## Psychology 105

## Chapter 6 – Memory

**List five things that you use your memory to do**

Spring 2008

## Memory - Outline

- What is Memory?
  - Essential Functions of Memory
  - Stages of Memory Formation
- Forming Memories
  - Processing in Sensory Memory
  - Processing in Working Memory
  - Processing in Long-term Memory
    - Types of Long-Term Memory
- Mnemonics
- Retrieving Memories
- Forgetting: "Seven Sins" of Memory
- Biological Bases of Memory



## Memory Defined

- **Memory**
  1. The location where information is kept, as in a storehouse or memory store
  2. What holds the contents of experience: memory trace, mental representation
  3. The processes used to acquire, encode, store and retrieve (remember) all sorts of information
- **Memory Processes**
  - Acts of using information in specific ways
    - to make it available for later use
    - to bring back stored information into current focus

## Demos of Memory

Listen…

Now, write down what you just heard.

Listen again, and this time try to visualize what you're hearing…

Now, write down what you just heard.

-Oliver Wendell Holmes



## Match the pictures, buildings and denominations

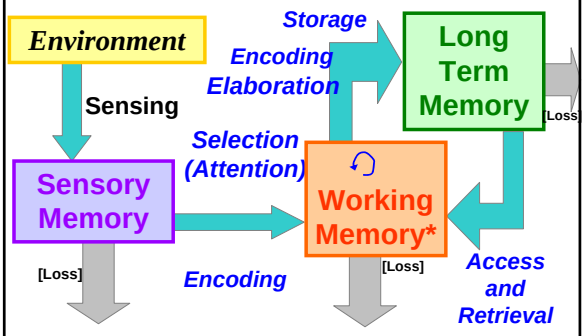
DEMO – slide will be unblanked on-line after class



## Three Essential Functions of Memory

- *Encoding:* Getting a stimulus into memory, and modifying it to the preferred format of memory system
  - Select the stimulus event
  - Identify its distinctive features
  - Tag, or label, the experience
  - Elaboration – relating memory to other information
- *Storage:* Retention of encoded information over time
- *Access and Retrieval:* Finding and recovering stored information, bringing information to a place where it can be used by other systems (conscious or unconscious)

## Stages of Memory Formation:
### Atkinson and Shiffrin's Modal Model




*Working Memory is a modern version of Short Term Memory

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## Processing in Sensory Memory

*Sensory Memory:* Preserves brief sensory impressions of stimuli; also called *sensory register*

- Holds sensory impression just long enough for brain to select out information for further processing
- Capacity of sensory memory is very large, but of very short duration
  - Demonstrated by George Sperling, using Partial Report Technique

Demo:

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## Sensory Memory for Picture

DEMO

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A savant with a remarkable memory:

http://www.wisconsinmedicalsociety.org/savant/wiltshire.cfm

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## Working Memory (Short Term Memory)

- Working Memory:
  - Stage of memory where sensory input is
    - encoded,
    - rehearsed,
    - elaborated and
    - transferred to long term memory
  - Stage of memory where memories that are retrieved from long-term memory are brought for further processing
  - Duration – about 20-60 seconds, without rehearsal
  - Capacity also limited …



## Working Memory Capacity - Demo

Demo:

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## Working Memory Capacity – about 7 items

- *The magical number 7, plus or minus two items (George Miller)*
- Capacity is much smaller than sensory memory, but items remain available in working memory for around 20-60 seconds, more if rehearsed (repeated to oneself)
- Additional items are often lost, or not processed
- What is an item?

## Working Memory – increasing capacity

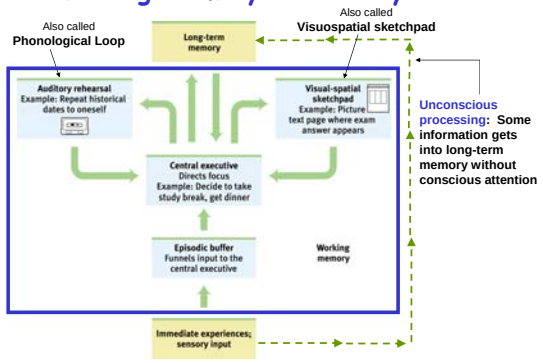
- *Chunking* – organizing pieces of information into larger, sometimes meaningful units, increases capacity of working memory

Which is easier to remember:

- 7 1 3 9 4 0 2 7 5 3 or
  713 – 940 - 2753 ?
- C E B G E R I N H T E S E H or
  BRING THE CHEESE ?
- ATV XOB RYT ESW or
  VAT BOX TRY SEW ?
- BUILT TWO WITH HOUSES ARE STORIES MANY or
  MANY HOUSES ARE BUILT WITH TWO STORIES ?



