MIE 240: Human-centred system design

Information Processing Model

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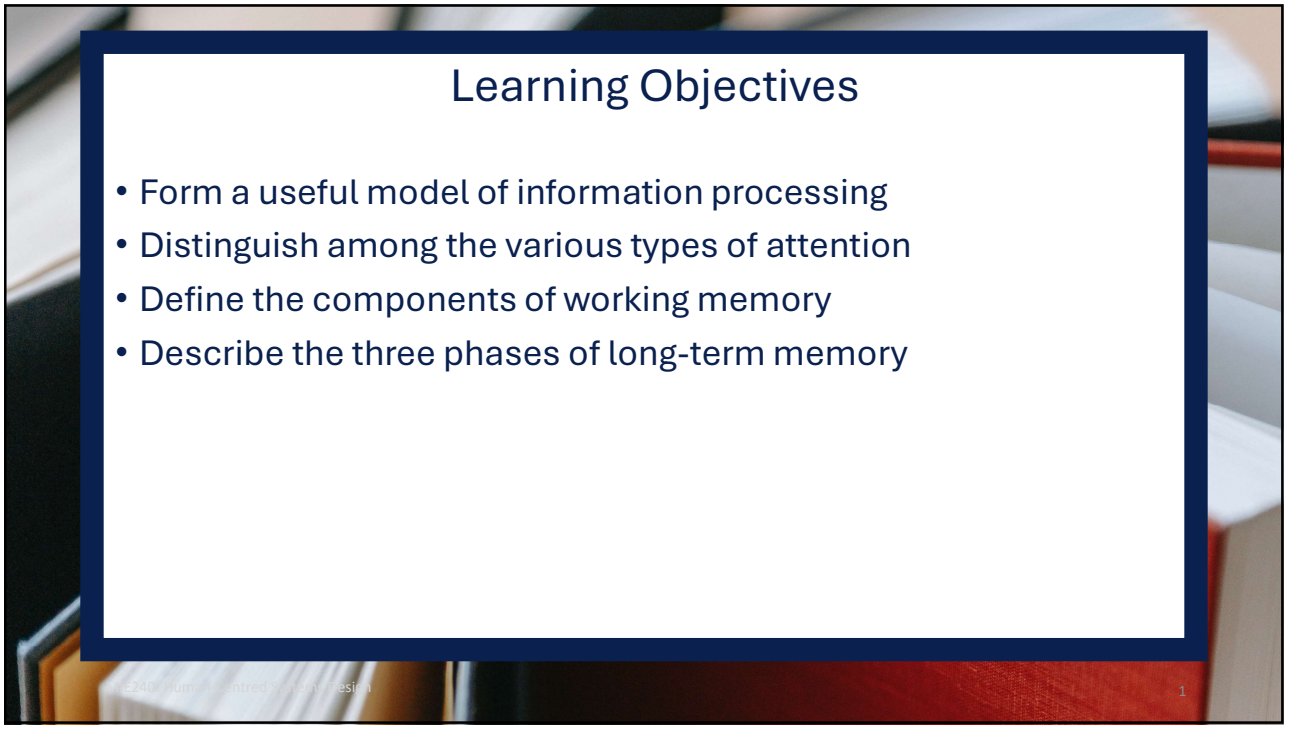

