PSYCH 260

Learning & Memory, Part II

Rick Gilmore

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Today's topics

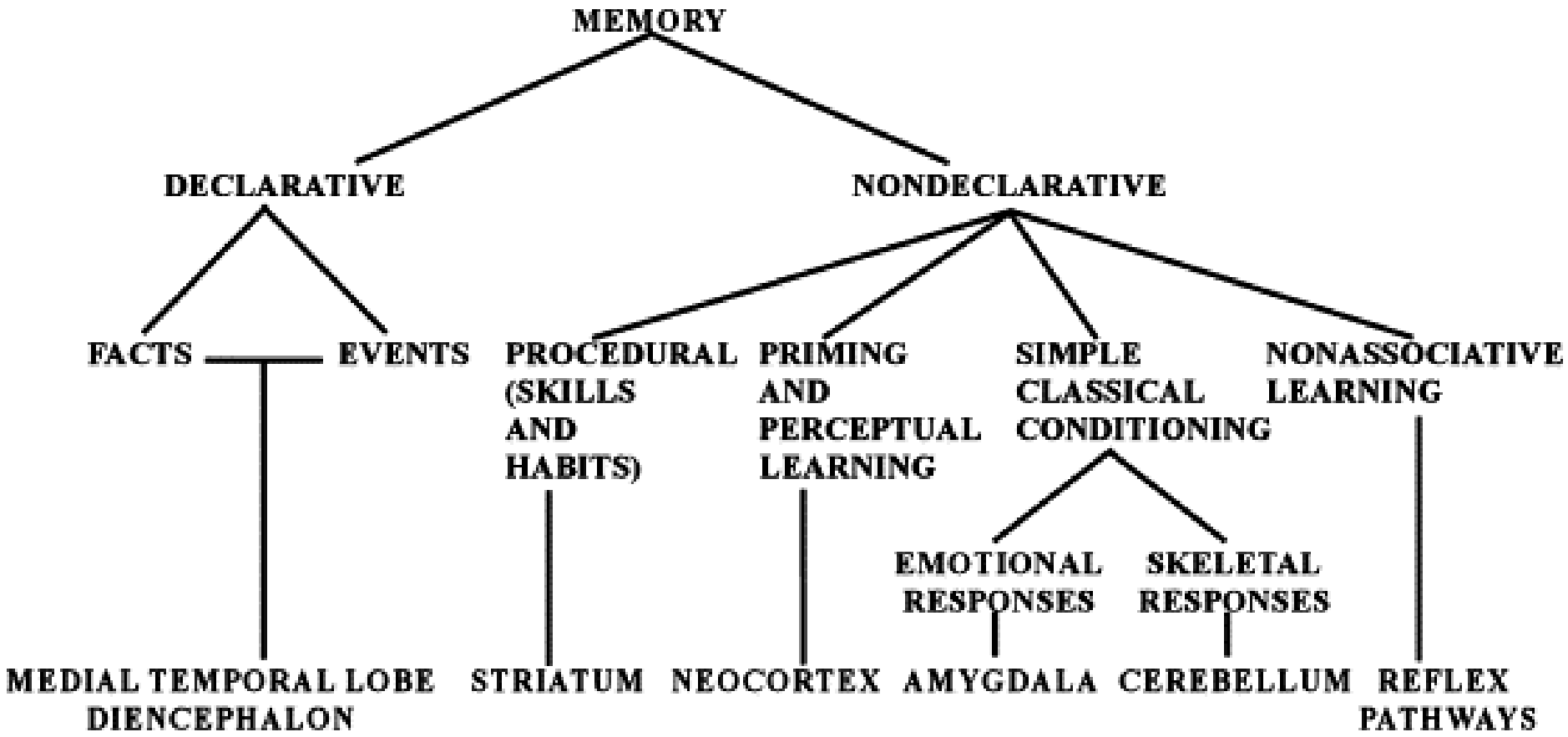
- Disorders of memory

Coming up

- Quiz 4, in-class lab next Tuesday
- Exam 4, Tuesday, December 14, 10:10 - 12:00 PM

Review from last time

Memory systems in the brain



(Squire, 2004)

