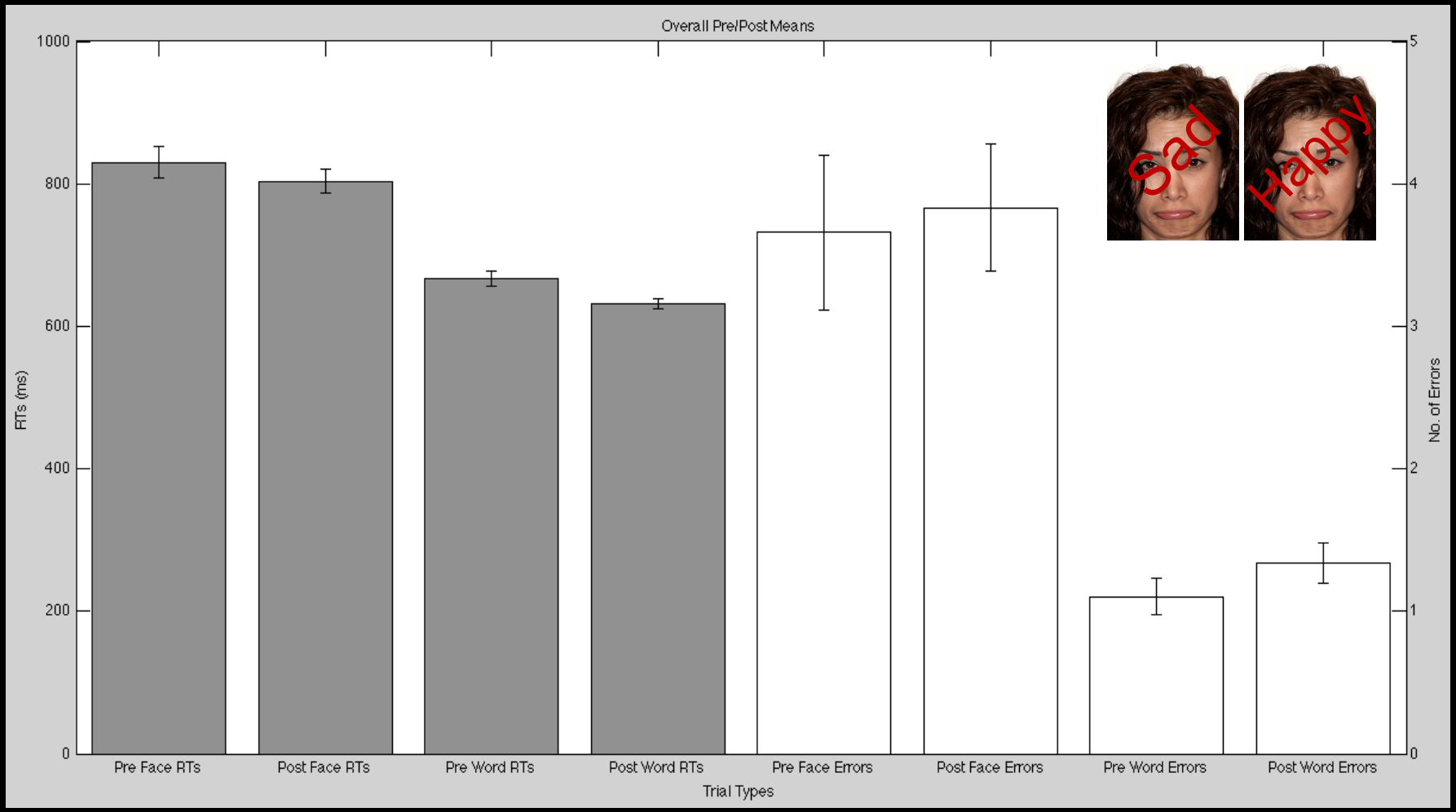
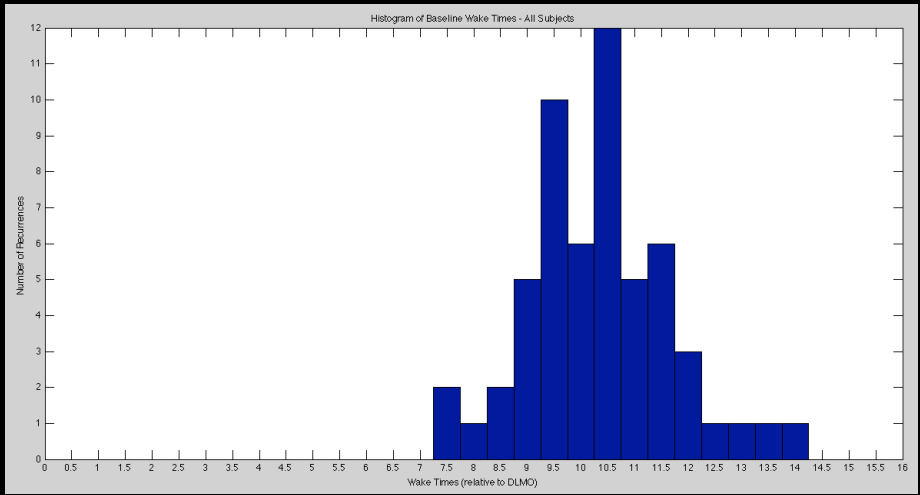
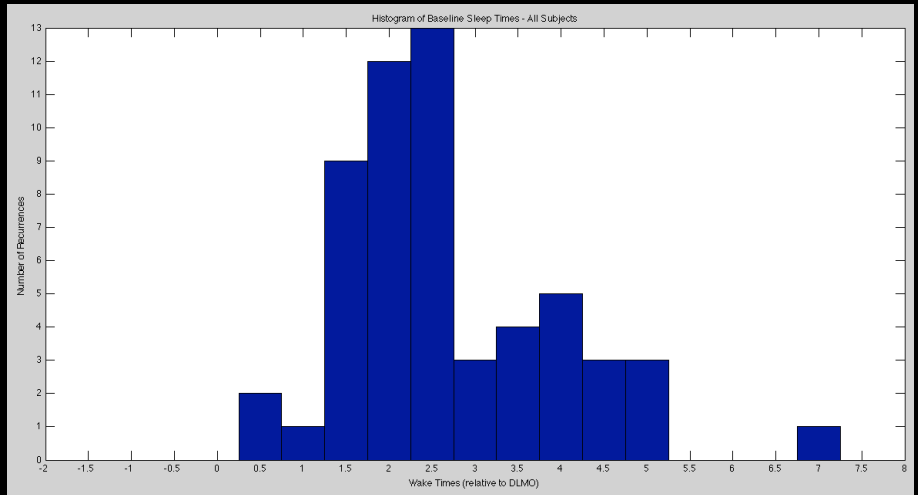
The effects of melatonin on the performance and brain activation of desynchronized people performing the emotional Stroop task

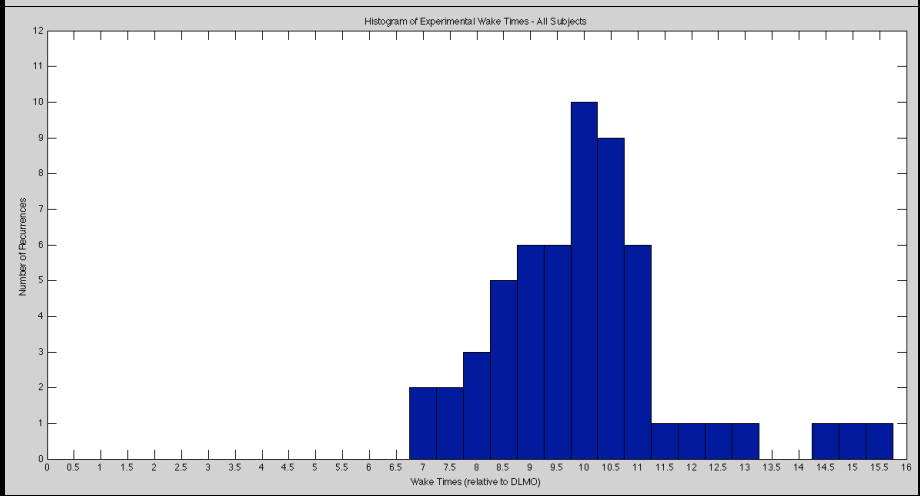
Samantha Leung

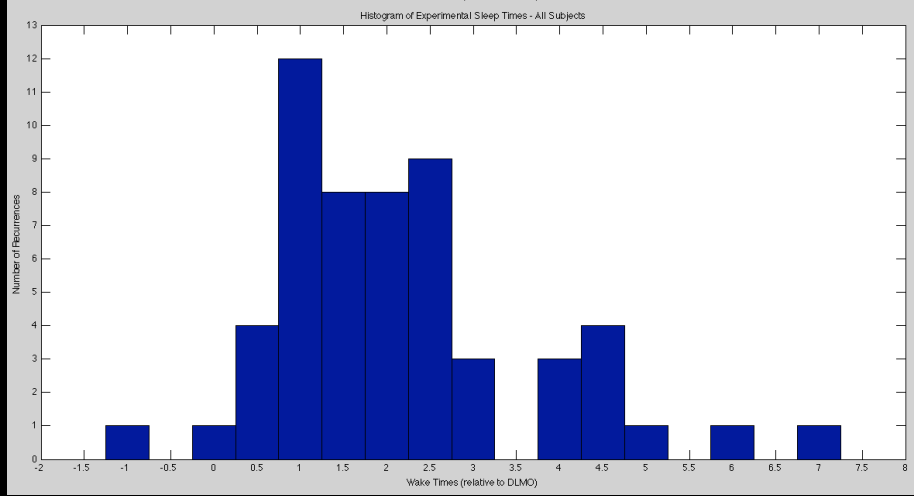


Overall mean reaction times (RTs; grey bars) and errors (white bars) from subjects performing the emotional Stroop task. All subjects reported here took part in the **melatonin** treatment, and their baseline and experimental condition performances are shown for each instruction set (face and word). The error bars signify the standard error of mean (SEM).

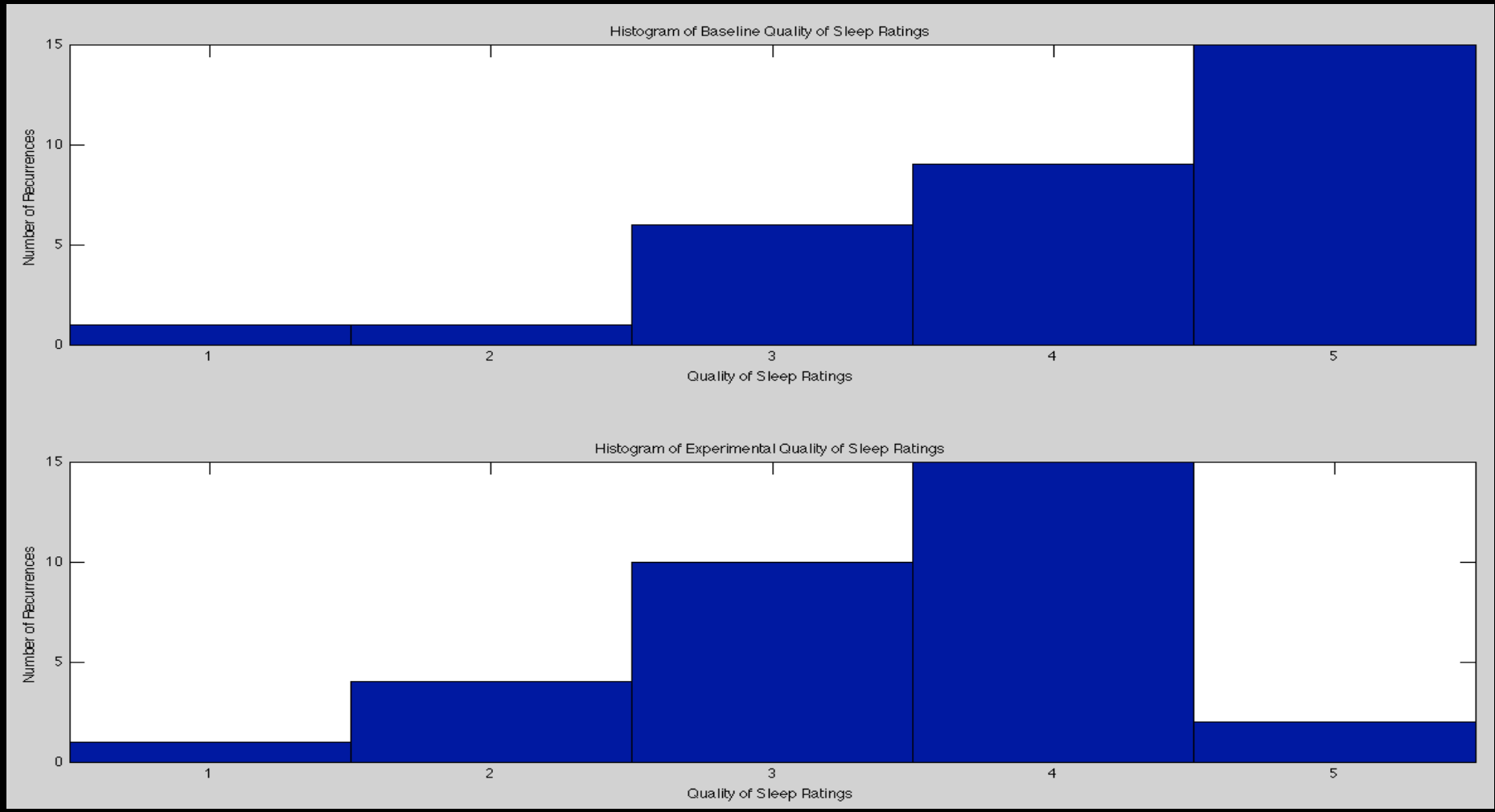




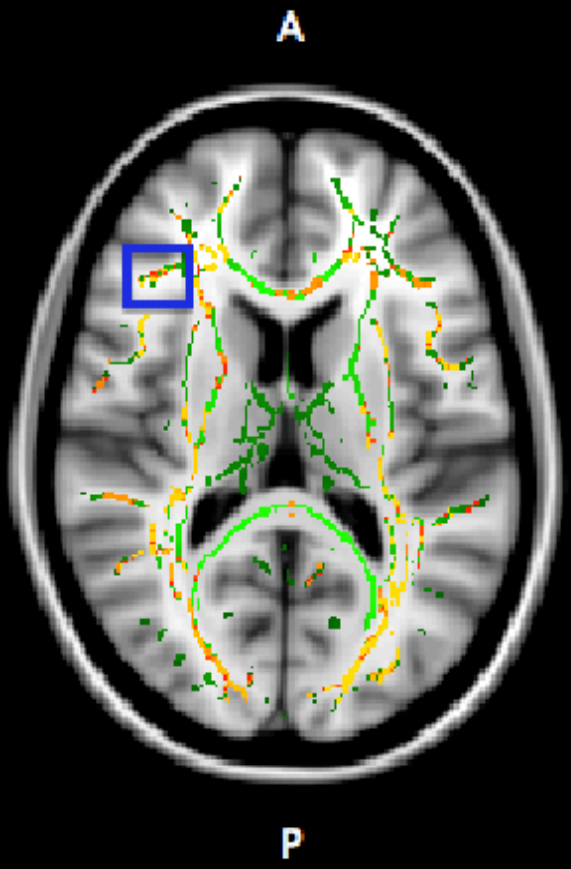


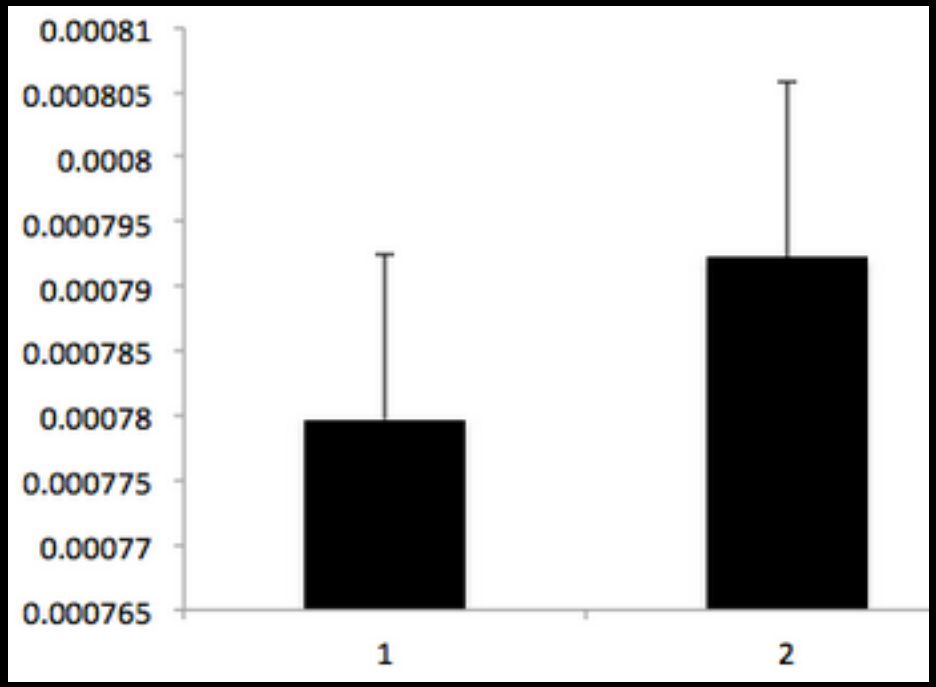


Histograms of subjects' wake (left panels) and sleep (right panels) times during the baseline period (top panels) and the experimental conditions (bottom panels). Numbers on the x-axes represent times relative to dim-light melatonin onset (DLMO = 0). All reported subjects took part in the **melatonin** treatment. Paired *t* tests revealed a significant statistical difference between baseline and experimental condition sleep times ($p < 0.05$), and a trend towards significance for the baseline and experimental condition wake times ($p = 0.07$).



