CLPS 1490 Syllabus
Functional Magnetic Resonance Imaging: Theory and Practice
Fall, 2012 TTh 2:30-4:00pm
Metcalf 107

Instructor
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Course Goals

The objective of the course is to provide introductory training in both the theory and use of functional magnetic resonance imaging (fMRI) as a cognitive neuroscience methodology. Lectures will focus primarily on the discussion of basic concepts, and will include some tutorials. Problem sets and a research project conducted in stages throughout the semester will complement lectures to provide practical training.

At the conclusion of the course, students should be able to:
(1) Design, conduct, and analyze a basic fMRI experiment.
(2) Critically evaluate the use of fMRI methods in primary research papers.
(3) Independently pursue additional training in advanced techniques and methods, as necessary for their own research.

Primary Textbook

Huettel, S. A., Song, A. W., and McCarthy, G. (2009). *Functional Magnetic Resonance Imaging,* 2nd Edition. Sunderland, MA: Sinauer Associates, Inc.

Additional References

Poldrack, R. A., Mumford, J. A., and Nichols, T. E. (2011). *Handbook of Functional MRI Data Analysis*. New York, NY: Cambridge University Press.

Jezzard, P., Matthews, P. M., Smith, S. M. (2003). *Functional MRI: An Introduction to the Methods*. Oxford, UK: Oxford University Press

Course Policies

Grade distribution	*Grade Ranges*
Attendance/participation/oral presentations: 20%	A – 90-100%
Problem sets: 40%	B – 80-89%
Project proposal 15%	C – 70-79%
Final project paper: 25%	NC – <70

Late Policy

Course material is cumulative and the six problem sets assigned throughout the term are intended to gain mastery of concepts covered in lecture and to provide you the necessary technical skills to complete your independent research project. Thus, completing these assignments on time is crucial in order not to fall behind in the course. These short assignments must be turned in at the *beginning* of class on the day they are due. For each day that they are late without an acceptable excuse, one letter grade will be deducted.

The written experiment proposal and the final project paper should be turned in to Metcalf 341 by 5 pm on the day they are due. For each day that they are late without an acceptable excuse, one letter grade will be deducted.

Course Website

The course has a MyCourses page. On the webpage, you will find the course syllabus, lectures, readings, problem sets, and other course materials. In addition, there are some useful links to web resources related to fMRI analysis and methods. If you find other on-line resources that you think would be helpful to others, please let a course instructor know for posting on the course website.

Scanning at the Brown MRI Research Facility (MRF)

The final paper for the course will describe the results of an independent fMRI project that you will conduct in stages over the course of the term. Each project will be conducted by a team of 5 students. Scanning will take place at the Brown MRI Research Facility (MRF) during two weekend sessions (**Nov. 11th** and **Nov. 18th, 10am-4pm**). Your attendance at one of these is required. If you know you will have a conflict with both dates, please let Prof. Badre know immediately.

In order to enter the MRI control room or magnet room, students must complete an MRI safety screening form and receive Level 1 safety training. We will be doing the primary safety training on **Sep 27**. If you know that you will be unable to make this meeting, please see Prof. Badre immediately to make alternative arrangements.

A subset of students will also be given the opportunity to participate as research subjects in the class experiments. We will take volunteers later in the term. Please

note, choosing not to participate as a subject will not affect your grade negatively, and likewise choosing to participate as a subject will not affect your grade positively. However, for those interested in pursuing MRI research, it is a helpful educational experience to see what it is like to be a research subject; and you get a picture of your own brain!

Computing Resources

Most data analysis for the course will use the Statistical Parametric Mapping (SPM8) software based in Matlab. This is free software and can be installed on most systems running Matlab (downloadable for free from Brown software services). The link to the SPM website for downloading their software is available on the class myCourses page. You are welcome to install the relevant software on your home or lab computer (it is all freely available at Brown or over the web). The TA (Scimeca) has agreed to provide support for this solution, if you choose to do so.

For those not installing the software on their own machine, the software has been installed on all the machines available in Metcalf 107.

