

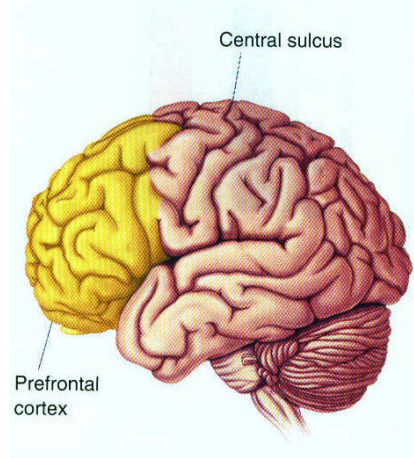
Losing Your Memory

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- “Memory” very complex *functionally* and *anatomically*
- *How do we know that these areas play a role in different types of memory?*
- Here we will restrict our focus to prefrontal cortex and MTL/MDS systems

Prefrontal Cortex

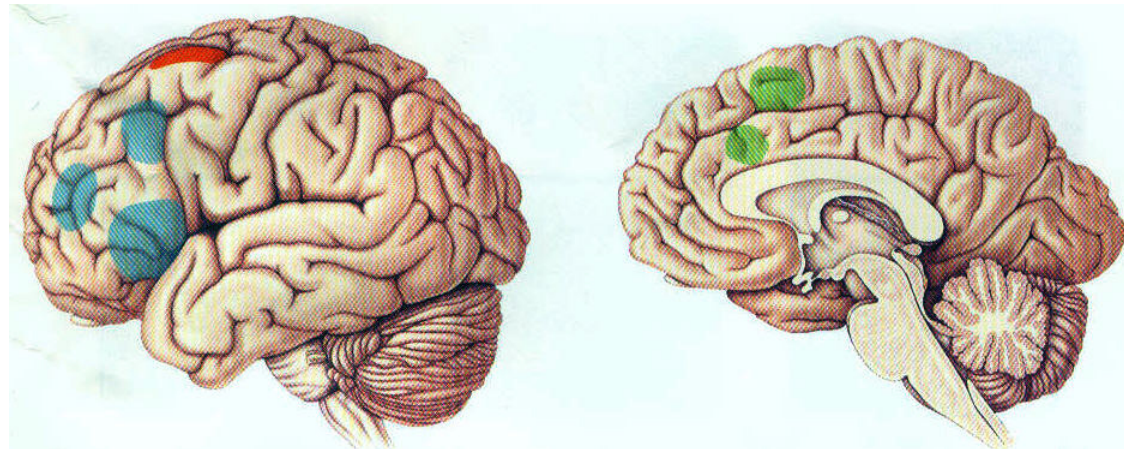


- Plays a role in many different cognitive functions, including judgment, planning of behavior, organization of thoughts/actions and prioritizing, abstraction of social mores, inhibition of inappropriate thoughts/actions, ability to delay gratification, curiosity, flexibility, abstract reasoning, insight, and many more, including

Working Memory!

Prefrontal Cortex: Working Memory

- Prefrontal lobe: different areas play a role in different “types” of working memory

