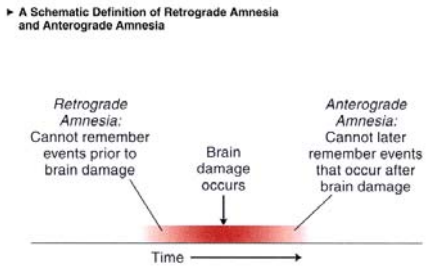
Amnesia

Amnesia

- Anterograde amnesia
  - Amnesia for events that occur after some disturbance to the brain
- Retrograde amnesia
  - Amnesia for events that preceded some disturbance to the brain
- Pre-morbid period
  - Time prior to brain damage
- Post-morbid period
  - Time subsequent to damage

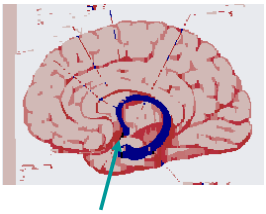


Retrograde

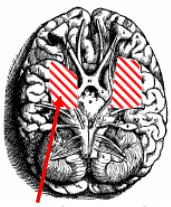
Anterograde

HM: Amnesic

- Severe epilepsy, treated with surgery to bilaterally remove medial temporal lobes, including hippocampus
- Operation 9/1953, 27 years old



HIPPOCAMPUS



MEDIAL TEMPORAL LOBES

HM: Amnesic

Operation 9/1953, 27 years old

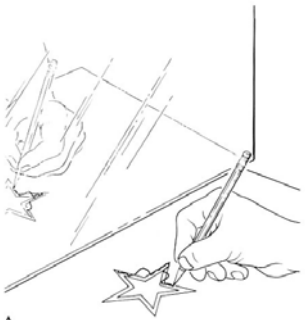
- Tested 4/1955, age 29
  - Reported date as 3/1953, age of 27
  - No memories since operation
  - IQ better than pre-op (112)
  - Fewer seizures

HM: Amnesic

- Profound failure to create new memories
  - Can't find new home (after 10 mos.)
  - Can't remember new people, names, tasks
  - Events/People since operation
  - Language essentially frozen in 50's
  - Exceptions: Ayatollah, rock 'n roll

HM: Amnesic

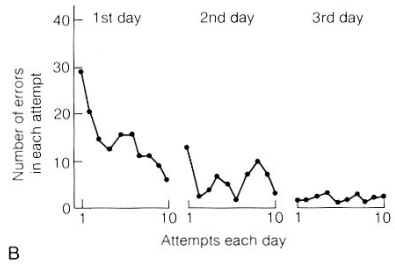
- Mirror tracing task, Milner, 1965



HM: Amnesic

Mirror tracing task, Milner, 1965

- improvement in H.M.
- no conscious recollection of previous training episodes

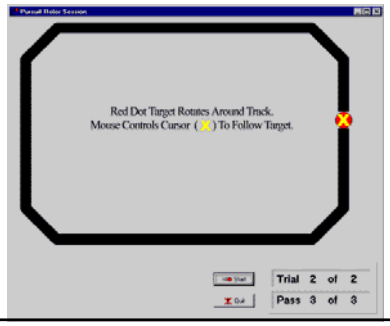


B

Behavioral Features

- STM functioning
  - Normal performance among amnesiac in digit span
- Procedural memory
  - HM (Corkin 1984)
    - Severe episodic memory impairment
    - Pursuit rotor task (see next slide)
    - Demonstrated learning within and across sessions
    - No memory of having done the task before

Pursuit Rotor Task



Implications

- Store/Modal model of STM as passage-way into LTM falsified
  - Anterograde amnesics can have normal digit spans but not form new memories
- Distinction between Declarative & Procedural Memory supported
  - H.M. learns new procedural knowledge but not new declarative knowledge

Procedural & Declarative memory

- Procedural memory:
  remembering "how to …"
  without awareness that any info from past is accessed?
- Declarative memory:
  conscious access to info from the past
  ("I remember that..")
  -> involves conscious recollection
  -> term often used synonymously with episodic memory

Implicit and explicit memory

- implicit memory:
  past experiences influence perceptions, thoughts & actions
  without awareness that any info from past is accessed
- explicit memory:
  conscious access to info from the past
  ("I remember that..")
  -> involves conscious recollection
  -> term often used synonymously with episodic memory

