

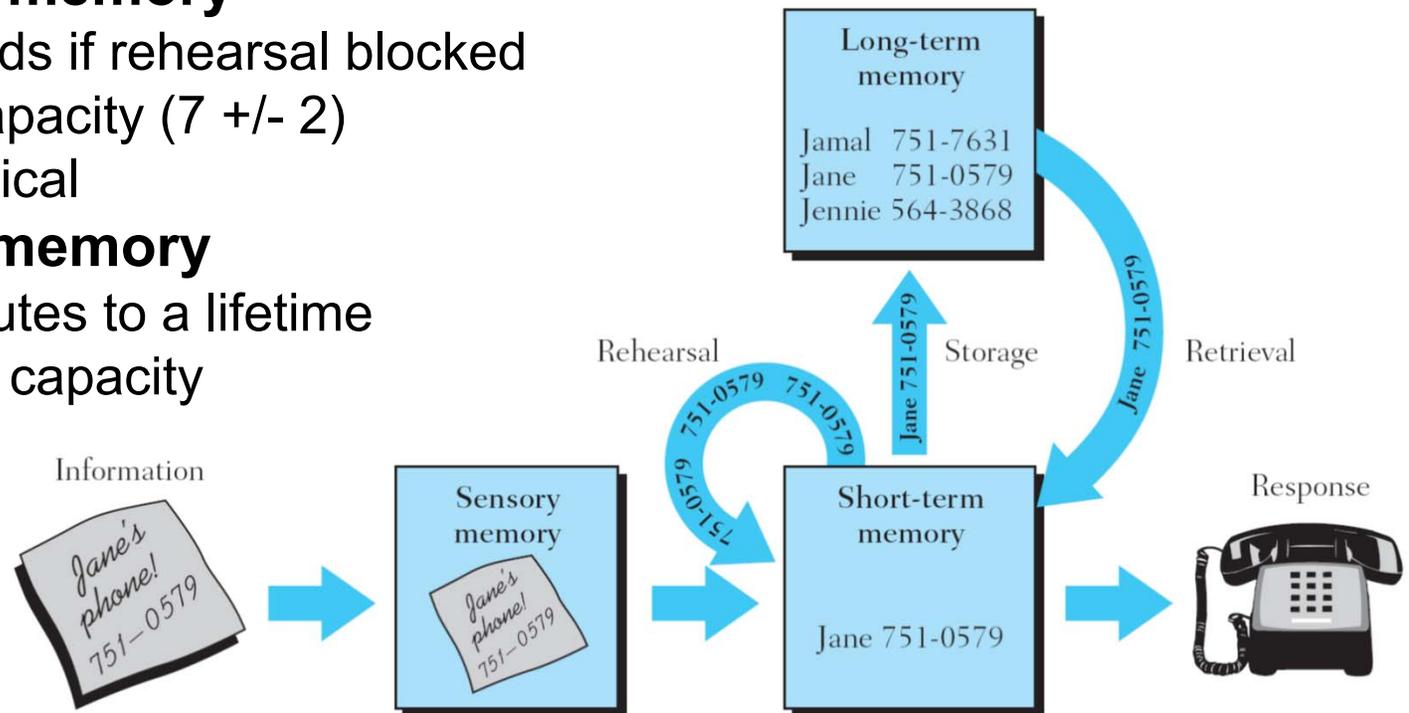
- **How should you study for Friday's exam?**
 - re-read textbook?
 - re-read lecture slides?
 - study guide?
 - **NO!** these are passive. Use active study. Test yourself by
 - Take the practice quizzes in Moodle
 - Create your own quiz questions
 - Create your own study guide
 - Look at each figure in the textbook and attempt to recall what it was about
 - Do the same for each figure in the lecture slides
 - Text in lecture slides is incomplete. Try to remember what was said by using the text as a retrieval cue

The Modal Model of memory

(Atkinson & Shiffrin, 1968; Waugh & Norman, 1965)

3 **modes** of memory based on *duration* (how long), *capacity* (how much), and *coding* (what is stored)

- **sensory memory**
 - 1-2 seconds, unless masked
 - good capacity (e.g., a whole image)
 - perceptual
- **short-term memory**
 - 30 seconds if rehearsal blocked
 - limited capacity (7 +/- 2)
 - phonological
- **long-term memory**
 - from minutes to a lifetime
 - unlimited capacity
 - semantic



Serial Position curve for immediate free-recall: an example of short- and long-term memory

- **primacy effect**
 - reflects long-term memory
 - more **rehearsal** for first words
- **recency effect**
 - reflects short-term memory
 - first recalled words

1 Table	11 Kitten
2 Candle	12 Doorknob
3 Maple	13 Folder
4 Subway	14 Concrete
5 Pencil	15 Railroad
6 Coffee	16 Doctor
7 Towel	17 Sunshine
8 Softball	18 Letter
9 Curtain	19 Turkey
10 Player	20 Hammer

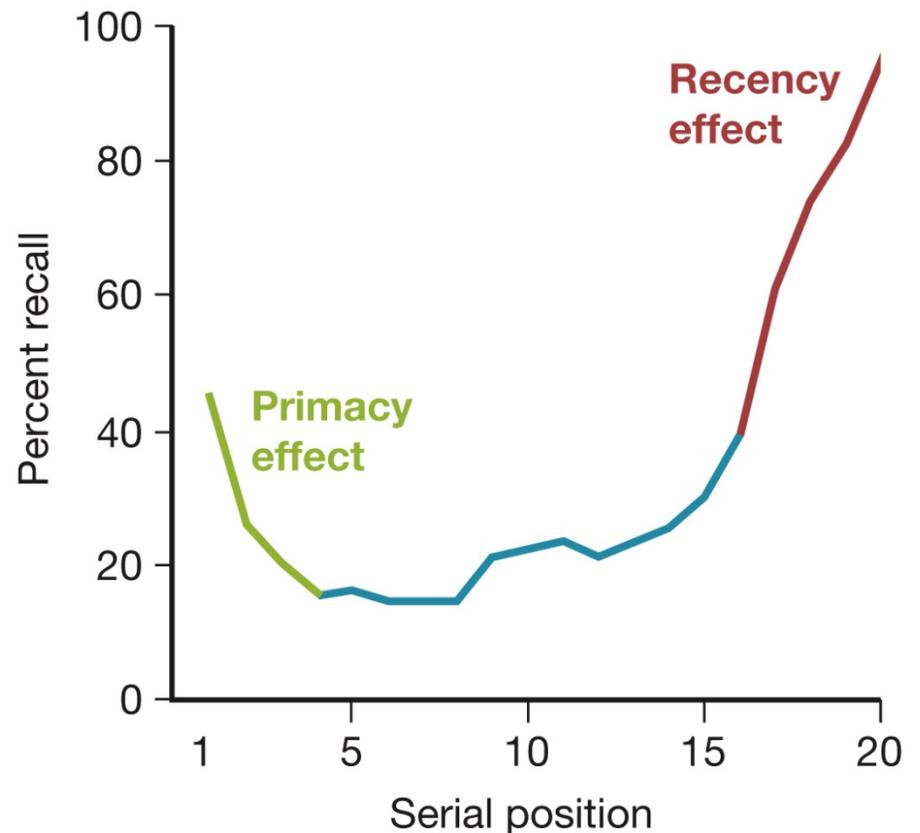


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Dissociating Primacy and Recency

