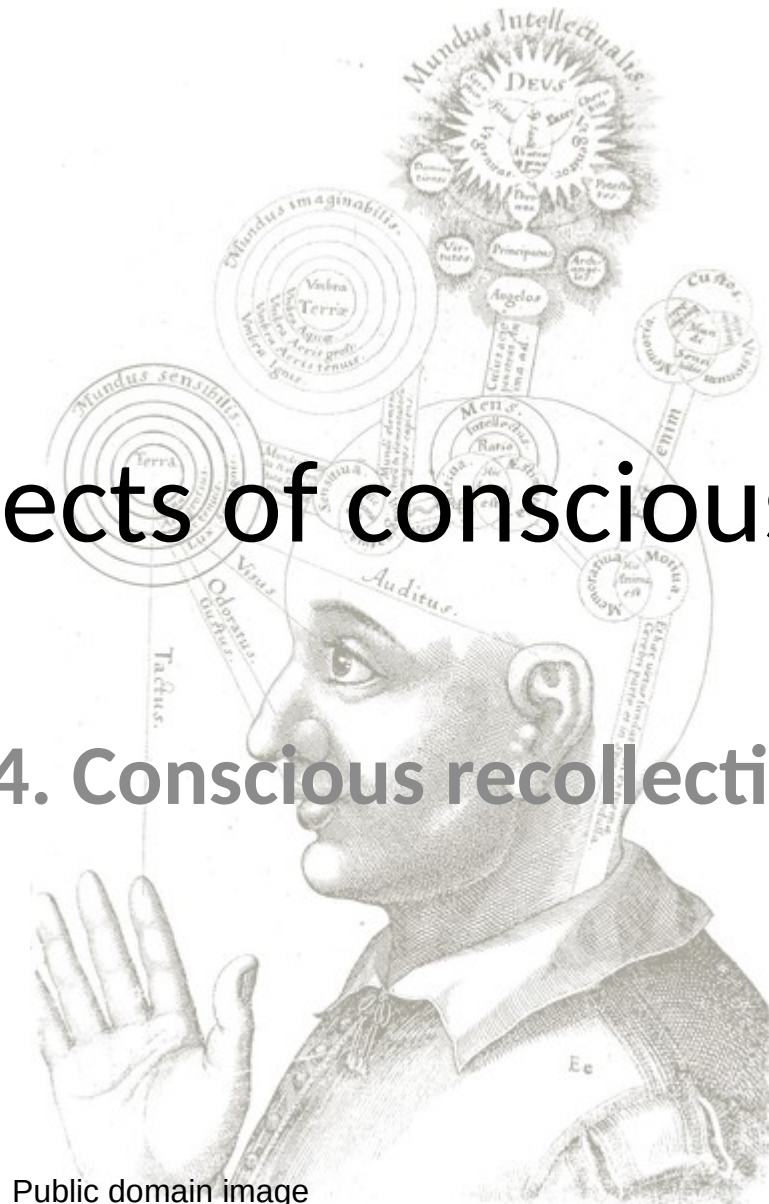


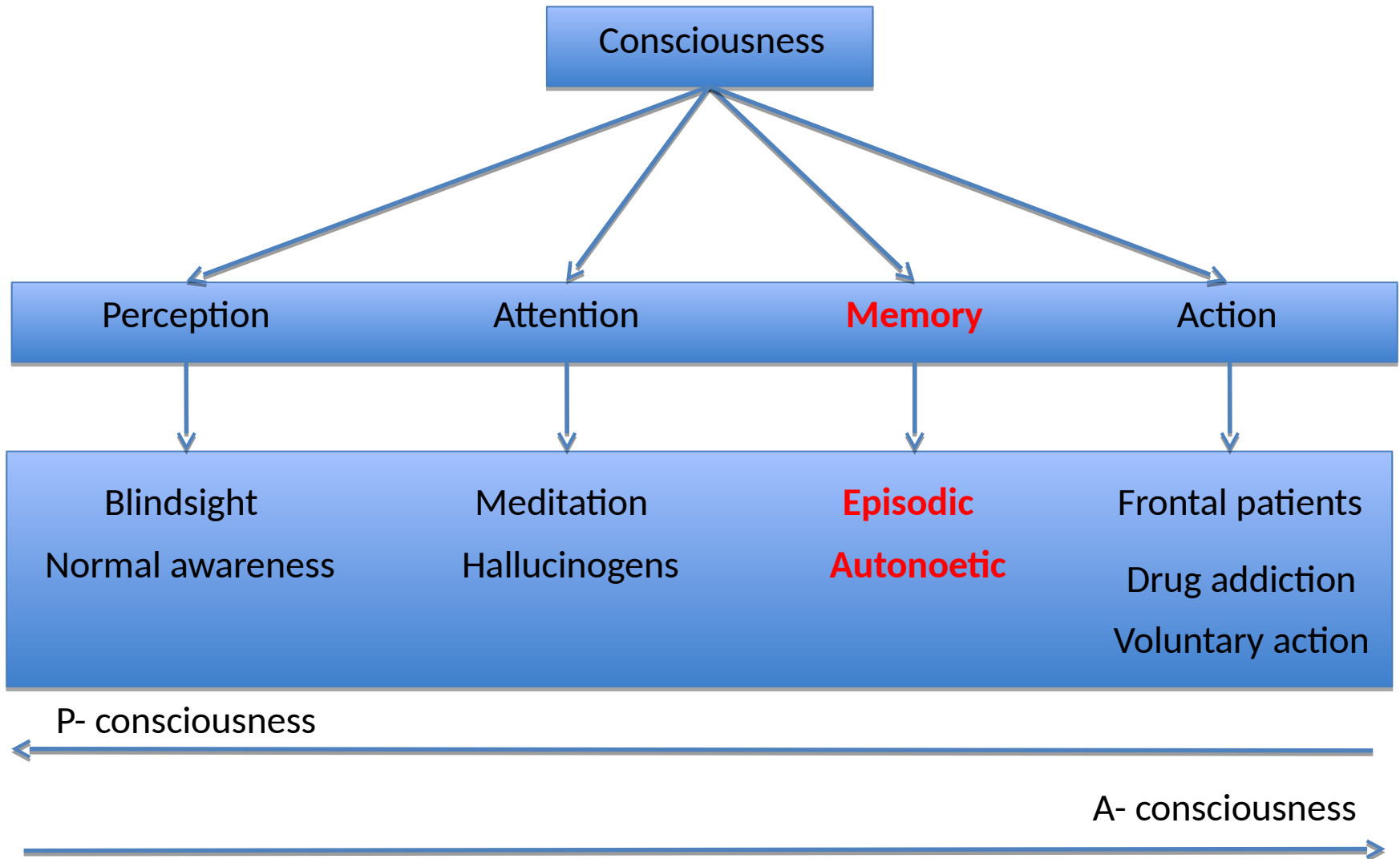
# Aspects of consciousness

## 4. Conscious recollection



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# Scientific study of consciousness



# À la recherche du temps perdu

- A literary example of the phenomenology of conscious recollection.
  - Marcel Proust (1871-1922)
  - *“In search of lost time”*, previously translated as *“Remembrance of things past”*.
- What can psychology tell us about the mechanisms of conscious recollection?