Review from last time

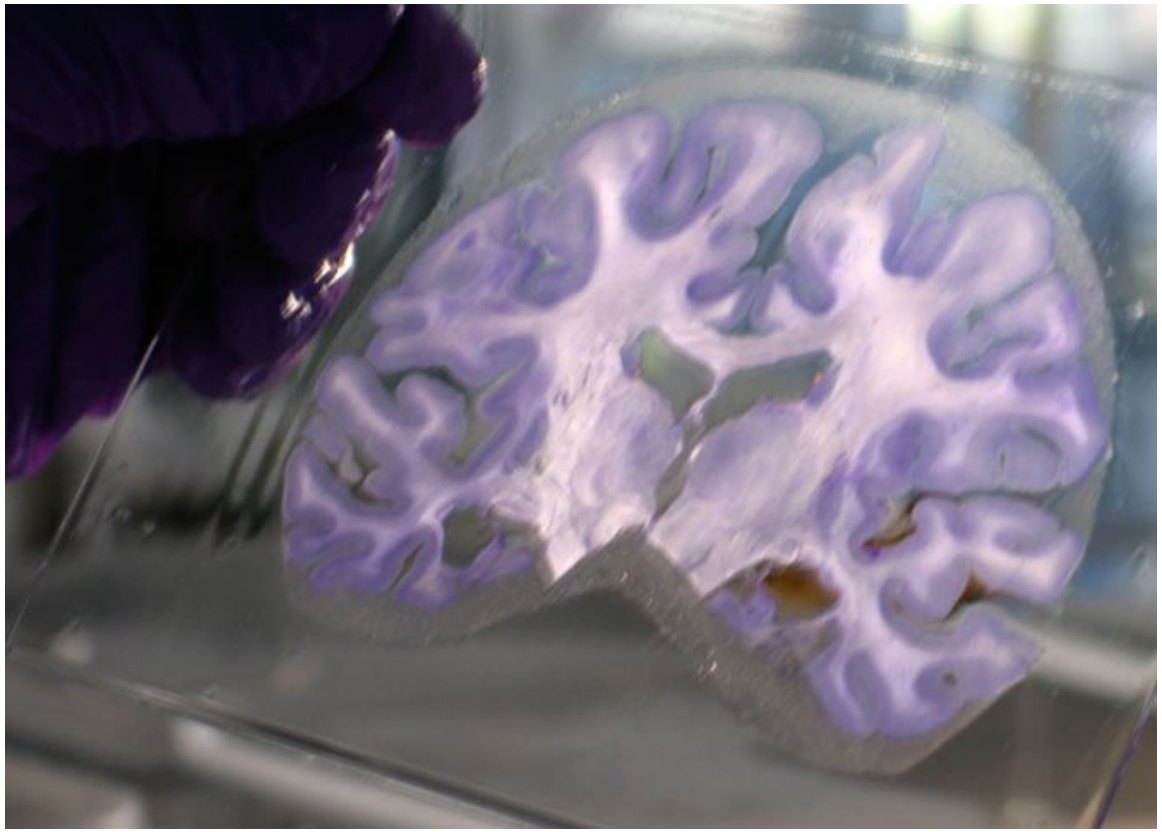
- Learning and memory involve changes in neural firing, circuitry
- Hebbian learning a type of associative learning
- NMDA receptor as coincidence detector
    - Molecular basis of one form of long-term potentiation (LTP)
- Different types of information stored in different brain systems

Disorders of memory

Patient HM (Henry G. Molaison)

- Intractable/untreatable epilepsy
- Bilateral resection of medial temporal lobe (1953)
- Epilepsy now treatable
- But, memory impaired
- Lived until 2008

HM's surgery



https://www.pbs.org/wgbh/nova/media/images/corkin-hm-memory-08.width-800.jpg

Brenda Milner tells the story

Amnesia

- Acquired loss of memory
- ≠ normal forgetting
- Note: computers don’t forget

HM's amnesia

- Retrograde amnesia
  - Can't remember 10 yrs before operation
  - Distant past better than more recent
- Severe, global anterograde amnesia
  - Impaired learning of new facts, events, people
- But, skills (mirror learning) intact

Types of amnesia

- Retrograde (‘backwards’ in time)
  - Damage to information acquired pre-injury
  - Temporally graded
- Anterograde (‘forward’ in time)
  - Damage to information acquired/experienced post-injury

What it's like

Every day is alone in itself, whatever enjoyment I've had, and whatever sorrow I've had…Right now, I'm wondering, have I done or said anything amiss? You see at this moment, everything looks clear to me, but what happened just before? That's what worries me. It's like waking from a dream. I just don't remember.

