Announcements

- 1. Online issues (Acrobat 5.0 or greater)

http://www.adobe.com/products/acrobat/readermain.html

- 2. The beginning of class
- 3. My office hours -- at The Grove until further notice
- 4. Reasons to come to office hours
- 5. Demos from last time:

http://viscog.beckman.uiuc.edu/djs_lab/demos.html
(Free online demos)

or

http://www.viscog.com
($45 DVD - academic discount)

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Memory I

- Intro
  - The Case of H.M.
  - The Big Picture
- Sensory Stores
  - Iconic Memory
  - Echoic Memory
- Short term memory
  - Encoding: Chunking
  - Maintenance: Rehearsal
  - Retrieval: Serial Exhaustive Search
  - Purposes
  - Working Memory Theory
- Long term memory
  - Serial position effects
  - Encoding: Levels of Processing
  - Encoding-retrieval interactions
- Forgetting
  - Interference
  - Are forgotten memories truly lost?

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The Case of H.M.

- H.M. (Henry M.) in 1953
  - A 27 year old man from Hartford, Connecticut
  - Above average intelligence
  - Liked ice-skating
  - Had an uncanny ability to work out who the killer was on detective shows before the detective
  - At age 16, out with his parents for his birthday, had a severe "grand mal" seizure
  - By 1953, he was having 11 seizures a week. He couldn't get a job or even leave the house.
  - Drugs available weren't working

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The Case of H.M.

- H.M. in 1953
  - Radical, experimental brain surgery including removal of portions of the temporal lobes (thus damaging the hippocampus, too.)
  - Following surgery, he seemed normal except for a severe memory deficit.
  - "Right now, I'm wondering. Have I done or said anything amiss? You see, at this moment everything looks clear to me, but what happened just before? That's what worries me. It's just like waking from a dream; I just don't remember."--H.M.

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The Case of H.M.

- H.M. (Henry M.) in 1953
  - What was wrong?
    - His personality, IQ, and knowledge of the world were intact.
    - It wasn't his long-term memory; he could still remember aspects of his youth
    - It wasn't his short-term memory, as he could memorize 8-digit numbers and retain the info for 30 seconds
    - What was lost was the ability to convert short-term memories into long-term memories.
    - Anterograde amnesia--the inability to learn new information after some trauma

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The Case of H.M.

- H.M. Today (2002)
  - One of the most studied brain-damage cases ever
  - "At the time of this writing, HM is still alive… He still likes detective shows. He likes doing crosswords, and watching TV. However, it is impossible for him to make new friends as he cannot remember a person for any longer than 10 minutes. He lives in a world where, for him, Truman is still president. News of his mother's death evokes the same painful grief for a short period of time, and then it is gone. He never really knows exactly how old he is, but reckons that he is about 30. When he looks into a mirror, he is shocked by the reflection." --BBC

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The Case of H.M.

- H.M. Today (2002) (BBC continued)
  - "Even with this, he is quite happy, if slightly confused, and quite unaware of the unexpected sacrifice he made that provided the groundbreaking evidence of the link between memory and the brain. And he says:
  - "…What I keep thinking is that possibly I had an operation. And somehow the memory is gone… and I'm trying to figure it out… I think of it all the time. I don't' remember this, and why I don't remember that… It isn't worrisome in a way, to me, because I know that if they ever performed an operation on me, they'd learn from it. It would help others." -- H.M.