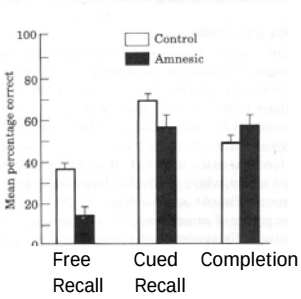
Explicit, Declarative Memory

- Free recall
  - Recall one or two items from a 12 word list after a one minute delay and nothing after a longer delay
- Paired associate learning with unrelated words
  - Little learning
- Forced choice recognition task
  - Chance performance

HM: Stem-Completion

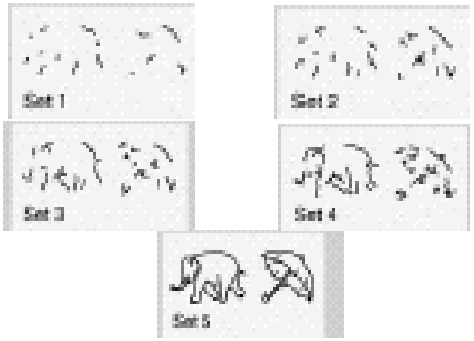
Graf et al. (1984):
Study: word list (table, garden, umbrella)
Test:
- free recall
- cued recall: complete word stem with word from study list
  umb____ ??
- word stem completion: complete word stem with first word that comes to mind
  gar___??

HM: Stem-Completion

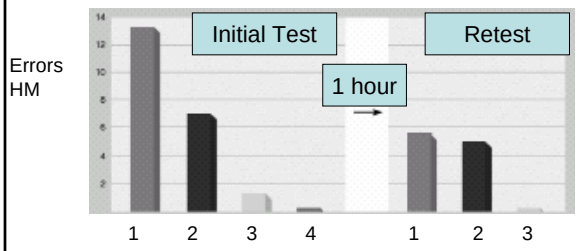


HM: No memory for studying of list

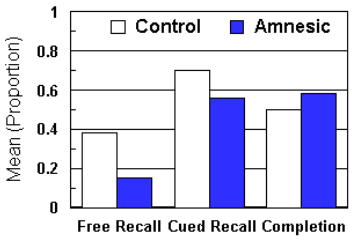
Incomplete- Pictures Task



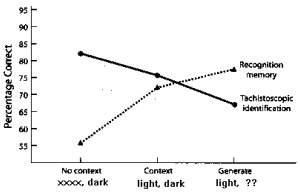
HM: Picture Completion Gollin, 1960



Dissociations & Patients



Dissociations in Normals



Subjects in the "no context" condition saw words and read them aloud; subjects in the "generate" condition had to generate the words (antonyms) on their own (and did not see them). Subjects in the "context" condition saw the words, but had a meaningful context (antonyms) and so only had to glance at the words in order to identify them. The "generate" condition was the best preparation for a direct test ("Are these the words you saw before?") but worst for an indirect test (tachistoscopic identification). [After Jacoby, 1983.]

Implicit Memory

- Information expressed w/o conscious recollection
- Task-Based
  - Stem completion
  - Priming
- No single goal
  - No direct reference to past events

Explicit Memory

- Information expressed with conscious recollection
- Task-Based
  - Free recall
  - Recognition
- Goal-directed
  - Refer to past events

Amnesia & Episodic/Semantic Distinction

- Amnesics remember what words mean, basic facts about the world, but don't remember what happens to them
- However,
  - Little conclusive evidence that different brain systems mediate episodic and semantic memory

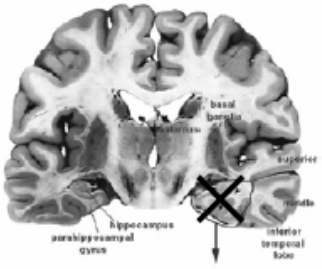
Retrograde Amnesia

- Difficulty
  - Identify people and events from different decades
  - Autobiographical cueing
    - Date memories retrieved in response to specific cue words
  - Temporal gradient
    - Memories formed early in life are more likely to survive than memories formed later in life
    - The vulnerability of a memory to brain injury is inversely related to its age

