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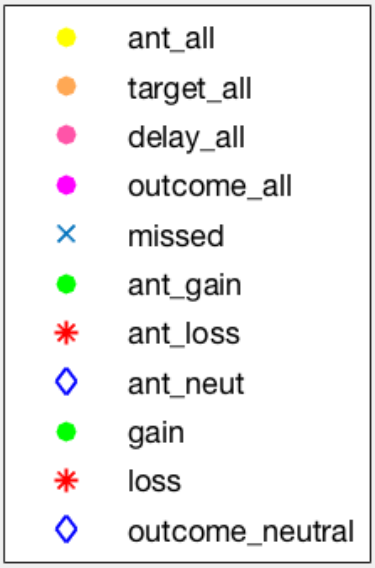
Project updates
05/21/2019

1. An activation map showing the contrast of interest in your data
2. Time-course of a functional or anatomical ROI
3. Multi-voxel activations of your functional or anatomical ROI

Activation maps are comparing the different conditions of the fMRI sequence (e.g. anticipation of gain and loss; actual gain and loss; and neutral stimulus)

Time courses

We plotted the percent change of the hemodynamic response in our regions of interest across the time course of the kid monetary incentive delay (KIDMID) fMRI task. Participants received a cue indicating whether they could gain (circle) or lose (square) points, or whether the stimulus was neutral (triangle). After the anticipation phase, participants received feedback as to whether they won or lost points, or whether nothing happened at all (outcome). All anticipation trials are indicated by the yellow bars whereas all outcomes are indicated by the pink bars. Additionally, the anticipation of gain and actual gain are indicated by the green bars and the anticipation of loss and actual loss are indicated by the red bars. Neutral trials are indicated by blue triangle and missed trials are indicated by blue x's.


ant_all
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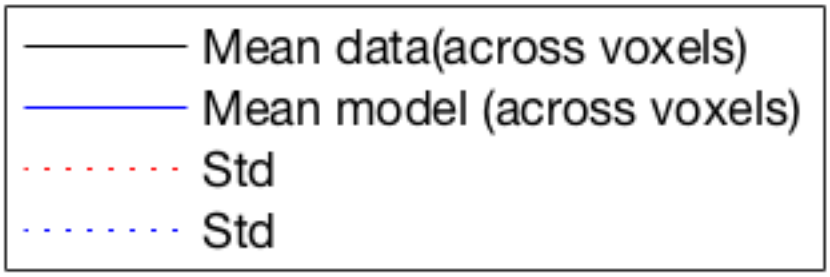

Mean data(across voxels)
Mean model (across voxels)
Std
Std


Left-Accumbens-area
Avg Variance Explained = 0.21369
Mean data(across voxels)
Mean model (across voxels)
Std
Std
Percent Change
Time (s) since start of scan
Time (s) since start of scan

Figure 1.
The timecourse figure denotes the percent change in the hemodynamic response during the KIDMID, for all the voxels in left accumbens area (black line). It is clear that there are differences in the hemodynamic response across voxels in the ROI, represented by the standard deviation (dotted red line). The percent change rises and falls often, likely dependent upon whether the participant was in the gain, loss, or neutral phase of the KIDMID. There also seems to be significant artifacts in this region of the brain, including some sudden changes that resemble motion artifacts (for instance at time ~275s).

Our mean model (blue line) did not do a great job of predicting the mean data, explaining only about 21% of the variance in the original signal. Our model prediction would likely improve significantly with the introduction of more trials/runs and including additional participants. The statistical power of the model may be improved by limiting the analysis to timeframes without significant motion.

