Learning and The Brain

Psychology 4430
Thursday 2:10-4:00
Room 405 Schermerhorn Hall

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Course Description
How does past experience guide behavior? Are there different forms of learning and memory that guide behavior? If so, when do these different forms of learning take place? How do they guide choices and actions? What are the neural mechanisms that support learning, memory, and choices? These are the questions we will focus on in this seminar. We will review current theories in the cognitive neuroscience of human learning, with a particular eye towards understanding how learning and decision-making – typically studied separately from each other – interact. We will review these fields with a focus on two heavily influential methods in the study of brain and behavior in humans: functional imaging and patient studies. We will debate the strengths and weaknesses of each approach, and will discuss how methodological trends and limitations have shaped our view of cognitive function.

Course Structure
The seminar will survey recent literature on the cognitive neuroscience of learning, memory and decision-making. Each weekly meeting will address a question in the field. We will begin each meeting by discussing the background and importance of that week’s topic, followed by a student presentation of a recent empirical journal article that bears on this question. Finally, we will together consider how the data presented inform our understanding of that week’s topic, and how it relates to other questions discussed in the course.

Course Requirements
- **Class participation**: Prior to each class, students are expected to read the assigned papers. Students are encouraged to seek out additional research or theoretical papers that are relevant to the topic and to bring these up during the class discussion. All class participants are expected to actively contribute to the discussion.
- **Class presentation**: Each student will be responsible for presenting at least once during the semester. Weekly presentations will be assigned during the first class. Presentations should be relatively brief (30-40 minutes), concise, and critical. The presentation should focus on providing a clear presentation of (a) Question – what is the main question the paper
addresses? (b) Methods – how did the researchers address this question? (c) Results and (d) Critique and Conclusions.

Written assignments:

- **Questions**: What would you like to learn about in this class? Before the second week students are required to email me a list of 5 questions that they are curious about on the topic of memory and decision-making. I encourage you to think about these questions broadly in terms of general interest, and to *not* build on prior knowledge of the literature.

- **Opinion/Critical Reviews**: During the semester, each student will select two topics they are particularly interested in for which to submit a brief written critical review. The review will be no longer than one page, and will briefly describe your opinion on the paper: did you like it, or not? Why not? What is your opinion on the theory, approach, findings, or conclusion?

- **Term Paper**: Term papers addressing a question discussed during the seminar can be written either as research proposals, or as review papers. The final paper will be 8-10 pages long, and will be submitted by the last class.

**Course Evaluation**

- Class participation will count towards 25% of the final grade.
- Class presentation will count towards 25% of the final grade.
- Written assignments will count towards 50% of the final grade, as follows:
  - Question assignment - 5%
  - Critical reviews – 20% (10% each)
  - Term paper – 25%

**Course Schedule**

**Week 1 (1/20): General Introduction**

**Week 2 (1/27): No Class**

**Week 3 (2/3): Do different kinds of learning depend on different brain mechanisms?**


**Week 4 (2/10): How do we remember what we did this morning? Declarative memory and the hippocampus**


Week 5 (2/17): How do we learn how to ride a bike? Habit learning and the basal ganglia


Week 6 (2/24): How do we learn to predict reward? Dopamine and the basal ganglia in reward-based learning


Week 7 (3/3): How do we predict future events? The hippocampus and imagining the future


Week 8 (3/10): How does feedback drive learning? Dopamine, the striatum, and feedback


Week 9 (3/24): How does prior knowledge impact behavior?


Week 10 (3/31): How does motivation impact learning?

Shohamy and Adock TICS

**Sleep Selectively Enhances Memory Expected to Be of Future Relevance**

*Ines Wilhelm, Susanne Diekelmann, Ina Molzow, Amr Ayoub, Matthias Mölle, and Jan Born*

Week 11 (4/7): How does novelty impact learning?


Week 12 (4/14): How do we learn about aversive events? The amygdala, striatum, and fear conditioning


Week 13 (4/21): How does learning drive choices?


Make-up Class (double class on 5/5); Class presentation of term paper research
**Articles**
Readings will consist of empirical and review articles. Empirical papers for presentation are italicized in the schedule. All papers are available as downloadable pdfs by searching the PubMed archive at: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi.