

# Basic Principles of Learning

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# Organization of This Presentation

- Two sources of thinking about learning will be reviewed Developmental and Cognitive approaches.
- Throughout the class, I will present (10) Teaching Tips (including research that supports them).
- Fielding questions about teaching at UF.

# Therriault's 10 Teaching Tips

## General:

1. Dr. Therriault's three tense approach. Tell your students what you are going to be saying, say it, then tell them what you said.
2. Do not focus on what a student cannot do.
3. Help students acquire an experiential knowledge base.
4. Scaffolding is a particularly effective method of instruction.

## Specific

5. Capacity: Provide opportunities for recoding in your teaching materials (e.g., use students current knowledge when presenting new material)... they will be more likely to remember it.
6. Timing: Students are more likely to remember the beginning and end of a lecture (and information presented out of lecture format). Plan your materials accordingly.
7. Clarity: Don't let your teaching become like the "fruit" lists, always make meaningful distinctions. It will aid in keeping away interference effects (i.e., student confusion).
8. Content: Highlight meaningful associations and study practices: Why? Because LTM is organized by meaning (information is connected by meaning).
9. Process: Forgetting curve shows that most forgetting occurs within a short time after learning. Repetition and over-learning improve our student's memories.
10. Testing: Provide multiple assessments to promote distributed learning

# Introduction to the Principles of Learning (useful for teachers)

- What do we mean by useful
  - Two Views on Learning (paradigms)
    - Developmental
    - **Cognitive**

# What do we mean by useful?

- Two Views on Learning (paradigms)
  - Developmental
  - **Cognitive**

# Developmental: Piaget and Vygotsky

- Piaget
  - Mechanisms of Cognitive Development
    - Equilibration Versus Disequilibrium
    - How does a child achieve equilibration?
      - Changing schemes
      - Assimilation
      - Accommodation

# Assimilation and Accommodation



# Piaget's Stage Theory of Cognitive Development

- Stages of Cognitive Development
  - Sensorimotor
  - Preoperational
  - Concrete Operational
  - Formal Operational



# Sensorimotor Stage

- Learning primarily through senses, rudimentary ability to represent things mentally
- Birth - Age 2
- Object Permanence
- Representational Thought

# Preoperational Stage

- Builds upon sensorimotor: further development in the ability to think and reason
- Age 2 - 7
- Language Development
- Egocentrism

# Concrete Operational Stage

- Children are becoming more adult like but tend to reasoning tasks based in the concrete world.
- Age 7 -11
- Representational Thought
- Conservation
- Reversible Thinking

# Formal Operational Thinking

- Highest stage: individuals are able to reason in a fully abstract manner
- Age 11 - 12
- Abstract Thought
- Second-order Relations

# Evaluating Piaget's Work

- The validity of Piaget's theory has been questioned for several reasons:
  - limitations of stages
  - accuracy of ages
  - truth regarding the reasons behind skill limitations
  - question regarding how many adults actually reach Formal Operations
  - limited cross-cultural generalizability

# Neo-Piagetian Views

- Neo-Piagetian - Current theorists that have built upon Piaget's initial work, addressing many of the concerns.
- Optimal Versus Typical Development
- Post Formal Thinking
- Problem Finding
- Dialectical Thinking

# Vygotsky's Sociocultural Theory of Cognitive Development

- Placed importance on the social and cultural aspects of development.
- Developed three main developmental ideas:
  - Internalization
  - Zone of Proximal Development
  - Scaffolding

# Vygotsky's Sociocultural Theory of Cognitive Development

- Internalization - taking in knowledge observed in a social context.
- Language is key to the internalization of complex ideas.



# Vygotsky's Sociocultural Theory of Cognitive Development

- Zone of Proximal Development - the range between a child's level of independent performance and the level of performance a child can reach with assistance.
- Scaffolding

# Teaching Tips

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# Cognition and Information Processing

# Relevant Questions

- How is information entered or encoded into memory? How do we go from seeing or hearing information, to learning the information, to putting it into memory?
- How is information stored in memory? What are the different kinds of memory storage that people use?
- What models have been proposed to account for how information is stored in memory?
- How do we retrieve information from memory? What factors influence remembering and forgetting?

# Relevant Questions Cont.

- What can people do to improve their memories? What specific techniques can students and teachers use to enhance their memories?
- How do the conditions under which we learn something influence our likelihood of remembering and using the information.

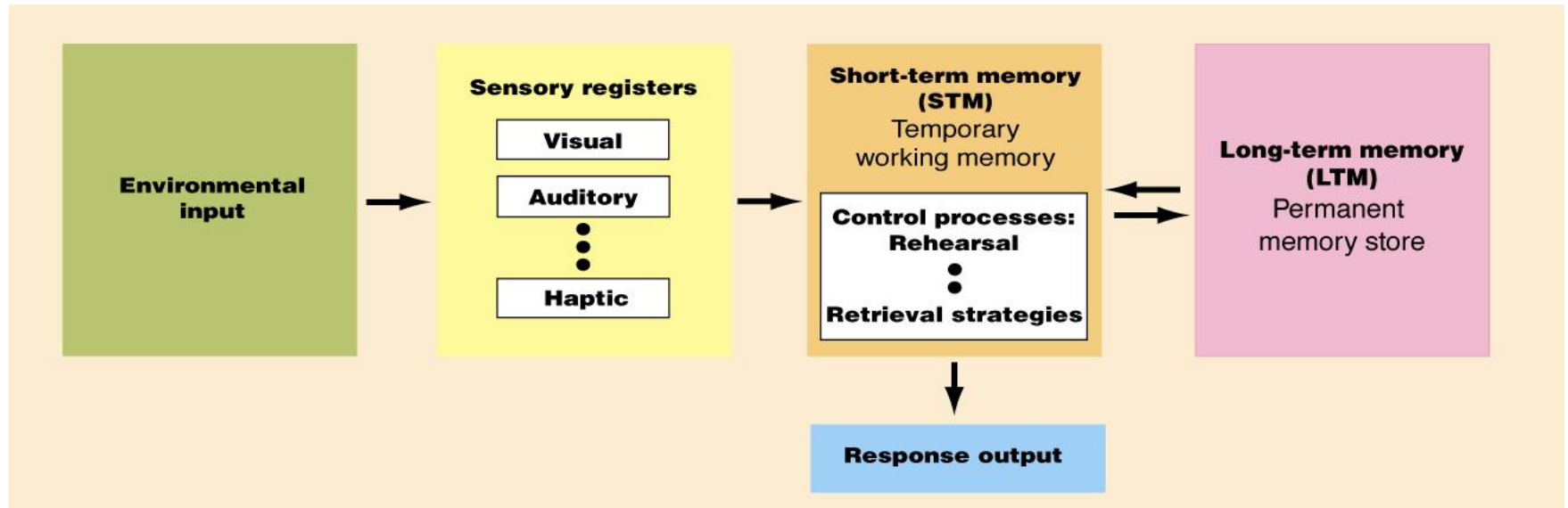
# Basic Memory Terminology

- Encoding: how you transform a sensory input into some kind of representation that can be placed in memory
- Storage: how you retain encoded information in memory
- Retrieval: how you access information stored in memory

# Information Processing Paradigm

- Sensory Memory: encodes information duration is very short.
- Attention or Short Term Memory or Working Memory: (Processing and Storage component) Storage area that holds information for a short period of time.
  - **e.g.**, Loading dock or Analogy to mental workbench
- Long-term Memory: Storage area in which information can be held for longer periods of time, possibly permanently.
  - **e.g.**, Warehouse or analogy to file cabinet.

# The Standard Memory Model





# Short Term Memory

- **Short Term Memory:** The limited-capacity memory component for temporary information storage. How much you can store.
- **Memory Span:** # of items that can be recalled immediately after a presentation (in order).
- **Capacity: Magic #  $7 \pm 2$  'bytes' or Chunks:** The limit of information that can be encoded, held, and reported from immediate memory (memory span).
- **Duration:** approximately 1 - 2 minutes

# Short Term Memory Terminology

- **Chunk:** A group of information, unit of memory.
- **The Bottleneck of STM:** How can we function at such a high level cognitively with such a small STM capacity?

# Short Term Memory Terminology

- **Chunk:** A group of information, unit of memory.
- **The Bottleneck of STM:** How can we function at such a high level cognitively with such a small STM capacity?
- **Recoding:** Process of grouping objects together (forming larger chunks).
  - e.g., recall the following:

# Chunking Example

PLDVNQSRBUEF

# Chunking Example

IBMPBSUSANFL

# Chunking Example

PLDVNQSRBUEF

Or...