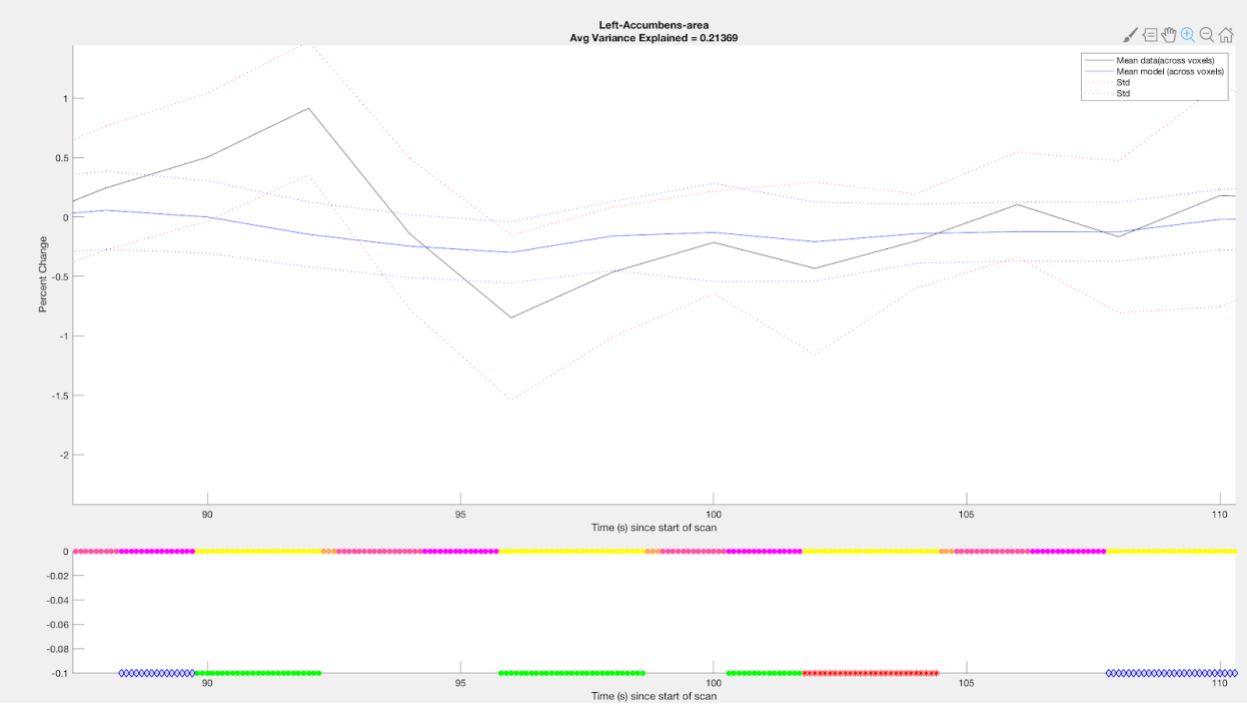


Figure 2.
This figure is a zoomed in version of figure 1, focusing on trials with gain anticipations. The hemodynamic response reached its peak (~0.75% change) during the anticipation of gain across participants and steadily declined during the subsequent outcome phase. The first peak of the gain trial may be a bit too early (~3/4s after gain anticipation onset) to be solely due to the gain anticipation and may be reflective of some background activity in the brain.

The hemodynamic response rose again during the second anticipation of reward, the first anticipation of loss, and the first anticipation of neutral. Though statistical tests are needed to confirm this observation, it appears as though the anticipation trials result in a greater hemodynamic response in the nucleus accumbens than the outcome trials.