Histograms of subjects' quality of sleep ratings on the 8 days before (top panel) and during the 8 days of (bottom panel) the experimental condition. Numbers on the x-axes represent subjects' reported ratings of their quality of sleep, with the scale as follows: 1 = very poor, 2 = poor, 3 = average, 4 = good, 5 = excellent. Numbers on the y-axes represent frequencies of occurrence. Paired *t* tests revealed a significant statistical difference between baseline and experimental condition sleep quality ratings ($p < 0.005$).



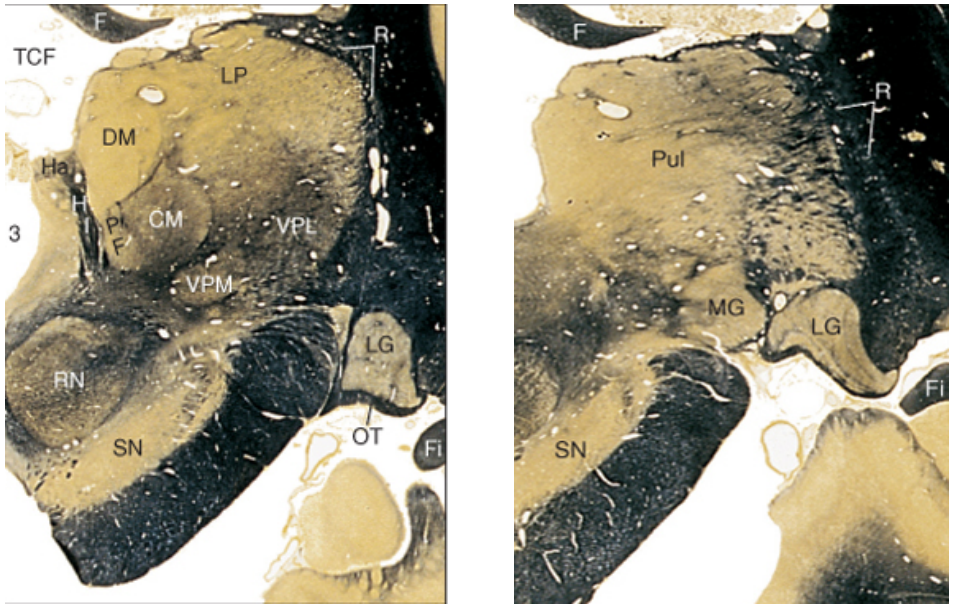


Tract-based spatial statistics (TBSS) images from 3 subjects' mean diffusivity (MD) data for the baseline > experimental contrast. The green tracts represent the mean skeletonized FA data, while the yellow and red tracts represent voxels that resulted in significantly different MD values at a confidence interval of 95%. The experimental > baseline condition did not result in any significant data. MD values were extracted from the voxels within the inferior frontal gyrus (IFG), as outlined by the blue box. The graph represents the significant changes in MD values in the IFG from scan 1 (baseline) to scan 2 (experimental); $p < 0.005$

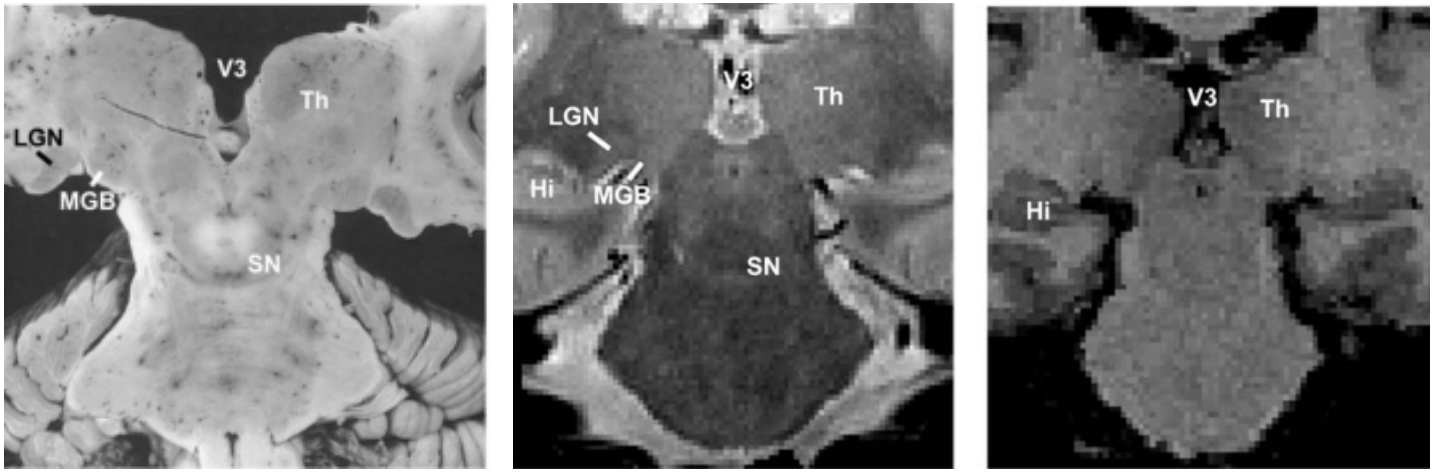
Structural Imaging of Thalamic Nuclei in Migraineurs a Proton Density Imaging Study

Charles Leger

Volumetric Analysis of the Thalamus, Lateral Geniculate and Thalamic Reticular Nuclei in Migraineurs



Volumetric Analysis of the Thalamus, Lateral Geniculate and Thalamic Reticular Nuclei in Migraineurs



LGN and TRN

- LGN has an approximate width of 4-6 mm (Andrews, Halpern, & Purves, 1997) and similar height (Gupta et al., 2009),
- The TRN is a sheet-like layer of neurons ~ 1 mm thick (Morel, Magnin, & Jeanmonod, 1997);
  - It surrounds the lateral aspect of the thalamus
- TRN's axons do not project to the cerebral cortex but rather to other thalamic nuclei
- Corticothalamic projections pass through the TRN
  - This connectivity coupled with the GABAergic (inhibitory) nature of the TRN neurons is suggestive of this nucleus's regulatory role

General Background

- The main subtypes for migraine are migraine without aura (MH-) and migraine with aura (MH+),
  - The latter occurs in about 1/3rd of migraineurs (Stewart, Linet, Celentano, Van Natta, & Ziegler, 1991)
- 12th most disabling disorder for women and 19th for men
- The prevalence of silent or cryptogenic stroke is higher in migraineurs than HCs (Kruit et al., 2004; Kruit et al., 2005)
- Migraine is a recognized risk factor for ischemic stroke in young women (Chang, Donaghy & Poulter, 1999; Kurth et al., 2006)
- Implicates an ischemic rather than neurogenic trigger of migraine
- However, outside the clinical context, research does not support a PE ischemic trigger of migraine (Dowson et al., 2008).
- Other pathologies have shown alterations of the thalamus (Schizophrenia) and LGN (glaucoma, amblyopia)

Literature review

- Migraine interictal data
  - Morphometric trends
    - Altered diffusional connectivity in visual motion and pain related tracts (DaSilva et al., 2007a; Granziera et al., 2006; Rocca et al., 2008; Schmitz et al., 2008)
    - increased cortical thickness
      - Visual motion processing (Granziera et al., 2006; Messina et al., 2013)
      - Somatosensory (DaSilva et al., 2007b; Maleki et al., 2012) areas
    - Reduced cortical thickness in pain processing areas (Kim et al., 2008; Messina et al., 2013; Rocca et al., 2006b; Valifre et al., 2008)
    - An absence of V3A and somatosensory cortex alteration has been reported in migraineurs
      - (Datta, Detre, Aguirre & Cucchiara, 2011)

Possible causes

- Structural alterations were interpreted as stemming from
  - Ischemia (Rocca et al., 2006a; Kim et al., 2008)
  - Congenital CNS disorder (Granziera et al., 2006; Kim et al., 2008; Messina et al., 2013; Rocca et al., 2008)
  - Frequency of attacks and disease duration (Maleki et al., 2011; Maleki et al., 2012; Schmitz et al., 2008;Valfre et al., 2008)
  - Age (Rocca et al., 2006a; Valfre et al., 2008).

Hypothesis

- Proton density (PD) weighted imaging and volumetric analysis
  - There will be thalamic structural alterations in migraine patients relative to age-matched healthy controls (HCs
  - Overall altered thalamus volume as well as alterations in specific thalamic nuclei:
    - Volume alteration is expected in
      - Lateral geniculate nucleus (LGN)
      - Altered thickness is expected in the thalamic reticular nucleus (TRN)

Method

- PD imaging
- Long duration TR and short TE will be used to minimize T_1 weighting making proton density the main tissue contrast source
  - A fast spin echo protocol will be used to acquire coronal 1 mm thick slices with the following parameters: TR= 3000 ms, TE = 22 ms, matrix resolution of 256 x 256, acquisition time 1:29, field of view (FOV) 192 mm, orientation C > T4.6 > S3.7, flip angle 120°.
- For each participant 5 to 8 scans will be acquired, averaged and reoriented to heighted the signal to noise ratio (SNR).
  - Each scan will take approximately 9 minutes and total PD scanning time will run between 45 and 72 minute
- For all participants, thalamus and LGN volume and TRN thickness will be calculated from the voxel count of 3D masks of the latter structures using *R,* version 3.0.1 GUI 1.61 (R Core Team, 2013, http://www.R-project.org/).

