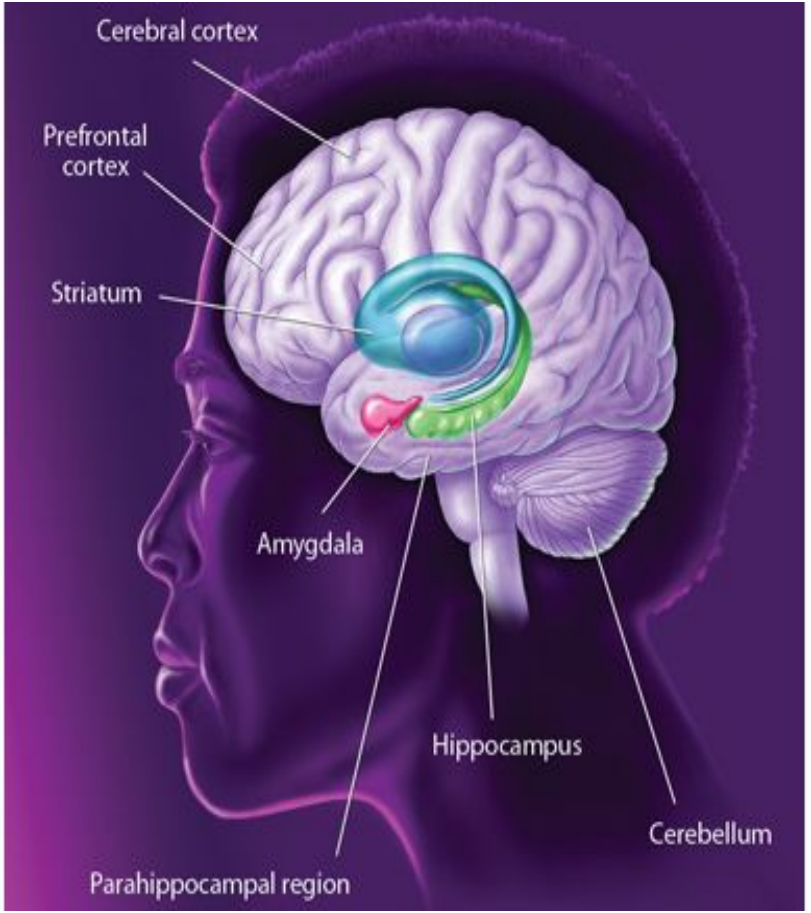
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Learning

And

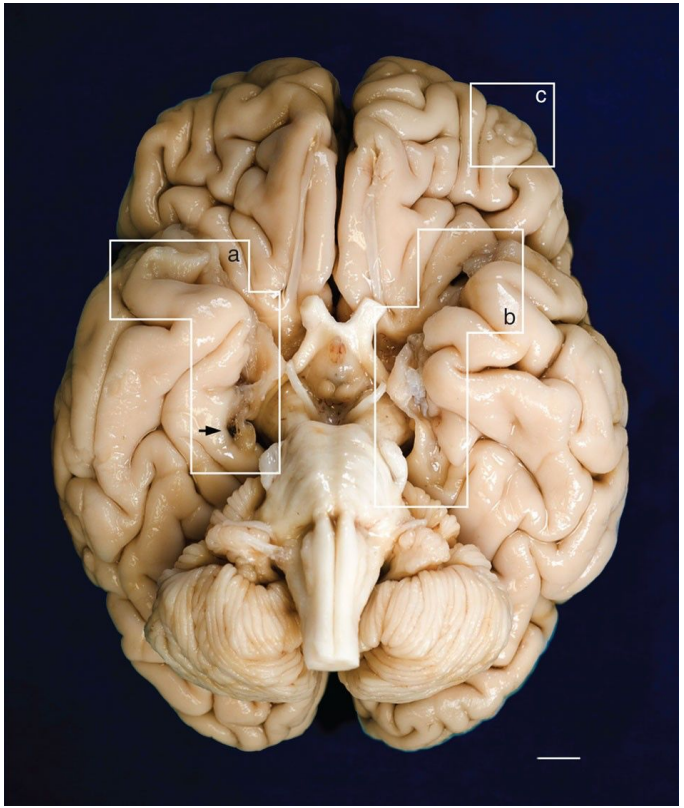
Memory

Drishti Trehan, Alec Robson, Dipak Athwal, Sue Ajit Kumar

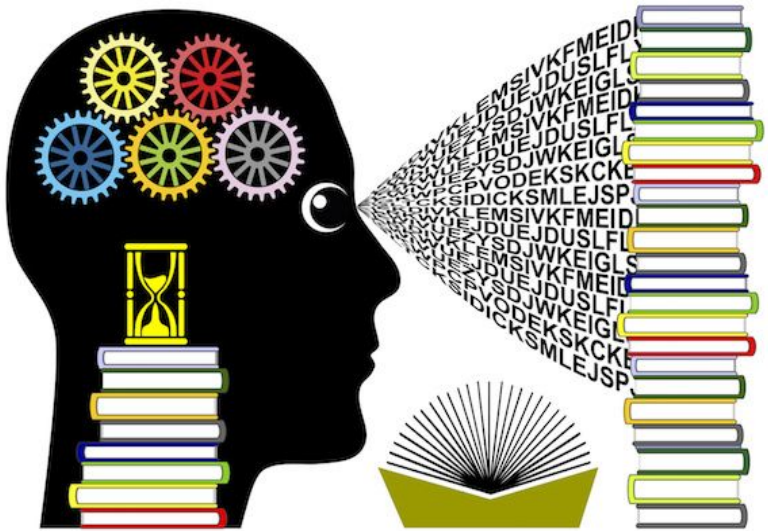


Overview

- Learning, Memory, Amnesia
- Long Term Memory
- Short Term Memory
- Special memory abilities
- Issues related to neural structure



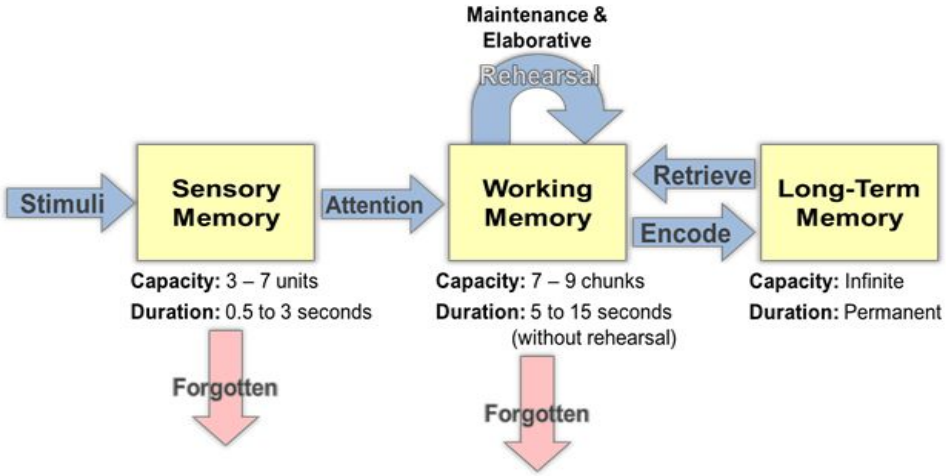
LEARNING AND MEMORY



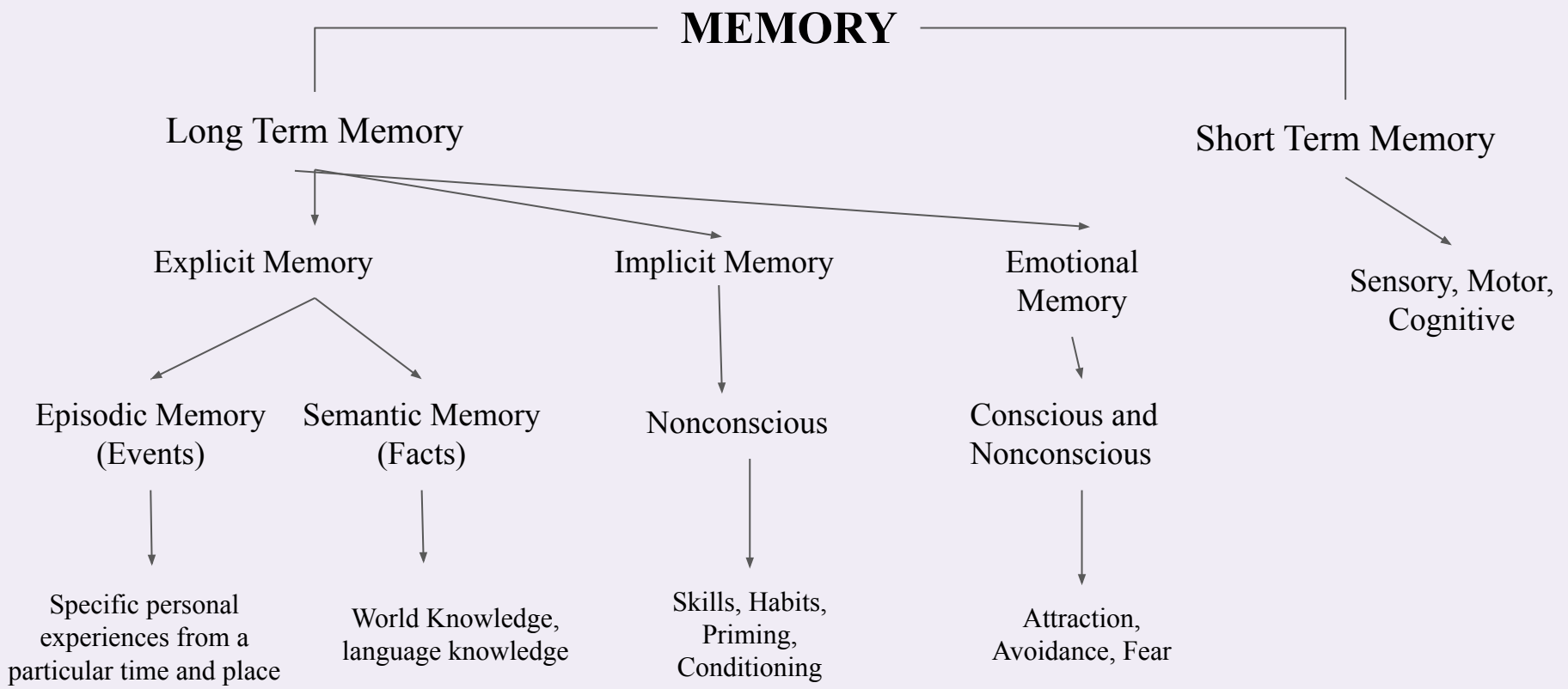
Learning- Acquisition of skill or knowledge

Memory- Expression of what we have acquired.

