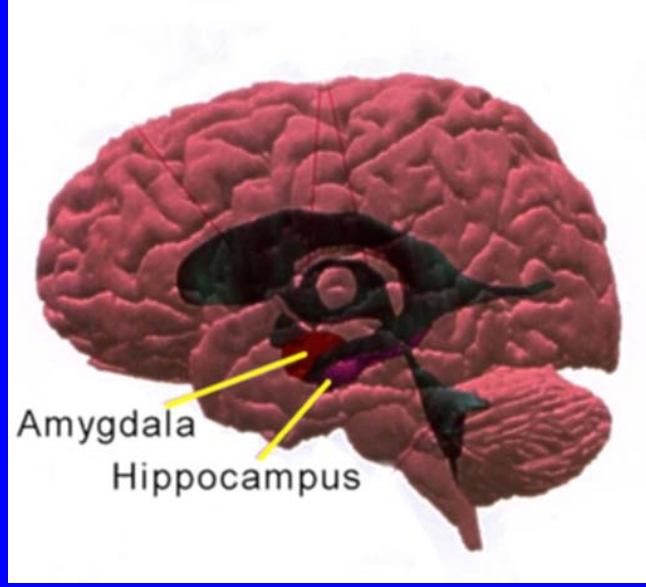


Memory of One's Life

Flashbulb Memories

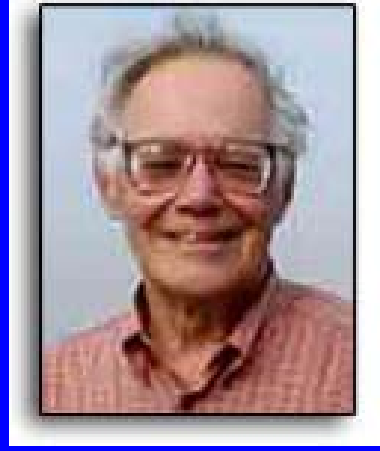
Term coined by Roger Brown and James Kulik

- Memory of the circumstances where one learned of a major event (personal or public)

These memories are usually especially vivid—"live" quality

Robert B. Livingston's idea of "Now Print" mechanism—causing a particularly vibrant trace to be left.

Accuracy of Flashbulb Memories



"For many years I have remembered how I heard the news of the Japanese attack on Pearl Harbor, which occurred on the day before my thirteenth birthday. I recall sitting in the living room of our house—we only lived in that house for one year, but I remember it will—listening to a baseball game on the radio. The game was interrupted by an announcement of the attack, and I rushed upstairs to tell my mother.

This memory has been so clear for so long that I never confronted its inherent absurdity until last year: no one broadcasts baseball games in December!" (Neisser, 1982, p. 45)

Memory Exercise

Recall as much as you can about how you heard the news of the attack on the World Trade Center

Recall as much as you can about what you did on the morning of September 10, 2001

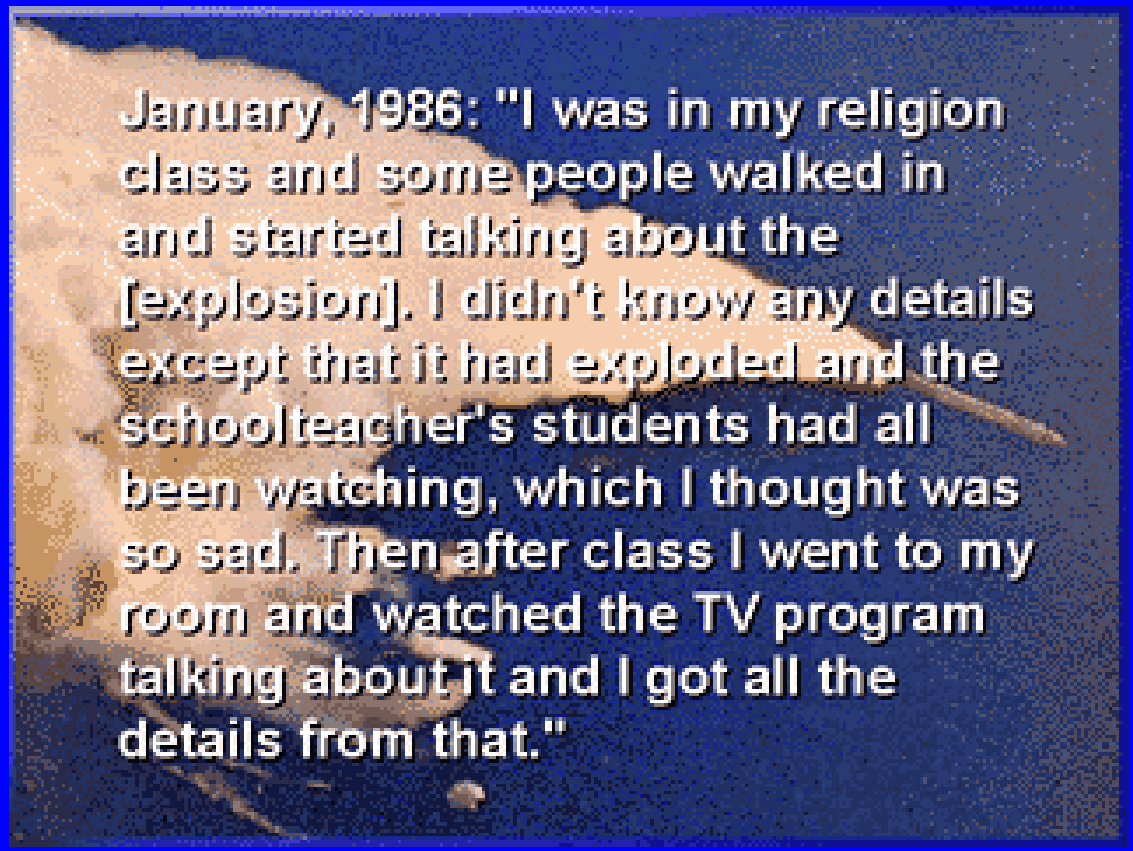
Studies of the Accuracy of Flashbulb Memories