weaken STM

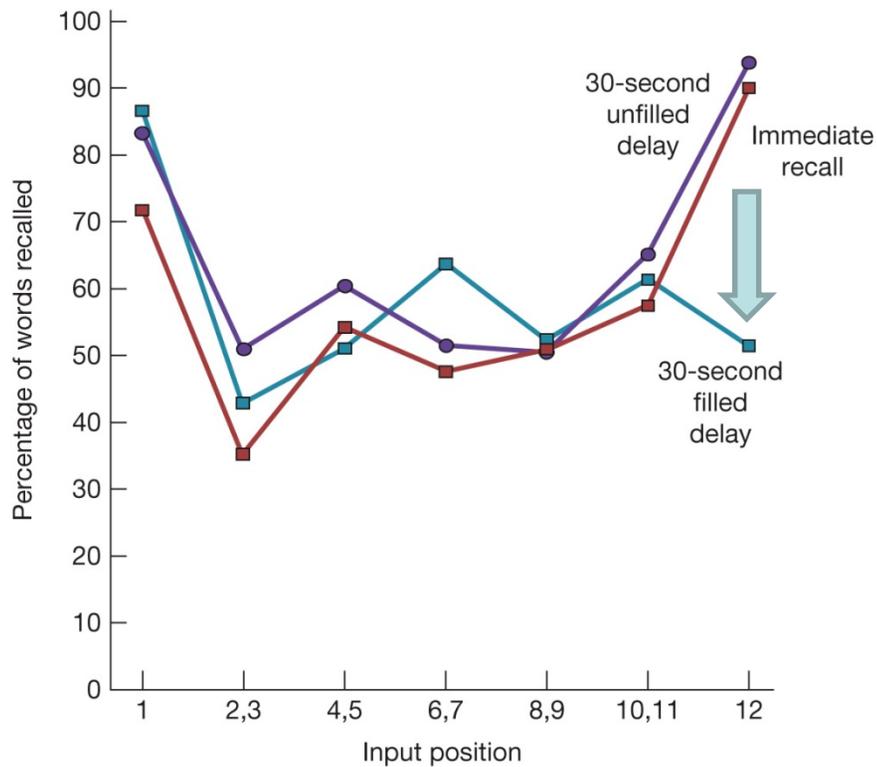


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strengthen LTM

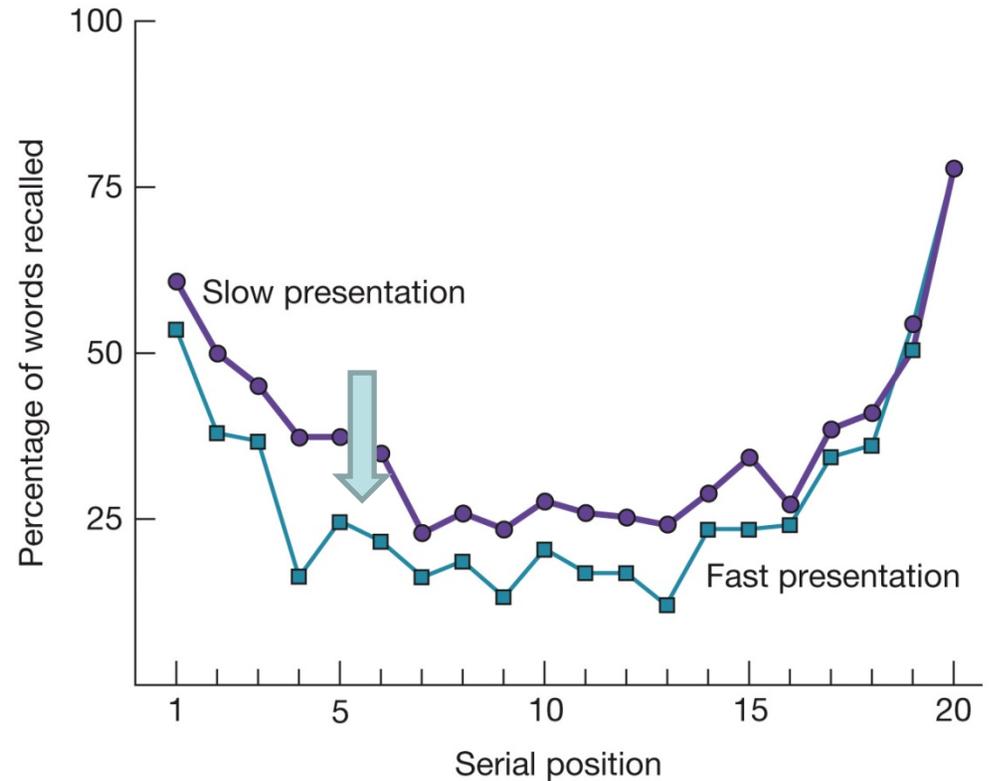
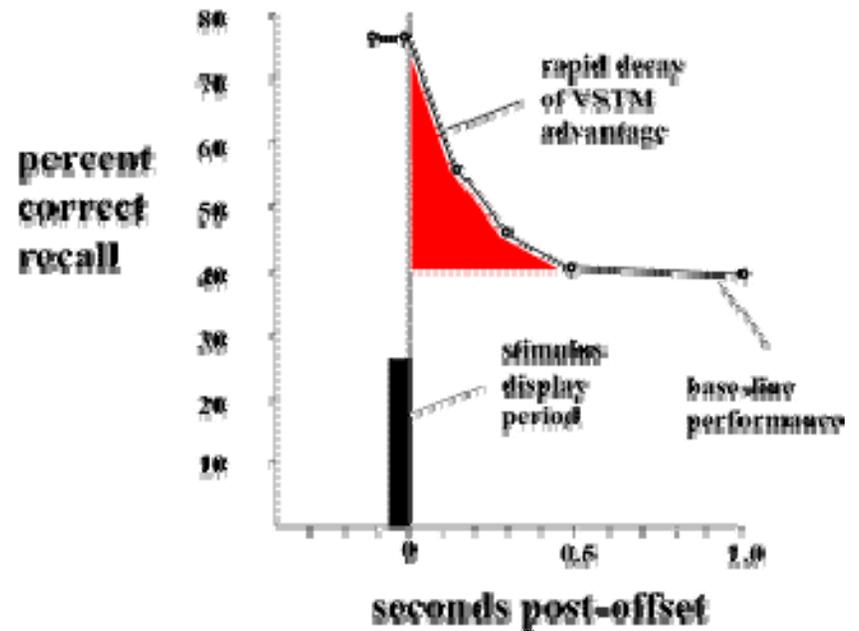
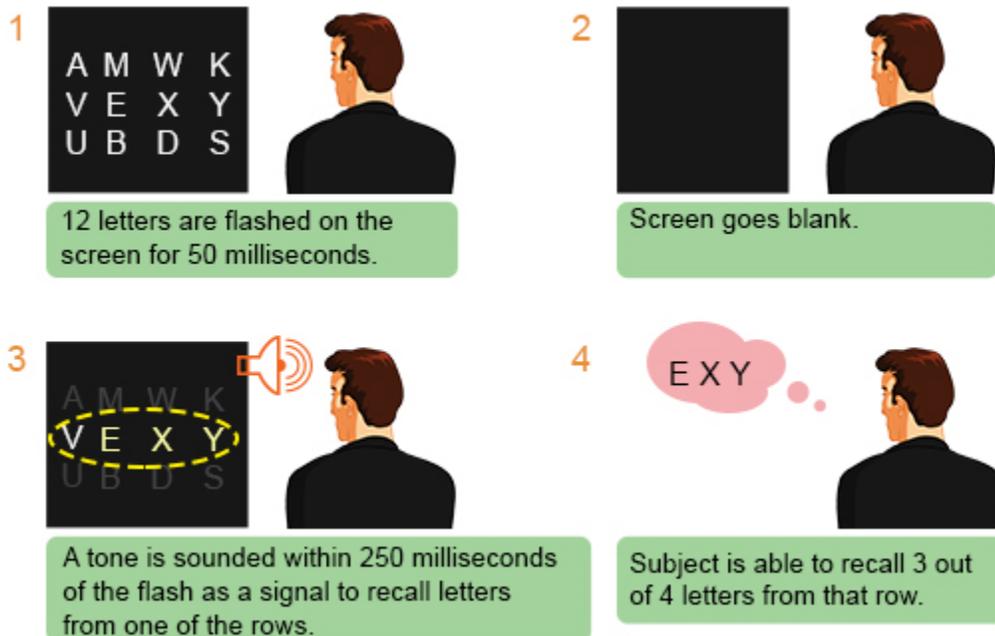


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Sensory Memory

- You continue to see/hear/feel/smell/taste something after it's gone (unless it's masked)
- Iconic memory: also called visual short-term memory
 - Sperling (1960) presented an array of 12 letters briefly
 - **whole report:** 4.5/12 (38%)
 - **partial report:** 3/4 (75%) if told afterwards which row to report
 - delays eliminate partial report advantage
 - partial report based on vowel/consonant doesn't work



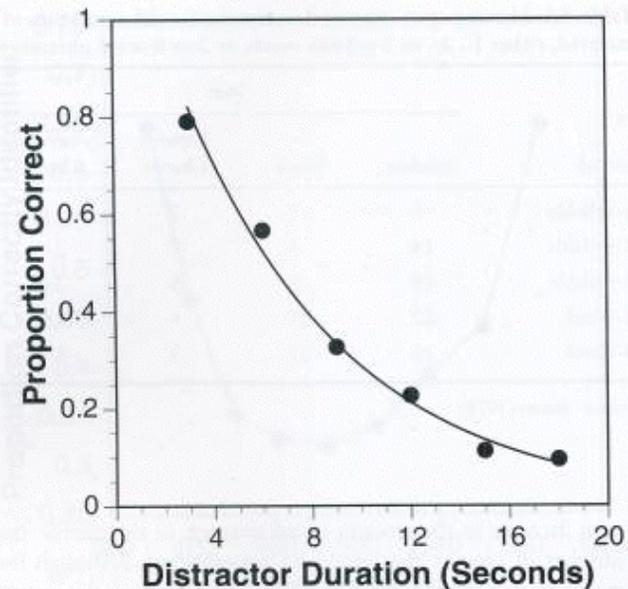
Capacity of STM

- People remember 7 items in a new sequence (plus or minus 2) – Miller (1956)
 - this is true for all items (numbers, letters, words)
 - **memory span** tasks are used to measure capacity
 - correlates with IQ scores and other measures
 - memory span can be increased by **chunking** together groups of items (recoding based on meaning)
 - N F L C B S S A T M T V
 - information is **coded** acoustically
 - confusions made between letters that sound alike (B and G)
 - but not between letters that look alike (B and F)

