

# 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 *scrapbook* 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 of neuronal transmission made by average human lifetime

## *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 )

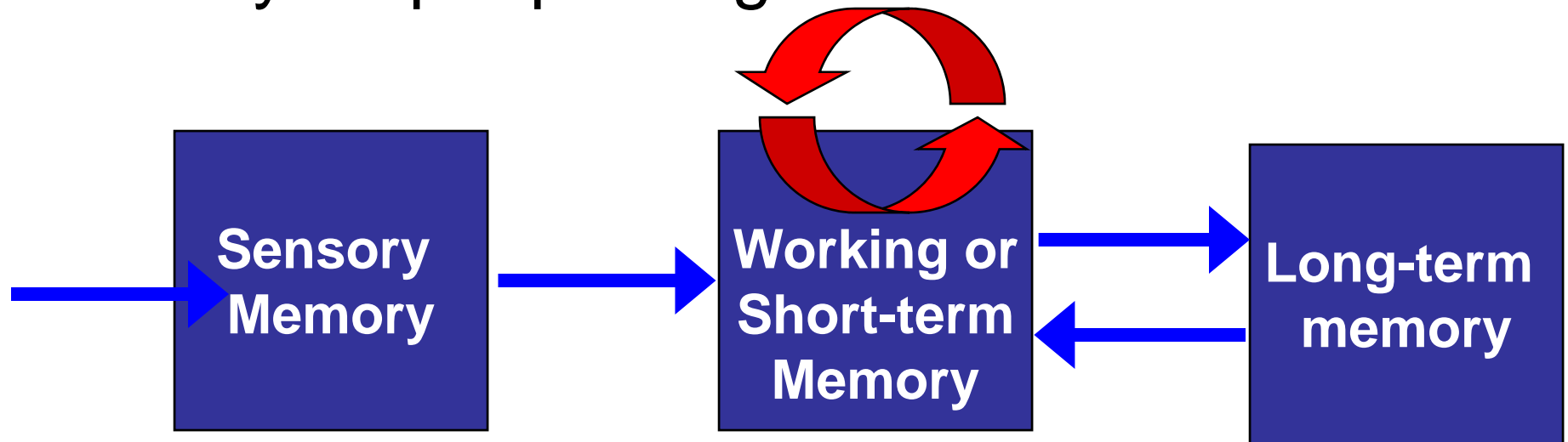
Group B                      Similar meaning words list 2 (huge, big, great)  
                                    Matched words from list 2 but not similar meaning (foul, old, deep )

