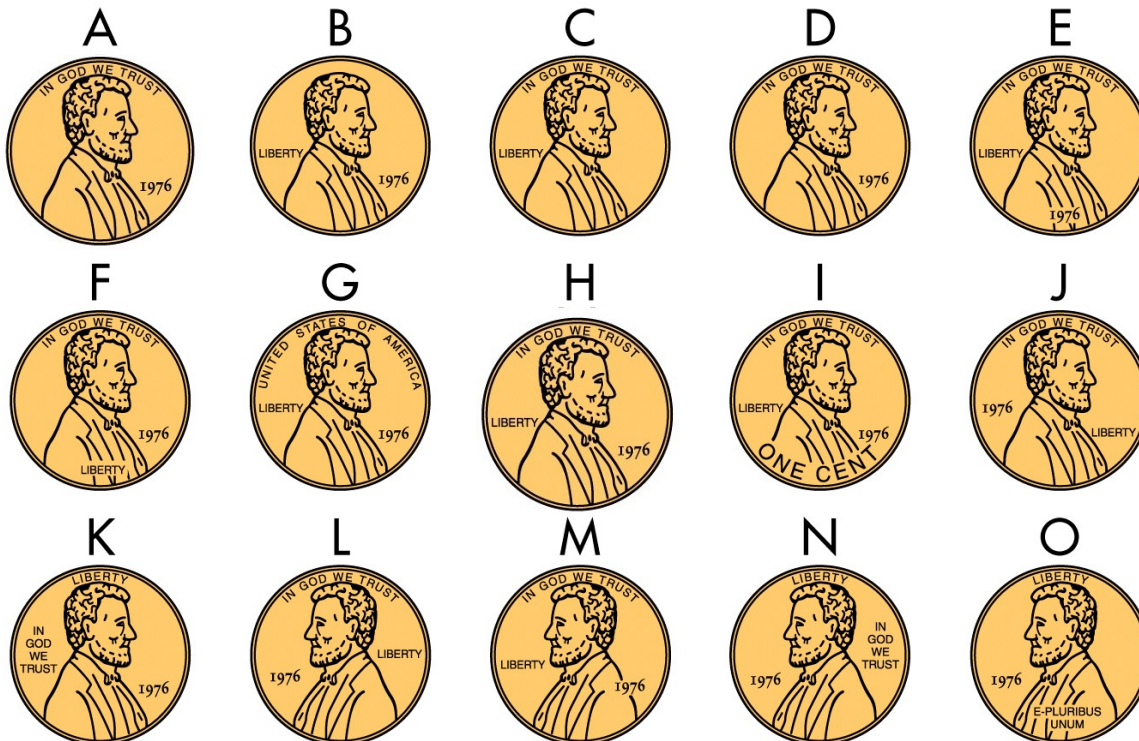
## Encoding Failure

Which coin portrays a real penny?





## Encoding Failure



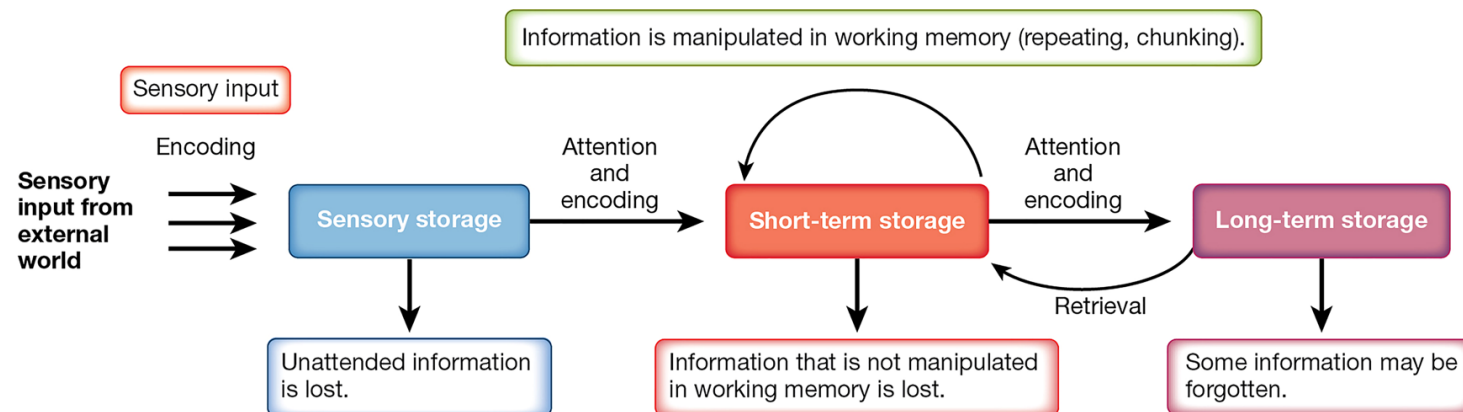
It is normal that most people can't identify the correct penny. Generally, we don't pay attention and encode all of the details of the penny. We only pay attention to items that are necessary for us to use it. The tendency to fail to encode all details and only pay attention to specific details is called encoding failure.

