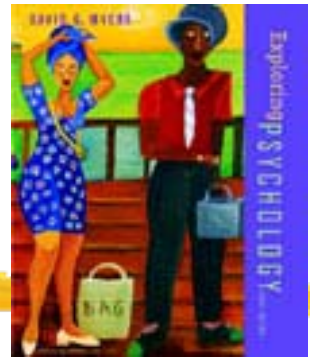# Psych 105

Chapter 8

Memory

Memory

- Memory
  - persistence of learning over time through the storage and retrieval of information
- Flashbulb Memory
  - a clear memory of an emotionally significant moment or event

Memory

- Memory as Information Processing
  - similar to a computer
    - write to file
    - save to disk
    - read from disk
- Encoding
  - the processing of information into the memory system
  - i.e., extracting meaning

Memory
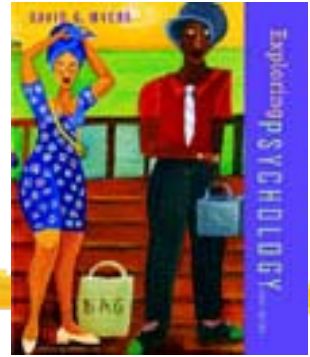
- Storage
  - the retention of encoded information over time

- Retrieval
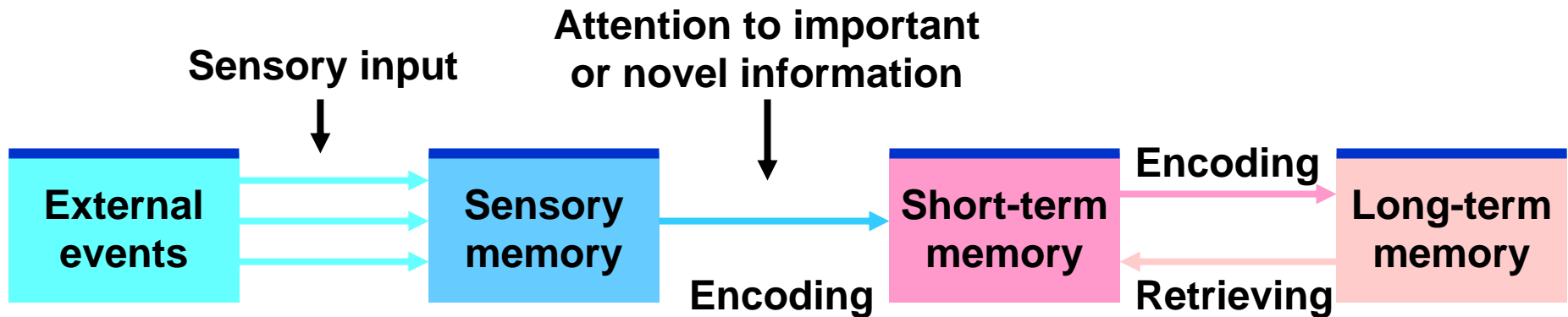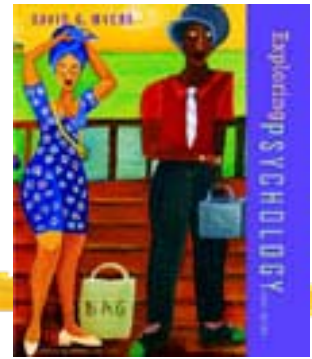 - process of getting information out of memory

Memory

- Sensory Memory
  - the immediate, initial recording of sensory information in the memory system
- Working Memory
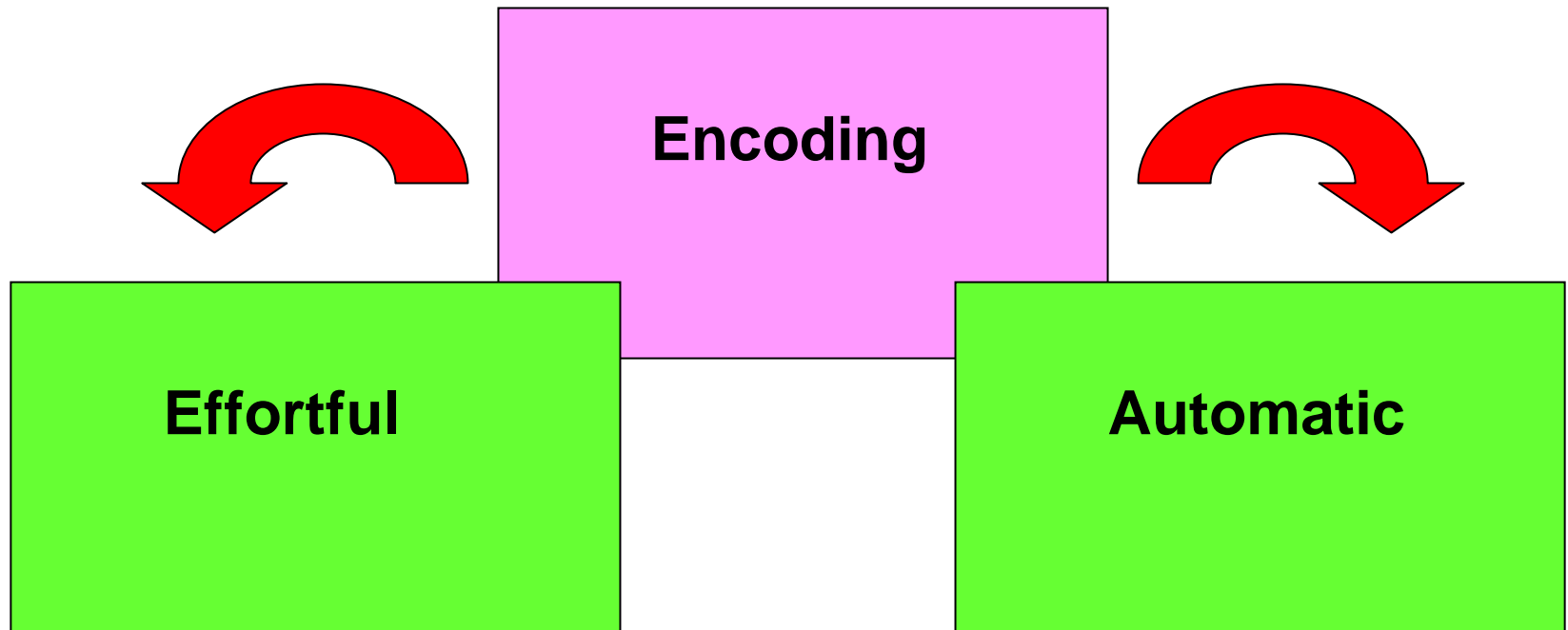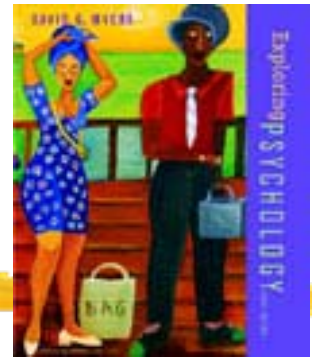 - focuses more on the processing of briefly stored information

Memory

- **Short-Term Memory**
  - activated memory that holds a few items briefly
  - look up a phone number, then quickly dial before the information is forgotten
- **Long-Term Memory**
  - the relatively permanent and limitless storehouse of the memory system

A Simplified Memory Model

Sensory input

Attention to important or novel information

| External events | | Sensory memory | | Short-term memory | | Long-term memory |

```
External          Sensory              Short-term           Long-term
events   ──────►  memory   ─────────►  memory   ─────────►  memory
                                                  ◄─────────
                           Encoding    Encoding
                                                  Retrieving
```

Encoding

Retrieving

Encoding - Getting Information In

Encoding

Effortful

**Automatic**

Encoding

- Automatic Processing
  - unconscious encoding of incidental information
    - space
    - time
    - frequency
  - well-learned information
    - word meanings
  - we can learn automatic processing
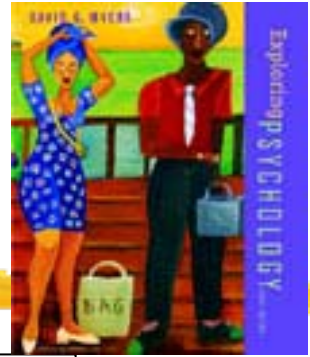   - reading backwards

