A multivariate resting-state fMRI technique for subject-specific parcels and sub-networks



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1. Introduction

Background

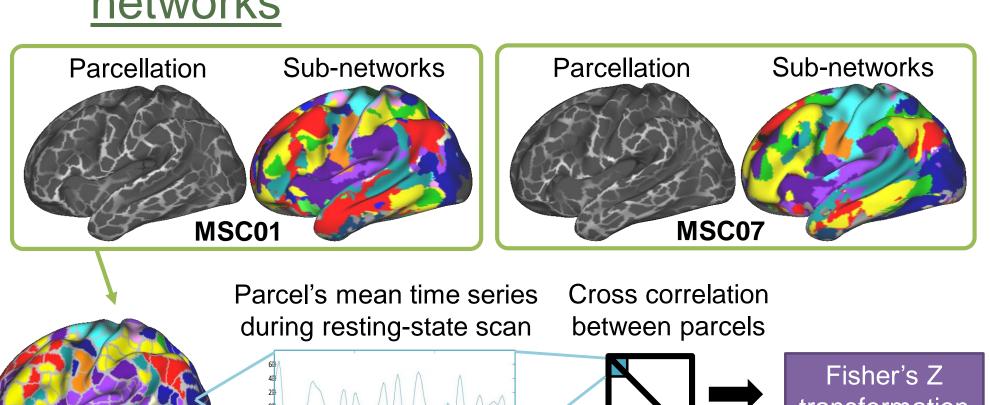
- Recent work in resting-state fMRI (rsfMRI) analysis can derive subject-specific parcellations and sub-networks.
- Standard approaches for rsfMRI:
 - Graph/network analysis accommodates different numbers of parcels/sub-networks.
 - Requires correction for multiple comparisons when examining subnetworks.
 - Multivariate analysis (e.g., MDS, DISTATIS) requires the same number of parcels/sub-networks.
 - Usually achieved by using a shared template.
 - Biases against individuals that vary greater from the target template.
- The above issues from standard approaches are particularly problematic for studies involving subjects that exhibit larger variance in brain structure and function (e.g., elderly, lesion patients, children).

Aim

To develop a new multivariate technique that allows different numbers of parcels/sub-networks.

2. Resting-state data set

- Midnight Scan Club (MSC; Gordon et al, 2017)
- Resting-state fMRI (30 minutes)
- 10 participants x 10 sessions
- Subject-specific <u>parcellations</u> and <u>sub-</u> networks



Extract time series and create correlation matrix for each session of each subject

Frames

3. Examples of connectivity matrices MSC01 (Sessions 1-5) MSC07 (Sessions 1-5) Dofault Visual Frontal-parietal control Dorsal Attention Ventral attention Cingulo-opercular control Hand somato-motor Auditory Common protectivity matrices

- Common networks across participants were selected for the analysis.
- Negative and perfect z-transformed correlations were excluded from further analysis.

 Scale

 0.0 0.5 1.0 1.5

4. Proposed method Session 1 Session 2 Session 10 Sess

5. Choices of preprocessing steps **Dimensions** Preprocessing *z*-matrices To exclude: Mean magnitudes of edges To equalize: edge tables The contributions of subjects subject tables | MFA-normalized z-matrices To exclude: Mean magnitudes of edges To equalize: centered First the contributions of edges edge tables | HMFA-normalized Second the contributions of subjects subject tables (edge → subject) z-matrices double-centered Mean magnitudes of regions Mean magnitudes of edges To equalize: edge tables The contributions of subjects subject tables | MFA-normalized z-matrices To exclude: Mean magnitudes of regions Mean magnitudes of edges To equalize: edge tables | HMFA-normalized First the contributions of edges subject tables | (edge → subject) Second the contributions of subjects

Justifications and thoughts

- Normalizations were not applied to rows or columns because their units are the same.
- The rows were unprocessed because we want to apply this technique to the data where the differences in both magnitudes and variances of rows are of interest.
- The choices of the preprocessing steps should be optional and decided based on the research question.

