Department of Psychiatry Seminar Series:

**Introduction to Functional and Anatomical Brain MRI Research**

Dates: Fridays (08-01-2014 – 08-29-2014)

Time: 12:00-1:30PM

Location: L-431

**Instructors**: Dr. Sarah Keedy, Dr. Henk Cremers

Series summary: This seminar is designed to provide an introduction to MRI research as it is most commonly implemented in behavioral neuroscience and related fields. Conceptual as well as practical aspects will be covered. Those new to such work will ideally feel more empowered to move forward in implementing MRI brain studies directly, and also will appreciate the landscape of resources they can access for help. Opportunities to practice working with MRI data between seminars will be included.

**Resources:**

**Online:**

* <http://www.fmrimethods.org/index.php/Main_Page>
* <http://www.fil.ion.ucl.ac.uk/spm/>
* <http://afni.nimh.nih.gov/afni/>
* <http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/>

*SPM is the program we will use most for demonstration and homework throughout the seminar. In addition to demonstrations during the seminar, step-by-step instructions on how to analyze the practice data, made available on the Midway supercomputer for this seminar, can be found in the SPM manual (see SPM website).*

Seminar material will be archived at:

http://cnpru.bsd.uchicago.edu/ImagingCourse.html

**Textbooks:**

* Nichols, Mumford, Poldrack (2011). *Handbook of Functional MRI Data Analysis.*
* F. Gregory Ashby (2011).  *Statistical Analysis of fMRI Data.*

# Huettel, Song, McCarthy (2008).  *Functional Magnetic Resonance Imaging*.

**Program:**

**Week 1: Introduction – SK/HC**

* Welcome & overview – SK
* Useful Resources – HC
* What is (f)MRI ?–
	+ basic physics
	+ the BOLD response– HC
* Structural MRI
	+ Voxel Based Morphometry
	+ Structure tracing (hand or automated)
	+ Surface measurements
	+ DTI
* Functional MRI
* Overview of analysis pipeline
* Overview of Main software Packages + Demonstration
	+ Matlab & SPM - HC
	+ FSL – HC
	+ AFNI - SK

Homework: Get on Midway, find the practice data, launch software, look at brains

**Week 2: Processing of (f)MRI Images – HC**

* Overview of preprocessing steps:
	+ Slice-time correction
	+ Image registration
	+ Tissue-classification
	+ Normalization
	+ Temporal Filtering
	+ Spatial Smoothing
* Recommendations of preprocessing settings
* Demonstration of preprocessing data, assessing data quality

Homework: Preprocess practice dataset

**Week 3: Statistical Analysis of (f)MRI data – HC**

* The General Linear Model.
* Subject-level analysis
* Group-level analysis
* Statistical inferences (statistical test, multiple comparisons problem)
* Whole brain vs. Region Of Interest approaches
* Resting-State fMRI
* Demonstration of subject and group analyses

Homework: Group analysis practice dataset

**Week 4: Planning MRI Research to Address Your Scientific Question - SK**

* ”Optimal design” considerations:
	+ Block vs. Even-Related designs
	+ How many factors?
	+ How many trials?
	+ How to order trials?
	+ How to time trials?
	+ How many subjects?
	+ Longitudinal design factors
* Demonstration of task-optimization and power calculations

Homework: TBD

**Week 5: Interpretation, Limitations and new applications of (f)MRI –HC**

* What can (f)MRI tell us?
	+ Structural MRI
	+ fMRI: Activation and Reverse inferences
* Limitations:
	+ Physics
	+ Statistical
	+ Psychological
* Beyond “basic” fMRI: overview of advanced analyses options– connectivity, networks, pattern-recognition, meta-analysis
* Demonstrations (TBD)

Homework: TBD