Encoding

- Effortful Processing
  - requires attention and conscious effort

- Rehearsal
  - conscious repetition of information
    - to maintain it in consciousness
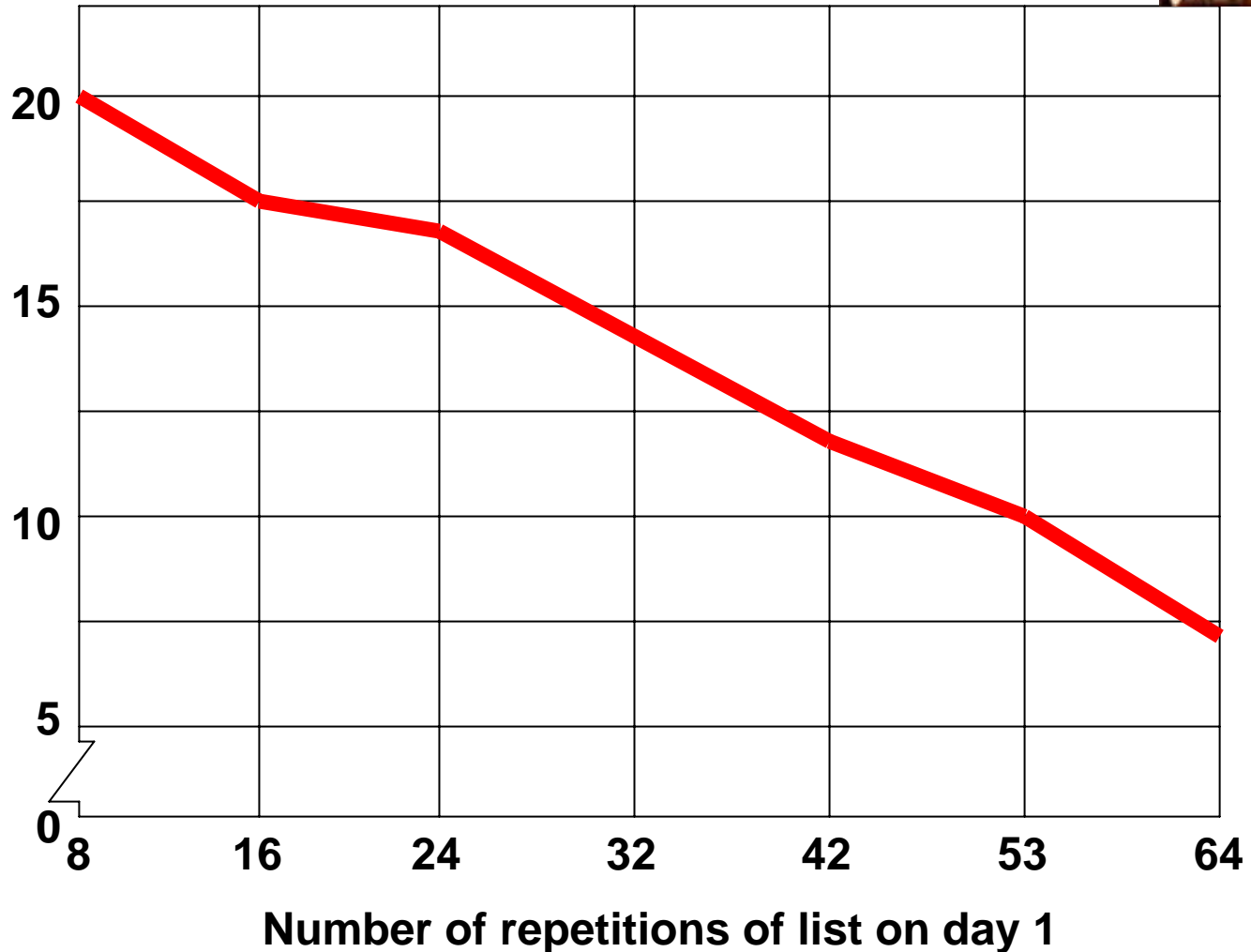   - to encode it for storage

Encoding
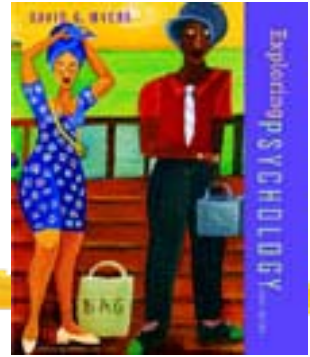
- Ebbinghaus used nonsense syllables
    - TUV ZOF GEK WAV
    - the more times practiced on Day 1, the fewer repetitions to relearn on Day 2
- Spacing Effect
    - distributed practice yields better long-term retention than massed practice

Encoding

Time in minutes taken to relearn list on day 2

Number of repetitions of list on day 1

Encoding - Serial Position Effect

Percent age of words recalled

Position of word in list
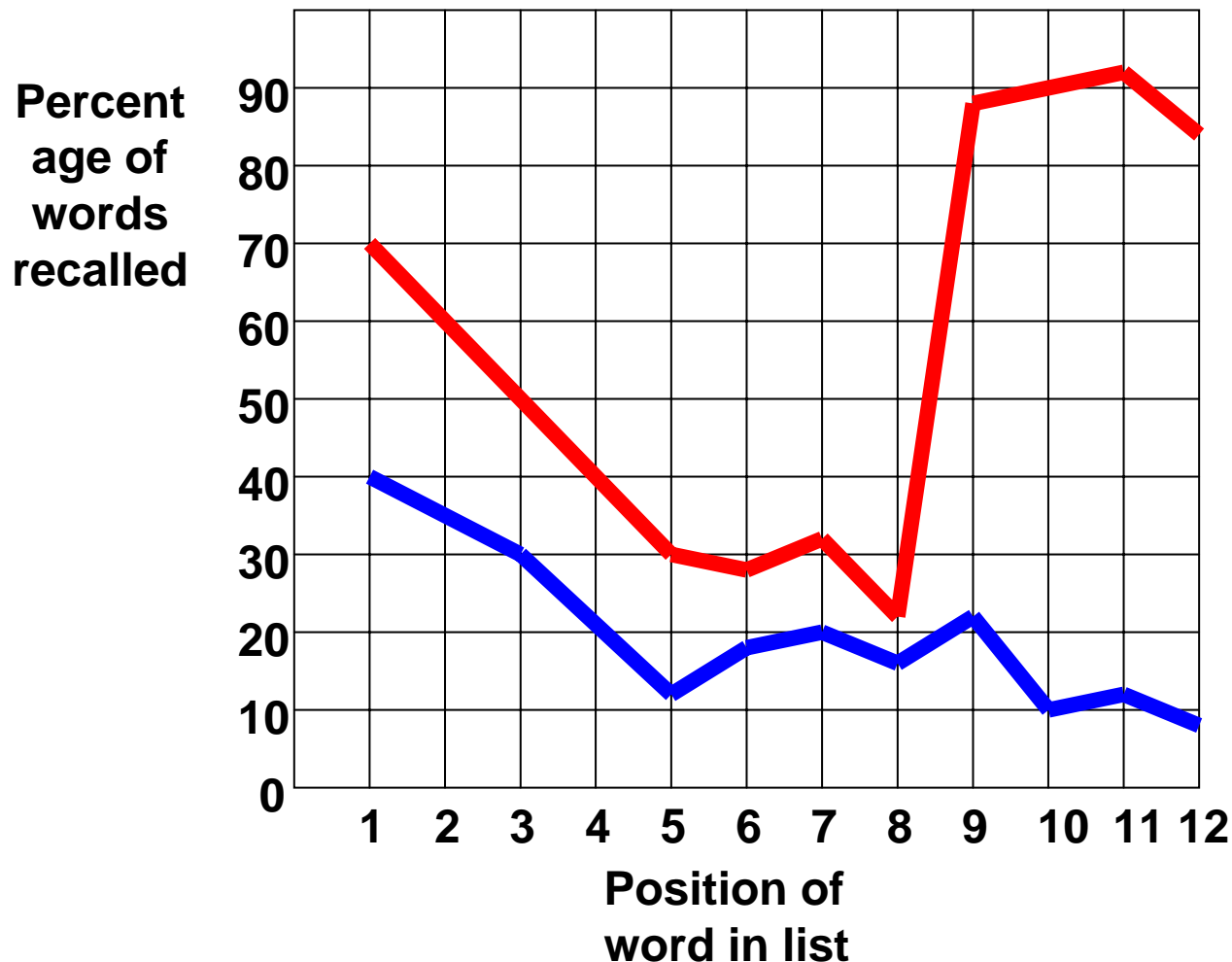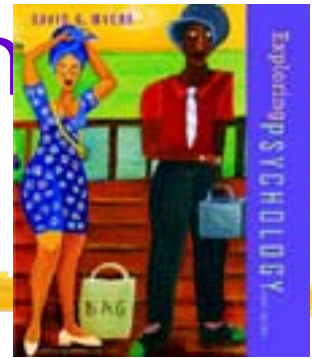
Serial Position Effect-tendency to recall best the last items in a list

