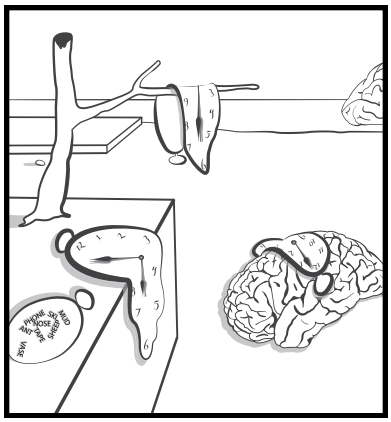
PSYC 51.09: Human Memory

Winter 2016 (TuTh 10 - 11:50 am)
Classroom: TBA



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Office Hours: TBA
X-hour: W 3 - 3:50 pm

Course Description

Knowing how our brains organize and spontaneously retrieve memories is at the heart of understanding the basis of the ongoing internal dialog of our conscious thoughts. Put simply, our memories make us *who we are*. The field of human memory also has a practical side. For example, how much should we trust eyewitness testimony? Or, should you cram for tomorrow's exam or get a good night's sleep instead? We will examine a range of classic and cutting-edge experimental results and theories that form the foundation of our current understanding of how we learn and remember.

Course Goals

First, I want you to leave this course with a solid grounding in our current understanding of how we learn and remember. You will learn to critically evaluate theories that describe how memory works, and you will learn to build your own theories.

Second, I want you to be able to apply what you learn in my course in your everyday life. We'll consider "brain hacks" for improving your memory and learn how (and why) memory can fail (e.g. Alzheimer's disease, amnesia, post-traumatic stress disorder, etc.).

Pre-Requisites

Some experience with Psychology or Neuroscience (PSYC 1 or PSYC 6) will help to ground the materials covered in this course. All other concepts will be covered in the readings and course lectures.

Course Materials

You will need a copy of the course textbook: *Foundations of Human Memory*, by Michael J. Kahana (Oxford University Press). It is available at the Dartmouth Bookstore or on Amazon.com for just over $9.

You will also need a basic scientific calculator for the problem sets and midterm exam (see descriptions in the *Grading* section). A fancy graphing calculator is not necessary; the calculator just needs to be able to support basic operations (add, subtract, multiply, divide, log, square root) and trigonometric functions (sine, cosine, tangent). Calculators that satisfy these requirements may be purchased on Amazon.com for just under $9.

I will also occasionally upload supplemental readings to the course's Canvas site. These readings will be made available as freely downloadable PDFs to all students taking the course.

If obtaining these course materials presents a financial hardship for you, please speak to me privately and we will figure something out.

Format

The textbook and supplemental readings will provide most of the background and theoretical grounding for the course. In my lectures I will be developing and expanding on the material from the readings. The lectures are also where you'll learn about real-world examples and useful brain hacks.

Some of my lectures will be slide-based; I will make PDFs of my slides available on the course's Canvas site soon after each slide-based lecture. Other lectures will be chalkboard-based, and will evolve organically as a function of students' discussion points, questions, interests, etc.

The X-hour before the midterm exam (Week 5) will be used as an optional review session. The X-hour before the final paper is due (Week 10) will be used for student presentations (see below for more information on student presentations).

Grading

All course materials will be graded on a 0–100 scale, weighted, and then converted to the nearest equivalent letter grade as follows: A (93–100); A- (90–92); B+ (87–89); B (83–86); B- (80–82); C+ (74–79); C (57–73); C- (50–56); D+ (44–49); D (37–43); D- (30–36); or F (0–29). A grade of A+ may, at my discretion, be given to students whose final scores are in the 'A' range, and who demonstrate notably exceptional performance in the course. Examples of notably exceptional performance include an unusually creative and well-executed final paper, exemplary contributions throughout the semester to the class dialogue, etc. I have tried to design this course so that you will do well if you put in a consistent moderate level of effort throughout the term. Putting in a consistent effort is the best way to learn this material well. (In this course you'll learn why!)

Problem sets (21%)

A total of 7 short take-home problem sets will be distributed over the course of the term (approximately 1 per week, except for the week prior to the midterm exam and the weeks prior to the final paper). These problem sets will help to solidify the concepts we learn about in the lectures and readings. One ungraded question on each problem set will also ask you to provide your candid thoughts on that week's reading assignment. Each problem set will be worth 3% of your final grade and should take approximately 1-2 hours to complete.

