

Psyc 101, Pomerantz
Section 7: Memory

Memory: the capacity to encode, store, and retrieve (recall, recognize, remember) information.

Memory store: set of neurons that retains information over time. Note: the neural mechanisms underlying memory are not well understood; and many sets of neurons hold information that we would not call memory per se.

Types of Memory: several different ways to classify memory stores.

Classifying memory by its duration: sensory, STM, LTM

Sensory memory (iconic, echoic)

- Very short duration, < 1 sec
- Nearly unlimited capacity, very fine detail
- Automatic (no effort required, can't be prevented normally)
- Works bottom-up
- Demonstrated in vision by Sperling's partial report experiment (1960)
- Iconic memory may reside in the retina

Short Term Memory (STM)

- Medium duration (several seconds, can be sustained longer with effort)
- Very small capacity – demonstrate span with digits.
 - George Miller's famous "Magical Number Seven plus/minus Two" paper: STM can hold maybe 5 "chunks" of information, a chunk being defined by grouping.
 - Binary recoding into octal: 100011111011101=> 43735=>Roseville, OH
- "Conscious" memory (not very well defined)
- Analogy: volatile RAM memory
- Rehearsal is one way to sustain it (e.g., mental repetition of a phone number)

Long Term Memory (LTM)

- Lifetime duration (in theory; your mileage may vary)
- Capacity perhaps limited only by lifespan, health (Cf. Stanford's ichthyologist president David Jordan)
- Not conscious until retrieved into STM
- Analogy: nonvolatile memory (e.g., hard drive)
- Fine detail often lacking (cf. debatable "photographic memory," which Luria's S seemed to have; reading off tables of digits backwards)
- Modality-specific: stores for vision, audition, even motor memory (necktie)
- Olfactory store may be totally different – zero forgetting, powerful retrieval for early memories, Garcia effect

Memory curves

- Serial position curve (Ebbinghaus, Nipher): two components, primacy (lost with fast presentations) and recency (lost with counting-backwards task)

- Suffix effect: loss of recency effect from irrelevant information presented at the end of a to-be-remembered list.
- Forgetting curve: loss of information over time

Varieties of LTM: Semantic vs. Episodic

- Semantic: memory for factual information
- Episodic: memory for specific places and times (autobiographical memories)
- Example: who was first president of US vs. when did you first learn this fact?

Varieties of LTM: Explicit vs. Implicit

- Explicit (declarative): conscious, retrieved intentionally, as with semantic and episodic
- Implicit (nondeclarative memories): not consciously experienced, but they influence behavior
 - Classically conditioned responses
 - “Habits” (procedural memories)
 - Priming: buildup from previous processing that makes further processing easier
 - HM (bilateral removal of hippocampus): retained ability to form implicit memories but not explicit memories.

Working Memory (Baddeley)

- Include STM and the processes that act on STMs
- Articulatory loop for verbally produced sounds
- Visuospatial sketchpad
- Central executive (cf. homunculus)

Biological foundation of memory = change at a set of synapses to form memory stores.
 “Long Term Potentiation”: a strengthened connection between two neurons, so that one neuron has a great effect on the other after a memory is established.

One mechanism: change at synapse so less transmitter substance is required to produce the same effect

Creating and recalling memories: Encoding, storage, and retrieval

- Encoding: putting information into memory
- Storage: retaining information in memory
- Retrieval: fetching information out of memory
- Library analogy: label, put on shelf, retrieve from shelf

Encoding

- Many types of codes possible (e.g., verbal and visual)
- Some information may be coded redundantly (e.g. dual code may explain why pictures are remembered better than words)

- Consolidation: the conversation of short-term memories into long-term memories through neural changes in the brain; i.e. dynamic into structural, or volatile into non-volatile.
- Patient HM with hippocampi removed is unable to consolidate; similarly, electroconvulsive therapy produces memory disruption.
- Depth of processing affects strength of encoding: attending to semantics (meaning) leads to better memory than attending to superficial properties (font case).
- Transfer-appropriate processing: better memory when you perform the same task (e.g., remember words better with rhyming cues if attention was directed at their sound characteristics during studying – Suparna Rajaram)
- Breadth of processing: elaborative encoding (e.g., recode groups of 5 digits into postal zip codes)
- Intentional vs. incidental learning: the latter often works quite well. You don't need to try to remember, so long as you are processing the to-be-remembered information.
- Timing and memory: usually distributed practice is better than massed practice after controlling for total study time (implication: cramming is unwise)
- Memory and emotion: flashbulb memories for emotionally charged information are generally stronger and clearer than memories for neutral information.
- Von Restorff effect: poor memory for information that immediately precedes or follows distinctive or emotional information.

