Lecture 17

Memory loss associated with the MTL

- Medial temporal lobe, hippocampus and surrounding structures
    - Encoding disorders, patients can't form new long-term memories: **Anterograde amnesia**
    - Most severe forms of long-term memory loss occur when both hippocampus and surrounding structures are affected
    - Parahippocampal and perihinal cortex lesions affect long-term memory, but entorhinal cortex lesions have much less adverse effects
    - Some forms of procedural memory may be spared as long as basal ganglia and cerebellum are intact

The hippocampus is activated during encoding

- Experimental design
    - Memory and recall
    - Given a word, blank period, and then queue to decide whether the word was in the screen or not
    - Depending on the color of the word you need to decide on color or animacy
    - Whether you saw the word, and how confident you are
- Behavioral results
    - People have memory on both what and when they saw something

- Encoding, storage and retrieval with MRI
- Two regions:
    - Posterior hippocampus
    - Posterior parahippocampal/fusiform gyrus
- During encoding phase, when there is a greater activation of those areas then you are more likely to remember that information

The hippocampus is activated during retrieval

- Memory and recall task similar to previous one
- In this case, measuring brain activity during retrieval phase
- 4 conditions
    - Correct R: correctly recollect item and when
    - Correct K: correctly recollect item but lost episodic tag
    - Correct rejection: correctly recalled that didn't see it
    - Miss
- Basis for the argument that the hippocampus is critically involved in encoding and recording episodic memories

Perirhinal cortex is activated during recall of familiar events

- Systematic relationship between the BOLD signal and confidence level in judgements on whether you say the item or not
- When the perirhinal region is active, there is more information available on whether you saw the item and when
- No clear distinction between hippocampus and parahippocampal regions

    - Structures directly feed to each other
    - Difficult to dissociate them

Memories involving MTL versus not

- Memory not involving MTL
    - Unidimensional
    - Representation is highly localized in brain
    - Outside awareness: implicit
    - Procedural memory?
- Memory involving MTL
    - Can be multidimensional (e.g., context)
    - Representation can be distributed over multiple locations in brain
    - Often accessible to awareness

MTL and memory consolidation

One possibility is that MTL (and in particular the hippocampus) is part of a network for developing associations between representations in different cortical areas

Implications for consolidation in MTL

- Retrograde and anterograde amnesia can be dissociated
- The hippocampus may be critical for initial episodic encoding, but later reactivation makes memories more semantic and less dependent on hippocampus
- MTL lesions should not affect memories that are stored within a single

cortical region, so they will not affect priming and procedural skill learning

- MTL lesions should affect contextual memories, including implicit learning that depends on context

The case of HM

- Bilateral resection of MTL
- No significant changes in language, personality, general cognitive abilities
- Little evidence of retrograde amnesia
- Severe anterograde amnesia. Did not remember researchers after continua testing over 50 years, did not remember death of father
- Short term memory with rehearsal relatively spared
- Some anterograde procedural memory/learning remained
- Procedural memory
    - HM had some residual procedural memory, though he had no recollection of having learned the procedure. He also had some ability to learn new declarative concepts (e.g., world events), though again w/o episodic tags

Korsakoff's syndrome

- Caused by lack of thiamine (vitamin B1) in the brain, usually brought on by alcoholism or severe malnutrition
- This causes metabolic damage to medial thalamus, mammillary bodies and posterior hypothalamus

- Often accompanied by Wernicke's encephalotopathy (not Wernicke's aphasia)
- Results in severe anterograde amnesia moderate retrograde amnesia, confabulation, apathy, lack of insight

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The frontal and parietal cortex and memory
Memory loss caused by cortical lesions

- Cerebral cortex
    - Deficits in attention, short-term memory, working memory and many other cognitive functions
    - Lesions of left hemisphere supramarginal gyrus (BA40) or left premotor cortex (BA44) have deficits in phonological working memory
    - **copy from slides**

Alzheimer's brain showing extensive atrophy

- Building up globs of protein that is not cleared from the brain and forms amyloid plaques and neurofibrillary tangles
- Alzheimer's brain distribution of amyloid plaques
    - PET study using PIB, which binds to amyloid plaques

Frontal cortex and memory encoding & retrieval

- The role of frontal cortex (and left vs. right FC) in memory is still under

debate

- Many studies argue left FC is involved in encoding, right FC in retrieval
- However, this may be due to the type of information used in these studies

A BCI for memory