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Information processing

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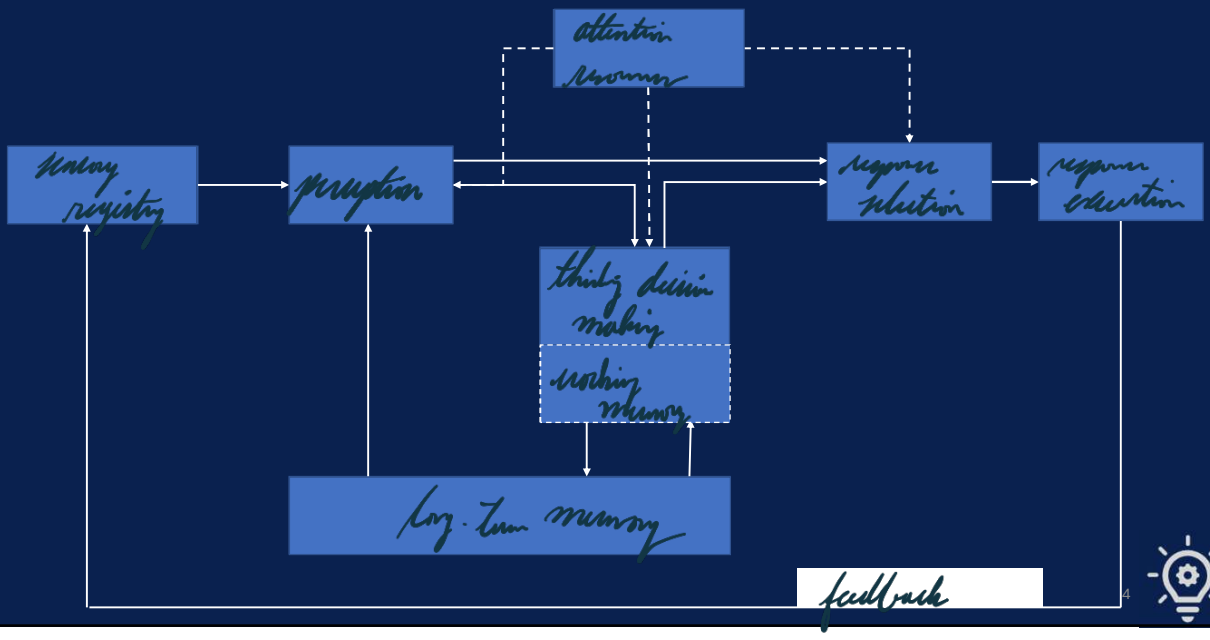
Information processing model



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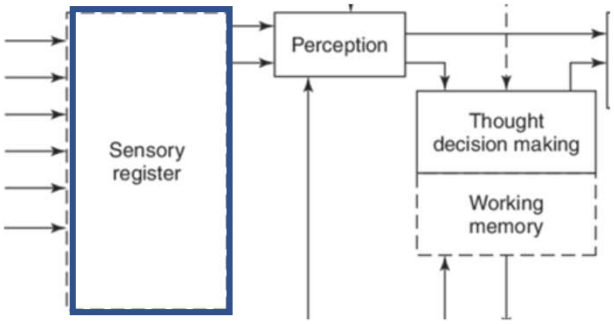
Sensory register



- Sight (visual)
- Sound (auditory)
- Touch (tactile)
- Vestibular (balance/coordinating movement)
- Smell (olfactory)
- Taste (gustatory)

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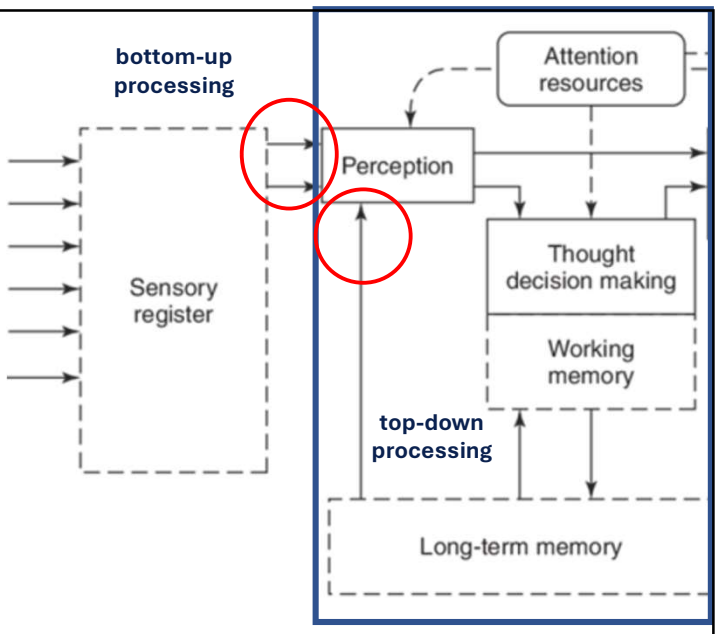
Perception

recognition and interpretation of sensory information.