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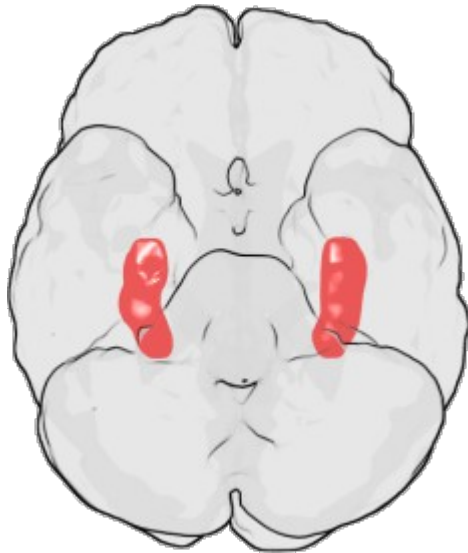
# Episodic memory

- Proust is describing an *episodic* memory.
  - A “what, where, when” memory.
- What brain structure(s) are responsible for the encoding and retrieval of episodic memories?



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# *Hippocampus* – “Sea horse”



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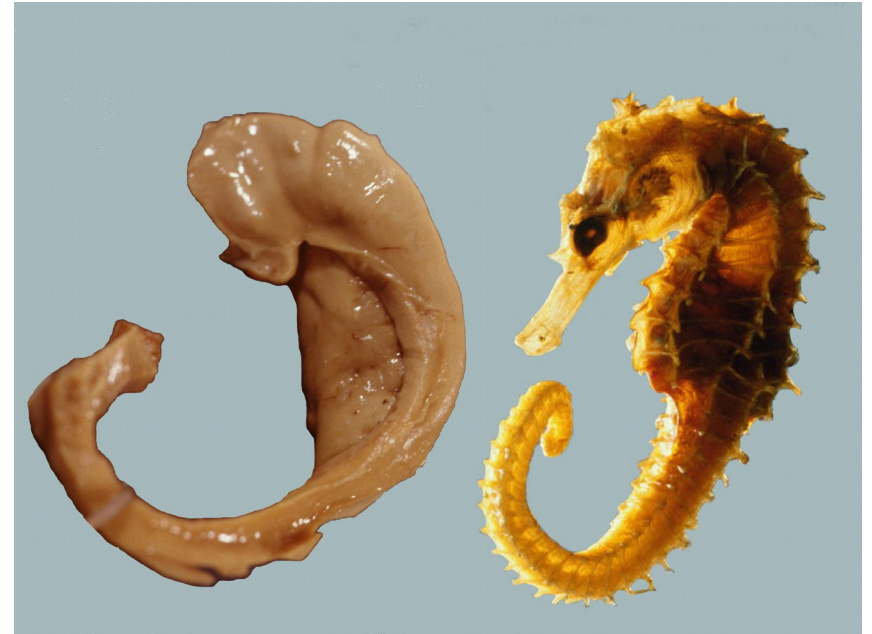
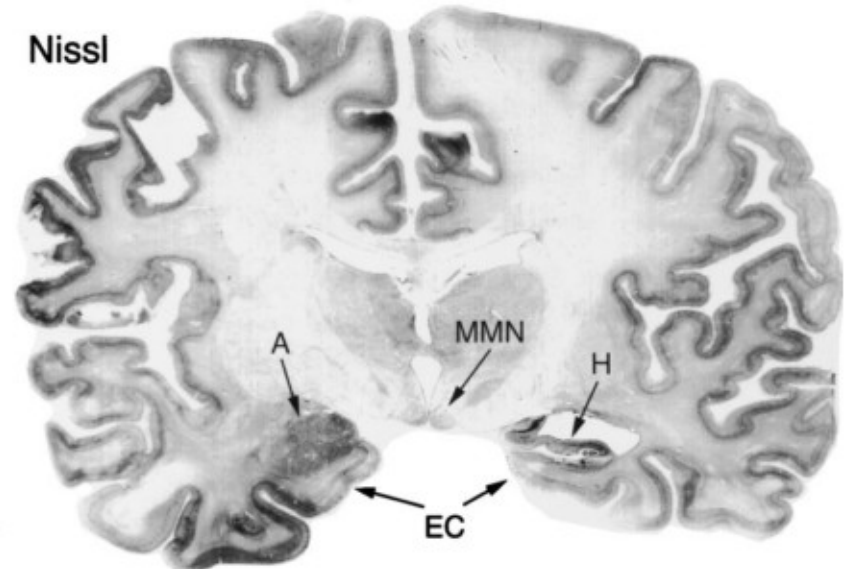
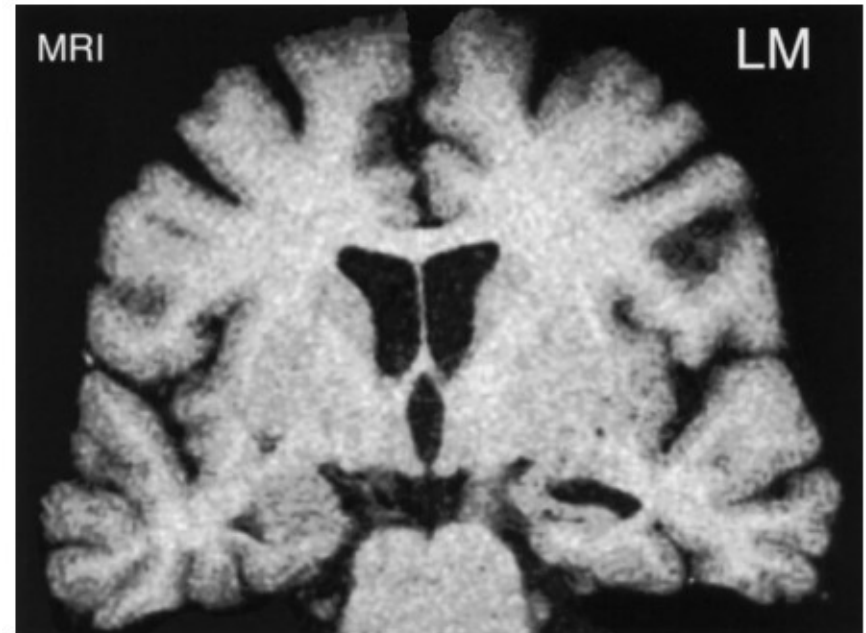