What it’s like

Other causes of amnesia

- Disease
  - Alzheimer's, herpes virus
- Korsakoff's syndrome
  - Result of severe alcoholism
  - Impairs medial thalamus & mammillary bodies

Patient NA

- Fencing accident
- Damage to medial thalamus
- Anterograde + graded retrograde amnesia
- Are thalamus & medial temporal region connected?

Patient NA

Spared skills in amnesia

- Skill-learning
- Mirror-reading, writing
- Short-term memory
- “Cognitive” skills
- Priming

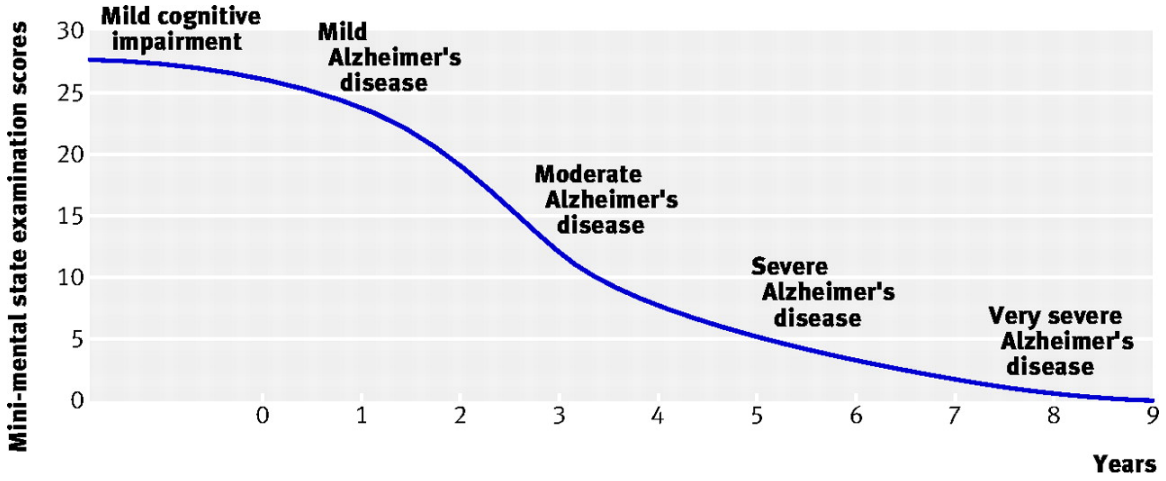
What does amnesia tell us?

- Long-term memory for facts, events, people
- ≠ Short-term memory
- ≠ Long-term memory for “skills”
- Separate memory systems in the brain?

Alzheimer's Disease (AD)

- Chronic, neurodegenerative disease affecting ~5 M Americans
- Cognitive dysfunction (memory loss, language difficulties, planning, coordination)
- Psychiatric symptoms and behavioral disturbances
- Difficulties with daily living
- (Burns & Iliffe, 2009)

Progression



Mild cognitive impairment: Complaints of memory loss, intact activities of daily living, no evidence of Alzheimer's disease

Mild Alzheimer's disease: Forgetfulness, short term memory loss, repetitive questions, hobbies, interests lost, impaired activities of daily living

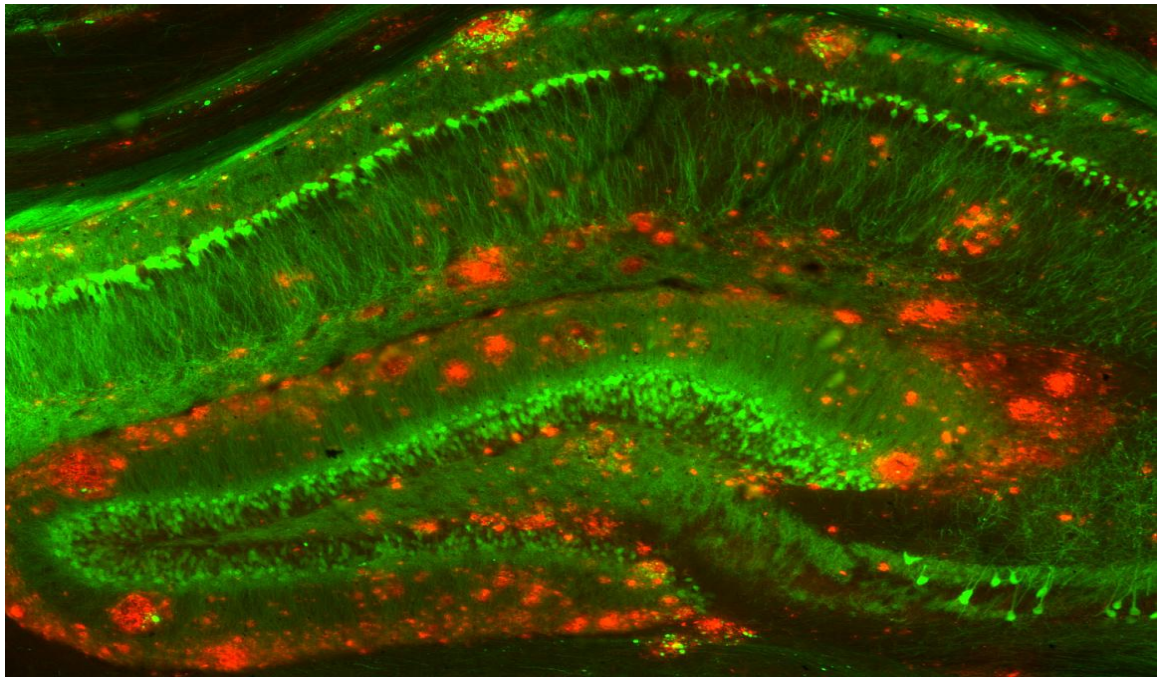
Moderate Alzheimer's disease: Progression of cognitive deficits, dysexecutive syndrome, further impaired activities of daily living, transitions in care, emergence of behavioural and psychological symptoms of dementia

Severe Alzheimer's disease: Agitation, altered sleep patterns, assistance required in dressing, feeding, bathing, established behavioural and psychological symptoms of dementia

Very severe Alzheimer's disease: Bedbound, no speech, incontinent, basic psychomotor skills lost

(Burns & Iliffe, 2009)

- Post-mortem exams show β amyloid plaques and neurofibrillary tangles in hippocampus + other brain areas



AD Treatments

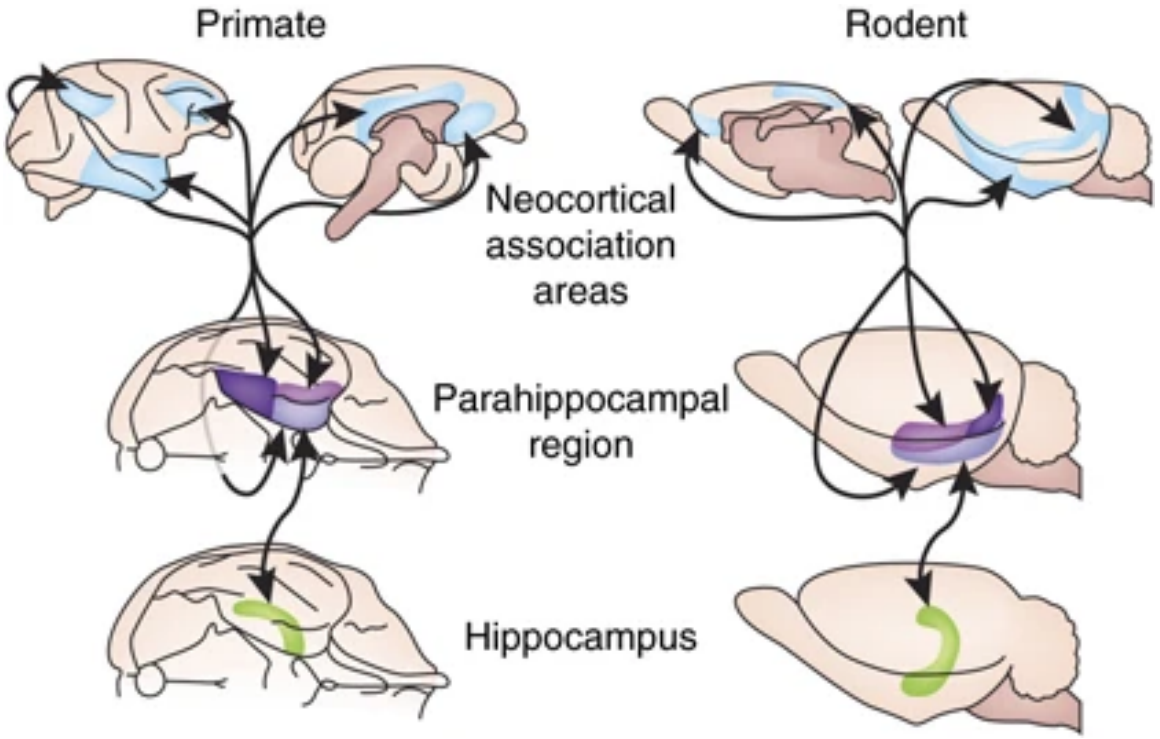
- Acetylcholinesterase (AChE) inhibitors (e.g. Aricept)
  - ACh a neuromodulator in the brain
- NMDA-R partial antagonists (e.g., Memantine)
- Drugs that address amyloid β don't work especially well
- AD the result of disordered immune response?