When people aren't sure is the correct penny, they decide using a heuristic (a mental shortcut) based on what looks familiar--"ONE CENT".

## Encoding, Storage and Retrieval

Memory is the mental processes that enable us to retain and use information over time that involve three fundamental processes: encoding, storage and retrieval

- Encoding: The processing of information into a neural code that can be stored in the brain (page 260).
- Storage: The retention of information in the brain over time (page 261).
- Retrieval: The act of accessing stored information when it is needed (page 261).



**FIGURE 7.4**



## **Memory Demonstration**

You will see 15 questions that will ask you a yes/no question about a word on the right.

For example:

- |    |   |            |
|----|---|------------|
| 1. | Is the word in capital letters?                                       | PETER      |
| 2. | Does the word rhyme with PARKER?                                      | Barker     |
| 3. | Would the word fit the sentence:<br>"I saw _____ crawl on the wall."? | Spider-Man |

- (1) Answer yes or no to each question. Read through each question once. Don't write anything down.
- (2) Stop after reading all 15 questions and do not look at the screen.

## THINKING ABOUT PSYCHOLOGY AND LIFE: Memory and Study Strategies

Candidly respond to the following items about your own memory and study strategies. Rate yourself on the following questions and then total your points.

|   | 1     | 2    | 3        | 4                | 5      |
|---|-------|------|----------|------------------|--------|
|   | Never | Some | Moderate | Almost<br>always | always |
| 1. I'm good at focusing my attention and minimizing distractions.             |       |      |          |                  |        |
| 2. I study for understanding rather than rote memorization of material.       |       |      |          |                  |        |
| 3. I organize information hierarchically as part of my memory strategy.       |       |      |          |                  |        |
| 4. I use mnemonic strategies when I have to memorize lists or specific facts. |       |      |          |                  |        |
| 5. I ask myself questions about what I have read or about class activities.   |       |      |          |                  |        |
| 6. I spread out my studying and consolidate my learning.                      |       |      |          |                  |        |
| 7. I cognitively monitor what I read and study.                               |       |      |          |                  |        |
| 8. I am a good time manager and planner.                                      |       |      |          |                  |        |
| 9. I have a good note-taking system.  |       |      |          |                  |        |
| 10. I regularly review my notes.  |       |      |          |                  |        |
| 11. I use the SQ3R* or similar systematic study system.                       |       |      |          |                  |        |

Total: \_\_\_\_\_

- If you scored 50 to 55 points, you likely use good memory and study strategies.
- If you scored 45 to 49 points, you likely have some reasonably good memory and study strategies.
- If you scored below 45, spend some time working on improving your memory and study strategies. Most colleges and universities have a study skills center where specialists can help you. If you are concerned about your study skills, visit Academic Learning Services.

\*SQ3R (Survey, Question, Read, Recite, Review)

## **Deep Encoding for Long-Term Memory**

There are effective and less effective strategies to encode information.

The following are effective ways of encoding information.

- Practice, feedback and distribute your learning
- Deeper levels of processing and elaboration