Expected results

- Exploratory research
  - Liberal significance level of 0.10 will adopted
  - With 24 participants, and at a significance level of 0.10
    - Expected power of .80 with a medium effect size
  - Mean values for all migraine participants and HCs will be calculated
    - mean values for subtypes (MH+ and MH-) and HCs
  - If the data are normal, one-way ANOVA (Welch's *F*) will be used to compare the means of MH+, MH- and HCs groups
  - In the event of non-normal data, a robust version of ANOVA (Wilcox, 2005) will be used for group mean comparisons.
  - False discovery rate (Benjamini & Hochberg, 1995) will be used for post hoc multiple comparison analysis.
  - Effect size will be calculated using omega squared (ω^2)

Subsequent research

- Planned subsequent study
  - Using data from the same participants (DTI)
  - VPM nucleus will be localized by its diffusion-weighted connectivity profile (Behrens, 2007)
  - Migraineur and HCs VPM volume will be compared
  - FA analysis will be conducted for the input and output tracts of
    - VPM (trigeminothalamic and thalamocortical)
    - LGN (retinal ganglion and optic radiations).
    - FA values of the TRN input tract (corticothalamic) will also be analyzed
    - The results should corroborate the findings of the current study

THE EFFECTS OF ATTENTION ON MULTISENSORY PROCESSING: COMPARING EXPERTS VS. NON-EXPERTS

Michael Olshansky

MA - 2
Psychology – BBCS

Supervisor: Joseph F.X. DeSouza
Committee Member: Richard Murray

Research Questions

Question #1

How might modality specific attentional tasks modulate how both unisensory and multisensory stimuli are processed?

Question #2

During focused attention, which modality (auditory or visual) will have a greater effect modulating processing.

Question #3

How does specialized experience with certain complex multisensory stimuli (music) effect how and where they are processed?

Question #4

How are the effects of the modality specific attentional task mediated by specialized experience with certain complex multisensory stimuli?

Question #5

How might this experience effect ones performance on a modality specific cognitive task? *<Behaviour>*

Research Questions

Hypothesis #1

Modality specific attentional tasks will increase neural activity in response to stimuli of similar modalities, as well as related multimodal stimuli.

Hypothesis #2

Both visual and auditory tasks will result in enhanced signal, however the visual attention task should produce greater effects, as it is a more salient stimuli.

Hypothesis #3

There will be less activation in areas involved in multisensory integration in experts when compared to non-experts

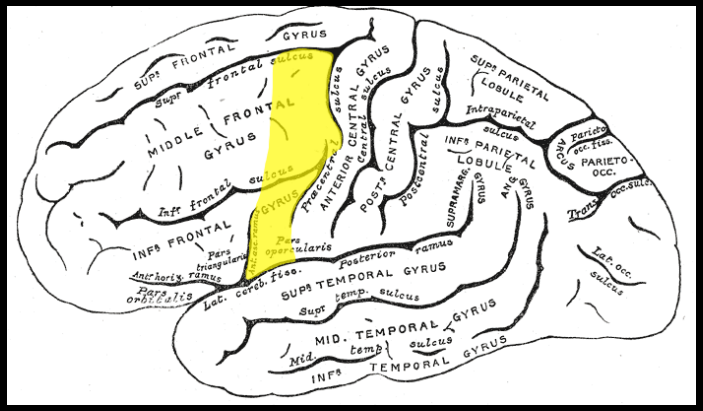
Hypothesis #4

Experts will show greater increases in activity in multisensory processing areas when both unisensory and multisensory stimuli are paired with their corresponding attentional tasks. (i.e., Visual with visual task...etc.)

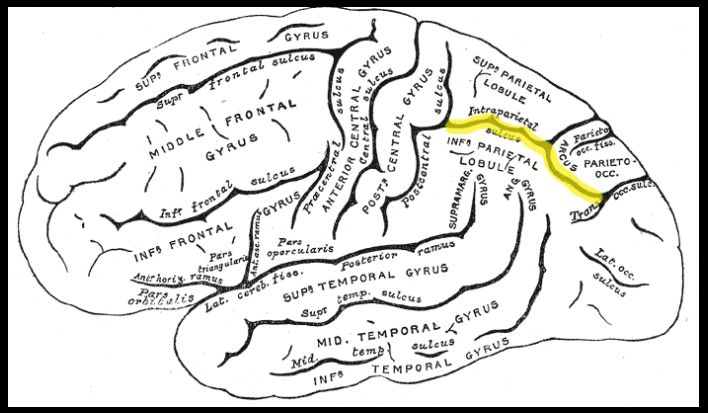
Hypothesis #5

Given their [audiovisual] exposure to performed music, experts will outperform non-experts on the cognitive tasks.

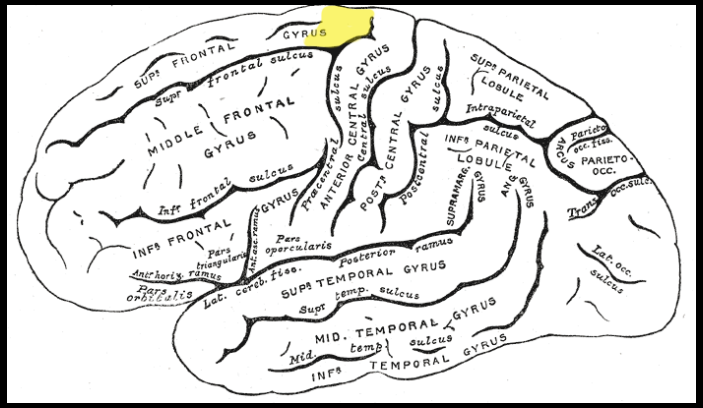
Regions of interest



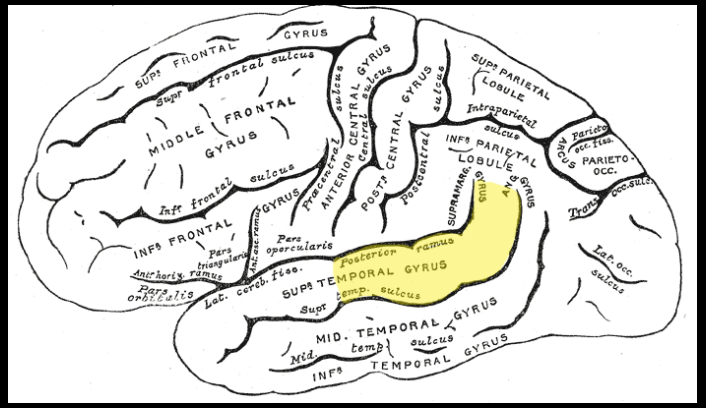
Premotor cortex



Intraparietal sulcus



Supplementary Motor Area



Superior Temporal Gyrus

Research Design

- 4 vignettes (clips) - 6 seconds each
  - Different original music in each clip
  - The multimodal audio/visual vignette, were also segregated into both audio only and video only clips.

Vignette #1

Vignette #2

Vignette #3

Vignette #4

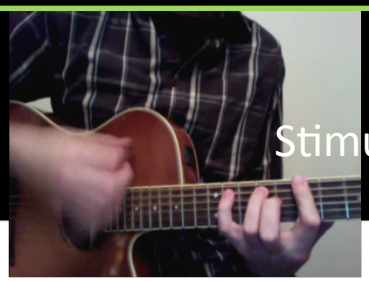
Stimulus

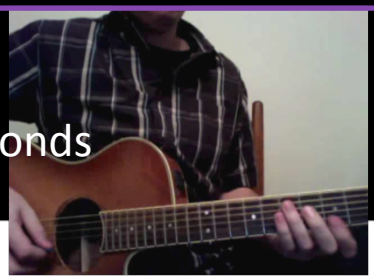
- Matlab code
- Replicates Laura's Flash stimulus
- Records behavioral responses
- Produces a log with all timing information (i.e., Stimulus presentation times and responses

