Time: 1:30pm-4:10pm Mondays
Classroom: Innovation Hall
Instructor: James Thompson
email: jthompsz@gmu.edu
Office Hours: 11.30am-12.30pm Mondays

Objectives:
Brain imaging methods, particularly functional magnetic resonance imaging (fMRI), structural MRI, and event-related potentials (ERPs), are 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 these methods can contribute to cognitive neuroscience. 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:

It is important to keep up with the reading, especially the assigned chapters from Huettel et al. This book does have a conceptual path and a quantitative path, so try at least to keep up the conceptual path. If you are struggling to keep up, make sure to let me know early!

Additional papers for presentations/discussion and online exercises will be available via the course Blackboard website.

Format:
This course will consist of a weekly seminar/lecture/discussion and supplementary videos and notebooks posted online. As many of the concepts that will be covered may be new to most of you, I expect everyone to have read the assigned chapters/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 the zoom meeting 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.

**Access to Computers:**
Students must have access to their GMU Email account. Students should feel free to communicate with me via email. Updates and notifications will be sent to the class email list using your GMU email address. If you need to use university facilities, you can find out about location and hours of university facilities at http://www.labs.gmu.edu/ or ask at the information desk at the Johnson Center. I will ONLY use your GMU Email address to contact you. Please use and check this address frequently. You may forward your GMU email to another address if you like, but please ensure that you are receiving the email to your GMU Email address.

**Cancellation Policy:**
In case class needs to be canceled due to an unexpected event, students will be informed via email as soon as possible. Make-up sessions will be arranged for canceled classes.
Technology:
You will need to have or have access to a computer running Windows, mac OS, or Linux. You will also need a gmail account in order to run Google Colaboratory workbooks. You will also need access to Blackboard for assignments and class materials.

Assessment:
Assessment will consist of two take-home quizzes (20%), analysis mini-projects (20%), class participation (20%), and a final project (40%).

Analysis mini-projects 20%
We will use Colabs notebooks to work through some preprocessing and analysis exercises. These exercises problems will be performed using Python, although I expect you will have little to no experience with Python before this class (if you do that is a bonus!). You wont need to do much (if any) coding, but we will run through the code for each exercise and I want you to write up your understanding of the results of the exercises and post to Blackboard. You will need to have a Google Gmai/Drive account.

Class Participation 20%
I expect you to contribute to discussions during our weekly class, and discussions via the Blackboard discussion boards.

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

Final Project 40%
The final project will comprise an analysis, write up, and presentation of an fMRI dataset we have worked through during the semester. You will be expected to prepare a report (4000 words maximum) of a) the literature behind the data we use (from neuroimaging or other domains such as cognitive science or psychophysics); b) a hypothesis about the pattern of results you expect to find; c) a description of the preprocessing and analysis steps that you took; d) a description of the results; e) a discussion of your findings; and f) present your findings to the class as a 5min video. You will be expected to incorporate the ideas discussed in the lectures and discussions presented throughout the course into your written proposal and its presentation. Additional guidelines will be provided in class.
Grades:
Total 100 points, letter grades as follows:
A: 90-100
A-: 87-89
B+: 84-86
B: 80-83
B-: 77-79
C: 70-76
F: 0-69

Important Dates: Last day to add: Jan 31th. Last day to drop Feb 14th. Spring Break Mar 14th-20th

SCHEDULE OF CLASSES

Jan 24
Introduction and overview
What is an MRI and how does it work?
Huettel, Song, & McCarthy (2014) Chapter 2

Jan 31
Basics of the MRI Signal: Spins, Excitation, Relaxation
Huettel, Song, & McCarthy (2014) Chapter 3 (focus on the conceptual path)
Mini-project #1

Feb 7
From MR Signal to Images
Spatial Encoding, Contrast, Slices, Volumes, Voxels.
Huettel, Song, & McCarthy (2014) Chapters 4(focus on the conceptual path) and 5
Take home quiz #1

Feb 14
Neurovascular Coupling
Huettel, Song, & McCarthy (2014) Chapter 6

Feb 21
The BOLD Response
Huettel, Song, & McCarthy (2014) Chapter 7
Feb 28
fMRI Design and Analysis I
Safety issues in MRI research. Sources of artifact and noise in fMRI. Preprocessing
Huettel, Song, & McCarthy (2014)  Chapter 8
Miniproject #2

Mar 7
fMRI Design and the GLM
Huettel, Song, & McCarthy (2014)  Chapters 9-10  (you can stop at page 387)
Take home quiz #2

Mar 14
No Class

Mar 21
Analyze an fMRI dataset

Mar 28
Whole brain analysis, regions of interest, multiple comparisons
Huettel, Song, & McCarthy (2014)  Chapter 10 (starting at page 388)
Miniproject #3

Apr 4
Functional connectivity analysis

Apr 11
Multivoxel pattern analysis

Apr 18
Naturalistic stimuli and intersubject correlations

Apr 25
Structural MRI and diffusion-weighted imaging

May 2
Presentation of final projects