Retrieval: fetching information back out of memory

- Tip-of-tongue (TOT) phenomenon demonstrates retrieval difficulties, effectiveness of retrieval cues (e.g., number of syllables vs. 3rd letter)
 - Waxy substance from whales used to make perfume?
 - Small, flatbottomed boats used in harbors and rivers of Japan?
 - Favoritism shown, or patronage granted, to relatives (e.g., hiring your cousin)?
- Memory retrieval is reconstructive: assembling a coherent memory from fragments
- Bartlett's famous 1932 story: recollections changed over time, included elaborations and reorganizations
- Two (of several) ways of testing memory retrieval:
 - Recall: write down words you remember
 - Recognition: pick remembered words from a list
 - Recognition is almost always superior to recall
 - Distractor similarity plays a large role in recognition
 - Cf. objective vs. essay tests
- Even more sensitive measure of memory: savings.
- Retrieval cues: information that helps us recall (cf. CS in classical conditioning)
- Encoding specificity principle: memories retrieval works best if cues at recall match cues at learning. Thus, we will recall "bank" better if its meaning (financial institution vs. side of river) agrees between study and test.

- State-dependent learning: memory is better if test takes place in same setting, body state as learning. Will the final exam be in the same classroom as the lectures?
- Hypermnnesia: recalling more information over time. Due in part to each retrieved bit of information serving as a cue for further bits. (Common experience: we remember later something we cannot remember now).

False Memories: a consequence of memory's reconstructive process

- Beth Loftus: shopping mall study, stop sign study. Shows the malleability of memory, although the correct, original memory may in fact persist but just be harder to retrieve.
- Deese-Roediger-McDermott (DRM) effect: easy to make people remember things that did not happen (e.g., "sweet" study). Has become the standard paradigm for understanding false memories created by inference and reconstruction of what likely happened.
- Schacter: neuroimaging may reveal differences between real and false memories, in temporal and parietal lobes.
- Source amnesia: remembering information but not where you learned it. I.e., semantic memory without episodic memory. Note implications for slander and libel from low-credibility sources.

Forgetting: decline in memory retrieval over time.

- Ebbinghaus: basic "decay" curve (but it may well not reflect actual decay).
- Library analogy: wrong cataloguing, paper fades, mis-shelving
- Is it *possible* that we never forget anything?
- Reasons for forgetting:
 - Encoding failure/ inattention
 - Consolidation failure (ECT)
 - Decay (demonstrated in aplysia sea slug); Penfield's evidence against
 - Interference / overwriting (retroactive, proactive): very common! E.g., your previous telephone number
 - Faulty retrieval (lack of cues, wrong cues)
 - Brain damage (amnesia: retrograde, anterograde)
 - Repression, especially of traumatic memories? Williams: yes. Loftus: no. Hard in these cases to know what really happened. Gail Goodman's studies on children.

Mnemonic devices: known since before ancient Greek and Roman orators

- Interactive images (for paired associates)
- Method of loci: Location, item pairs – preserves sequence information
- Pegword system (one is a bun, two is a shoe)
- Surprising property: pegwords and loci can be recycled indefinitely!

| <u>Example list of words</u> | <u>List of places</u> | <u>Pegwords</u> |
|------------------------------|-----------------------|-----------------|
| Milk | Closet | Bun |
| Bread | Front door | Shoe |
| Apples | Car | Tree |
| Hot dogs | Driveway | Door |
| Candy bar | Mailbox | Hive |

Other forms of memory skill

- Memory for chessboard positions in Grand Masters
 - Far better than normal for regular positions
 - No better than normal for random positions

Note: Answers to TOT questions above are ambergris, sampan, and nepotism