MEMORY

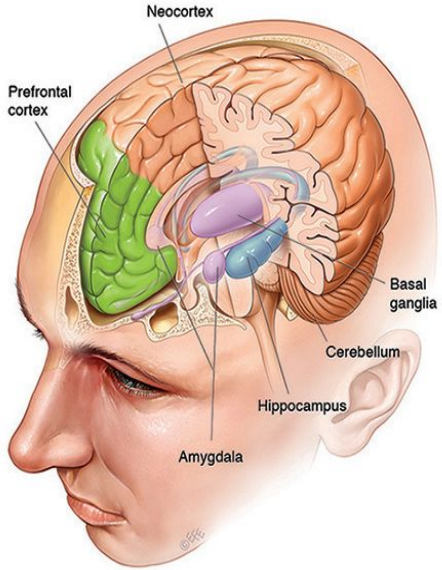


- **Encoding**- process of getting information into the memory system
- **Storage**- manner in which information is represented and kept in memory
- **Retrieval**- process of getting information back out of memory


MEMORY
Long Term Memory
Short Term Memory
Explicit Memory
Implicit Memory
Emotional Memory
Sensory, Motor, Cognitive
Episodic Memory (Events)
Semantic Memory (Facts)
Nonconscious
Conscious and Nonconscious
Specific personal experiences from a particular time and place
World Knowledge, language knowledge
Skills, Habits, Priming, Conditioning
Attraction, Avoidance, Fear

Parts of brain involved in Learning and Memory

- **Hippocampus**- Formation of new long term semantic and episodic memory (explicit memory)
- **Amygdala**- Formation of new emotional memory
- **Basal Ganglia**- Formation of motor and implicit memory
- **Cerebellum**- Storage of procedural memory



ACADEMIC RESEARCH

The role of the hippocampus in memory and mental construction

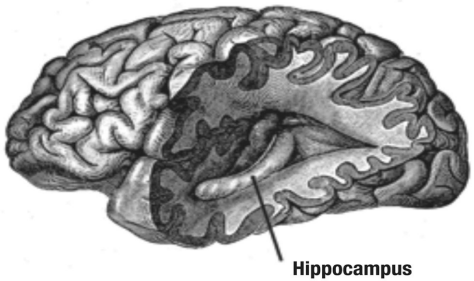
GOAL- To examine the role of the hippocampus in memory and mental construction

PROCEDURE-

- Proposed a new framework which incorporates task demands that prompt hippocampal contributions to mental construction (Main focus was on autobiographical memory)

FINDINGS-

- Suggests that when one is thinking about past events, the hippocampus constructs a scene as a method of packaging information. Once these scenes are generated, details of a remembered event can be integrated, and these same processes can be used to form imaginative scenes to guide behavior, such as bringing to mind future and novel scenarios.
- if the specificity of the recalled knowledge framework is insufficient for retrieval, then hippocampal mechanisms will be recruited to fill in the representation with more details



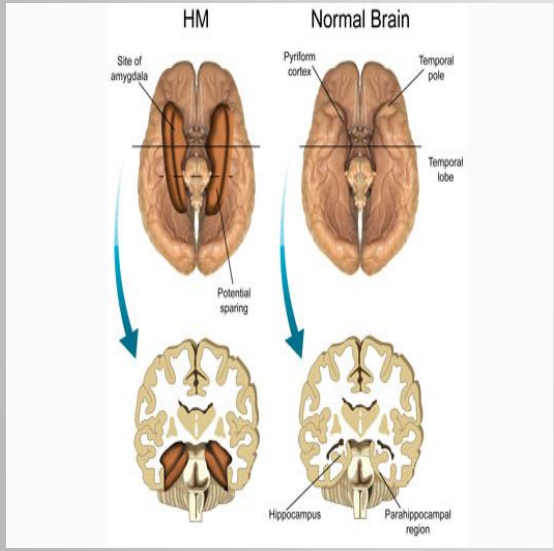
Hippocampal Functions:

- Memory formation and retrieval
  - Pattern separation and completion
  - Association of information in time & space
  - General linking node that processes new memories, stores associations to representations and retrieves old memories
- Spatial navigation and orientation skills

Sheldon, S., & Levine, B. (2016). The role of hippocampus in memory and mental construction. 1369 (1), 76-92.

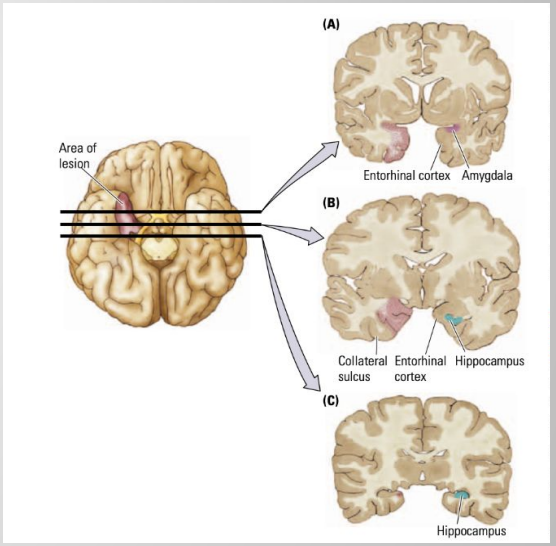
AMNESIA

Amnesia is the loss of memories, including facts, information and experiences.



