

FMRI-guided TMS procedure

I ..Processing the fMRI part

- 1. Do fMRI study with tasks of interest to obtain ROI used for TMS coil guidance.**
- 2. Finger-tapping task can be used to obtain motor cortex activation for motor threshold determination if not using EMG**
- 3. Make sure you also scan a high resolution image (we currently use SPGR) covering ears and tip of nose. This image will be used for rendering in Brainsight for the purpose of coregistration.**
- 4. SPM processing for TMS Brainsight (SPM99 is mostly used currently, although SPM2 could also be used if desired)**
- 5. Realignment for motion correction of functional series-- choose coreg & reslice to obtain r*.img/hdr**
- 6. Perform design matrix setup, stats etc. to obtain activation maps or t-maps.**
- 7. In a new folder, cp over img and hdr of the t-maps (do not cp over the mat files), meanV* img/hdr files and anatomy files (SPGR – if contrast is poor, use John’s IDL rescale_anat program).**
- 8. Coregistration (spm2 does a better job here).**
- 9. Target = spgr (T1 in this case)**
 - a. Object = EPI (meanV*.img)**
 - b. Others = the t-maps**
 - c. Rename the resliced files identifiable to you. Files are ready to be imported into Brainsight.**

II. In the TMS Lab

Psyscope setup for TMS

Check the following:

1. Polaris camera port is connected to the keyspan on the G4 (port 2)
2. Another keyspan is connected from the psyscope button box to the ibook (port 1)
3. Turn the mic volume behind the psyscope all the way down (white line at the bottom, and the circle hole on top).
4. Connect the black/grey 4-button box to the psyscope button box.
5. Open Psyscope program and test button box.
6. During practice, Magstim can also be turned on to allow subject to be familiarized with the click sound.

Operating BrainSight

Steps in getting ready prior to subject arrival

1. Calibrate coils with the CT-169 tracker or LCT006 attached to coil (this has to be done every time the tracker is removed from the coil, if there is multiple sessions/subjects for the day, only need to be done once)
 - a. Place the coil in the coil holder and place it on a flat surface.
 - b. The pointer and coil tracker should be about 5 feet away from the Polaris.
 - c. Turn on the Polaris system.
 - d. Power up the Mac and launch Brainsight
 - e. Open the Polaris window (Menu: Window > Polaris control)
 - f. The Polaris Camera will beep to reset, as the Polaris window opens, or if the serial port is not connected, there will be an error message.
 - g. Expand the Polaris window by clicking on the triangle on the bottom left
 - i. For Display, set passive Polaris C to coil.
 - ii. Set Display to pointer
 - iii. Set Reference to Coil
 - iv. Open Tool Calibrator window (Menu: Windows > Calibrate Tool)
 1. set Tool to pointer and select rom file for coil (CT-169 e.g.)
 2. save Tool Name as coil or sham
 - v. Sample all 8 points on the puck and save file
2. Make a note of where you have save the file, saving it in the tools folder and naming it with a date is recommended
3. Fetch with binary selected, subject's anatomy and functional files to the MAC

4. Import subject's SPGRs in ANALYZE format (Use MR Brain2 for Analyze format anat images and MR Brain3 for functional images). We are currently using radiological convention for brain orientation.
 - a. Draw 3D image using the curvilinear tool to make layers
 - i. Use coronal for cortex and sagittal view for cerebellum, it may provide better viewing if the cerebellum was drawn separately.
 - ii. Input number of guide curves, thickness or use series option
 - iii. Example:

1. Cortex:	start-depth (mm):	0
	End depth (mm):	15
	Step size (mm):	3
2. Cerebellum:	start depth (mm):	0
	End Depth (mm):	10
	Step size (mm):	2
 - iv. When drawing the guide curves, no need to hug sulci etc. just make approx. curves, start from the bottom and left and end on the bottom right (close or leave curves open depending on the default you have set).
 - v. Use the bisection rule to cover the whole brain, drop a curve at the region in the juncture of the temporal and frontal lobes.
 - vi. Use cursor tool to move around the image
 - vii. Short cuts: when curvilinear tool is selected, use control apple to move around image and spacebar to scroll across image. Use "Peeler" tool to save RAM.
 - viii. On one of the windows, click on the 3D icon to see 3D rendering of the brain, check to see if enough volume is covered.
 - b. Identify landmarks on the image using annotate <Mark+>
 - i. BN – bridge of nose
 - ii. TN – Tip of nose
 - iii. RE – Right ear
 - iv. LE – Left ear – use axial view to see ear canal, and sagittal view to identify the tragus and mark the indentation right above (dark area on a T1 image) the tragus and below the cartilage.
 - v. Identify the targets (this can be done manually if SPM prespecified SPM coordinates are used).
 - c. Recommended window views:
 - i. Transverse, coronal, axial, inline90, annotate target, 3D-image window
 - d. Save Project in subject's directory

5. After subject arrives:

- a. Do paperwork, inform-consent, briefing etc.
 - b. Have subject position comfortably in chair, and wear the headband with the ST-614 attached.
 - c. Open the pre-saved project for this subject.
 - d. Use “assisted registration” on the left column and follow through with the assistant.
 - e. Use pointer to identify landmarks stored previously on image on the subject
 - f. Use both hands to hold the pointer with one hand guiding, and make sure the pointer is not pushed too much into the skin
 - g. Click sample when pointer is positioned on landmark.
 - h. Verify landmarks registration with pointer by placing it on all lobes of the brain
 - i. When satisfied, exit out of registration assistant.
6. Change display on upper left corner to the coil being used.
 7. Position coil over the prespecified target. Use “annotation targeting tool” to help positioning of coil.
 8. For motor cortex, the net current should be going from anterior to posterior (anti-clockwise) with the arrows point towards the back of the head.
 9. Always gradually increase the magstim amplitude for subject’s comfort.
 10. Current cbl threshold used is 120% of the motor cortex threshold.

This document is also located at:

<http://www.stanford.edu/group/DesmondLab/Resources.htm>