## Working Memory – Baddeley Model




Based on Myers, 2007, p 352



## Working Memory – Encoding information into LTM

- *Maintenance rehearsal* – repeating to yourself
  - Refreshes contents of working memory, preventing loss
  - Prevents competing information from entering working memory
- *Elaborative rehearsal* – transfer information from WM to LTM by actively connecting contents of working memory to what you already know (focus on meaning)
  - Chunking
  - Use of mnemonics - Every Good Bird Does Fly (EGBDF – the lines on treble (G) clef)
  - Use of analogy, e.g., iconic: "like icon (picture)"
  - Fit it in knowledge structure – relate it to what you know
  - Organize it (outline, diagram, hierarchy)
  - Form images or sentences with it
  - Ask questions about it

**Under most circumstances, elaborative rehearsal is much more effective than maintenance rehearsal**

## Working Memory in a Chimp

http://www.youtube.com/watch?v=cPiDHXtM0VA

**Chimp task demonstrates sensory and working memory**

- **Chimpanzees perform better than college students**
- **Chimps got more practice?**
- **One theory: human capability for this type of task lessened with development of linguistic encoding**



## Mnemonics – Facilitating Remembering

*Mnemonics* – associating items to be remembered with something already in long-term memory (elaborative rehearsal). Most use visual imagery as an aid in memory formation.

- *Method of Loci* – key items to a walk around a familiar room
- *Peg List* – one-bun two-shoe, associated with new items to be learned
- *Natural language mediators* (acronyms, story)
- *Names as bizarre images*



## Working Memory – Levels of Processing

*Levels of Processing Theory:* The more connections you can make between an item in working memory and items in long term memory, the more likely you will remember it later. (Craik and Tulving)

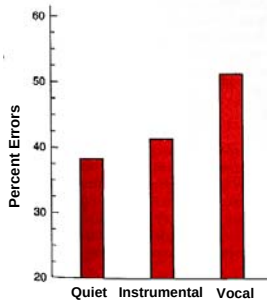
Study: The more deeply a word is processed, the more likely it is to be remembered

Target word: *Cat*

- Is in ALL CAPS? (mostly visual processing)
- Does it rhyme with hat? (v. + acoustic)
- Is a ____ an animal? (v. + a. + semantic)

Recognition was worst for visual (17%) , better for acoustic (37%), best for semantic (65%) – which required the deepest processing to answer the question.

## Working Memory: Interference Decreases Capacity




Effects of background music type on recall of verbal materials (e.g., from a history textbook)

(Salame & Baddeley, 1989)

*If you listen to music while you study, music with vocals leads to poorer retention!*



## Long-Term Memory

- Stage(s) of memory where memories are kept for future use
- Duration: up to a lifetime
  - Time (hours or more) required to consolidate information in LTM; if not consolidated, can be lost
  - Much initial memory consolidation takes place during sleep
- Capacity: "Unlimited" (no limit to size has been established)



## Types of Long-Term Memory

**Long-term memory**

***What:*** **Declarative memory (Explicit Memory)** (conscious effort to recall)

***How:*** **Procedural memory (Implicit Memory)** (no conscious effort to recall)

**Semantic memory**
Includes memory for:
- language
- facts
- general knowledge

**Episodic memory**
Includes memory for:
- events
- personal experiences
- "flashbulb" memories

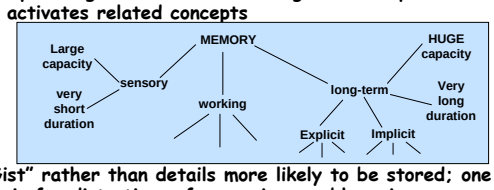
Includes memory for:
- motor & cognitive skills
- habits
- effects of:
  - operant conditioning
  - classical conditioning
- things learned unconsciously

Retrospective Memory

Prospective Memory

## Storing Declarative (Explicit) Memories

- Memories are filed according to pattern or meaning
- If not encoded well, may be "lost" – present but not retrievable
- Encoding often takes form of a network of related information and linked concepts
  - Spreading activation: activating one concept activates related concepts




- "Gist" rather than details more likely to be stored; one basis for distortions of memories, problems in eyewitness testimony

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## Studying What's Remembered and Forgotten

- *Recall* – must produce previously presented or learned information
  - Essay exam, name the US Presidents, name of 7th grade English teacher
  - Tip-of-the-tongue phenomenon (problem with recall)
- *Recognition* – Identify stimuli as having previously been presented or learned
  - Multiple choice exam, "I know I've seen you somewhere," "Stop! This is the turn!," deja vú
  - Normally much easier than recall – better cued
- *Relearning* – repeating learning steps for material already studied
  - For learned materials, usually takes less time & trials ("savings")