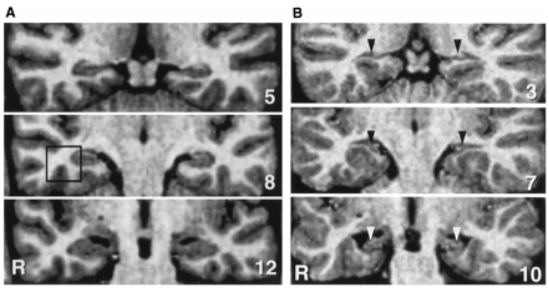
Retrograde Amnesia in PZ

- Scientist who became amnesic after writing an autobiography
- Memory for events in life
  - Temporal Gradient
- Memory for scientific facts
  - Temporal Gradient
- Suggests memory for events and for facts more tied together than previously thought

Vharga-Khadem (1997): Episodic vs. Semantic Memory



Atrophied Hippocampal Formation



Amnesic Kids

- Speech, language, IQ all normal
- Digit span normal, immediate recall normal
- Delayed recall severely impaired
- Inability to remember what they did yesterday!

Amnesics Kids' Performance

TYPE OF STIMULI PRESENTED	ITEM RECOGNITION	ASSOCIATIVE RECOGNITION
Nonwords	INTACT	INTACT
Faces	INTACT	INTACT
Object-place pairs	---	IMPAIRED
Voice-face pairs	---	IMPAIRED

Performance revealed a selective deficit in remembering the *associations* or *relationships* between stimuli.

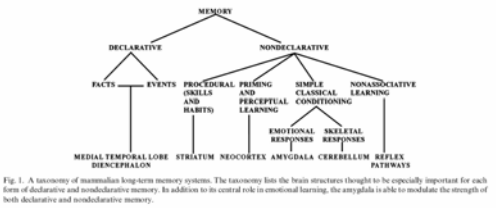
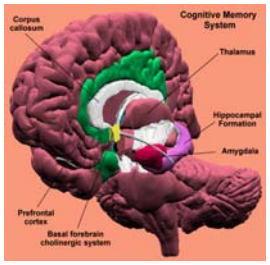


Fig. 1. A taxonomy of mammalian long-term memory systems. The taxonomy lists the brain structures thought to be especially important for each form of declarative and nondeclarative memory. In addition to its central role in emotional learning, the amygdala is able to modulate the strength of both declarative and nondeclarative memory.

Why do we have multiple memory systems?

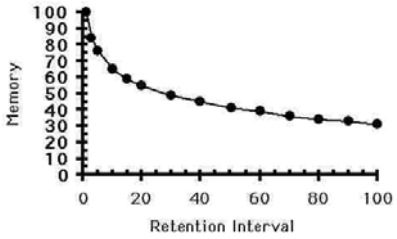
- Explicit, declarative memory
  - Cortex, Medial temporal lobe structures
  - Fast, phylogenetically recent
  - Interference, retrieval failure
- Implicit, procedural memory
  - Phylogenetically early
  - Nonconscious ways of responding to world



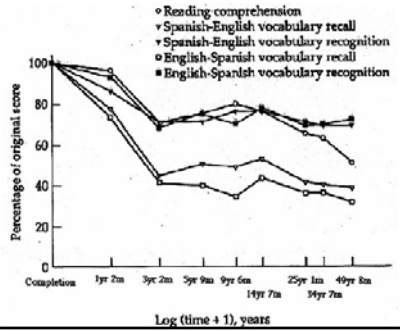
Forgetting Theory

- Decay
- Consolidation Failure
- Interference
- Retrieval Failure

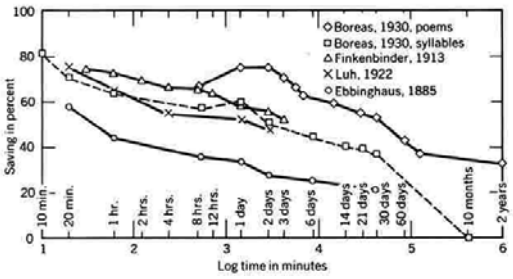
Decay Processes in Forgetting



Retention Function

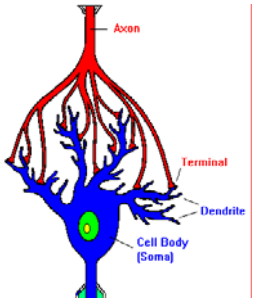


Retention Functions



Forgetting Functions

- Systematic
- Independent of Interference
- Psychological Causes?
- Physiological Causes?
  - Deterioration of synaptic efficacy also follows a power law