Causes-

- Brain injury
- Illness
- Traumatic Events
- Medical drugs
- Illegal drugs



TYPES OF AMNESIA

Anterograde Amnesia

Unable to form new memories

Retrograde Amnesia

Unable to recall memories from Long Term Memory



ANTEROGRADE AMNESIA

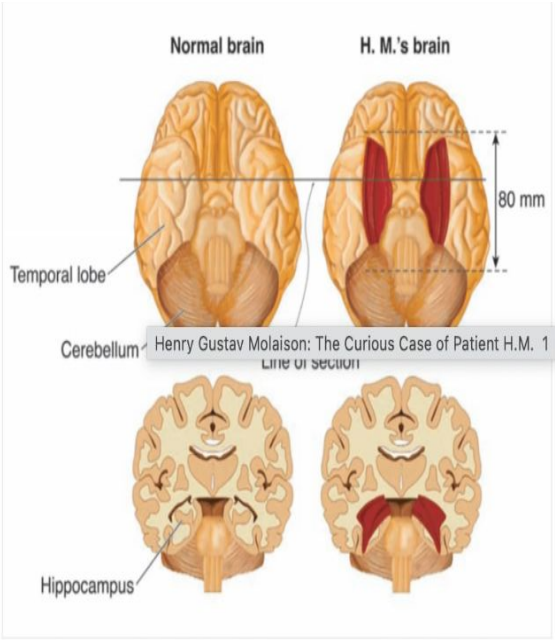
1. Unable to form or have problems forming new memories
2. Information cannot be passed from Short Term memory to Long term memory
3. Does not impair long term memories that were stored before the event of amnesia

RETROGRADE AMNESIA

1. Unable to recall existing memories from long term memory
2. Not being able to remember personal events, names, faces, and general knowledge that were learned before the onset of amnesia.

HM STUDY- Anterograde Amnesia

- Henry Molaison his hippocampus was removed to treat seizures
- After surgery his seizures decrease but left him with anterograde amnesia.
- He could no longer create new memories
- Able to acquire new skills eg mirror drawing task, and recall childhood experiences and recognise faces prior to onset of amnesia.
- His language, motor skills, perception and intellect not effected.
- Scoville and Milner describe HM surgery and suggested link between hippocampus and ability to remember specific facts and episodes.
- Findings- Memory was limited to specific areas of brain such as hippocampus.



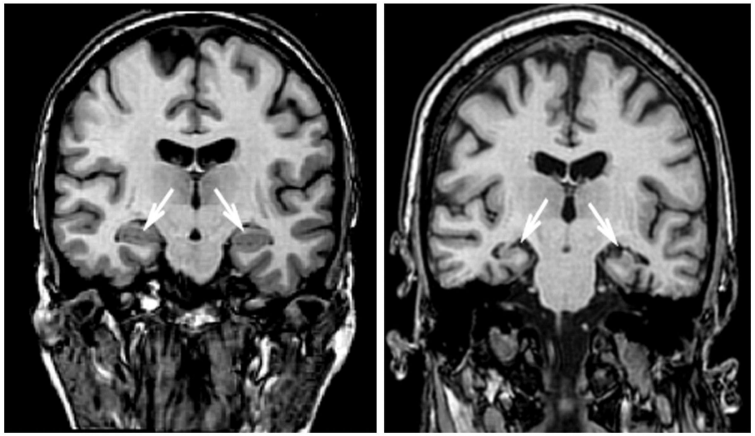
Dossani, R.H., Missios, S., & Nanda, A. (2015). The Legacy of Henry Molaison (1926–2008) and the Impact of His Bilateral Mesial Temporal Lobe Surgery the Study of Human Memory. 84 (4), 1127-1135.

THEORIES OF AMNESIA

1. **System Consolidation Theory-** Consolidation theory explains why older memories tend to survive cases of hippocampal damage whereas more-recent memories are likely to be lost.

2. **Multiple-Trace Theory**- Accounts for individual differences in amnesia.
- In any learning event memories of many types are encoded in parallel in different brain locations.
- Memories change throughout a person's life as they are recalled, reevaluated, and restored.
- Different kinds of memory, being stored in different locations, are differentially susceptible to brain injury.

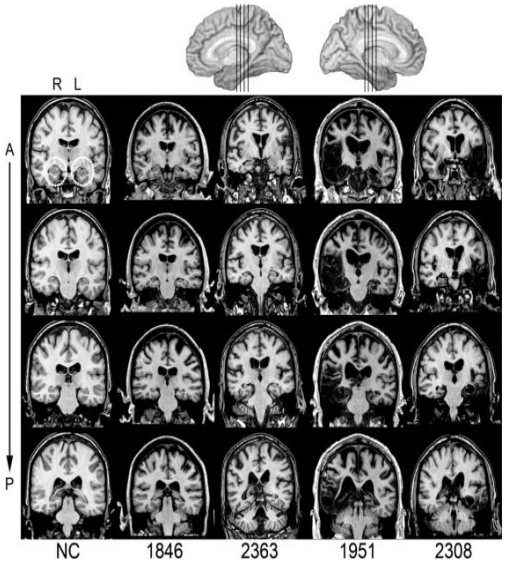
3. **Reconsolidation Theory-** According to this theory, each time a memory is used, it is reconsolidated. Each use of memory is associated with a new phase of storage, resulting in many different traces for the same event.



Healthy brain Amnesic brain

ACADEMIC RESEARCH

Remote semantic memory is impoverished in hippocampal amnesia



GOAL- Remote semantic memory is intact in amnesia and is independent of hippocampus

PROCEDURE-

- They took 3 groups of sample, out of which 1 was control group with participants free of neurological and psychiatric disorder.
- They did scans and experimental procedure (such as word associates test, feature and sense tasks)

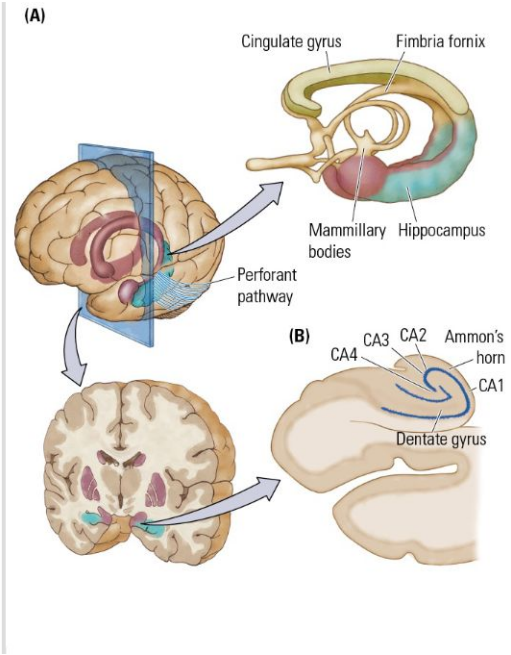
RESULTS- Hippocampus plays an important role in maintenance and updating of semantic memory beyond its initial acquisition.

DRAWBACK- Very small sample size.

Klooster, N.B., & Duff, M.C. (2015). Remote semantic memory is impoverished in hippocampal amnesia. 79 (A), 42-52.

Hippocampus the Explicit Memory Factory

- Is a major part of both semantic and episodic memory
- In the temporal lobe and part of the limbic ‘system’ and looks like a seahorse
- Grabule cells the hippocampus’s output cells actually increase overtime one of the few neurons that do
- New theory from Kovacs (2020) suggests that episodic memory is created in the entorhinal cortex connected to the hippocampus in a temporal code and then organized by one of the output cells CA3.



Explicit Memory: Semantic Memory

The storage of facts, concepts and truths

Everything from knowing 2 + 2 = 4, to your parent's names, to who Julius Caesar is part of semantic memory.

Other core controllers of semantic memory

- Rhinal Cortex of the temporal lobe with amnesia studies suggesting greater importance than Hippocampus
- Split function of the hemispheres
- Frontal Cortex is also involved
- Left prefrontal seems to affect verbal memory more
- Right prefrontal seems to affect nonverbal more
-



Priming of Episodic by Semantic Memory

Episodic and semantic memory are linked

Semantic activation can prime episodic memory retrieval as seen in the research by Mace et al. and others.

Semantic-to-autobiographical memory priming is ubiquitous

John H Mace [1], Kendra L Ostermeier [2], Jian Zhu [2]

Affiliations + expand

PMID: 37173590 DOI: 10.3758/s13421-023-01430-6

Abstract

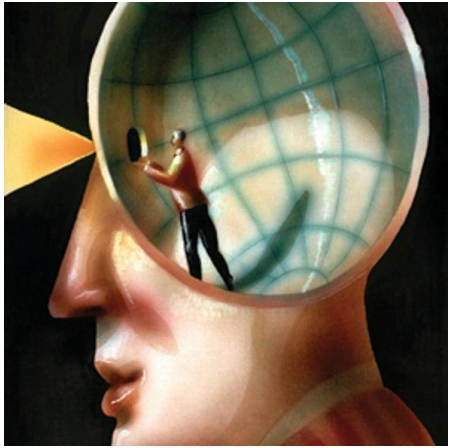
It is now well established that the activation of semantic memories leads to the activation of autobiographical memories. Studies have shown that semantic processing of words or pictures primes autobiographical memories on voluntary and involuntary autobiographical memory tasks (the Crovitz cue-word task and the vigilance task). Known as semantic-to-autobiographical memory priming, our goal in the current study was to demonstrate the ubiquitous nature of this form of priming by showing that a wide variety of stimuli will prime involuntary autobiographical memories on the vigilance task. In Experiment 1, semantic-to-autobiographical priming was obtained on the vigilance task following the processing of sounds (e.g., the sound of bowling) and spoken words (e.g., the word bowling). In Experiment 2, semantic-to-autobiographical priming was observed on the vigilance task following tactile processing (e.g., the objects ball, glasses) and visual word processing (e.g., the words ball, glasses). In Experiment 3, semantic-to-autobiographical priming was observed on the vigilance

Episodic/Autobiographical Memory

The memory of the events of our lives

Endel Tulving a Canadian psychologist coined the term to differ remembering from knowing

Also gives autonetic awareness or sense of time.