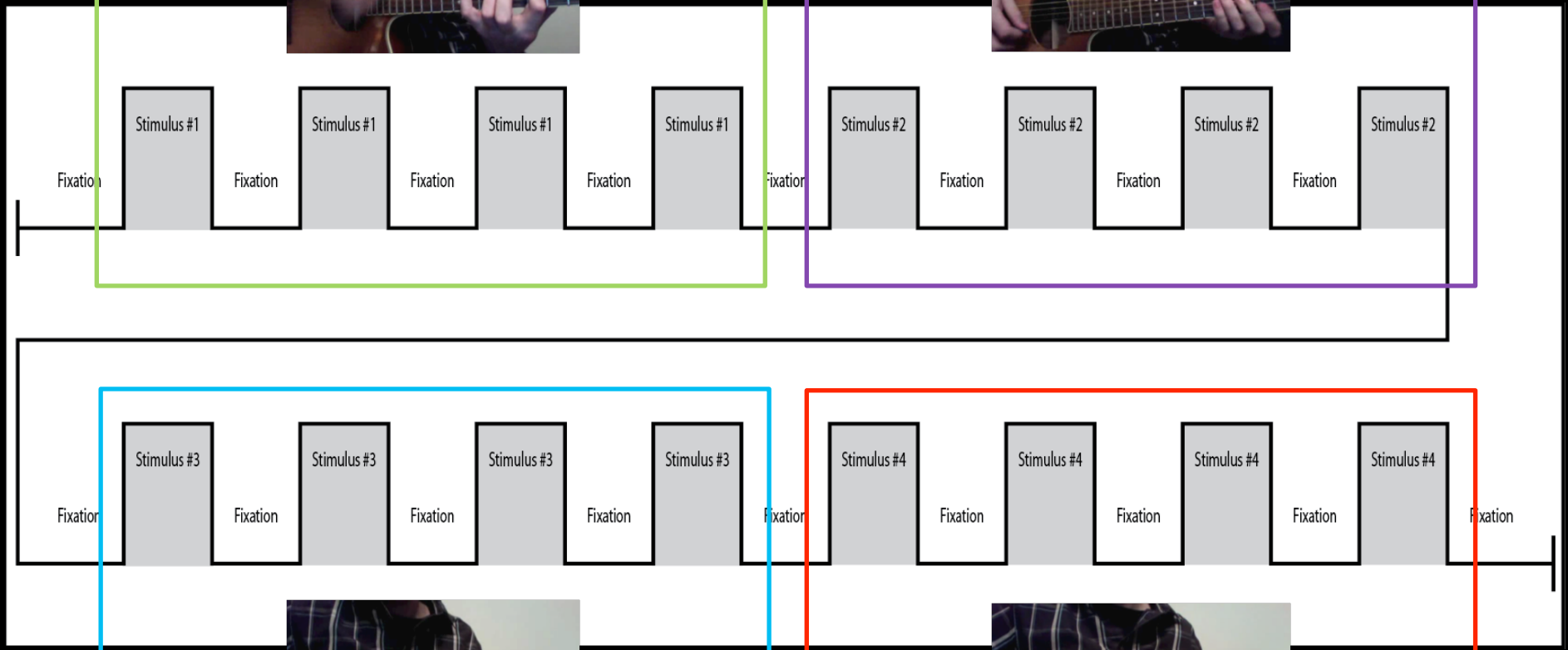
```
% Michael Olshansky - 2013-07-04

% Check for OpenGL
AssertOpenGL;

% Set Subject name

prompt='Please enter your initials:';
name='I.D.';
numlines=1;

Subj = inputdlg(prompt,name,numlines);

options.Resize='on';
options.WindowStyle='normal';
options.Interpreter='tex';

% Create Log File
tmp=clock;
fname = sprintf('%s_Behavioural-Log_%d%02d%02d',Subj{1},tmp(1),tmp(2), tmp(3));
save(fname);
fid=fopen([fname,'.txt'],'w');
fprintf(fid, 'SUBJECT_%s\n\n', Subj{1});


% Hide cursor
HideCursor;

% Movie location, define variables. (THE FULL PATH WILL NEED TO BE TYPED IN HERE)
% Here you just need to insert the file path of any 'AVI' file.
moviename.a = 'Users/michaelolshansky/Desktop/Stim Flash/Stimulus/Clip-A.avi';
moviename.b = 'Users/michaelolshansky/Desktop/Stim Flash/Stimulus/Clip-B.avi';
moviename.c = 'Users/michaelolshansky/Desktop/Stim Flash/Stimulus/Clip-C.avi';
moviename.d = 'Users/michaelolshansky/Desktop/Stim Flash/Stimulus/Clip-D.avi';

% Fixation length (in seconds)
f = 6;

try

    windowrect = [];

    % Select screen for display of movie:
    Screen('Preference', 'ScreenToHead', 0, 1, 1);
    screenid = max(Screen('Screens'));

    % Open 'windowrect' sized window on screen, Skip sync test, suppress all warnings, load normalized Gamma Table
    % LIMITED TO 800X800 RESOLUTION FOR TESTING PURPOSES
    [winID,winRect] = Screen('OpenWindow', screenid, 0); % [0 0 800 600]);
    Screen('Preference', 'SkipSyncTests', 1 );
    Screen('Preference', 'SuppressAllWarnings',1);
    gtable = repmat( linspace(0,1,256)', [ 1 3 ] );
    Screen('LoadNormalizedGammaTable',winID,gtable);

    % Get center (Cartesean Coordinates)
    [cx,cy] = RectCenter(winRect);

    % Draw fixation point for initial fixation period
    Screen('DrawLine',winID, 256, (cx), (cy-30), (cx), (cy+30), 5);
    Screen('DrawLine',winID, 256, (cx-30), (cy), (cx+30), (cy), 5);
    Screen('Flip',winID);

    % Start Time used to calculate all Response Times
    Tstart = GetSecs;

    % Calculate current time And print to log
    T = (GetSecs - Tstart);
    fprintf(fid, 'First Fixation Starts at: %3.5f\n\n', T);

    % Fixation Period
    WaitSecs(f);

    % Initially set keyIsDown to 0 -  this will be redefined once playback
    % commences.
    keyIsDown = 0;

    % Loop, re-defining 'mname' each time
    for i = 1:4

        if i == 1
            mname = moviename.a;
        elseif i == 2
            mname = moviename.b;
        elseif i == 3
            mname = moviename.c;
        else
            mname = moviename.d;
        end

        oldTextSize = Screen('TextSize', winID, 20);
        Screen(winID, 'TextFont', 'Courier');
        [nx, ny, textbounds] = DrawFormattedText(winID, 'Indicate with a key press each time\nthe guitarist''s right hand touches\nthe bottom 3rd string', 'center', 'center', 256, [], [], [], 2);
        Screen('Flip',winID);
        WaitSecs(8);

        % Loop, for each 'mname' repeat 4 times
        for it = 1:4

            % Open movie file:
            mov = Screen('OpenMovie', winID, mname);

            % Start playback engine:
            Screen('PlayMovie', mov, 1);

            % Calculate current time And print to log
            T = (GetSecs - Tstart);
            fprintf(fid, '  Video Start - Video # %d - Iteration # %d - Start Time = %3.5f\n', i, it, T);

            % Playback loop: Runs until end of movie:
            tex = inf;
```

Protocol

Fixations = 8 seconds
Stimulus Presentation = 6 seconds

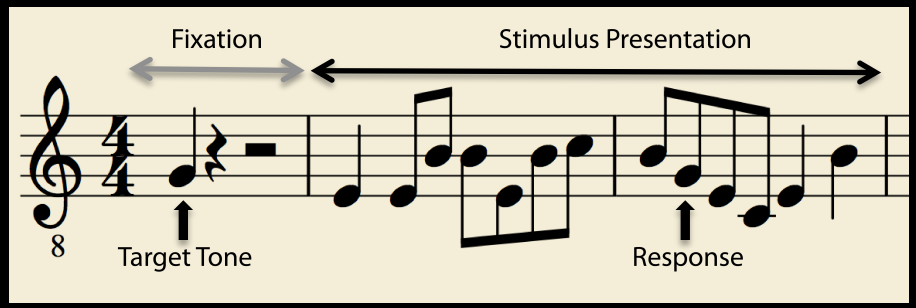




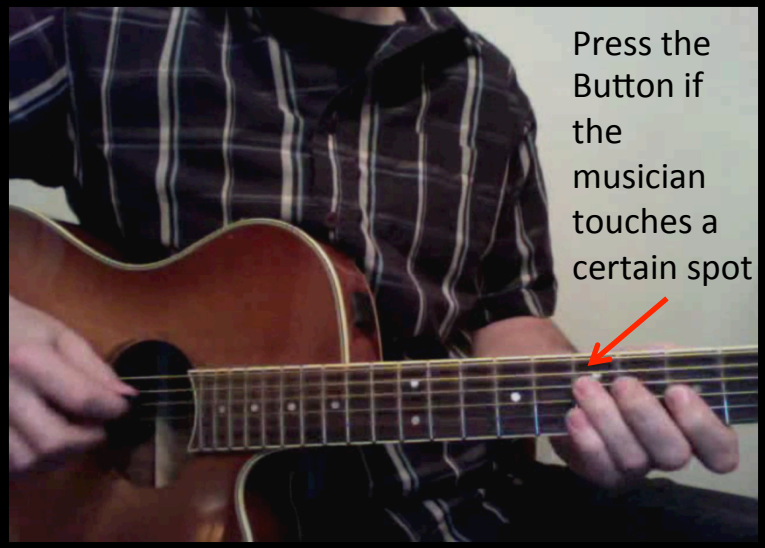


Research Design

- **Auditory Task:**
  - A target tone is played during the fixation period before the first block of each vignette.
  - Subjects will be asked to respond when they hear the target tone.



