Comparing and parcellating voxel-scale multimodal human brain connectivity

Christopher Baldassano[1], Andre Esteva[1], Diane M. Beck[2], Li Fei-Fei[1]

[1]Department of Computer Science, Stanford University

[2]Psychology Department and Beckman Institute, University of Illinois Urbana-Champaign

Summary

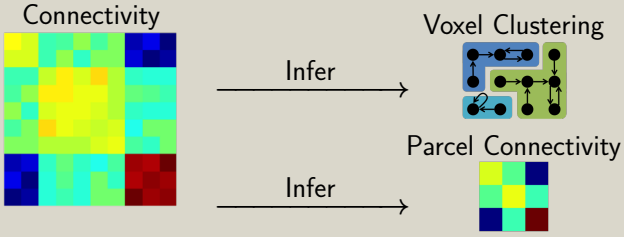
- How is the cortex functionally and structurally organized?
  - Examine with voxel-level resting-state and tractography connectivity matrices (60,000 by 60,000)
- **Goal 1:** Parcellate cortex based on connectivity
  - Use generative model to select best clustering of functional connectivity matrix
  - Reveals regions related to fine-grain topographic map structure in visual cortex
- **Goal 2:** Characterize the properties of each parcel
  - Distributed functional and structural connectivity networks
  - Functional task and category selectivity

Data Sources

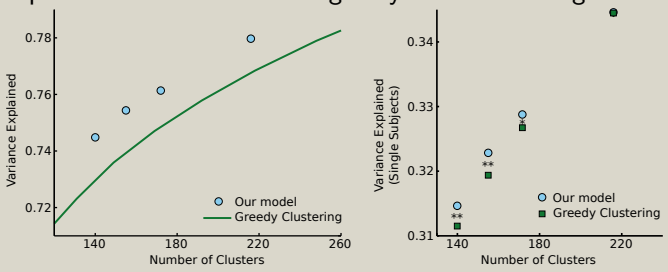
- Human Connectome Project
  - Resting-state fMRI - 468 subjects (2mm, 0.72s)
  - Diffusion Tractography - 10 subjects (1.25mm)
    - Sampled 33 billion tracts using FSL
  - Task fMRI - 20 subjects (2mm, 0.72s)
- Category Localizers (24 subjects)
- Probabilistic field map atlas

Probabilistic Parcellation Model

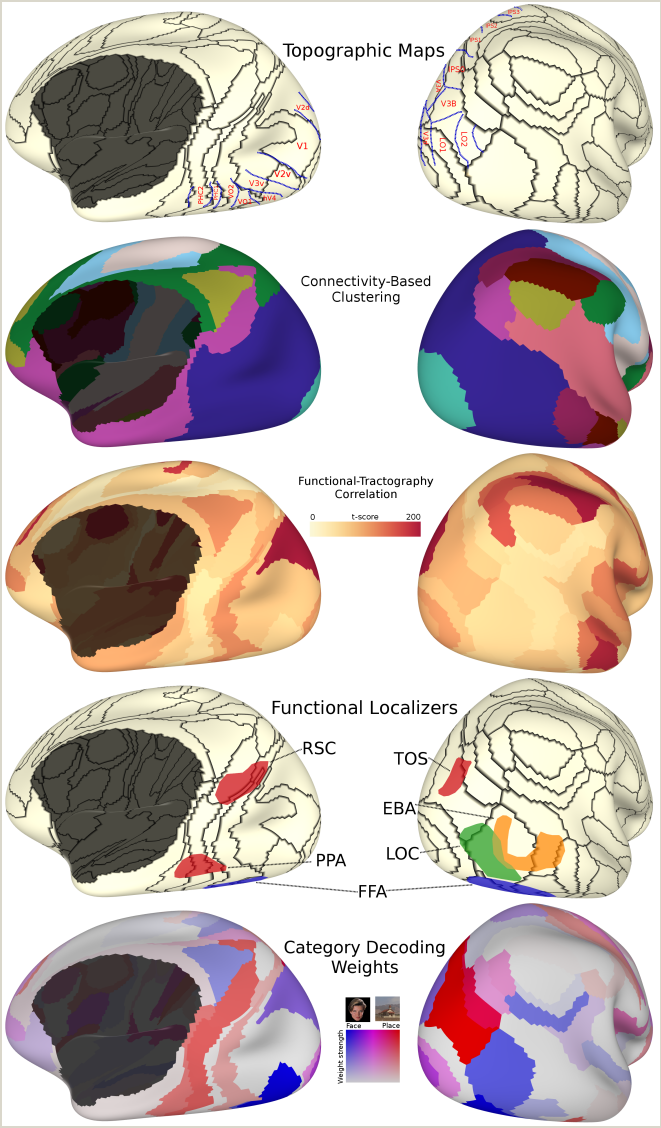
- Produces spatially-contiguous "supervoxels"
- Refines clustering with multiple passes
- Uses data statistics to help set number of clusters



- Captures more variance than greedy Ward clustering



Parcel Properties



- Early eccentricity parcels, ventral field map parcels
- Default network comprised of $\geq$2 subnetworks
- PPA bridges retinotopic cluster and posterior default network
- Functional connectivity in dorsal angular gyrus and inferior temporal sulcus strongly driven by structural connectivity

Acknowledgments

Thanks to Mike Arcaro, NSF GRFP (DGE-0645962), WU-Minn Human Connectome Project (1U54MH091657)