NEUROIMAGING
PSYC 555 Spring 2013

Time: 4:30pm-7:10 pm Thurs
Classroom: David King Hall 2073
Instructor: **James Thompson**
                     2056 David King Hall
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Office Hours: 3:30pm-4:30pm Thurs

Objectives:
Brain imaging methods, particularly functional magnetic resonance imaging (fMRI), structural MRI, and event-related potentials (ERPs), are becoming common tools to study specialized human brain regions involved in cognitive functions. This course will cover: a brief overview of fMRI methods, experimental design and analysis issues in fMRI, structural MRI techniques and how they can contribute to cognitive neuroscience, and an overview of ERP methods. Throughout the course we will discuss the merits and limitations of neuroimaging as a tool for cognitive neuroscientists. By the end of the class, students should be able to read, understand and critique papers in brain imaging, and have a reasonable understanding on how to successfully design and analyze a neuroimaging study.

Required Readings:
Huettel SA, Song AW, McCarthy G (2014). *Functional Magnetic Resonance Imaging 3rd Edition*. Sunderland, MA: Sinauer.

Additional papers for presentations/discussion will be available via the course website.

Format:
This course will consist of a *few* lectures that cover particular technical areas, but the majority of the course will consist of discussion driven by students presenting papers. As many of the concepts that will be covered may be new to most of you, I expect everyone to have read the assigned papers before the class. Prerequisites for the course are: basic (undergraduate level) knowledge of cognitive psychology and neuroscience (or physiological psychology), or willingness to cover this ground through your own reading. A willingness and ability to do extensive research outside the assigned reading, seek assistance if you are finding any area difficult, and participate in class discussion, is essential.

Attendance Policy:
Although you will not be graded on attendance, this is a graduate level course and I expect to see you in class each week.

GMU Honor Code:

George Mason University has a code of Honor that each of you accepts by enrolling as a student. You should read and become familiar with this code at http://mason.gmu.edu/%7Emontecin/plagiarism.htm. The expectation is that all of the work you do for this class will be the work of one individual. However, you are fully encouraged to discuss the readings and topics raised in this class with your fellow students.

Disabilities:
If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

Assessment: Assessment will consist of two take-home quizzes (20%), a class presentation and opinion paper (20%), class participation (20%), and a group project (40%).

Class Presentation & Opinion Paper 20%
Most of this class will consistent of discussion of papers. You will be expected to give a brief (10 minute **maximum**) presentation from the assigned readings (either from the Special Topics or the Neuroimaging Controversy sections) and then lead the discussion. I have chosen each of the readings with a specific goal in mind, and many of the readings may contain information that is unfamiliar to you, so it is <u>essential that you briefly discuss with me your paper before your presentation</u>.

Along with your presentation you will be required to write a brief (1000 words **maximum**) opinion paper about the topic of your presentation.

Class Participation 20%
Keep in mind, if you are not presenting a paper that week make sure you come to class with opinions about the papers we will discuss!

Take-home Quizzes 20%
The take home quizzes will consist of short answer items based on material covered in the classes.

Group Project 40%
During the course of the semester you will design, conduct, and analyze a basic fMRI experiment examining the brain response to faces versus houses. Groups of three students will work together to decide on the study design, analyze the data, and present the results to the class. Each team member will then prepare their own written report of the project.

Grades:
Total 100 points, letter grades as follows:

A: 90-100	B-: 77-79
A-: 87-89	C: 70-76
B+: 84-86	F: 0-69

B: 80-83

Important Dates
Last day to drop without penalty Sep 2; Last day to drop Sep 26; Thanksgiving Nov 26-30.

SCHEDULE OF CLASSES

Weeks 1 & 2:
Basics of the MR Signal
What is MRI and how does it work? Overview of topics, assignment of presentations.

Lecture Notes for Weeks 1&2

Week 3
From MR Signal to Images
What is k-space? Slices, Volumes, Voxels.
Take home quiz #1

http://www.revisemri.com/tutorials/what_is_k_space/
http://www.revisemri.com/tutorials/how_k_space_works/

Lecture Notes

Week 4:
Physiology & Metabolics of fMRI
What is the Blood Oxygen Level Dependent (BOLD) response? What is the contribution of neuronal spiking vs local field potentials?

Week 5:
fMRI Design and Analysis I
Safety issues in MRI research. Sources of noise in fMRI. Preprocessing – motion correction, slice timing, etc.

Week 6:
fMRI Design and Analysis II
Basic fMRI designs.
Take home quiz #2

Week 7:
fMRI Design and Analysis III
GLM and multiple comparisons.

Week 8:
Neuroimaging Controversy: Voxel-wise Factorial Models vs Independently Identified Regions of Interest.
What is the best strategy for the analysis of fMRI data?

Friston KJ, Rotshtein P, Geng JJ, Sterzer P, Henson RN. (2006). A critique of functional localisers. Neuroimage. 30:1077-87

Saxe R, Brett M, Kanwisher N. (2006). Divide and conquer: a defense of functional localizers. Neuroimage. 30:1088-96; discussion 1097-9.

Vul E, Harris C, Winkeilman P, Pashler H (2009). Puzzlingly high correlations in fMRI studies of emotion, personality, and social cognition. Perspectives on Psychological Science. 4, 274-290.

Week 9:
Special Topic Area: Retinotopic/Spatiotopic mapping.
Phase-encoding imaging

Wandell BA, Dumoulin SO, Brewer AA. (2007). Visual Field Maps in Human Cortex. Neuron, 56:366-383.

Sereno, MI, Dale AM, Reppas JB, Kwong KK, Belliveau JW, Brady TJ, Rosen BR, Tootell RBH. Borders of Multiple Visual Areas in Humans Revealed by Functional Magnetic Resonance Imaging. Science 268:889-893.

Kastner S, DeSimone K, Konen CS, Szczepanski SM, Weiner KS, Schneider KA. (2007). Topographic maps in human frontal cortex revealed in memory-guided saccade and spatial working-memory tasks. J Neurophysiol. 97:3494-507

Week 10:
Special Topic Area: fMRI Adaptation and Repetition Effects
Am I ever going to see your face again?

Grill-Spector K, Henson R, Martin A. (2006).Repetition and the brain: neural models of stimulus-specific effects. Trends Cogn Sci. 10:14-23.

Rotshtein P, Henson RN, Treves A, Driver J, Dolan RJ. (2005). Morphing Marilyn into Maggie dissociates physical and identity face representations in the brain. Nat Neurosci. 8:107-13.

Summerfield C, Trittschuh EH, Monti JM, Mesulam MM, Egner T. (2008). Neural repetition suppression reflects fulfilled perceptual expectations. Nat Neurosci. 11:1004-6.

Week 11:
Special Topic Area: Multivoxel Pattern Analysis
Decoding stimuli from neural signals

Huettel et al (2008). Chapter 11 pages 408-415

Haxby JV, Gobbini MI, Furey ML, Ishai A, Schouten JL, Pietrini P. (2001). Distributed and overlapping representations of faces and objects in ventral temporal cortex. Science. 293, 2425-30.

Kamitani Y, Tong F. (2005). Decoding the visual and subjective contents of the human brain. Nat Neurosci. 8, 679-85.

Norman KA, Polyn SM, Detre GJ, Haxby JV. (2006). Beyond mind-reading: multi-voxel pattern analysis of fMRI data. Trends Cogn Sci. 10, 424-30.

Week 12:
Event-Related Potentials.
How do we measure event-related potentials and what do they mean?

Luck, SJ. An Introduction to the Event-Related Potential Technique. Oxford: Oxford University Press. Ch 1

Weeks 13-14:
Class Presentations