Method: After a particularly major public event (Challenger crash, California earthquake), ask people to write down how they heard about the event. Then return as ask them again sometime (6 months, 2 years) later.

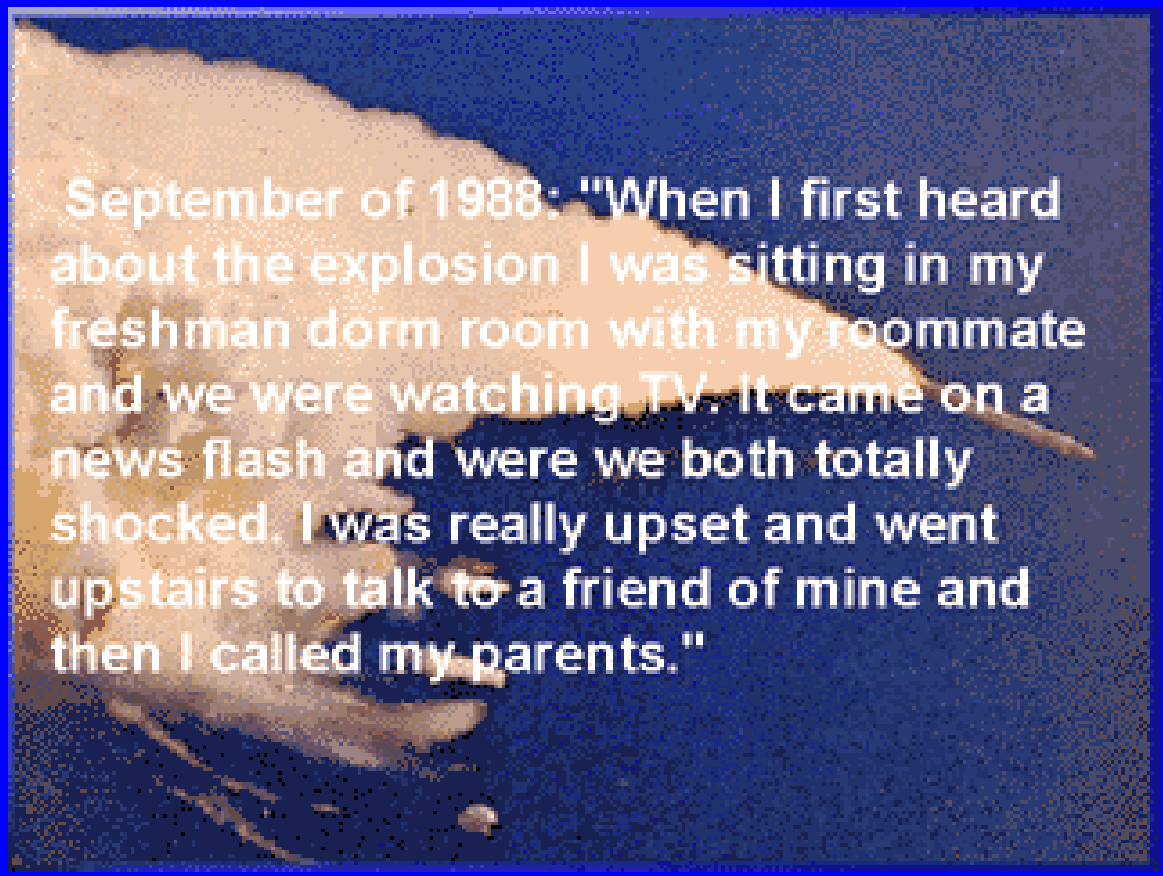
- Frequently many discrepancies between subject's first report and subsequent report
- Nonetheless, the memories remain very vivid

Those who experienced the events first hand (e.g., were in the region of the earthquake and had to take action) generally had much more accurate later recalls.

Neisser's Challenger Study



Neisser's Challenger Study



Memory and Trauma

Memories for highly emotionally charged events are often very vivid (precise, detailed). Does intensity correlate with accuracy?