Image credit: Laszlo Seress. CC BY-SA 1.0 Generic

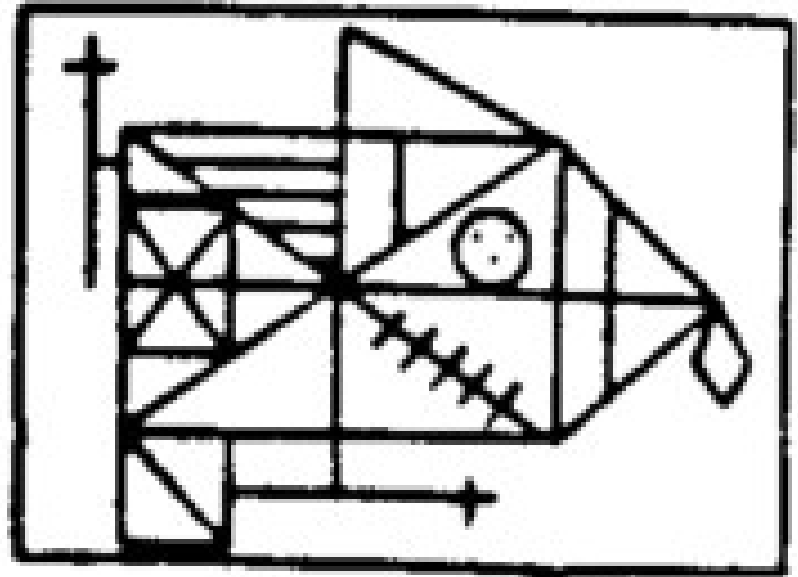
# Hippocampal damage

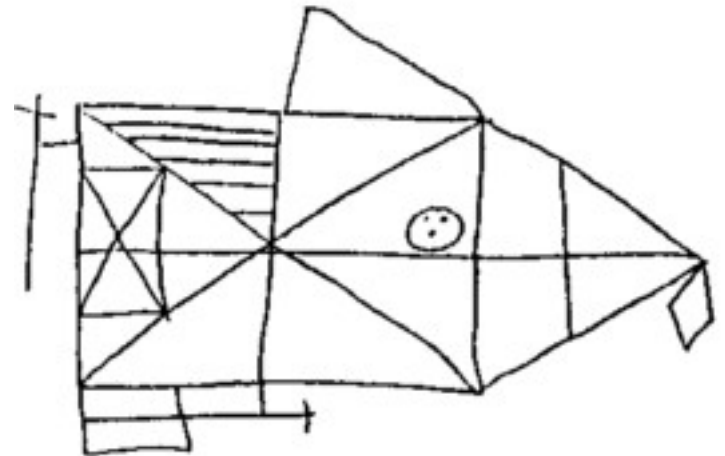
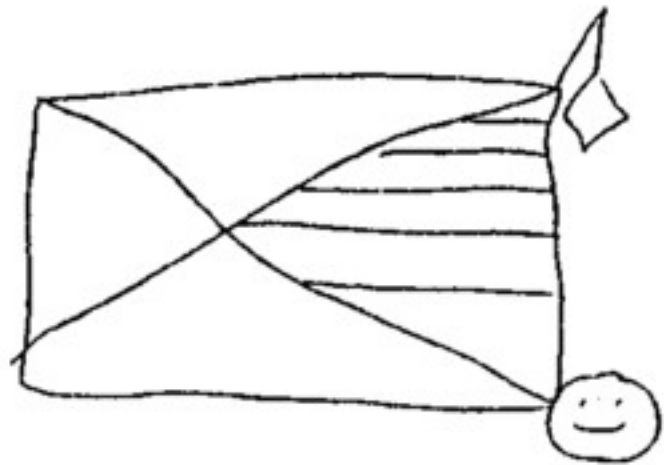
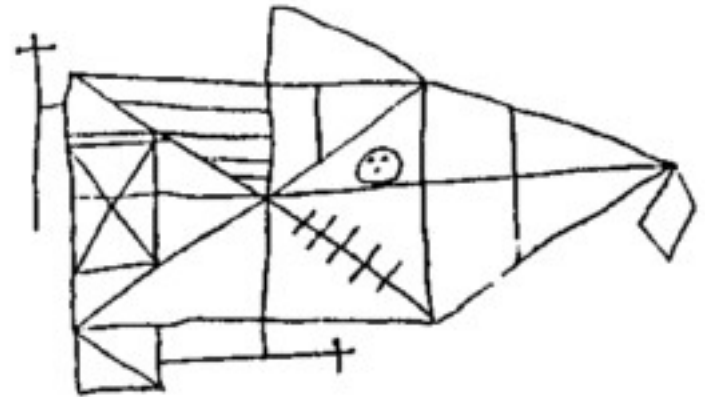
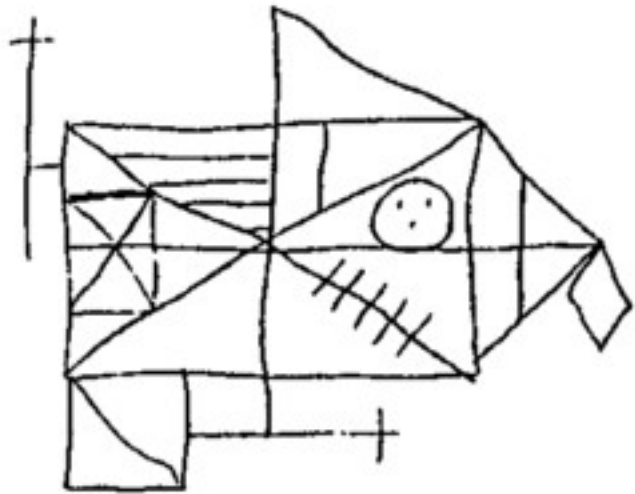
- Rempel-Clover et al. (1996)
  - Three patients with brain damage limited to the hippocampus.



# Memory impairments

- Paired associates test
  - CUP - TREE
  - ...
  - BRICK - ELEPHANT
  - (10 items)
- Word recall
  - POTATO
  - ...
  - BLACK
  - (15 items)
- Diagram completion
  - Copy, and then reproduce after 15 min delay.