↓ 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

# Review of Long-term Memory

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



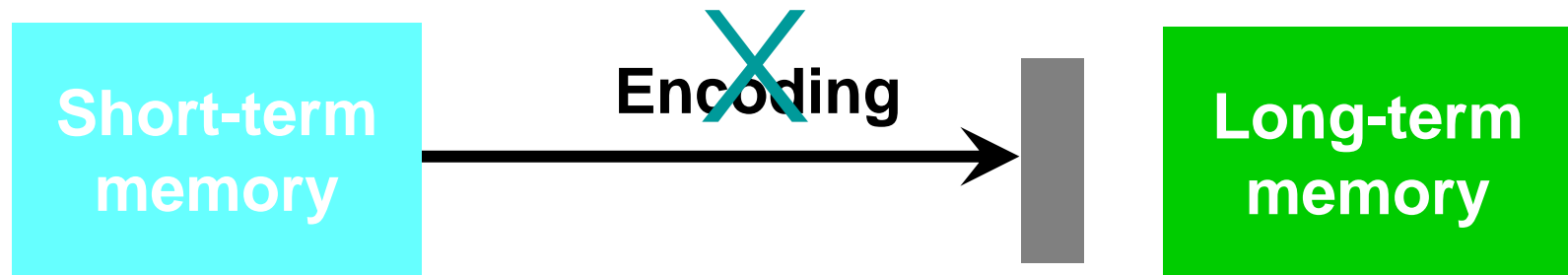
# Forgetting theories

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



# Forgetting as encoding failure

- Info never encoded into LTM



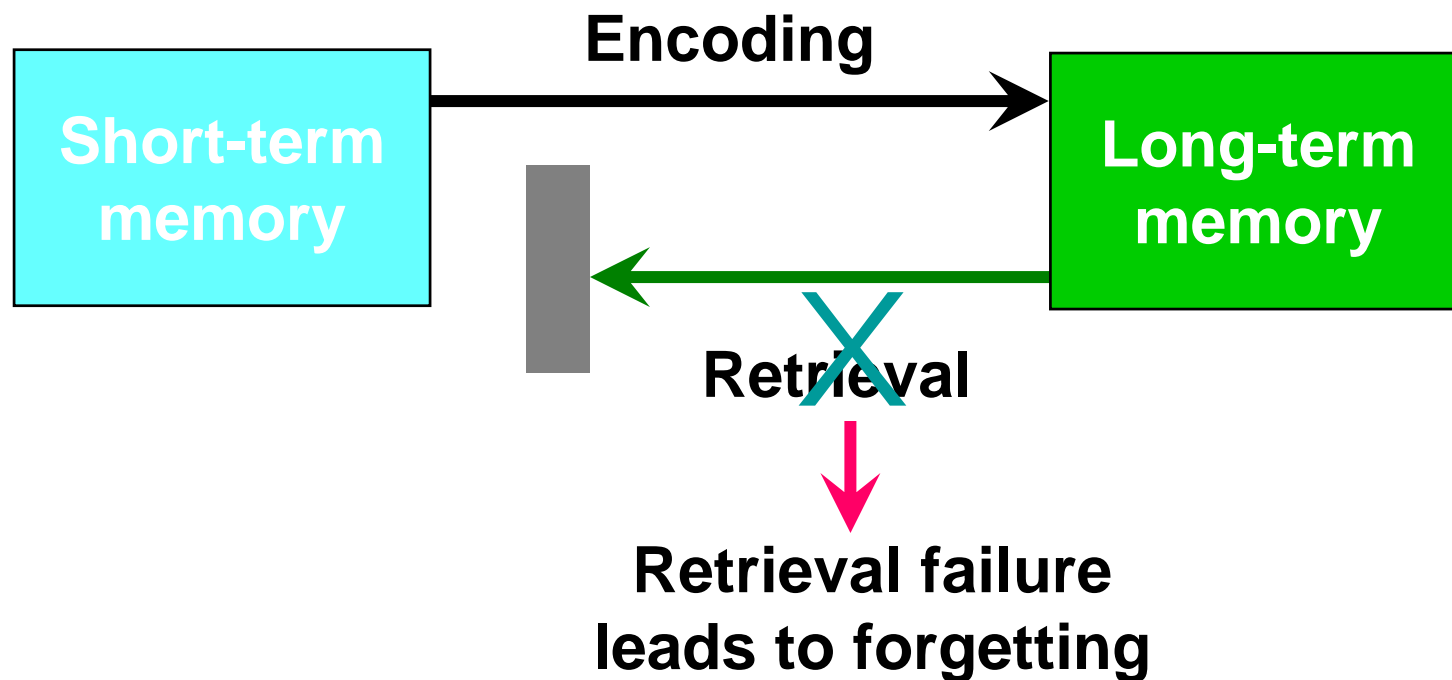
**Encoding failure  
leads to forgetting**

# 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

# Forgetting as retrieval failure

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



# 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?



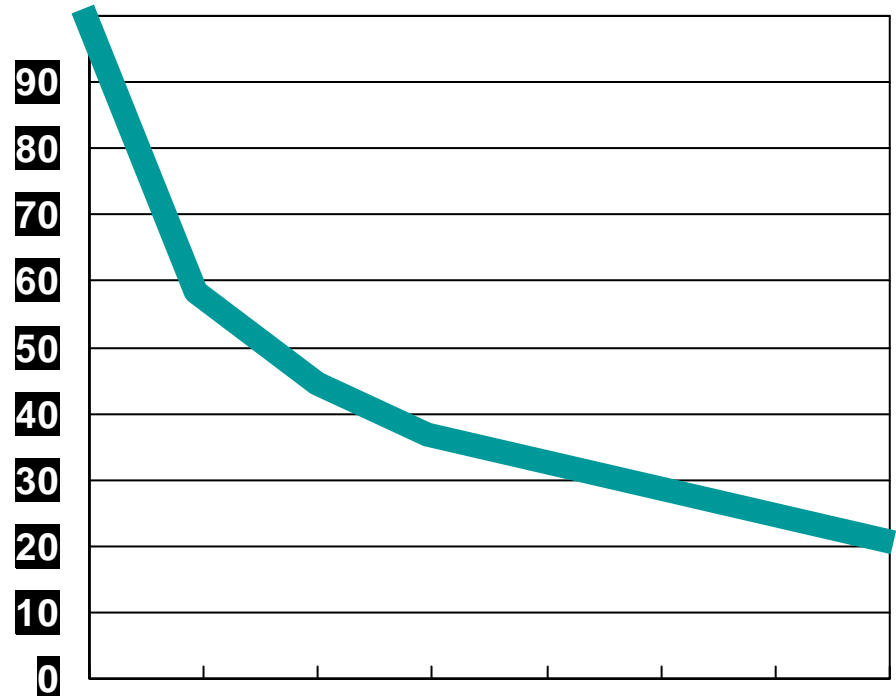
# Retrieval failure theories

- Decay theories
- Interference theories
- Retrieval cue theories

# Decay theories

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

Average  
percentage of  
information  
retained



Interval between original learning of  
nonsense syllables and memory test

# 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

# 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

# Experimental Paradigm for Interference

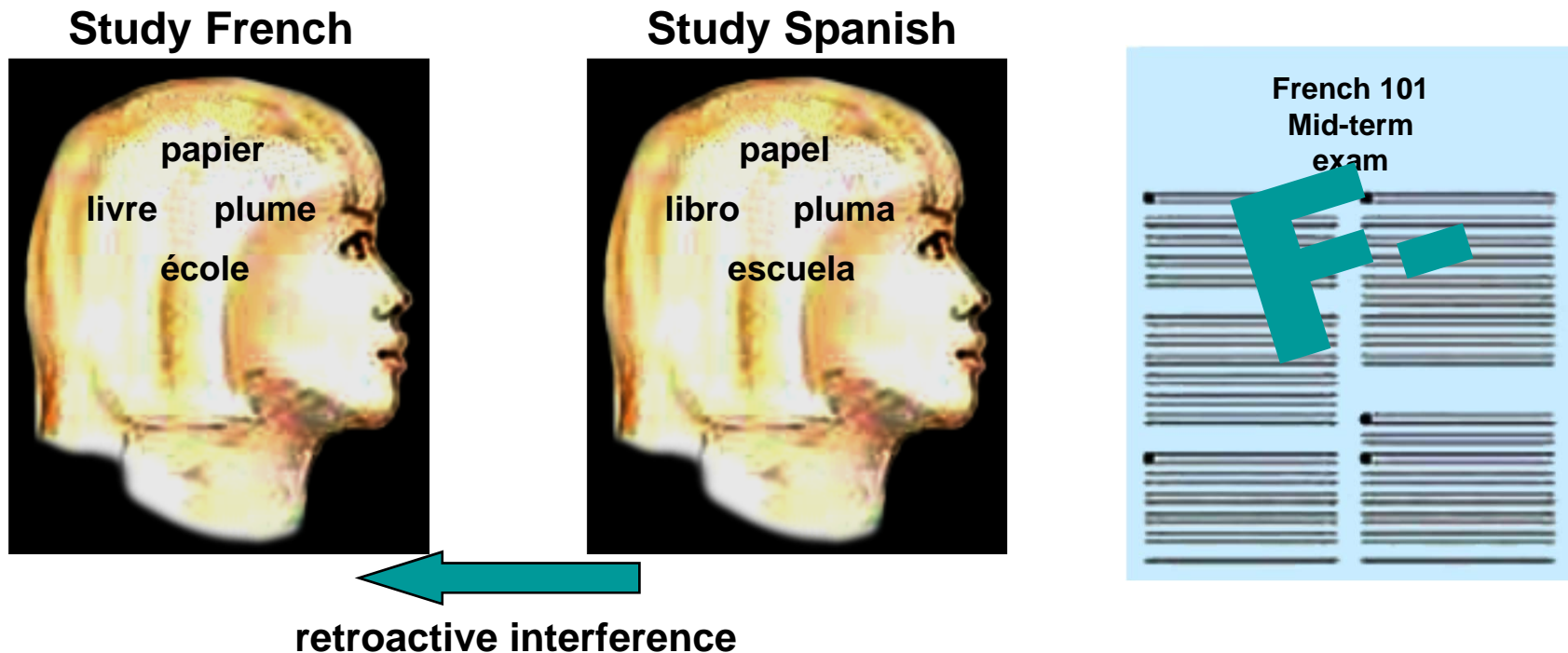
Phase	Experimental Group	Control Group
<i>Proactive Interference</i>		
I	Learn List A-B	Unrelated Activity
II	Learn List A-C	Learn List A-C
Test	List A-C	List A-C
Retroactive Interference		
I	Learn List A-B	Learn List A-B
II	Learn List A-C	Unrelated Activity
Test	List A-B	List A-B