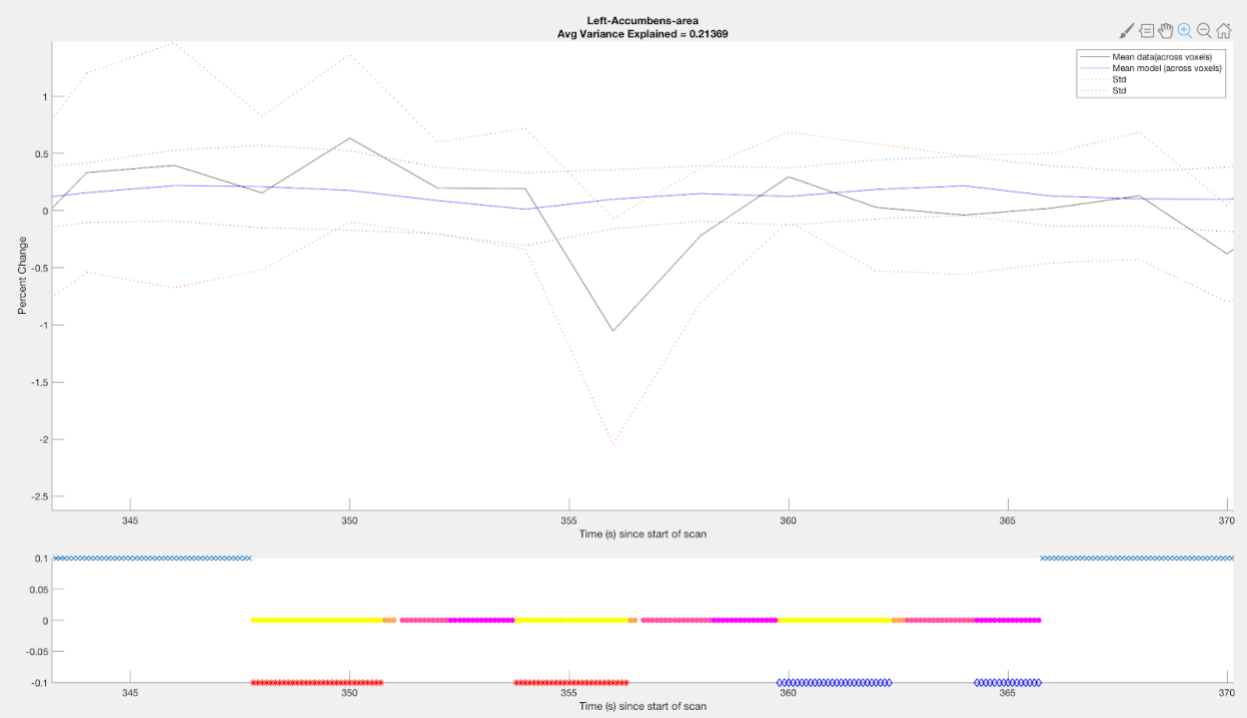


Figure 3.
This figure is a zoomed in version of figure 1, focusing on trials with loss anticipations. Note that outcome was neutral in this example.
Interestingly, the left nucleus accumbens showed a stark decrease in the hemodynamic response during the second trial of the anticipation of loss, with relatively stable hemodynamic responses prior to and following this trial.

Activation maps

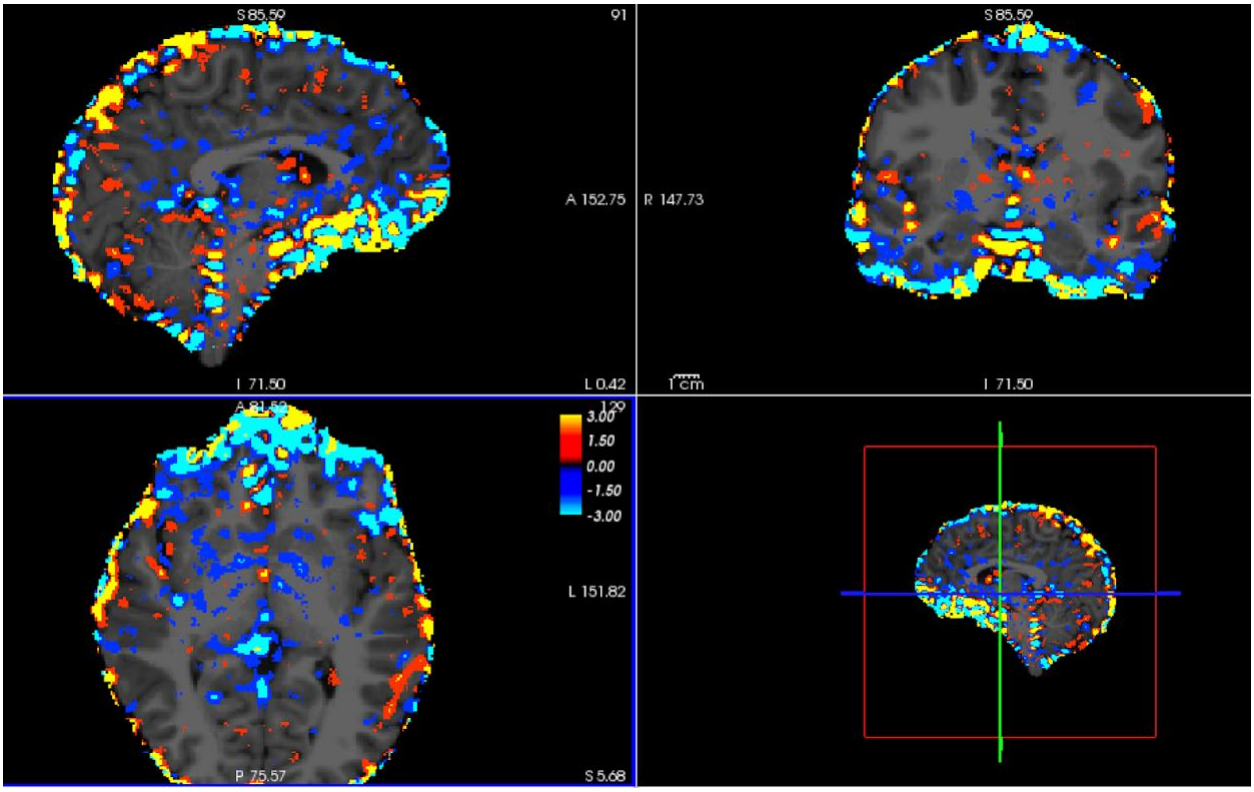


Figure 4.