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## Forgetting

- When we forget, what happens? Potential explanations include:
  - Decay theory: memory trace 'fades' over time
  - Retrieval theory
    - Material is present but retrieval cues lost or incorrect?
    - Material was poorly or never encoded?
  - Interference theory:
    - Other memories interfere
    - Material is displaced by old or new material
  - Motivated forgetting
    - Repression
    - Suppression

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## Seven Sins of Memory: Failures of memory

"Seven Sins" of Memory (Daniel Schacter, 1999)

Can you think of a peg-list mnemonic for these?

| *You want to remember* (Schacter's 7 Sins) | *Peg List* | *Associations and Images that you form* |
|---|---|---|
| 1. Transience | One-bun | Train on a hot-dog bun |
| 2. Absent-mindedness | Two-shoe | |
| 3. Blocking | Three-tree | |
| 4. Misattribution | Four-door | |
| 5. Suggestibility | Five-hive | |
| 6. Bias | Six-sticks | |
| 7. Persistence | Seven-heaven | |



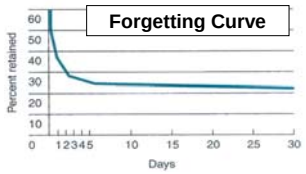
## Seven Sins of Memory - Omission

*1. Transience:* impermanence of long term memory

Ebbinghaus: Used nonsense syllables to study forgetting and found that for relatively meaningless material, forgetting is initially rapid, and then plateaus:

Nonsense Syllables

| | |
|---|---|
| RUH | WAB |
| DOQ | XIP |
| LUM | ZOM |
| TIV | JES |




Up-side: loss of memories of useless info



## Seven Sins of Memory - Omission

*2. Absent-mindedness:* forgetting caused by lapses in attention

- Failure to encode:
  - Where did I leave my keys?
  - What was the last thing you said?
- Failure to recall (distracted)
  - Your birthday was YESTERDAY???

http://viscog.beckman.uiuc.edu/grafs/demos/15.html

Alternate clip (not available on-line)

Up-side: Useful ability to shift and focus attention

## Seven Sins of Memory - Omission

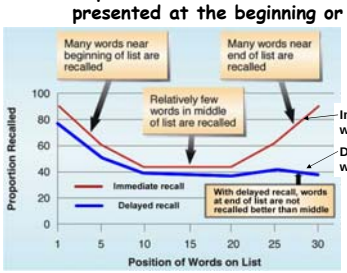
3. *Blocking* – interference from other memories, inaccessibility of stored information
   - *Proactive Interference* – Previously stored memories interfere with retrieval of later memories
     - Learning a word in Russian interferes with later learning that word in German
   - *Retroactive Interference* – Memories stored later interfere with retrieval of items learned earlier
     - Learn to drive in US (right side), drive on vacation in England (left side), then return to US and try to drive
   - "Tip of the tongue" phenomenon



## Seven Sins of Memory - Omission

*Transience (1) and Blocking (3)*

*Serial Position Effect:* Items in the middle of a sequence are less well remembered than items presented at the beginning or end:




Immediate recall – still in working memory

Delayed recall – lost from working memory

Middle and end of list – proactive interference and retroactive interference effects reduce recall after a delay



## Demo

**Demo:**

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## Seven Sins of Memory - Distortion

*Sins 4-6 illustrate the CONSTRUCTIVE nature of memory: Constructionist Theory holds that memories are not played back like a video recorder; they are constructed from stored information and cues*

4. *Misattribution* – Memories connected with the wrong context
   - Hearing an idea, then later believing it was your own
   - Remembering that your brother told you a joke, when you actually read it in a newsgroup
   - Seeing a person in one place, then later misidentifying him as someone who committed a crime elsewhere



## Seven Sins of Memory - Distortion

5. *Suggestibility* – Memory distortion as the result of accidental or deliberate suggestion
   - Memories are *reconstructed* during the process of recall from memory fragments, cues. We fill in gaps to try to "make sense" of the memory without being conscious of the process. Suggestion and use of imagination can easily distort the process of reconstruction.
   - Misinformation effect: incorporating misleading or suggested information into one's memory of an event
   - "Recovered memory": memory of severe abuse or trauma, repressed, and then recalled during adulthood, usually with the help of a therapist



## Seven Sins of Memory - Distortion

6. *Bias* – when attitudes, beliefs, emotions or experiences distort memories
   - "Should" have happened this way
   - *Mood-congruent memory:* Memories that are retrieved are heavily biased by one's present mood.
     - When you're angry at someone, try to recall something good that they have done (and v.v.)
   - *Self-consistency bias:* Earlier memories are distorted to be consistent with current beliefs and views
   - *Bias influenced by prejudice:* Example: believing that "minority group members are more likely to commit crimes" leads to misidentification of minorities as criminals

Sins 4-6 (misattribution, suggestibility, bias) make you ask: *how reliable is eyewitness testimony?*

## Seven Sins of Memory - Intrusion

7. *Persistence* – an unwanted memory can't be put out of mind or forgotten
   - Intrusive memories of unpleasant events, usually associated with negative emotions (anger, fear, high stress)
   - Often cued by mood or cues similar to initiating event (post-trauma)
   - Difficult to "erase" or extinguish
   - Intrusive memories are characteristic of Post Traumatic Stress Disorder (PTSD)

Upside: memories connected with negative emotions may have survival value (don't do that again!)



