Exploring latent networks in resting-state fMRI using voxel-to-voxel causal modeling feature selection

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Goal
● Model the rs-fMRI for all cortical grey-matter voxels using a subset of predictive voxels.
● Find latent networks within the selected voxels.

Methodology (Stage 1 and 2)

Fig. I: Divide and conquer sparse linear modeling approach

(Stage 1) Find voxels within each region.
○ For each of 1000 regions, use a $\ell_{2,1}$-norm penalized linear causal model to predict the activity at the next time step of all other regions.
■ Take the union over predictive voxel subsets for each region.
○ (Stage 2) For each voxel, find a non-redundant set of voxels from stage 1 by applying an $\ell_1$-norm penalized linear model (LASSO).

Methodology (Stage 3)

(Stage 3) Apply ICA on stage 2 voxels and project each source back using predictive coefficients.
○ Align to common space (MNI152) and blur to deal with cortical misalignment.

Results
● (Fig. II) Method finds unique ICs that have high similarity across multiple subjects but low similarity with ICs obtained from group-based ICA.
● (Fig. III) Our analysis is able to find common latent networks across subjects that group-based ICA is not able to find.

Future Work
We are now testing whether these unique IC patterns are meaningful in distinguishing healthy versus non-healthy subjects.