Encoding

- Imagery
    - mental pictures
    - a powerful aid to effortful processing, especially when combined with semantic encoding
- Mnemonics
    - memory aids
    - especially those techniques that use vivid imagery and organizational devices

Encoding
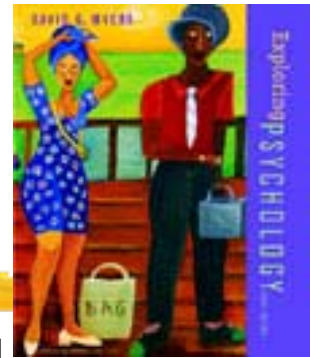
- Chunking
  - organizing items into familiar, manageable units
    - like horizontal organization--1776149218121941
  - often occurs automatically
  - use of acronyms
    - HOMES--Huron, Ontario, Michigan, Erie, Superior
    - ARITHMETIC--A Rat In Tom's House Might Eat Tom's Ice Cream

Encoding - Chunking

- Organized information is more easily recalled

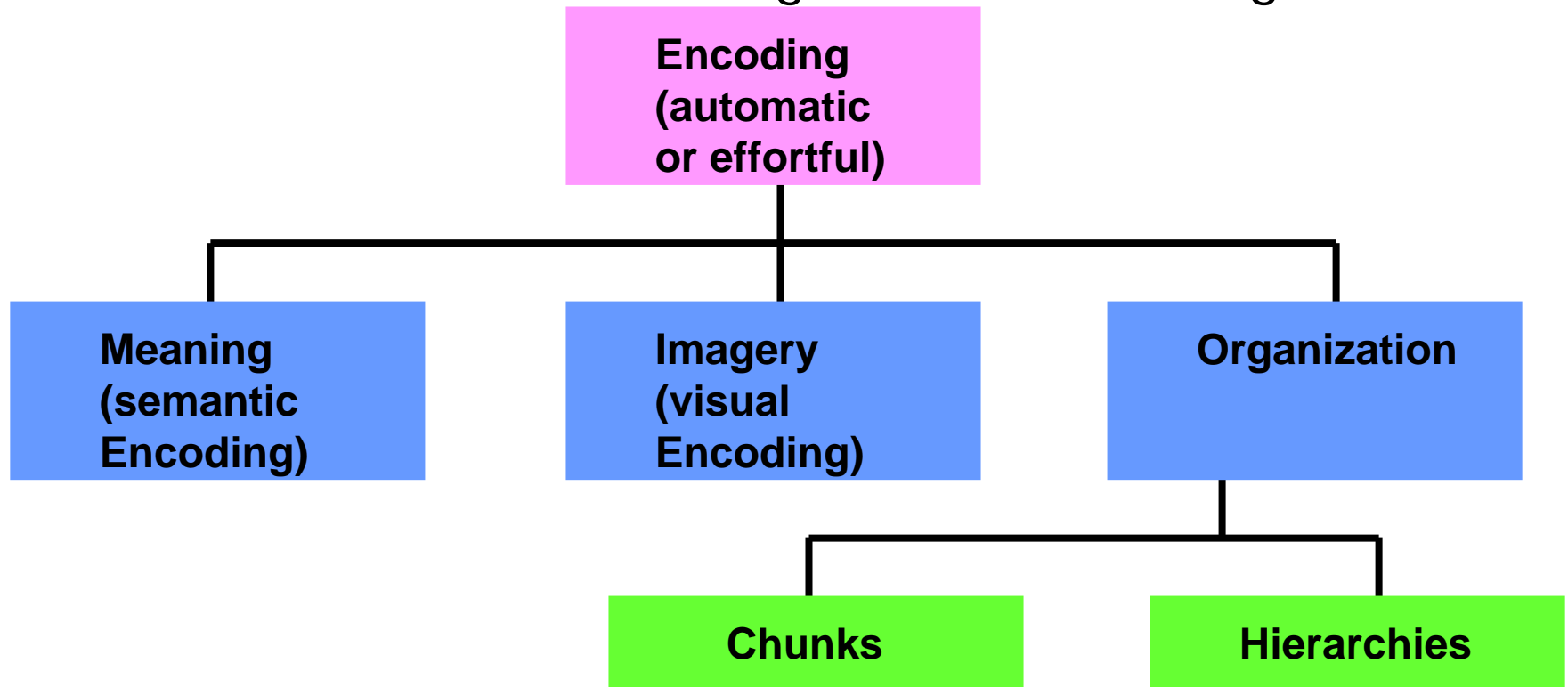|	
1.	◁ ⊃ Ᵹ ∾ ∩ ͳ ⊥
2.	K L C I S N E
3.	KLCISNE NVESE YNA NI CSTTIH TNDO
4.	NICKELS SEVEN ANY IN STITCH DONT
5.	NICKELS SEVEN ANY IN STITCH DONT SAVES AGO A SCORE TIME AND NINE WOODEN FOUR YEARS TAKE
6.	DONT TAKE ANY WOODEN NICKELS FOUR SCORE AND SEVEN YEARS AGO A STITCH IN TIME SAVES NINE

Encoding

- Hierarchies
  - complex information broken down into broad concepts and further subdivided into categories and subcategories

```
                    Encoding
                    (automatic
                    or effortful)
            |           |           |
    Meaning        Imagery      Organization
    (semantic      (visual           |
    Encoding)      Encoding)    |          |
                              Chunks   Hierarchies
```

Storage - Retaining Information
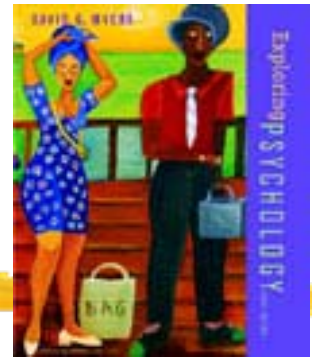
- ## Iconic Memory
    - a momentary sensory memory of visual stimuli
    - a photographic or picture image memory lasting no more that a few tenths of a second
- ## Echoic Memory
    - momentary sensory memory of auditory stimuli

Storage - Short-Term Memory

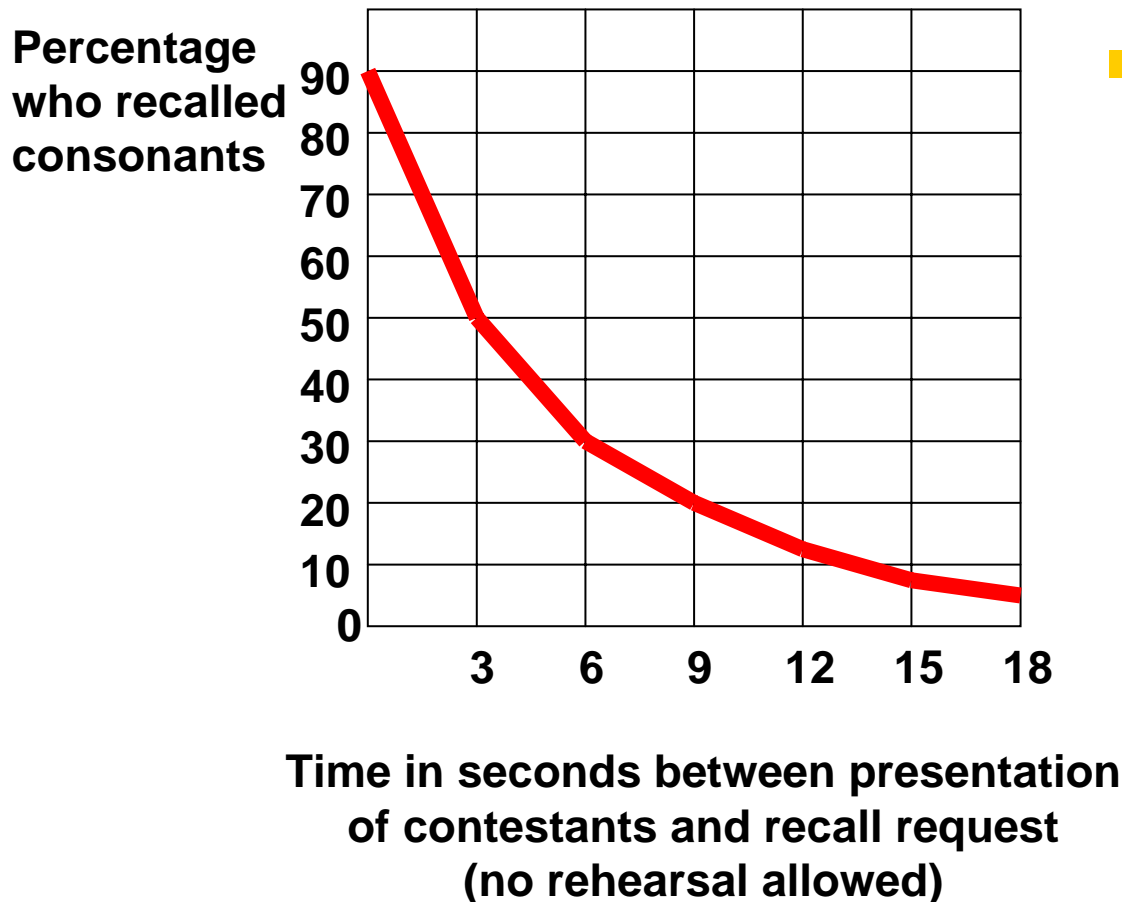**Percentage who recalled consonants**

[Graph: Percentage who recalled consonants (y-axis, 0–90) vs. Time in seconds (x-axis: 3, 6, 9, 12, 15, 18) showing a red curve declining from ~90% to ~5%]

Time in seconds between presentation of contestants and recall request (no rehearsal allowed)

- Short-Term Memory
  - limited in duration and capacity
  - "magical" number 7+/-2

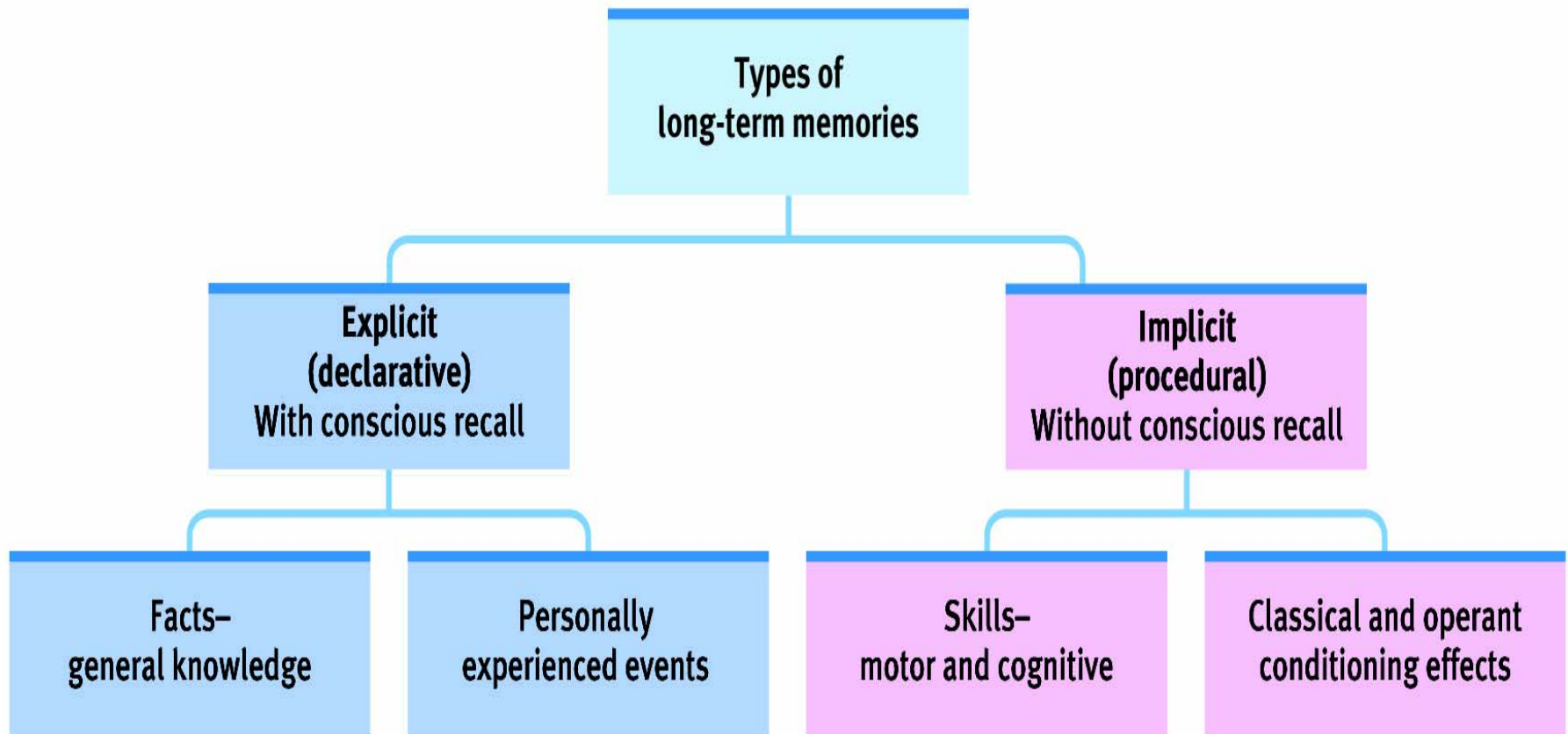# Storage - Long-Term Memory

- **How does storage work?**
  - Karl Lashley (1950)
    - rats learn maze
    - lesion cortex
    - test memory
- Synaptic changes
  - **Long-term Potentiation**
    - increase in synapse's firing potential after brief, rapid stimulation
- Strong emotions make for stronger memories
  - some stress hormones boost learning and retention

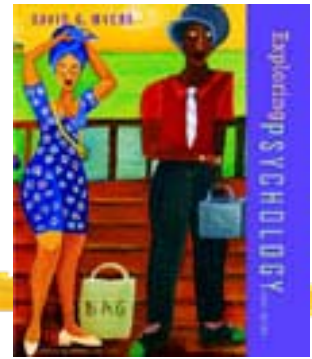# Storage - Long-Term Memory

- Amnesia--the loss of memory
- Explicit Memory
    - memory of facts and experiences that one can consciously know and declare
    - also called declarative memory
    - hippocampus--neural center in limbic system that helps process explicit memories for storage
- Implicit Memory
    - retention independent of conscious recollection
   - also called procedural memory
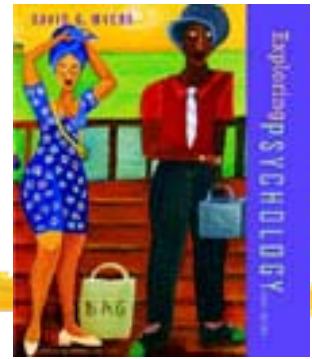
Storage - Long-Term Memory Subsystems

```
                    ┌─────────────────────┐
                    │      Types of       │
                    │  long-term memories │
                    └─────────────────────┘
                 ┌──────────────┴──────────────┐
    ┌──────────────────────┐      ┌──────────────────────┐
    │       Explicit       │      │       Implicit       │
    │     (declarative)    │      │     (procedural)     │
    │ With conscious recall│      │Without conscious recall│
    └──────────────────────┘      └──────────────────────┘
      ┌──────┴──────┐                ┌──────┴──────┐
┌──────────┐  ┌──────────┐     ┌──────────┐  ┌──────────────┐
│  Facts—  │  │Personally│     │  Skills— │  │Classical and │
│ general  │  │experienced│    │motor and │  │   operant    │
│knowledge │  │  events  │     │cognitive │  │ conditioning │
└──────────┘  └──────────┘     └──────────┘  │   effects    │
                                             └──────────────┘
```

Storage - Long-Term Memory

- MRI scan of hippocampus (in red)

Hippocampus
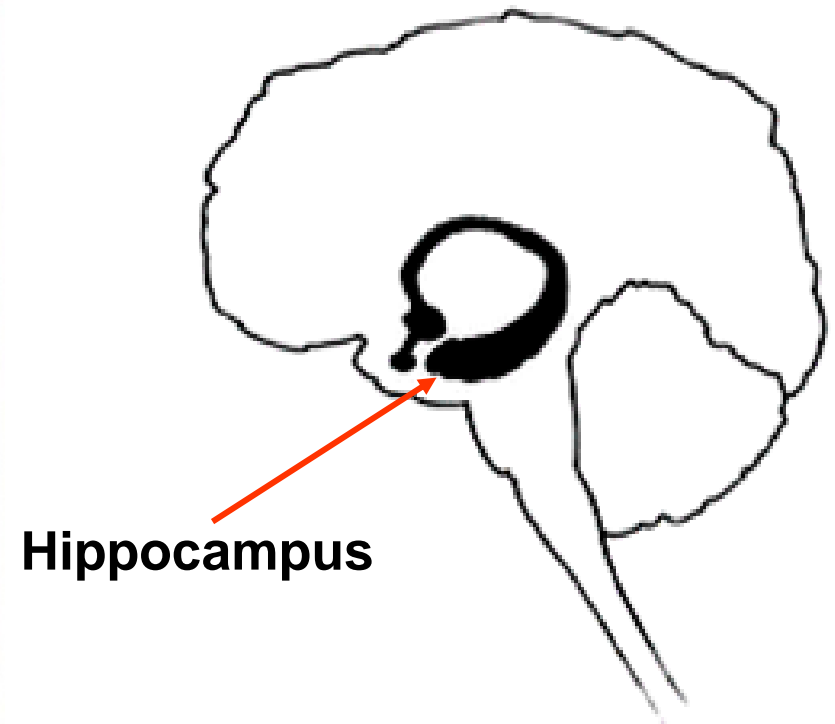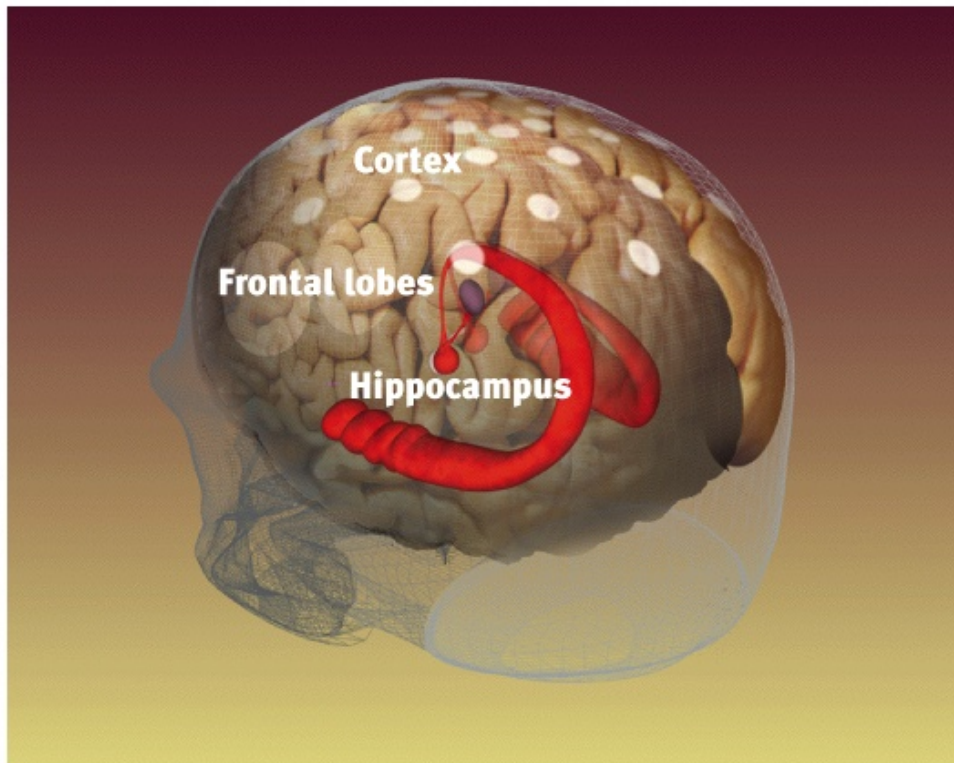
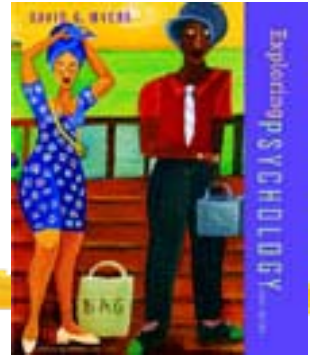# Retrieval - Getting Information Out

- ## Recall
  - measure of memory in which the person must retrieve information learned earlier
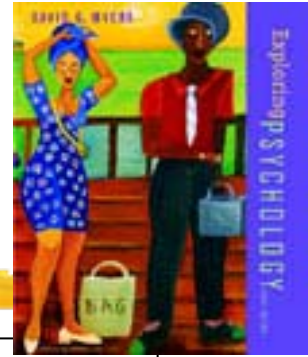 - as on a fill-in-the blank test
- ## Recognition
  - Measure of memory in which the person has only to identify items previously learned
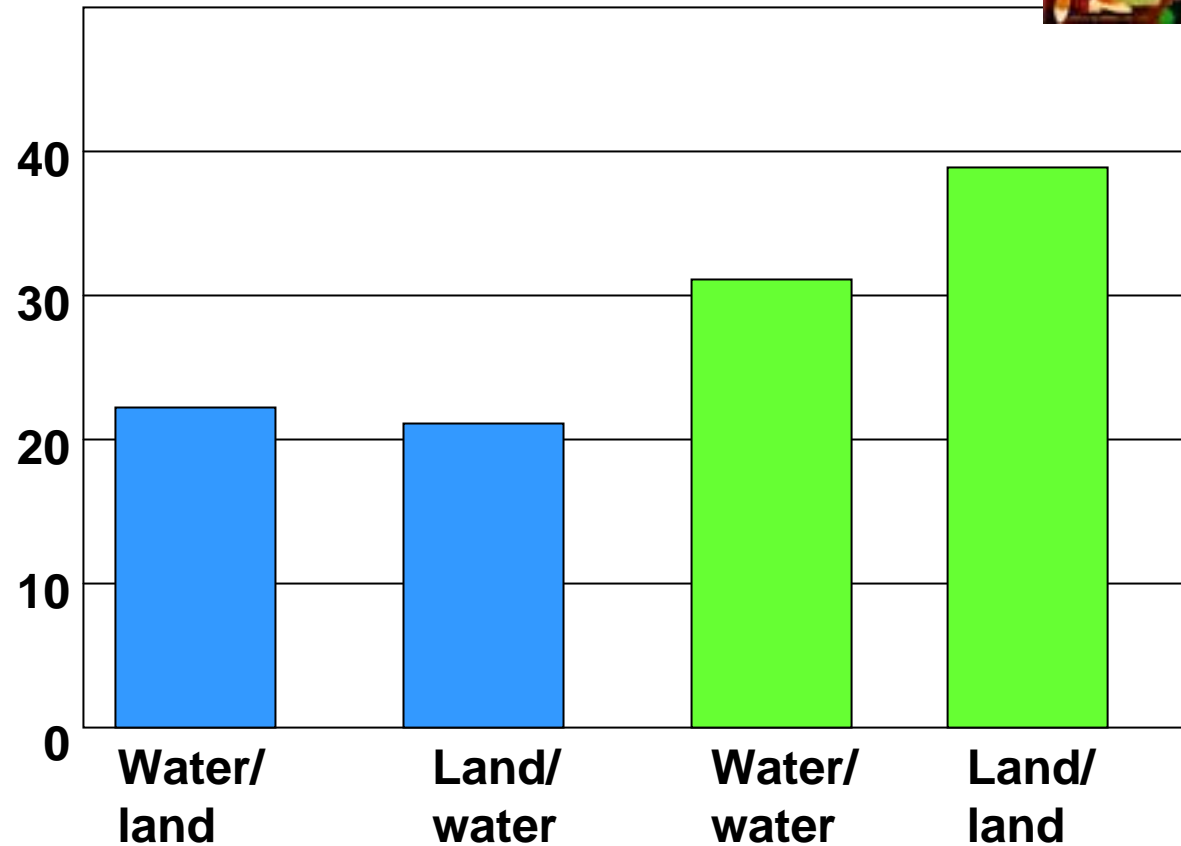 - as on a multiple-choice test

Retrieval

- Relearning
  - memory measure that assesses the amount of time saved when learning material a second time
- Priming
  - activation, often unconsciously, of particular associations in memory

Retrieval Cues

**Percentage of
words recalled**

Bar chart. Y-axis: Percentage of words recalled (0, 10, 20, 30, 40).

Different contexts for hearing and recall (blue bars):
- Water/land: ~22
- Land/water: ~21

Same contexts for hearing and recall (green bars):
- Water/water: ~31
- Land/land: ~39

**Different contexts for
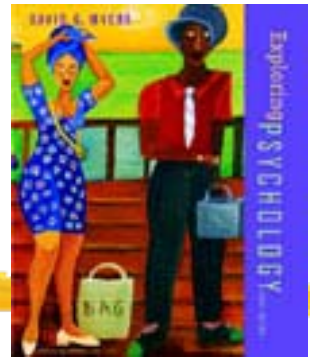hearing and recall**

**Same contexts for
hearing and recall**

Retrieval Cues

- Deja Vu (French)--already seen
  - cues from the current situation may subconsciously trigger retrieval of an earlier similar experience
  - "I've experienced this before."
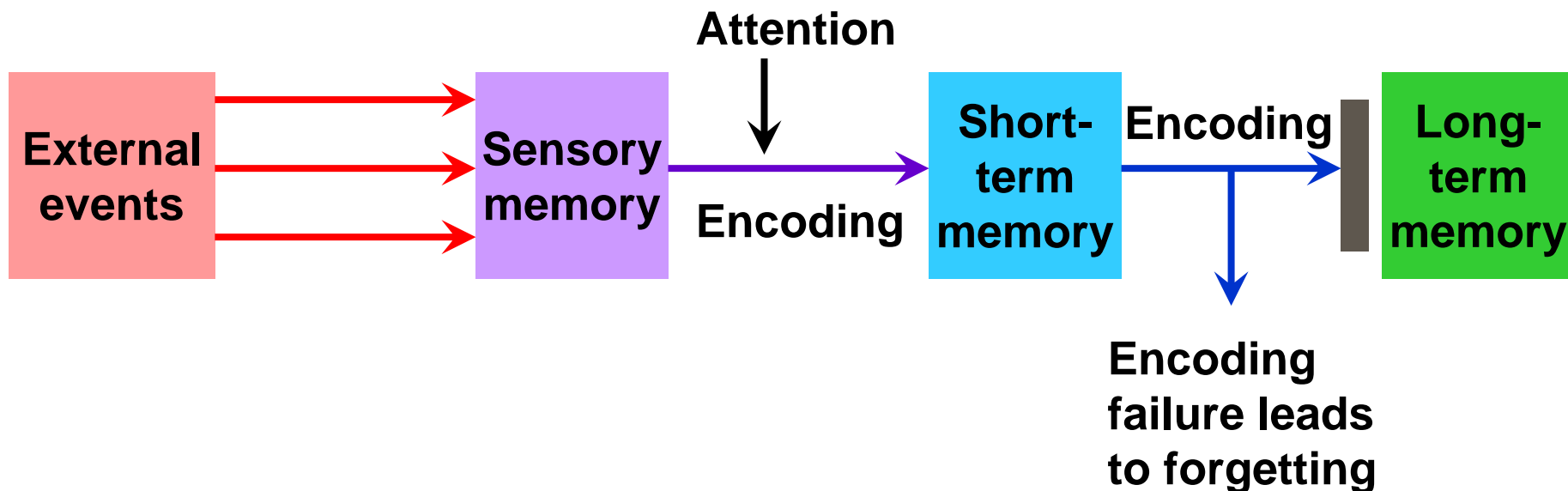
Retrieval Cues

- Mood-congruent Memory
  - tendency to recall experiences that are consistent with one's current mood
  - memory, emotions, or moods serve as retrieval cues
- State-dependent Memory
  - what is learned in one state (while one is high, drunk, or depressed) can more easily be remembered when in same state
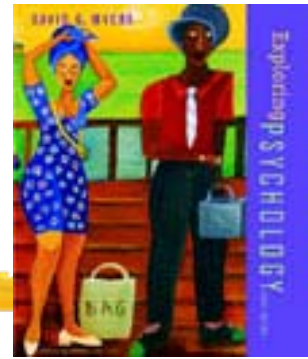
Forgetting
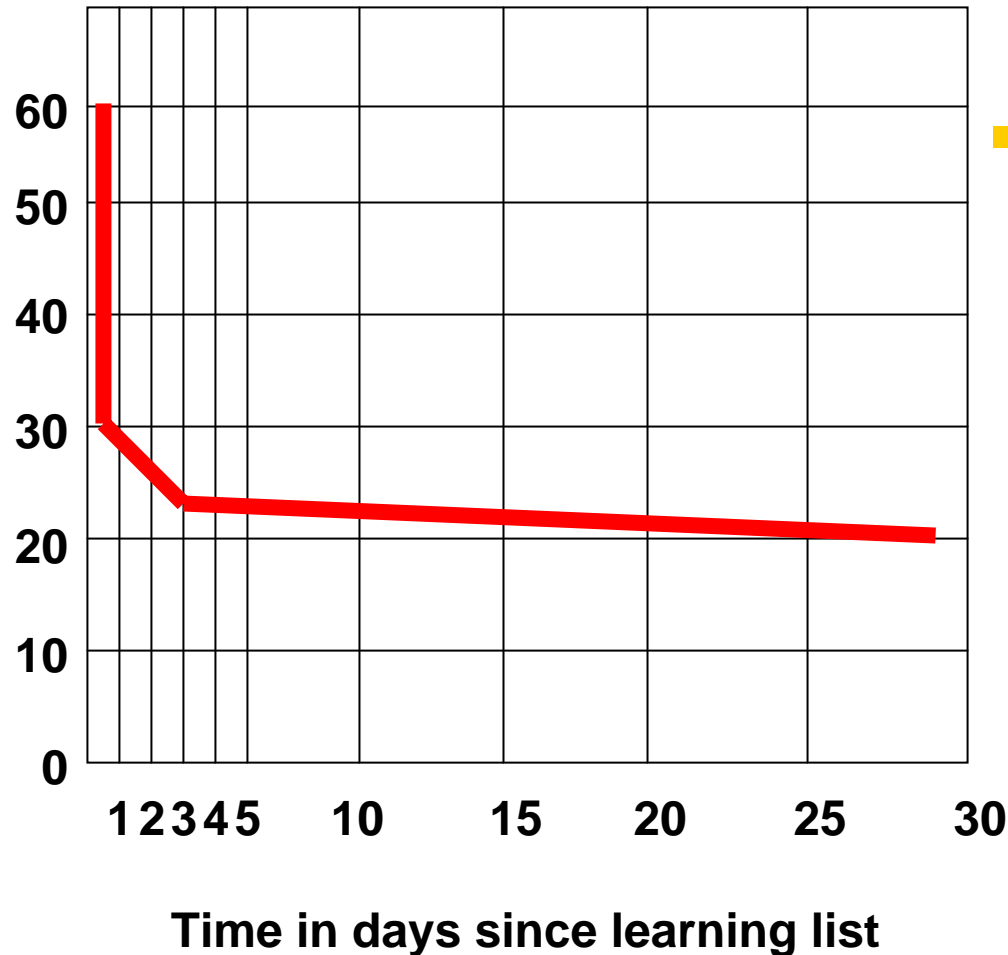
- Forgetting as encoding failure
- Information never enters long-term memory