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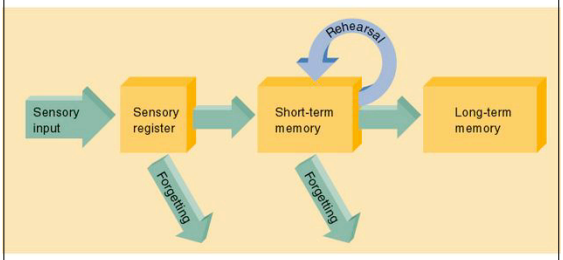
Memory: The Big Picture



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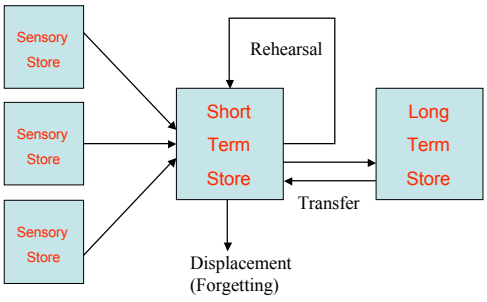

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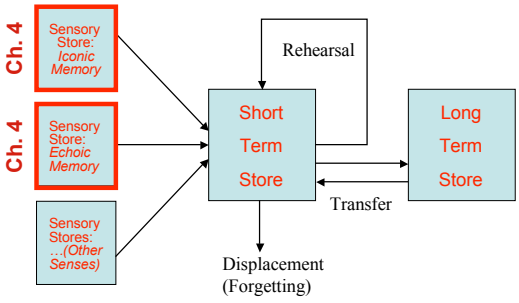

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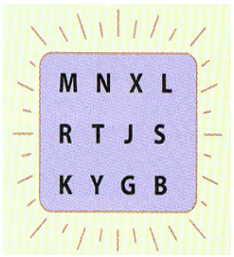
Sperling (1960) Experiment 1

- Subjects are presented with a brief glimpse (50 msec) of letter matrix.
- Asked to give a "FULL REPORT".
- 7 (+/- 2)
- Measures STM capacity



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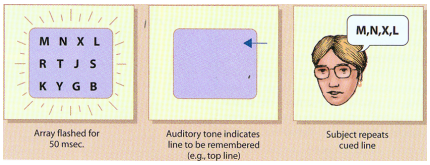
Sperling (1960) Experiment 2



- Asked to give a "PARTIAL REPORT".
- All letters from any row.
- Subjects can recall all items from the cued line (Figure 4.1 in book)
- Evidence for Iconic Memory

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How long does Iconic Memory last?

- The information lasts for 300 to 500 milliseconds, and then decays.
- Iconic Memory allows the visual image to persist long enough for us to select the information that is most important to us at a given moment.
- Information is either sent to short-term memory or lost

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Experiment (Moray 1965)

- Simultaneously presented sequences of consonants from four different locations
- When cued to recall one location the estimated total amount of material stored was greater than when Full Recall was requested
- Same as Sperling

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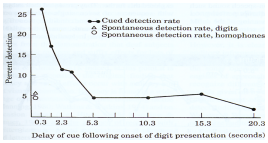
Experiment 2 (Darwin 1972)

- "Four-eared man" technique
- Delay of cue (0, 1, 2, 3 or 4 seconds)
- Information was lost after about 4 seconds



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Conclusion:

- Echoic memory is similar to Iconic memory in that there is more information accessible than can be recalled
- Echoic memory is different in that the trace lasts longer than a second

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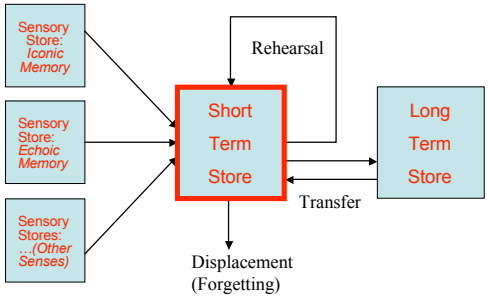

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STM Encoding: Chunking

- Encoding: The initial processing of a stimulus that leads to a mental representation in memory (p. 479)
- F BIV IPG NPC BS
- STM limited to 7 +/- 2 items
- FBI VIP GNP CBS
- What counts as an "item"?

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Chunking

- FBI is 1 item, not 3
- In last task, only holding 4 items in STM, which is easy
  - Is "858" area code 3 items or 1?
- A chunk is a *meaningful* piece of info, and meaning is a function of prior knowledge
  - If not familiar with FBI, then becomes 3 items
  - If not familiar with alphabet, F might be 3 items...
- The bigger the chunks, the more info stored in STM

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How big can chunks get?