Duration of STM

(Brown-Peterson task)

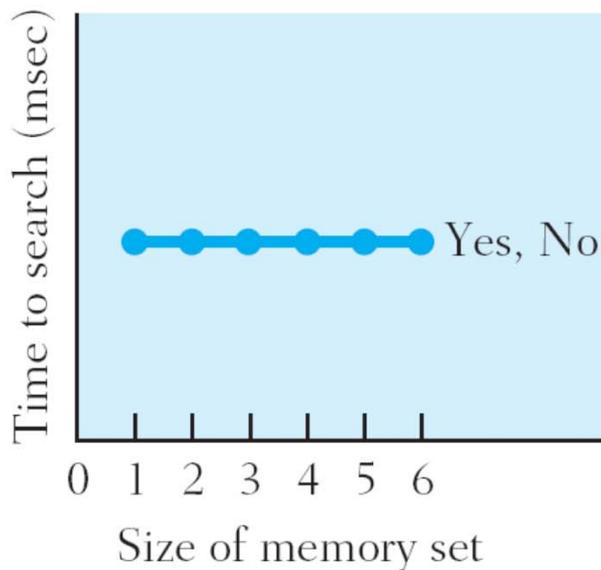
- Study a trigram (e.g., BKG) followed by a counting task before recall
 - after 18 seconds of counting, the trigram is forgotten



Retrieval from STM

(Sternberg search)

- Maintain in STM a new sequence of possible targets (memory set)
- reaction times suggest a **serial exhaustive search**
 - parallel search predicts no effect of memory set (A)
 - two kinds of serial search
 - **self-terminating** = stop once you find the target (B)
 - **exhaustive** = continue through all the items (C)

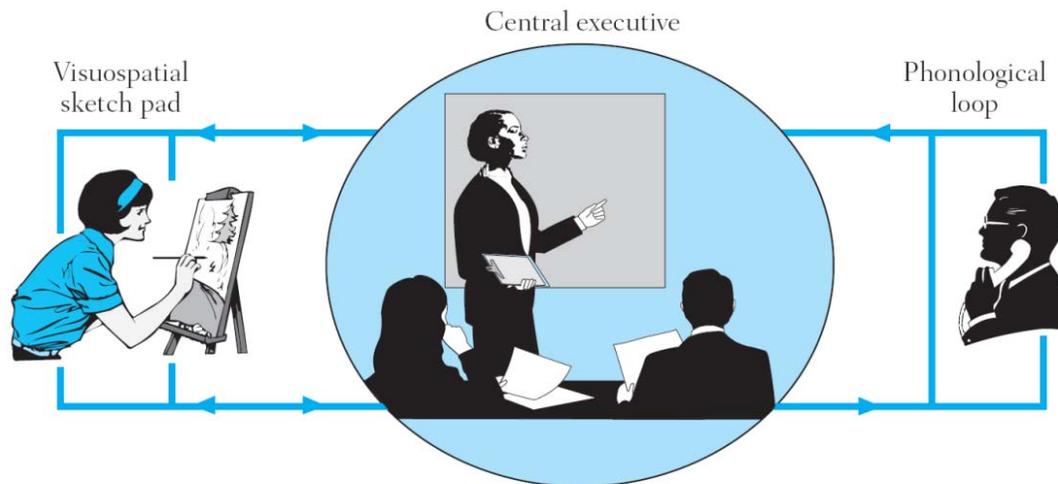


(A)

Working Memory

(Baddeley & Hitch, 1974)

- Short-term memory is not passive storage; it holds information so you can work with it
 - a breakdown of STM into separate components
 - People can do two tasks at once if the tasks involve different types of information (e.g., visual versus verbal)
 - A central executive and two ‘slave’ storage components



- **phonological loop**
 - like a 2 second loop of speech (and subvocalization)
 - memory span is actually less than 7 for longer words
 - explains why there are confusions based on sound
 - explains why verbal STM search is serial exhaustive
- **visuospatial sketch pad**
 - STM for visual / spatial information
 - change blindness
 - flicker paradigm
 - object tracking
- **central executive**
 - controls what gets into the loop and sketch pad (attention)
 - filters out unwanted, distracting, stimuli
 - dichotic listening
 - Stroop effect
 - allows in task relevant stimuli
 - visual search
 - maintains task goals and objectives

Measuring STM capacity

- Simple span tasks (e.g., digit span)
 - Passive storage
 - don't reflect central executive
- Complex span tasks
 - Require central executive
 - shifting, updating, inhibition
 - Reading span
 - Read a sentence, memorize last word, repeat
 - Operation span
 - Do a math problem, memorize last word, repeat

Individual Differences in WM

- WM tasks correlate with many abilities
 - Better WM performance correlates with higher IQs, GPAs, SATs, GREs, etc.
 - Central executive tasks correlate verbal fluency, reading ability, reasoning, etc.
 - People with ADHD do poorly on central executive tasks
 - People with better WM
 - less likely to notice unattended information in dichotic listening
 - less likely to suffer from change blindness
 - have less Stroop interference and smaller IAT scores

Which Penny is Correct?