The computer lab is open weekly class-related work: M-Th 7:00-9:00pm

In addition, TA office hours (M: 1-3pm) will routinely be held at the computing site.

A couple of additional reminders about using the computer lab:

(1) Please do not leave the door to the lab open when you leave the lab for any reason.

(2) Please do not bring any food or drink into the computer lab.

Class Schedule

Date	Topic	
Sep. 6	Introduction	
	Reading Course Syllabus	
Sep. 11	The BOLD signal	
	Reading HSM: Ch. 7	
Sep. 13	MRI Physics I (Worden)	
	Reading HSM: Ch. 3-4	
Sep. 18	MRI Physics II (Worden)	
	Reading HSM: Ch. 5	
Sep. 20	MRI Signal and Noise	
	Reading HSM: Ch. 8, pp. 255-267	
Sep. 25	Experimental Design I	
	Reading HSM: Ch. 9, pp. 293-310	***Problem Set 1 is due***
Sep. 27	MRI Safety & Ethics – **NOTE: Meet at SFH 350**	
	Reading HSM: Ch. 2, pp. 44-55 Ch. 14, pp. 494-504	
Oct. 2	Experimental Design II	
	Reading HSM: Ch. 9, pp. 313-327	***Problem Set 2 is due***
Oct. 4	Experimental Design III	
	Reading	

Liu (2004). Efficiency, power, and entropy in event-related fMRI with multiple trial types, Part II: Design of Experiments *NeuroImage, 21,* 401-413.

Oct. 9 Experimental Proposal Presentations

Oct. 11 Experimental Proposal Presentations

Experiment proposal due

Oct. 16 Stimulus Presentation Programming Workshop

Oct. 18 Preprocessing I

Reading

HSM: Ch. 8, pp. 267-280

Oct. 23 Preprocessing II

Reading ***Problem Set 3 due***

HSM: Ch. 8 pp. 280-290

Oct. 25 Preprocessing III

Oct. 30 Univariate Analysis I

Reading

HSM: Ch. 10, pp. 333-351

Nov. 1 Univariate Analysis II

Reading

HSM: Ch. 10, pp. 351-374

Nov. 6 Univariate Analysis III

Reading

Poldrack (2007). Region of interest analysis for fMRI. *SCAN, 2,* 67-70.

Nov. 8 Univariate Analysis IV

Reading ***Problem Set 4 due***

Henson (2006). Forward inference using functional neuroimaging: Dissociations versus associations. *TICS, 10(2),* 64-69.

Poldrack (2006). Can cognitive processes be inferred from neuroimaging data? *TICS, 10(2),* 59-63.

D'Esposito et al. (2003). Alterations in the BOLD fMRI signal with ageing and disease: A challenge for neuroimaging. *Nature Reviews Neuroscience, 4,* 863-872.

Nov. 11 ***** MRF Scanfest I *****

Nov. 13 Visualizing and Reporting fMRI Data

Reading

HSM: Ch. 14, pp. 485-490

Nov. 15 Guest lecture – Topic TBA (Moore)

Nov. 18 ***** MRF Scanfest II *****

Nov. 20 Multivariate Approaches I

Reading

HSM: Ch. 11, pp. 386-399

Problem Set 5 due

Nov. 22 **No Class - Happy Thanksgiving!**

Nov. 27 Multivariate Approaches II

Reading

Friston et al. (1997). Psychophysiological and modulatory interactions in neuroimaging. *NeuroImage, 6,* 218-229.

Sun et al. (2004). Measuring interregional functional connectivity using coherence and partial coherence analyses of fMRI data. *NeuroImage, 21,* 647-658.

Nov. 29 Multivoxel Pattern Classification and Machine Learning

Reading ***Problem Set 6 due***

HSM: Ch. 11, pp. 401-412

Dec. 4 Structural Imaging and Diffusion Tractography (Barredo)

Dec. 6 Group Project presentations

Dec. 11 Group Project presentations

Dec. 12 ***** FINAL PAPER DUE BY 5pm*****