Other core controllers of episodic memory

Frontal cortex

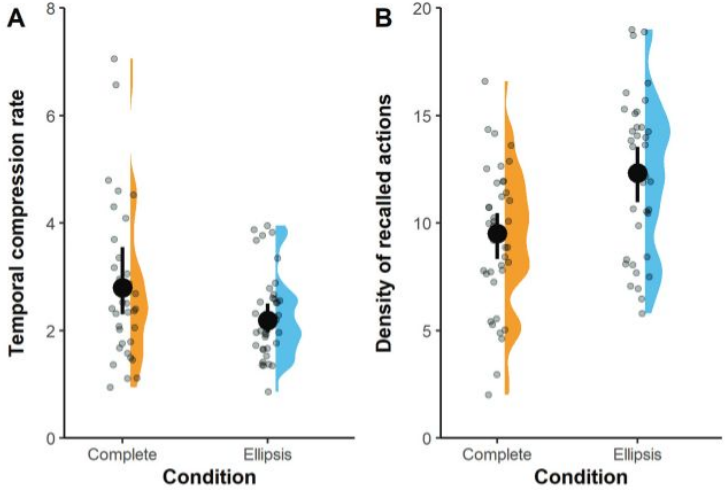
- Left prefrontal cortex much more active during acquisition of information
- Right prefrontal much more active during recall

Temporal Effects on Episodic Memory

- Recall of events happens significantly faster than the events
- Jeunehome and D'Argembeau tested possible causes
- One is that the memory is accelerated compared to the event recalled
- The one they found more evidence for was the removal of less important parts of the event from memory, essentially editing the event

Figure 2

Rates of Temporal Compression and Densities of Recalled Actions in the Complete and Ellipsis Conditions in Experiment 1



Note. (A) Temporal compression is estimated as the ratio of the video duration to the time needed to mentally re-experience this video. (B) The density of recalled actions corresponds to the number of recalled actions per minute of the video. Raincloud plots show the distribution of the data and point-range plots represent the 20% trimmed means and their 95% robust confidence intervals. See the online article for the color version of this figure.

Jeunehome & D'Argembeau 2023

Emotions and social cues effect on Episodic Memory

- Negative emotion increases memory but reduces ability to associate
- Social cues increase both memory and associative memory (Only when negative emotion also present)

Episodic memory through a social and emotional lens

Charlotte I Stewardson [1], Michelle C Hunsche [1], Victoria Wardell [1], Daniela J Palombo [1], Connor M Kerns [1]

Affiliations + expand

PMID: 36048038 DOI: 10.1037/emo0001147

Abstract

Negative emotion enhances item memory but may reduce associative memory. Social information may also enhance memory, yet how social and emotional cues combine to affect memory for focal and surrounding details is unknown. Gender differences may also exist, but whether women and men encode and remember negative and social information differently is unclear. This study examines how social information contributes to or interacts with emotion to influence item and associative memory, and whether gender plays a role in how social and/or emotional information is recognized. Discovery and replication samples (N = 706) were recruited. Stimuli included (1) images with varying social and emotional content categorized into four conditions: negative social, negative nonsocial, neutral social, neutral nonsocial and (2) neutral images of objects paired with target stimuli to assess associative memory. Participants viewed the image pairings (Encoding). Twenty-four hours later, item and associative recognition memory were tested. Item recognition memory was better for negative vs. neutral and social vs. nonsocial images. By contrast, associative recognition memory was worse for negative vs. neutral, but better for social vs. nonsocial images. Finally, women demonstrated similar item memory performance compared to men but better associative recognition memory performance overall compared to men. Emotional and social cues impart distinct effects on how we form holistic episodic memories, highlighting the importance of considering these critical factors when striving to understand how and what we remember. (PsycInfo Database Record (c) 2023 APA, all rights reserved).

Implicit Memory

- Non-conscious memories
- Uses bottom-up processing
- Relies on sensory or motor information
- Manipulation by higher-level cortical processing is not required

Includes:

- Habits
- Priming
- Conditioning



Implicit Memory

- Examples;
- Riding a bike
- Typing
- Language

- When and where to wash our hands
- Specific actions in a sports



Implicit Memory

- Implicit Learning vs Explicit Learning in Sports
- Study found that comparisons did not show group differences
- In particular study risk of bias was unclear

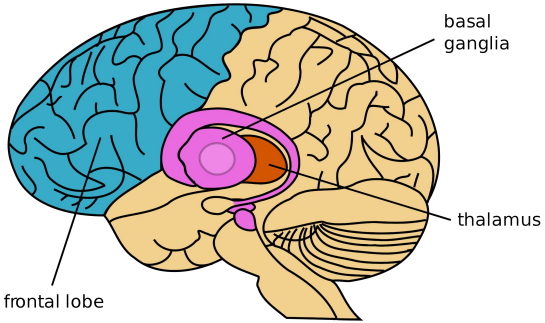
Kal, E., Prosée, R., Winters, M., & van der Kamp, J. (2018). Does implicit motor learning lead to greater automatization of motor skills compared to explicit motor learning? A systematic review. *PloS one*, *13*(9), e0203591. https://doi.org/10.1371/journal.pone.0203591