(repeated exposure does not necessarily create LTMs)



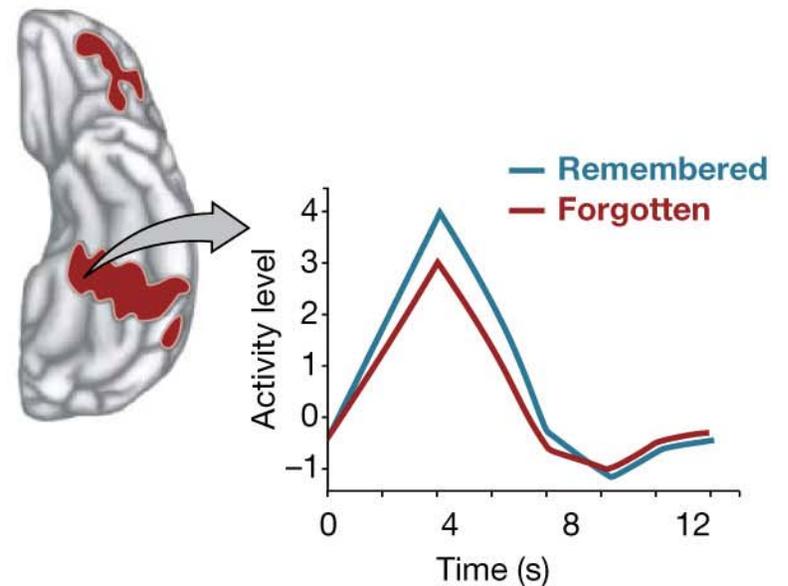
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Entering Long-Term Storage

- The need for active encoding

Hippocampus and adjacent areas

Left medial temporal lobe



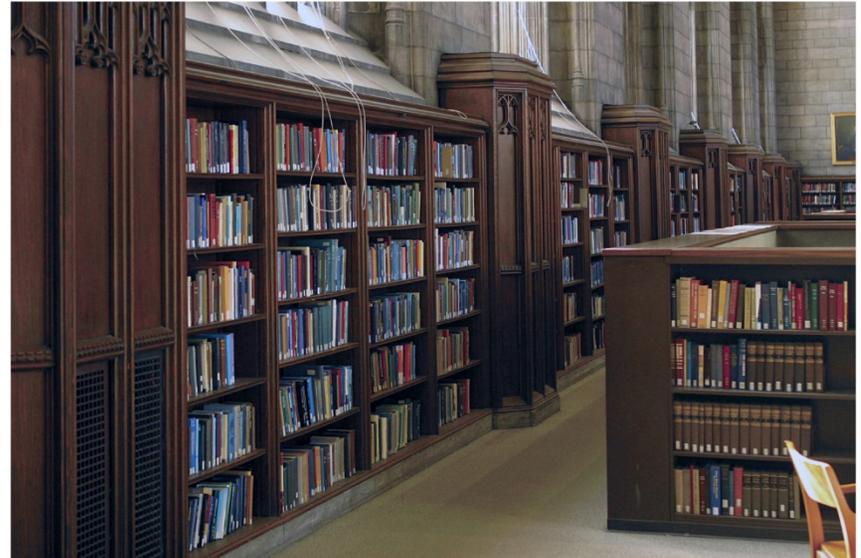
Remembered greater than forgotten

A Unitary Account of Memory

- **levels of processing:** the only difference between STM and LTM is whether encoding is “shallow” or “deep”
 - memory is a continuum, rather than different modes
 - deep processing is more **semantic** and **self-referential**, causing stronger, longer lasting memories
 - deep memories are more easily retrieved because of connections
 - shallow processing is concerned with physical characteristics, causing weaker, temporary memories