Students may (and are encouraged to!) work together in small groups on these problem sets, and are also encouraged to post and answer questions to the course's Canvas site. However, every student must write up and hand in their own work, and must clearly indicate who they collaborated with. Problem sets will be posted to Canvas prior to the first class meetings of the given week (see *Preliminary Schedule*) and will be due at the start of class 1 week from the posted date. Problem sets should be submitted to me electronically via email prior to the start of class. ***Late policy for problem sets: because we will go over the answers to problem sets in class on the days they are due, no late problem sets will be accepted.*** I will make every effort to grade and return the problem sets within 1 week of the due date.

Participation (10%)

You are expected to actively participate in class discussions, ask questions during the lectures, and generally engage with the course materials. In addition to in-class participation, part of your participation grade will be determined by your engagement with the course Canvas site. For example, you should monitor the Canvas site periodically, and post or answer questions about the problem sets and reading materials. You should aim to make 1-2 posts per week to the Canvas site and participate as much as you feel comfortable in class.

Midterm exam (24%)

The in-class midterm will be designed to test and build on your understanding the fundamental concepts we discuss in class. The exam questions will be similar to those covered in the problem sets, and will cover material learned through the end of Week 5. The exam will consist of short-answer questions, essay questions, simple computation questions, and graph-based questions (e.g. interpreting or drawing a graph, diagram, or figure).

I won't ask you to memorize complicated equations, but you'll need to have a working familiarity with the equations we cover in class—for example, I may show you an equation and ask you to explain it or use it to do some basic calculations. To this end, you will need a basic

(non-phone, non-tablet, non-laptop) calculator to answer some of the exam questions (see *Course Materials*). In addition to answering questions that require you to remember and understand the concepts we cover in class, some questions will have you reason using material you are familiar with to generate an answer to a novel question. If you work through the problem sets, do the readings, and participate in class, you will very likely do well on the exam.

Final paper (40%)

A 15-page final paper (not including bibliography) will serve as a focal point for the course, and will ask you to synthesize many elements from the course into a unified whole. As described below, the format of the final paper will take one of three possible forms— you get to choose which one you like best. I encourage you to email me a proposed description and/or outline of their final paper at least 2 weeks prior to the due date (due date TBA). If you do so, I will send back comments by the following Monday. Although general discussions between students are encouraged during the final paper writing process, you must ultimately write your own final paper on your own unique chosen topic.

Option 1: Mock grant proposal. You will write up an NIH-style grant proposal describing a substantial project that would advance our understanding of one (or more) of the topics covered in the course. (You don't actually need to do the project— just describe it.) The mock grant proposal will contain the following sections:

> *Specific Aims (1-2 pages)*. Briefly describe the overarching goal of your proposed "grant," the hypotheses you wish to test (or questions you wish to explore), along with a brief summary of the experiments you propose to undertake. Your grant should have 3 or 4 aims.
>
> *Background and Significance (5 pages)*. Provide a context and motivation for your proposed project by summarizing and synthesizing the relevant literature. The idea is to identify gaps in the literature that your proposed research would fill, and explain how your proposed research would fill those gaps.
>
> *Preliminary Data (2-3 pages)*. Pretend that you've run some preliminary "pilot" experiments that help to motivate your hypotheses and approach. Using your knowledge of the course materials and your readings of the relevant literature, make up some expected results and explain why you came up with those predictions.
>
> *Approach (5-7 pages)*. Describe in detail the experiments and analyses you're proposing. Explain how you expect the experiments to turn out. Importantly, also explain what you'd learn if your proposed experiments didn't turn out the way you expect.

Option 2: Book chapter or literature review. You will perform an in-depth literature review, focusing on a course topic of your choice. Pretend you are writing a book chapter for an introductory textbook or a review article for a major scientific journal. Provide the historical context for your topic, explain what progress has been made, and describe what the major open questions and future directions are. You will probably want to include some figures (these may be copied, with proper citation, from scientific articles). The format of the book chapter or literature review is more free-form than the other options. I encourage you to email me a paper proposal (or discuss your ideas with me) well in advance of the due date.

Option 3: Mini research project. You will pick a previously collected, already published dataset (examples will be posted to the course's Canvas site). Your job will be to replicate several existing results from the published paper and then design (and carry out!) one or two additional analyses using Excel, MATLAB, Python, etc. You will write an 8-10 page report with the following sections (note the shorter paper length if you choose this option):

> *Abstract (½ page)*. Briefly summarize your research question, approach, and findings.
>
> *Introduction (1-3 pages)*. Describe your dataset and summarize the previously reported findings and open questions.

Methods and Results (4-5 pages). Describe in detail the new analyses you carried out, and report the results (with several captioned figures, not included in the page count).

