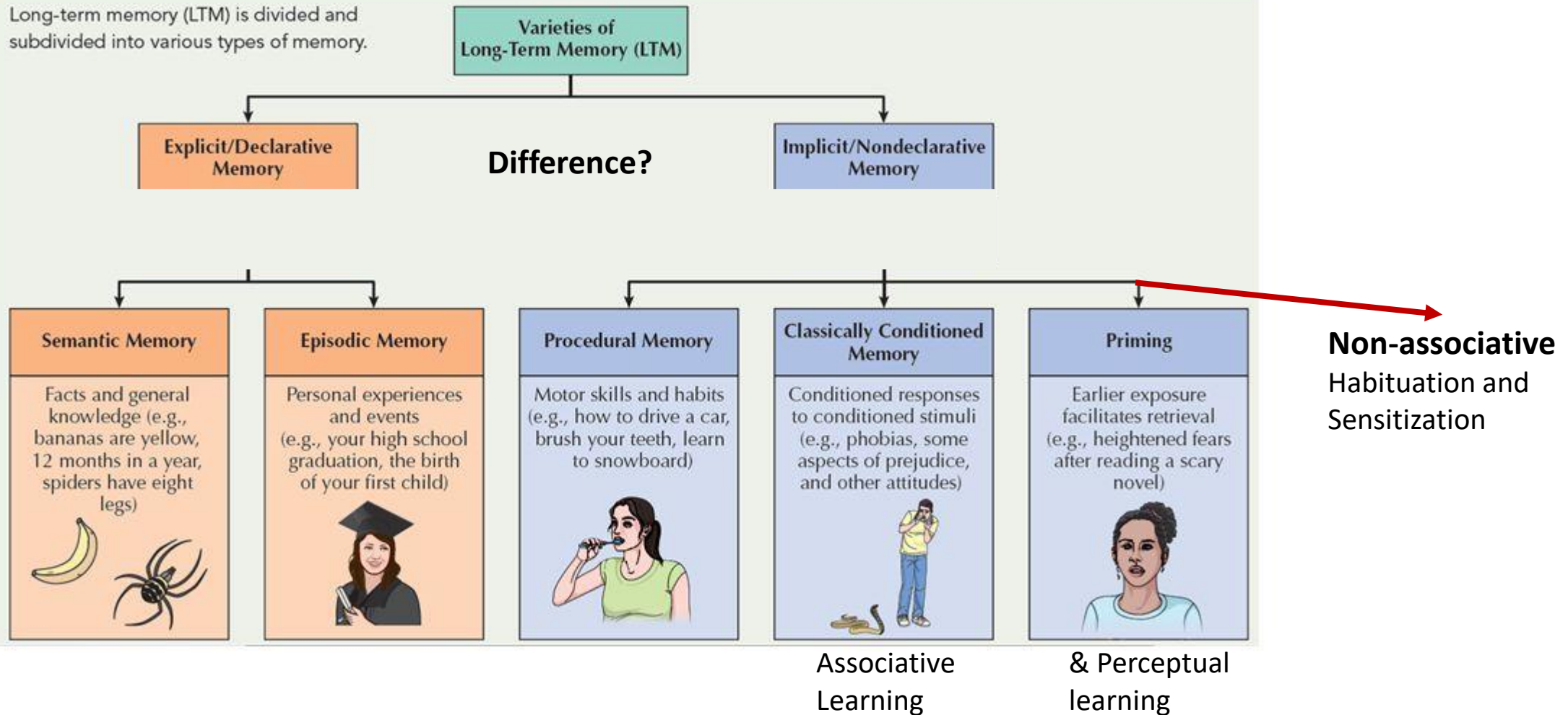


Remembering vs forgetting

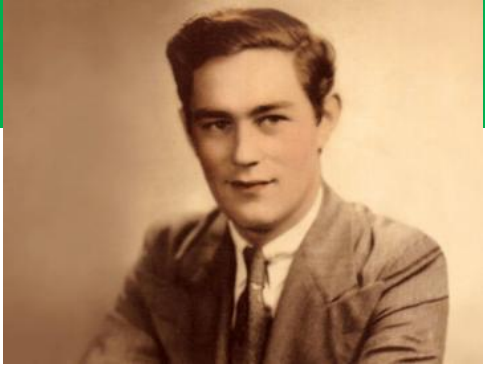


# Types of Long-Term Memories

Long-term memory (LTM) is divided and subdivided into various types of memory.



# Patient HM

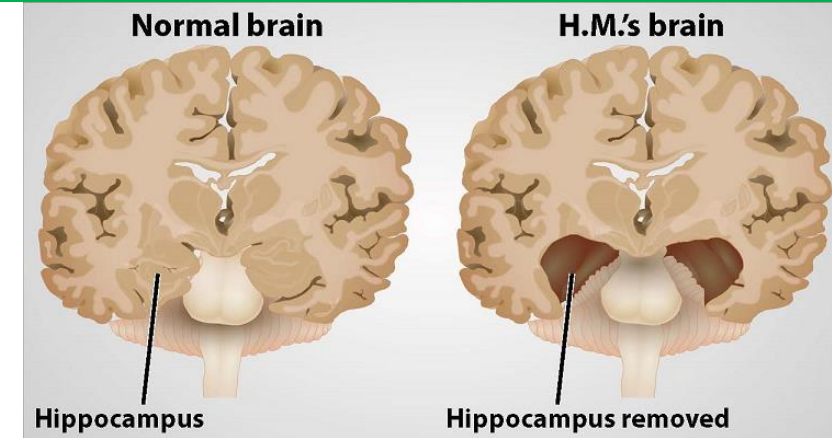


- Henry Molaison (1926-2008)
- Most studied patient in the history of neuroscience
- At age 7, HM was knocked down by a bicycle
- Accident resulted in seizures or epileptic attacks
- Seizures worsened after he turned 16 and could not lead a normal life



# Patient HM

- At 27, HM's bilateral medial temporal lobes removed to control his seizures.
- After surgery, HM could remember his name, family, and childhood.
- But he could not remember his day- to- day activities, not even his doctor, Dr. Scoville, who visited HM daily.



