Project Theta Progress Report

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Background

The Paper

- Neural Basis of Loss Aversion in Decision-Making Under Risk
- Decisions influenced more by potential loss than by potential gain?

Paper Purpose

- Investigate whether potential loss/gain coded the same neurally
- Brain activation results in different regions points towards yes

The Data

- 16 subjects, 3 runs, 256 unique combinations total
- Behavioral data, BOLD data

Initial Analysis

-Basic preprocessing so far: identify dvars (RMS of signal derivative) and fd

Initial work

EDA

- downloaded data
- simple plots, summary statistics

Plan

Models and analysis

- Behavioral analysis

Logistic regression model on the behavioral data:

$$logit(Y_{resp}) = \beta_0 + \beta_{loss} * X_{loss} + \beta_{gain} * X_{gain} + \epsilon \quad (1)$$

Calculate the the behavioral loss aversion:

$$\lambda = -\beta_{loss}/\beta_{gain} \quad (2)$$

Models and analysis (Continued)

- Linear Regression on BOLD data

For each voxel i, we fit a multiple linear model:

$$Y_i = \beta_{i,0} + \beta_{i,loss} * X_{loss} + \beta_{i,gain} * X_{gain} + \epsilon_i \tag{3}$$

For each voxel, we calculate the neural loss aversion η_i:

$$\eta_i = (-\beta_{loss}) - \beta_{gain} \tag{4}$$

Models and analysis (Continued)

- Whole brain analysis of correlation between neural activity and behavioral response across participants

Examine the relationship between neural activity and behavioral using the following regression model:

$$\lambda = \alpha_0 + \alpha_1 * \eta + \epsilon \tag{5}$$

Models and analysis (Continued)

- Inferences on Data

1. Test the normal assumption of residuals in linear models
2. Test of significance of coefficients
3. Calculate the (adjusted) R squares.

Explanation on model simplification

- Use of Data

Leave out the regressor euclidean distance to indifference

- Simplification of regression on BOLD data

Perform simple linear models rather than mixed effect models

Issues with analyses and potential solutions

- Selecting specific regions to further explore correlation between neural and behavioral activity

1. Further research on brain
2. Look for regions with most significant neural loss aversion and regression coefficients

- Producing heat map

Need to map bold data onto standard brain

Our Process

Hardest part of process?

- Working with the FMRI data and trying to understand our paper
- Keeping up with documentation

Success in overcoming these obstacles?

- Using git workflows to raise issue and problems for the group.
- Limited success in the FMRI part, still figuring things out.

Issues facing the team?

- Debugging each other's code when travis CI fails in a pull request
- Addressing this by meeting up for teamwork or ask for help
- Most helpful?
  - Python/numpy, lab sections with git workflows
- Most confusing?
  - FMRI analysis

What do you need to do to successfully complete the project?

- Have a clear idea of what we can get done
- Make work as reproducible as possible

Diffuculty in reproducibility?

- Very frustrating if Travis fails on a pull request
- Remembering to write documentation in the scripts
- Test functions for plotting functions are hard to write/assert
- With a lot of work we may be able to get most of it reproducible

Remaining weeks:

- Could cover:
  - Software tools like statmodels, make and toolkits that are frequently used in fMRI research
  - More regression: linear and logistic