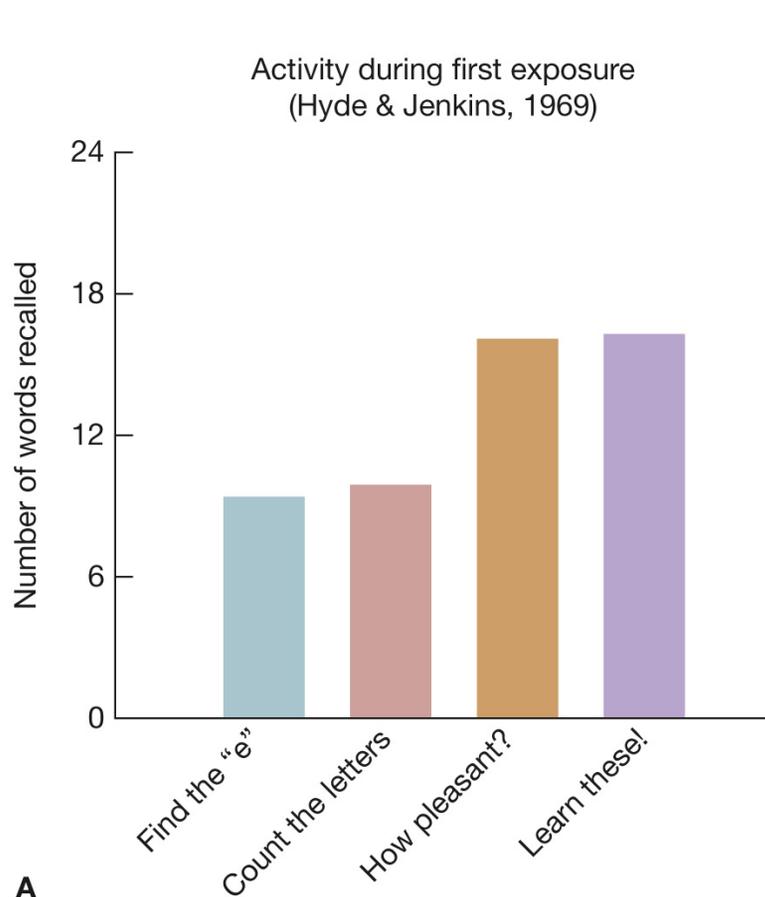


Stuart Black/Alamy

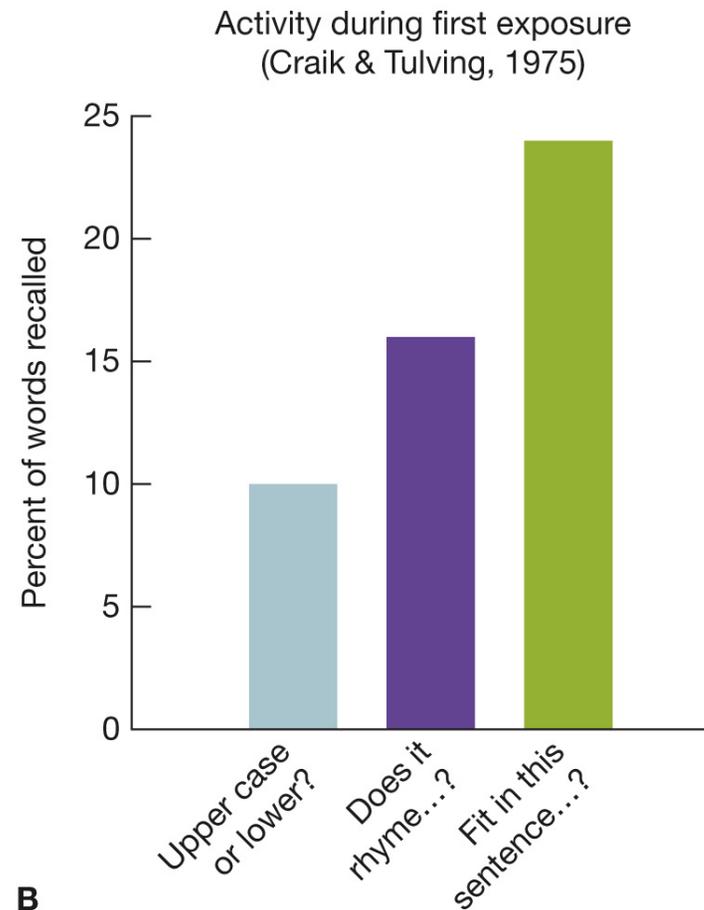


Imagic Chicago/Alamy

Shallow vs. Deep Encoding (and incidental vs intentional)



A
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B
Figure 6.10b
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Elaboration (really deep)

	Example (chicken)
Complex	“The great bird swooped down and carried off the struggling _____.”
Simple	“She cooked the _____.”

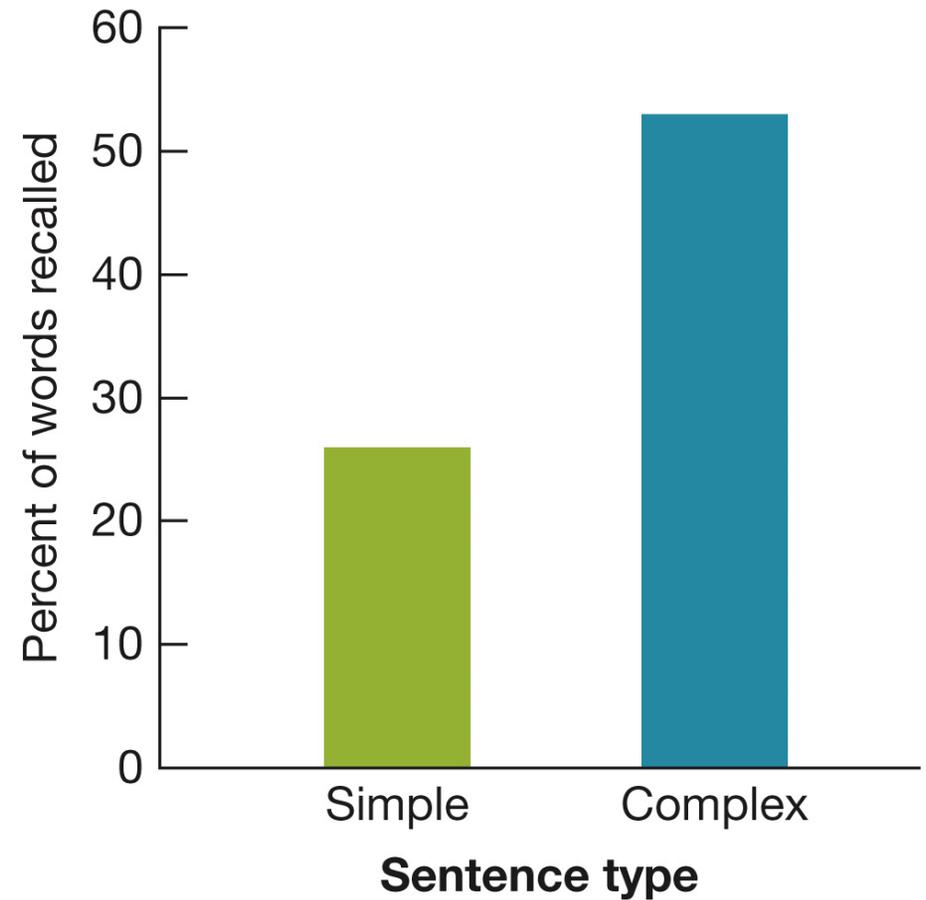
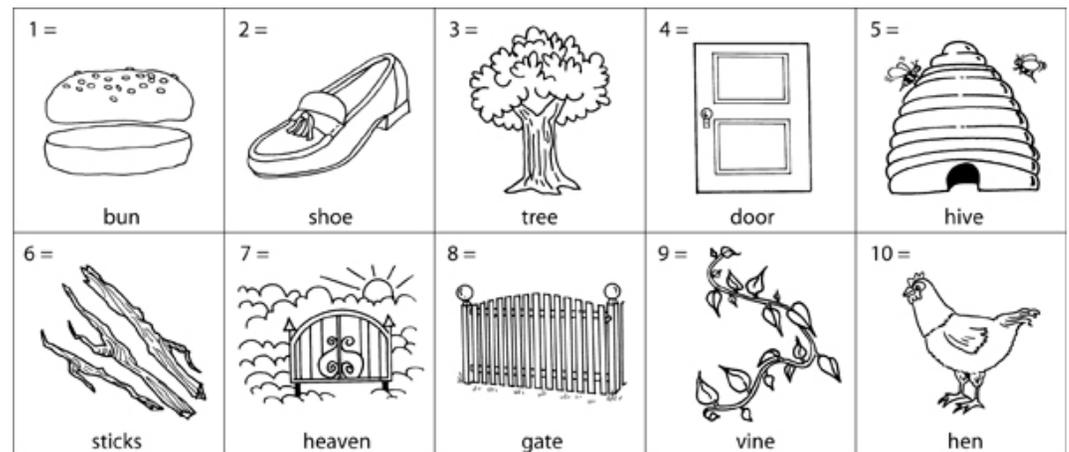
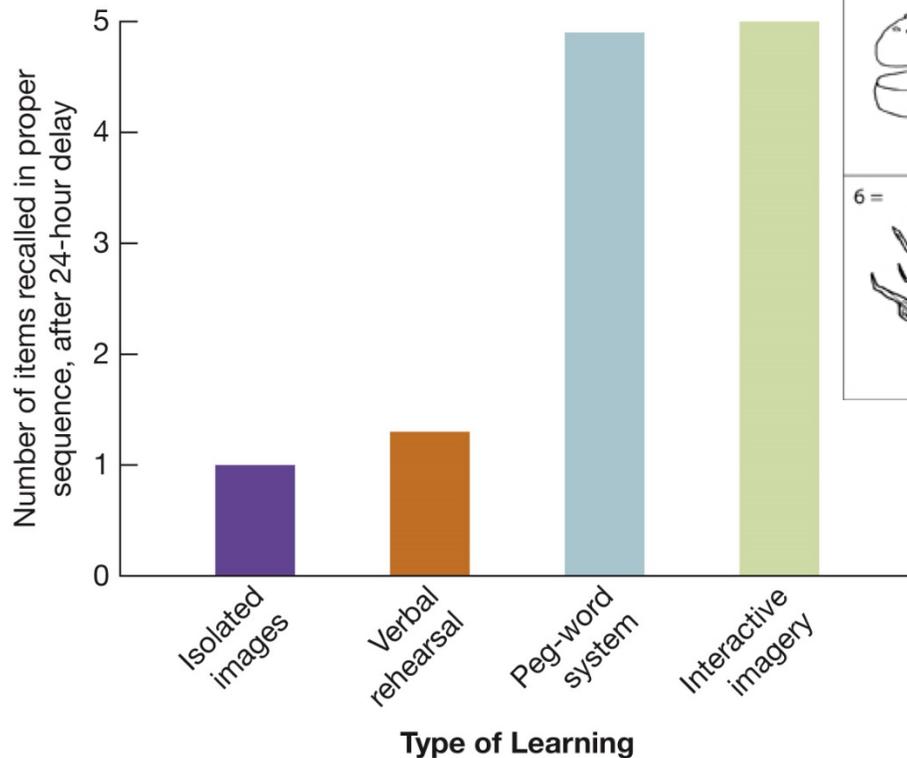


