PSYC 473 / BIBB 473 / NGG 706
NEUROECONOMICS
Spring 2015
Wednesdays 5:00-8:00, Solomon B-35

Instructor: Joe Kable (kable@psych.upenn.edu), office hours by appointment, Solomon C-5

Course Description: This seminar will review recent research that combines psychological, economic, and neuroscientific approaches to study human and animal decision-making. The course will focus on our current state of knowledge regarding the neuroscience of decision-making, and how evidence concerning the neural processes associated with choices might be used to constrain or advance economic and psychological theories of decision-making. Topics covered will include decisions involving risk and uncertainty, decisions that involve learning from experience, decisions in strategic interactions and games, and social preferences. Prerequisite: Psychology 149, 153, or 165, or permission of the instructor.

Readings: There is one required text for the course, "Neuroeconomics: Decision making and the brain," edited by Glimcher & Fehr, 2014, Elsevier Academic Press (henceforth GF). There are also a number of additional readings, mostly primary scientific articles, which will be posted on Canvas.

Format: Generally, the first half of class will be a lecture format in which I introduce new topics and concepts relevant to the readings for the following week. The second half of class will be a discussion format, in which we discuss primary research articles as a group.

Course requirements: Evaluations will be based on one quiz (5%), class participation, including the roles one is asked to play in the discussions (50%), and individual papers (one for undergraduates, two for graduates) and one final small-group project (45%).

- For all of the assigned readings, students will be required to email me one discussion question per reading by 3 p.m. on the day of class. Submission of questions will be considered as part of your participation grade. These questions will also help steer the discussion of the readings during class.
- There will be one short quiz on neuroanatomy and cognitive neuroscience methods, as an incentive for you to learn this information that will be useful to you for the rest of the course.
- Participation in the discussions of primary research articles will be the largest part of your grade in this course. As we move through the semester, I will ask students (before class) to take different formal roles in the discussions. For instance, I may ask a student to present a 5-10 minute introduction and summary of the paper we are discussing, or I may a student to come prepared to explain a specific figure from the paper, or I may structure the larger discussion through a series of smaller-group activities/discussions.

- The paper (4 p, ~1000 words) will be a critical media review of a recent media report related to neuroeconomics. The media can be any format—print, television, internet, etc.—the only requirement is that I also have access to the report in some way. I will provide some examples to get you thinking, but part of the assignment will be to first find an appropriate and interesting media report. Your task will be to critique how the popular press has reported the scientific findings. What did they get right? What did they oversimplify? How might you have conveyed the same research more accurately? How might you have made the same research more interesting to non-scientists?
- The final project will be done in groups, and will involve putting together a research proposal to address an interesting unanswered question in the field. Creativity is strongly encouraged. You will write a paper outlining your proposal (10 p, ~2500 words, one paper per group), and also give a short presentation (20 min) of your proposal to the class.
- **Additional requirements for graduate students:** In addition to the above requirements, graduate students will also be required to write a "news and views"-style paper (4 p, ~1000 words) concerning a research article related to neuroeconomics. The research article must be one we did not discuss in class. Many journals publish "news and views," or something similar, to highlight specific articles in that issue of the journal. This short piece summarizes the central findings of the article, and explains the innovation as well as the limitations of the research. I will provide some example "news and views." You can choose your own article to write about, as long as the article is published in the last year and did not already have an accompanying piece when it was published. Several journals now publish "journal club" articles by graduate students, and I would be happy to work with you to get your "news and views" paper from this class published in this manner. In calculating your grade, each of the two papers will count equally (so the percentages cited above will decrease accordingly). Graduate students are also particularly encouraged to read the "of interest" chapters, in addition to the assigned reading.

Course Outline

1/21 ANATOMY/METHODS

Background Reading: GF (Glimcher & Fehr) 5-6

Of Interest: GF Preface, 1-4, 7

1/28 VALUATION & UTILITY

Background Reading: GF 8

Of Interest: GF 12, 13, 22

2/3 & 2/4: RISK & UNCERTAINTY

Background Reading: GF 9

Of Interest: GF 10, 14, 24, Appendix

Discussion Readings:

Chib V, Rangel A, Shimojo S, O'Doherty JP (2009). Evidence for a common representation of decision values for dissimilar goods in human ventromedial prefrontal cortex. *Journal of Neuroscience*, **29**, 12315-12320.

Fellows LK and Farah MJ (2007). The role of ventromedial prefrontal cortex in decision making: judgment under uncertainty or judgment per se? *Cerebral Cortex*, **17**, 2669-74.

2/10 & 2/11 FROM VALUE TO ACTION

Background Reading: GF 23

Of Interest: GF 19, 20

Discussion Readings:

Burke CJ & Tobler PN (2011). Reward skewness coding in the insula independent of probability and loss. *Journal of Neurophysiology*, **106**, 2415-2422.

Levy DJ & Glimcher PW (2011). Comparing apples and oranges: Using reward-specific and reward-general subjective value representation in the brain. *Journal of Neuroscience*, **31,** 14693-707.

NEUROANATOMY & METHODS QUIZ ON 2/11

2/17 & 2/18 VALUE LEARNING I

Assigned Reading: GF 15

Of Interest: GF 16-18

Discussion Readings:

Hunt LT, Kolling N, Soltani A, Woolrich MW, Rushworth MFS, Behrens TEJ (2012). Mechanisms underlying cortical activity during value-guided choice. *Nature Neuroscience*, **15**, 470-476.