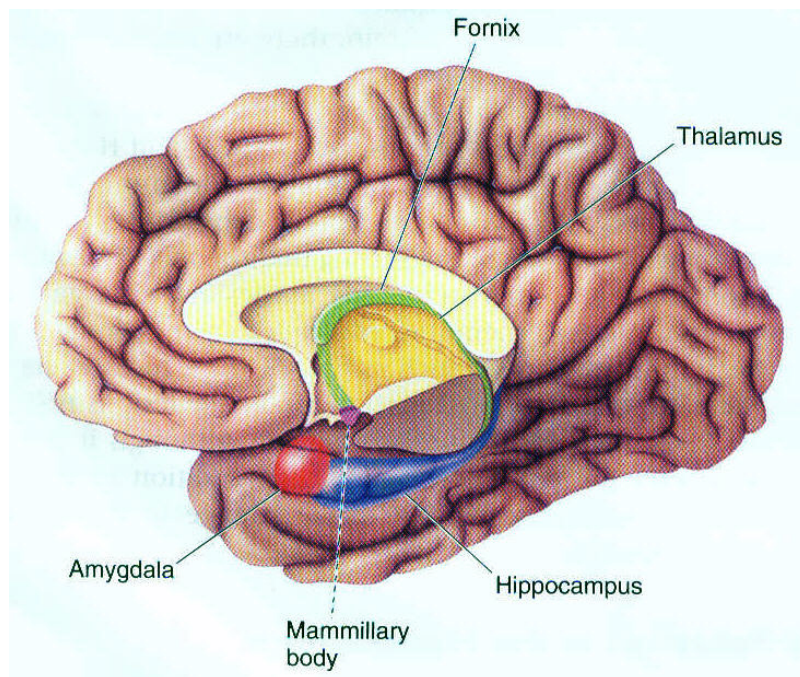


Adapted from Bear et al., 2007

A number of areas play a role in short-term memory and in the ability to consolidate memory

- **Medial Temporal Lobe Structures (MTLS):** includes parahippocampal gyrus and other adjacent structures in the medial temporal lobe
- **Medial Diencephalic Structures (MDS):** includes specific nuclei in the thalamus and hypothalamus

Medial Temporal Lobe Structures (MTLS)



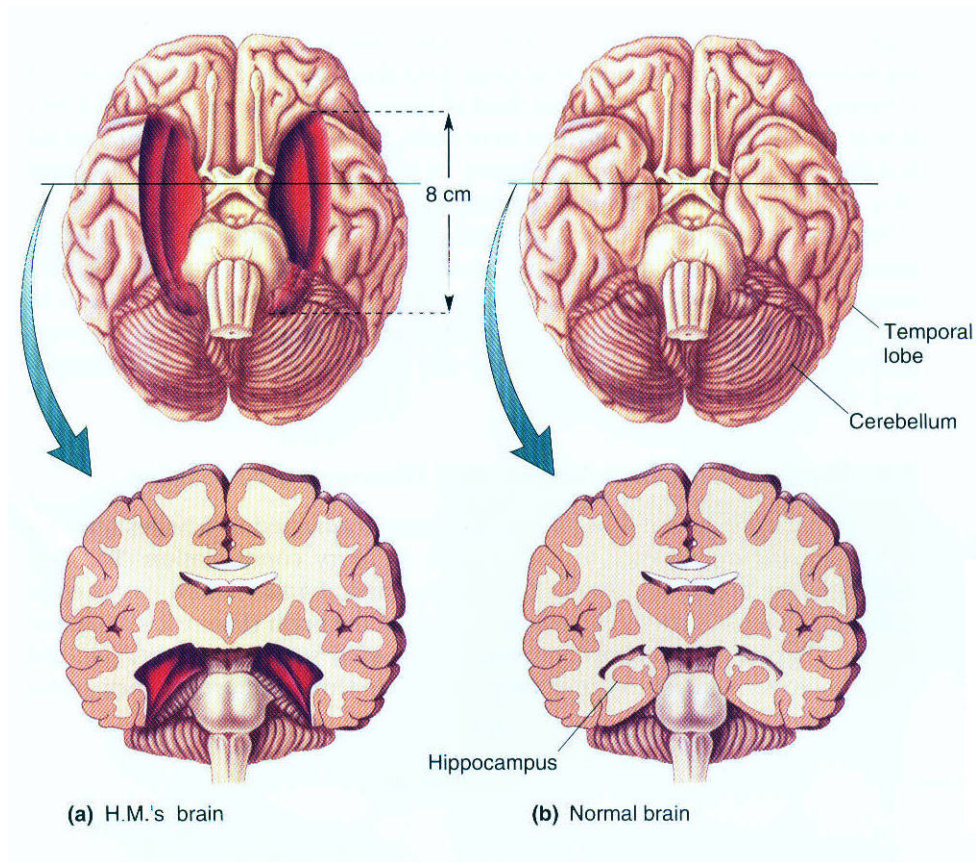
Adapted from Bear et al., 2007

Medial Diencephalic Structures (MDS)



Adapted from Fix, 1981

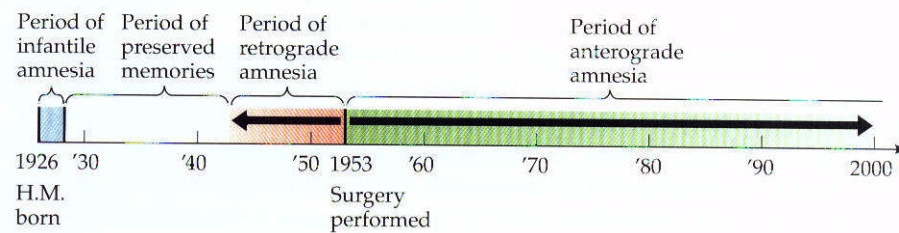
Patient H. M.



