Predicting Memory Performance using Connectome-based Predictive Modeling

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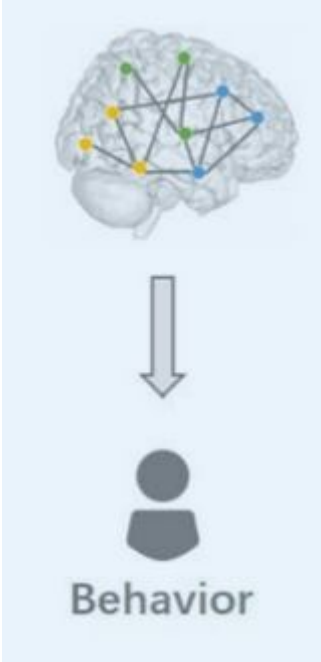
Introduction

- Working memory (WM) is our mental sketchpad. It allows us to temporarily hold and manipulate information in mind and is critical for daily functioning

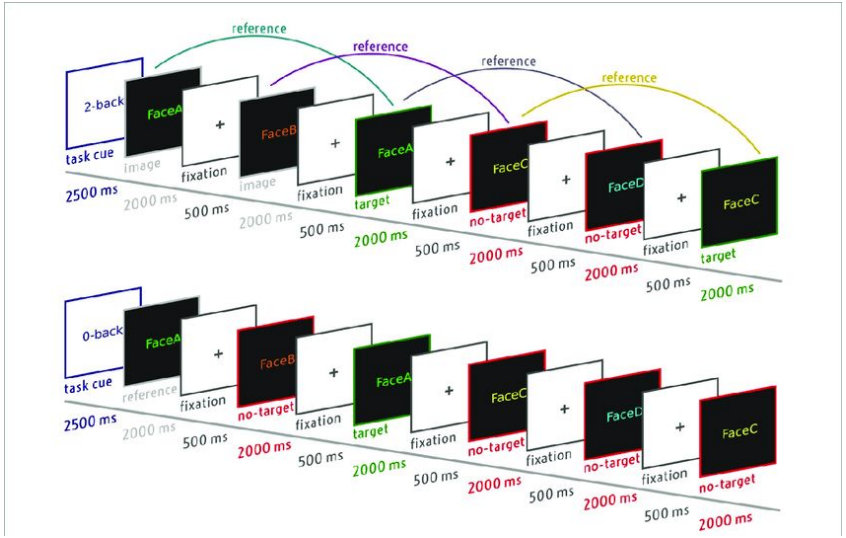
- Previous studies implicate DMN and FPN as critical networks underlying working memory, but predicting behavior from neural activity remains elusive

- Here, we hypothesized that WM performance in the 2-back task can be predicted from individuals' task-concurrent whole-brain functional connectivity using Connectome-based Predictive Modeling (CPM)



Methods: HCP fMRI Dataset

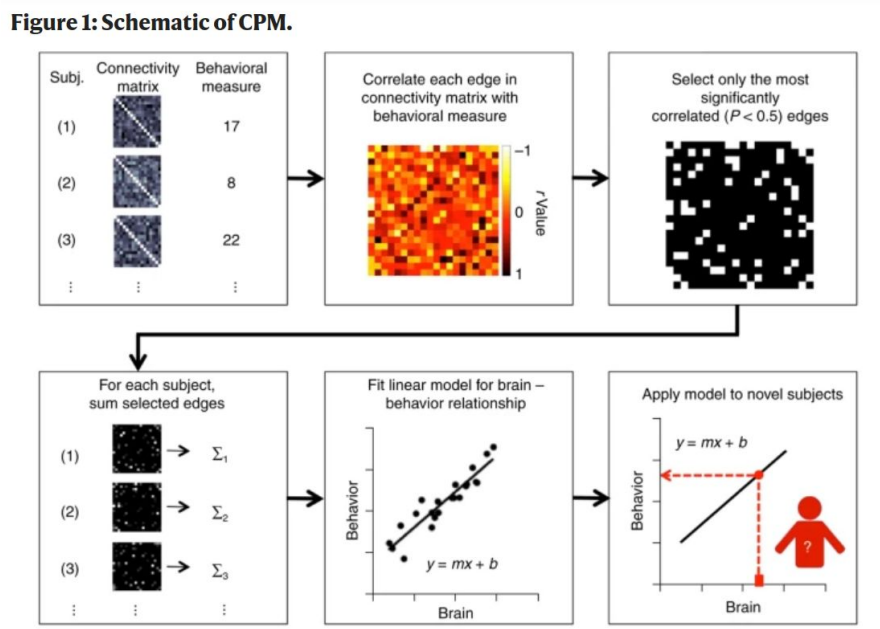
- 339 subjects from preprocessed dataset
- participants are presented a sequence of images
- 2-back working memory task
- Behavioral measures
  - Accuracy: The percentage of correct responses
  - Response Time: The time taken to respond to each stimulus



Methods: Analysis

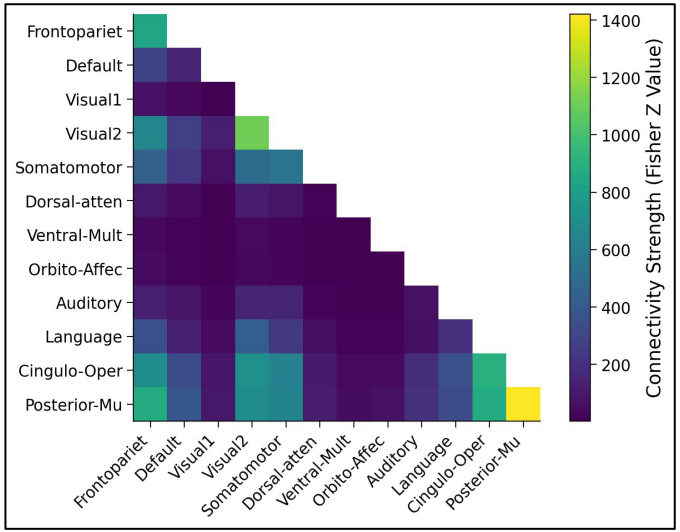
Connectome-based predictive modeling (CPM)

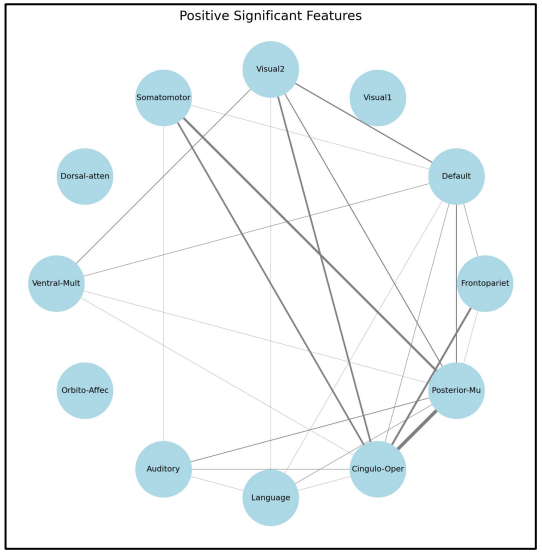
- Task-based FC matrix and behavioral measure (2-back accuracy) for each subject
- Each edge in FC matrix correlated with behavior
- Get significant edges and separate them into positive and negative edges (P < 0.01)
- IV observation for each participant is the sum of the edges
- Linear regression of behavior on individuals' "connectome", bootstrapping at 500 iterations