- Very big
  - If you were read "Pledge of Allegiance," you would only have to remember 1 item – but would be able to recall dozens of words
- One person could recall more than 80 digits read to him
  - He was avid runner who chunked the numbers in terms of running times
  - E.g., 2 1 4 1 0 3 4 0 8 4 7 5 0 chunked as:

  Marathon (2 hr 14 min)

  100-yd dash (10.3 sec)

  Mile (4 min 8 sec)

  10 miles (47 min 50 sec)
- How do you think he remembered 80+ digits?

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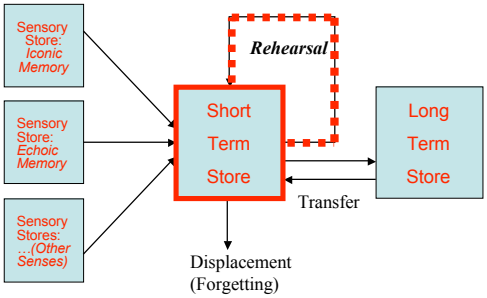

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STM Storage: Rehearsal

- Storage: How info is stored/lost? What is the capacity?
- Take 20 seconds to say the following 4 words over and over to yourself:
- Hat, star, dog, glove (close your eyes)
- "***maintenance rehearsal***": repeating by rote some info without any effort to develop meaningful associations to it.
- An effective way to hold info in STM but not very effective for later remembering

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STM: Blocked Rehearsal and Forgetting

- Peterson & Peterson (1959):
- Subject read a 3-letter consonant group (e.g., BKF)…
- …then immediately given a 3-digit number (e.g. 397)… (to block maintenance rehearsal)…
- …then subject counted backwards by threes (i.e. 397, 394, 391, etc.) for either 3, 6, 9, 12, 15 or 18 seconds
- …then asked to recall the consonant group…

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STM Blocked Rehearsal & Forgetting

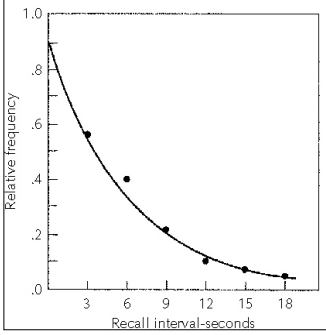

Fig 5.1 in book: Proportion recalled in an STM task as a function of delay during which subjects are counting backward by 3. (Petersen & Petersen, 1959)

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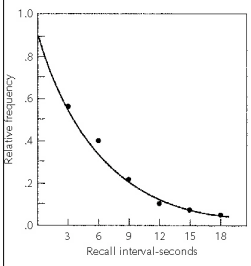
Short term memory



- Rehearsal keeps info active in STM
- Inactive info disappears quickly in STM
- Memory an *active* process

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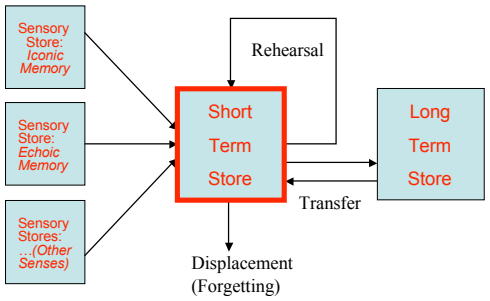
Memory: The Big Picture



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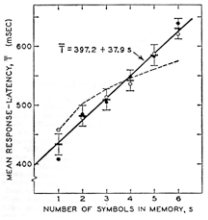
STM Retrieval

- Imagine holding short string of digits in STM
- Would it take longer to identify a digit in STM if you were holding 5 vs. 3 digits in STM?
- Would it take as long to know the answer was "yes" as it would to know it was "no"?
- "Yes" to both questions (Sternberg, 1966)
- Implies serial and exhaustive search of STM