Contrast for beta(gain) - beta (loss)

Here, we plotted a contrast map of betas for gain outcome minus the beta for loss outcome in Subject 006-T1 (a participant in our sample). On average, loss resulted in a greater hemodynamic response compared to gain. While there is a slight positive contrast in the central part of the right Nucleus accumbens, most of the nucleus accumbens showed negative contrast.

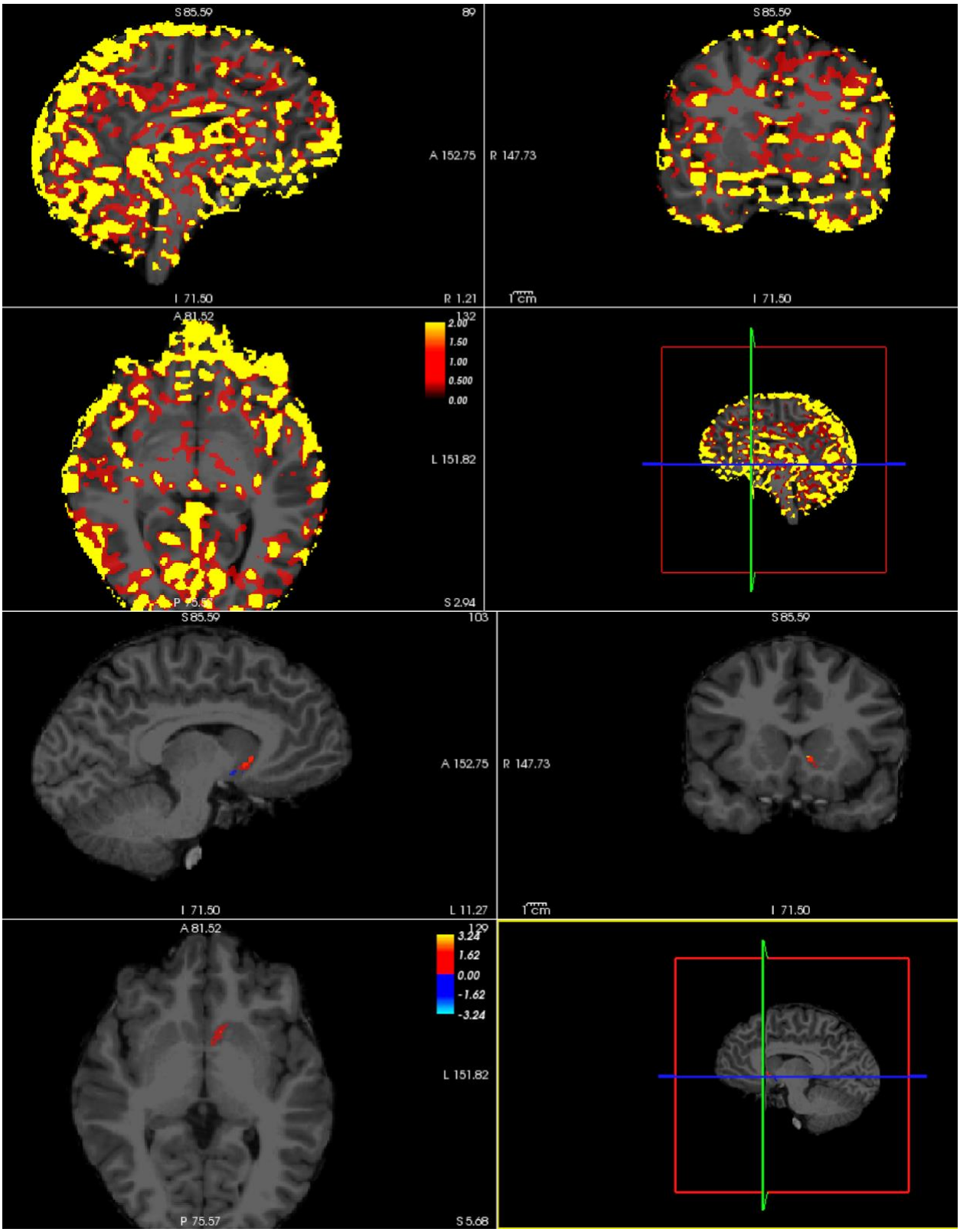
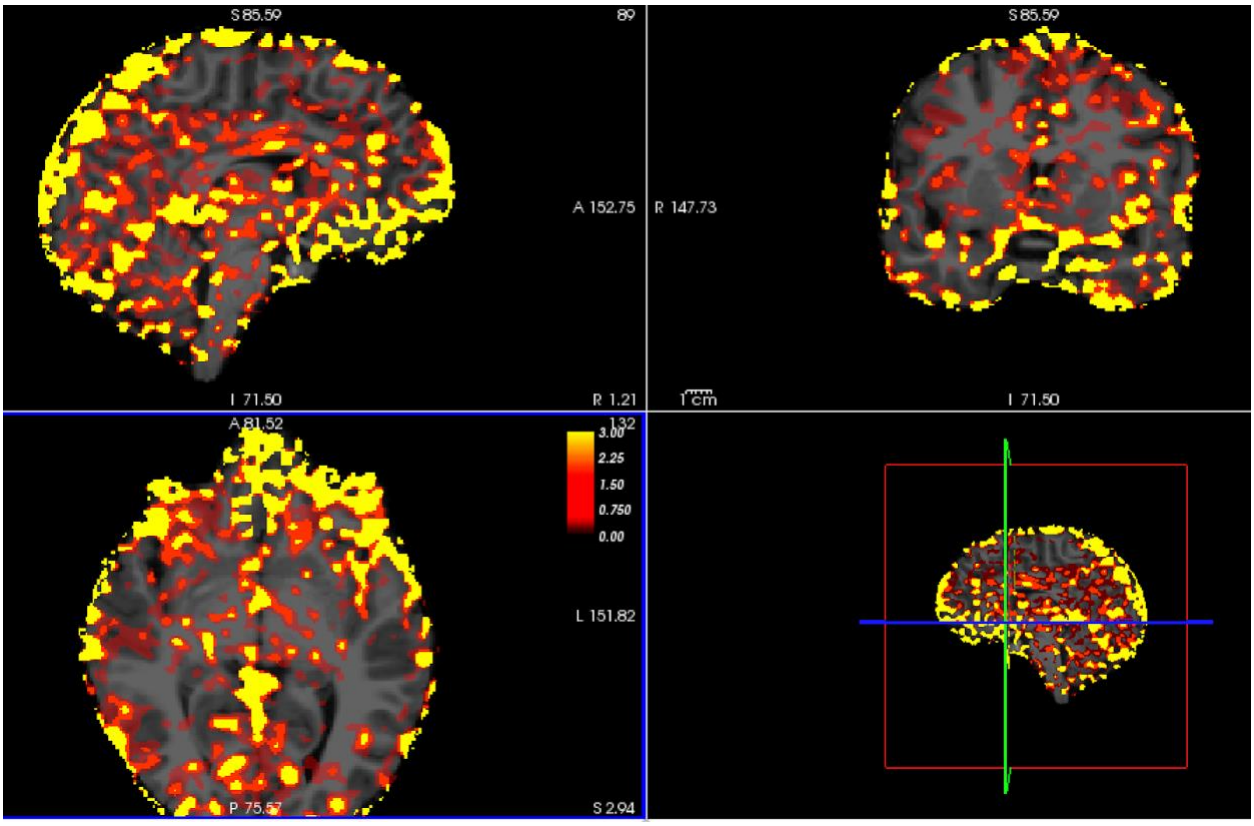


Figure 5.

Beta of gain outcome for the whole brain (top), and just the left nucleus Accumbens (bottom)

The whole brain showed a lot of activation during the gain trials (top panel). The deactivations are not plotted on the whole brain map, for simplicity. The map was not thresholded, and also not thresholded for the variance explained in the voxels. Blue indicates a decrease in the hemodynamic response and the red indicates an increase in the hemodynamic response. This participant predominantly showed an increase in the hemodynamic response in the left nucleus accumbens during trials that resulted in gain (bottom panel).