Hippocampus

https://upload.wikimedia.org/wikipedia/commons/5/5b/Hip

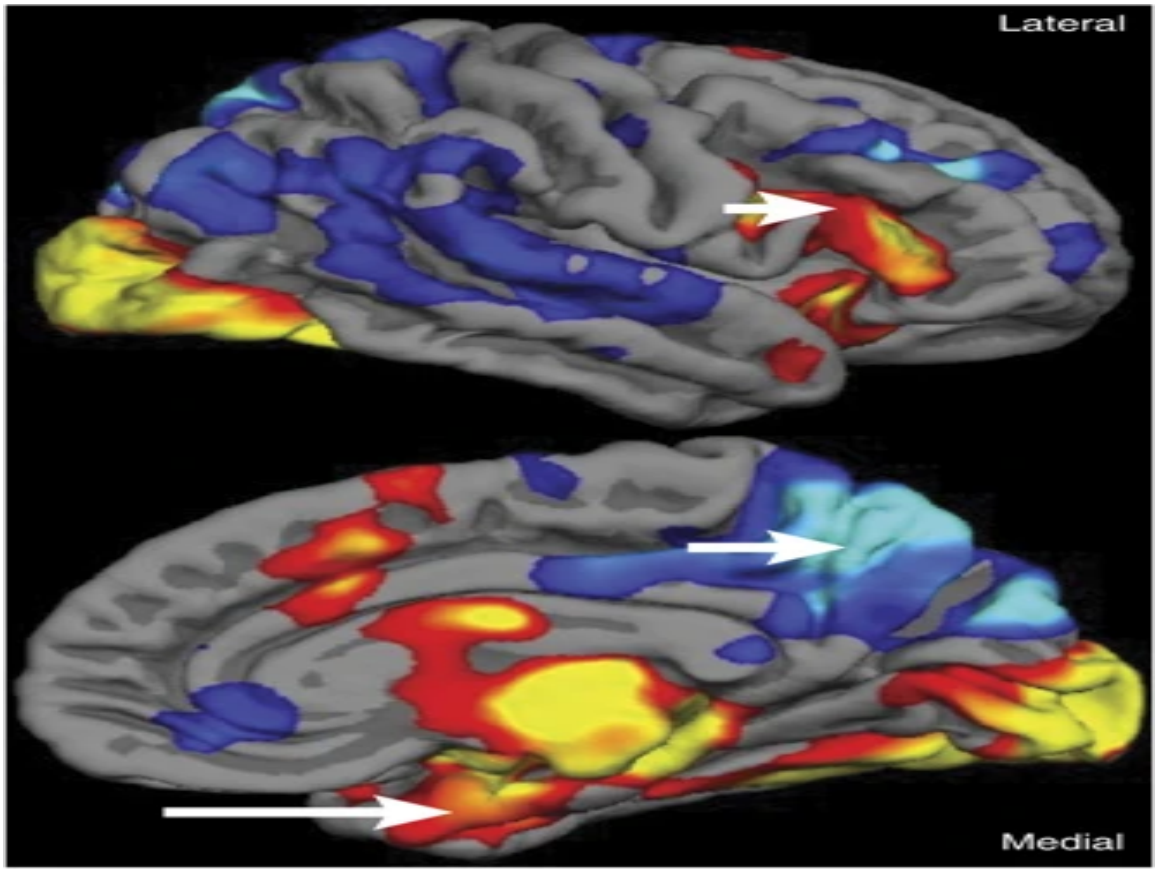
Hippocampus & medial temporal lobe areas