Adapted from Bear et al.,
2007

Henry Molaison (H.M.)

- Bilateral removal of temporal lobes (MTLS) in 1953; died in 2008



Adapted from Blumenfeld, 2010

- Other patients with trauma, etc. have shown that a similar impairment occurs with MDS involvement

Contusions & Concussions

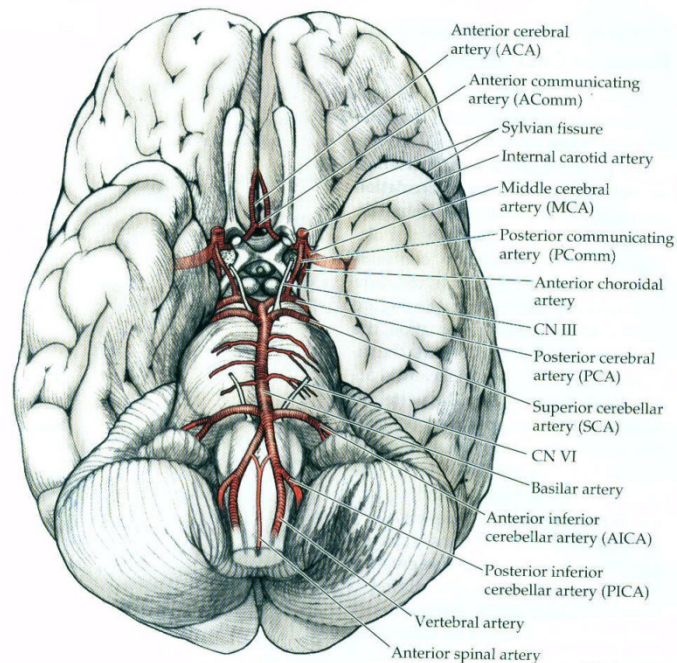
- A contusion is a “bruise”, generally on the surface of the brain; occurs from rupture of surface vessels
- A concussion is a transient disruption of electrical activity in the brain from trauma; now called “mild traumatic brain injury” (mild TBI)
- Even a single mild TBI increases risk (slightly) for Alzheimer’s disease; repeated mild or severe TBIs are a significant risk factor in the development of neurodegenerative disorders (Alzheimer’s, Parkinson’s, etc.)

Infarctions/Ischemic Events

- Both the MTLs and the MDS are supplied by branches of the same artery (the posterior cerebral artery)
- Even unilateral blockage, etc. can produce memory loss (L hippo – words/facts; R hippo – spatial)
- The two PCAs arise from a single basilar artery; thus, bilateral loss of blood supply to MTLs and MDS can occur from occlusion of the superior portion of the basilar artery (for ex., from atherosclerosis or an aneurysm)