Dr. William Scoville  
Neurosurgeon  
Hartford Hospital  
Connecticut, USA

Dr. Brenda Milner (b. 1918 - present)  
Clinical Neuropsychologist  
Donald Hebb's student at McGill University





# Patient HM

- Over many years of testing HM, Brenda's team found that HM's IQ was intact.
- He could remember facts and general knowledge (Semantic Memory)
- He could also learn motor skills (like tracing a star by looking at its mirror reflection) over many practice trials, but was never conscious of these learning sessions. This type of learning is independent of the hippocampus.

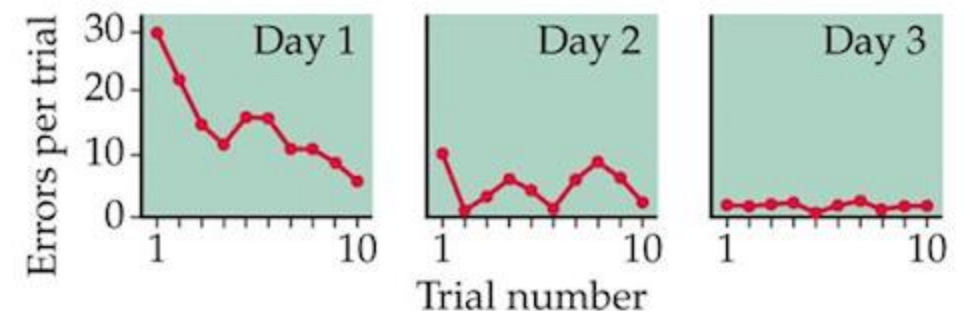
[Video](#)

[Patient Clive Wearing – pianist with amnesia](#)

(a) The mirror-tracing task



(b) Performance of H.M. on mirror-tracing task



# Amnesia

## Ribots gradient

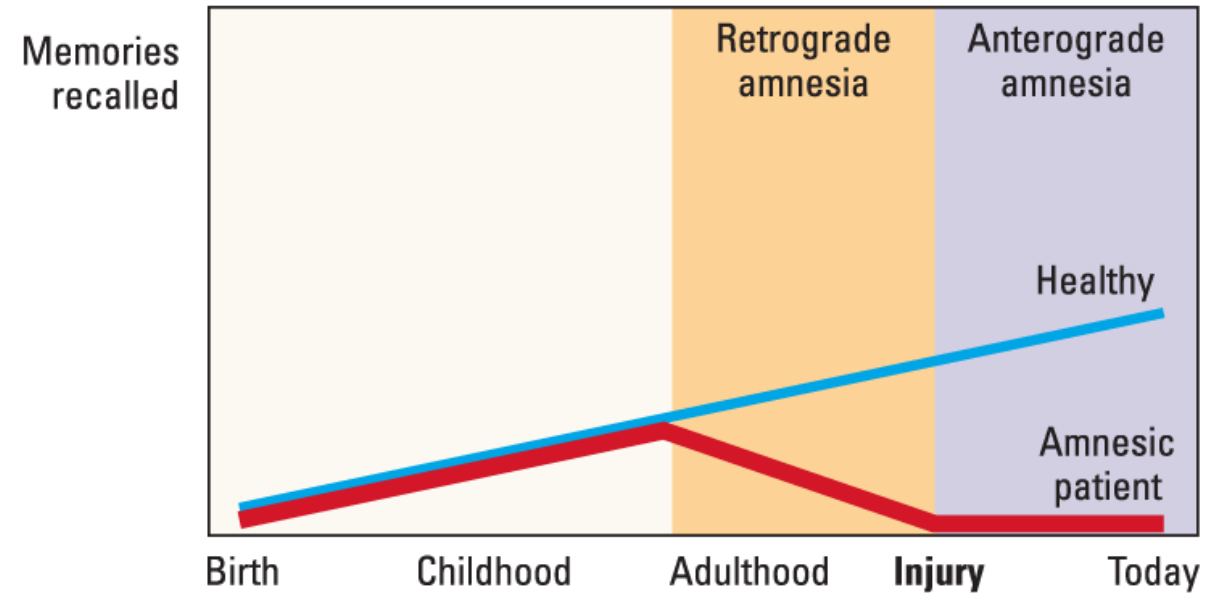
In the late 1800s, Theodore Ribot noticed that individuals with head injury often developed **retrograde amnesia**, gradient loss of memories for events that occurred before the injury

**Retrograde amnesia** - difficult to remember events from the past few years leading up to his (HM) surgery

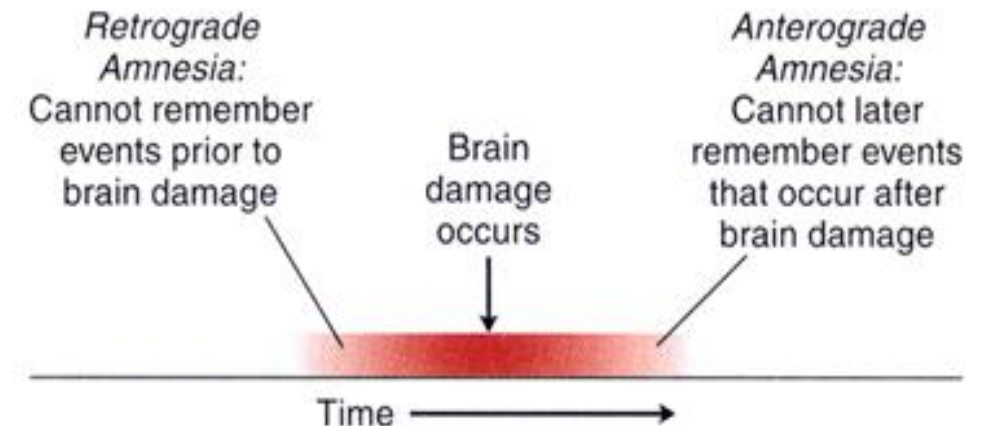
**Antero-grade amnesia** – HM could not form new memories, which is why he could not remember his doctor.

He lived only in the present.

The 'hippocampus' - important for forming, maintaining, and retrieving long term memories.

