Long Term Memory: Elephants Remember for Lifetime

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Retrieval and Encoding in Long Term Memory

The traditional view of long term memory

LTM or long term memory can be described as a place for storing large amounts of information for indefinite periods of time. LTM is often thought of as a *treasure chest* of memories or *scrape* book of memories

Capacity **-** What is the capacity of LTM?

Thomas Landauer (1986) has tried to provide the answer by making two estimates

a) The size of the human brain is equal to the no of synapses in the Cerebral Cortex = $10^{13,}$ which is the no of bits of information stored in the brain

b) Another estimate is 10^{20} bits of information which is the no is neuronal transmission made by average human lifetime

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Coding in LTM

Errors made while recalling information from LTM are likely to be semantic confusion.

Baddeley (1966a)

Group A — Similar sounding words list 1 (map, mad, man)

Matched words from list 1 but not similar sounding (pen, day, rig)

Group B — Similar meaning words list 2 (huge, big, great)

Matched words from list 2 but not similar meaning (foul, old, deep)

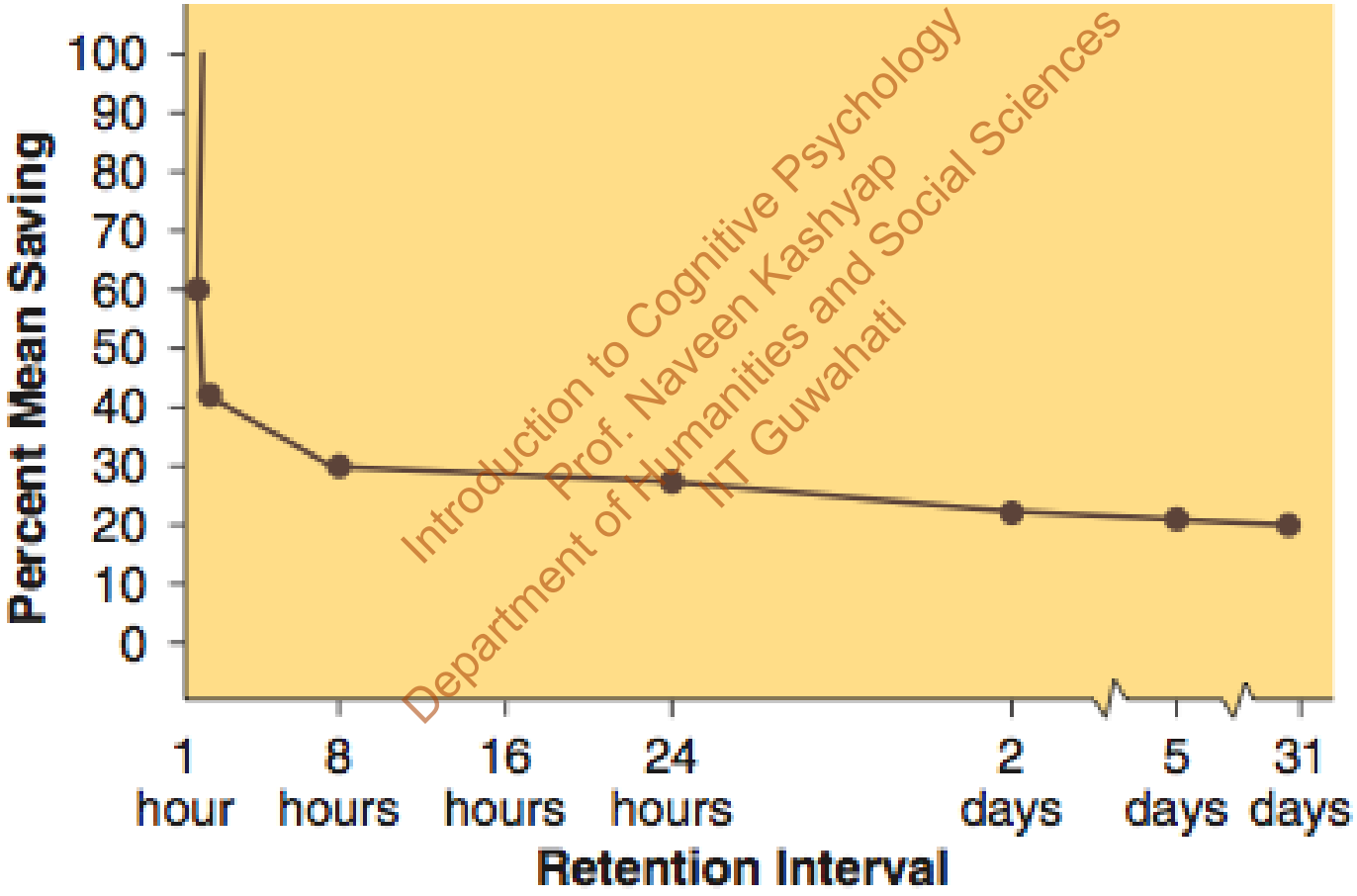
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Recall after 20 min / participants engaged in unrelated task

