**Decision Making and the Brain**  
Psych 112E; Spring Quarter, 2020  

**The basics**  

**Instructor:** Dr. Andrew Wikenheiser (amwikenheiser@psych.ucla.edu)  
Office hours: Wednesdays, 2 PM, via Zoom:  
[https://ucla.zoom.us/j/4338554151](https://ucla.zoom.us/j/4338554151) (Meeting ID: 433 855 4151)  

**Lecture:** Pre-recorded and posted on CCLE each Monday (you can watch them whenever)  

**Textbook:** Neuroeconomics: Decision Making and the Brain, 2nd Ed.  
Eds. Glimcher & Fehr; Academic Press (2014)  
(PDFs of assigned readings will be posted on CCLE)  

Digital copies of the entire book are freely available through the UCLA network here:  

**Important note**  
Because of the unprecedented COVID19 situation, everything in the syllabus is subject to change to accommodate the changing situation in the world. We will all need to be flexible. The course has been re-structured so that we can get through the material with as few disruptions as possible. I’ve tried to be generous with due dates for assignments to ensure everyone has sufficient time to complete them, no matter which time zone you happen to be in right now or what other challenges you are facing.  
*Nevertheless, if something isn’t working for you, let me know ASAP and we’ll find a solution.*  

**Course overview**  
We make hundreds of decisions every day. Some of these decisions are easy choices, either because the best course of action is obvious (deciding to get a cat rather than a dog as a pet, because cats are better than dogs), or because the stakes are low (bagel or toast for breakfast?). Other decisions are more difficult. The correct answer may be obscure (should I marry this person or wait for someone better to come along?), and the consequences of our choices may have long-lasting impacts on our lives (take a high-paying job on Wall Street or join the Peace Corps?).  

All of these decisions—from the mundane to the profound—are mediated by a complex interaction of decision making systems in the brain. Understanding how these systems work (and sometimes fail to work) has occupied students of philosophy, psychology, economics, neuroscience, and more for centuries. In this course we will examine a recently emerged framework for thinking about how the brain mediates decisions. This approach—referred to as *neuroeconomics*—borrows quantitative frameworks for framing decisions from economics, and combines them with mechanistic insights into behavior derived from psychology and neuroscience. This merger offers a rigorous, quantitative description of how decisions ought to be made, and a means of testing whether behavior and information processing in the brain conform to these normative predictions.  

In this course we will consider broadly how economic perspectives can inform our understanding of the psychology and neuroscience of value-based decision making. We will trace the development of theoretical models of behavior and decision making, and along the way we will examine how the brain represents quantities that impact our decisions, how information is combined, reduced, and simplified in neural circuits, and how different options are arbitrated and ultimately selected.  

**Important:** Much of this course is based on experimental work in animals. Lectures will include diagrams, pictures, and videos of animals in experimental settings.
Learning objectives

1) Describe the major determinants of choice, according to standard economic theory.

   Students will be able to summarize the basic tenants of economic utility theory, and explain how factors such as risk, delay, effort, etc. should influence a utility-maximizing decision maker.

2) Describe how information relevant to decision making is represented and transformed in different neural circuits, from perception to action.

   Students will be able to explain how neurons in the brain represent information by firing action potentials, and will be able to describe how information relevant to decision making is represented and transformed from early sensory areas to motor output.

3) Critically evaluate primary scientific literature relating to decision making.

   Students will learn strategies for reading and understanding scientific papers in economics and decision making.

4) Relate particular experimental findings to general theoretical models of decision making.

   Students will gain a deeper understanding of the interplay between theoretical and experimental work—in particular, the way in which theories are developed in the light of experimental results, but then generate predictions that spur new experimentation, which in turn refines theories.

Components of the course

Lecture. Lecture videos will be recorded in advance and posted on the course website, where you can stream them at your leisure. All course material will be posted in the appropriate “Week” section on CCLE. The lecture slides I discuss in the videos will be posted, as will any assigned readings and/or assignments.

Typically I will post the entire week’s lectures and materials by Monday of each week at the latest. I will add new lectures as I record them, but you are only responsible for the material in each week’s section on CCLE. (So if I manage to record and post Week 3 lectures/material during Week 1, you don’t have to do anything with them until week 3. You’re welcome to work ahead if the material is there, but don’t feel obligated to do so just because the material is up).

Assigned readings. Assigned readings from the text book and other sources will provide a deeper understanding of the material covered in lecture. I will post .pdf copies of all assigned readings and make sure they are clearly labelled on CCLE. You can complete the reading assignments either before or after watching the lecture materials; whichever way is most helpful for you is fine.

The assigned readings will parallel—though not perfectly overlap—the content discussed in class. Some of the readings are dense, and will contain greater depth than what is discussed in lecture. Try to work through the readings even if they are difficult, and see if you can extract the main take-away points without getting bogged down in the details. Let the lectures guide your reading; if something is discussed extensively in lecture it’s worthwhile to read sections related to that topic carefully. If something in the readings is never mentioned in lecture, you don’t need to be as concerned with every little detail.

Office hours. Office hours will be our best chance to interact in real time during the course. It’s a great opportunity to ask questions or get clarifications on material covered in lecture. Please try to attend if you can! I will record the zoom meeting for each session and post it on CCLE.
Assessment

You will be assessed on two types of assignments in this course: paper critique write-ups and problem sets. All work will be submitted via TurnItIn on CCLE. I will place each TurnItIn assignment in the CCLE section for the week it was assigned. Due dates for all assignments are listed below; they are typically on Sunday evenings at 11:59 PM, and you'll have around two weeks to complete each assignment. The only exception to this is the final problem set—that will be due on the last day of Finals week.

Paper critique write-ups. You will read an assigned scientific article related to material covered in lecture, and respond to a series of short answer questions. Lectures will prepare you to tackle each of these papers and questions, so be sure to work through all the preceding lectures before attempting these assignments.

There will be 3-6 questions for each paper. Expect to write approximately 1 page total in answering the questions.

There are five assigned paper critiques, and your lowest score will be dropped.

Problem sets. Problem sets will consist of 5-10 short answer questions relating to material discussed in lecture.

You can use any materials you like to complete the problem sets. Lecture notes and assigned readings will probably be the most useful resources for you in completing these. You may collaborate with other students in the course PROVIDED YOU DO SO VIA THE COURSE MESSAGE BOARD ON CCLE. You are free to use the message board to post your thinking on the questions and get others’ opinions, discuss aspects that seem confusing or you are unsure about, etc. You can also choose to complete the assignments entirely on your own.

Regardless of how you complete the problem sets, every student must submit their own work, and you cannot quote or otherwise include the work of others in your answers. TurnItIn will automatically scan all submissions for plagiarism. So—use the course message board to discuss the questions and potential answers, but make sure that your submission is entirely your own, unique work, and not something copied directly from anywhere else.

There will be three problem sets, and your lowest score will be dropped.

Grading policies. Grades will be posted in the gradebook as soon as I finish scoring submissions. Standard mathematical rounding rules will be used in determining your final grade. No curving or scaling will be applied to any grades in the course. There will be no extra credit in the course.

Grading scale. A+: 97-100; A: 93-96; A-: 90-92; B+: 87-89; B: 83-86; B-: 80-82; C+: 77-79; C: 73-76; C-: 70-72; D+: 67-69; D: 60-66; F: <60

Point breakdown and summary:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points</th>
<th>% of total points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper critique write-ups (best 4 of 5)</td>
<td>120 (30 points each)</td>
<td>66.6%</td>
</tr>
<tr>
<td>Problem sets (best 2 of 3)</td>
<td>60 (30 points each)</td>
<td>33.3%</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>100%</td>
</tr>
</tbody>
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Cheating, plagiarism, & other un-pleasantries. Students must submit only their own, unique work for credit in this course. Because everything is submitted via TurnItIn, all submissions will be automatically scanned for plagiarism. Any instances of plagiarism or other violations of the student code of conduct will be reported to the dean of students.
Course Schedule

Week 1

Lecture 1: Syllabus, course intro, methods in neuroscience
Lecture 2: Economic rationality
Assigned readings: The marketplace in your brain, Glimcher Ch. 1 (pg 3-12), Glimcher Ch. 6
Assignment: None

Week 2

Lecture 1: Motor systems & action execution
Lecture 2: Sensory systems & utility
Assigned readings: Glimcher Ch. 19 (skim)
Assignment: Problem set #1 (Due: 11:59 PM, April 19)

Week 3

Lecture 1: Sensory decision making
Lecture 2: Brain systems for decision making 1: frontal cortex
Assigned readings: “Dialogues on vmPFC”
Assignment: Paper critique #1
“Dissociated functional significance of decision-related activity in the primate dorsal stream” Katz et al, (2016). (Due: 11:59 PM, April 26)

Week 4

Lecture 1: Brain systems for decision making 2: subcortical structures
Lecture 2: Uncertainty, behavioral economics, and prospect theory
Assigned readings: Glimcher Appendix: prospect theory & the brain
Assignment: Paper critique #2
“The hippocampus supports deliberation during value-based decisions” Bakkour et al, (2019). (Due: 11:59 PM, May 3)

Week 5

Lecture 1: Learning values
Lecture 2: Dopamine and reward prediction errors
Assigned readings: Niv & Schoenbaum: “Dialogues on prediction errors”
Assignment: Problem set #2 (Due: 11:59 PM, May 10)
Week 6
Lecture 1: Learning which action to take
Lecture 2: State spaces & cognitive maps
Assigned readings: Jones et al: “Orbitofrontal cortex supports behavior using inferred, not cached values”
Assignment: None

Week 7
Lecture 1: Temporal discounting and the question of impulsivity
Lecture 2: Anticipation, dread, and sub-optimal choice
Assigned readings: Stevens & Stephens: “The adaptive nature of impulsivity”
Assignment: Paper critique #3
“The ecology and evolution of patience in two New World monkeys”
Stevens et al, (2005). (Due: 11:59 PM, May 24)

Week 8
Lecture 1: Behavioral ecology and optimality modelling
Lecture 2: Neural mechanisms of foraging behaviors
Assigned readings: Glimcher Ch. 22
Assignment: Paper critique #4
“The neuronal basis of sequential foraging decisions in a patchy environment”
Hayden et al, (2011). (Due: 11:59 PM, May 31)

Week 9
Lecture 1: Game theory and the brain
Lecture 2: Accounting for taste
Assigned readings: Glimcher Ch. 25
Assignment: Paper critique #5
“Oxytocin increases trust in humans”
Kosfield et al, (2005). (Due: 11:59 PM, June 7)

Week 10
Lecture 1 & 2: Putting it all together—Multiple decision systems in the brain
Assigned readings: Glimcher Ch. 21
Assignment: Problem set #3 (Due: 11:59 PM, June 12 [last day of finals week])