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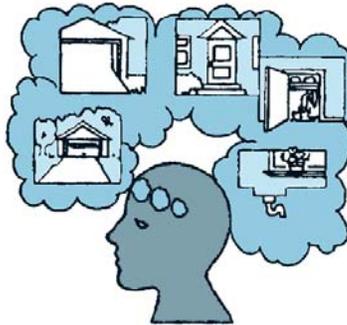
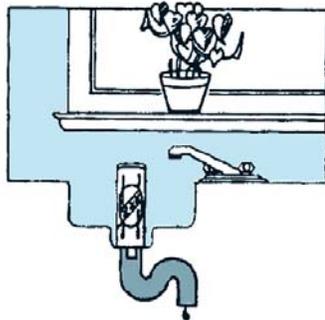
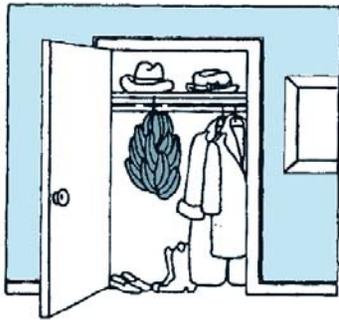
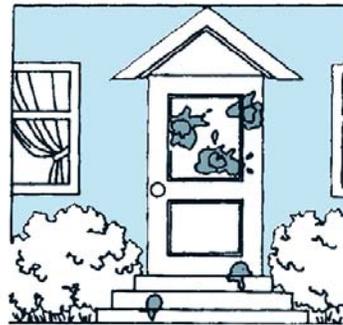
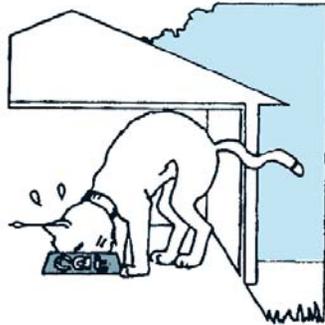
Improving Memory

(tricks for organizing memories)

- Terms
 - Mnemosyne: Greek goddess
 - Mnemonic: memory aid
 - Mnemonist: skilled memory
- Peg-word method