- **Visual Task**
  - A target position is described during the fixation period before the first block of each vignette .
  - Subjects will be asked to respond when they see the musician touch the target position.



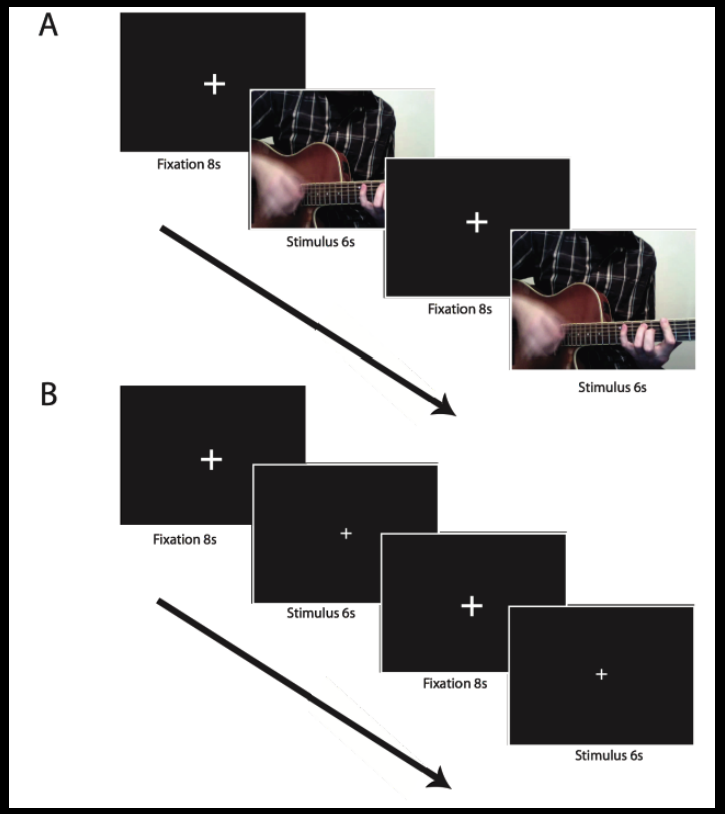
Research Design

Each participant will undergo 14 functional scans

- 7 conditions – each repeated twice
- 232 seconds per run
- ≈ 54 minutes of functional scan time per participant

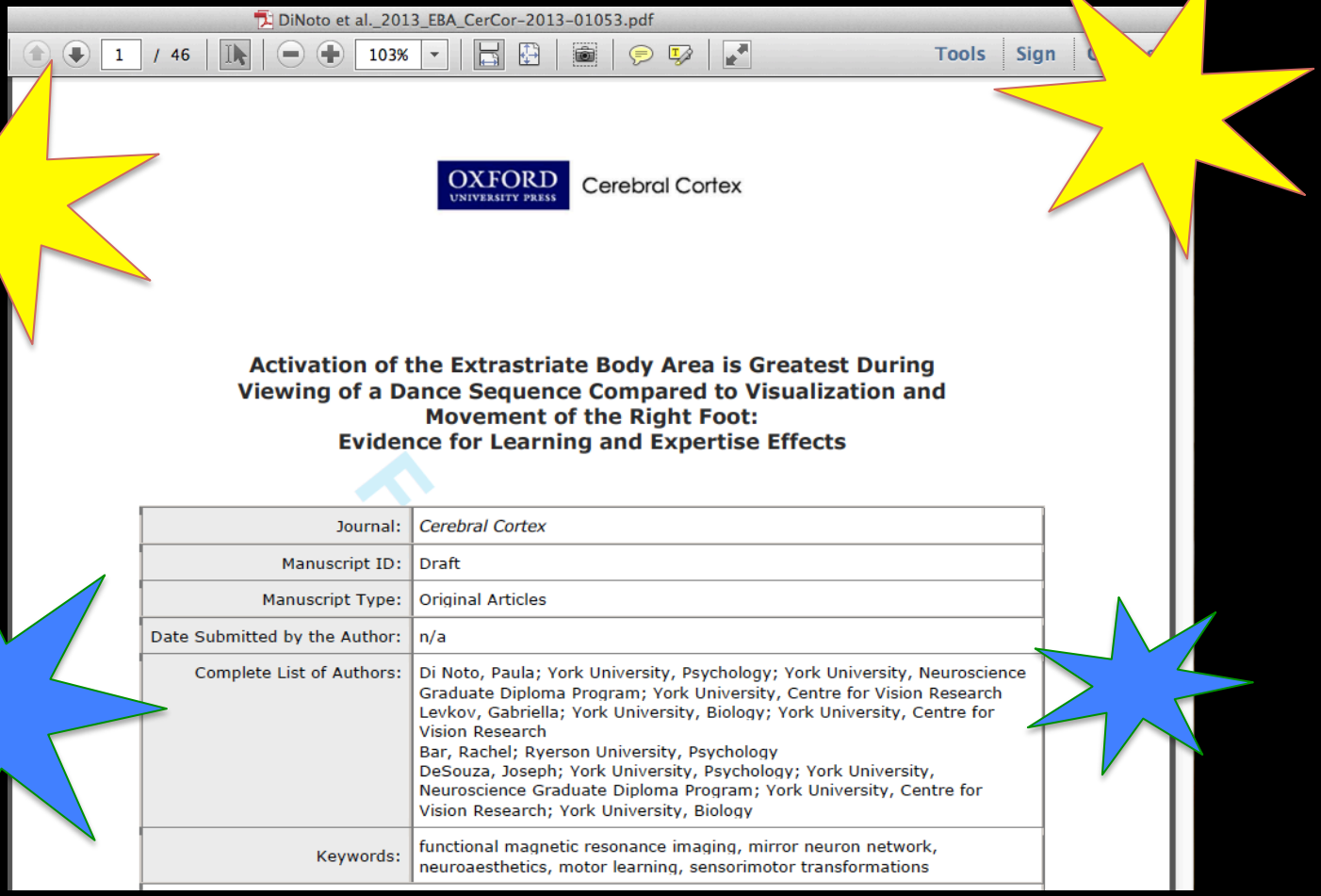
<u>7 conditions</u> (Control / Experimental)

1. Auditory stimulus only
2. Visual stimulus only
3. Auditory / visual stimuli together
4. Auditory stimulus only with auditory task
5. Visual stimulus only with visual task
6. Auditory / visual together with auditory task
7. Auditory / visual together with visual task



Paula's Update

- Submitted EBA manuscript to Cerebral Cortex!
  - Thanks to all lab members for your valued feedback!



Paula's Update

We found extrastriate body area activity

- Greatest when all subjects **viewed** a video of a ballet dance
- Increased in right hemisphere at 34 weeks compared to all previous scans, and from 4 to 34 weeks in left hemisphere during **visualization** of a newly learned ballet sequence
- Significantly activated during **movement** of the right foot in control subjects only

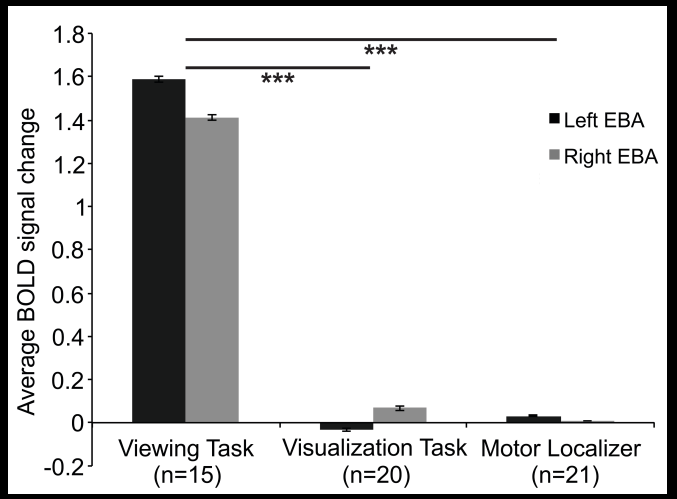
Paula's Update

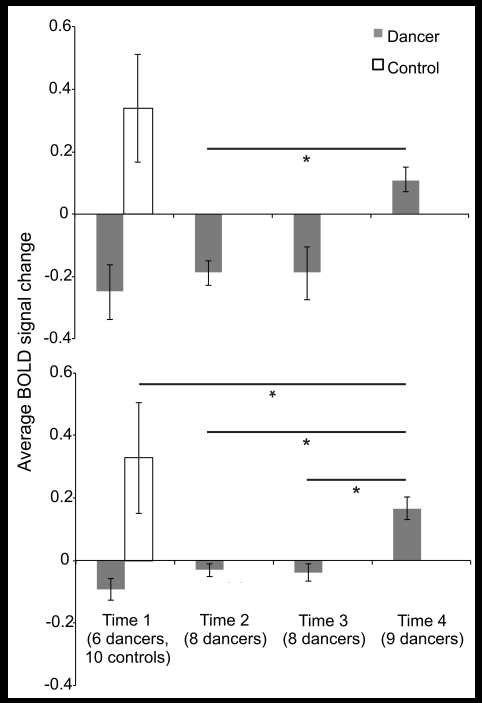
Implications:

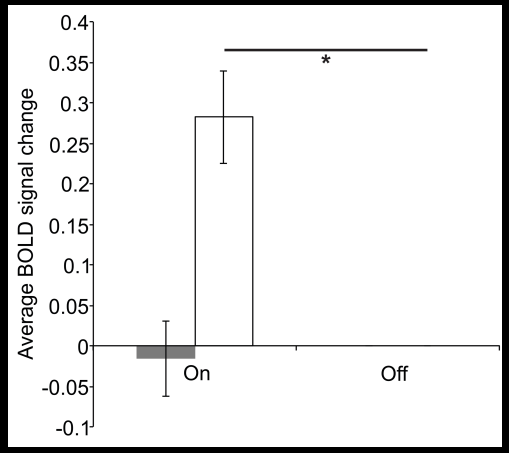
1. EBA is mainly a higher-order visual processing area, activated greatest by dynamic images of whole bodies dancing accompanied by music

2. Learning effects demonstrated bilaterally during kinesthetic motor imagery

3. Recruited as a motor processing region in control subjects only, suggesting dancers rely on an enhanced auditory-motor or dance network



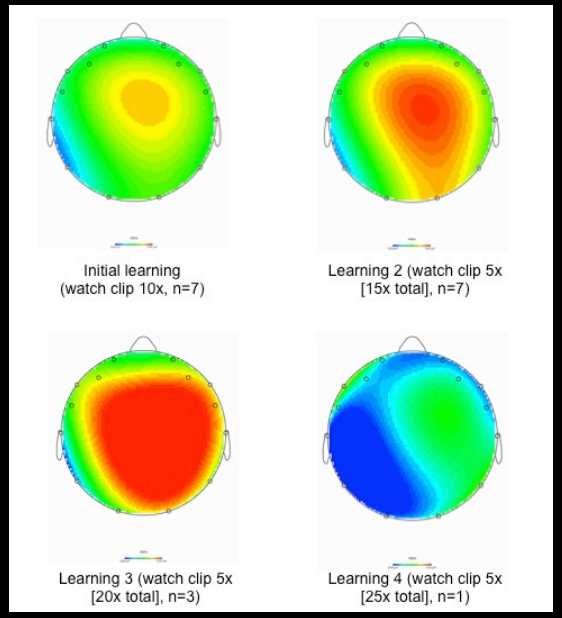


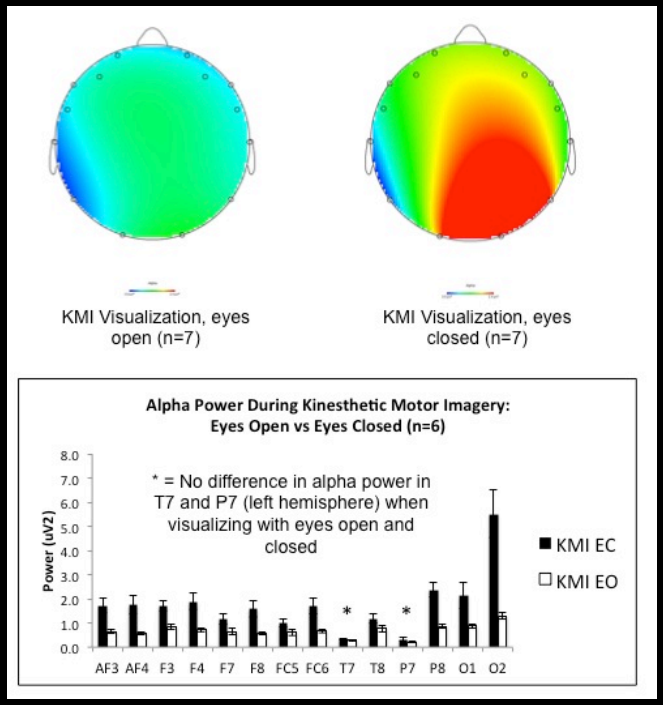


Paula's Update

Next steps:

1. EEG study launched on URPP
   - Continue testing motor learning and visualization experiment
     - Alpha and beta activation
     - Motor learning through observation
     - KMI during eyes open vs closed
2. Finalizing manuscript from McGregor Lab EEG study
   - Methods write-up in progress
   - Submission to Social Neuroscience journal by January 2014
3. Finalizing dissertation proposal
   - Introduction , Research Questions, Hypotheses and Methods for Project #1 (EBA) and #2 (EEG)
   - Due March 2013





DANCE FOR PD: SHORT AND LONG TERM CHANGES IN RESTING EEG

GABRIELLA LEVKOV

RESEARCH QUESTION(S)

1. Will changes in resting EEG occur after a single dance class?

2. Will changes in resting EEG occur after 6-12 dance classes?

3. How do these changes correlate with overt behavioral changes, such as balance? (Far stretch)

HYPOTHESES

Changes in resting EEG will parallel…

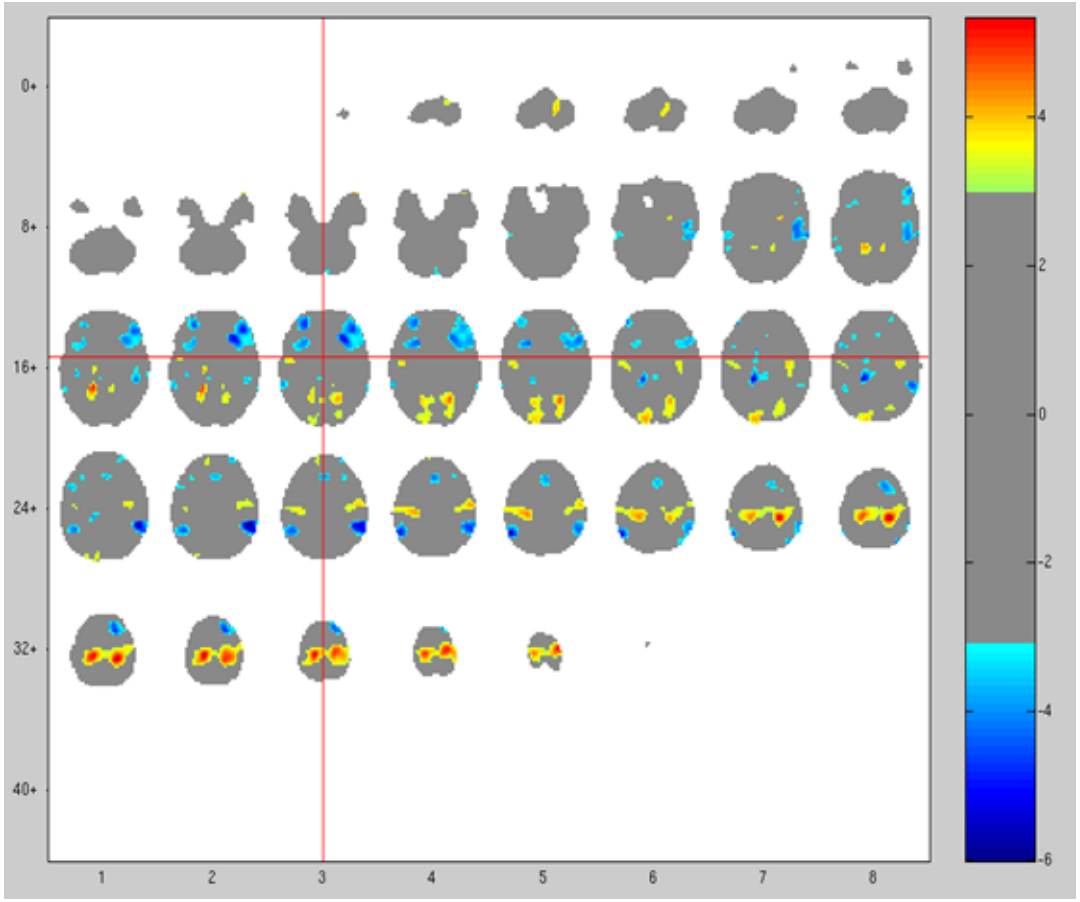
1. **Comparisons to age-matched controls**
2. **Comparisons to changes observed in ON/OFF levodopa studies**

METHODS

- **Subjects will be asked to keep their eyes closed while seating comfortably (chin rest optional)**
- **Resting EEG will be recorded for 5 minutes (Moazami-Goudarzi et al. 2008; Babiloni et al. 2011)**
- **Recordings will take place at two instances**
  - Before and after a SINGLE dance class
  - Before and after 6-12 weeks of dance