# Retroactive interference

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

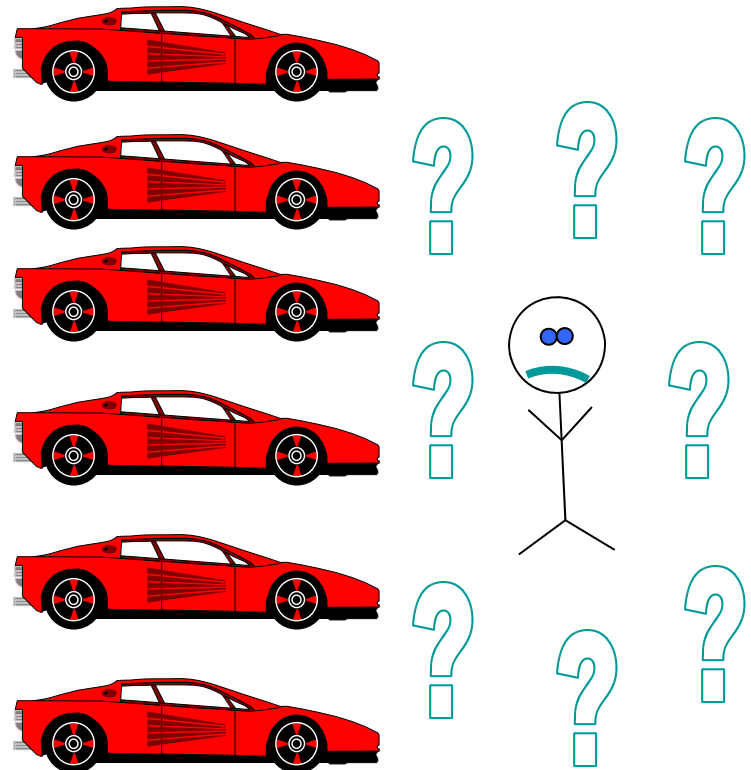
# Retroactive interference

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



# 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





# Retrieval cue theories

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

# 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

What is the capital of  
Finland?

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?

# Which retrieval cues work best?

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

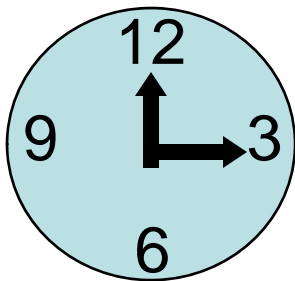
# Which retrieval cues work best?