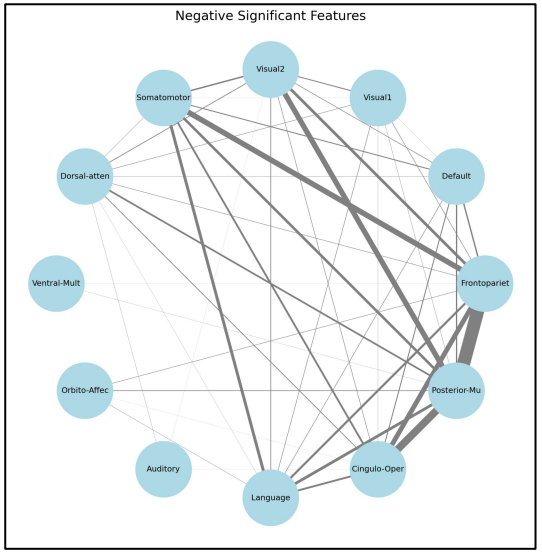


Shen et al., 2017, Nature Protocols

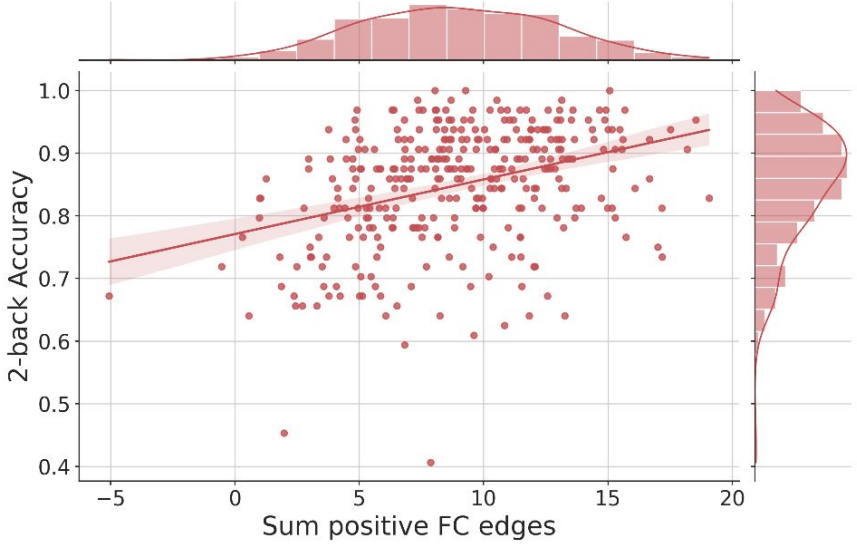
Results: Networks Connectivity Strength

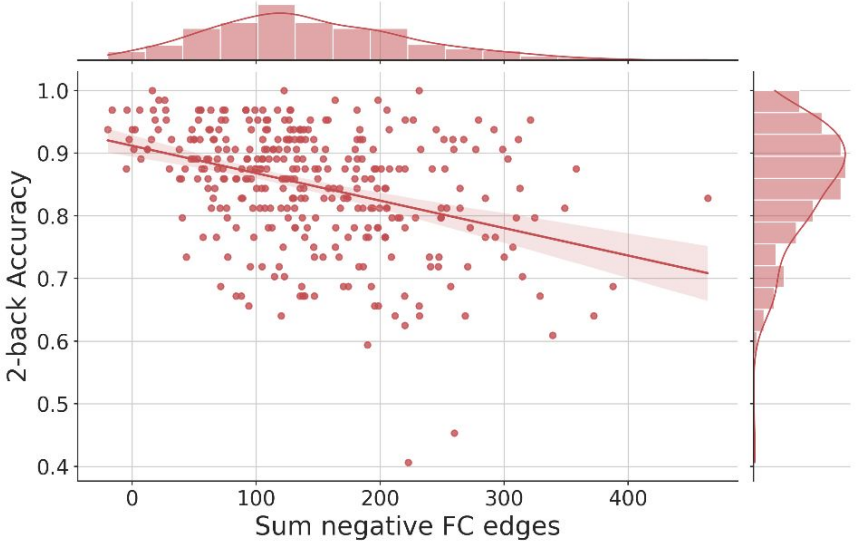






Whole-brain FC patterns significantly predict 2-back accuracy





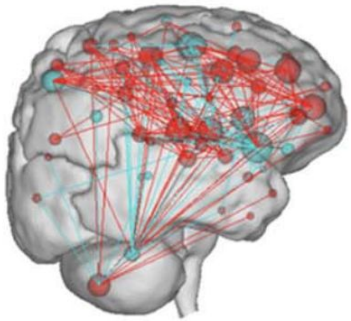
Positive network: Pearson's r = 0.26, p = <0.001

Negative network: Pearson's r = 0.23, p < 0.001

Conclusion

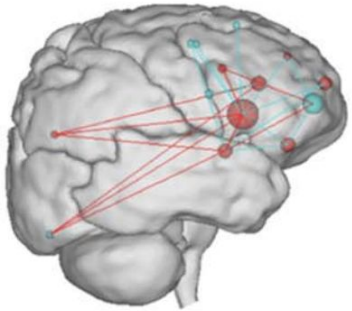
Summary

- Whole-brain task-based functional connectivity significantly relates to working memory performance
- CPM is a promising method for modeling working performance from FC matrices
- Data set was limited by potential BOLD response bleeding in from 0-back task blocks



Future work

- Explore multi-modal CPM combining other neuroimaging modalities with better temporal resolution (e.g., EEG/MEG)
- Future work can investigate CPM's ability to predict performance in other cognitive domains



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