NEURONAL BASES OF LEARNING AND MEMORY
PSYCH 558/472, NEUR 480, FALL 2019 (Draft)

DR. JANE FLINN

I will be away Aug 31- SEpt 15 at a conference on learning and memory so Vjosa Poshka, the GTA, will take those weeks. This may also lead to some changes in the readings based on that conference.

AUG 27/29
TOPICS: OVERVIEW OF THE COURSE; THERE ARE SEVERAL TYPES OF LONG-TERM MEMORY AND THEY DEPEND ON DIFFERENT BRAIN REGIONS
Memories lost and spared in an amnesic patient, H.M. Two types of long-term memory, declarative and non-declarative, show differential sparing in amnesiacs. Short-term memory is retained. Squire’s model of memory. A monkey model of temporal lobe amnesia, Mishkin and Squire's lesion experiments.
Readings:
Introduction and Chapter 1 from Notes.

SEP 3/5
TOPICS: RELATIVE CONTRIBUTIONS OF HIPPOCAMPUS AND OVERLYING CORTEX TO LONG-TERM EPISODIC MEMORY.
IMAGING ;
Memory in children with hippocampal damage. The hippocampus is important in episodic memories but may be less important for semantic memories.
Readings:
Chapter 2, (5) from Notes.

SEP 3 IS THE LAST DAY TO ADD, SEP 9 IS THE FINAL DROP DATE FOR 100% REIMBURSEMENT.

SEP 10/12
HSAM, AUTOBIOGRAPHIC VS EPISODIC MEMORY, THE DEFAULT NETWORK.
THE ROLE BASAL GANGLIA IN MEMORY,
Some people have exceptional autobiographical memory, this may differ from normal episodic memory.
The basal ganglia are needed for habit learning. It may be more important in memory than thought; it communicates with the PFL and may provide a “back up” system. Clive Wearing, a modern H.M.
Clive Wearing Video
Readings:
Chapter 4 from Notes:
Commentary on Chen et al.

SEP 17/19
TOPICS: THE HIPPOCAMPUS AND SPATIAL MEMORIES
The hippocampus is important in spatial memories. Morris water maze. Films of John and of Clive Wearing
Readings:
Chapter 5 from Notes.

SEP 24/26
TOPICS: EMOTIONAL MEMORIES, ROLE OF THE AMYGDALA, HIPPOCAMPUS;
The amygdala is important in emotional memories.. The prefrontal lobe inhibits the amygdala. Fear conditioning in animals. Some memories must be actively extinguished. Reconsolidation.
Studies using optogenetics show how memories are changed.
(LTP)
Readings
Chapter 3 from Notes.

**Topics for Student presentations/papers due**

**OCT 1/3** WE REMEMBER WHAT IS IMPORTANT TO US.
SEARCH FOR THE ENGRAM. CONCEPT CELLS (LTP.)
DIFFERENT FORMS OF AMNESIA
Lashley, Penfield and Thompson's work. Classical conditioning in rabbits and humans.

**OCT 8/10**
TOPICS: (ROLE OF THE FRONTAL LOBES. HUMAN MEMORY DEFICITS
The frontal lobes are largest in humans. They are responsible for some forms of memory and affect others. Schizophrenia is thought to be associated with impaired working memory and frontal lobe dysfunction
Readings
Chapter 6, 7 from Notes.


**OCT 15/17** Monday Oct15, is a holiday, Monday classes are held on Tuesday, there will be no class on Tue the 15th.
TH ; REVIEW. HUMAN MEMORY DEFICITS,

**OCT 22/ 24** TOPICS: HUMAN MEMORY DEFICITS, Dr Flinn will be off campus this week at SFN .

**NEURONAL BASES OF LEARNING AND MEMORY**
Many human illnesses involve memory deficits, alcoholism, schizophrenia, and Alzheimer's disease. Memory impairments in Alzheimer's disease, (interaction with stroke). The default network may play a role. **THURSDAY, EXAM**

**Readings:**
- Chapter 7 from Notes

**LEARNING IN SIMPLE ANIMALS:** LEARNING INVOLVES STRENGTHENING SYNAPTIC CONNECTIONS. NEURONAL CONDUCTION.

Some types of learning can be studied in simple animals. *Aplysia Californica* show habituation dishabituation, sensitization and classical conditioning, which model non-declarative learning in humans. Morphological changes are seen with long-term learning.

**Readings:**
- Chapter 8 from Notes

**OCT 29/31**

**TOPICS:** LEARNING INVOLVES STRENGTHENING SYNAPTIC CONNECTIONS: FROM SHORT-TERM TO LONG-TERM MEMORY. CREB, A MASTER SWITCH.

Chemical pathways associated with learning and memory were discovered in *A. californica* and *Drosophila*; second messenger systems. (Higher order conditioning in invertebrates, *Hermisenda* and drosphila.)