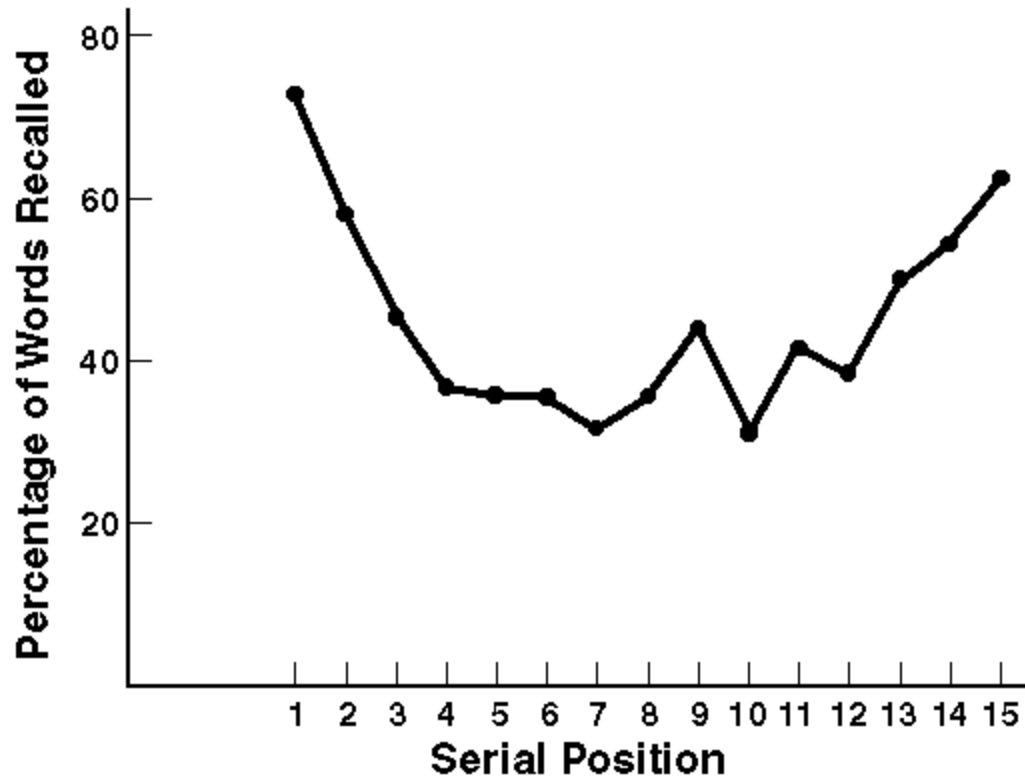
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- We can chunk the second into units of three letters rather than units containing one letter each

# Teaching Tip

5. Capacity: Provide opportunities for recoding in your teaching materials (e.g., use students current knowledge when presenting new material)... they will be more likely to remember it.