- Dense in NMDA receptors
- Formation, storage, consolidation of long-term episodic or declarative memories
- Stores info for later transfer to cortex



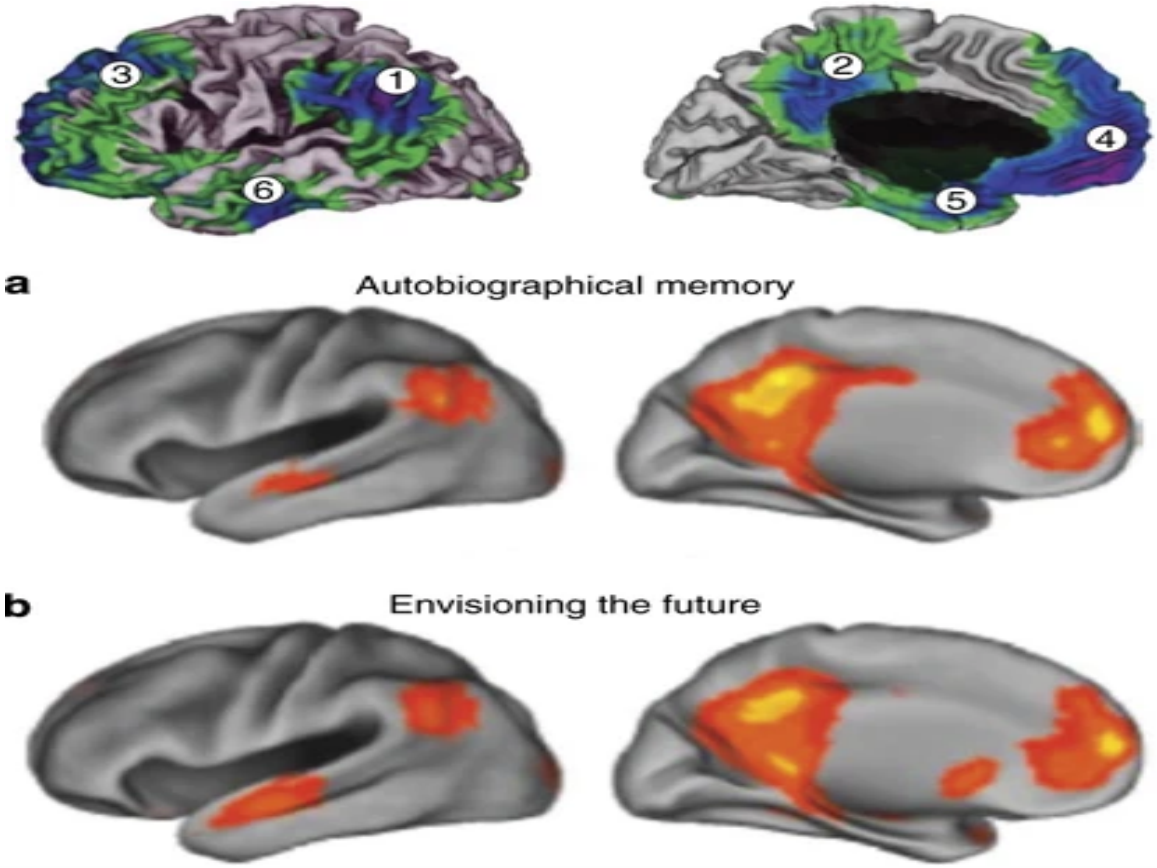
(Dickerson & Eichenbaum, 2010)

Cortical areas activated or deactivated during memory encoding



(Dickerson & Eichenbaum, 2010)

Cortical areas deactivated in non-memory cognitive tasks but activated during memory retrieval

