Psychology 2320 Syllabus

What, when, & where

<table>
<thead>
<tr>
<th>Course #s</th>
<th>Psychology 2320, Applying fMRI to cognitive research</th>
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<tbody>
<tr>
<td>Course type</td>
<td>Graduate and advanced undergraduate seminar</td>
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<tr>
<td>When</td>
<td>Fall 2006, Tuesday 2-4pm</td>
</tr>
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<td>Where</td>
<td>WJH Room 950 (9th floor)</td>
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<tr>
<td>Webpage</td>
<td><a href="http://www.courses.fas.harvard.edu/colgsas/5380">http://www.courses.fas.harvard.edu/colgsas/5380</a></td>
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Instructor Info

<table>
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<tr>
<th>Instructor</th>
<th>Yuhong Jiang (Assistant professor, Dept of Psychology)</th>
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<tr>
<td>Office</td>
<td>William James Hall 820 (33 Kirkland Street)</td>
</tr>
<tr>
<td>Email</td>
<td>yuhong ^ wjh * harvard * edu</td>
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<td>Office hours</td>
<td>by appointment</td>
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Course Description

Neuroimaging, particularly functional Magnetic Resonance Imaging (fMRI), is becoming a common tool to study the neural substrates for human cognition. This course will include a brief overview of brain imaging technology, steps one would go through from having a good experimental idea to publishing an fMRI paper, and a discussion of the merits and limitations of neuroimaging as a tool for cognitive neuroscientists.

This seminar is organized from a user’s and a reader’s perspective. By the end of the class, students should be well prepared to start applying fMRI to their own research, be able to read, understand, and critique papers in brain imaging. Each student will present an overview of previous research in his/her area of interest along with a proposal for a new experiment.

This course vs. other fMRI courses

Other fMRI courses include condensed sessions or semester-long courses run by faculty at MGH-NMR center. They require more expertise on the part of the students and are good for people who have been using fMRI for a while. The current course is geared toward beginners, with a special emphasis on designing good fMRI experiments, which is hard even for experts. This course also offers consultation for first-time fMRI users.

Textbook

No textbook. A preliminary list of readings is included in this syllabus. Readings will be uploaded onto the course webpage every week.

Info for Auditors

Auditors are welcome and encouraged to take the course, but for lack of time, consultation (see schedule) will only be offered to students taking the class for credit.

Expected work & grading
1. (20%) **Presentation of research articles**

Each student taking the course for credit will be required to present at least one research article. For weeks where many papers are assigned, they may be divided between several presenters, as determined on the previous week.

2. (40%) **Written summary of assigned readings and class participation**

When reading materials are assigned for discussions, it is essential that you carefully and critically study the readings, even though you are not the presenter. To encourage this, you will be asked to write a short summary that need not be longer than 1 single-space page. The summary includes: (1) Summary of the study (2-3 sentences); (2) two things that you like about this article; (3) one thing that you didn’t like and wish the authors have done better; (4) one research question to pursue in the future. You must hand in your reading homework to the instructor (yuhong@wjh). The written homework should be submitted via email, and it is due at 12:00 noon on Tuesday, prior to our meeting. No late submissions will be accepted.

3. (40%) **Written research proposal and presentation**

Each student taking the course for credit will prepare a research proposal (no more than 3000 words including *everything*). The proposal will include a brief review of the literature in the topic of interest (from neuroimaging to behavioral measures), a description of a new question that could be addressed with fMRI (or an old question that could be addressed by a better design), and a proposal of the actual experimental design to be suggested (based on our discussion of design issues) and approaches used to analyze the data. The proposed study will not actually be conducted. I would be happy to provide consultation on potential projects. More instructions on the proposal will be given in Week 8’s class.

**Consultations:** Week 3 & Week 12’s classes will be held individually between each student taken the class for credit and the instructor (for 30 minutes each). Email Yuhong to arrange a time for the consultation. Week 3’s meeting serves as initial consultation for potential projects, and Week 12’s meeting serves as a final check.

**Presentation (15%):** The student should give a short 20-minute overview of the background and their proposal, followed by a 10-min discussion. Students who themselves are involved in fMRI research must prepare a proposal for a project they have not yet begun and will not form part of their thesis work.

**Written proposal (25%):** The entire written proposal should not exceed 3,000 words (including references and everything else). A preliminary draft is due at 12pm on the assigned presentation date, in Weeks 12-13. The final proposal is due at 12:00 noon on 12/19/06. No extension will be granted.