Some dramatic changes:

- People remember being present at events they were not
- Feel they were more at risk than they were

But most often the core memory remains accurate

Exceptions tend to involve cases of active imagination fueling memory

Flashbacks in drug experiences

Most reported among those highly hypnotizable who easily engage in imaginative-fantasy-based activities

Memory and Emotion

Emotion improves memory for the main features of an experience—focusing of attention

- But not for the details

Mood contingent recall:

- Easier to remember episodes that correspond to one's current mood

Kluver-Bucy Syndrome

Psychic Blindness or visual agnosia

Effects of temporal-lobe lesions on monkeys:

"the ability to recognize and detect the meaning of objects on visual criteria alone seems to be lost although the animal exhibits no or at least no gross defects in the ability to discriminate visually."

also, loss of emotional responsiveness (loss of fear responses) and increased sexual behavior.

Hippocampus and Amygdala

Adjacent structures with different effects on memory

Damasio: conditioning fear response—linking an aversive stimulus (noise) with a non-aversive stimulus

- Patient with amygdala damage failed to develop fear conditioning but remembered the episode
- Patient with hippocampal damage—developed fear response but could not remember the episode

Double dissociation

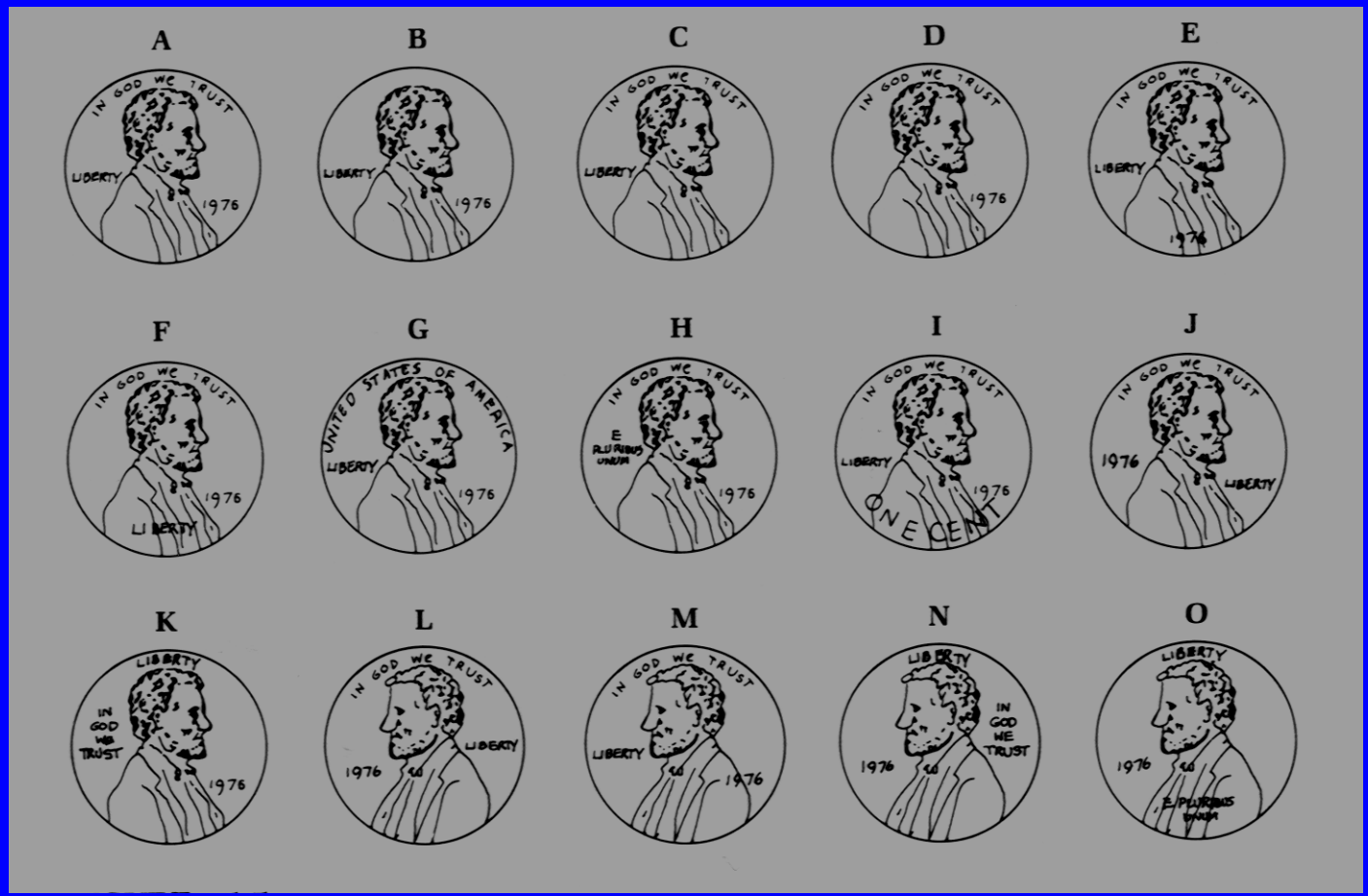
Patients with amygdala damage do not show memory enhancement for emotionally charged pictures

Connectivity of amygdala to different levels of sensory processing equips it to perform emotional evaluation

Recall Failure: Encoding Failure, Retrieval Failure, or Loss of Engram?

Which of the following appear on a US penny?	
The word JUSTICE	NO
The words UNITED STATES OF AMERICA	YES
The words LEGAL TENDER	NO
The word VERITAS	NO
The words ONE CENT	YES
The date (year of mint)	YES
The presidential seal	NO
The word COIN	NO
The words WASHINGTON, D.C.	NO
The left side of Lincoln's face	NO
The right side of Lincoln's face	YES
The White House	NO
An eagle with spread wings	NO
The Lincoln memorial	YES
The words IN GOD WE TRUST	YES
The word LIBERTY	YES
Sheaves of wheat	NO
The Roman numeral I	NO
The words E PLURIBUS UNUM	YES
The words MINTED IN USA	NO

Which is the Penny?



Memory Exercise

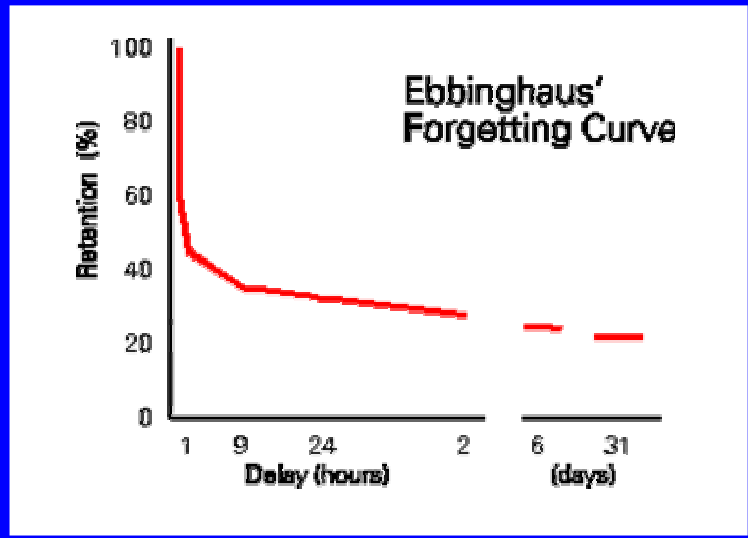
Write down where your car is parked
Write down where you parked your car the last time you went to that location
Write down where you parked your car two times back
Write down where you parked your car three times back
Write down where you parked your car four time back

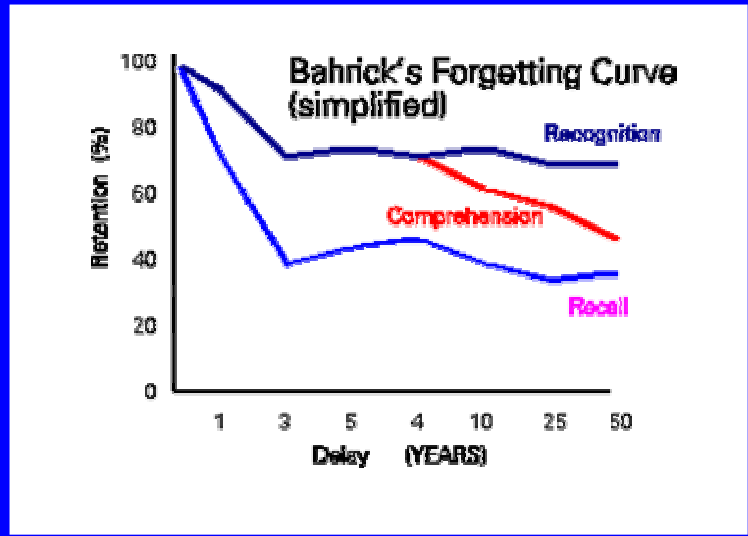
Write down the topic of our last class
Write down the topic of the class before that
Write down the topic of two classes back
Write down the topic of three classes back

Forgetting

"Forgetting, though often frustrating, is an adaptive feature of our memories. We don't need to remember everything that has ever happened to us; engrams that we never use are probably best forgotten." (Schacter, p. 81)

Some things, like memory for words in a foreign language, we retain for a very long time





Forgetting and the Engram

One of the most recognized features of memory is that we remember less as time goes on.

What happens to the engram as we forget

- Is itself lost (perhaps because of overwriting)
- Remains undisturbed but becomes less accessible

Behavioral Pattern of Forgetting

Marigold Linton: self study of the natural history of memories

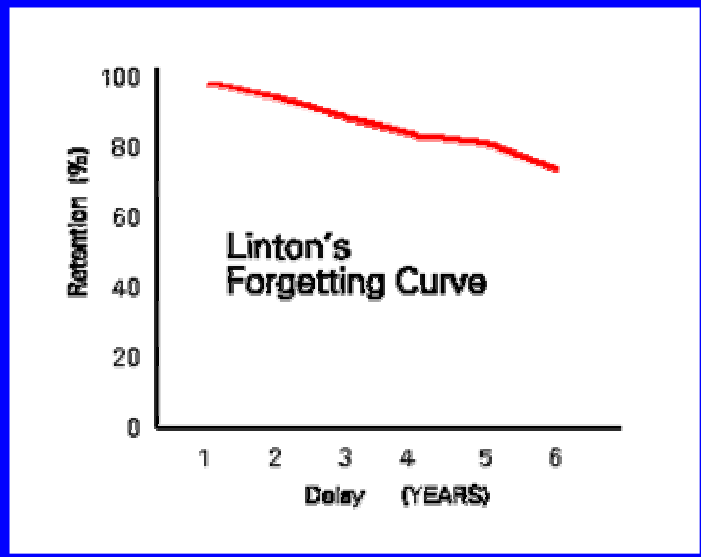
- Over 6 years Linton daily wrote down brief descriptions of events from her life (5,500 items)
  - Challenge: to write events down briefly yet retain distinctiveness after first time for event (first trip to Europe)
- Monthly pairs of items were drawn semi-randomly from the event pool (totaling about 150 items per month)
  - Tried to place them in proper chronological order
  - Tried to reconstruct each item's date
  - Briefly noted her memory search strategy
  - Reevaluated each items salience

Forgetting, failing to discriminate, etc.

