A multivariate approach to analyze connectivity matrices with individual-specific parcellation

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1. Introduction

Background

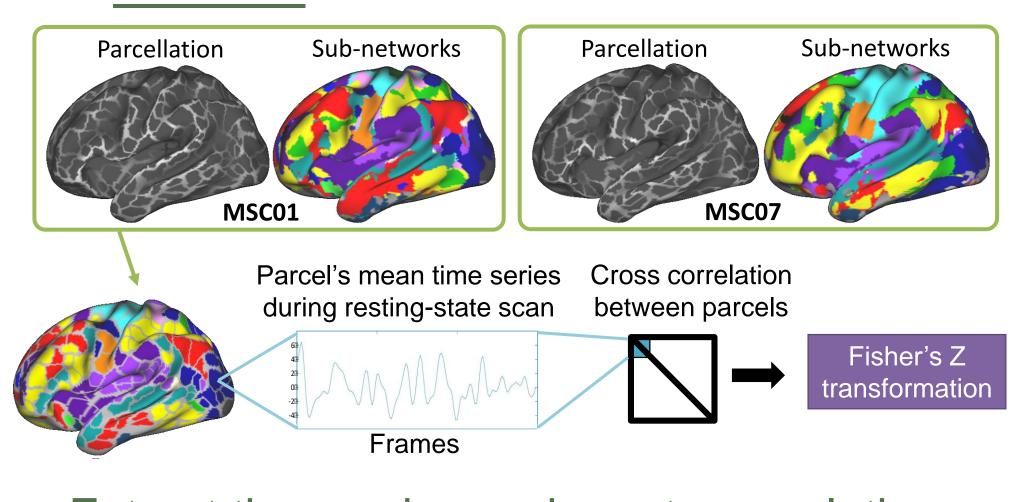
- Current resting-state fMRI (rsfMRI) analysis derives subject-specific parcellations and sub-networks.
- Standard approaches for rsfMRI:
 - Graph/network analysis accommodates different numbers of parcels/sub-networks.
 - Requires correction for multiple comparisons when examining subnetworks.
 - Multivariate analysis (e.g., MDS, DISTATIS) requires the same number of parcels/sub-networks.
 - Usually achieved by using a common template.
 - Biased against individuals who vary most from the target template.
- These problems are particularly severe for studies involving subjects that exhibit larger variance in brain structure and function.

Aim

To develop a new approach to accommodate different numbers of parcels and sub-networks.

2. Resting-state data set

- Midnight Scan Club (MSC; Gordon et al, 2017)
- Resting-state fMRI (30 minutes)
- 10 participants × 10 sessions
- Subject-specific parcellations and subnetworks