## Encoding: Elaborative Encoding (Depth of Processing)

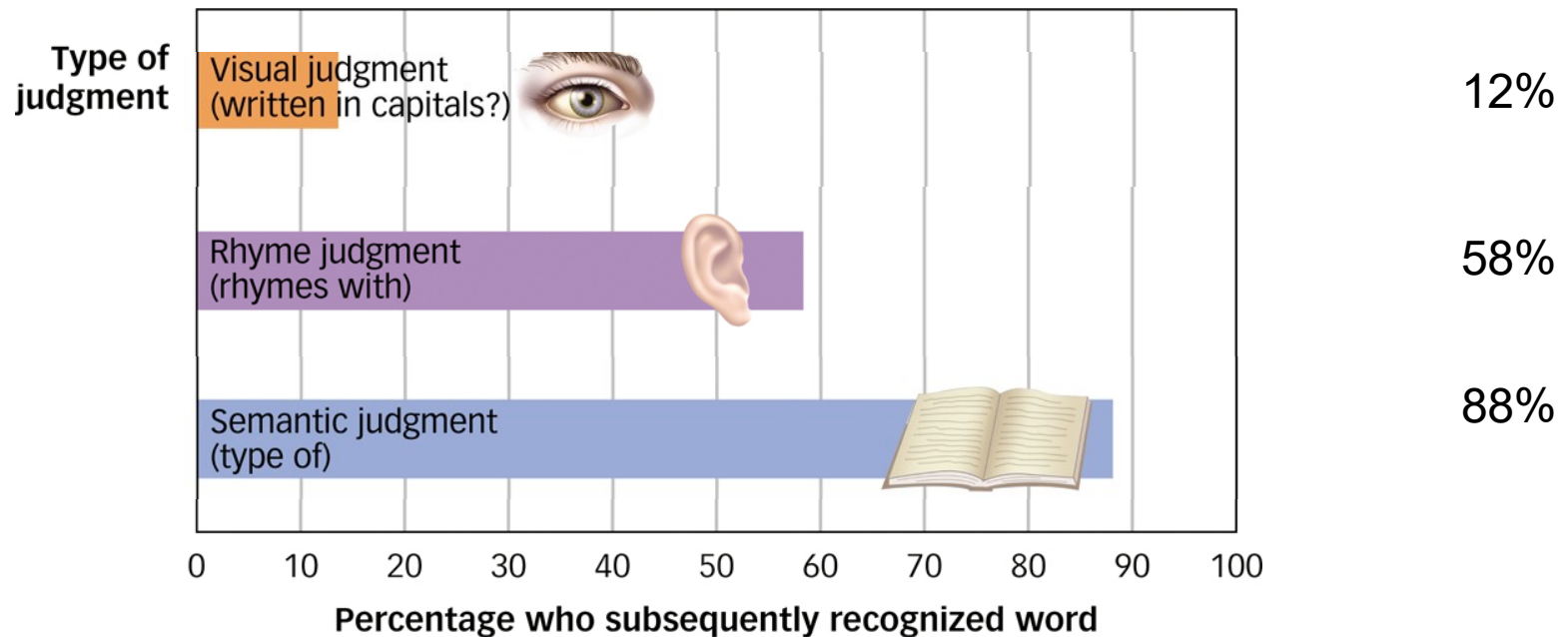


Image Source: Myers, Psychology

The type of judgment task influences how you think about each word and what you remember. Putting meaning to the word, it makes it more likely that your memory will endure.

- What do these results suggest about bad strategies for studying information?
- What do these results suggest about good strategies for studying information?

## **Maintenance versus Elaborative Rehearsal**

**Maintenance rehearsal:** Using working memory processes to repeat information based on how it sounds (auditory information); provides only shallow encoding of information and less successful long-term storage.

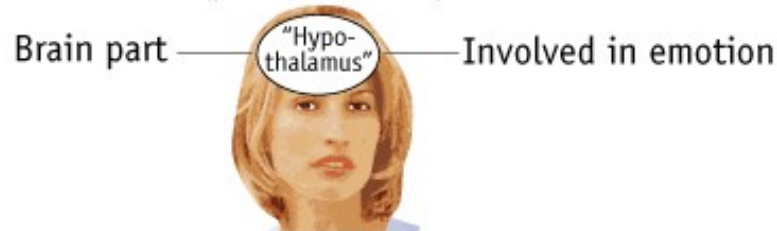
**Elaborative rehearsal:** Using working memory process to think about how new information relates to yourself or your prior knowledge (semantic information)' provides deeper encoding of information for more successful long-term storage.

- Elaboration takes time and effort to make the connections to previous knowledge.
- Information learned through elaborative rehearsal tends to last longer than information learned through maintenance rehearsal.
- Information learned through elaborative rehearsal can be more complex, leads to better understanding and ability to apply your knowledge more broadly.

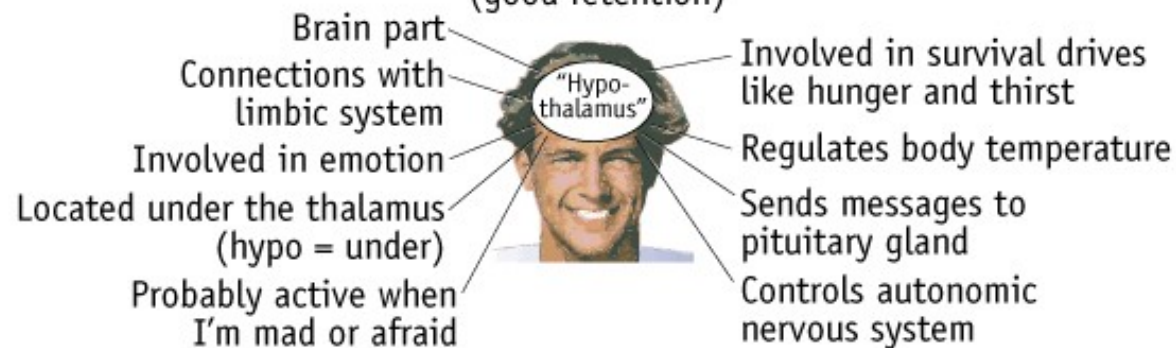
## Encoding: Elaborative Encoding

If you can elaborate on the information and connect it with information you already know that is relevant, it increases the likelihood you will remember the information.

### **IMPOVERISHED ENCODING** (poor retention)



### **ELABORATE ENCODING** (good retention)





## **Encoding: Elaborative Encoding (types of Rehearsal)**

Rehearsal or Maintenance Rehearsal: The process of keeping information in short term memory by mentally repeating it (page 279).

- hypothalamus, hippocampus, amygdala are all parts of the limbic system\*
- hypothalamus, hippocampus, amygdala are all parts of the limbic system\*
- hypothalamus, hippocampus, amygdala are all parts of the limbic system\*


\*your book breaks the limbic system down differently

Elaborative Encoding or Elaborative rehearsal: Encoding by actively relating new information to knowledge that is already in memory (page 279).

- “I knew it was lunchtime because my hypothalamus told me I was hungry, thirsty and cold. My hippocampus helped me remember a new restaurant on campus, but I got there and had to wait in line, which my amygdala made me angry.

1. What are other examples of these rehearsal strategies?
2. Why does elaborative rehearsal work better than maintenance rehearsal for remembering information?

## Maintenance Rehearsal vs. Elaborative Rehearsal for Networking Success

| Maintenance Rehearsal  | Elaborative Rehearsal  |
|--|--|
| <ol style="list-style-type: none"><li>1. polite greeting</li><li>2. state your name</li><li>3. relevant personal link</li><li>4. manage expectations</li></ol><br><ol style="list-style-type: none"><li>1. polite greeting</li><li>2. state your name</li><li>3. relevant personal link</li><li>4. manage expectations</li></ol><br><ol style="list-style-type: none"><li>1. polite greeting</li><li>2. state your name</li><li>3. relevant personal link</li><li>4. manage expectations</li></ol> |  <p data-bbox="1045 792 1885 880"><b>HELLO. MY NAME IS INIGO MONTOYA.<br/>YOU KILLED MY FATHER. PREPARE TO DIE.</b></p> <p data-bbox="1052 948 1879 984"><b>INIGO'S GUIDE TO NETWORKING SUCCESS</b></p> <ol style="list-style-type: none"><li data-bbox="1098 1019 1493 1055"><b>1. POLITE GREETING</b></li><li data-bbox="1098 1091 1262 1127"><b>2. NAME</b></li><li data-bbox="1098 1162 1682 1198"><b>3. RELEVANT PERSONAL LINK</b></li><li data-bbox="1098 1234 1629 1269"><b>4. MANAGE EXPECTATIONS</b></li></ol> |

## Simple Connections

| <b>Brain Area</b> | <b>Basic Description</b>  | <b>Connecting the Information</b>             |
|-------------------|---|---|
| Medulla           | A hindbrain structure that controls vital life functions such as breathing and circulation.   | Medulla - medicine<br>Medulla - medusa        |
| Cerebellum        | A large, two-sided hindbrain structure at the back of the brain; responsible for muscle coordination and maintaining posture and equilibrium. | The Belle of the Ball<br>needs her cerebellum |
| Broca's Area      | A region on the left frontal lobe involved with language production.  | Broca - Spoke-a<br>Broca - Boca               |

## **Encoding: Visual Imagery Encoding**

Visual imagery encoding: The process of storing new information by converting it into mental pictures ([page 223, Schacter, Gilbert and Wegner](#)).

If you can visually imagine the material to remember, it increases the likelihood that you are going to remember the information. Therefore, pay attention to the images in the text or lecture or generate your own visual images.