During the forth year, “I began to encounter a few old items that simply did not ‘make sense’. . . . [I]tems that I could interpret meaningfully shortly after they were written did not, at the time of the crucial test, permit me to reconstruct a sensible whole.”

Rate of forgetting: after first year (<1%), flat curve (5-6%)

A common way Linton “forgot” events was by losing the ability to discriminate the memory of one event from another—sometimes yielding only a general memory of a type of episode



Effect of frequency of event type on semantic/episodic character of memory

"Number of trials (or experiences) has contrastive effects on episodic and semantic memories. Increased experience with any particular event class increases semantic (or general) knowledge about the event and its context. Increased experience with similar events, however, makes specific episodic knowledge increasingly confusable, and ultimately episodes cannot be distinguished." (Linton, 1982, p. 79)

From semantic to episodic to semantic

It seems plausible that a fairly small number of general schemes provide the basic framework for storing episodic information. These schemes organize the event in terms of actors, action, location, and the like. These elements that comprise the building blocks of *episodic* memories are themselves information from our semantic store. . . . A specific event is a unique *configuration* of these elements. As our experience with a particular event type increases, we seem at first to make finer discriminations among related events. . . . At some point, however, this expansion of elements and configuration ends. . . . As similar events are repeated, the specific configurations—the patterns that link familiar elements to form unique episodes—themselves become a well-established potentially confusable part of semantic knowledge. (Linton, 1982, p. 81)

Emotion in Linton's self study

Evaluated emotional salience at initial writing and each recall

Very low correlation between initial emotional salience and later success in recall

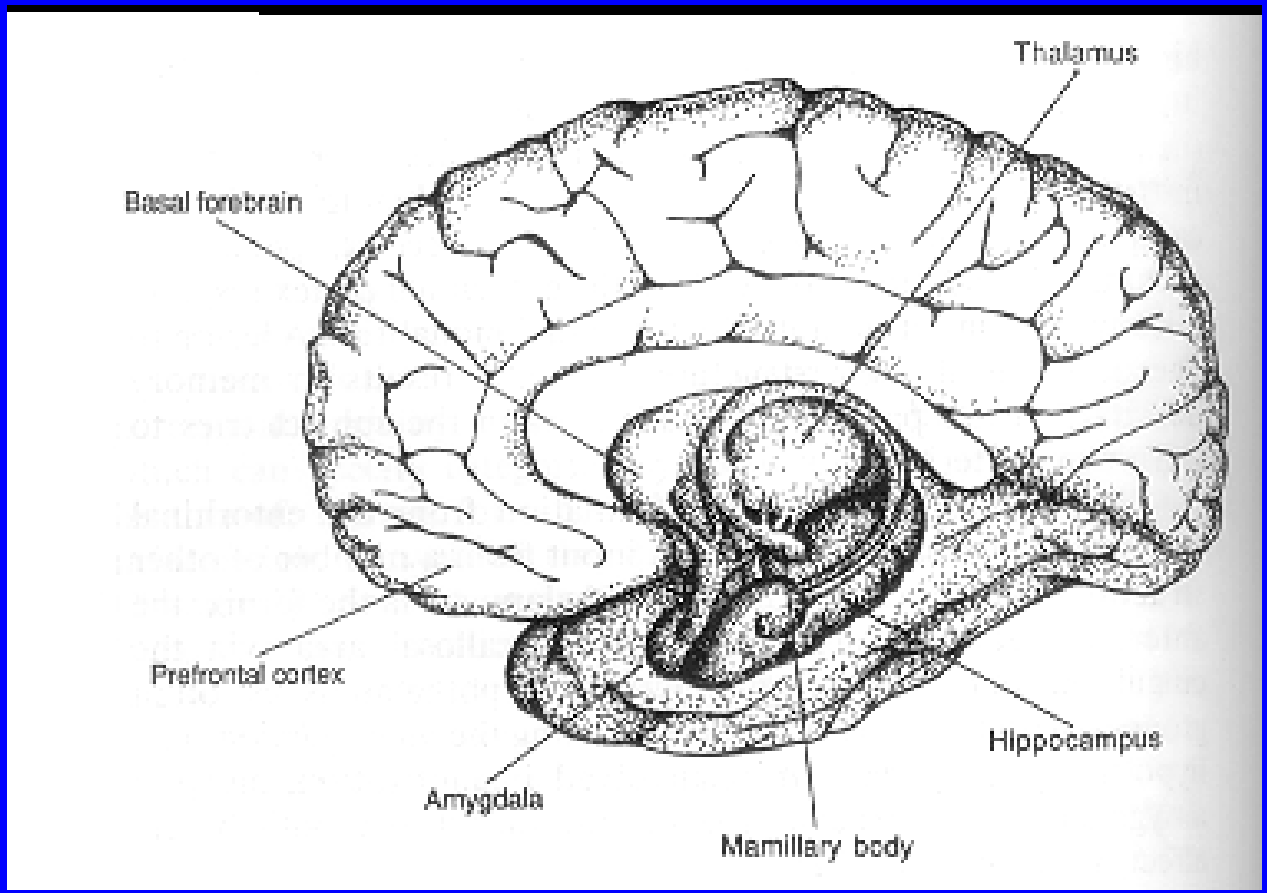
Change in emotional salience from encoding to recall