LM

CONTROL



# Anterograde memory impairments

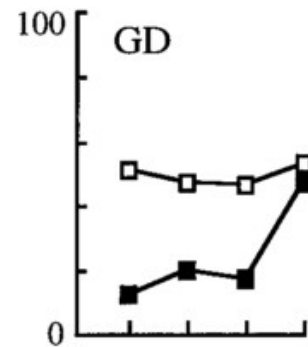
Patient/group	Diagram recall	Paired associates	Word recall
GD	7	2-1-2	40
LM	6	1-1-3	47
WH	1	0-0-0	40
RB	3	0-0-1	—
MTL (3)	3.3	0.3-0.3-1.0	33.3
KOR (8)	3.6	0.4-0.1-1.4	27.8
CON (8)	20.6	5.6-7.6-8.8	71.0
	[11-28]		[52-93]

The diagram recall score is based on delayed (10-15 min) reproduction of the Rey-Osterrieth figure (Osterrieth, 1944) (maximum score: 36). The paired associates score is the number of words recalled on three successive trials (maximum score: 10 / trial). The word recall score is the percentage of words recalled out of 15 across five successive study-test trials (Rey, 1964). [Rempel-Clower et al., 1985]

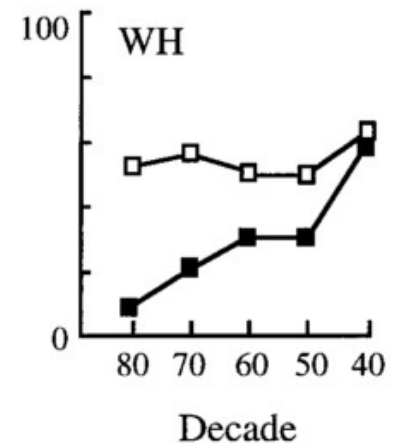
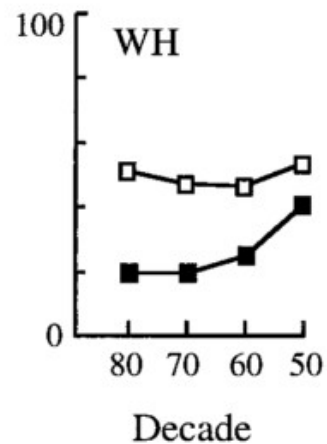
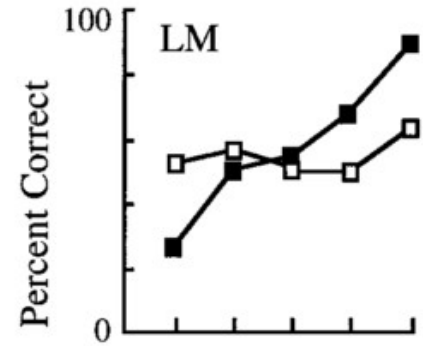
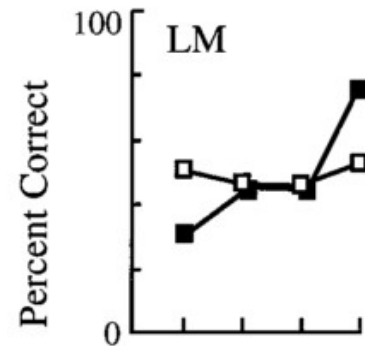
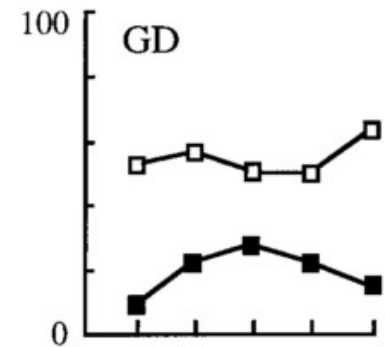
# Retrograde impairments

- Recall tests, by decade.
- Open squares show control performance.

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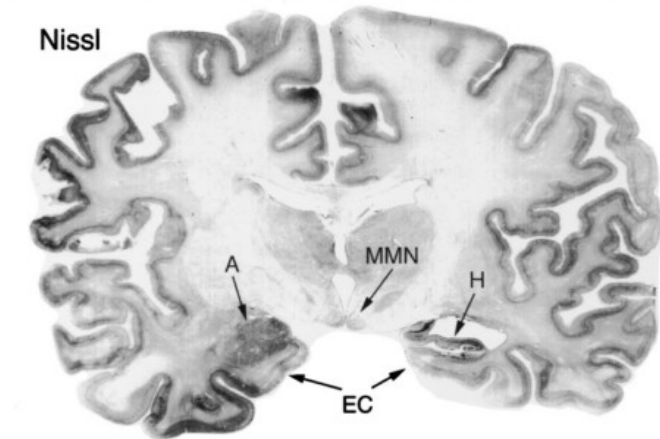
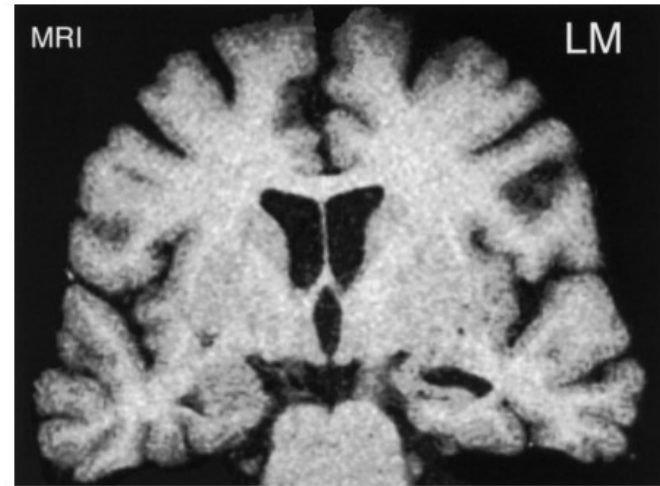


**FAMOUS FACES**



# Specific impairment?

- A bit of the brain is damaged (hippocampus), and memory is affected.
- This is in the context of normal IQ (WAIS-R) scores.
- So, interesting ... but is this specifically an episodic memory impairment? Or just memory in general?



# Korsakoff amnesia

- Korsakoff syndrome is caused, most commonly, by vitamin B1 deficiency brought about by chronic alcoholism.
- Recent work confirms that the amnesic symptoms are due to hippocampal damage (Sullivan & Marsh, 2003).



Public domain image

# Cermak et al. (1985)

- Korsakoff amnesic vs. alcoholic controls.
- Recognition memory
  - Train: BOAT, ... HEDGE (5 items)
  - Test (immediate or 1 min delay):  
BOAT, ... FRIDGE (10 items, 5 targets).
- Priming
  - Present word for 35ms, record time to identify word.
  - Faster RT for presented words = memory for those words.
- Summary: impaired recognition but preserved priming.