# Memory Retrieval: The Serial Position Curve

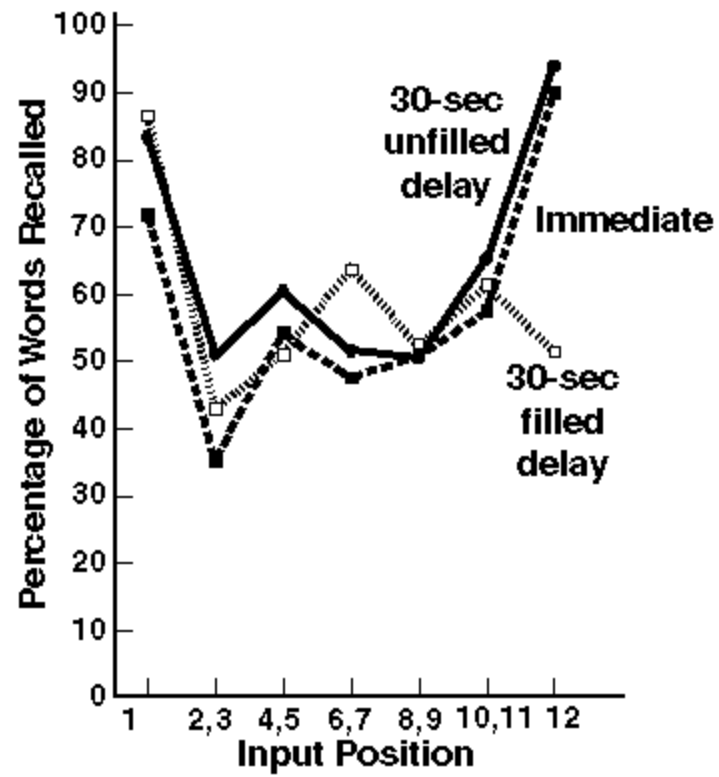




# Primacy & Recency

- **Primacy effect:** The tendency for items at the beginning of a list to be more accurately recalled than items in the middle of the list. This is due to the fact that the first few items “make it” into LTM.
- **Recency effect:** The tendency for items at the end of a list to be more accurately recalled than items in the middle of the list. This is due to the fact that the last few items are still in STM.

- **Evidence**



# Teaching Tip

6. Timing: Students are more likely to remember beginning/ end of a lecture (and information presented out of lecture format). Plan your materials accordingly.

# Forgetting...?

- **Decay:** The fading or forgetting of information over time.
- **Interference:** Forgetting due to the introduction of new material.

# Decay

- Brown and Peterson & Peterson and Peterson's (1959) Task
- Investigated **decay** from STM. Three-letter stimulus (trigram) was presented to Ss, followed by a three-digit number. Ss were instructed to count backwards (by threes) from the presented number. After a specified time, Ss were required to recall the original letter stimulus.
- Results: Ss were less accurate in recall as their counting time increased.
- Conclusion: This provides evidence for decay in STM.

# Decay vs. Interference?

- Waugh & Norman's task (1965)  
Investigated decay/ interference from STM.
- Probe digit task: A task in which Ss hear a list of digits. The final digit (probe) is a repeat of a digit presented earlier. The Ss task is to produce the digit that followed the probe in the original list.

# Waugh & Norman Cont.

## **Example:**

- (A) 195293804637602-tone- respond“9”
- (B) 195293804637607-tone- respond“6”
- In A there are 10 items interfering in B only 2.

## **Manipulations:**

- Varied the amount of interference (1-13 digits)
- Varied presentation rate (decay) (1 or 4 digits per second)
- Measured ability to recall # following the target.

# Waugh & Norman Cont.

- Results: Amount of interference had a large effect. Presentation rate had no effect.
- Conclude: Interference is the primary cause of forgetting from STM.