Discussion (1-2 pages). Interpret your new findings— what did you learn? What questions are still left open and how might one go about answering them?

Final presentation (5%)

During the last week of class, each student will prepare a 10 minute slide presentation on the topic of their final paper. You should practice your presentation several times prior to class to make sure that you present the material clearly and well, and that you don't run over time. Suggested presentation format:

Introduction (2-3 minutes). Summarize your topic and why others might find it interesting. Use some real world examples and/or fun pictures!

Key findings (5-7 minutes). Present 2 or 3 of the most interesting and relevant findings related to your topic. Or, pick the most interesting thing and go into a bit of detail.

Future directions (1-2 minutes). Leave your classmates with a taste of what's to come in the future. What questions have been left unanswered? What are the most exciting next steps?

The Academic Honor Principle

I expect you to abide by Dartmouth's Academic Honor Principle at all times. For example, I encourage you to discuss your assignments with your classmates. However, any work you hand in should be your own (and should acknowledge any help or collaborations with classmates). In other words, you can work together and ask for help, but you cannot simply copy someone else's answers.

Violations of the Principle will not be tolerated, and if you become aware of any such violations you are honor bound to take action. If you have any questions about the Academic Honor Principle and how it applies to this course, please ask.

Preliminary Schedule[1]

Week 1. Introduction (Chapter 1)
- What is memory and why do we have it?
- How reliable is our memory?
- General principles: how can we study memory in the laboratory?
- General principles: what do formal "theories" of memory look like? How can we make them? How can we test them?
- *Problem Set 1*

Week 2. Recognition memory (Chapter 2)
- How can you recognize when you've experienced something before?
- Why can we sometimes remember a previous experience vividly and other times only recover a few hazy details?
- Key experimental findings in recognition memory
- Building and evaluating formal theories of recognition memory
- *Problem Set 2*

Week 3. Attribute models (Chapter 3)
- How can we model representations of complex memories and thoughts?
- Models of text and language
- The Distributed Memory Hypothesis
- Quantifying our thoughts: thought spaces and thought trajectories
- How can we use brain recordings to track people's thoughts?

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[1] All chapter numbers refer to the course textbook, *Foundations of Human Memory*. **The schedule is preliminary and subject to change.** All changes will be posted to the course's Canvas site and distributed via email. Additional readings may be included or substituted as appropriate.

- *Problem Set 3*

Week 4. Associative memory part I (Chapter 4)
- How do we form links between memories and concepts?
- Does learning new information "overwrite" old information?
- Why are some things easier to associate than others?
- Why and how do we forget?
- *Problem Set 4*

Week 5. Associative memory part II (Chapter 5)
- Building and evaluating models of associative memory
- What's our memory capacity?
- The learning rate vs. forgetting rate tradeoff
- *Midterm Exam*

Week 6. Episodic memory part I (Chapter 6)
- How do we remember autobiographical events or episodes?
- How fast (or slow) are our thoughts?
- Memory illusions: inducing false memories
- *Problem Set 5*

Week 7. Episodic memory part II (Chapter 7)
- Building and evaluating models of episodic memory
- Is our memory system more like a computer or a hologram?
- What can brain recordings tell us about how we remember our past?
- *Problem Set 6*

Week 8. Sequence memory (Chapters 8 and 9)
- How do we remember the orders of things?
- Is learning the alphabet a simpler form of learning to read?
- Building and evaluating models of sequence memory
- *Problem Set 7*

Week 9. Advanced topics in human memory research
- Brain hacks: how can we "trick" our memory into being better?
- Memory for movies and stories
- Building theories that integrate brain and behavioral data

Week 10. Final presentations and paper
- *Student presentations* (in class and during X-hour)
- *Final paper*

Scheduling Conflicts

I won't take attendance, but some of your class participation grade requires you to be physically present (e.g. to take part in the in-class discussions, etc.). However, I also understand that extenuating circumstances (religious holidays, family emergencies, illness, etc.) may occasionally conflict with your ability to attend class. ***If you know you will have a scheduling conflict with this course during the term, please meet with me before the end of Week 2 to discuss appropriate arrangements.***

Student Needs

I strive to maintain a welcoming and accessible classroom environment. I want you to be an active participant and contributor to ongoing discussions and activities, and that means that every student should feel comfortable in my classroom. If you would like me to be aware of any issues that arise during the term, or any personal needs that may require adjusting how I run my class or how you participate, I encourage you to see me privately. Dartmouth's Student Accessibility Services Office can also help assist with setting up disability-related accommodations.