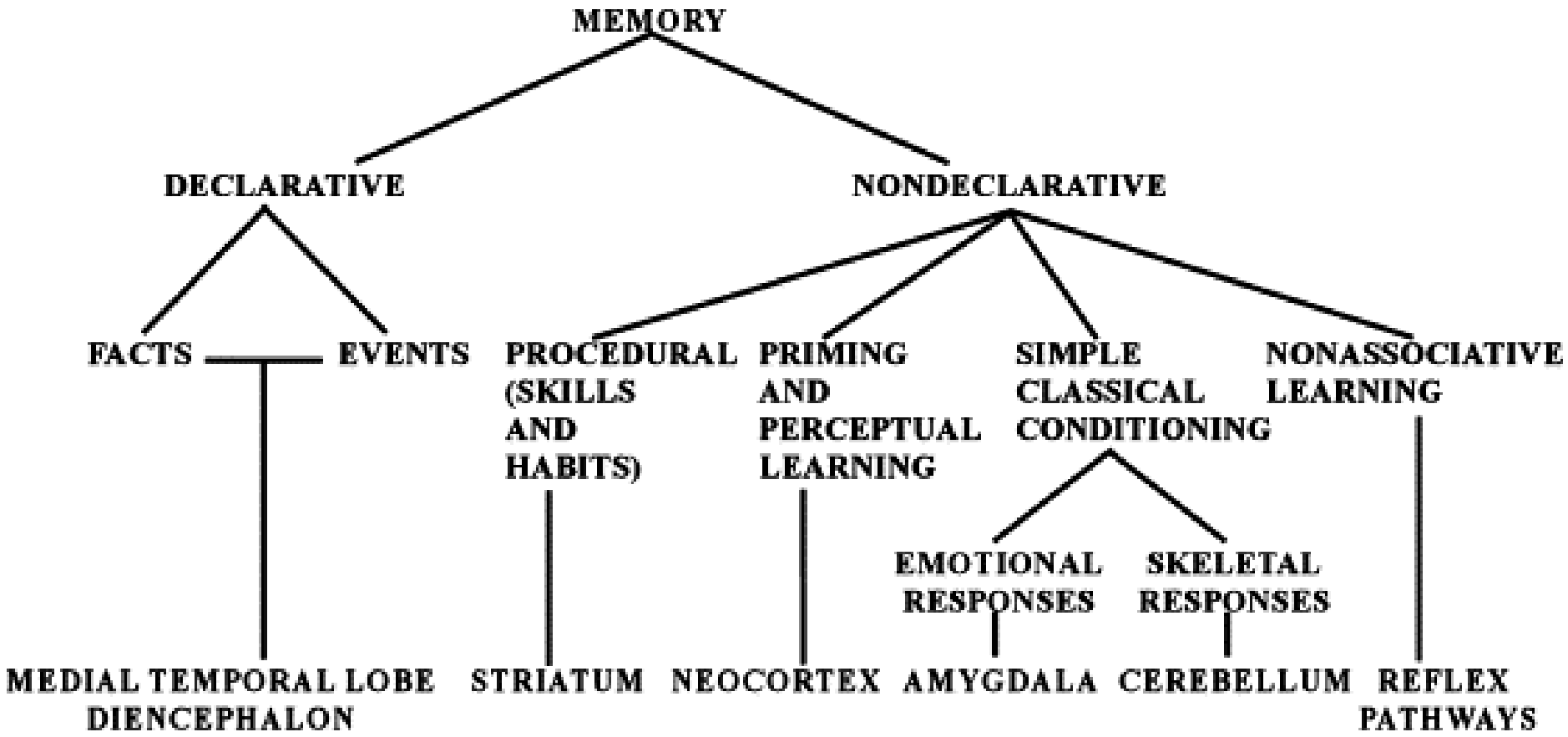


(Dickerson & Eichenbaum, 2010)

Hippocampus in non-human animals

- Similar architecture to humans
  - More known about mechnanisms for *spatial* than *non-spatial* memory
- Place cells
- Grid cells
- Head-direction cells

Memory systems in the brain



(Squire, 2004)

References

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Dickerson, B. C., & Eichenbaum, H. (2010). The episodic memory system: Neurocircuitry and disorders. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology*, *35*(1), 86–104. https://doi.org/10.1038/npp.2009.126

Squire, L. R. (2004). Memory systems of the brain: A brief history and current perspective. *Neurobiology of Learning and Memory*, *82*(3), 171–177. https://doi.org/10.1016/j.nlm.2004.06.005