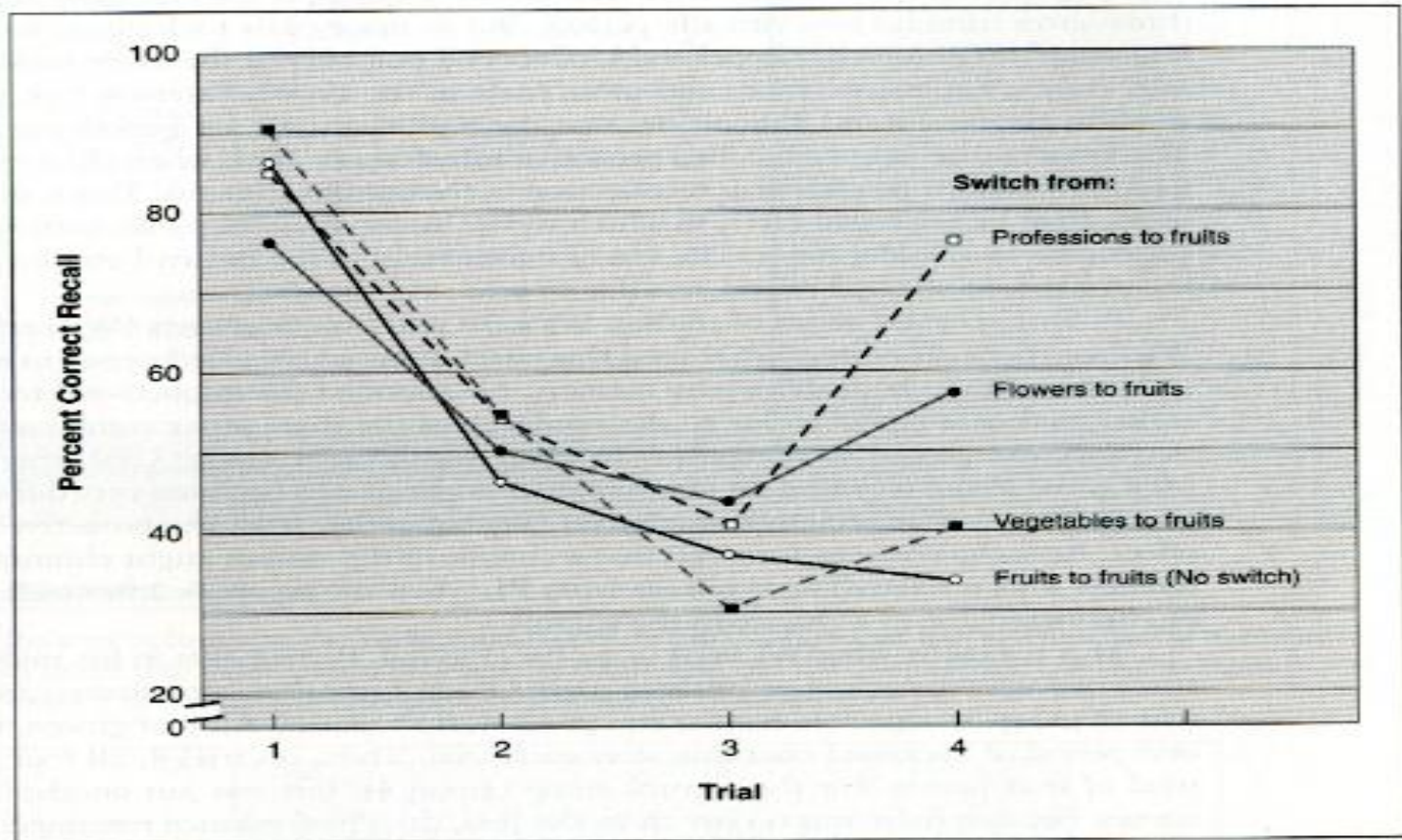
# Interference

- **Proactive interference (Wickens, 1972):** Another challenge to Peterson and Peterson's experiment. Wickens suggested that: Older material interferes forward in time with remembering the current stimulus.
- **Retroactive interference:** Newer material interferes backward in time with memory for older items.

# Release from PI: Proactive interference is reduced or eliminated due to a change in the nature of the stimuli.

**FIGURE 4.5**

Recall accuracy in a release-from-PI experiment reported in Wickens (1972). All subjects received word triads from the fruit category on trial 4. On trials 1 to 3, different groups received triads from the categories fruits, vegetables, flowers, and professions. (From Wickens, 1972.)



# Teaching Tip

7. Clarity: Don't let your teaching become like the fruit lists, always make meaningful distinctions. It will aid in keeping away interference effects (i.e., student confusion).

# Studying and The Rehearsal Buffer

- **Rehearsal:** The deliberate mental repetition or practicing of to-be-learned material.
- **Two functions of Rehearsal:**
  - Maintain information in STM by simple repetition or recycling
  - Transferring information to LTM

# Two types of rehearsal

- **Maintenance Rehearsal:** Focus on the to-be-remembered items, but no focus on what the items “mean” or how they are related to what you already know.
- **Elaborative Rehearsal:** Focus on what the to-be-remembered items “mean” and how they are related to things that you already know.
  - What’s active then? The to-be-remembered items AND information already in LTM (This will help form a connection, and will aid storage and retrieval)
  - **Example: Learning someone’s phone # (312) 935-1482**

# Teaching Tip

8. Content: Highlight meaningful associations and study practices: Why? Because LTM is organized by meaning (information is connected by meaning).