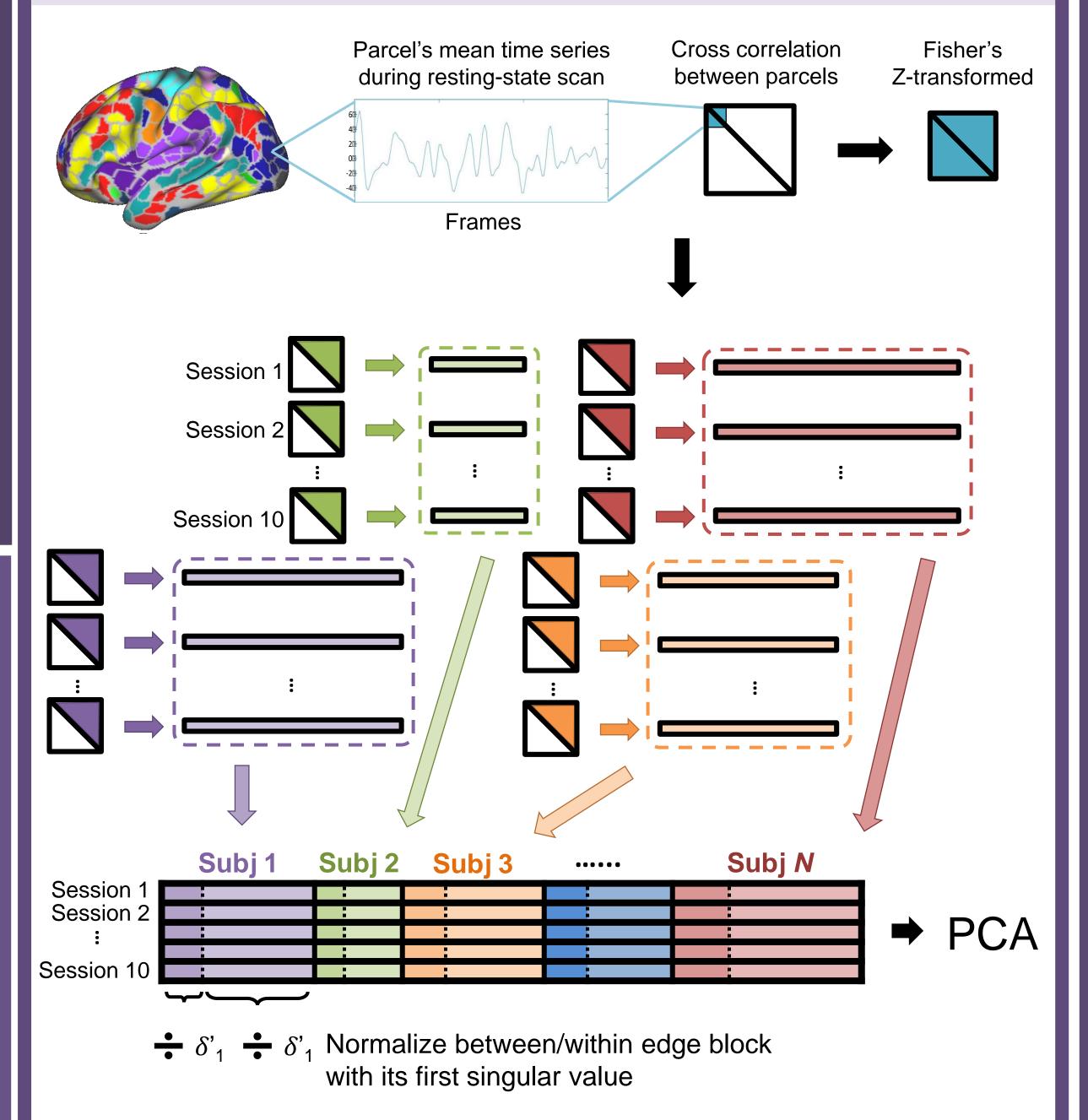
Extract time series and create correlation matrix for each session of each subject

3. Examples of connectivity matrices MSC01 (Sessions 1-5) MSC07 (Sessions 1-5) **Common Sub-networks** Frontal-parietal control (FPN) **Detault (DIMIN)** Dorsal Attention (DAN) Auditory ■ Ventral attention **■** Hand somato-motor ■ Cingulo-opercular control ■ Mouth somato-motor Select common networks across participants