Involves:

bottom-up processing: perceptions constructed from sensory register

top-down processing: using context or general knowledge to make sense of what we perceive



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An example of bottom-up and top-down processing

What is this image?

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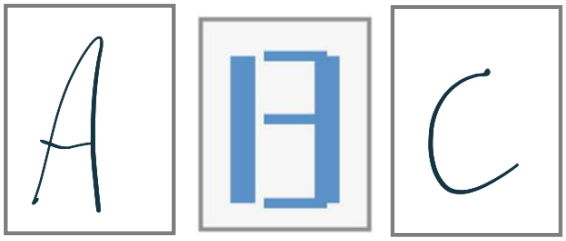
An example of bottom-up and top-down processing



What about now?

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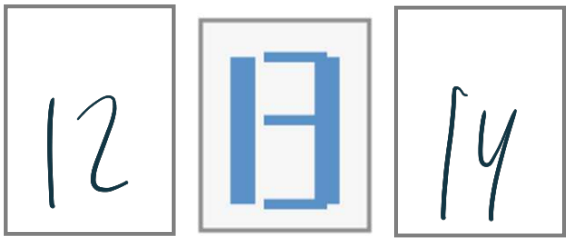
An example of bottom-up and top-down processing



What about now?

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Attention

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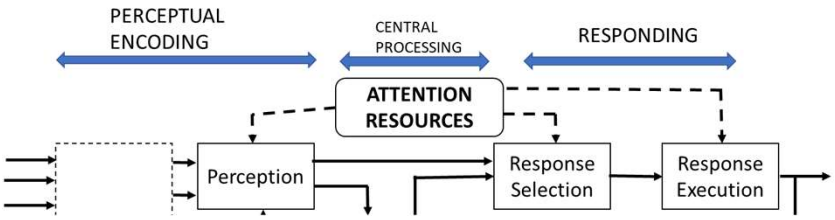
Attention

A cognitive process of selectively concentrating on one aspect of the external or internal environment while ignoring other aspects.

Driven by four factors:

- _____ - How emergent is the cue? (*bottom-up process*)
- *Effort* - prefer to use less effort
- _____- cues which we are *expecting (top-down)*
- _____- things which are of more value to us (*top-down*)



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Attention

a) **Selective Attention** – is simply the act of focusing on a particular object while ignoring irrelevant information.

b) **Sustained Attention** – allows us to filter out unwanted information (*e.g., concentrating*)

c) **Divided Attention** – allows us to perform multiple tasks at once

d) **Alternating Attention (Time-Sharing)** – switching between tasks

Selective attention

Sustained attention

What type of attention is described in the examples below:

1) Listening to music while exercising _____c_____
2) Having a conversation at a party _____a_____
3) Watching TV and folding clothes _____d_____
4) Studying for a final exam _____b_____
5) Talking on the phone and typing an email _____c_____
6) Reading a recipe and preparing a cake _____d_____

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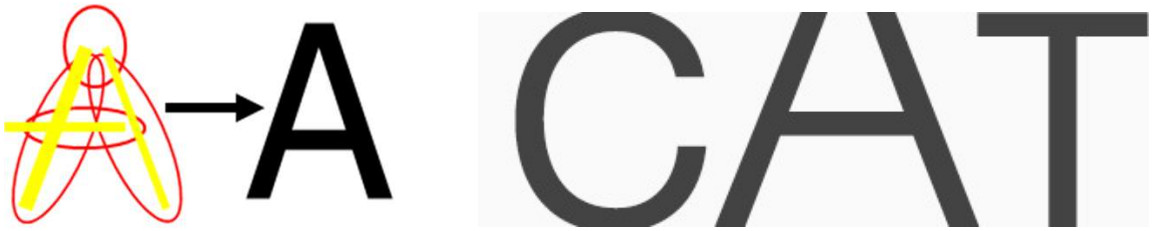
Attention

- Perception proceeds by analyzing the raw features of stimulus and events.
  - Bottom-up feature analysis, top-down processing, unitization
- **Unitization** - transformation from feature analysis to global or holistic processing as familiarity with pattern increases.