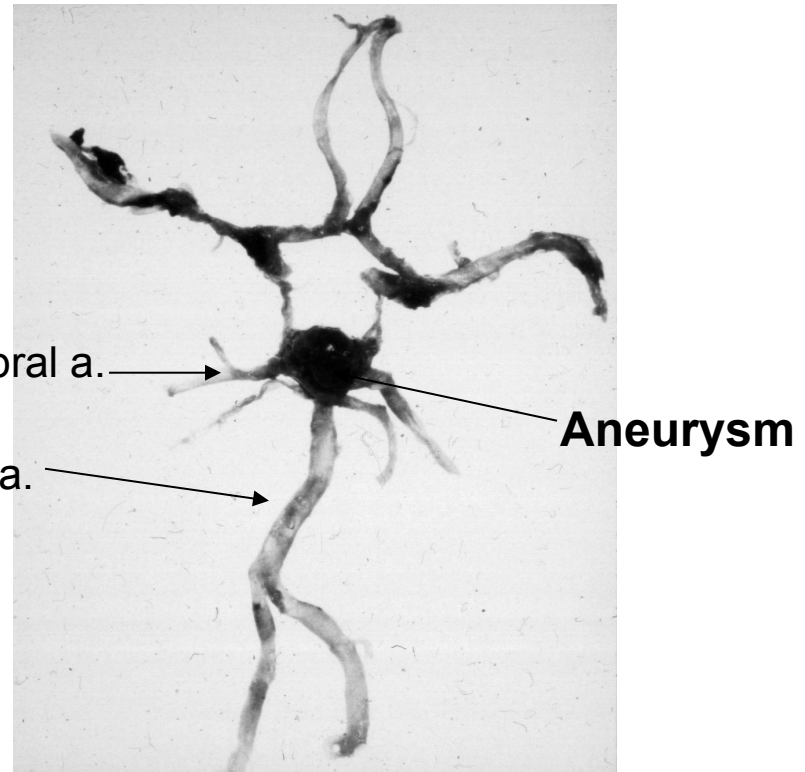
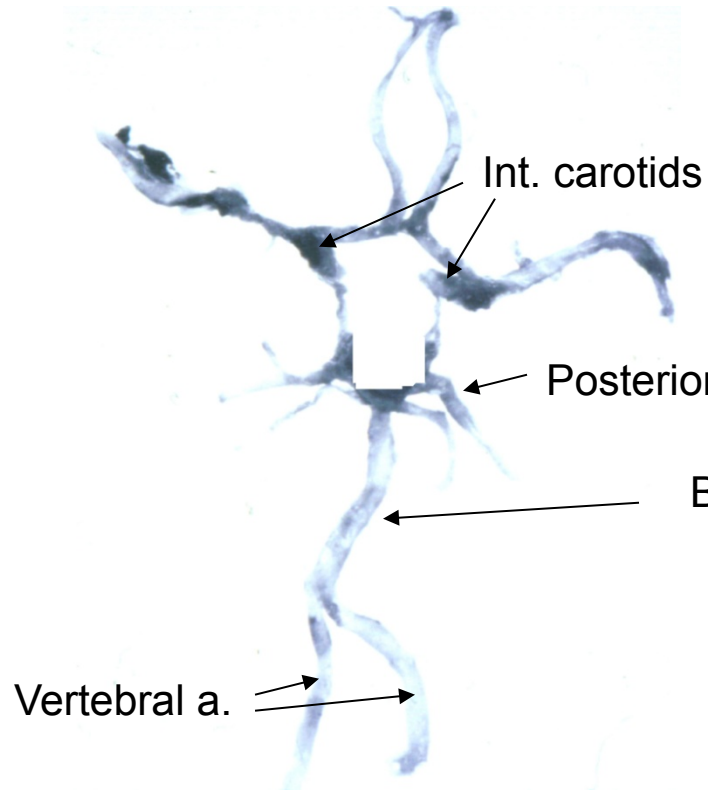
Circle of Willis

- The internal carotids and vertebral arteries supply the entire brain; they join on the underside of the brain to form a circle of vessels called the Circle of Willis



From Blumenfeld, 2010

Circle of Willis



Global Cerebral Anoxia

- This can occur following cardiac arrest; due to decreased brain perfusion
- Within minutes, neurons start to die
- The hippocampus is one of the most vulnerable areas of the brain to hypoxia!

