Class 18 Forgetting

Monday 6/11/22

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.
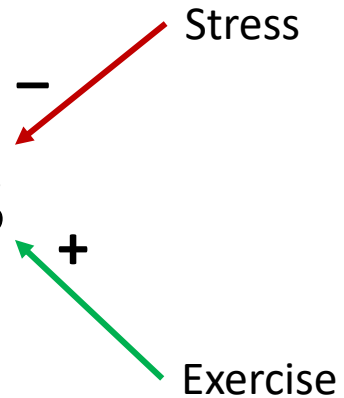
Mechanisms of forgetting

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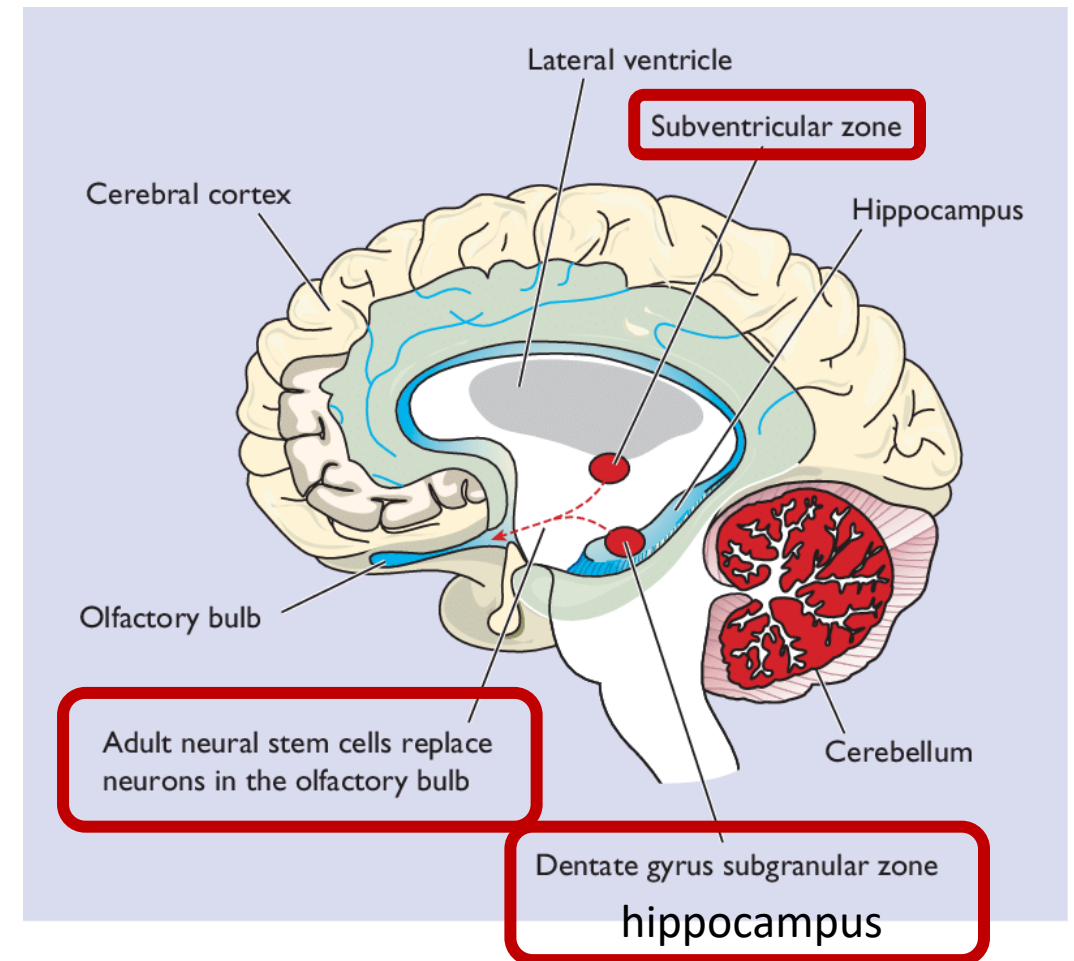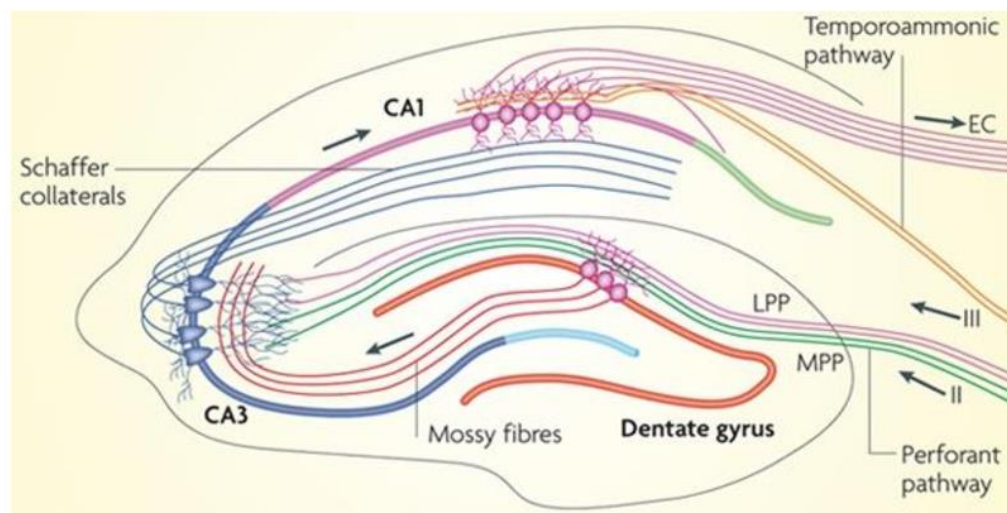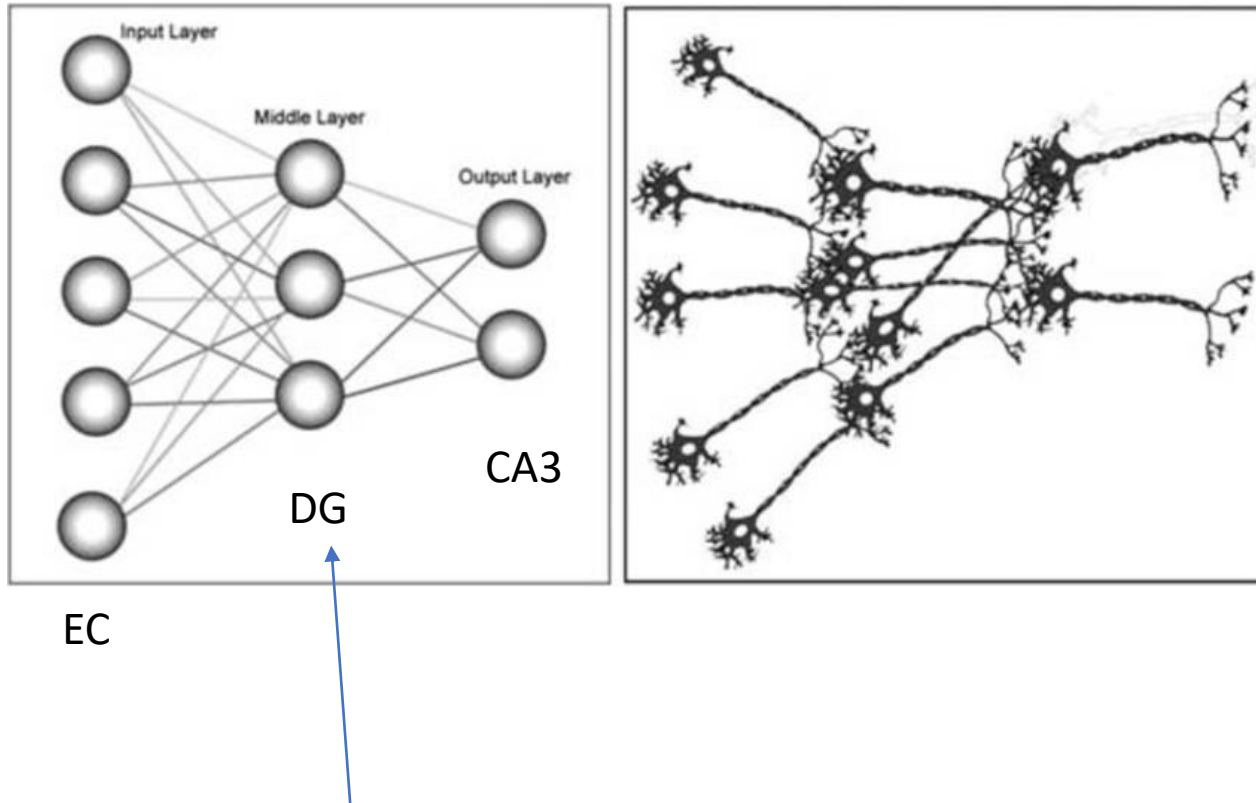- Neurogenesis