# STM Representation

**How is information represented in STM (representation)?**

**Four Types:**

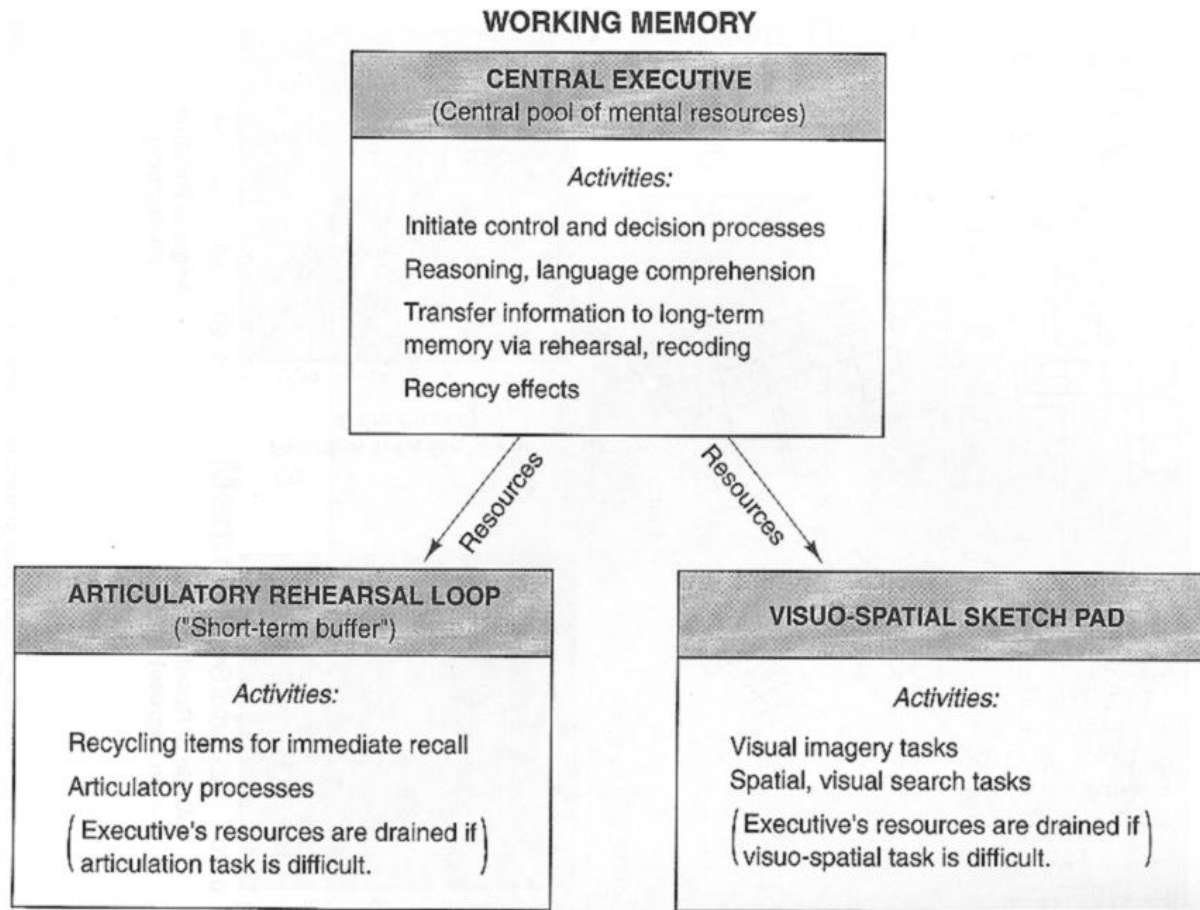
1. Verbal (acoustic-articulatory): evidence that we do this is the fact that we make mistakes on the sounds of letters (e.g., D for E).
2. Semantic: evidence STM is sensitive to meaning information.
3. Visual: evidence mental rotation tasks, (Shepard's work)
4. Movement based codes: evidence congenitally deaf will confuse like hand movements but not show difficulty reading similar sounding words

# Baddeley's Working-Memory Model

- So we have all of these various codes in STM.
- But STM is simply thought of as storage of information.
- We need a more flexible system to explain these codes.
- He proposed Working Memory (WM).



# Baddeley's Model



# Working Memory Components

- **Central Executive:** overall controller of the system. Responsible for decision making, retrieval from LTM, and rehearsal for transfer of info into LTM. Also where reasoning and language comprehension take place.
- **Articulatory Loop:** Holds and recycle small amounts of sound information. You can think of this as older STM rehearsal buffer we discussed earlier.
- **Visuo-spatial Sketchpad:** Holds spatial and visual information for a short time. This component would be engaged in a spatial rotation task.

# Working Memory cont.

- **Resources:** Work is done by allocating resources to a task. All the components have resources but the CE can also send more resources to the slave systems if a task is difficult. Resources only flow down in the system.

# The Forgetting Curve: Ebbinghaus

- **Ebbinghaus:** was the first researcher to explicitly study memory. Invented the relearning task (used nonsense syllables).
- **Relearning task:** learn a list up to a set level of recall, put the list aside for a period of time, then learn the list again to the same level of recall.