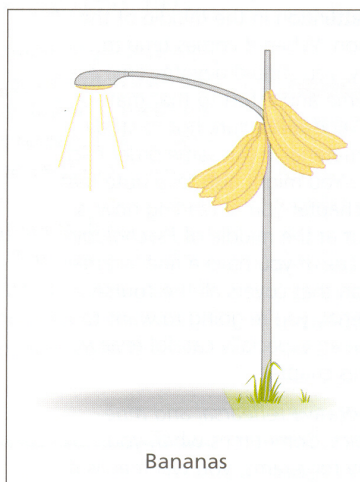
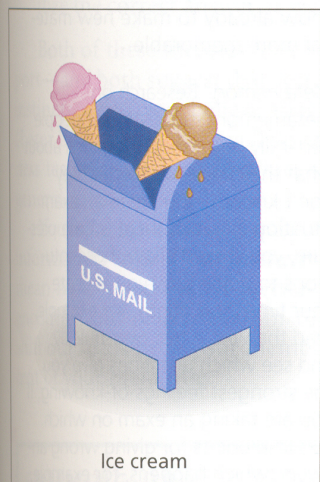
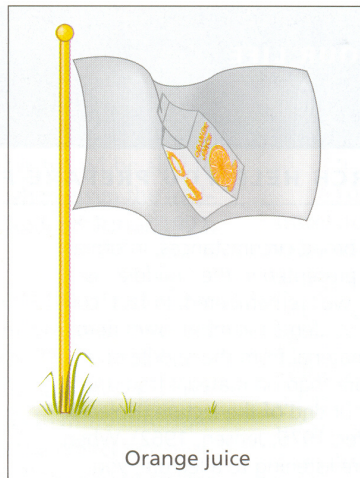
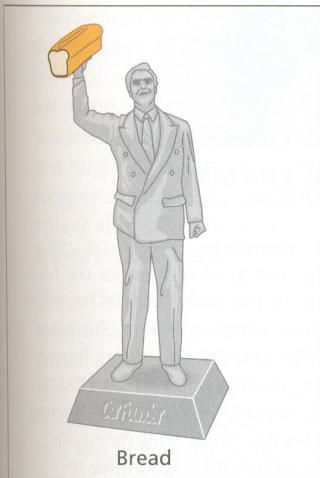


FIGURE 8.10

### The Method of Loci

In the method of loci, you associate the items you wish to remember (such as the items on a grocery list) with locations along a familiar path (such as your route to and from school).

## Visual Imagery



One is a bun.



Two is a shoe.



Three is a tree.



Four is a door.



Five is a hive.



Six is a pile of sticks.



Seven is heaven.



Eight is a gate.



Nine is a line.



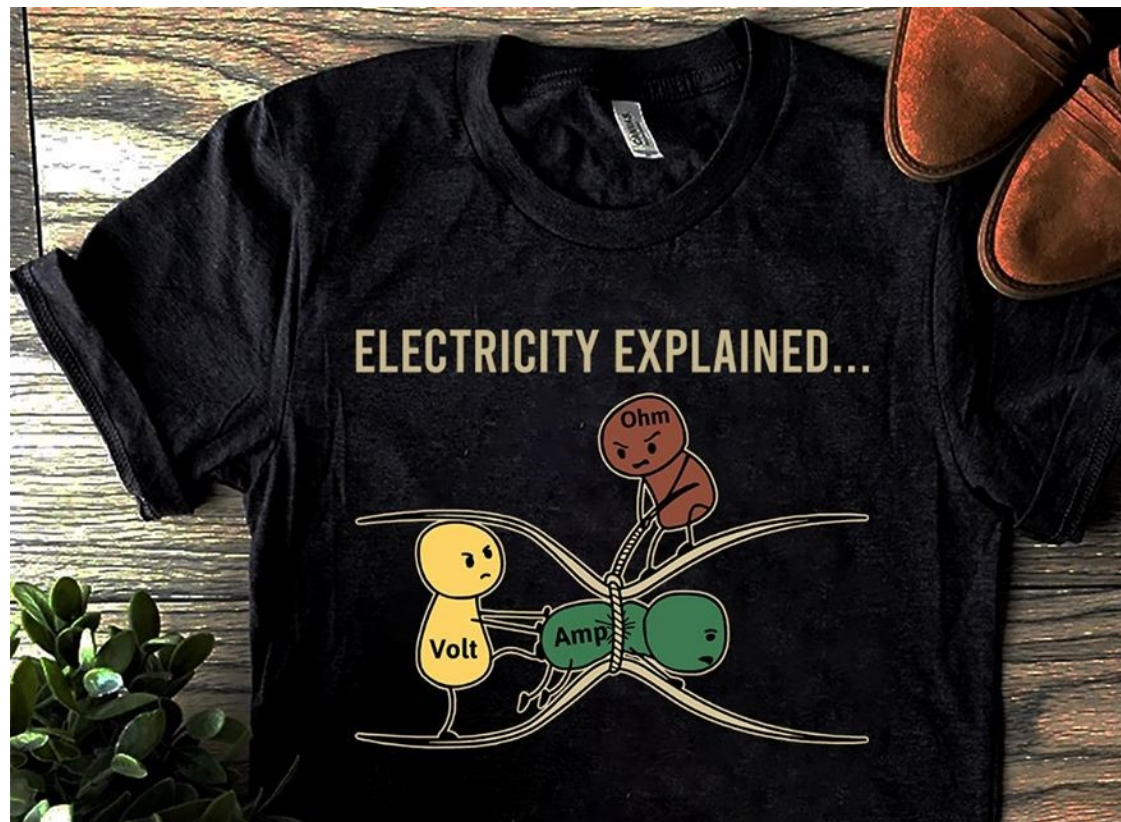
Ten is a hen.





