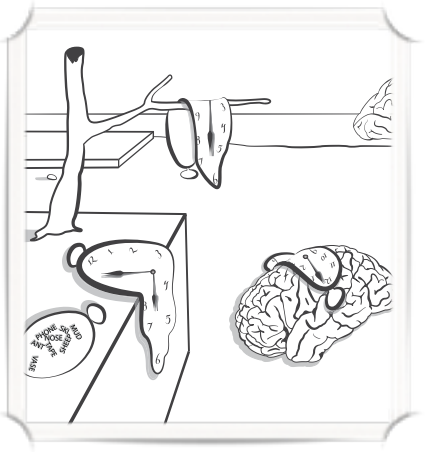
PSYC50: Human Memory

Winter 2016
Classroom: TBA



Instructor:	Dr. Jeremy R. Manning
Office Location:	359 Moore Hall
Email:	jeremy@dartmouth.edu
Office Hours:	TBA
X-hour:	TBA

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, should you cram for your exam, or is it better to get a good night's sleep instead? Or, what's the fastest way to memorize a large amount of new information or learn to play a new song on the piano? In this course, we will systematically explore the field of modern human memory by examining the classic and cutting-edge experimental paradigms and formal (mathematical) models that form the foundation of our current understanding of human memory.

Course Goals

The main goal of this course is to provide an introduction to the scientific literature on human memory. You will learn how to read and critically evaluate scientific articles on memory. You will also learn to use calculators, pencil and paper, and computer demonstrations to explore and understand in detail the models we read about. Finally, you will learn to understand and interpret results from the psychological and neuroscientific experiments that have shaped modern views on how humans remember. In addition to providing an introduction to human memory from a theoretical perspective, we will also discuss the practical applications and real-world implications of the theories we learn about.

Pre-Requisites

I have listed PSYC1 or PSYC6 as a pre-requisite for taking this course. Some experience with Psychology or Neuroscience will help to ground the materials covered in this course. You don't need prior math or programming experience to do well in this class. However, if you do happen to have experience with these subjects, you will find that experience useful. If you have any questions about whether your background or experience level is a good match for this course, please ask!

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 $33 (softcover) or $56 (hardcover).

You will also need a basic scientific calculator for the problem sets and midterm exam (see description of the midterm exam in the *Format* section). A fancy graphing calculator is not necessary; the calculator 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 $7.

I will also be uploading PDF articles to the course's Piazza site. These readings will be made available as free downloads 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

During the class meetings, I will introduce new material and expand on concepts from the readings. Some lectures will be slide-based; I will make PDFs of my slides available on the course's Piazza site following each slide-based lecture. Other lectures will be whiteboard-based, and will evolve organically as a function of students' discussion points, questions, interests, etc. Importantly, my lectures (what I *say* in class) will be substantially more detailed than my slides or whiteboard notes (what I *show* in class), and will often go beyond the material covered in the readings.

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 (10%)

A total of 8 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 week 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 1.25% of your final grade.

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 Piazza 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 Piazza 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 I will be going over the answers to problem sets 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.

Course notes (10%)

For each class meeting, one or two students will be assigned to take notes for that day (each student will volunteer to take notes for one or two lectures during the term). These notes will be uploaded to the course's Piazza site and made visible to everyone taking the class. For students who take notes on multiple days, the lower-scoring notes grade will either be dropped or will replace the lowest problem set grade (whichever results in the higher total grade). If another student is also scheduled to take notes on your assigned day, you are expected not to peek at the notes they upload to Piazza before uploading your own notes (doing so is a violation of the Academic Honor Principle). Course notes must be submitted within 1 week of the beginning of the class meeting they cover. For example, if you are assigned to cover class on Monday, January 3 from 10 - 10:30 AM, then your course notes must be uploaded to Piazza by 10 AM on Monday, January 10. **Late policy:** 15 points will be deducted for each late day after the deadline (rounded up to the nearest day). I will make every effort to grade and provide feedback on your course notes within 1 week of posting.

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 Piazza site. For example, you should monitor the Piazza site periodically, and post or answer questions about the problem sets and reading materials.

Midterm exam (25%)
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. In addition to answering questions that require you to remember and understand the course material, 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. The mock 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 4-5 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 a 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 Piazza site). Your job will be to replicate several existing results from the published paper and then design (and carry out!) one or two substantial 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* (0.5 pages). 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 cleanly 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 us 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 problem sets 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***
- Introduction & historical background (Chapter 1)
- Overview of experimental methods (Chapter 1)
- Repetition & recency (Chapter 1)
- Cognitivism (Chapter 1)
- The role of context in memory (Supplemental readings)
- *Problem Set 1*

Week 2. ***Recognition memory: how do we know we've seen something before?***
- Introduction to recognition memory & strength theory (Chapter 2)

[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 Piazza site and distributed via email.

- Introduction to probability and random variables (Chapter 2, supplemental readings)
- Strength theory (Chapter 2, supplemental readings)
- The Receiver Operating Characteristic (ROC) curve (Chapter 2)
- Reaction time (RT), the speed-accuracy tradeoff, and Sternberg's procedure (Chapter 2, supplemental readings)
- Familiarity vs. recollection, remembering vs. knowing (Chapter 2)
- Serial vs. parallel search (Chapter 2)
- *Problem Set 2*

Week 3. ***Attribute models: how can we model representations of complex memories and thoughts?***
- Introduction to attribute models (Chapter 3)
- Feature vectors and matrix algebra (Chapter 3, Supplemental readings)
- The Distributed Memory Hypothesis (Chapter 3)
- Summed similarity models (Chapter 3)
- The Drift Diffusion Model (Chapter 3, supplemental readings)
- *Problem Set 3*

Week 4. ***Associative memory: how do we form links between memories and concepts?***
- Introduction to associative memory and cued recall (Chapter 4)
- The Paired Associates experiment (Chapter 4)
- Recency and list length effects in associative memory (Chapter 4)
- Retrieval-induced forgetting (Supplemental readings)
- Competition vs. associative "unlearning" (Chapter 4)
- Proactive and retroactive interference (Chapter 4)
- Name-face associations (Chapter 4)
- *Problem Set 4*

Week 5. ***Models of associative memory***
- Models of associative memory (Chapter 5)
- The attribute-similarity framework (Chapter 5)
- Neural-network models (Chapter 5)
- The Lag-Conditional Response Probability (Lag-CRP) curve (Chapter 5, supplemental readings)
- *Midterm Exam*

Week 6. ***Episodic memory: how do we remember autobiographical events or episodes?***
- The Free Recall experiment (Chapter 6)
- The primacy and recency effects in free recall (Chapter 6)
- Retrieval dynamics in Free Recall (Chapter 6)
- Temporal and semantic clustering (Chapter 6, supplemental readings)
- The Deese-Roediger-McDermott False Memory experiment (Chapter 6)
- Subsequent memory effects (Supplemental readings)
- *Problem Set 5*

Week 7. ***Models of episodic memory***
- Models of Free Recall (Chapter 7, supplemental readings)
- Dual-store vs. single-store models (Chapter 7)
- The Search of Associative Memory (SAM) model (Chapter 7)
- The Temporal Context Model (TCM; Chapter 7, supplemental readings)
- Neural evidence for contextual reinstatement (Supplemental readings)
- *Problem Set 6*

Week 8. ***Sequence memory: how do we remember the orders of things?***
- Introduction to Sequence Memory (Chapter 8)
- The Serial Recall experiment (Chapter 8)
- Clustering and errors in serial recall (Chapter 8)
- Theories of Sequence Memory (Chapter 9)
- The Associative Chaining model (Chapter 9)
- The Positional Coding model (Chapter 9)
- Chucking models (Chapter 9)
- Transfer effects, serial-position effects, and clustering effects in sequence memory (Chapter 9)
- *Problem Set 7*

Week 9. ***Advanced topics in human memory research***
- The future of human memory research (Supplemental readings)
- Multivariate Pattern Analysis (MVPA; Supplemental reading)
- Neuroimaging as a window to cognition (Supplemental reading)
- Complex stimuli (Supplemental reading)
- *Problem Set 8*

Week 10. ***Advanced topics in human memory research (continued)***
- Student presentations

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 discussions, sit for the midterm exam, etc.). However, I also understand that extenuating circumstances (religious holidays, family emergencies, illness, etc.) may rarely conflict with your participation in this course. If you know you will have some scheduling conflicts 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 you 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.