## Biological Basis of Memory - 1

- Neural networks form basis of memory storage, according to current theory
- Different brain areas participate for different stages and different types of memory functions
  - Sensory memory - Sense organs, sensory pathways, primary sensory cortex (e.g., occipital cortex) are used in recall as well as initial encoding of memory
  - Working memory – Processing thought to occur in frontal lobes (which are richly connected within themselves and to other brain areas); there may be a separate "executive" region that directs processing



## Biological Basis of Memory - 2

- Brain areas, cont.
  - Long-term memory
    - Hippocampus: converts declarative and episodic memories from short-term to long-term; may be holding area; other brain areas involved later
      - Severe damage to hippocampus prevents forming of new memories, even though memories formed pre-damage are intact (anterograde amnesia)
    - Amygdala: emotional significance of experience
    - Cerebellum: critical in formation and storage of implicit (procedural) memories

## Biological Basis of Memory - 3

- Long term memory
  - "Permanent" storage is not immediate – electric shock or a blow to the head can disrupt storage of recent memories (retrograde amnesia)
  - Memory formation is associated with structural changes in neural circuits (e.g., Long-Term Potentiation, formation of new synapses, increased neurotransmitter and receptors at synapses)
  - Permanent memory loss is associated with destruction of neural tissue (Alzheimer's, stroke, certain brain surgery)
  - Emotional arousal promotes memory formation, but…
  - Long-term stress inhibits memory formation and retrieval; brain shrinkage, including hippocampus, is found
  - Conversion of STM to LTM depends on protein formation, regulated by genes (which vary in effectiveness)



## Human memory

Humans are good at remembering information that is:

- Meaningful
- Attended to
- Of interest
- Emotionally arousing
- Rehearsed
- Organized
- Over-learned
- Fits with prior experience or knowledge



## Part II – more information

- Demos of Memory: Droodles
  - Demonstrate the importance of attaching meaning in order to recall materials

## Demos of Memory – Droodles - 1

Blish



Cend

Rist

Teaf

Droodles: Look at each drawing and its label, and try to remember them.

http://www.exploratorium.edu/exhibits/droodles/index.html

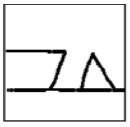


## Demos of Memory – Droodles - 2

Without looking, draw the droodle named "Rist"

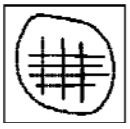


## Memory Demo – Droodles - 3

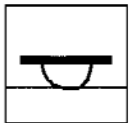


Titanic hits iceburg

Inchworm on roller skates



Elephant steps on waffle



Fried egg, sunny-side down

Droodles: Look at each drawing and its label, and try to remember them.

http://www.exploratorium.edu/exhibits/droodles/index.html

## Memory Demo – Droodles - 4

- Without looking, draw the Droodle labeled "Titanic hits iceburg"



## Which is the real penny?

Look at the penny handout – which one looks most like a real penny?

http://www.exploratorium.edu/exhibits/common_cents/


Which image shows a US penny?

Rearranged from image at http://www.exploratorium.edu/exhibits/common_cents/



## TouchtoneTelephone Keypad

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |
| | 0 | |

Can you fill in the blanks – FROM MEMORY?

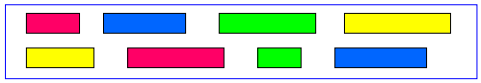
(no cheating – don't look at a phone!)

## Stroop Effect: Encoding Interference

As quickly as you can, name the colors of the ink in which each of the following items is printed. As you read the items in each box, have someone time you. Does it take the same amount of time to read the eight items in each box?

BLUE GREEN RED YELLOW
RED YELLOW BLUE GREEN

RED GREEN YELLOW BLUE
BLUE YELLOW RED GREEN





## Incidental Learning/Memory

Look briefly at the following pictures, and then cover it up and name all of the items that have a red border



## Incidental Learning/Memory - 2

Without looking at the previous slide, choose from the following pictures the ones that you have already seen on that slide.

## Declarative memory: Context and Encoding Specificity

- *Context:* Recall is normally better if it is done in the same context as initial learning – same cues, same situation
- *Encoding specificity:* Memory is encoded and stored with specific cues related to the context in which it was formed. Recall is better when cues for recall match cues present at encoding