## Visual Imagery (Ohm's Law)

$$\begin{aligned} V &= IR \\ \text{Voltage} &= \text{current} \times \text{resistance} \\ \text{Volt} &= \text{Amp} \times \text{Ohm} \end{aligned}$$



## Encoding Memories into Long-term Storage: Organizational Encoding

Good organization of information, increases the chance that you will effectively encode, store and retrieve information.

The more you practice organizing information, the more you will be able to use this skill efficiently and automatically while recalling information at a faster rate.

Examples of organizational encoding are:

| Categories or Clusters |                |                |                | Hierarchies   |
|------------------------|----------------|----------------|----------------|---|
| A♠<br>8♠<br>5♠         | 6♥<br>3♥<br>2♥ | K♦<br>5♦<br>4♦ | 8♣<br>7♣<br>2♣ | <pre>                     graph TD                         Animals --&gt; Birds                         Animals --&gt; Mammals                         Birds --&gt; Waterfowl                         Birds --&gt; Songbirds                         Waterfowl --- W["Duck<br/>Goose<br/>Swan"]                         Songbirds --- SB["Wren<br/>Sparrow<br/>Warbler<br/>Finch"]                         Mammals --&gt; Horses                         Mammals --&gt; Dogs                         Mammals --&gt; Cats                         Horses --- HS["Arabian<br/>Pinto<br/>Mustang"]                         Dogs --- DS["Collie<br/>Shepherd<br/>Terrier<br/>Dachshund"]                         Cats --- CS["Manx<br/>Siamese<br/>Persian"]                     </pre> |

## Encoding: Clustering or Categorize

One way to organize information is to cluster similar items together.

### Examples:

- Demonstration of lists
- Harvey Korman in Blazing Saddles
- When I memorize my shopping list or “to do” list, I cluster my groceries or errands in “clusters” that are similar.

Fruits/Vegetables

Canned/Box

Meat/Deli

- When playing cards (such as bridge, hearts, pinochle), it is easier to remember the cards you have if you organize it by suit and then by number.

| Spades | Hearts | Diamonds | Clubs |    | Spades | Hearts | Diamonds | Clubs |
|--------|--------|----------|-------|----|--------|--------|----------|-------|
| A♠     | 6♥     | K♦       | 8♣    |    | A♠     | 8♥     | 5♦       | 3♥    |
| 8♠     | 3♥     | 5♦       | 7♣    | vs | K♦     | 7♣     | 5♦       | 2♣    |
| 5♠     | 2♥     | 4♦       | 2♣    |    | 8♣     | 6♥     | 4♦       | 2♥    |

- When studying vocabulary/chapter key terms, organize by clusters

Study the list for about a minute to try to memorize as many words on this list.

|            |        |           |
|------------|--------|-----------|
| broccoli   | apple  | parsley   |
| elevator   | bus    | submarine |
| bicycle    | potato | grapes    |
| watermelon | lemon  | turnip    |

How many could you recall?

Study the list for about a minute to try to memorize as many words on this list.

|            |          |           |
|------------|----------|-----------|
| watermelon | broccoli | elevator  |
| apple      | potato   | bicycle   |
| lemon      | parsley  | bus       |
| grapes     | turnip   | submarine |

How many could you recall?

## Clusters of Vicious Criminals

From the movie Blazing Saddles: I want you to gather the most vicious criminals and gunslingers in the West

rustlers  
cut throats  
murderers  
bounty hunters  
desperadoes  
**mugs**  
**bugs**  
**thugs**  
nitwits  
half-wits  
dimwits

**vipers**  
**snipers**  
con-men  
Indian agents  
Mexican bandits  
**muggers**  
**buglers**

bushwhackers  
horn swaggers  
horse thieves  
bull dikes  
train robbers  
bank robbers  
**ass kickers**  
**shit kickers**, and  
Methodist

## **Encoding: Clusters or Categories**

When studying vocabulary/chapter key terms, organize by clusters

Example:

### **Learning**

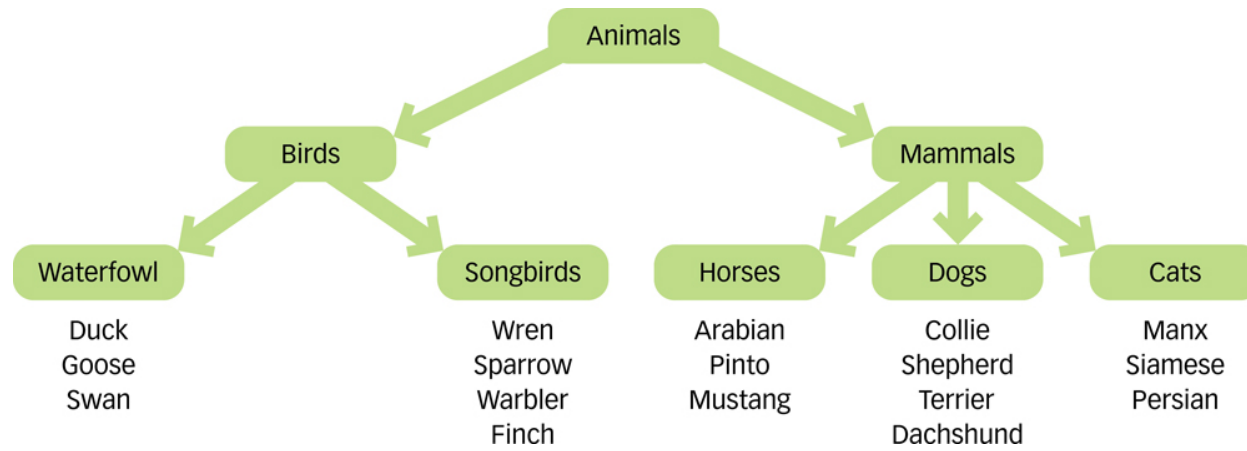
| Classical Conditioning | Operant Conditioning | Watching Others |
|------------------------|----------------------|-----------------|
|                        |                      |                 |



## Encoding: Hierarchies

Like clusters you can organize information in a hierarchy with headings and overarching categories.

### Example #1:



## Encoding: Hierarchies

Example #2:

### Learning

| Classical Conditioning |                     |                      | Operant Conditioning                  |                                   | Watching Others        |          |                    |
|------------------------|---------------------|----------------------|---------------------------------------|-----------------------------------|------------------------|----------|--------------------|
| Classical conditioning | Adaptive Influences | Cognitive influences | <b>Reinforcements and punishments</b> | <b>Schedules of Reinforcement</b> | Observational Learning | Modeling | Vicarious Learning |

Example #3:

### The Brain

| Hindbrain                     | Midbrain         | Forebrain   |   |
|-------------------------------|------------------|---|---|
|                               |                  | Subcortical structures                              | Cortical structures   |
| Medulla<br>Pons<br>Cerebellum | Substantia Nigra | Thalamus<br>Hypothalamus<br>Hippocampus<br>Amygdala | Corpus callosum<br>Cerebral cortex <ul style="list-style-type: none"> <li>• Occipital lobe</li> <li>• Parietal lobe</li> <li>• Temporal lobe</li> <li>• Frontal lobe</li> </ul> |

## Encoding: Hierarchies

Organize these minerals in a way that make it easier to remember these minerals. There are different many different ways to organize the information.

emerald    marble    slate    ruby

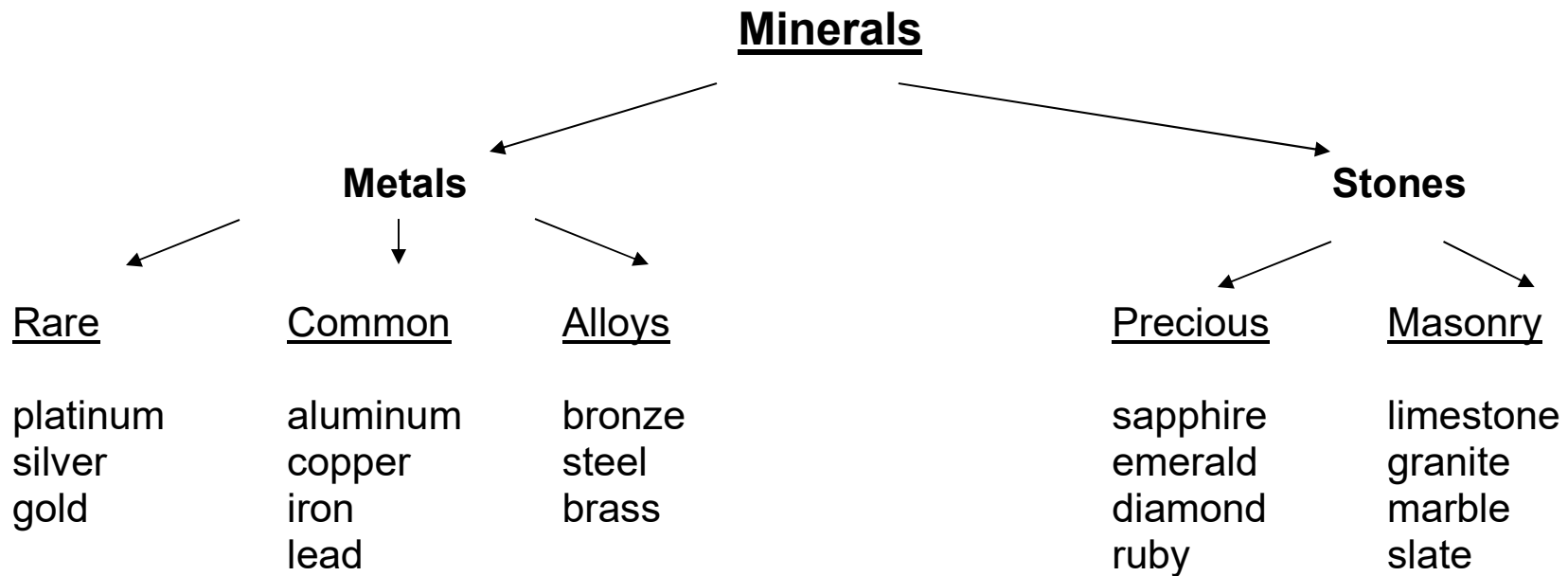
silver    limestone    diamond    aluminum