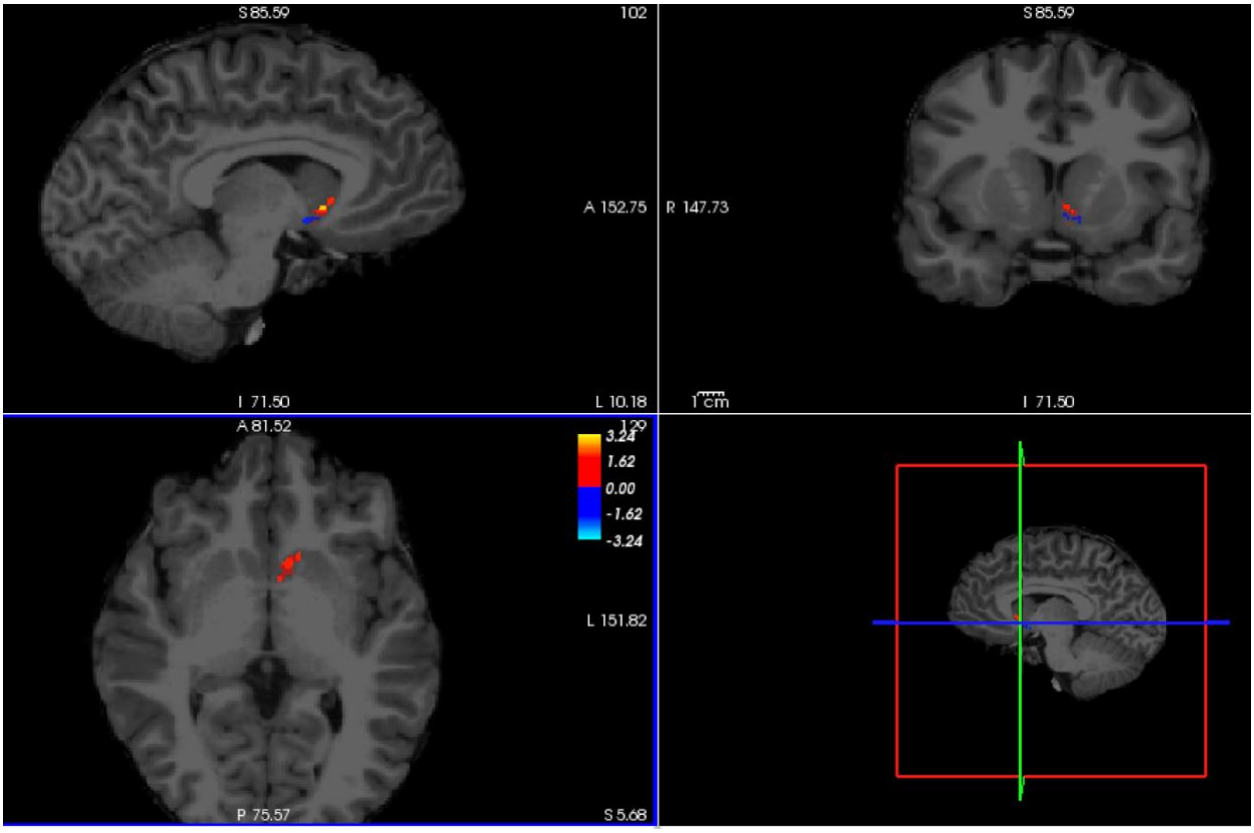


Figure 6.
Beta of loss outcome for the whole brain (top), and just the left nucleus Accumbens (bottom)
There was a lot of activation in the whole brain during loss trials (top panel). Increases in the hemodynamic response are plotted in blue and increases are plotted in red. This participant showed predominantly increased activation during loss in the left nucleus accumbens (bottom panel).

Summary and future directions

Preliminary analyses show promising activations in the nucleus accumbens during the kidmid task. Patterns in the timecourses show that there may be significant changes in the left nucleus accumbens for the *anticipation* of reward and loss, and less for the actual outcome, but the pattern has not yet been statistically tested. On average, the hemodynamic response increased in this region of interest.

Further statistical analyses include:

1. Visualization of contrasts for other sets of conditions, as well as t-statistics
2. Thresholding the map according to percent variance explained
3. Analyses across rois
4. Analyses across subjects (comparing females with high vs. low levels of early life stress)

Finally, assessment of the right nucleus accumbens and bilateral amygdala will elucidate more of the neural substrates of reward and punishment.