Wernicke-Korsakoff's Syndrome

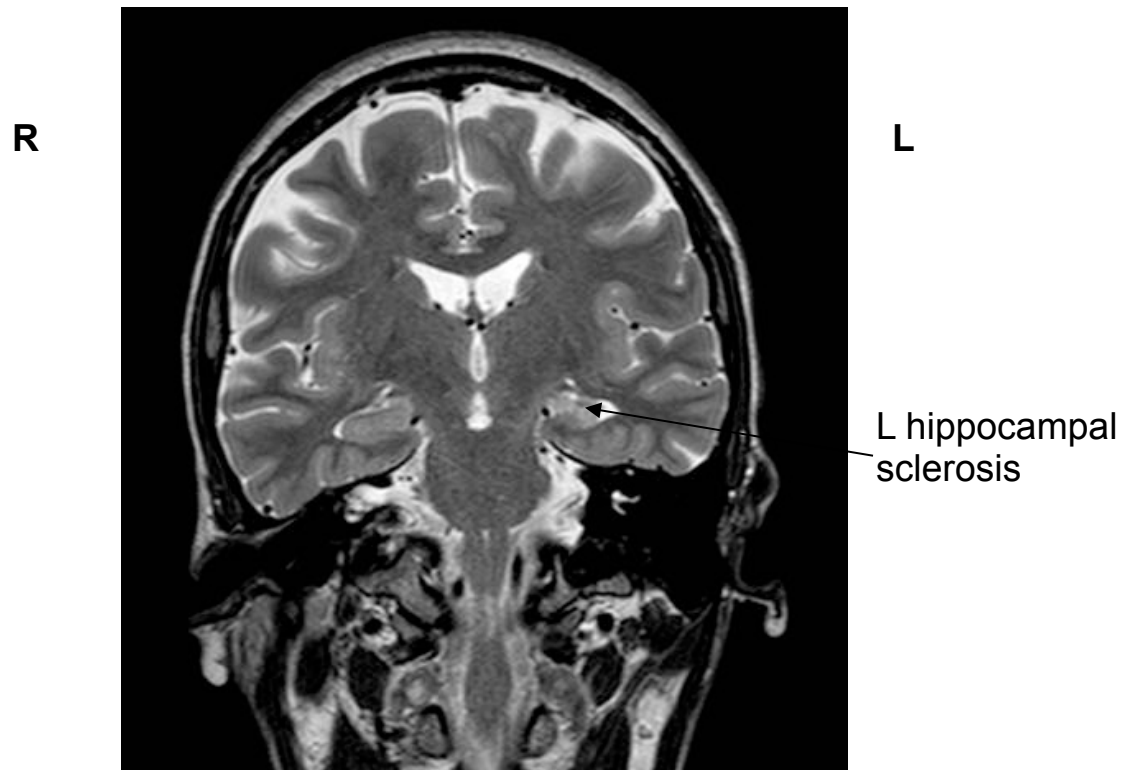
- This syndrome is the result of poor nutrition (vitamin B1 [thiamin]) deficiency; potentially fatal
- Most commonly seen in alcoholics, but can be seen in others with poor nutrition
- The syndrome involves many signs/symptoms, but memory loss is prominent
- “Confabulation” – where the brain “fills in” missing elements in memory is a common feature of this disorder

Seizures

- Temporal lobe seizures, which involve many of the MTLs are common – and may present with “déjà vu” – and other memory phenomena; after a seizure, the individual may suffer from “post-ictal” amnesia or loss of memory for some time surrounding the seizure
- All generalized seizures (seizures involving both hemispheres – except the most brief) cause some memory impairment

Hippocampal Sclerosis

- Hippocampal sclerosis (“scarring”) may be both the result or cause of repeated temporal lobe seizures – or both; may be unilateral (one-sided) or bilateral (both sides of the brain)



Transient Global Amnesia

- A sudden, transient loss of the ability to form new memories; lasts from 4-12 hrs
- Full recovery within hours; memory of episode never encoded
- Occurs most commonly during strenuous exercise or under conditions of extreme emotional stress
- Cause unknown, although there is recent evidence for very tiny hippocampal infarctions

Brain Disorders

- Many different brain disorders can cause memory impairment – ranging from brain tumors, multiple sclerosis, any disorder which involves MTLs/MDS – even unilaterally, may produce some memory loss and difficulty in establishing new memories