steel    brass    bronze    iron

granite    sapphire    gold    lead

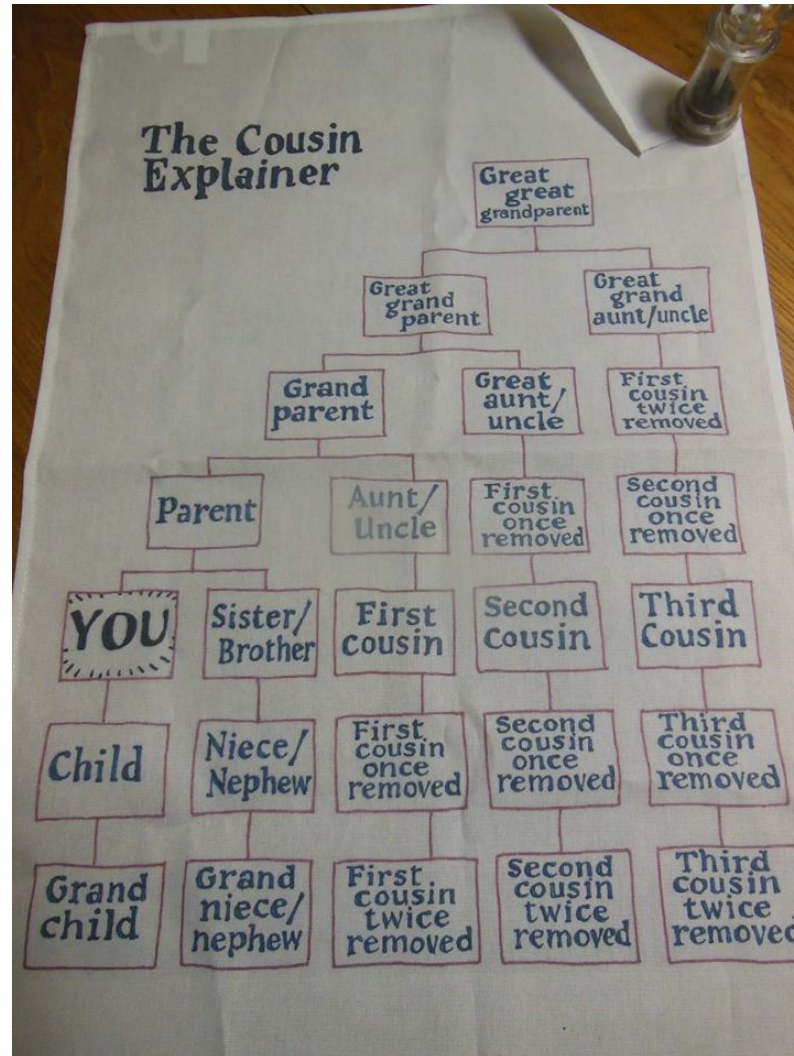
platinum    copper

## Encoding: Hierarchies



Role of organization in memory (from Baron, Psychology, p226)

## Hierarchies and Visual Organization







## **Strategies to Encoding Information--Getting Information into Memory**

Before we can have a memory to retrieve, it needs to be encoded and stored. If you don't effectively encode information, it will be more difficult to retrieve that information.

### **Effective strategies:**

- Elaboration,
  - elaborative rehearsal
  - encode with “depth” or semantic meaning
- Visual imagery
- Organization
  - clusters or categories
  - hierarchies

### **Less Effective strategies:**

- Encode with superficial characteristics
- Maintenance rehearsal (extends short-term memory)

Reasons why we might not know information is due to lack of encoding:

- Inattention
  - Encoding failure
  - Multitasking
- 
- What were examples of these strategies?
  - How can you use these strategies?
  - Why is understanding these strategies important?