**Readings:**
- Chapters 8, (9), 13 from Notes.

**NOV 5/7**

**TOPICS:** FROM SHORT-TERM TO LONG-TERM MEMORY. CREB, A MASTER SWITCH; THERE ARE 2 FORMS OF CREB. Mechanisms of long-term memory are conserved in long term memory across species. The morphological changes seen with long-term learning, require protein synthesis i.e. gene expression is changed when long-term memories are formed.

**Readings**
- Chapters 10, 11, 12 from Notes.
Frank and Greenberg. CREB: a mediator of long-term memory from mollusks to mammals.  
*Cell.* 79:5-8. 1994

**Student presentations begin**

**NOV 12/14**  
**TOPICS: LTP**  
Role of the different glutamate receptors. (Hebbian synapses in *Aplysia*)  
**Readings:**  
Chapter 13 from Notes.  
Baer et al., Discovering LTP. In *Neuroscience*.  
**Presentations**

**NOV 19/21**  
**TOPICS: GENETIC MANIPULATIONS AND THE ENVIRONMENT BOTH AFFECT LEARNING:**  
Genetic manipulations can change how animals learn. The environment interacts with the genome.  
The brain is most plastic during neo-natal sensitive periods in order to fine-tune the brain. Implications for human memory. Stress affects memory through the glutocorticoid system.  
**Readings:**  
Chapters 10, 13, 14 from Notes.  
**Presentations**

**NOV 26/28** **YOUNG BLOOD IS GOOD.**  
**THANKSGIVING,**  

**DEC 3/5** **TOPICS: ENVIRONMENTAL EFFECTS, NEUROGENESIS AND LEARNING.**  
Neurogenesis also takes place in the adult mammalian brain.  
The environment can affect brain function. New evidence suggests that memory can be transferred from one animal to another via RNA. But there are other ways to enhance your brain. The importance of sleep.
Readings:

Presentations

NOV 30 PAPERS DUE
DEC 7 TAKE HOME FINAL DUE.

Grading Policy:
35% midterm exam
30% final exam (take home)
5% class participation, including in-class quizzes.
15% quizzes,
15 % presentation and paper, (8% for paper, on the same topic as the presentation (7%)).

Office Hours: Tu/Th3-4:30 , DKH 2022
Call 993-4107 or send an e mail for an appointment at other times. E-MAIL jflinn@gmu.edu

• Each PhD student needs give a presentation on topic related to the field of learning and memory and to write a paper on the same topic. This should not be narrowly your MA/ PhD topic. Please have the topic approved first.
• MA and undergraduate students will also make presentations, but can work in groups of 2/3 due to time limitations. The papers should be individually written.
• There will be a quiz most weeks on one of the assigned papers.
• The goal of this course is to examine the tremendous strides that have been made in understanding the biological bases of memory in the last 50 years. The first part of the course examines the role of various structures in the mammalian brain in memory formation and retention. The second part of the course describes the basic neuronal mechanisms that underlie learning and the formation of memories and how these may be modified.
• Students with disabilities should present documentation to me and appropriate arrangements will be made.
• The George Mason Honor code will be followed.
Class cancellation policy: Since the class is in the afternoon, Mason will probably have made an announcement, however, I will also e-mail the class the class to give the status.

Cell phones may not be used in class. If you are using your computer I may ask to see your notes at the end of class or ask you to send me a copy of your notes. A zero may be given for the following quiz if the computer is being used for other purposes than taking notes.

Official Communications via GMU E-mail: Mason uses electronic mail to provide official information to students. Examples include communications from course instructors, notices from the library, notices about academic standing, financial aid information, class materials, assignments, questions, and instructor feedback. Students are responsible for the content of university communication sent to their Mason e-mail account and are required to activate that account and check it regularly.

Readings are from class notes, and from assigned readings. Additional/alternative research articles may be assigned.

How We Remember, by Flinn, (Notes)

Recommended Books (Get online)

Time, Love, Memory, by J. Weiner. 1999. Describes the early work on genetics and discusses the genetic bases of memory. (Chapters 10,16))

The Pursuit of Memory, E. Kandel. Kandel won the Nobel prize for his work on memory. This is his autobiography.

Forever Today, Wearing, D. (2005) The first few chapters read like a “true Romance” paperback. However, this book does make very clear the devastating consequences of damage to the hippocampus. Unfortunately the Mason bookstore cannot order it due to copyright issues, however you may obtain it via Amazon etc.

Patient H.M. (2016) A rather dark book written by the grandson of William Scoville who operated on H.M. which also discusses the final brain dissection. (General interest.)

Each of the first three books are worth reading in full and are not expensive.

A Murder of, Crows", Crows show sophisticated learning and memory abilities.
"Stress, Portrait of a Killer";
"League of Denial", 1st part shows the effect of continued blows to the brain on behavior
All films available on You Tube. Choose 2.

Supplementary Readings:


