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HST.583 Functional Magnetic Resonance Imaging: Data Acquisition and Analysis  
Fall 2008

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## Problem Set #1 Neural Systems

HST.583

September 8, 2008

Due Date: September 24, 2008

- 1) You have been learning about the many unique features of the fMRI environment. You have also been learning about complexities of human brain function that we wish to study by scanning subjects in this environment.
  - A) (5 points) Please describe five (5) attributes of the fMRI environment and
  - B) (5 points) for each attribute describe at least one neural system that would be affected by this attribute and
  - C) (10 points) give an example of an approach that might overcome this limitation (you may either cite a published study or provide an original, feasible idea).

Example:

- A) Noise made by gradient coils during scan acquisition
  - B) The neural circuitry associated with tone perception
  - C) Special pulse sequences that cluster image acquisition so that auditory stimuli can be delivered during the silences (Talavage TM, Edmister WB, Ledden PJ, Weisskoff RM. Quantitative assessment of auditory cortex responses induced by imager acoustic noise. Hum Brain Mapp. 1999;7(2):79-88. PMID: 9950065)
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- 2) (20 points) Choose one example from among the known neural systems and describe the detailed knowledge from all available sources of information (e.g. human and animal electrophysiology, optical imaging, lesion, track labeling studies, etc) of the spatial representation of that system. Then describe the most detailed spatial information that could be obtained using fMRI, include a description of the kinds of experimental paradigms used to obtain these results. Cite your references. For those of you with fMRI experience, do not select a neural system in which you are currently working or have worked in the past.
  
  - 3) (10 points) What is the most common cause of morbidity and/or mortality in fMRI studies? How can it be prevented?
  
  - 4) (20 points) Name 3 hypotheses in the study of emotion and its neural representation that

can be tested with functional imaging and, equally importantly, 3 hypotheses that can't be addressed with fMRI or like approaches.

- 5) (30 points) Describe in as much detail as you can all the neural processing that is going on during the fMRI task described below. State explicitly whether or not you could detect this activity in the recorded fMRI data. Note what additional information you would need if you were being asked to analyze this data (e.g. how you would tease out each component of interest).

“Subject lies supine in scanner, eyes open, box with 3 buttons (one under each of the first three fingers of their right hand) held throughout, earphones on connected to stereo playing a pre-recorded Red Sox game. Each foot is resting against a flat surface that can vibrate at four different intensities. The task is to respond as fast as possible to the onset of each randomly occurring vibration (can be left or right foot), using the button that best describes whether the intensity of the vibration is 1-less than, 2- same as, or 3- stronger than they felt on the previous stimulus. There is a flash of light for 80 milliseconds just prior to the onset of each stimulus. Subjects have been trained immediately prior to scanning by experiencing each one of the four intensities of vibration once only.”