Acoustic similarity produced little effect on performance as compared to semantic similarity. Group 2 performed worse compared to group 1

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Forgetting: Ebbinghaus's forgetting curve

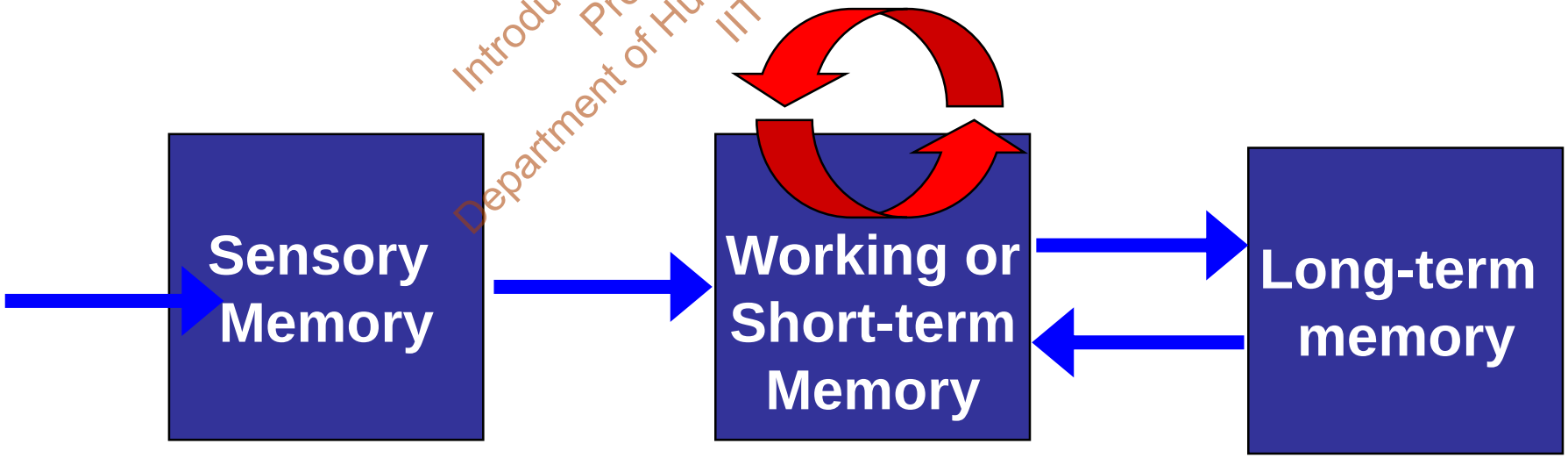


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Review of Long-term Memory

- Retrieval transfers info from LTM to STM
- Forgetting - inability to retrieve previously available information
- Why do people forget?

