

Course Syllabus for Neuroeconomics

Class Time: Thu 10:10 am – 12:10 pm

Spring term, 2011

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Office Hour: Mon 11:00 am- noon

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Office Hour: Wed 4:30-5:30pm

Course Description: This is a topics course on neuroeconomics. According to the Wikipedia, “neuroeconomics combines neuroscience, economics, and psychology to study how people make decisions. It looks at the role of the brain when we evaluate decisions, categorize risks and rewards, and interact with each other.” Together we will read a set of papers which would serve as an introduction to some of the fun themes in the field.

Our goal is that each of us will get a rough feel about what is going on in the field and be able to ask an interesting research question. Since it is a topics course, we would hope students won't hesitate to speak up. Understanding a paper is the first step. Being able to criticize scientifically may be the next. The third big step is to become so motivated to start your own research. That is where you get the most fun, but unfortunately, you may have to go through the previous two steps of laboring before arriving there.

Each week we will be discussing a particular topic. For that topic, there will be one paper which we will focus on. A student will make a presentation about that paper. Students not presenting that week will read the paper in advance and hand in a one-page report including a short summary (less than 250 words) and (at least) a question by emailing Chen-Ying's assistant Shu-Ching Lee (sanmogreen@gmail.com) before 9:30 am that Thursday. During the presentation, each one not presenting will raise at least one question. You can raise the question you have prepared in the report. However, if some other student has raised the same question before, you will have to come up with a question on spot. The presenting student will try to answer all the questions. We will help whenever we can.

Note that in your short summary (less than 250 words), you should briefly answer the following questions:

- a. What is the question (of the paper)?**
- b. Why should we care about it?**
- c. What is your (or the author's) answer?**
- d. How did you (or the author) get there?**

After the class, Shu-Ching will forward all the emails to the presenting student. The presenting student now will have to 1) grade the reports handed in by the non-presenting students according to the quality of the summary and the quality of the question, and 2) write down the answers to all the questions asked. The presenting student will email the grades, the answers together with the ppt file of presentation to Shu-Ching within one week after the presentation. Shu-Ching will then post the answers and the ppt to the course web site so we can all take a look at them.

The presenting student will have to talk to us at least one week before the presentation about the plan of presentation. In your presentation you should discuss clearly the research question asked, the experiment design (and the model if there is one), the result, whether you are happy with the interpretation of the result in the paper, whether you will run the experiment differently and whatever interests, excites or confuses you when you read the paper. Please be aware that some papers are very short, but they could have a very long supporting material. You need to read the supporting materials carefully too, in order to have a solid understanding.

Since there are 15 papers that we will discuss, your final grade will depend on your class presentation (50%) and the 14 grades you get from the presenting student each week (50%). We will give you bonus points if you participate well in the discussions.

We have reserved a useful textbook, Paul Glimcher, Colin Camerer, Ernst Fehr, and Russ Poldrack. *Neuroeconomics: Decision Making and the Brain*, Academic Press, 2008 (shorthanded as GCFP), at the library of Econ department. It summarizes many important topics in the field and could serve as a good starting point when you want to know more about a topic.

Reading List

1. **[Introduction]:** The two instructors will each present an introductory regarding neuroeconomics (in general or on a specific subfield). **Feb 24**

* Wang, J. T.-Y. (2010), "Pupil Dilation and Eye-Tracking," in *Handbook of Process Tracing Methods for Decision Research: A Critical Review and User's Guide*, ed. by M. Schulte-Mecklenbeck, A. Kuhberger and R. Ranyard, Psychology Press, 185-204.

Paul Glimcher, *Foundations of Neuroeconomic Analysis*, Oxford University Press, 2010.

Paul Glimcher, Colin Camerer, Ernst Fehr, and Russ Poldrack. *Neuroeconomics: Decision Making and the Brain*, Academic Press, 2008 (shorthand as GCFP)

Scott Huettel, Allen Song, and Gregory McCarthy. *Functional Magnetic Resonance Imaging*, Sinauer Associates, 2004. (shorthand as HSM).

王道一,「用神經科學的手術刀,剖開經濟學的黑盒子——神經經濟學淺談」,人文與社會科學簡訊 2009, vol. 10, no. 4, pp. 8-15. (Laymen article)

2. **[Level-k, Strategic Thinking]:** Let us learn a bit about level-k and the beauty contest game. In the literature we have levels of players as in level-k theory, knowledge or beliefs of different orders in a game. Are they similar or different?

* Brocas, I. Carrillo, J. D., Wang, S. W. and Camerer, C. F. "Imperfect choice or imperfect attention? Understanding strategic thinking in private information games," working paper 2010. (available at Stephanie W. Wang's web page) **March 3**

* Bailey, B. P. and Iqbal, S. T. "Understanding changes in mental workload during execution of goal-directed tasks and its application for interruption management," *ACM Transactions on Computer-Human Interaction* 2008, vol. 14, no. 4, pp. 1-28.

March 10

Costa-Gomes, M. Crawford, V. and Iriberri, N. "Strategic Thinking," working paper 2010. (review article available at Vincent Crawford's web page)

Bailey, B. P., Busbey, C. W., and Iqbal, S. T. "TAPRAV: An interactive analysis tool for exploring workload aligned to models of task execution," *Interacting with Computers* 2007, vol. 19, no. 3, pp. 314-329.

Coricellia, G. and Nagel, R. "Neural correlates of depth of strategic reasoning in medial prefrontal cortex," *PNAS* 2009, vol. 106, no. 23, pp. 9163–9168.

Bhatt, M. and Camerer, C. "Self-Referential Thinking and Equilibrium as States of Mind in Games: Fmri Evidence," *Games and Economic Behavior*, 2005, 52(2), pp. 424-59.