	Recognition (% correct)	
	Imm	Delay (1 min)
Kor	83%	68%
Alc	87%	79%

	Priming (ms)	
	Imm	Delay (1 min)
Kor	10	10
Alc	6	17

# Cermak et al. (1985) ... cont'd

- As previous experiment, except using pseudo-words  
– *STIMP*

Recognition (delayed)	
Kor	53%
Alc	86%
- Summary: Amnesiacs have impaired priming for pseudo-words (in fact n.s. priming in this study).

Priming (immediate)	
Kor	18
Alc	55

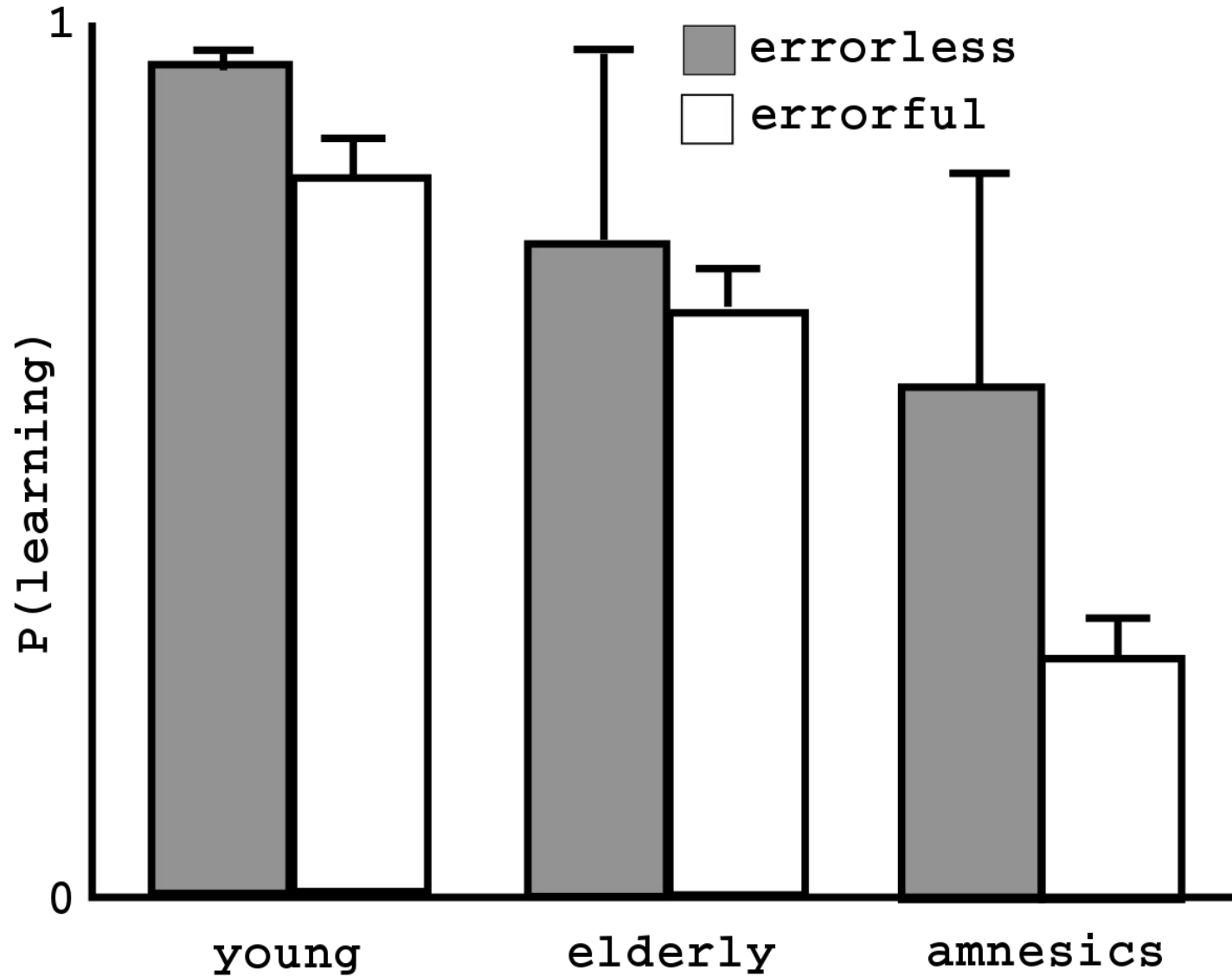
# Baddeley & Wilson

- Errorful training
  - I am thinking of a five-letter word beginning “QU”. Can you guess what it is?
  - QUEEN?
  - No, good guess, but the word is QUOTE.

- Errorless training
  - I am thinking of a five-letter word beginning “QU” and the word is QUOTE.

Amnesics (5 items) vs.  
Controls (10 items)

# Baddeley & Wilson





# Baddeley & Wilson

- Summary
  - Amnesiacs find errorful training particularly difficult.
  - The theory here is that they have particular difficulty distinguishing between memories of errors they have made with the memories of the correct answer.
  - Again, then, evidence that amnesiacs may have relatively unimpaired familiarity-based memory, but problems in the appropriate use of more episodic information.

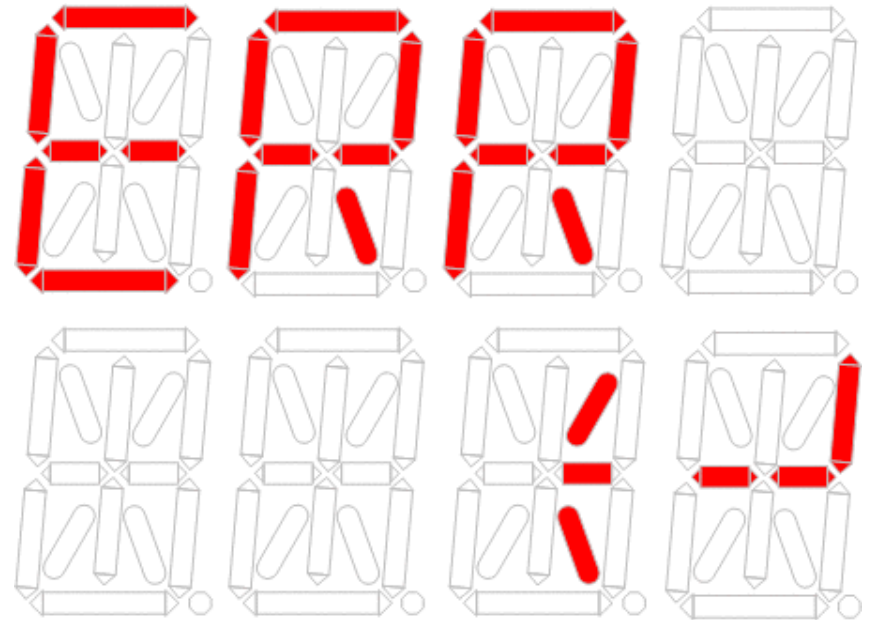
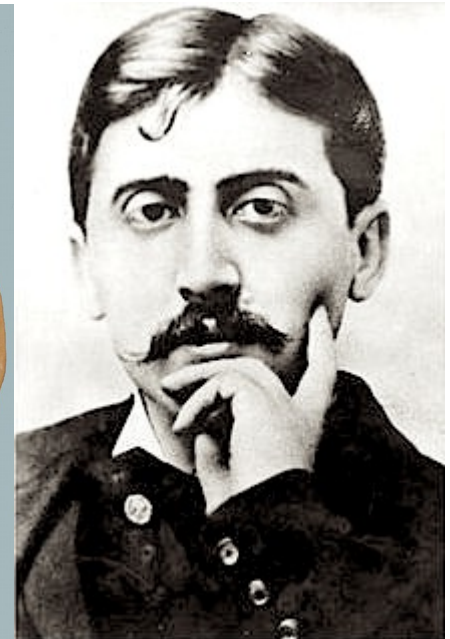