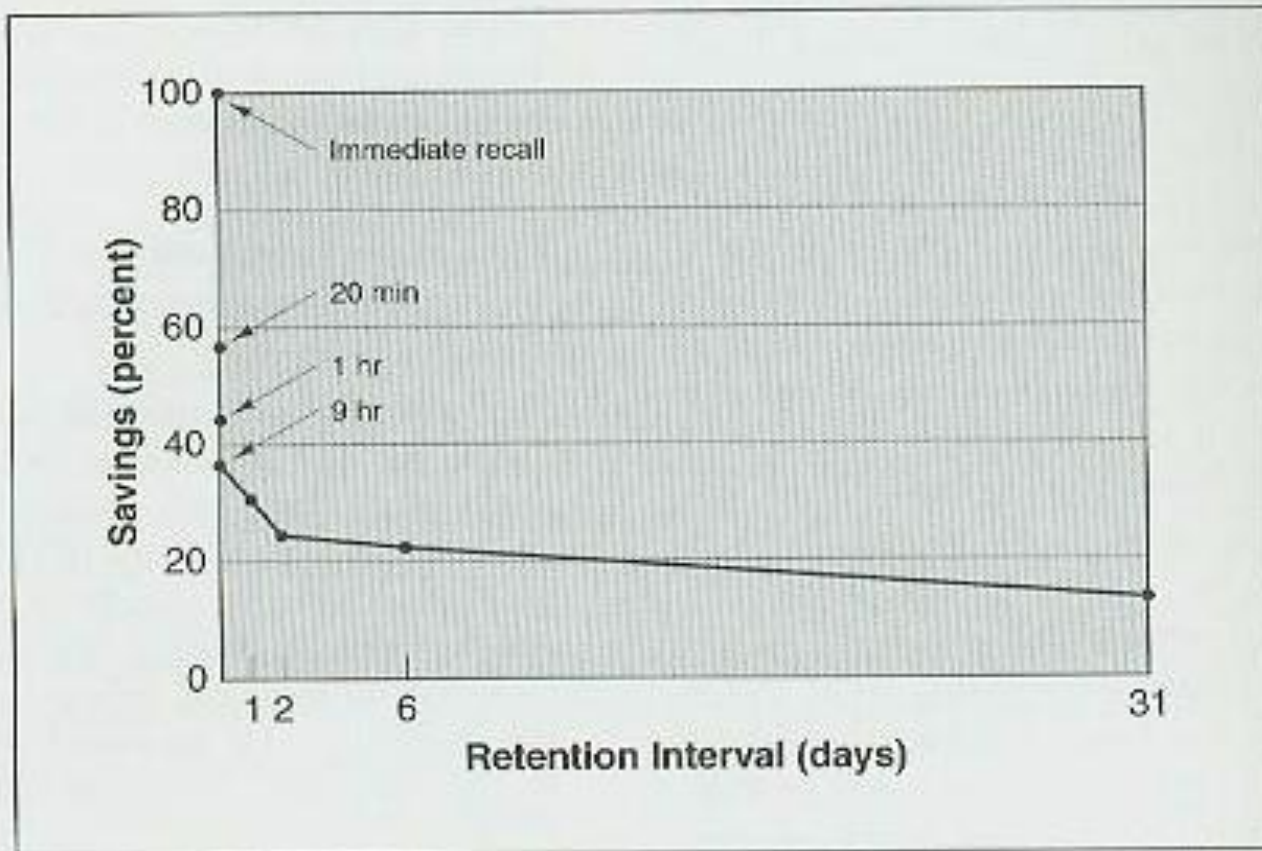
# The Forgetting Curve: Ebbinghaus

- How many fewer trials were needed was referred to as your **savings score**
- Example:
- you learn a list it originally takes you 10 attempts,
- set the list aside for a week, then relearn the list
- this time it takes you 6 attempts.
- The four trials that were “saved” is your savings score (roughly 40% of the information did not need to be relearned)

# The Forgetting Curve

**FIGURE 5.2**

The classic forgetting curve from Ebbinghaus (1885/1913/1964). The figure shows the reduction in savings across increasing retention intervals, time between original learning and relearning. (Data from Ebbinghaus, 1885/1913/1964.)



# What can we conclude about studying from Ebbinghaus:

- **Distributed Learning** - learning spaced out over several learning sessions.

**Is generally more effective than**

- **Massed Learning** - learning that is crammed into a single session.

# Teaching Tip

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