Temporary forgetting/ retrieval failure

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

Neurogenesis

Stress −

Exercise +

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

Lateral ventricle

Subventricular zone

Cerebral cortex

Hippocampus

Olfactory bulb

Adult neural stem cells replace neurons in the olfactory bulb

Cerebellum

Dentate gyrus subgranular zone

hippocampus

Temporoammonic pathway

CA1

EC

Schaffer collaterals

LPP

III

MPP

II

CA3

Mossy fibres

Dentate gyrus

Perforant pathway

Input Layer
Middle Layer
Output Layer
CA3
DG
EC

A. **Pattern Separation**

Context A   Context B   Context A   Context B

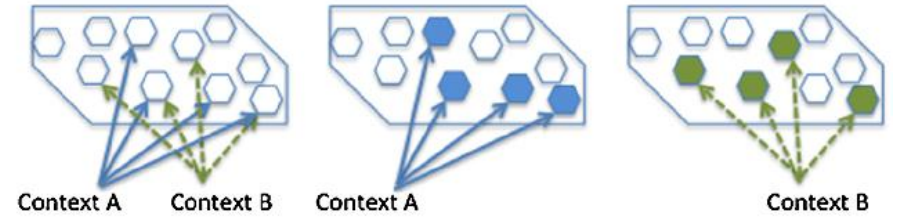B. **Pattern Completion**

Incomplete input   Context A

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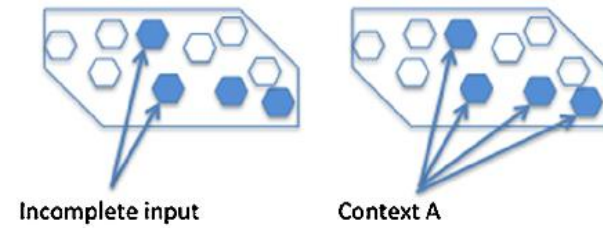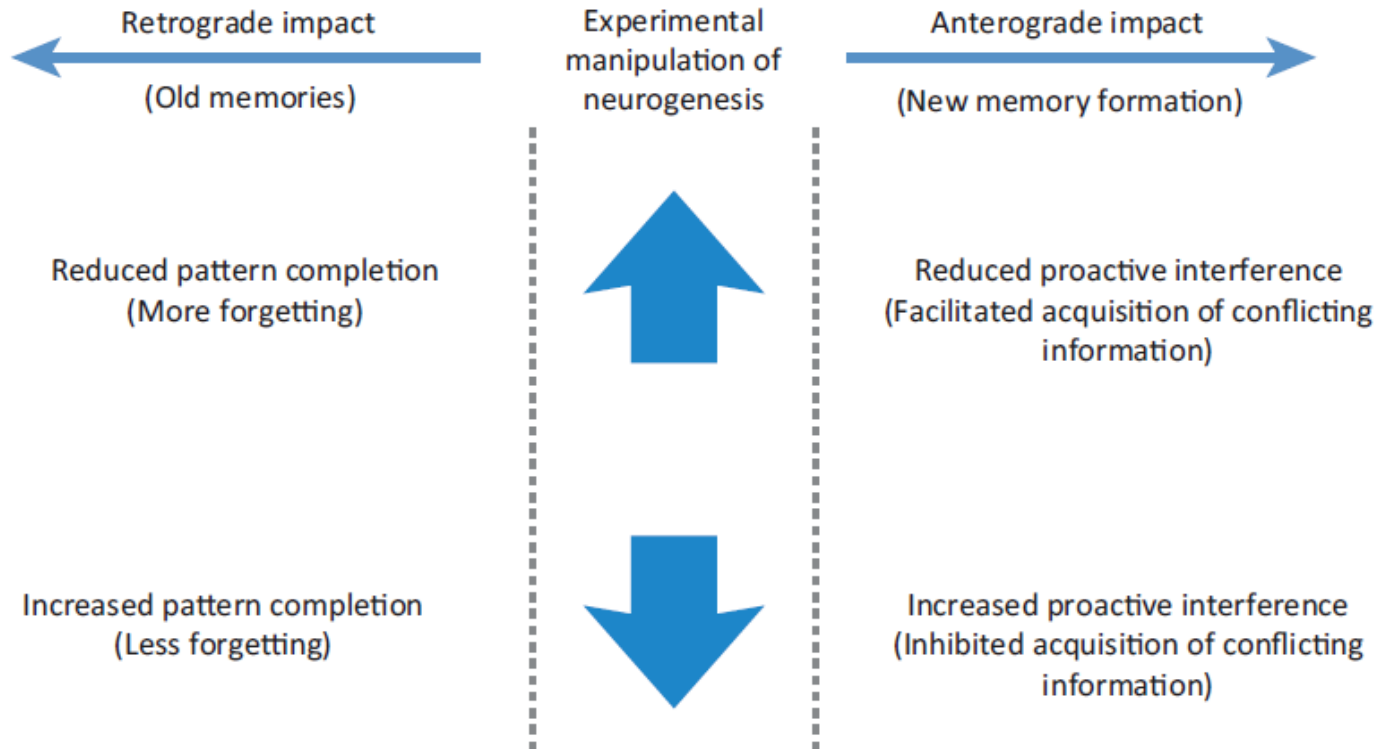- Older connections more prone to forgetting unless very strong

Retrograde impact
(Old memories)

Experimental manipulation of neurogenesis

Anterograde impact
(New memory formation)

Reduced pattern completion
(More forgetting)

Reduced proactive interference
(Facilitated acquisition of conflicting information)

Increased pattern completion
(Less forgetting)

Increased proactive interference
(Inhibited acquisition of conflicting information)

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

https://jflab.ca/pdfs/frankland-kohler-josselyn-2013.pdf

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.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3432421/