Functional Connectivity fMRI and PLS : Continuing Work at Baycrest

JoeLab – Paul Dhami

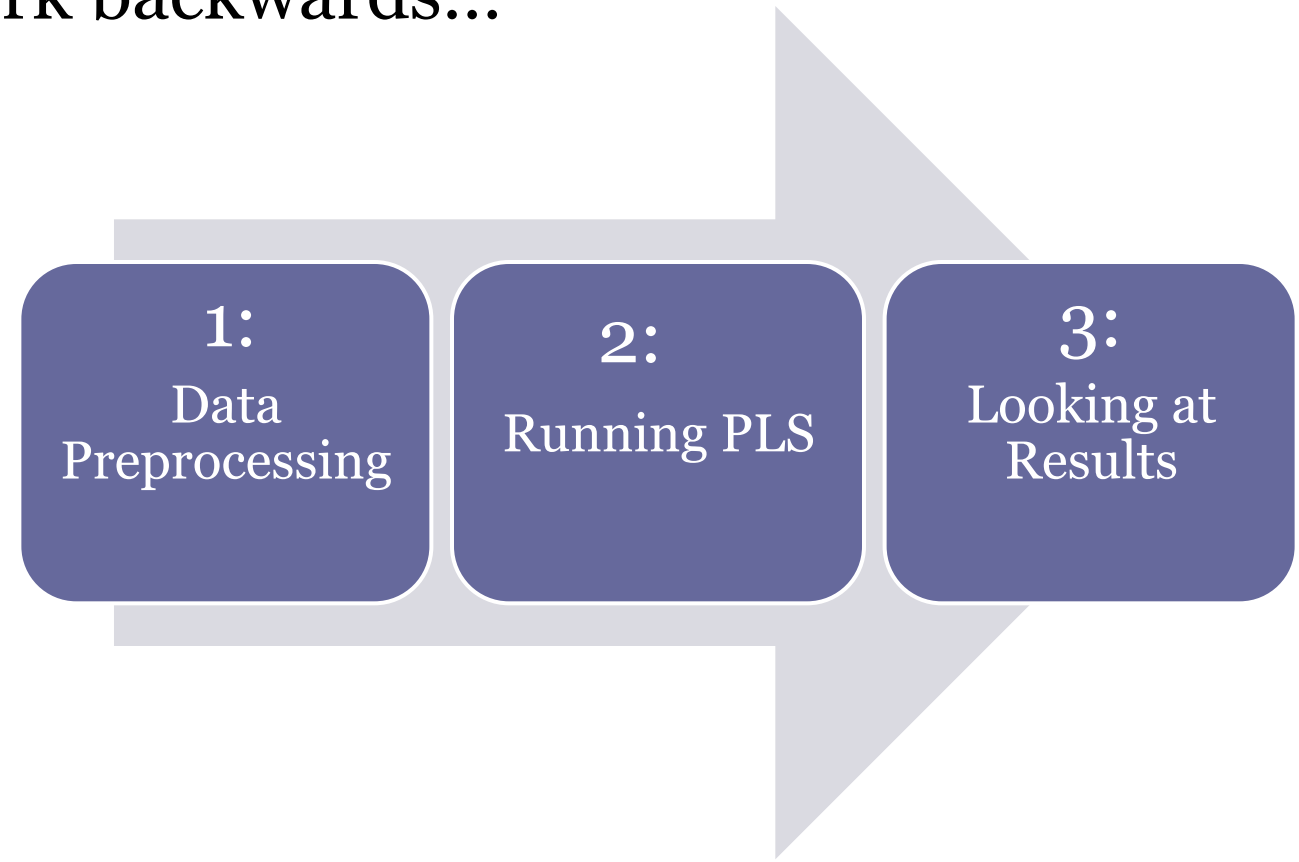


Resting State / Task fMRI Work

- Focused on Dancers 2 Cohort data
- Have looked at functional connectivity in both resting state and task related designs
- Have also looked at seed regions of interest (SMA and Auditory primarily) in resting state and task runs

Current Goals for PLS

- Work backwards…

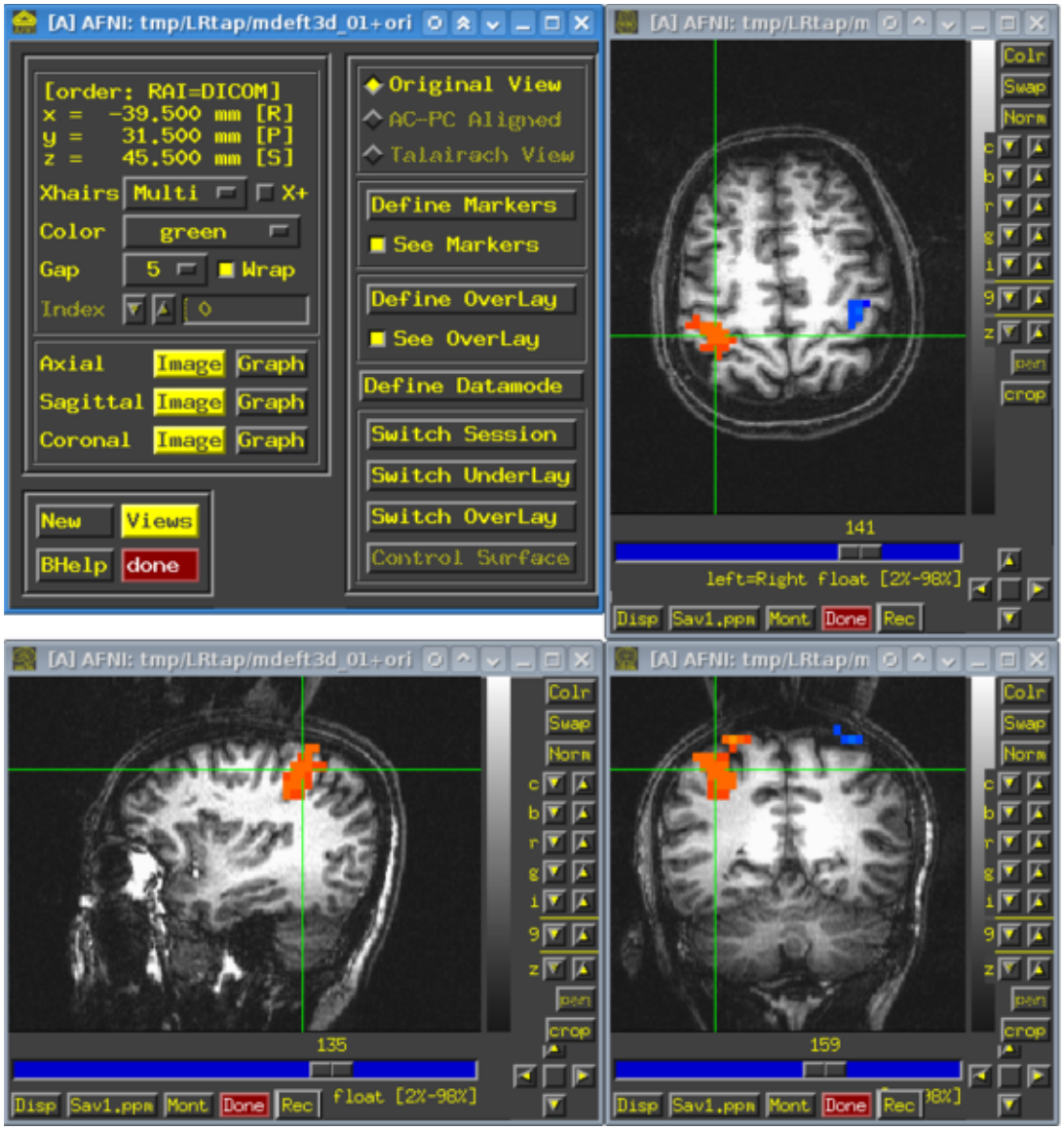


General Steps from Beginning to End for PLS

- Chapter 1: Data Preprocessing
  - 1.1 Reformat the directory structure
  - 1.2 Data Reconstruction (York Scanner)
    - Data Reconstruction
    - Checking Your Data
  - 1.3 Motion Correction
    - Slice Timing Correction
    - Rigid Motion Correction
  - 1.4 ICA Denoising
    - Running FSL MELODIC from the command line
    - Using SelectIca2 to select components to remove
    - Guidelines for rejecting ICA components
    - Regressing rejected components out of the signal
  - 1.5 Despike the Data
- Chapter 2: Resting State Analysis with PLS
  - 2.1 Getting the Data Ready for PLS
  - 2.2 Formatting Session and Datamat Files
  - 2.3 Running Mean-centered (Task) PLS
  - 2.4 Running a Seed PLS
- Chapter 3: Results
  - 3.1 Results: Mean-Centered PLS Rest Data
  - 3.2 Results: Mean-Centered PLS Visualize

AFNI and FSL

PLS



Data Preprocessing for PLS at Baycrest

- Requires AFNI (Analysis of Functional NeuroImages) which is the neuroimaging software used at Baycrest for PLS
- Requires FLS MELODIC for ICA Denoising

Current Goals

- Figure out how to load anatomical images behind the functional images in PLS…
- Get Dancers 1 Cohort Data onto Baycrest Servers…
- Continue going through AFNI and batch scripts provided
- Start going through preprocessing