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Forgetting theories

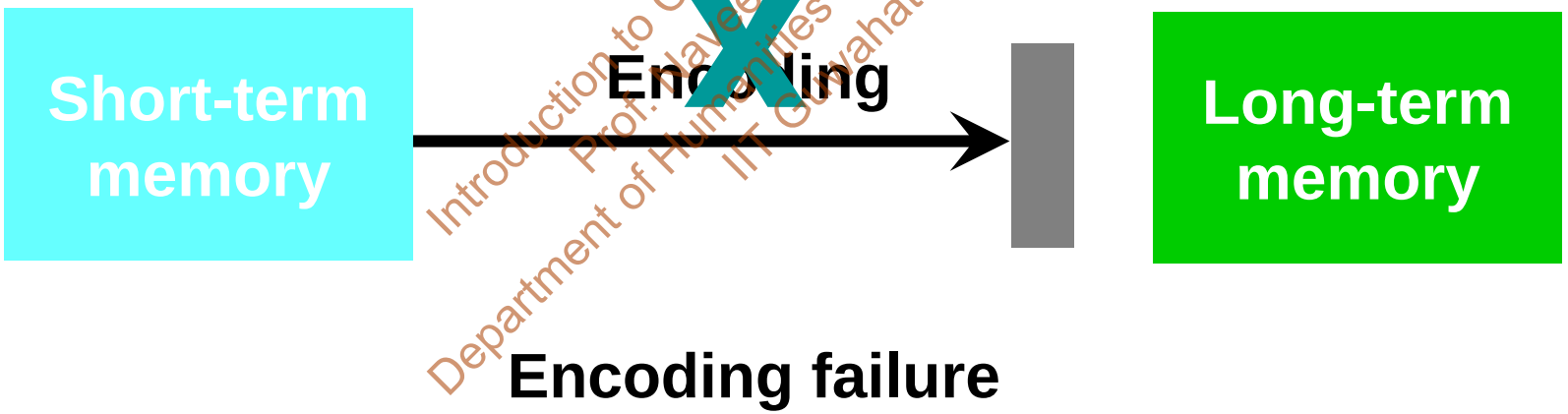
- Poor encoding theories
- Decay theories
- Interference theories
- Retrieval-cue theories



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Forgetting as encoding failure

- Info never encoded into LTM



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Encoding failure leads to forgetting