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Attention

Unitization allows us to read familiar words rapidly and overlook typographical errors:

"It deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoetnt tihng is taht the frist and lsat ltteer be at the rghit pclae. The rset can be a toatl mses and you can sitll raed it wouthit porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe."

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Attention models

Controlled Processing

- Requires attention
- Limited Capacity
- Rather Slow
- Effortful
- Is Aware

For example:
Learning to walk the first time
Driving a car while you are learning to drive

Automatic Processing

- Does not require attention
- Unlimited capacity
- Rather fast
- Effortless
- Outside awareness

For example:
Walking
Experienced driver driving a car

How does an activity become automatic? Practice - results in an increase in efficiency of these processes.

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Attention models

Dangers of automaticity

Revealed: Coroner warned 12 years ago about dangers of US service personnel driving on wrong side of road near American airbases in UK after two servicemen died in crash

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Working memory

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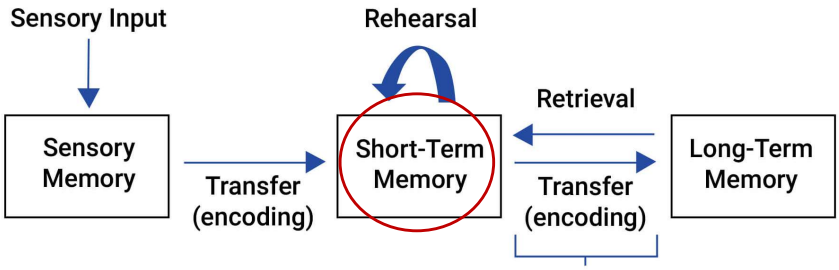
Working Memory

- **Working Memory**: temporary (~30 – 90 sec) and limited capacity (7 +/- 2 chunks) of verbal and spatial information that is currently being used.
- Information will be replaced by new information if not **rehearsed**.



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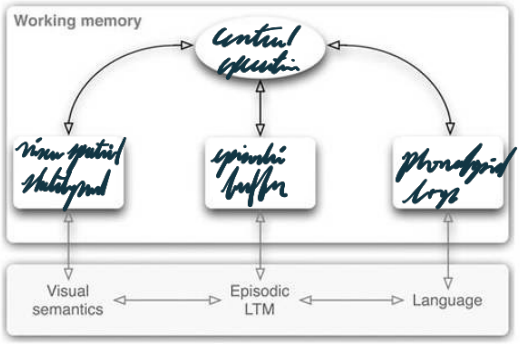
Working Memory

- **central executive**: attentional control system that coordinates information from the other three subsystems
- **visuospatial sketchpad**: holds information in an analog spatial form while it is being used (visual and maps)
- **phonological loop**: represents verbal information (words and numbers) in an acoustical form while it is being rehearsed
- **episodic buffer**: orders and sequences events and communicates with LT memory to provide meaning



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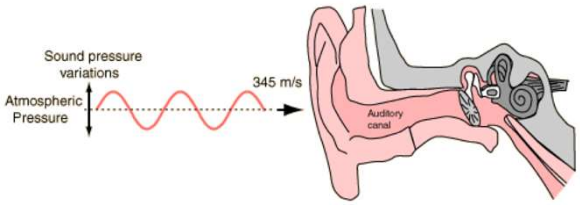
Working Memory

- Information must first be picked up by the senses before it can be processed
- Lasts different amount of time depending on the modality (*sensory memory*)
  - **iconic memory** involves the memory of visual stimuli (lasts briefly [<0.5sec])
  - **echoic memory** is specific to retaining auditory information, retained for 3–4 seconds
  - **haptic memory** involves sensory memories received via touch (*pain, pressure, itching etc.),* retained about 2 seconds