Neurodegenerative Disorders

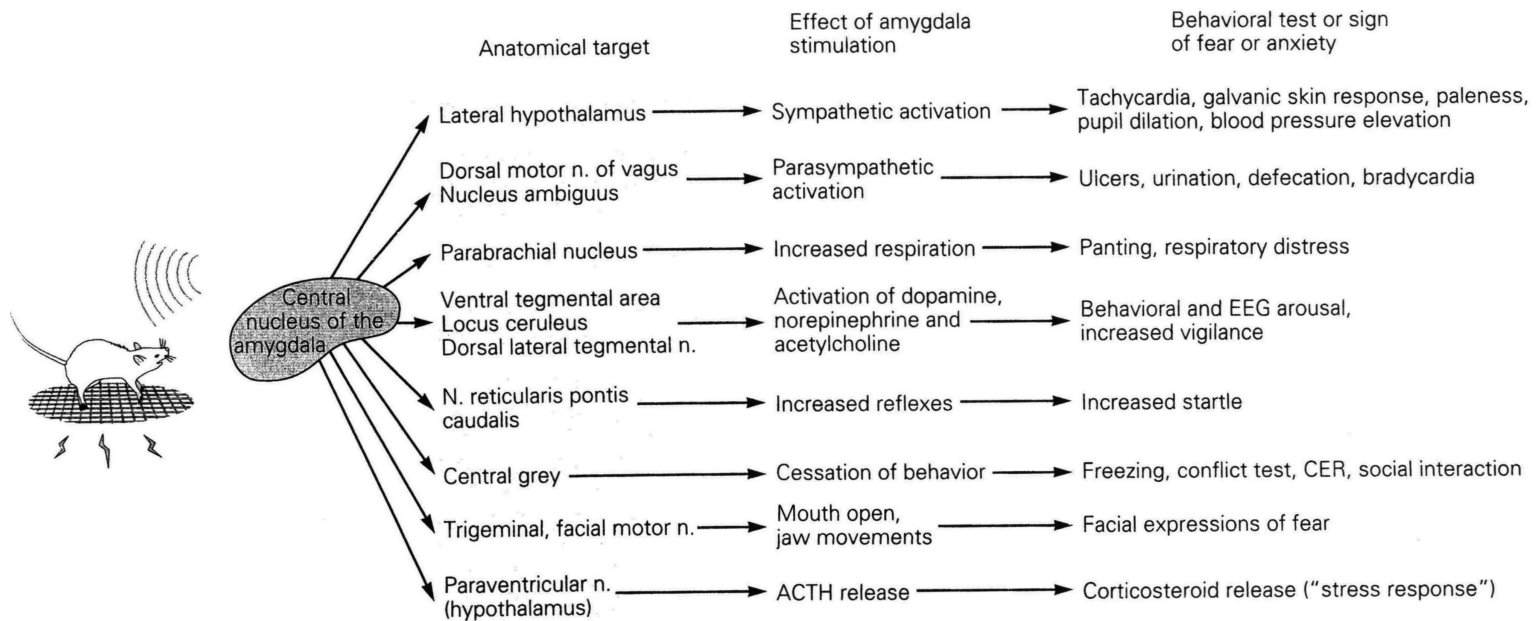
- Alzheimer's disease: areas of the neocortex that project to the hippocampus are the first areas to degenerate in Alzheimer's disease; significant hippocampal atrophy; significant "spindle" neuron loss. Later, global loss of neurons, particularly in higher-order and association cortex
- Short-term memory loss (both spatial and declarative) is one of the earliest signs/symptoms of the disorder
- Later, there is a global loss of memory, including long-term memory as widespread areas of the neocortex degenerate
- ***One of the most truly horrible things about this disorder is that individuals lose their autobiography***

Psychiatric Disorders

- Many different psychiatric disorders are associated with memory impairment
- May be primary in the disorder, for example, in schizophrenia (psychosis)
- May also be secondary, for example in depression, because of hypothalamic-pituitary-adrenal axis activation (the system that responds to “stress” – either psychological or physical and results in a “fight or flight” response); occurs in depression, “dissociative fugue”, PTSD

- *Dissociative fugue*: A temporary memory loss that involves amnesia for one's identity coupled with travel away from home; triggered by psychological trauma
- *Post-traumatic Stress Disorder*: while the traumatic event is "relived", formation of new memories, ability to recall, etc. is impaired; involves chronic HPA axis activation

HPA Axis & Stress



Adapted from Kandel et al., 1995

Abuse

- Memory impairment is present in adults who were emotionally, physically or sexually abused as children
- Involves primarily L hippocampus, amygdala
- Decreased hippocampal volume, increased amygdala and HPA activation

Lessons to be Learned

- Our final lecture will be on ***one single change*** you can make in your lifestyle that will help you keep stress under control and also keep your brain (and especially your hippocampus) healthy!