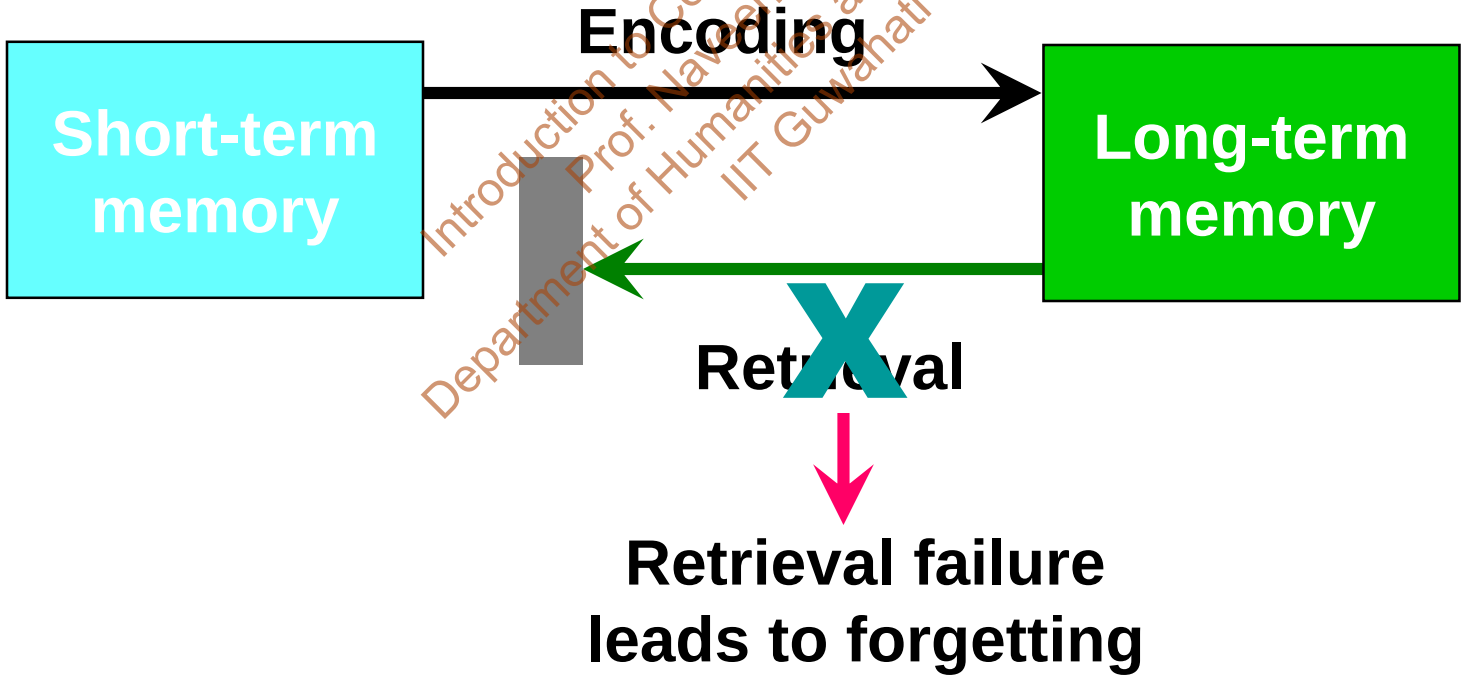
Some encoding failure demos

- What letters accompany the number 5 on your telephone?
- Where is the number 0 on your calculator?
- According to this theory, objects seen frequently, but info never encoded into LTM

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Forgetting as retrieval failure

- Not all forgetting is due to encoding failures
- Sometimes info IS encoded into LTM, but we can't retrieve it



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Tip of the tongue phenomenon

- a.k.a. TOT experience
- Can’t retrieve info that you absolutely know is stored in your LTM
- Example: ???
- Evidence of forgetting as an inability to retrieve info
- Why can’t we retrieve info?

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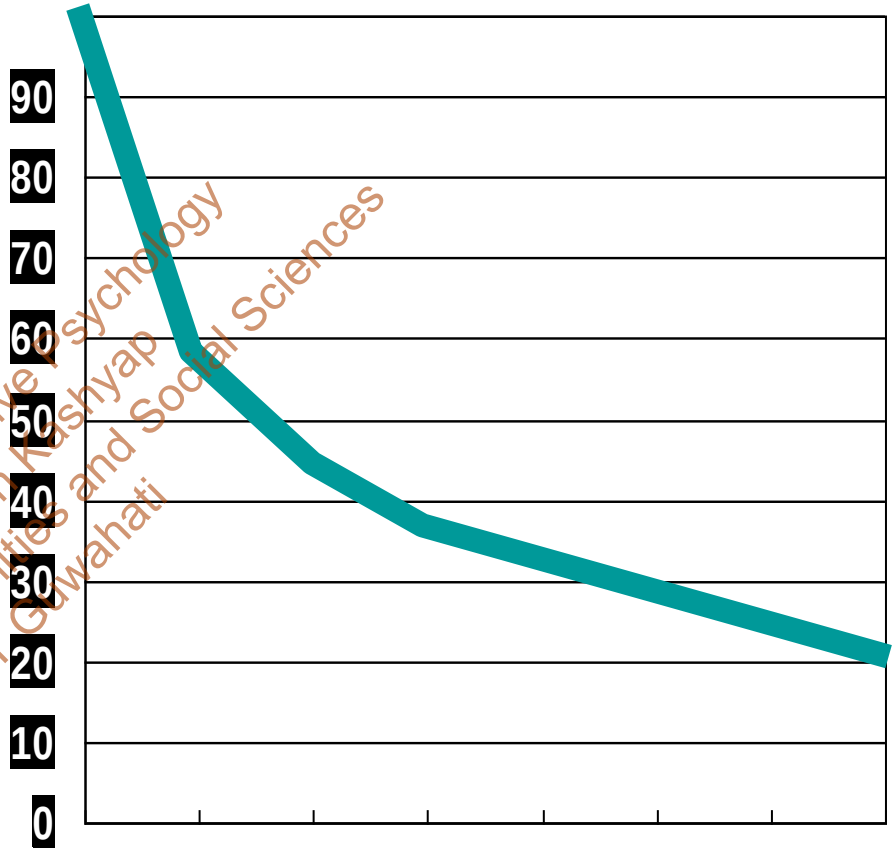
Retrieval failure theories

- Decay theories
- Interference theories
- Retrieval cue theories

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Decay theories

- Memories fade away or decay gradually if unused
- Time plays critical role
- Ability to retrieve info declines with time after original encoding



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Decay theories

- Biology-based theory
- When new memory formed, it creates a *memory trace*
  - a change in brain structure or chemistry
- If unused, normal brain metabolic processes erode memory trace
- Theory not widely favored today
  - info CAN be remembered decades after original learning
    - even if unused since original learning

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Interference theories

- “Memories interfering with memories”
- Forgetting NOT caused by mere passage of time
- Caused by one memory competing with or replacing another memory
- Two types of interference

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Experimental Paradigm for Interference

Phase	Experimental Group	Control Group
Proactive Interference		
I	Learn List A-B	Unrelated Activity
II	Learn List A-C	Learn List A-C
Test	List A-C	List A-C
Retroactive Interference		
I	Learn List A-B	Learn List A-B
II	Learn List A-C	Unrelated Activity
Test	List A-B	List A-B

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Retroactive interference

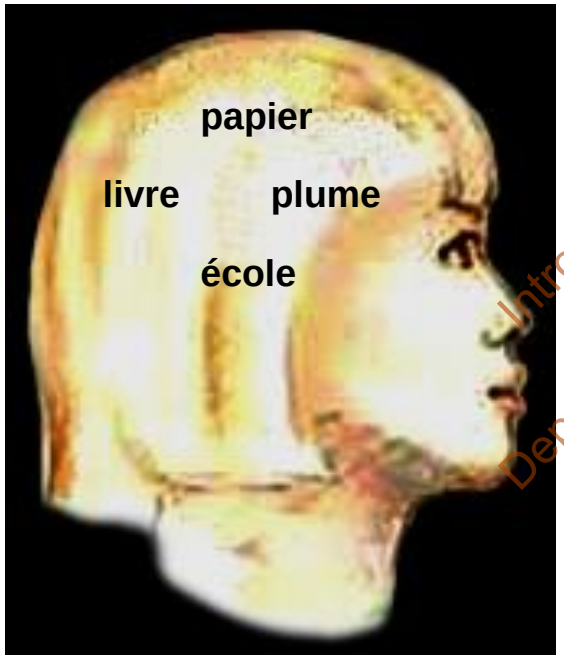
- When a NEW memory interferes with remembering OLD information
- Example: When new phone number interferes with ability to remember old phone number

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Retroactive interference

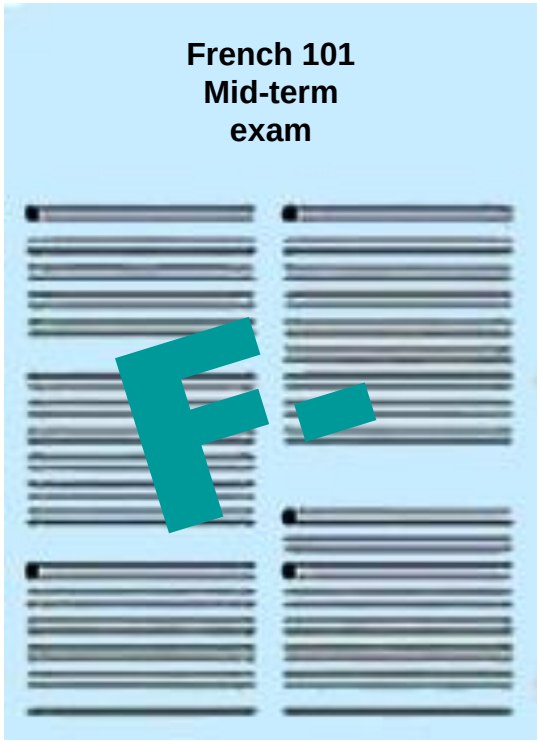
- Example: Learning a new language interferes with ability to remember old language