External events → **Sensory memory**

Attention

Encoding

Short-term memory

Encoding

Long-term memory

Encoding failure leads to forgetting

Forgetting

Percentage of list retained when relearning

- Ebbinghaus forgetting curve over 30 days-- initially rapid, then levels off with time

60
50
40
30
20
10
0

1 2 3 4 5   10   15   20   25   30

Time in days since learning list

Forgetting

- The forgetting curve for Spanish learned in school

Percentage of original vocabulary retained

Retention drops,

then levels off

100%
90
80
70
60
50
40
30
20
10
0

1 3 5   9½   14½   25   35½   49½

Time in years after completion of Spanish course
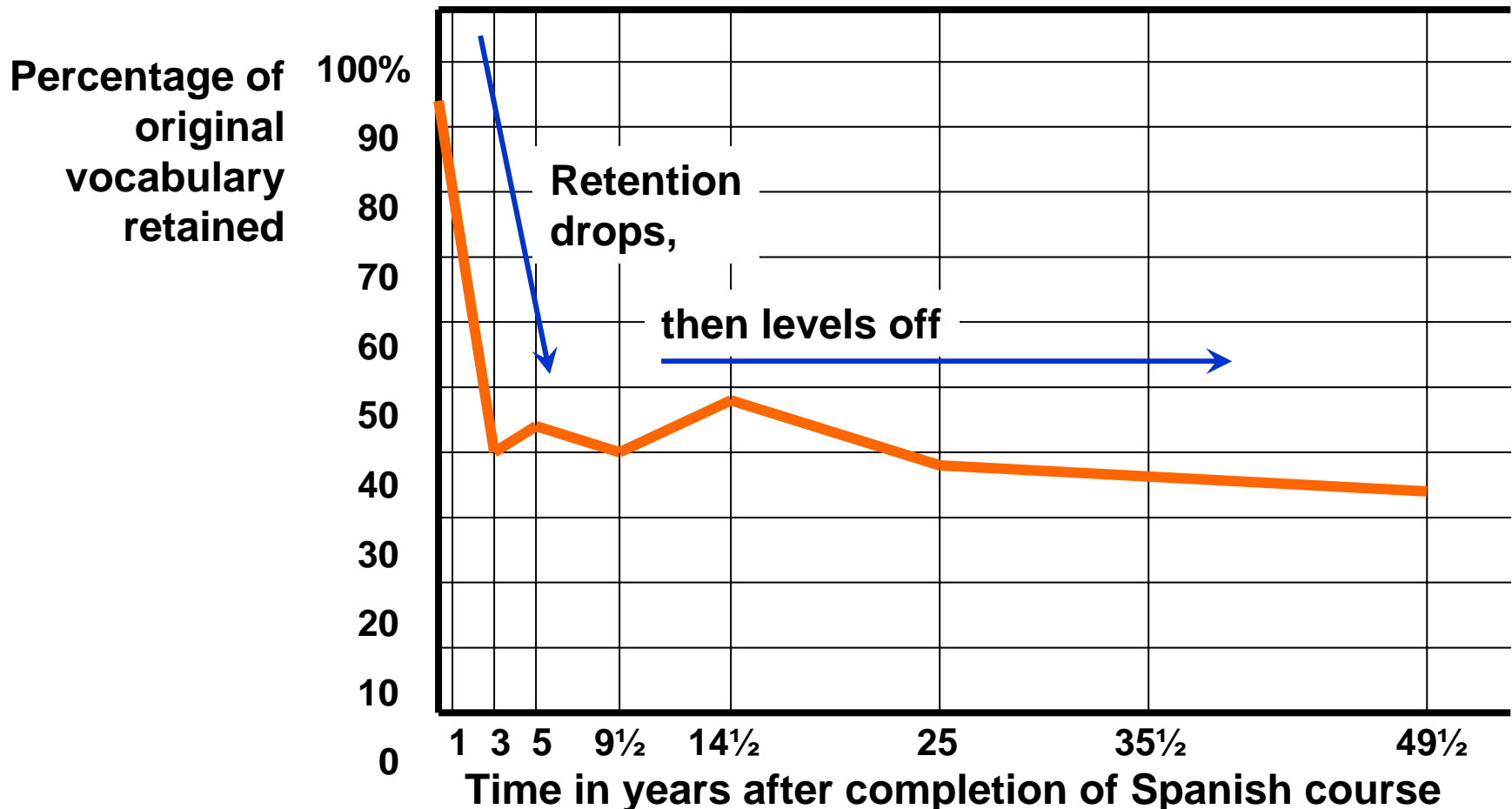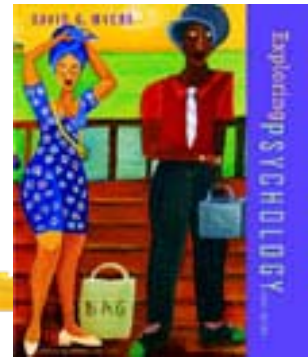
Retrieval

- Forgetting can result from failure to retrieve information from long-term memory
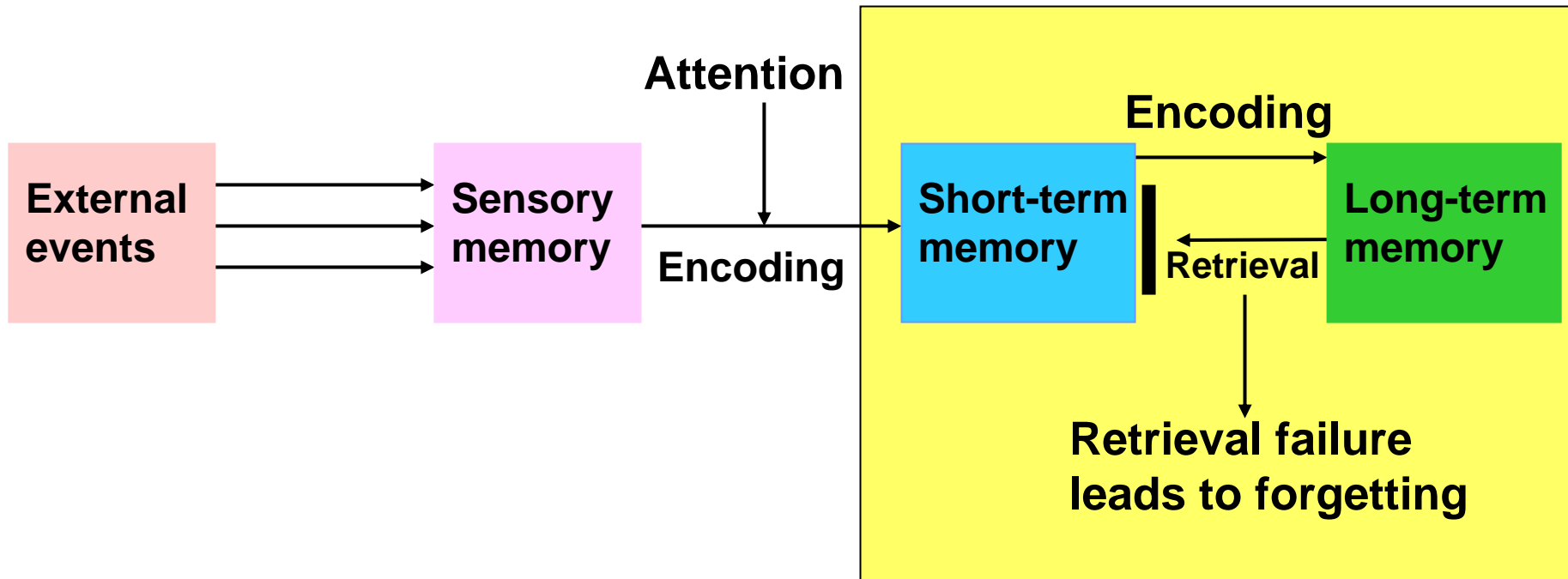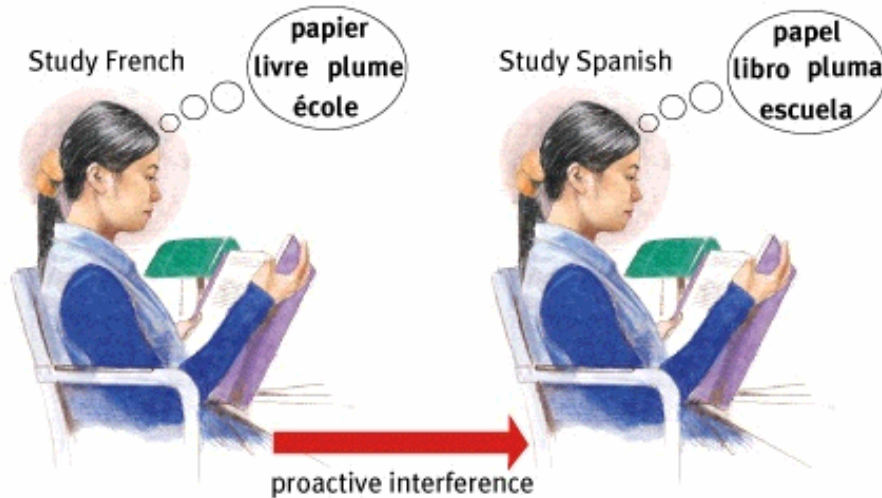
Forgetting as Interference