Chen, C.-T., Huang, C.-Y., and Wang J. T.-Y. "A Window of Cognition: Eyetracking the Reasoning Process in Spatial Beauty Contest Games," working paper, 2011. (available at Joseph Tao-yi Wang's web page)

Hampton, A., Bossaerts, P., and O'Doherty, J. "Neural correlates of mentalizing-related computations during strategic interactions in humans," *PNAS* 2008, vol. 105, pp. 6741-6746.

3. [**Probability, Risk, Prospect and Prediction Error**]: Let us understand a bit about how probability is coded in the brain. Moreover, let us understand what prediction error is and how it is coded and facilitates learning. Finally, let us learn a bit about genes. Maybe we will all be confused then. And it is good to be confused, btw. (GCFP Chapters 11, 21, 22)

* Caplin, A., Dean, M., Glimcher, P., and Rutledge, R. "Measuring beliefs and rewards: a neuroeconomic approach," *Quarterly Journal of Economics* 2010, vol. 125, no. 3, pp 923-960. **March 17**

* Frydman, C., Camerer, C., Bossaerts, P., and Antonio, R. "MAOA-L carriers are better at making optimal financial decisions under risk," *Proceedings of the Royal Society B*, forthcoming. **March 24 (Guest Speaker: Songfa Chong: 11:10-12:10)**

* Fiorillo, C., Tobler, P., and Schultz, W. "Discrete coding of reward probability and uncertainty by dopamine neurons," *Science* 2003, vol. 299, pp. 1898-1902. **March 31**

* Tobler, P., Fiorillo, C., and Schultz, W. "Adaptive coding of reward value by dopamine neurons," *Science* 2005, vol. 307, pp. 1642-1645. **April 7**

* Tom, S., Fox, C., Trepel, C., and Poldrack, R. “The neural basis of loss aversion in decision-making under risk,” *Science* 2007, vol. 315, pp. 515-518 **April 14**

Wu, S.-W., Delgado, M., and Maloney, L. “Economic decision-making compared with an equivalent motor task,” *PNAS* 2009, vol. 106, no. 15, pp. 6088-6093.

Tobler, P., Fletcher, P., Bullmore, E., and Schultz, W. “Learning-related human brain activations reflecting individual finances,” *Neuron* 2007, 54, pp. 167-175.

Midterm week: Visit Eyetracking Facility - April 21

4. [**Reward, Value and Choice**]: We will learn about how monkeys make choices, menu invariance, adaptation of the orbitofrontal cortex. We then read one paper on humans. This brings us to the issue of cardinality or ordinality. You should be aware though that value modulation in parietal cortex seems to be relative, not absolute. (GCFP Chapter 29)

* Padoa-Schioppa, C. and Assad, J. “Neurons in orbitofrontal cortex encode economic value,” *Nature* 2006, vol. 441, pp. 223-226. **April 28**

* Padoa-Schioppa, C. and Assad, J. “The representation of economic value in the orbitofrontal cortex is invariant for changes of menu,” *Nature Neuroscience* 2008, vol. 11, no. 1, pp. 95-102. **May 5**

* Padoa-Schioppa, C. “Range-adapting representation of economic value in the orbitofrontal cortex,” *Journal of Neuroscience* 2009, vol. 29, no. 44, pp. 14004-14014. **May 12**

* Bushong, B., King, L. M., Camerer, C. F. and Rangel, A. “[Pavlovian Processes in Consumer Choice: The Physical Presence of a Good Increases Willingness-to-Pay](#),” *American Economic Review* 2010, vol. 100, no. 4, pp. 1556–71. **May 19**

Levy, I., Lazzaro, S., Rutledge, R., and Glimcher, P. “Choice from non-choice: predicting consumer preferences from blood oxygenation level-dependent signals obtained during passive viewing,” *Journal of Neuroscience* 2011, vol. 31, no. 1, pp. 118-125.

Tremblay, L. and Schultz, W. "Relative reward preference in primate orbitofrontal cortex," *Nature* 1999, vol. 398, pp. 704-708.

5. [Time Preferences, Impulsivity and Self Control]: We will learn a bit on time discounting. There is a debate in the literature about whether there is indeed a β and a δ system in the brain. So you should be aware of an earlier paper in *Science* 2004 which we put in the reading below. Impulsivity is related to the issue of self-control, so we will read one paper on self-control.

* Kable, J. and Glimcher, P. "The neural correlates of subjective value during intertemporal choice," *Nature Neuroscience* 2007, vol. 10, no. 12, pp. 1625-1633.

May 26

*Hare, T., Camerer, C., and Rangel, A. "Self-control in decision-making involves modulation of the vmPFC valuation system," *Science* 2009, vol. 324, pp. 646-648.

June 2

McClure, S., Laibson, D., Loewenstein, G., and Cohen, J. "Separate neural systems value immediate and delayed monetary rewards," *Science* 2004, vol. 306, pp. 503-507.

6. [Social Preferences]: Let us learn a bit on inequality aversion, fairness in bargaining and charitable giving; these are social preferences. (GCFP Chp. 20)

* Tricomi, E., Rangel, A., Camerer, C., and O'Doherty, J. "Neural evidence for inequality-averse social preference," *Nature* 2010, 463, pp. 1089-1091. **June 9**

* Eisenegger, C., Naef, M., Snozzi, R., Heinrichs, M., and Fehr, E. "Prejudice and truth about the effect of testosterone on human bargaining behavior," *Nature* 2010, vol. 463, pp. 356-359. **June 16**

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

Moll, J., Krueger, F., Zahn, R., Pardini, M., De Oliveira-Souza, R., and Grafman, J. "Human fronto-mesolimbic networks guide decisions about charitable donations," *PNAS* 2006, vol. 103, no. 42, pp. 15623-15628.