Study French



Study Spanish



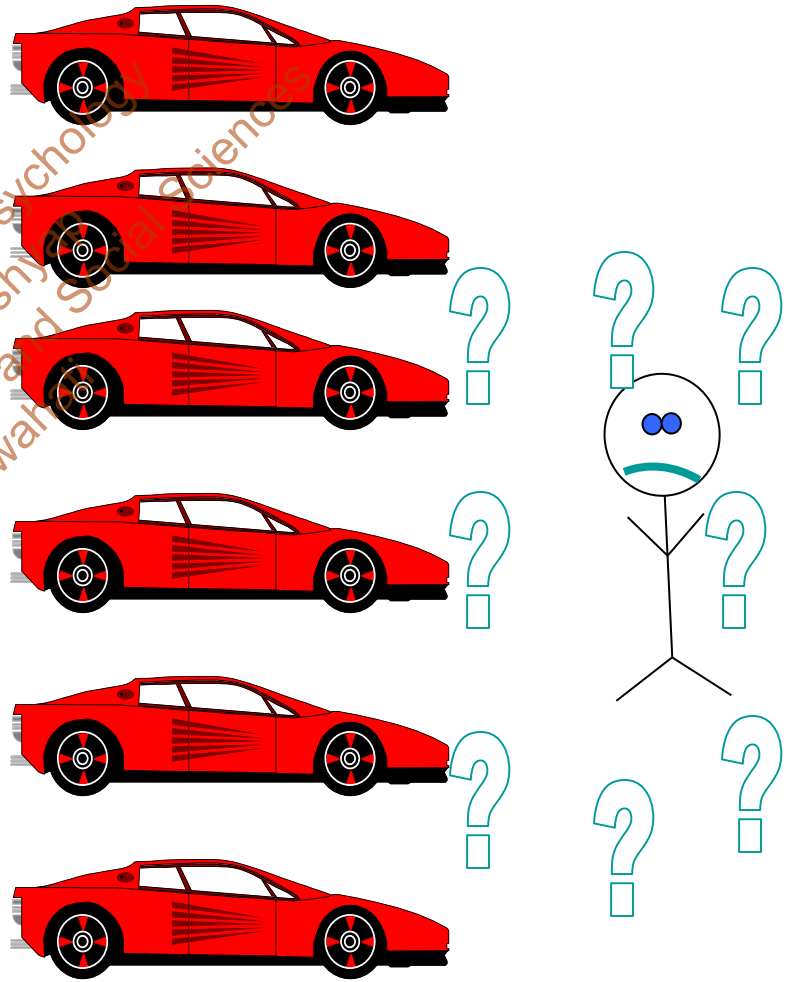


retroactive interference

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Proactive interference

- Opposite of retroactive interference
- When an OLD memory interferes with remembering NEW information
- Example: Memories of where you parked your car on campus the past week interferes with ability find car today



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Retrieval cue theories

- Retrieval cue - a clue, prompt or hint that can help memory retrieval
- Forgetting the result of using improper retrieval cues

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Recall vs. Recognition tests

- Importance of retrieval cues evident in recall vs. recognition tests
- Recall tests - must retrieve info learned earlier
  - Examples: Fill-in-the-blank test; essay exams
- Recognition tests - only need to identify the correct answer
  - Example: Multiple choice tests

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What is the capital of Finland?

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What is the capital of Finland?

- A. Uppsala
- B. Helsinki
- C. Tampere
- D. Amsterdam
- Which was easier: recall or recognition?
- For your psychology exam, would you rather have a fill-in-the-blank or a multiple choice test?

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Which retrieval cues work best?

- Encoding specificity principle - cues used during initial learning more effective during later retrieval than novel cues

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Which retrieval cues work best?

- Context-dependent memory - improved ability to remember if tested in the same environment as the initial learning environment
  - Better recall if tested in classroom where you initially learned info than if moved to a new classroom
  - If learning room smells of chocolate or mothballs, people will recall more info if tested in room with the same smell
    - compared to different smell or no smell at all

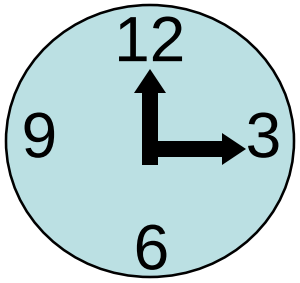
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Context dependent effects

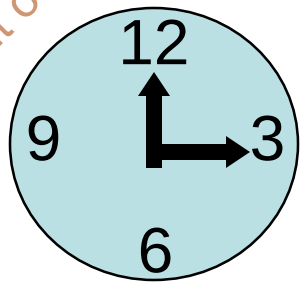
- Time of day is also important

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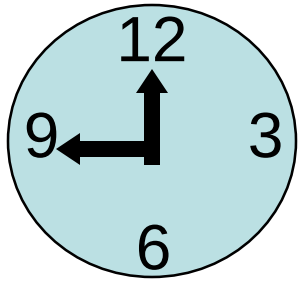
Learn at 3pm



Perform better at 3pm

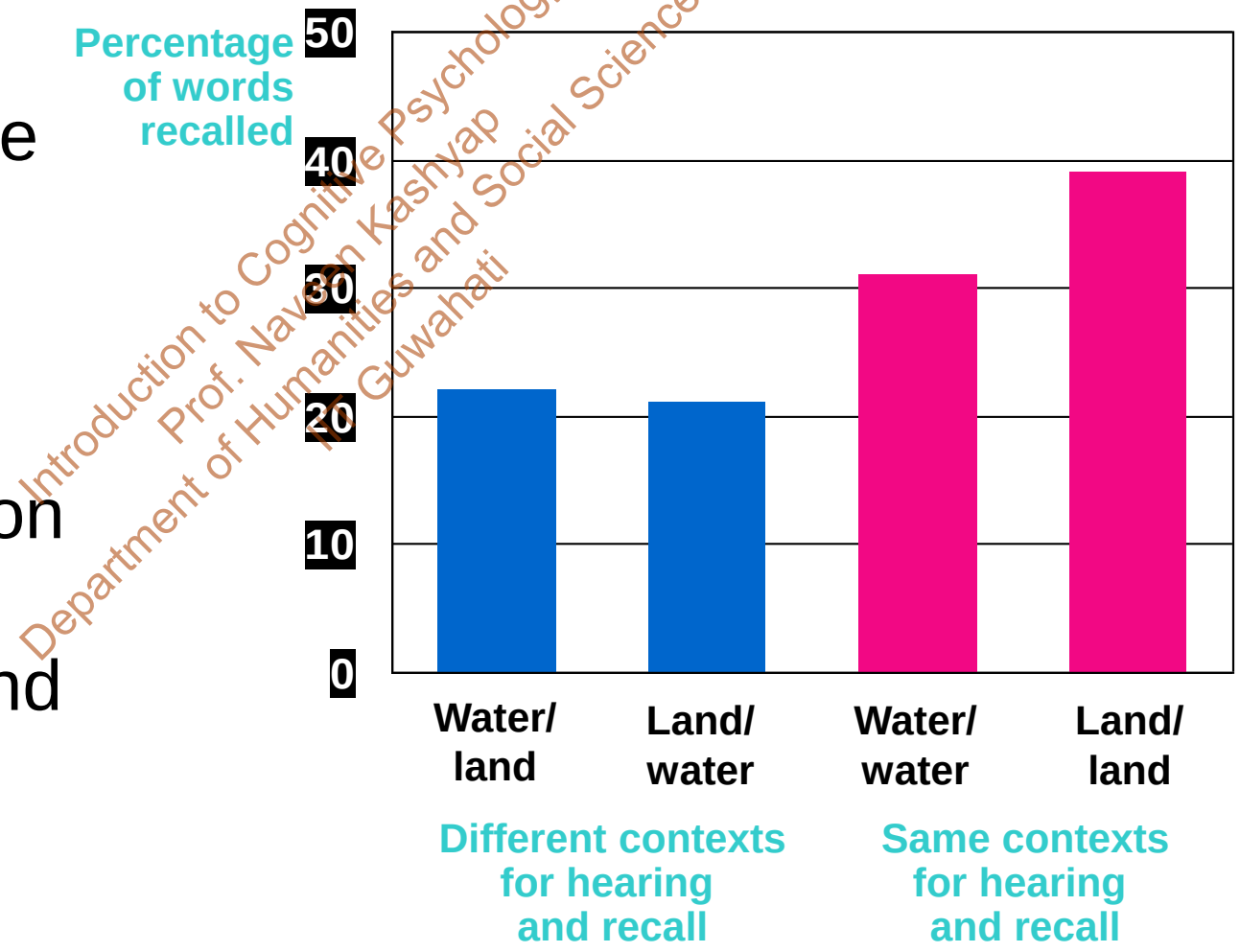


Than 9pm



Context-dependent effects

- Words heard underwater are best recalled underwater
- Words heard on land are best recalled on land