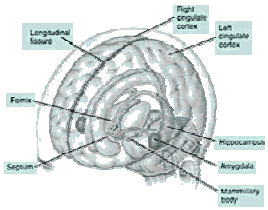


Decay & Forgetting

- Decay not *primary* source of forgetting
- Shape of forgetting curve influenced by type of memory and activities during retention interval

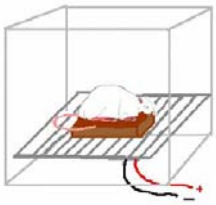
Consolidation Theory

- As a result of experience, certain neural processes responsible for permanent memories are set into motion
- Disruption of consolidation activities leads to poorly formed memories, and, thus forgetting

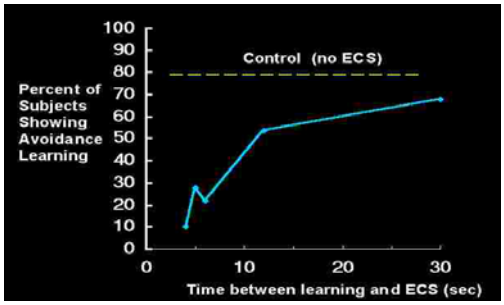


Evidence

- Anecdotal Evidence
  - H.M.'s retrograde amnesia
- Laboratory Evidence
  - Passive avoidance training
  - Electro-Convulsive Shock



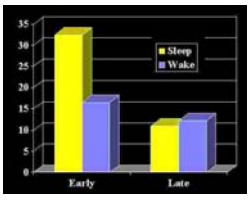
Chorover & Schiller



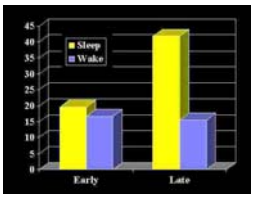
Consolidation & Sleep

- Plihal & Born
- Learning Task
  - Paired Associate Lists (Declarative, Explicit)
  OR
  - Mirror Tracing (Procedural, Implicit)
- Study Phase
  - Early (between 10:15 and 11 PM)
  - Late (after 3 hours of sleep)
- Test Phase
  - Sleep: tested after 3 hours of sleep
  - Wake: tested after 3 hours of viewing slides

Paired Associates



Mirror Tracing



Plihal & Born

- Sleeping during retention interval led to better memory than wakefulness
- Early Sleep (SWS?)
  - Aids declarative memory
- Late Sleep (REM?)
  - Aids procedural memory

Problems w/Consolidation

- Limited range of explanation
  - Trauma – disrupts consolidation
  - Sleep – aids consolidation
- Does not explain role of content of experiences during a retention interval

Interference Theory

- Forgetting caused by interference btw. info tested and other info that has been learned
- Occurs when
  - Same stimulus associated w/multiple responses
  - Similar stimuli associated w/different responses
- Two mechanisms
  - Response competition – multiple responses elicited by stimulus
  - Unlearning – new associations cause extinction of previous responses

Interference

- Phenomenon in which ability to remember concept X is disrupted by additional information about X
  - Proactive Interference
    - Earlier disrupts later
    - Tennis makes it hard to learn squash, racquetball
  - Retroactive Interference
    - Later disrupts earlier
    - Do you still remember the phone number of your best friend from 8th grade? Your current best friend's number?
- Interference related to similarity of items

Proactive Interference

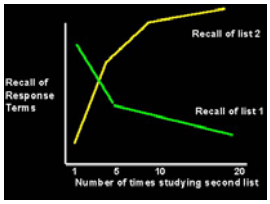
Group	*Learn*	*Learn*	*Test*
Experimental	A-B Cat-Tree	A-C Cat-Dirt	A-C Cat-Dirt
Control	----	A-C Cat-Dirt	A-C Cat-Dirt