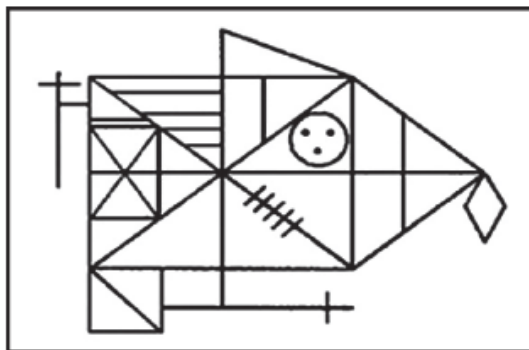


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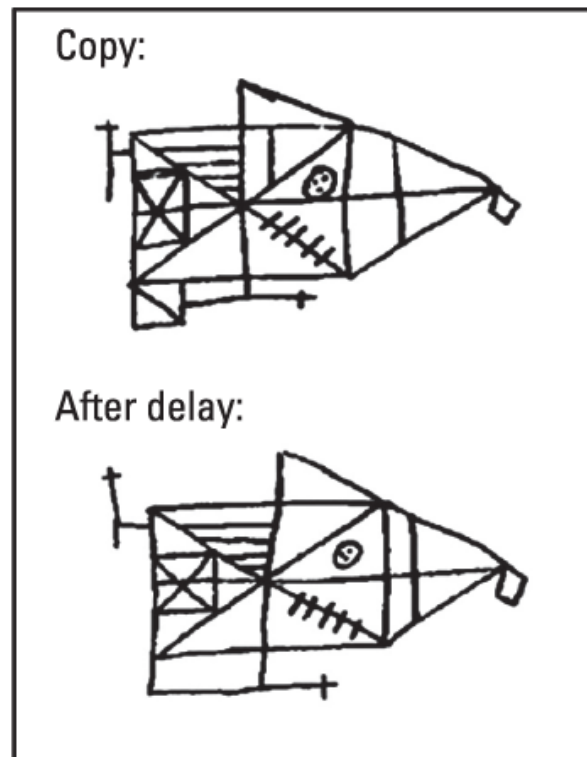


# Anterograde Amnesia in Patient E.P.

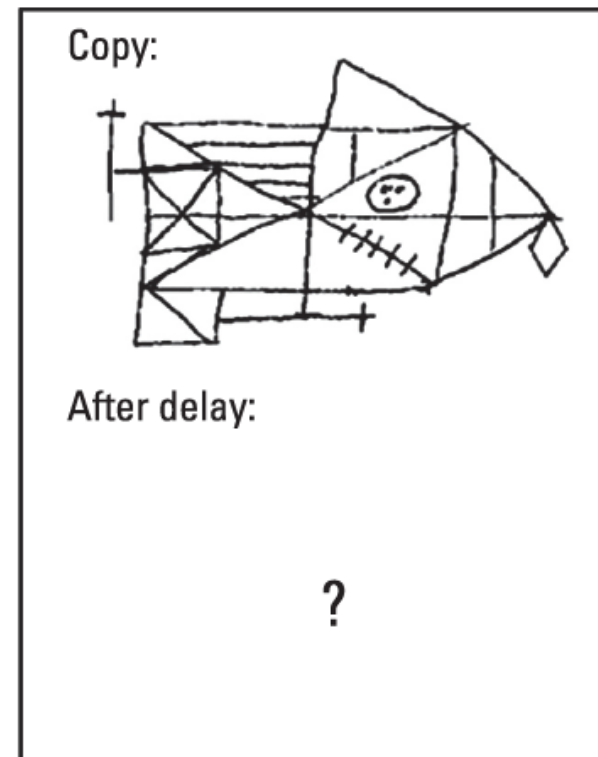
**A Original figure**



**B Healthy control**



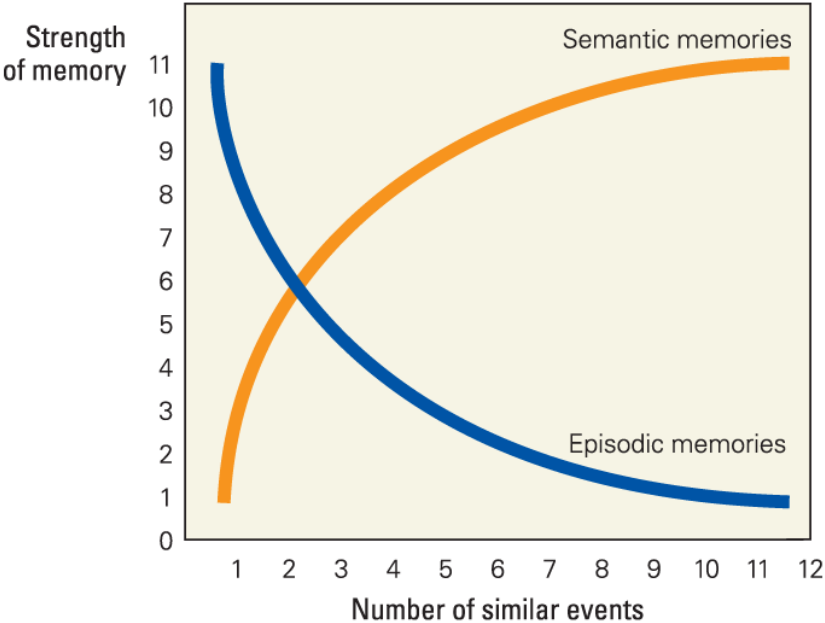
**C E.P.**





# Episodic and Semantic Memory

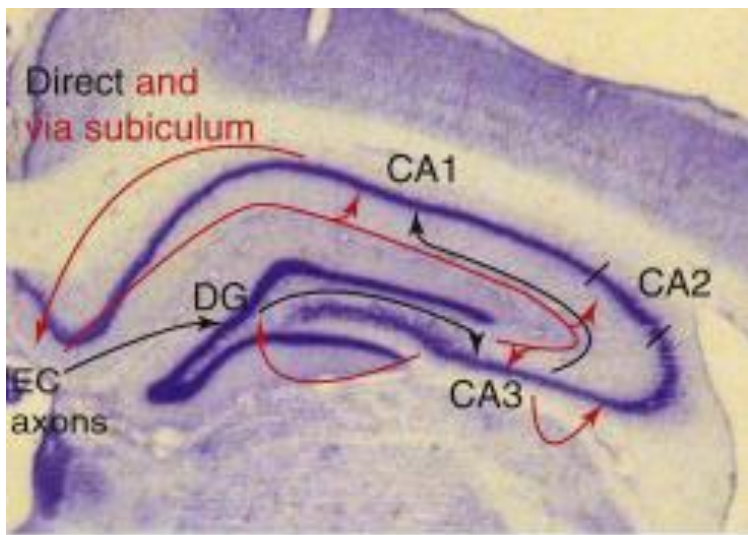
semantic memory is strengthened by repetition (abstracted from episodic content), but episodic memory can be weakened by repeated exposure to similar events