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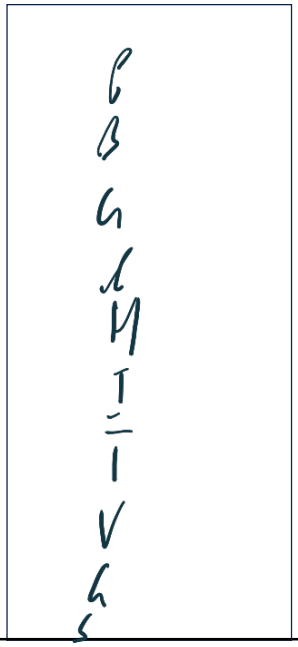
An example



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What were those words again?

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Long-term memory

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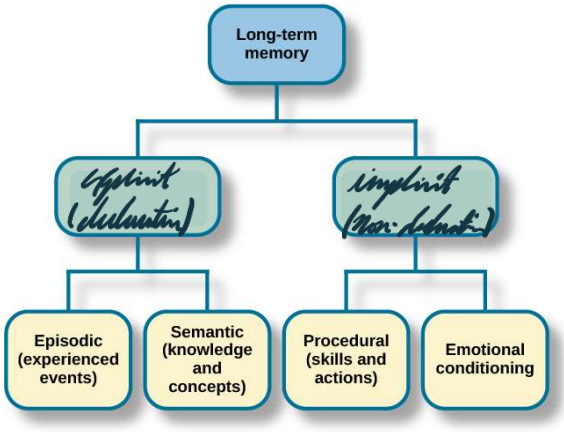
Long-Term Memory (LTM)

Nearly permanent storage of information with unlimited capacity

explicit memory: facts or events
- Semantic (*Capital of Spain*)
- Episodic (*Trip to Banff*)

implicit memory: non-declarative
- Procedures (how to swim, ride a bike)
- Priming - recent experience influence the interpretation of the world.



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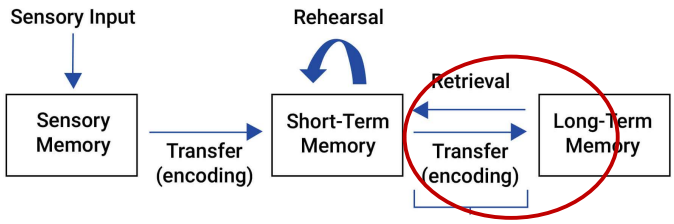
Long-Term Memory (LTM)

Three phases of LTM:

- encoding – placing information into memory
- storage – keeping information in memory
- retrieval – accessing information from LTM back into working memory



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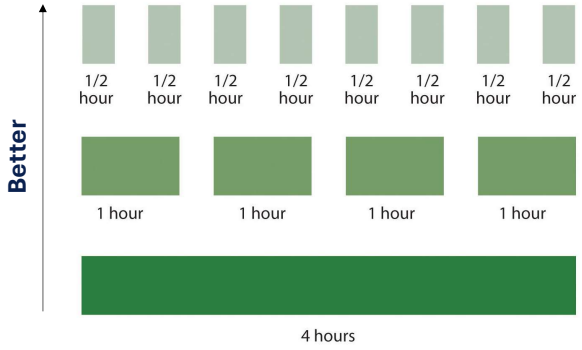
Long-Term Memory (LTM)

Encoding strategies

1. Rote Rehearsal
2. Chunking
3. Mnemonic devices
   - Acronyms
   - Method of loci
4. Self-referencing
5. Spacing



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Long-Term Memory (LTM)

Strategies

1.Rote Rehearsal: Memorizing the date of an event

2.Chunking: Organizing or grouping separate pieces of information together.

Remember the following 11 digits: 18646560856

You can break these numbers into chunks, such as: 1-864-656-0856.