Jocham G, Hunt LT, Near J, Behrens TEJ (2012). A mechanism for value-guided choice based on the excitation-inhibition balance in prefrontal cortex. *Nature Neuroscience*, **15**, 960-961.

TARGET FOR "NEWS & VIEWS" PAPERS MUST BE IDENTIFIED BY CLASS ON 2/18

2/24 & 2/25 VALUE LEARNING II

Assigned Reading: GF 21

Of Interest: GF 16-18

Discussion Readings:

Rutledge RB, Lazzaro SC, Lau B, Myers CE, Gluck MA, Glimcher PW (2009). Dopaminergic drugs modulate learning rates and perseveration in Parkinson's patients in a dynamic foraging task. *Journal of Neuroscience*, **29**, 15104-15114.

Tsai HC, Zhang F, Adamantidis A, Stuber GD, Bonci A, de Lecea L, Deisseroth, K. (2009). Phasic firing in dopaminergic neurons is sufficient for behavioral conditioning. *Science*, **324**, 1080-1084.

3/3 & 3/4 SOCIAL INFLUENCE

Discussion Readings:

Yin HH, Knowlton BJ and Balleine BW (2004). Lesions of dorsolateral striatum preserve outcome expectancy but disrupt habit formation in instrumental learning. *European Journal of Neuroscience*, **19**, 181-189.

Yin HH, Ostlund SB, Knowlton BJ and Balleine BW (2005). The role of the dorsomedial striatum in instrumental conditioning. *European Journal of Neuroscience*, **25**, 513-523.

TARGET FOR MEDIA CRITIQUE PAPERS MUST BE IDENTIFIED BY CLASS ON 3/4

"NEWS & VIEWS" SUMMARY DRAFT, 3/4

3/17 & 3/18 SOCIAL PREFERENCES

Assigned Reading: GF 11

Of Interest: GF 27

Discussion Readings:

Zaki J, Schirmer J, Mitchell JP (2011). Social influence modulates the neural computation of value. *Psychological Science*, **22**, 894-900.

Klucharev V, Munneke MAM, Smidts A, Fernandez G (2011). Downregulation of posterior medial frontal cortex prevents social conformity. *Journal of Neuroscience*, **31**, 11934-11940.

3/24 & 3/25 COOPERATION

Discussion Readings:

Harbaugh W, Mayr U, Burghart D (2007). Neural responses to taxation and voluntary giving reveal motives for charitable donations. *Science*, **316**, 1622-1625

Hsu M, Anen C, Quartz SR (2008). The right and the good: distributive justice and neural encoding of equity and efficiency. *Science*, **320**, 1092-1095

3/31 & 4/1 STRATEGIC CHOICE

Assigned Reading: GF 25

Of Interest: GF 26

Discussion Readings:

Kosfeld M, Heinrichs M, Zak P, Fischbacher U and Fehr E (2005). Oxytocin increases trust in humans. *Nature*, **435**, 673-676.

King-Casas B, Sharp C, Lomax-Bream L, Lohrenz T, Fonagy P, Montague PR (2008). The rupture and repair of cooperation in borderline personality disorder. *Science*, **321**, 806-810.

MEDIA CRITIQUE PAPERS ARE DUE BY THE BEGINNING OF CLASS, 4/1

4/8 CONSUMER NEUROSCIENCE

Assigned Reading: Ariely D & Berns GS (2010). Neuromarketing: the hope and hype of neuroimaging in business. *Nature Reviews Neuroscience*, **11**, 284-292.

Discussion Readings:

Coricelli G & Nagel R (2009). Neural correlates of depth of strategic reasoning in medial prefrontal cortex. *Proceedings of the National Academy of Sciences*, **106**, 9163-9168.

Carter RM, Bowling DL, Reeck C, and Huettel SA (2012). A distinct role of the temporal-parietal junction in predicting socially guided decisions. *Science*, **337**, 109-111.

"NEWS & VIEWS" SUMMARY + CRITIQUE DRAFT, 4/8

4/15 COULD NEUROSCIENCE INFORM ECONOMICS?

Discussion Readings:

Plassmann H, O'Doherty J, Shiv B, Rangel A (2008). Marketing actions can modulate neural representations of experienced pleasantness. *Proceedings of the National Academy of Sciences*, **105**, 1050-4.

Falk EB, Berkman ET, Lieberman MD (2012). From neural responses to population behavior: neural focus group predicts population-level media effects. *Psychological Science*, **23**, 439-445.

Clithero JA, Tankersley D, Huettel SA (2008). Foundations of neuroeconomics: from philosophy to practice. *PLoS Biology*, **6**, e298.

Camerer C (2007). Neuroeconomics: using neuroscience to make economic predictions. *Economic Journal*, **117**, C26-C42.

Bernheim, BD (2008). Neuroeconomics: a sober (but hopeful) appraisal. *AEJ: Microeconomics.*

4/22 FINAL PROJECT PRESENTATIONS

4/29 FINAL PROJECT PRESENTATIONS

FINAL PROJECT PAPERS ARE DUE BY 5 PM, 5/6

FINAL "NEWS & VIEWS" PAPERS ARE DUE BY MIDNIGHT ON 5/12