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Episodic memory	Semantic memory	Same (Yes) or Different (No)
<i>Event related:</i> “I remember”	<i>Factual:</i> “I know”	No
Can be <i>communicated flexibly</i> —in a format other than that in which it was acquired	Can be <i>communicated flexibly</i> —in a format other than that in which it was acquired	Yes
<i>Consciously accessible</i> (you know that you know)	<i>Consciously accessible</i> (you know that you know)	Yes
Attached to a <i>spatial and temporal context</i>	<i>Not necessarily</i> attached to a spatial or temporal context	No
You must have experienced the event <i>personally</i>	Can be <i>personal or general</i> information	No
Learned in a <i>single exposure</i> ; can be weakened by exposure to similar events	Can be learned in a single exposure but can also be <i>strengthened by repetition</i>	No

# Hippocampal Autoassociative Network

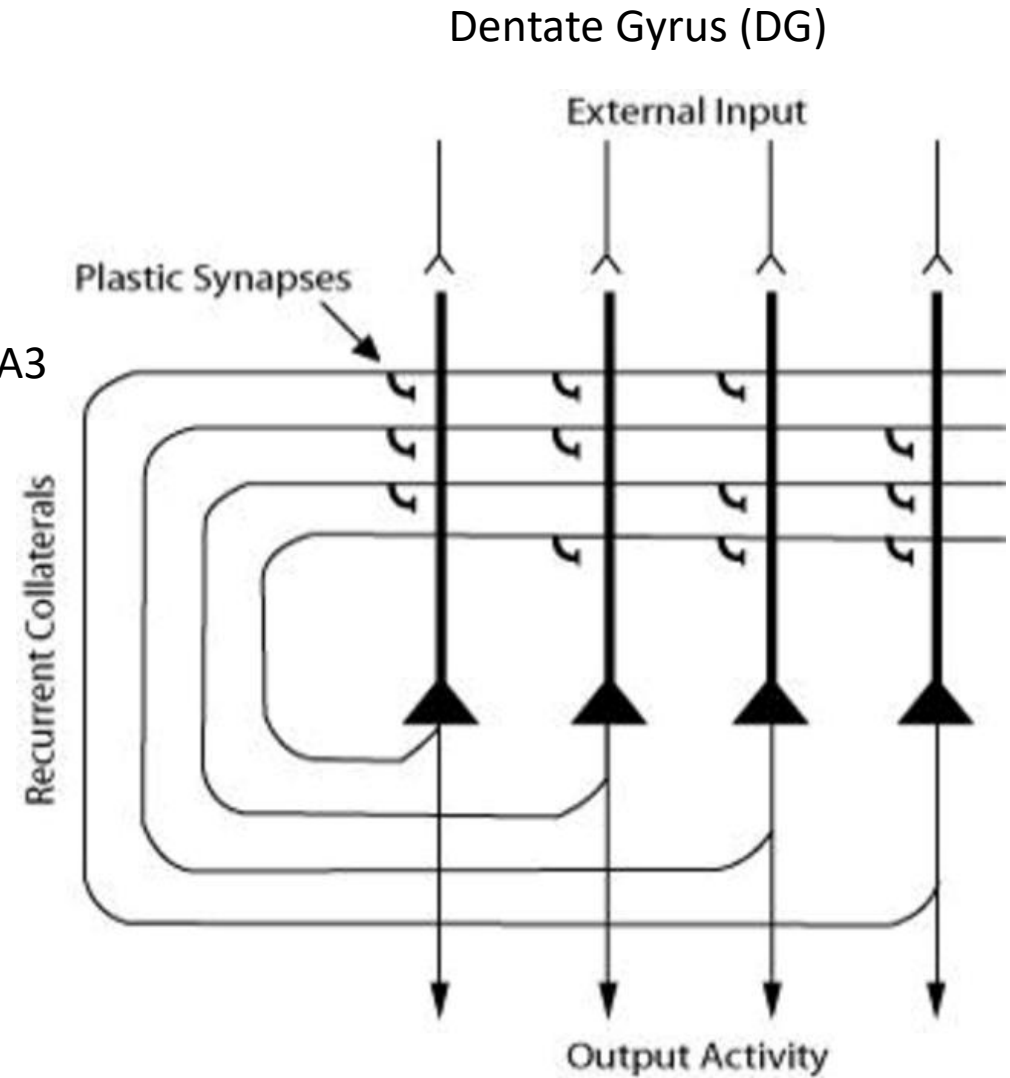


Current Biology



(Cornu Ammonis 3) CA3

- Sparse coding/representation
- Autoassociative



# Episodic or semantic?

1. A college senior takes his Sanskrit vocabulary exam. The first phrase to be translated is अनुगृहीतास्मि. This is an easy one; she knows the answer is “I am obliged,” even though she cannot remember exactly where she first heard this expression. Is this student using semantic or episodic memory?
2. The second phrase to be translated is भविष्यं निःश्वासं कुरु, अतीतं निःश्वासतु This is harder; the student can remember studying the phrase, and she even recalls that the phrase was printed in black ink on the lower left of a page in his textbook, but she cannot recall the translation. Is the student using semantic or episodic memory?
3. A senior is helping a new student learn places around the campus. When the tour finishes, the new student asks where coffee can be bought. The senior suggests a branded café outside campus that is highly rated by students, although the senior has never been to the café. Is the senior using semantic or episodic memory?

1. Recalling one's wedding day
2. Remembering the items on this week's shopping list (without writing them down)
3. Remembering how to make coffee
4. Learning the name of a new friend
5. Learning how to take photos with a new phone

Alphabetical order of first and last letter

- Kangaroo
- Chair
- Stone
- Yeast
- Apple
- Teacher

Living or non-living

- Sky
- Pencil
- Grapes
- Ant
- Laptop
- Frog



- Mid-term is on Saturday, 21<sup>st</sup> Sept – 4:30pm

Do you remember the picture on the first slide of today's class?

**Free recall:** a memory test that involves simply generating requested information from memory. Remember all you can.

Were there students wearing masks?

**Cued recall:** a memory test that involves some kind of prompt or cue to aid recall



**Recognition:** a memory test that involves picking out (or recognizing) a studied item from a set of options based on familiarity

# déjà vu?

- interpret a new experience as familiar due to similarities with past experiences.
  - Abnormal activity
  - Brief delays in information retrieval across networks – feelings of familiarity
  - environmental cues that subconsciously remind us of past experiences

Short or Long answer questions

What kind of remembering?

Multiple choice questions

What kind of remembering?



# Mere Exposure to Information Does Not Guarantee Memory

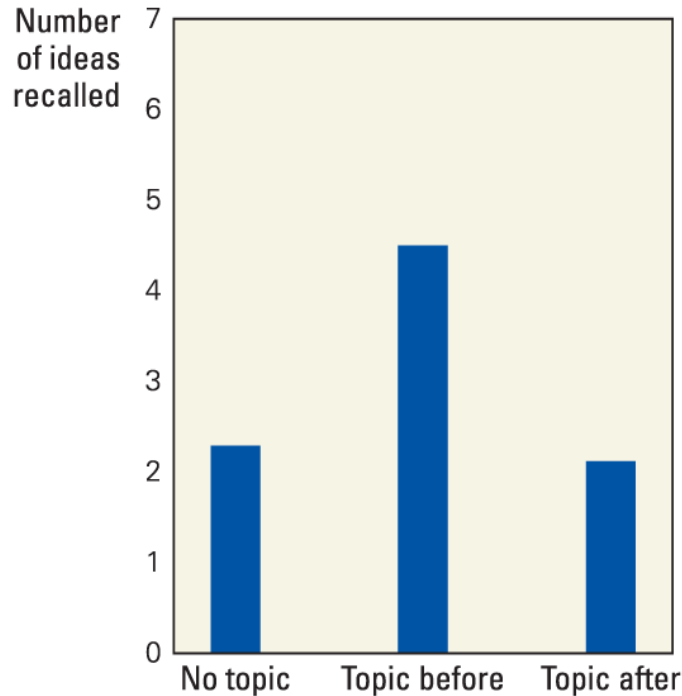
Can you pick out the correct coin?



Book detector in library  
Jagriti Tree on campus

# Memory Is Better for Information That Relates to Prior Knowledge

- A basic principle of memory is that new information is easier to remember if you can relate it to things you already know. E.g. giving examples in class to understand concepts



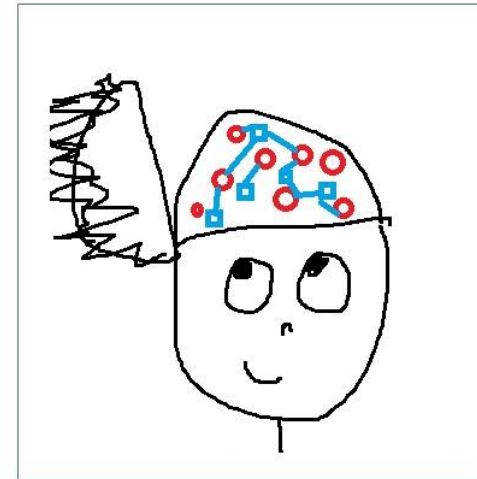
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You already know a TON of stuff.



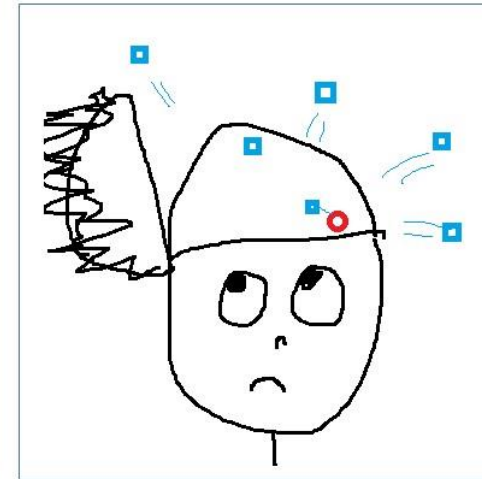
Stuff you know.

If you can connect the new stuff you learn to the old stuff you already know, chances are you will remember it much better."



Connect **new stuff** to the **stuff you already know**.

If you just learn new stuff without connecting it to something you already knew before, it will be harder to remember.



If you don't connect **new knowledge** to **existing knowledge**, you will remember less.

# Yes/No

- Pencil
- Apple
- Sky
- Chair
- Frog
- Grass
- Stone
- Teacher
- Kitten
- Grapes
- Bucket
- Laptop
- Mile
- Ant

Which list do they belong to?

Alphabetical order of first and last letter

- Teacher
- Kangaroo
- Stone
- Chair
- Mile
- Apple

Living or non-living

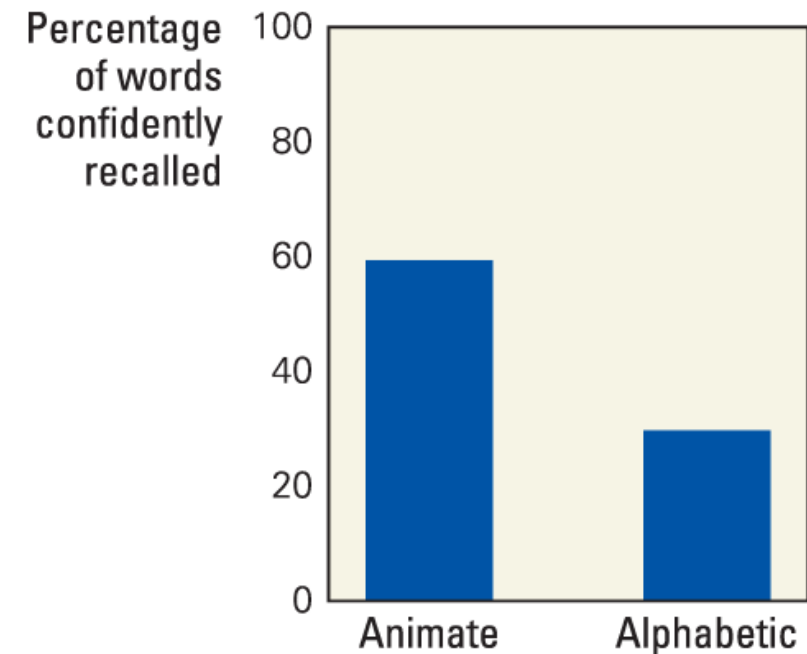
- Sky
- Pencil
- Grapes
- Ant
- Laptop
- Frog

# Deeper Processing at Encoding Improves Recall Later

- **Levels-of-processing effect:** the finding that, in general, deeper processing (such as thinking about the semantic meaning of a word) leads to better recall of the information than shallow processing (such as thinking about the spelling or pronunciation of a word)

## Usage of examples

Giving Examples to understand a concept also helps deeper processing – making more neuronal connections



Gluck et al., *Learning and Memory*, 4e,  
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# Principles of Encoding New Memories

- Three basic principles that govern how successfully a new episodic or semantic memory is encoded, or stored in memory
  - Mere exposure to information does not guarantee memory
  - Memory is better for information that relates to prior knowledge
  - Deeper processing at encoding improves recall later



# Encoding Specificity: Similar Conditions at Encoding and Retrieval

- how closely the current context (physical or mental) resembles the context in which the information was originally acquired
- The **encoding specificity effect** states that retrieval is more likely to be successful if the conditions at recall are similar to those that occurred at encoding
- E.g. Lectures and exams in the same classroom
- E.g. remembering certain events when you see an old friend or visit an old school

# Forgetting

Class 17

# How does the brain accommodate life-long learning ?

- What are the costs?
  - energy expenditure required to maintain information storage over large spans of time
  - consumption of finite storage space
  - Potential reductions in the efficiency or reliability of retrieval that might emerge with the proliferation of memory traces.

# Temporary forgetting/ retrieval failure

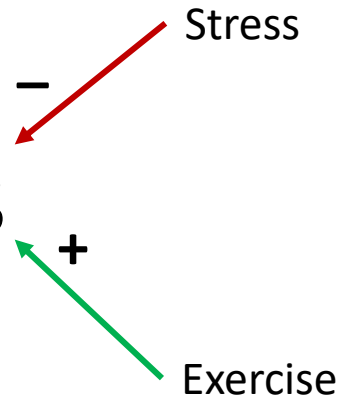
- Stress/depression/anxiety
- Illness
- Inattentiveness/multitasking

# Mechanisms of forgetting

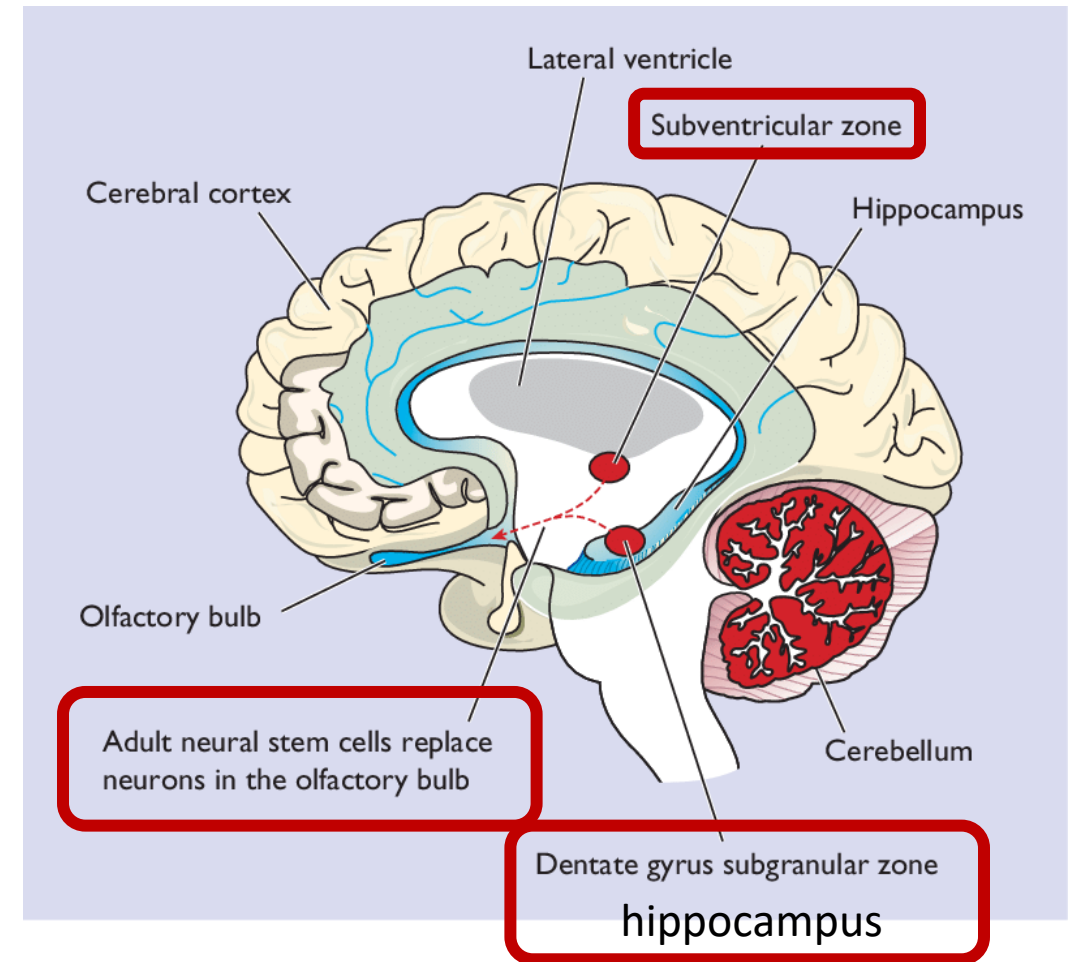
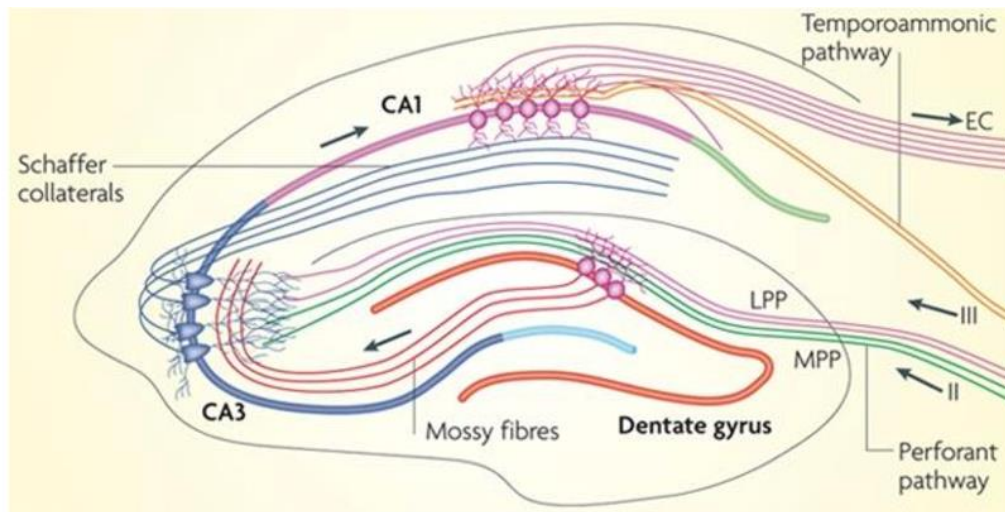
- Amnesia – physical change in the brain region
- Interference
- Updating
- Suppression/directed forgetting
  - Suppression without emotional evaluation of those events can be counter-productive → guilt, hurt, etc.
- Neurogenesis
  - Fading – gradual decrease in strength of neuronal activity (cellular/molecular activity)

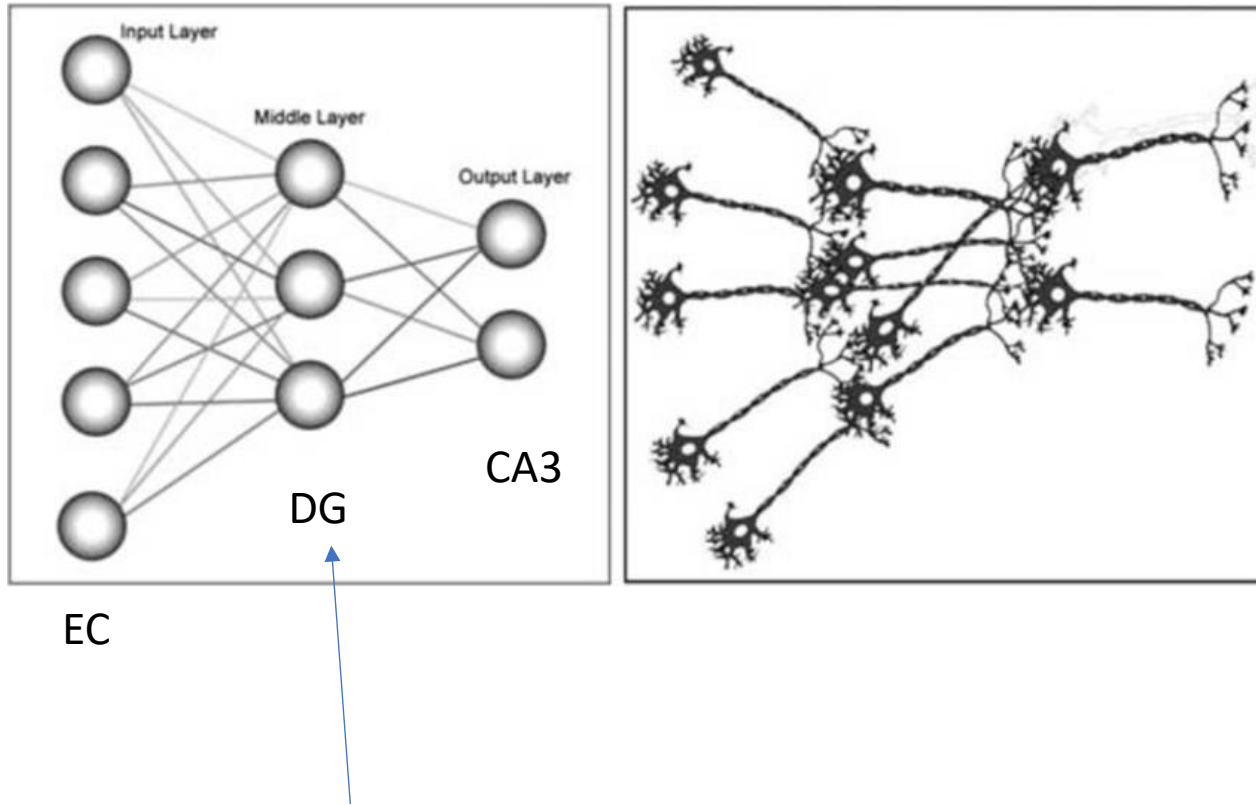


# Neurogenesis



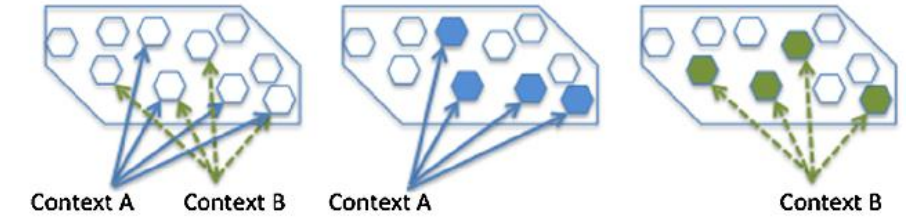
- Neurogenesis is the process by which new neurons are formed in the brain