**Preliminary Course Outline**

Here’s a preliminary outline of the material that we’ll cover in this course. Note that there will be didactic lectures in the beginning. Once the basics are taught, students’ presentations and discussions will occupy most of the weekly meeting. The exact timing of these lectures and the exact readings are very subject to change: We may end up spending more time than
is listed here on topics that strike you as especially interesting or difficult. Overall, I encourage you to interact with me regarding this material: If there are any topics you would like to add, or to cover in more depth, let me know!

Week 1: 9/19/06: Introduction to the course

- An introduction to a selected few old studies that demonstrate how fMRI is applied to cognitive research.
- Organizational meeting: divvy up the presentations
- Course requirements and guidelines for projects
- In-depth topic for serious potential users: rudimentary technical skills

Week 2: 9/26/06: Become an fMRI user: general procedure I: Data collection

- From having a good experimental idea to publishing an fMRI article: (1) experimental design & data collection.
- In-depth topic: computer set-up

Readings: Written homework required for any one of the three

Week 3: 10/3/06: Individual Consultation 1

- No in-class meeting today
- Email Yuhong to arrange a 30-min individual meeting for consultation of an fMRI project

Week 4: 10/10/06: Become an fMRI user: general procedure II: Data analysis

- Analyzing and reporting fMRI data
- In-depth topic: Regions of Interest versus whole brain analysis

Readings: Written homework required for any one of the four

Week 5: 10/17/06: Underlying mechanism I. Metabolism and neuronal activation; simple MR physics

- How can blood flow/blood oxygenation index neuronal activity? How can such signals be measured non-invasively?
- **In-depth topic:** Simple MR Physics

**Readings:** No written homework.


(2) Introduction to MRI at [www.simplyphysics.com/MRIIntro.html](http://www.simplyphysics.com/MRIIntro.html)

(3) Logothetis NK (2002). The neural basis of the blood-oxygen-level-dependent functional magnetic resonance imaging signal. Philosophical Transaction of the Royal Society of London, B. Biological Sciences, 357(1424), 1003-1037. (skim through)

**Week 6: 10/24/06: Know your signal I. Temporal summation basics**

- How the experimental design used in fMRI studies has evolved.
- In-depth topic: fMRI adaptation paradigm
- **Readings:** Written homework required for any 1 of the 3
  (2) Buckner RL et al. (1996). Detection of cortical activation during averaged single trials of a cognitive task using functional magnetic resonance imaging. PNAS, 93, 14878-14883.

**Week 7: 10/31/06: Know your signal II. Temporal summation application – optimize exp design**

- How properties of the hemodynamic response constrain experimental design, and how to optimize it.
- In-depth topic: SPM & FreeSurfer; optseq2 in FreeSurfer
- **Readings:** Written homework required for any 1 of the 3
  (1) Price CJ et al. (1999). The critical relationship between the timing of stimulus presentation and data acquisition in blocked designs with fMRI. NeuroImage, 10, 36-44

**Week 8: 11/7/06: Know your signal III. Hemodynamic response function**

- What’s the shape of the hemodynamic response function and how consistent it is across sessions and across individuals?
- In-depth topic: Retinotopic mapping
- **Readings:** Written homework required for any 2 of the 4 articles
Week 9: 11/14/06: **Underlying mechanism II. BOLD versus neuronal activation**

- What is the relationship between the fMRI signal and neuronal signals?
- **In-Depth topic:** ERP, fMRI, single-cell recording
- **Readings:** Written homework required for #1

Week 10: 11/21/06: **The resting human brain**

- Certain brain regions often decrease their BOLD activation during difficult cognitive tasks. Where are they? Can they be positively activated? What does it mean?
- **In-depth topic:** The default mode vs. social cognition
- **Readings:** Written homework required: select 1 from the list

Week 11: 11/28/06: **Final project consultation II**

No in-class meetings. Please email Yuhong to arrange a 30-min individual meeting.

Week 12: 12/5/06: **Modularity of the human brain: localized or distributed?**

- One of the biggest question about brain organization is whether functions are localized or distributed
- We will use face perception as an example to make an in-depth coverage of the debate
- **Readings:** Written homework required for any 2 of the 4.

Week 13: 12/12/06: **Presentations of student proposals.**

End of the semester. No meetings during the reading period. Final, final draft of paper (3000 words or less) due at noon on December 19, 2006, to WJH 820. No extension will be granted.