- 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

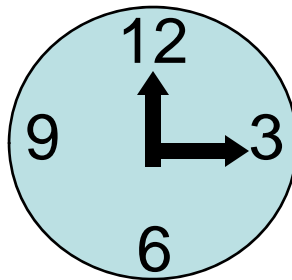
# Context dependent effects

- Time of day is also important

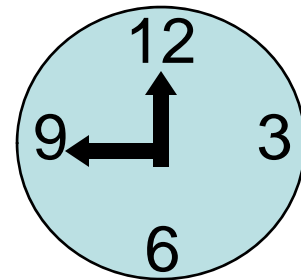
Learn at 3pm



Perform better at 3pm

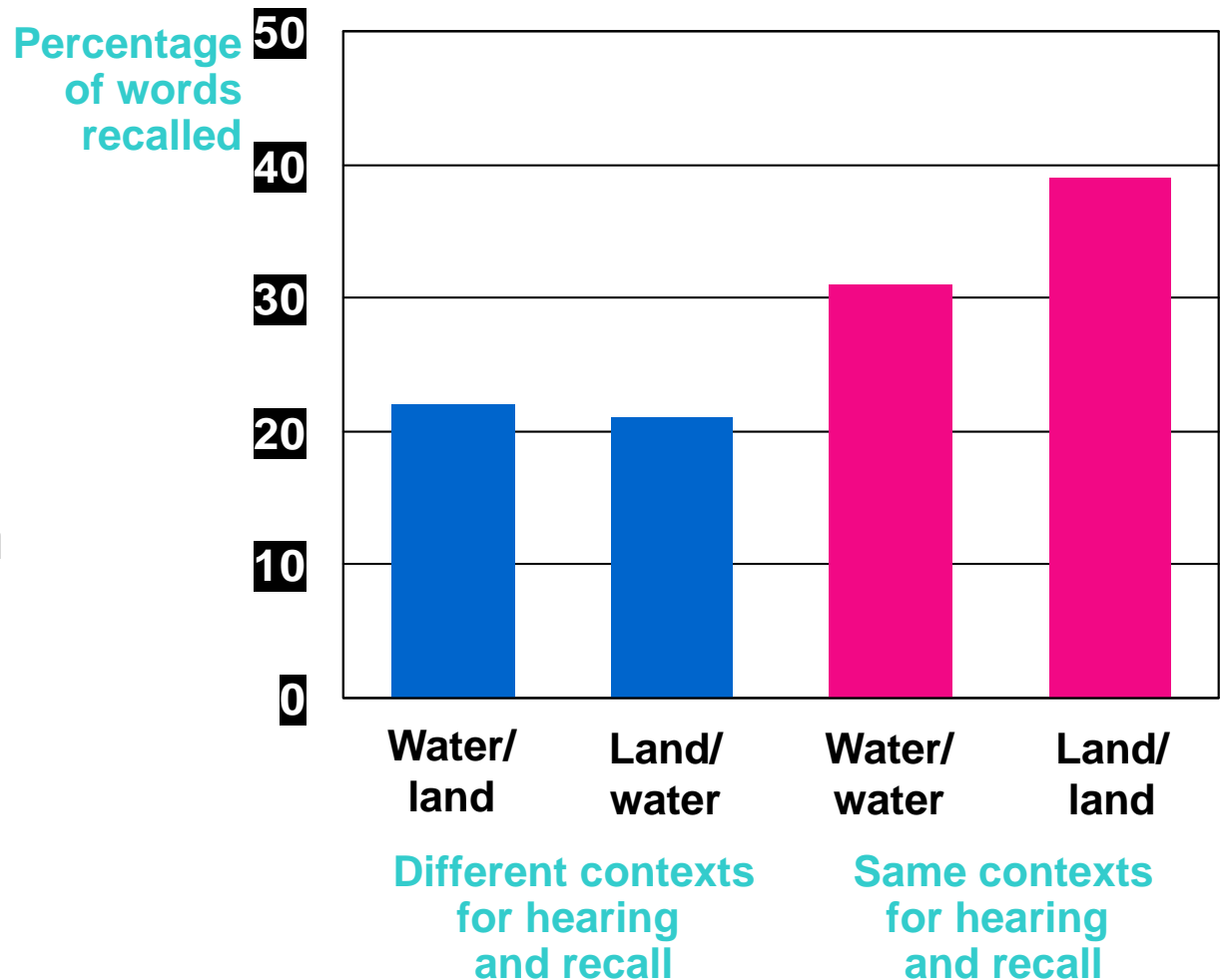


Than 9pm



# Context-dependent effects

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





# 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

# 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

# State dependent effects

Drunk during  
learning



Recall better  
if drunk



Than if sober



# 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.

# 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.

# 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

# 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 asked: How fast were the cars going when they hit each other?

Accident



Leading question:

“About how fast were the cars going  
When they *smashed* into each other?”

Memory construction



# 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