Image credit: [Ameya arsekar](#). CC BY-SA 3.0 Unported.

# Amnesia

- Hippocampal damage
- Memory deficit
- Deficit seems particularly for *episodic* information.
- So ... hippocampus is the (a?) site of episodic memory and hence of Proustian conscious recollection?

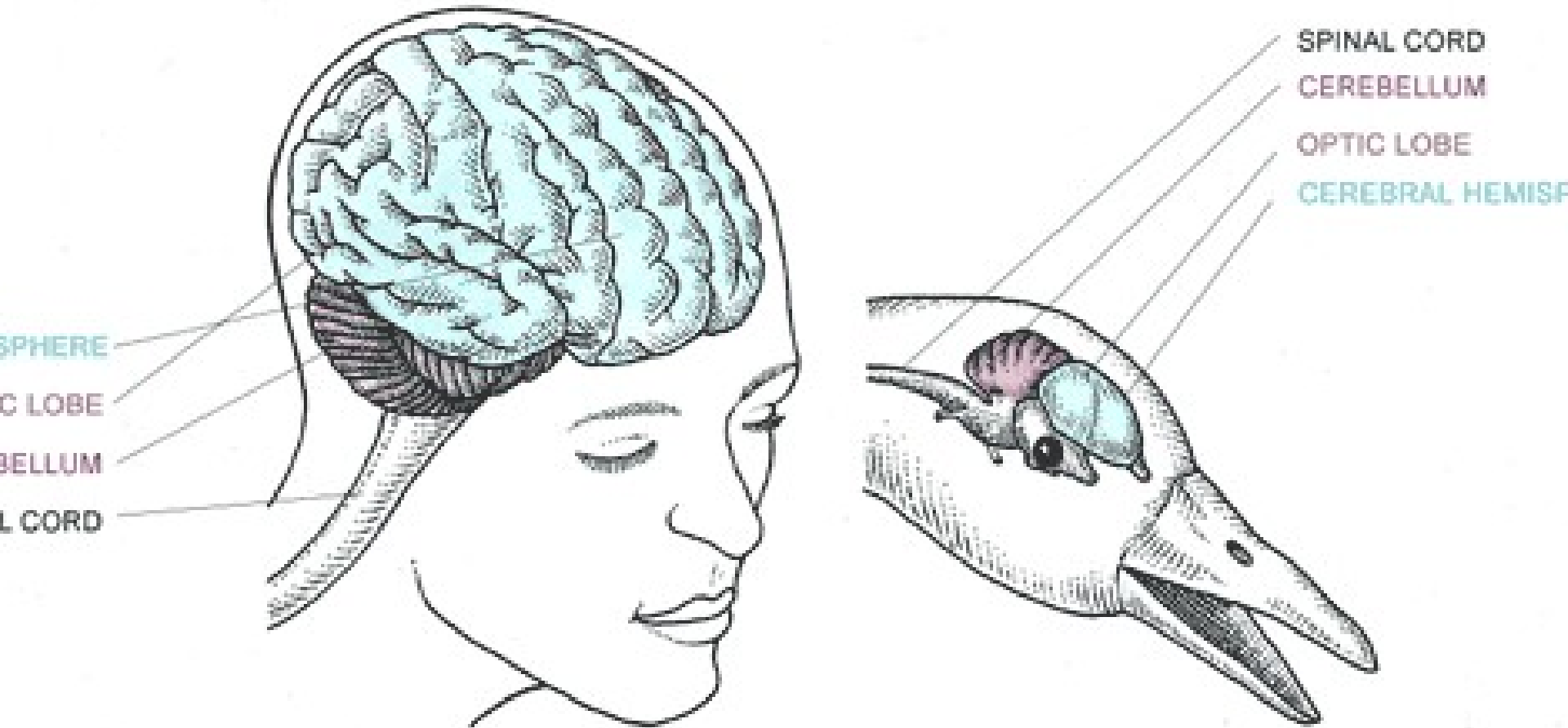


# Scrub jays



Image credit: [Jessica Merz](#). CC BY 2.0

# Bird brains



# Scrub jay memories

- Scrub jays cache 1000s of food items.
  - The scatter cache – distribute their caches over a wide area.
  - They successfully retrieve these caches after long delays.
  - Do scrub jays have episodic memories?
  - Could you do this ??
- Alternative explanations:
    - They are using smell / visual cues.
    - They do remember what and where, but do not remember when (hence not episodic).
    - Hard to test in the field; so let's look in the lab...