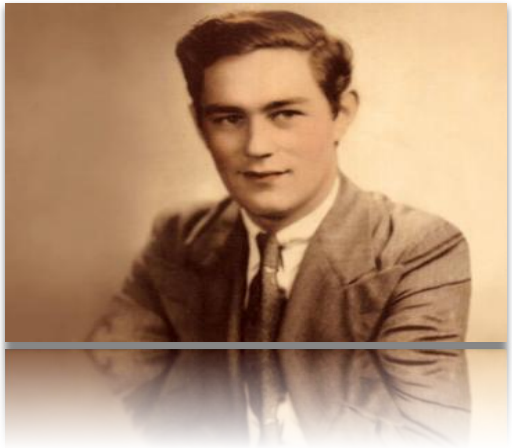
Implicit Memory

- In the H.M study ability to acquire Implicit Memories was typical
- H.M showed a positive learning curve on task requiring implicit memory.

- Studies show that even with impaired explicit memory implicit memory can still be good

- Circulatory of basal ganglia is important
- Huntington Disease stems from cellular degradation in basal ganglia. Such patients have troubles with implicit memory tasks such as mirror-drawing task
- Study about patients with Parkinson's Disease received L-dopa treatment. This treatment was used to restore basal ganglia dopamine and this led to improved implicit memory.





Emotional Memory



- Conscious and nonconscious

- Can involve;
- Attraction
- Avoidance
- Fear
- Relies on bottom-up processing and top down processing

- Bottom-up processing for “affective properties of stimuli or events”
- Top Down processing for memory which is arousing, vivid, and available on prompting

Emotional Memory

- As we get older less focused on goals more focused on emotional meaning
- View things in a more positive view as we get older
- Often think older people are grumpy and mean, not the case
- Known as the Positivity Effect
- We remember more positive things than negative

Carstensen, L. L., & DeLiema, M. (2018). The positivity effect: A negativity bias in youth fades with age. *Current Opinion in Behavioral Sciences, 19*, 7-12. https://doi.org/10.1016/j.cobeha.2017.07.009

Emotional Memory

- Examples;
- When recalling an accident we recall similar response associated with the event
- How we perceive attraction to a person
- Avoidance of people or things

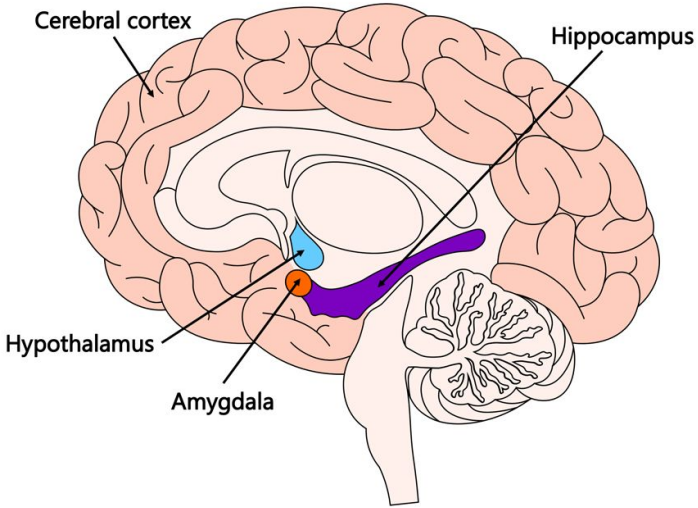


Emotional Memory

- H.S response was dampened. Had removed his amygdala a structure associated with emotion during surgery

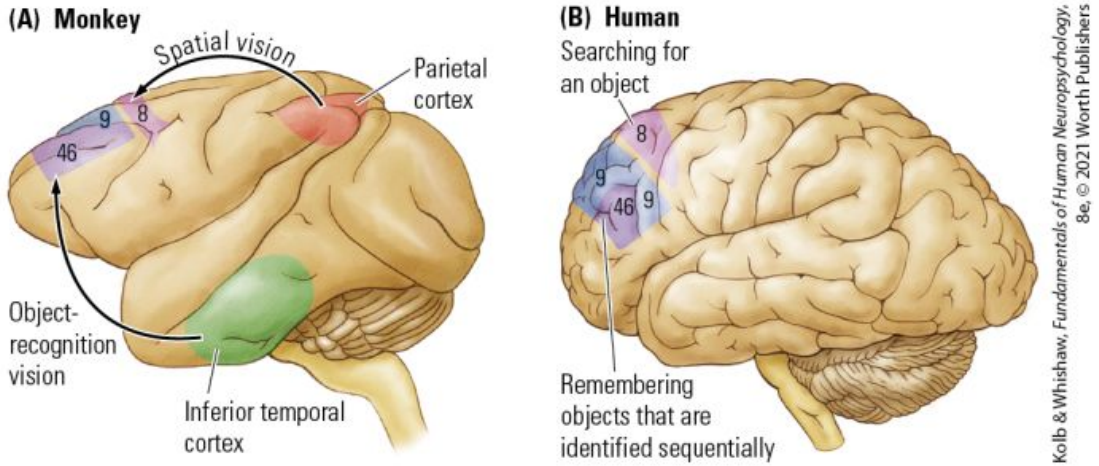
- Psychopaths?