3. Mnemonic devices: It's a memory technique to help your brain better encode and recall important information.

- Acronyms (HOMES, PEMDAS, BASMOQN)
- Method of loci: memory journey method

4. Self-referencing
   - Information that relates to oneself is more memorable in comparison to material that has less personal relevance.
5. Spacing
   - Study continuously for 8hrs for a test (not recommended)
   - Study 8 days (.5 -1 hr/day)

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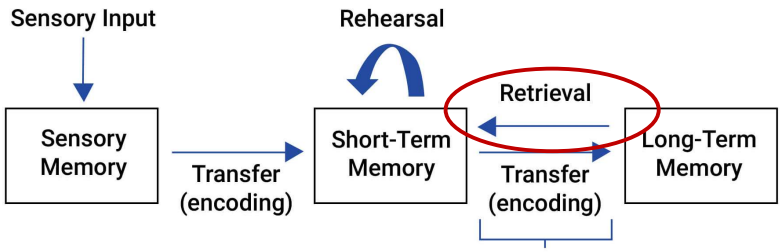
Information Retrieval

Retrieval: Act of gathering information from LT to working memory

Methods of Retrieval
- Free recall
- Cued recall
- Recognition



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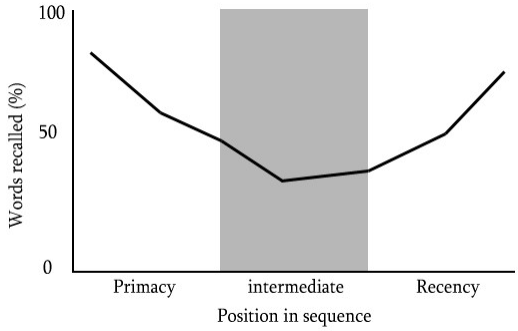
Information Retrieval

free recall: participant is presented a list of to-be-remembered items, one at a time ➔ asked to recall the item in any order



Serial position curve

https://en.wikipedia.org/wiki/Serial_position_effect

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Information Retrieval

cued recall: Retrieval of memory with the help of cues (often semantic).

- Differs from free recall in that a cue or word is presented that is related to the information being remembered.

Example: Fruit

Ap_ _ _ _ ➔ **Apple**

Or_ _ _ _ ➔ **Orange**

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Information Retrieval

Recognition: identifying something as familiar when encountered again

Recall

What are the three phases of the human-centered design process?

Recognition

Which of the following list include the three phases of the human-centered design process?

a
b
c
d ☆

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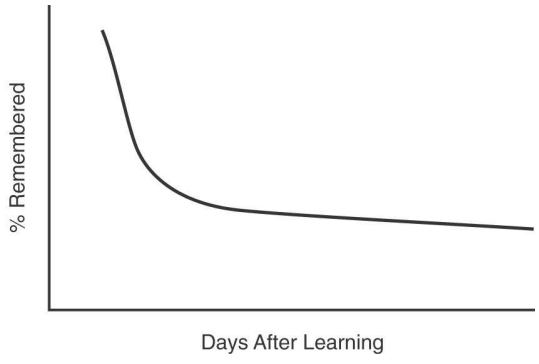
Forgetting

Caused by decay, interference, or inability to access (retrieve) information.

Memory retrieval fails due to:

1. Weak item **strength** due to low frequency or recency of reactivation
   - Ex: Password that is accessed once a semester
2. Weak or few **associations** of item with other info
   - Ex: (binaural – two??)
3. Interfering **associations**
   - Ex: mixing up friends' birthdays



Initial rate of forgetting is very high

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Summary

- Information processing model of cognition involves perceiving, thinking about, and responding to stimuli in your environment.
- Four types of attention: selective, sustained, divided, alternating
- Working memory describes temporary and limited capacity storage of verbal and spatial information that is currently being used.
- Four components of working memory:
  - Central executive:
  - Visuospatial Sketchpad
  - Phonological Loop
  - Episodic buffer
- LTM describes the nearly permanent storage of information with unlimited capacity. The three phases are **encoding, storage,** and **retrieval.**

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Next class (Tues., Jan. 21)

Topic: Design guidelines for cognition
Review: 6.3.3, 6.4.3 6.5.5

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