# Clayton & Dickinson (1998)



Image credit: [Ingrid Taylor](#) CC BY 2.0

# Clever tricks

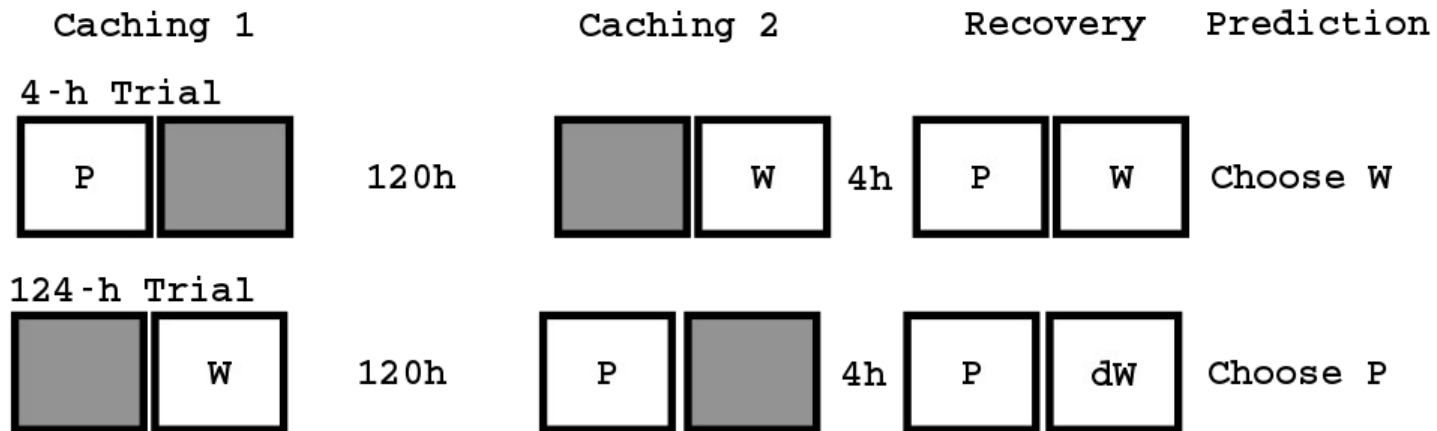
- Solving smell/visual cues
  - In final tests, wash trays, refresh the sand in the trays, and remove the caches.
- Solving “when”
  - Scrub jays prefer waxworms to peanuts.
  - But waxworms “go off” quite quickly.
  - So, if they know *when* they stored the foods, then they should retrieve the waxworm after a short interval, but the peanut after a longer interval.
- What if their memory for waxworms just decays more quickly?
  - Use hand-reared birds, and train one group that waxworms do not go off (by replenishing the worms).



Public domain image



# Lab procedure



Conditions and contents of the caching tray on different phases of 4-h and 124-h training and trials. The trial designation refers to the length of the time that elapsed between caching and recovering the wax worms. During the caching phases, birds were prevented from storing food items in the shaded halves of the tray by a cover, but they were free to cache in the open, non-shaded halves.



# Results

- As predicted
  - Worms favoured after 4hrs but not 124 hours
  - Only where jay knows worm decays over time.
- Seems like the jay could only do this if it knew:
  - What it cached,
  - Where it cached it,
  - When it cached it.

# Interim summary

- Storage and (sometimes) recall of episodic memories seems to critically involve the hippocampus.
- And hippocampal damage seems to hit the “conscious” (flexible) use of memory.
- But storage and recall of episodic memories is observed in very small-brained organisms.
- Thus ... is hippocampally-mediated episodic retrieval a good model of the kind of Proustian conscious recollection we started the session with?
- My feeling is ... no, it is not.

# À la recherche du temps perdu

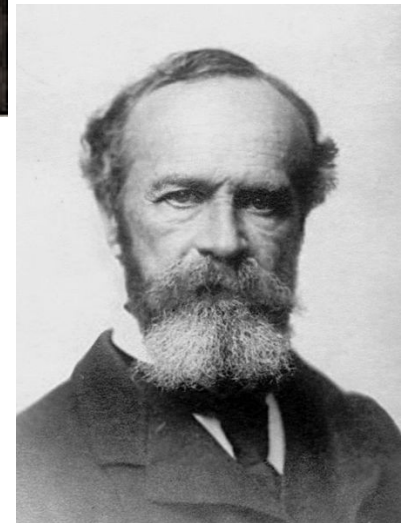
- “Remembrance of things past”.
- William James (brother of Henry James, and a founding figure of modern psychology):

“Remembrance is like a direct feeling; its object is suffused with a warmth and intimacy to which no object of mere conception ever attains”

- In modern terminology, a useful phrase is *autonoetic consciousness*.



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# Autonoetic consciousness

- Key reference:
  - Wheeler, M. A., Stuss, D. T., & Tulving, E. (1997). Toward a theory of episodic memory: the frontal lobes and autonoetic consciousness. *Psychological Bulletin*, 121 , 331-54.
- Summary
  - Autonoetic consciousness is the distinctly human state of “mental time travel” – the examples provided by Proust and the definition suggested by James.
  - The frontal lobes are a (the?) site of autonoetic consciousness.

# Defining auto-noetic consciousness

Noetic – knowing

Auto-noetic – self-knowing

“Auto-noetic consciousness is the capacity that allows adult humans to mentally represent and to become aware of their protracted existence across subjective time”.

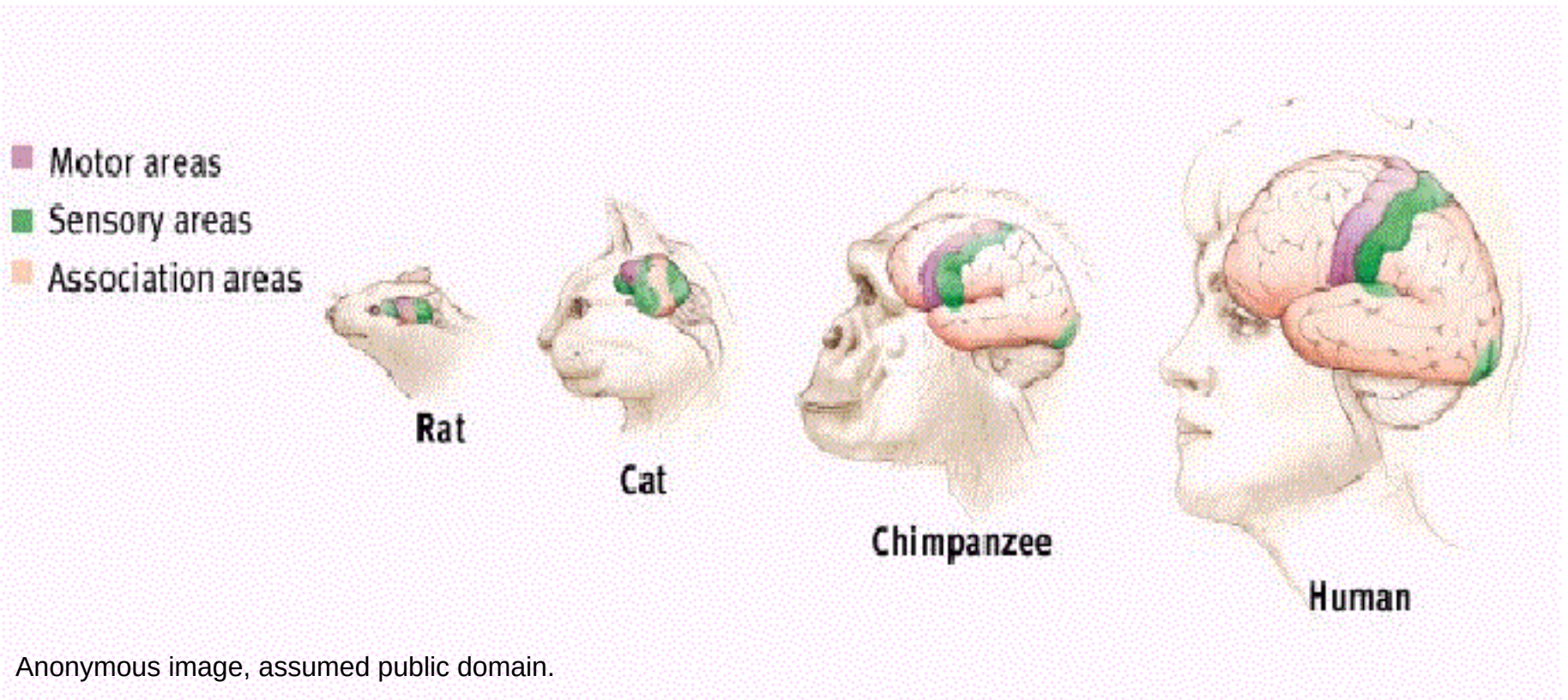
As distinct from noetic consciousness...

“It is possible to be noetically aware of one’s self, including position in space ... And even autobiographical facts that are not accompanied by a feeling of re-experiencing or reliving the past”.

Auto-noetic consciousness concerns projection both forward and backwards in time – mental time travel.

# Why the frontal lobes?

- Comparative arguments
  - If we assume that autoethic consciousness is a human-specific attribute, then perhaps makes sense to consider how the human brain differs most substantially from other brains.
    - It's frontal lobe enlargement



# Why the frontal lobes? Neuroimaging

- Study a list of words
- Episodic test (complete word stems using words from studied list)
- Semantic test (complete word stems using first word that comes to mind; it was not possible to complete the stems from words in the studied list).
- PET shows greater right frontal activity in the episodic than the semantic test.
- Consistent across a range of labs and procedures (Nyberg et al., 1996, review).
- Subsequent work indicates it is the *attempt* to retrieve, rather than its success or failure, that leads to right-PFC activity.
- This implies a control, rather than a storage, function.

# Frontal damage - Recall and recognition

- Frontal damage does not lead to full-blown amnesia
- But there are some free recall deficits, perhaps due to lack of application of strategic encoding (e.g. organization of material to aid later recall) and/or strategic retrieval (e.g. generate and recognise).



Anonymous image, assumed public domain.



# Frontal damage – Source amnesia

- Frontal damage can lead to profound source recollection deficits (i.e. much larger deficits than in standard recall tasks)
- For example, ability to say accurately whether a particular fact was acquired during, or before, the experiment.



# Developmental studies

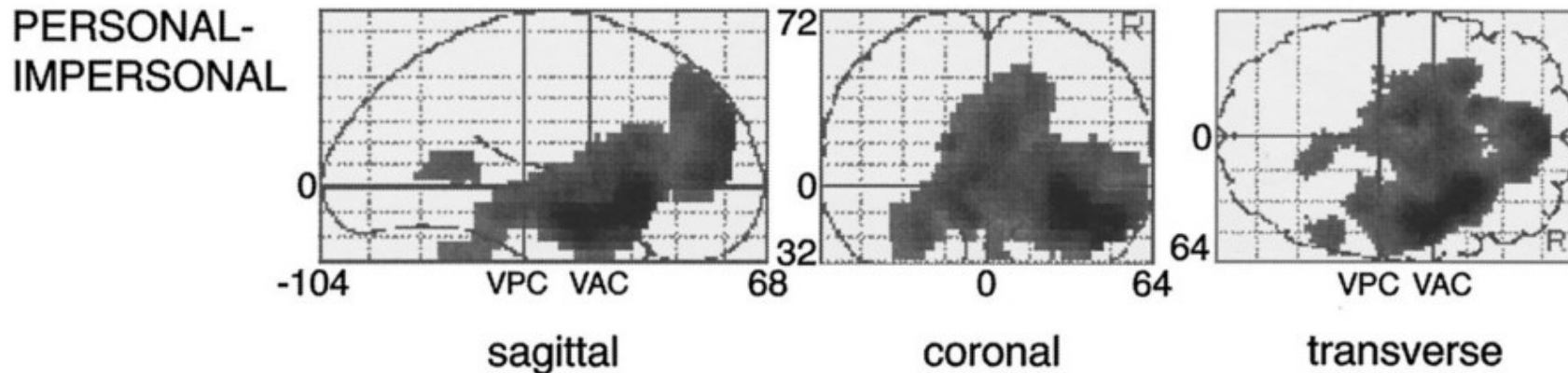
- Frontal lobes are late developing (significant neurogenesis until around Age 30, actually...).
- What's the relationship between age and autonoetic consciousness?
- *Place* some items in a box, also *tell* children about some other contents of the box.
- 3 and 4 year olds show excellent retention of box contents
- But only 4 year olds have good recollection of the *source* (ie. placed vs. told).
- Young children have source amnesia? (Other studies place this even later – say to around Age 6).

# Query

- Is *source* in such studies qualitatively different to *when* in the scrub jay studies?
  - On the one hand, *source* is not task-relevant whilst *when* is.
  - On the other hand, at least some studies confound *source* with *when*.

# Personal relevance

- Fink et al. (1996)
  - All the (human) work so far involves memories that, whilst *episodic* in nature are not *autobiographical*.
  - In a neat study, Fink compared PET activation to presentations of description of events from someone else's life, to presentation of events from your own life.
  - These truly *autobiographical* memories seem to activate a broad network, including the frontal lobes.
  - Perhaps this is one promising way of studying Proust / James remembrance?



# Summary

- Remembrance, in a Proustian sense, is a defining property of the concept of *autonoetic consciousness*.
- In order for *autonoetic consciousness* to function, one must presumably have a functioning episodic encoding and retrieval mechanism (a *necessary* condition).
- In humans at least, the hippocampus is one key mechanism.
- The case of good episodic memory in scrub jays challenges (for many) the idea that having an episodic system is *sufficient* for remembrance.
- Possibly, one also requires a functioning frontal memory system.
- This system seems to serve a control/strategic/flexibility function in episodic memory retrieval (frontal free recall deficits; source memory deficits in frontal patients and children; PET studies).
- It also seems particularly involved in autobiographical memory, as compared to similar information from other peoples' lives.
- Perhaps it is the involvement of this frontal control system that gives remembrance its particular vivid character?