Retroactive Interference

Group	*Learn*	*Learn*	*Test*
Experimental	A-B Cat-Tree	A-C Cat-Dirt	A-B Cat-Tree
Control	A-B Cat-Tree	---	A-B Cat-Tree

Interference Effects

- Barnes & Underwood
- S's learned list of paired associates until perfect recall
  - A—B (chair—dog)
- S's studied a 2nd list w/first terms paired w/new words
  - A—C (chair—tree)
  - Studied 2nd list 1,5,10 or 20 times
- Tested on memory for both response terms



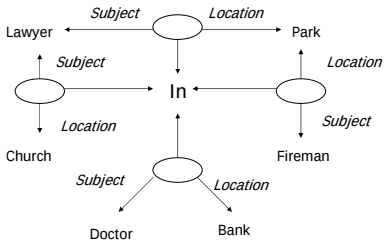
Fan Effect

- Memorize 26 facts (Person in Location)
- Vary # of locations paired to same person/people paired to same location
  - The doctor is in the bank.
  - The fireman is in the park.
  - The lawyer is in the church.
  - The lawyer is in the park.
- Speeded Recognition Judgment

Fan Effect

	1 sentence about a specific person	*2 sentences about a specific person*
1 sentence using a specific location	1.11 sec	1.17 sec
2 sentences using a specific location	1.17 sec	1.22 sec

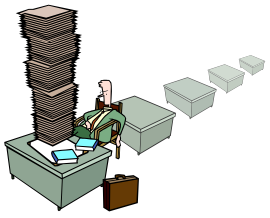
Network Representation



Fan Effect

- Limited capacity feature of spreading activation
- Source node has limited activation
- The more paths that exist, the less activation to any one path, the slower the activation
- Increase in RT related to increase in the fan of facts emanating from the network representation of the concept

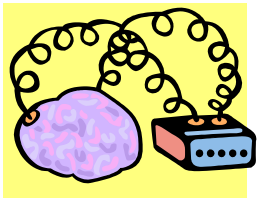
Retrieval Failure & Forgetting



- Forgetting caused by the inability to access information represented in memory
- Availability
  - Is info represented in memory?
- Accessibility
  - Can info be retrieved at a specific time/place?

Lost Memories?

- Penfield
- Recall or Hallucination?

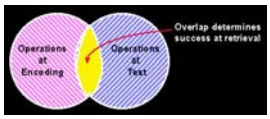


Forgotten Memories

- Nelson (1971)
- Study 20 number-noun pairs until perfect recall
  - 43-dog
- Recall Test 2 weeks later (75% correct)
- Retraining
  - Some missed pairs unchanged (43-dog)
  - Some missed changed (43-house)
- Advantage for unchanged items
- Nelson (1978)
- Study 20 number-noun pairs
- Recognition Test 4 weeks later (70% correct)
- Retraining
  - ½ missed pairs unchanged (34% correct)
  - ½ missed pairs changed (19% correct)
- Suggests memory is "in" there!

Encoding Specificity Principle

- Cue-Dependent Forgetting
  - Retrieval failure resulting from poor cues
- Phonological orienting, semantic retrieval cue…
- Forgetting occurs because cue not present at input does not access stored info



Two-Process Theory: An alternative explanation

- Generate
  - Retrieval cues used to generate associations
- Recognize
  - Recognize items based on familiarity

Encoding Specificity vs. Two-Process

- Encoding Specificity
  - Stresses study-test cue overlap
- Two Process
  - Stresses strength of cue-item association

Thomson & Tulving

- Study Phase
  - Strong associates: white-black
  - Weak associates: train-black
- Test Phase
  - Strong cues: white
  - Weak cues: train

Test Cues: *Study Cues*	**Strong** (white ?)	**Weak** (train ?)
Strong (white-black)	20.2	9.2
Weak (train-black)	13.9	15.7

LTM Processes

- Levels of Processing
  - Emphasizes operations at encoding
  - Semantic/Elaborative processing most effective
- Encoding Specificity
  - Information about retrieval cue must be encoded at the time of study for the cue to be effective
- Transfer Appropriate Processing
  - Memory best when processes at test match those at study