- Habituation of emotional response if event type repeated (including response to memory of initial events)
- Later changes in judgment depending on what followed: "Just as historians must interpret and rewrite history as time passes, so we all rewrite out own personal histories. Few of us are wise enough to be able to predict at the time of their occurrence how significant events will prove to be." (Linton, 1982, p. 88).

  Did the new person we met become a lover/spouse?

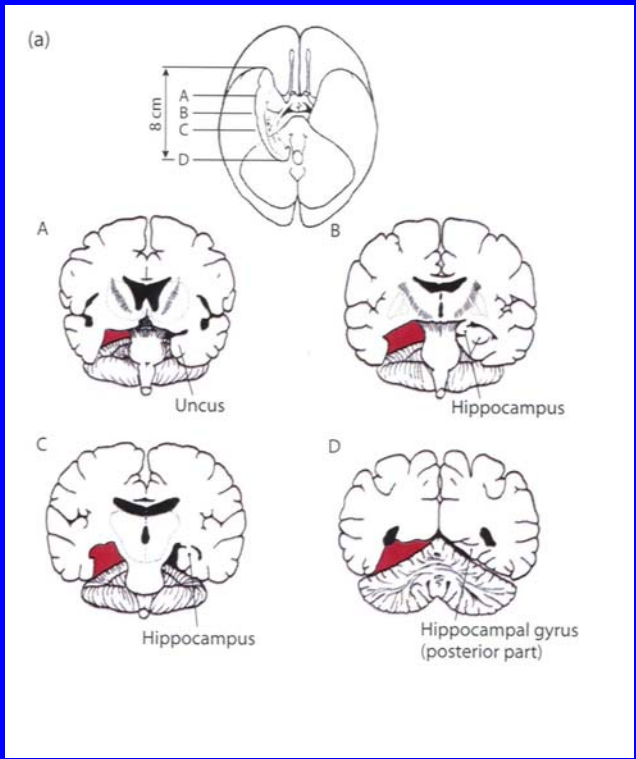
  Did you accept the job offer or not?

Brain regions for episodic encoding

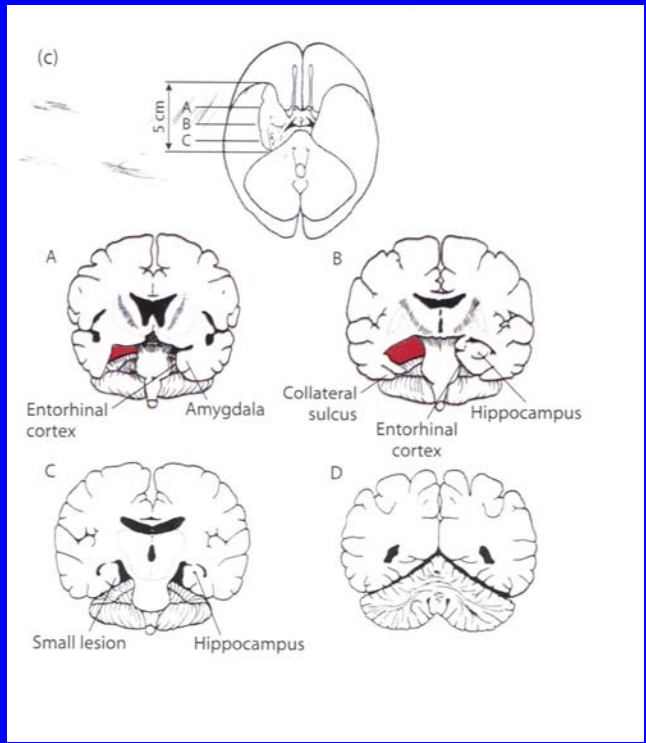


Amnesia

HM: bilateral resection of hippocampus and surrounding cortex in 1953 at age 29 for intractable epilepsy



Hypothesized lesions



Actual lesions

HM

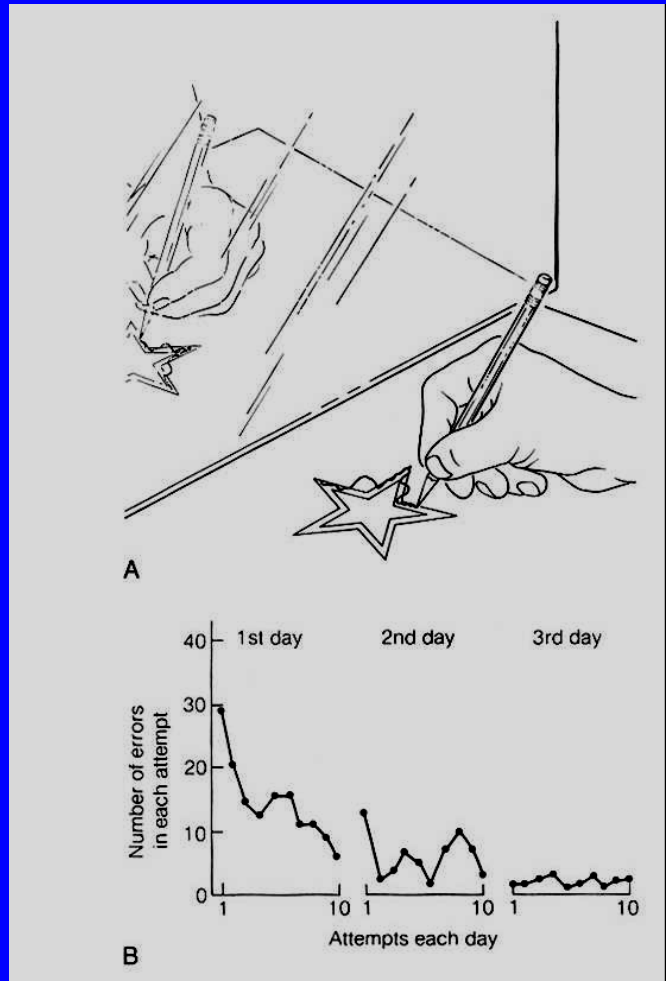
No recurrence of epilepsy

No effect on IQ, personality, etc.

Graded retrograde amnesia for several years prior to surgery

Anterograde amnesia

Can learn new skills (such as mirror tracing)



HM

HM likes detective shows, 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 ten minutes. He lives in a world where, for him, Truman is still President. When he is told again 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.

He comments on his situation:

... 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.

Forgetting and Consolidation

Many other patients with medial temporal lobe damage also exhibit pattern of anterograde and partial retrograde amnesia

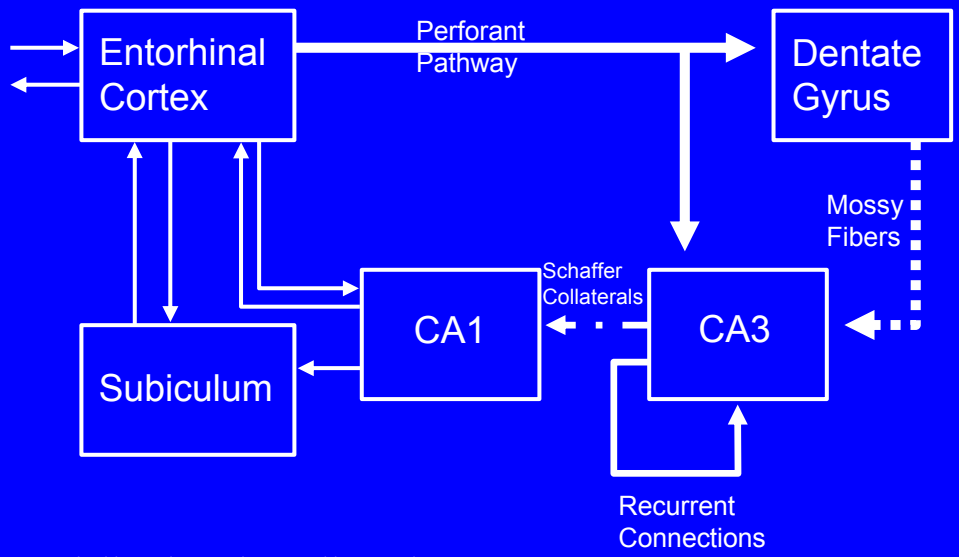
Suggests long-term engram is not laid down all at once

Rather, a period during which it is being developed

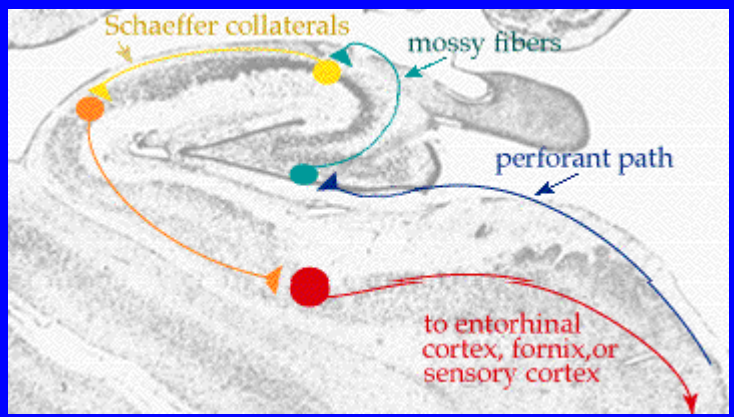
Proposal that medial temporal lobe plays role in consolidating the permanent connections

Even that playback during dreaming plays a role

Hippocampal Architecture



McClelland et al., Rolls and Treves



- Convergence of sensory information from rest of cortex
- Overall loop (EC both input and output center): Autoassociator?
- Recurrent connections esp. in CA3: Autoassociator?
- Sparse activations (especially in DG): Pattern Separation?