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Purposes of STM

- New info can be processed further, increasing chance for more permanent storage in LTM
  - Learning new telephone number might require rehearsal and chunking
- STM allows for processing old (LTM) info as well
  - Calculate uncle's age by retrieving his birth date and using it in calculation
  - Can think of this info in STM as LTM that is active

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Working Memory: Components

- **Central executive**
  - An attentional system which supervises and coordinates a number of subsidiary slave systems
- **Articulatory (Phonological) loop**
  - Responsible for speech-based information
- **Visuo-spatial sketch pad**
  - Responsible for visual images

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Baddeley and Hitch's Model of Working Memory

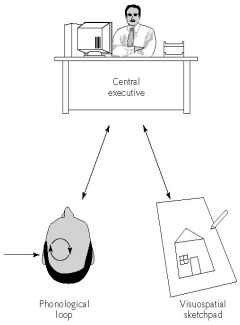

Fig 5.4 (page 147)

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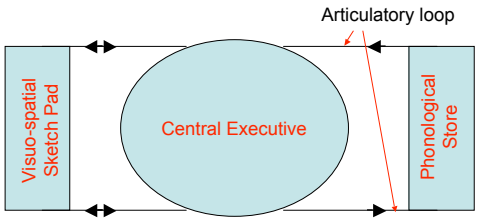
Baddeley and Hitch's model of Working Memory



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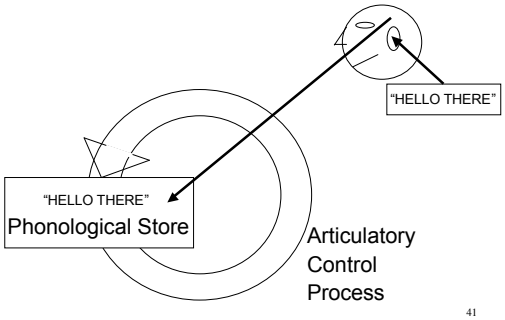
Listening & the Phonological Loop



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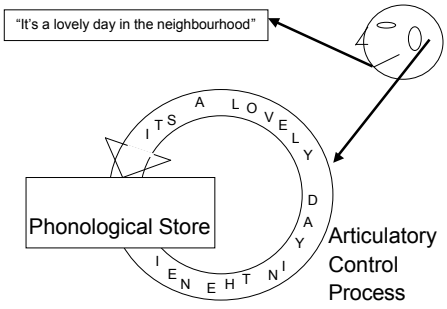
Speaking & the Phonological Loop



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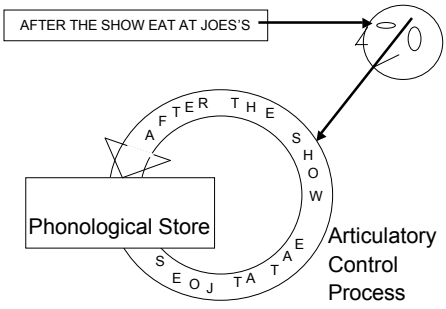
Reading & the Phonological Loop



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Structures of the Phonological Loop

- **Phonological store**
  - holds speech based information
  - limited capacity (about 2 seconds).
- **Articulatory control process**
  - based on inner speech
  - refresh information in the phonological store
  - convert written material into phonological code

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What is the phonological loop for?

1. Learning to read:
Children with impaired reading ability have reduced memory spans and have difficulties in tasks which require the manipulation of phonological information (e.g. given Stop, reply Top).