Short-term Memory

- Relies on two different sensory processing streams projecting into the prefrontal cortex (at different places)
    - Ventral stream -> object-recognition, vision for perception
    - Dorsal stream -> motor, vision for action



Short-term Memory

Lesions on left posterior temporal lobe cause deficits:

- Retention of verbal stimuli but not visual
- Retention of visual stimuli but not verbal

Damage to polymodal sensory areas of the posterior parietal and posterior temporal cortices.

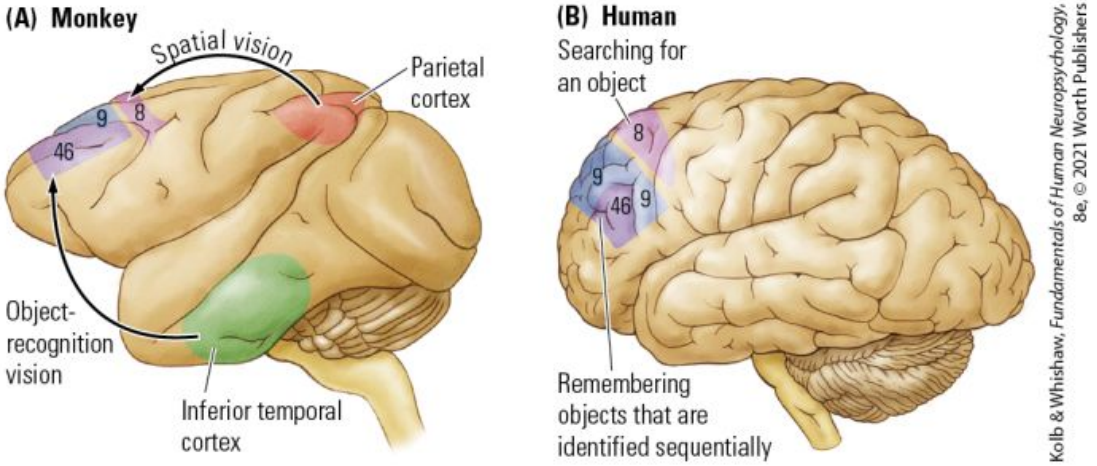
Damage to junction of parietal, temporal, and occipital cortices.

Frontal lobe lesions cause impairment where subject must remember location of stimuli

Short-term Memory

Testing via:

- Paired stimulus A = B or A =/= B
- Via vibratory stimuli presented to fingertips
- Word cards, match one or match both (recognition vs recency)
- Word list recall tasks (list 1 - 4 vs 5) -> release from PI



Special Memory Abilities



Savant Syndrome:

- Perfect recall, view table of numbers for 2 - 3 min, recall perfectly, recall perfectly after 30 years.
- Imprint image + synesthesia + mnemonic techniques
- Lack of ambition / aims in life
- Literal interpretation of metaphors

2	45	21	30
35	47	43	45
11	31	15	9
42	40	16	17
46	44	42	18
45	46	37	13
8	47	21	34
47	43	6	49
11	16	2	16
35	17	14	36
19	34	3	35
16	6	0	47
24	18	14	22

Special Memory Abilities

Superior Autobiographical Memory

- Virtually complete recall from 10 years on
- Use no memory strategy aids
- Can be OCD but otherwise ordinary
- Increased size of projections from temporal lobe to frontal cortex

Issues of Neural Structure

It is difficult to identify the neural structures involved in memory.
A simple short term memory task (viewing an object in a scene then seeing if it had been moved later) uses the following structures:

- Frontoparietal network for encoding
- Salience network for holding the scene in memory
- Visual network for retrieval
- Default network for forgetting after task is complete

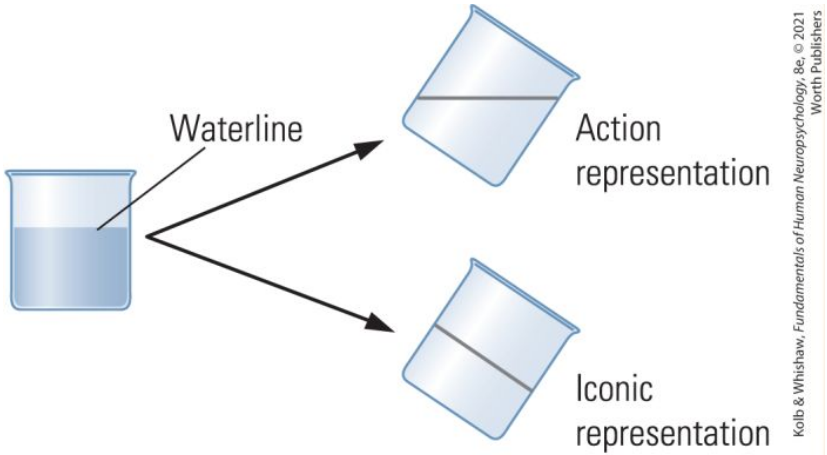
Issues of Neural Structure

Multiple theories relating memory to anatomical substrates:

- System Consolidation Theory
- Multiple-trace Theory
- Reconsolidation Theory
- Trace Transformation Theory
- Scene Construction Theory

Issues of Neural Structure

We mostly do not remember every aspect of our daily lives.
Memory is an active process of reconstruction via associative inference.
Gist is the objective of reconstructing a memory -> allows us to recreate the past and anticipate the future.
This means memory is prone to errors of commission as well as omission.
Perception of experiences and events affect our memory.



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