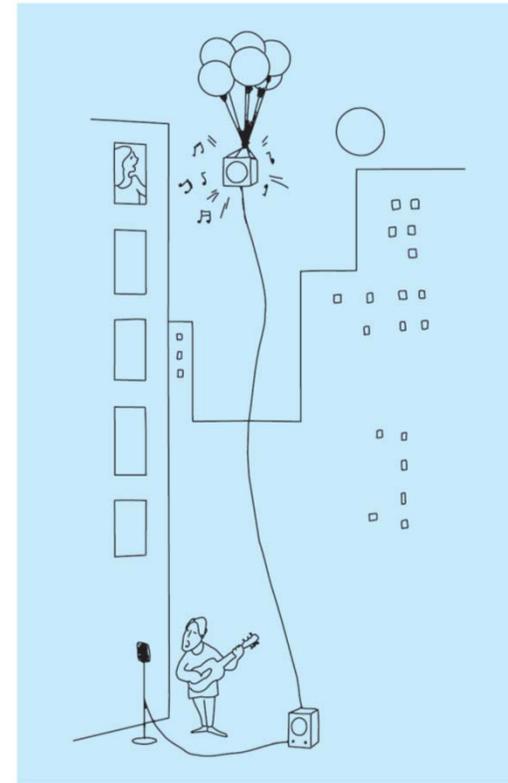


- first letter technique
 - HOMES, ROYGBIV, SOHCAHTOA
- the method of loci
 - ordered landmarks and imagery



The Importance of Understanding

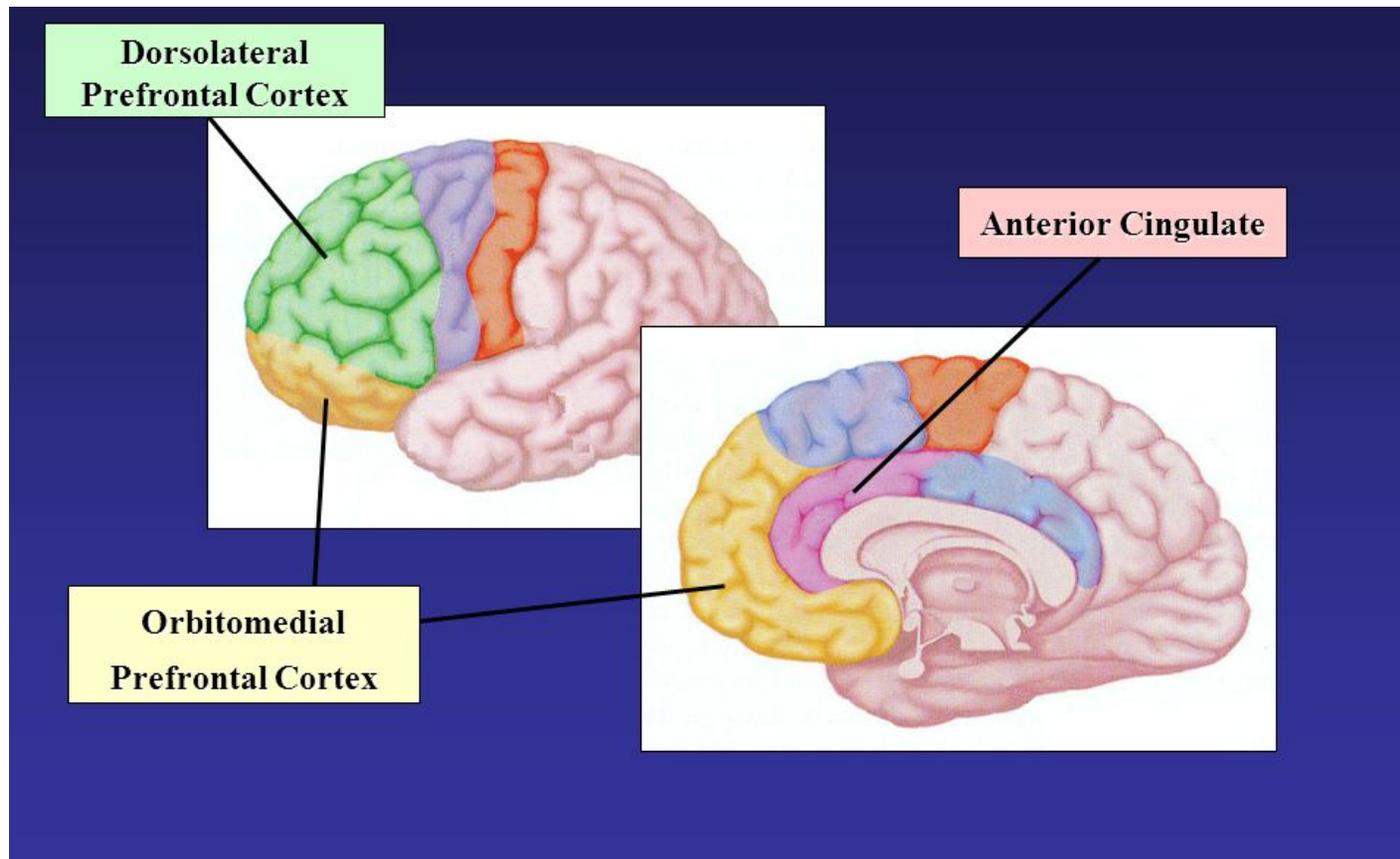
If the balloons popped, the sounds wouldn't be able to carry since everything would be too far away from the correct floor. A closed window would also prevent the sound from carrying, since most buildings tend to be well insulated. Since the whole operation depends on a steady flow of electricity, a break in the middle of the wire would also cause problems. Of course, the fellow could shout, but the human voice is not loud enough to carry that far. An additional problem is that the string could break on the instrument. Then there could be no accompaniment to the message. It is clear that the best situation would involve less distance. Then there would be fewer potential problems. With face-to-face contact, the least number of things could go wrong.



- Bransford and Johnson (1972)
 - without the context recalled 3.6 of 14 ideas
 - equally bad with context presented afterwards
 - with the context presented beforehand recalled 8 ideas

Prefrontal Cortex and WM

- Stroop effect
 - More DLPFC and ACC activation for Incongruent than congruent activates



- WM delayed response task
 - Location changes randomly every trial
 - Requires maintenance of most recent location
 - Can't be performed after PFC lesions
- normal learning for associative memory task
 - consistently rewarded object