- Learning some items may disrupt retrieval of other information
  - Proactive (forward acting) Interference
    - disruptive effect of prior learning on recall of new information
  - Retroactive (backwards acting) Interference
    - disruptive effect of new learning on recall of old information

Forgetting as Interference

French, learned beforehand, interferes proactively

Study French — papier livre plume école → Study Spanish — papel libro pluma escuela — Spanish 101 Mid-term exam

proactive interference

Spanish, learned afterward, interferes retroactively
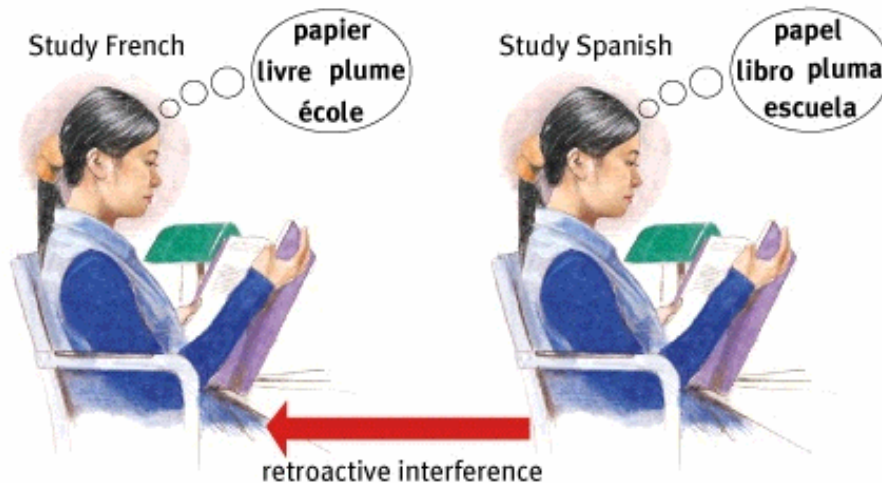
Study French — papier livre plume école → Study Spanish — papel libro pluma escuela — French 101 Mid-term exam

retroactive interference

Forgetting

- Retroactive Interference

Percentage of syllables recalled

90%
80
70
60
50
40
30
20
10
0

After sleep

Without interfering events, recall is better

After remaining awake

1   2   3   4   5   6   7   8

Hours elapsed after learning syllables

Forgetting

Information bits

Sensory memory The senses momentarily register amazing detail.

↓

Short-term memory A few items are both noticed and encoded.

↓

Long-term storage Some items are altered or lost.

↓

Retrieval from long-term memory Depending on interference, retrieval cues, moods, and motives, some things get retrieved, some don't.

- Forgetting can occur at any memory stage
- As we process information, we filter, alter, or lose much of it

Forgetting-Interference

- Motivated Forgetting
  - people unknowingly revise memories
- Repression
  - defense mechanism that banishes from consciousness anxiety-arousing thoughts, feelings, and memories
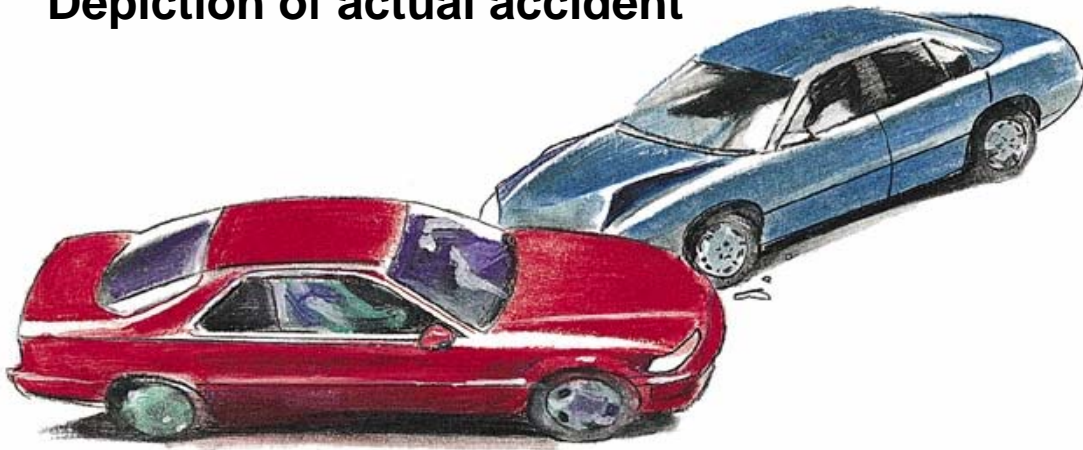
Memory Construction

- We filter information and fill in missing pieces
- Misinformation Effect
  - incorporating misleading information into one's memory of an event
- Source Amnesia
  - attributing to the wrong source an event that we experienced, heard about, read about, or imagined (misattribution)

Memory Construction

Depiction of actual accident
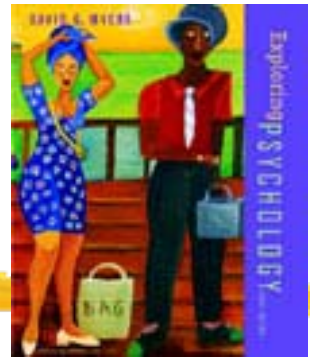

- Eyewitnesses reconstruct memories when questioned

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

Memory construction

Memory Construction

- Most people can agree on the following:
  - Injustice happens
  - Incest and sexual abuse happens
  - Forgetting happens
  - Recovered memories are commonplace
  - Memories recovered under hypnosis or drugs are especially unreliable
  - Memories of things happening before age 3 are unreliable
  - Memories, whether false or real, are upsetting

Improve Your Memory

- Study repeatedly to boost recall
- Spend more time rehearsing or actively thinking about the material
- Make material personally meaningful
- Use mnemonic devices
  - associate with peg words--something already stored
  - make up story
  - chunk--acronyms

Improve Your Memory

- Activate retrieval cues--mentally recreate situation and mood
- Recall events while they are fresh--before you encounter misinformation
- Minimize interference
- Test your own knowledge
  - rehearse
  - determine what you do not yet know