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State-dependent effects

- Recall improved if internal physiological or emotional state is the same during testing and initial encoding
- Context-dependent - external, environmental factors
- State-dependent - internal, physiological factors

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State-dependent effects

- Mood or emotions also a factor
- Bipolar depressives
  - Info learned in manic state, recall more if testing done during manic state
  - Info learned in depressed state, recall more if testing done during depressed state

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State dependent effects

Drunk during learning



Recall better if drunk



Than if sober



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The spacing effect

- Better to study for several shorter periods than for one longer period
- One hour per day for 8 days leads to better recall than 8 hours of cramming!
- Why? *Encoding variability*: best to encode in a variety of ways, to attach a wider variety of memory cues to the material. Spacing practice sessions allows for more variability.

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Subdivisions of long-term memory

- Semantic memory: general knowledge
- Episodic memory: events in which you participated
- Explicit memory: consciously recollected
- Implicit memory: not consciously recollected, but shown in other ways

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Declarative vs. procedural memory

- Procedural memory: how to do things
- Declarative memory: facts, information, ideas

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Levels of processing

- Participants told to answer questions as quickly as possible about words on screen:

DOG

- “Is it in capital letters?”
- “Does it rhyme with FROG?”
- “Does it fit in this sentence: The ____ jumped up on the mailman”?

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Levels of processing

- Later, on a surprise recall test, participants showed best memory for words that had been fit into sentences.
- Better recall because of DEEPER PROCESSING for these types of questions, which forced participants to think about the MEANING of the words on the screen

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Reconstructive memory

- Retelling of stories leads to distortions in what is remembered.
- Eyewitness memory is subject to distortion when leading questions are asked.
  - "Did another car pass the red Datsun at the stop sign?"
  - The sign was actually a yield sign.
  - Participants later falsely recognized the stop sign 59% of the time.

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Eyewitness testimony

- Recall not an exact replica of original events
- Recall a *construction* built and rebuilt from various sources
- Often fit memories into existing beliefs or schemas
- Schema - mental representation of an object, scene or event
  - Example: schema of a countryside may include green grass, hills, farms, a barn, cows etc.

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Eyewitness testimony

- Scripts - type of schema
  - Mental organization of events in time
  - Example of a classroom script: Come into class, sit down, talk to friends, bell rings, instructor begins to speak, take notes, bell rings again; leave class etc.

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Memory distortion

- Memory can be distorted as people try to fit new info into existing schemas
- Giving misleading information after an event causes subjects to unknowingly distort their memories to incorporate the new misleading information

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Loftus experiment

- Subjects shown video of an accident between two cars
- Some subjects asked: How fast were the cars going when the smashed into each other?
- Others aksed: How fast were the cars going when the hit each other?

Accident



Leading question:
"About how fast were the cars going When they *smashed* into each other?"

Memory construction



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Loftus results

Word Used in Question	Average Speed Estimate
smashed	41 m.p.h.
collided	39 m.p.h.
bumped	38 m.p.h.
hit	34 m.p.h.
contacted	32 m.p.h

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Autobiographical memory

- Real-world memories are more durable than laboratory memories of word lists.
- Some items are forgotten because they are hard to distinguish from other, similar memories.
- Single-event memories are often combined into extended or summarized events.
- Rare actions are more likely to be recalled than frequent actions.

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Flashbulb memories



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False memory creation

- “You went on a shopping trip with your mom and your cousin. Somehow, you wandered away in the store and got lost. A security guard found you and you were reunited with your mom about an hour later.”
- This event never happened. But after repeated questioning, 29% of participants “recalled” details of the false event!

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The Deese/Roediger-McDermott paradigm

- Study of list of words related to sleep:

Dark

Dream

Pillow

Nap

Night

Quiet

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- 80% of participants false recognize “sleep” as having been on the list, although it wasn’t.

Amnesia

- Anterograde amnesia: inability to learn new information after the initial point of memory loss (“H.M.”)
- Old memories in LTM remain intact.
- General knowledge and skills remain intact.

- Retrograde amnesia: loss of memory for information stored before the point of memory loss
- Spares “overlearned” information, and skills

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