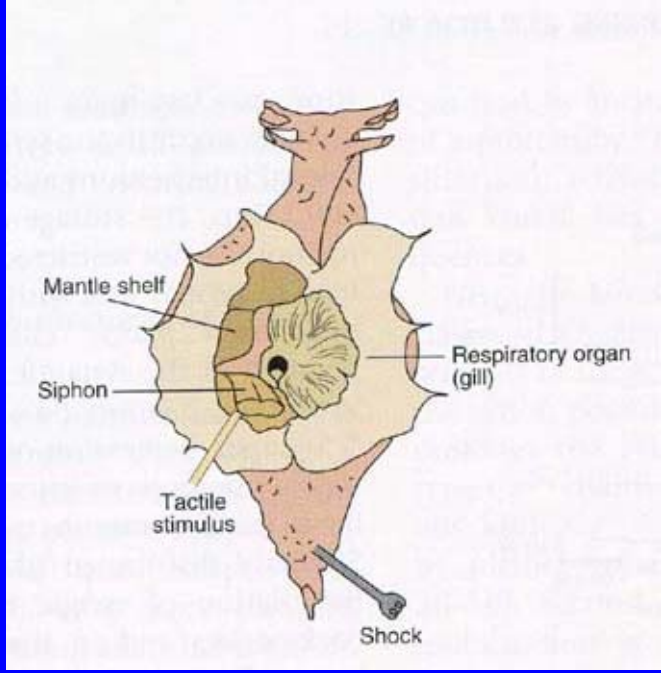
Patients with Hippocampal only Deficits

RB: damage limited to CA1 fields bilaterally: moderate anterograde but minimal retrograde amnesia

GD: damage restricted primarily to the CA1 fields: moderate anterograde but minimal retrograde amnesia

LM: damage to all CA fields and dentate gyrus and some cells in entorhinal cortex: moderate anterograde AND graded retrograde amnesia

The Aplysia Model



Sea slugs exhibit both a short-lasting and a longer-lasting change in its gill retraction response to noxious stimuli

The short-lasting response results from even a single stimulation, whereas the longer-lasting response stems from multiple stimulations

- Short-lasting response involves increases in neurotransmitter release
- Longer-lasting response involves growth of new synapses

Mechanism: long-term potentiation

Alternative Hypothesis about Hippocampal Function: Place Memory

Two systems for spatial navigation

- Taxon System: egocentric and governed by local landmarks
- Locale System: allocentric map

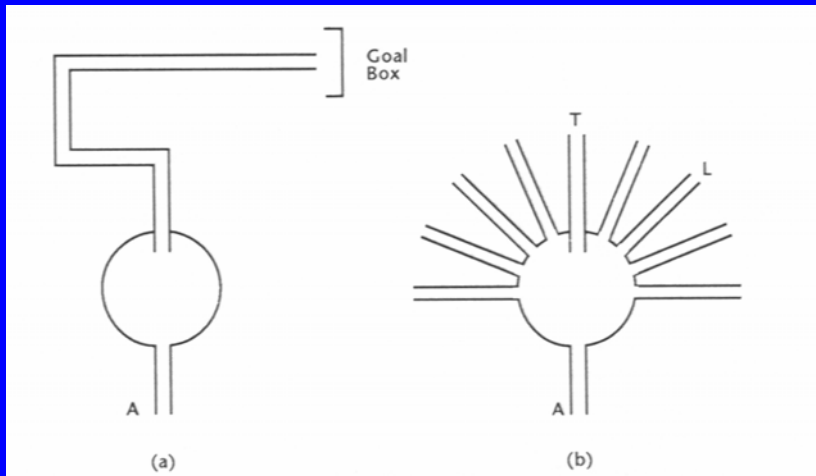


Figure 6.2. A Simplified Version of a Sunburst Maze Used by Tolman, Ritchie, and Kalish (1946). The rats were trained initially on the simple maze depicted in (a), taught to run through the central chamber from A, through the corridor, and to the goal box at the end. Subsequently, rats were released in a sunburst maze such as that illustrated in (b). Tolman, Ritchie, and Kalish reasoned that the path chosen in the second phase would reveal whether the rats had learned a specific route to follow or had learned the location of the goal. Rats uniformly took the direct route in the later trial.

Role of Hippocampus in Spatial Navigation

Locale memory system lost with hippocampal lesions

Evidence of "place cells" in hippocampus

Although these cells may not specify only place

Current ongoing attempts to resolve the competing claims about the hippocampus: entry into long term memory versus place memory

Long-term storage in cortex

Although medial temporal lobe damage does cause graded retrograde amnesia, memories for the far past are retained, indicating that they are stored elsewhere

Knowledge of objects depends on inferotemporal cortex
Knowledge of faces depends on fusiform gyrus
Knowledge of spatial layouts depends on parietal cortex

Damasio—episodic memory depends on *convergence zones* (at least until the direct cortico-cortico connections are established.