2. Language comprehension:
STM patients such as TB have some difficulty in comprehending verbose or complex sentences e.g. "The boys pick the apples" = OK; "The two boys pick the green apples from the tree" = Impaired

3. Vocabulary acquisition
There is a strong correlation between non-word repetition (which strongly taxes the phonological loop) and vocabulary size (Gathercole & Baddeley, 1989)

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Visuo-Spatial Sketchpad

- Can take input directly through perception
- Can take input indirectly through visual image
- Has both visual and spatial dimensions
- Helps plan and perform spatial tasks

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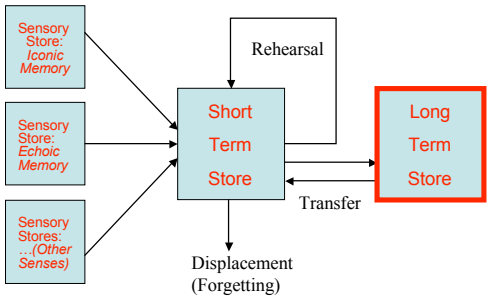

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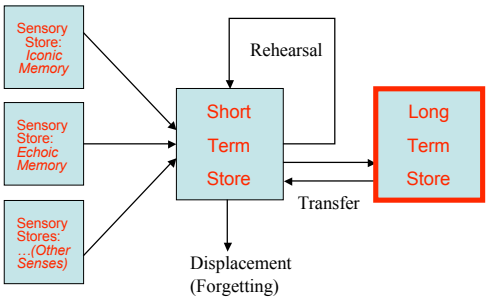

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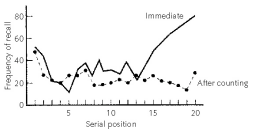
Long term memory and Serial Position Effects

- Results from free recall task
- Recency effect (words at end of list remembered well). Why?
- Primacy effect (words at beginning of list remembered well). Why?
- Lessons learned from STM can explain both *serial position effects*
- Primacy effect illustrates relation between STM and LTM



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Encoding: Levels of processing

- Subjects answer questions about list of 60 nouns, presented one at a time. When each noun was presented…
- In *case* condition, report if word in upper case (TABLE, table)
- In *rhyme* condition, report if word rhymes with (e.g.) "weight" (crate, market)
- In *sentence* condition, report if word fits into sentence (e.g., "He met a ____ in the street"; friend, cloud)
- Idea is that the 3 conditions require increasingly deep processing of words
- ***Incidental learning***: Subjects didn't know they'd be tested for recall.
- In subsequent recognition test, percent of words correctly recognized were 17, 37, and 65, respectively (Craik & Tulving, 1975)
- Illustrates importance of *encoding* on memory (again, an *active* process!)

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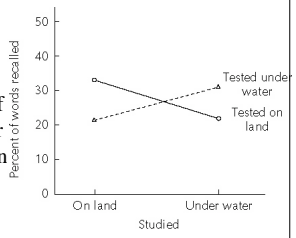
Encoding-retrieval interactions

- Context effect (state-dependent learning)
- The improvement (or decrement) in memory of having information occur with the same (or differen context.
  - Physical environment
  - Emotional state



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Forgetting: Hermann Ebbinghaus (1885)

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Forgetting

- Retroactive interference
  - Group 1: learn A, learn B, test A
  - Group 2: learn A, rest, test A
  - Group 2 performs best on test
  - New info makes it harder to retrieve old info
- Proactive interference
  - Group 1: learn B, learn A, test A
  - Group 2: rest, learn A, test A
  - Group 2 performs best on test
  - Old info makes it harder to learn new info
- Generally, the more items stored with a particular cue, the harder it is to retrieve particular item

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  - Echoic Memory
- Short term memory
  - Encoding: Chunking
  - Maintenance: Rehearsal
  - Retrieval: Serial Exhaustive Search
  - Purposes
  - Working Memory Theory
- Long term memory
  - Serial position effects
  - Encoding: Levels of Processing
  - Encoding-retrieval interactions
- ***Forgetting***
  - Interference
  - ***Are forgotten memories truly lost?***

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Are forgotten memories truly lost?

- Already seen instances where inability to recall does not mean that info is gone
  - Encoding-retrieval interactions
  - Some measures of memory more sensitive than others (recall vs. recognition vs. savings in relearning)
- Maybe "forgotten" info just really hard to access
  - Memories from infancy still in there?
  - What about claims of "forgotten" memories of abuse dredged up by therapy?

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