4. Multiple factor analysis

Keep only positive correlation

Z-transformed correlation



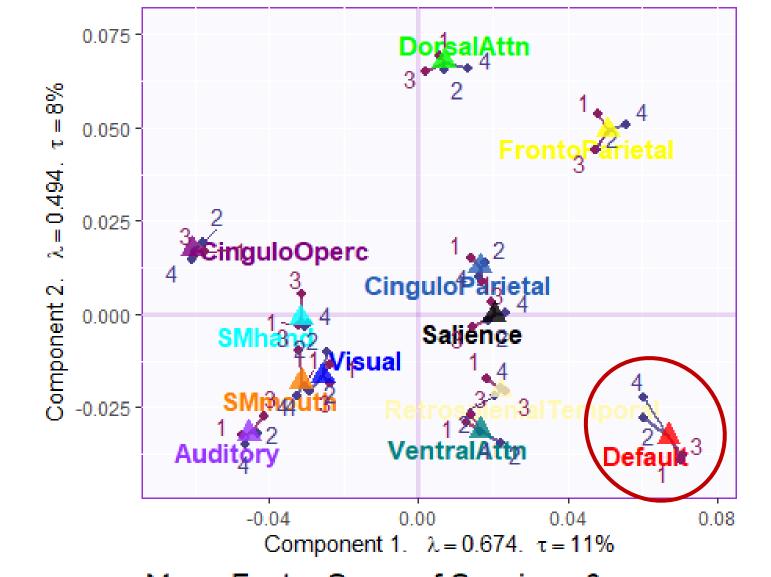
- The columns are grouped by their edge types (i.e., between- or within-network edges).
- First singular value of each block equals 1
- Equalizes block effects

5. Simulations

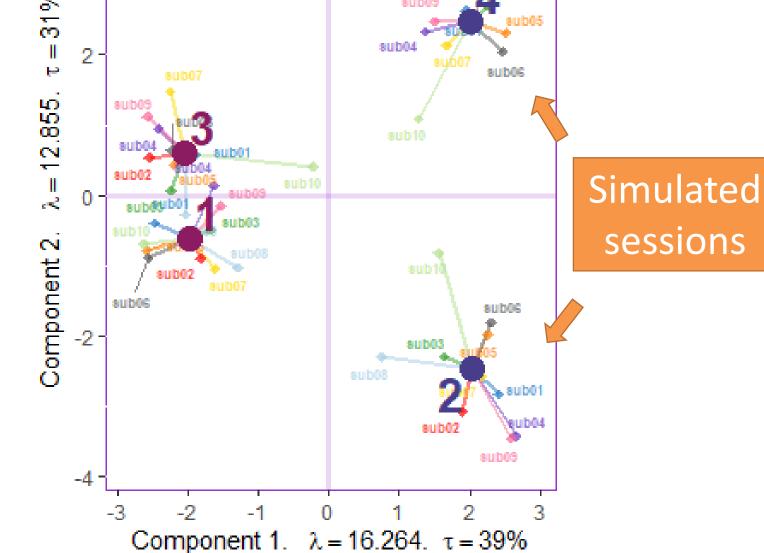
- Sessions selection
 - 4 sessions from MSC were kept
 - Only Sessions 2 and 4 were simulated
- Simulating aging effect
 - A decrease within **DMN**
 - An increase between **DMN** and **FPN**
- An increase between **DMN** and **DAN**



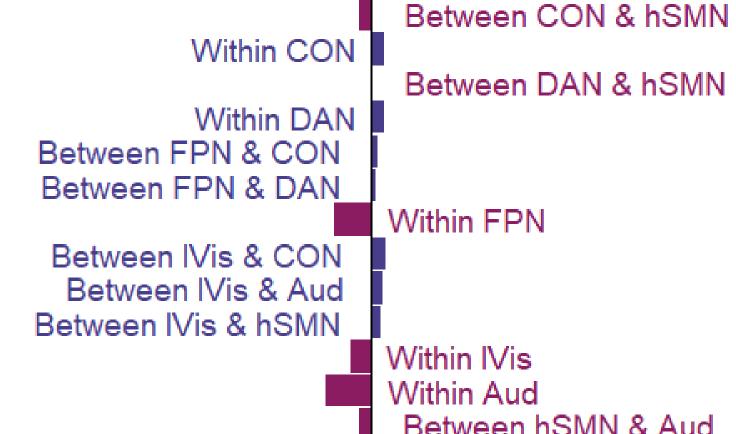
DISTATIS-Mean Factor Score of Networks & Partial Factor Scores of Sessions



Mean Factor Score of Sessions & Partial Factor Scores of Subjects



Mean significant loadings on Component 1



Between hSMN & Aud Within hSMN Between DMN & FPN 🛑

Between CON & Aud

Between DMN & Aud Within DMN —