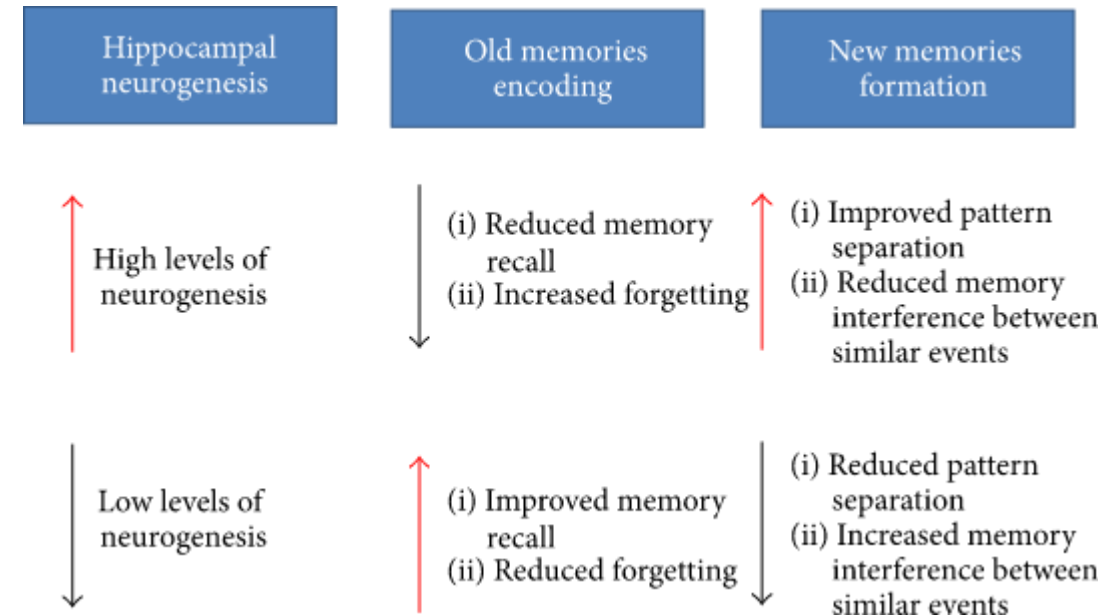
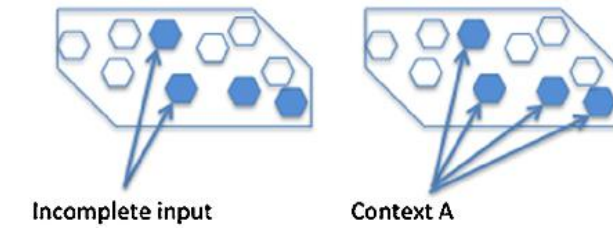


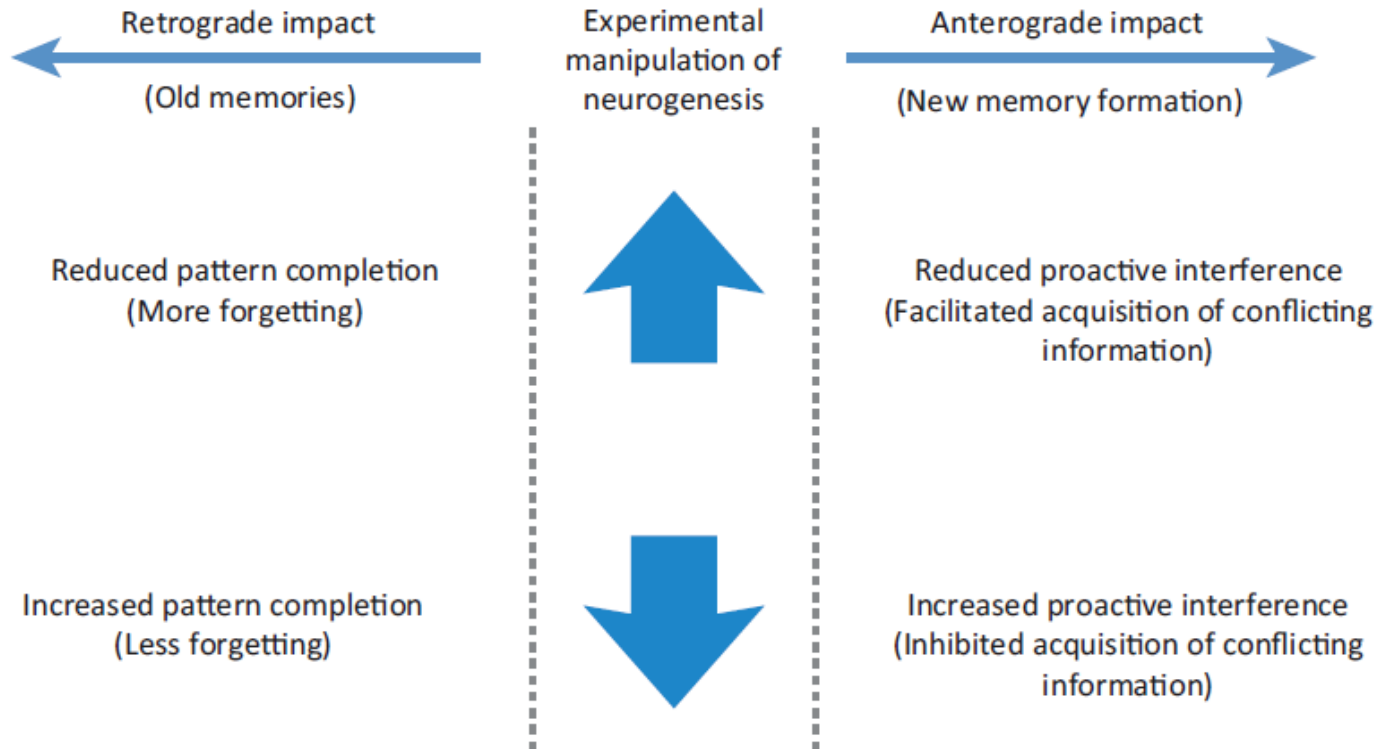
- New neurons bring in more activity (excitability).
- The circuits have to balance the excitation.
- Existing/older connections may become weak.
- Older connections more prone to forgetting unless very strong

## A. Pattern Separation



## B. Pattern Completion





*TRENDS in Neurosciences*

Due to integration of new neurons, existing memory networks are not stable, they continuously evolve.

Remodeled by neurogenesis  
(Also explains infantile amnesia)

- Memories are not stable, prone to change
- Only well consolidated or regularly retrieved memories can resist forgetting.
- Use it or lose it

# Hyperthymesia

- highly superior autobiographical memory (HSAM)
- people to remember nearly every event of their life with great precision
- Blessing and curse!
- Possible explanation – (Ally, Hussey, & Donahue, 2013)
  - Amygdala charges autobiographical memories with emotional, social, and self-relevance.
  - (n=1, case study) amygdala hypertrophy (20% larger) and enhanced amygdala-to-hippocampus connectivity (>10 SD)
  - Amygdala-hippocampus system may be hyperactive, allowing emotionally benign info to be more efficiently processed as self-relevant for encoding and storage.