Influence of Brain State, *a priori* Feature Selection, and Individualized Parcellation on Connectivity-Based Predictions of Behavior

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Introduction

- Brain-behavior **prediction** can **improve understanding of human brain functioning**, but **prediction accuracies** using brain data **are rather low**[1–3]
- Possible improvement of prediction through:
  - task-based functional connectivity (FC), rather than resting-state FC[1]
  - feature-reduction methods[1–4]
- In previous work[5], we found **limited improvement** of prediction, possibly due to **insufficient capture of individual FC variability**
- **Individualizing**[4,6,7] parcels for network representation prior to prediction to incorporate individual node-topology could yield improved FC-estimates

Research question: Can individualizing parcel networks improve prediction (1) and capture specificity of state (2) or task-based feature selection (3)?

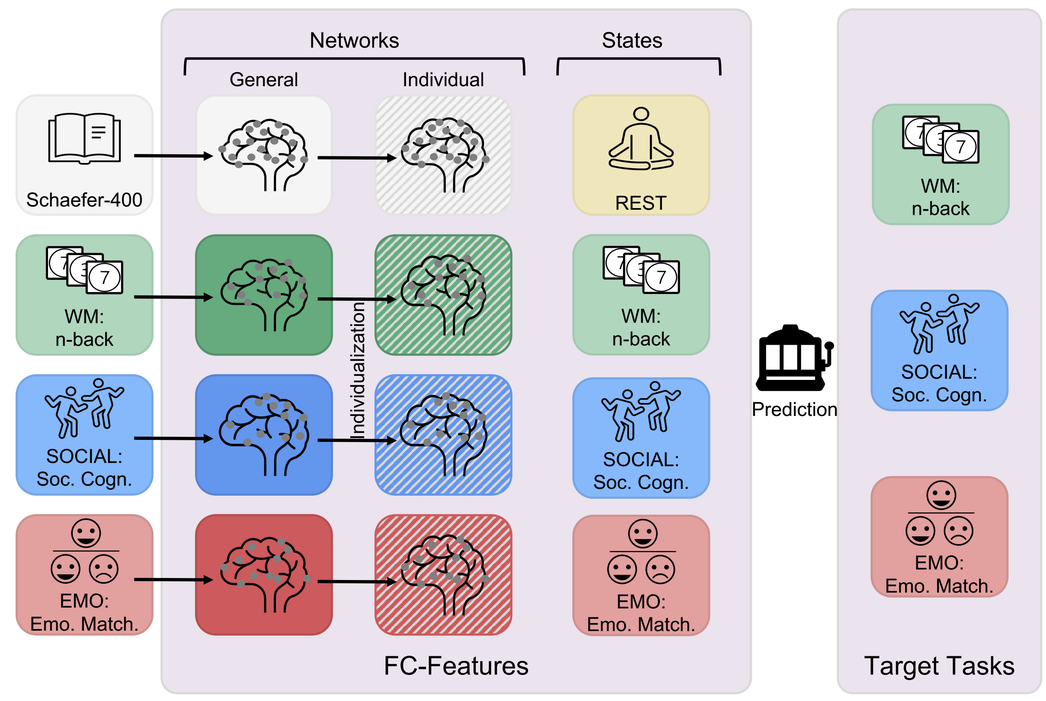
Methods

Sample: 440 subjects from 114 families from Human Connectome Project[8].

Features: FC from **whole-brain** Schaefer-400 parcels[9], and selection of **task-related parcels** from task-activation analysis based on n-back (working memory; WM), social cognition (SOCIAL), and emotional face matching task (EMO); both **general** and **individualized networks** with MS-HBM-algorithm[6]. All FC obtained from resting (REST) and 3 task **states**: WM, SOCIAL, and EMO.

Targets: Task performance (z-scored) from the 3 domains (same as task states and task-related parcel networks).

Prediction: Partial least squares prediction, leave-30%-family-out cross-validation scheme, root mean squared error (RMSE) for prediction evaluation.



Results

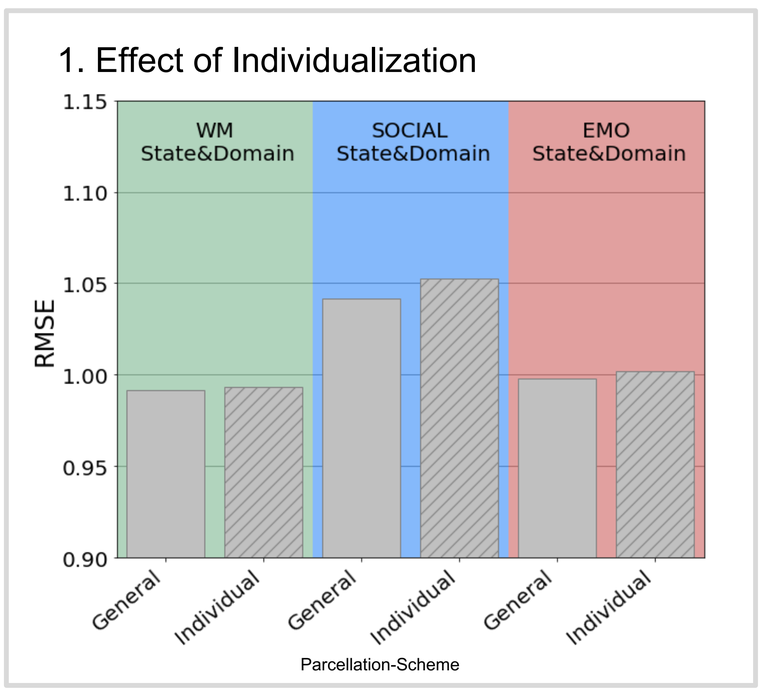
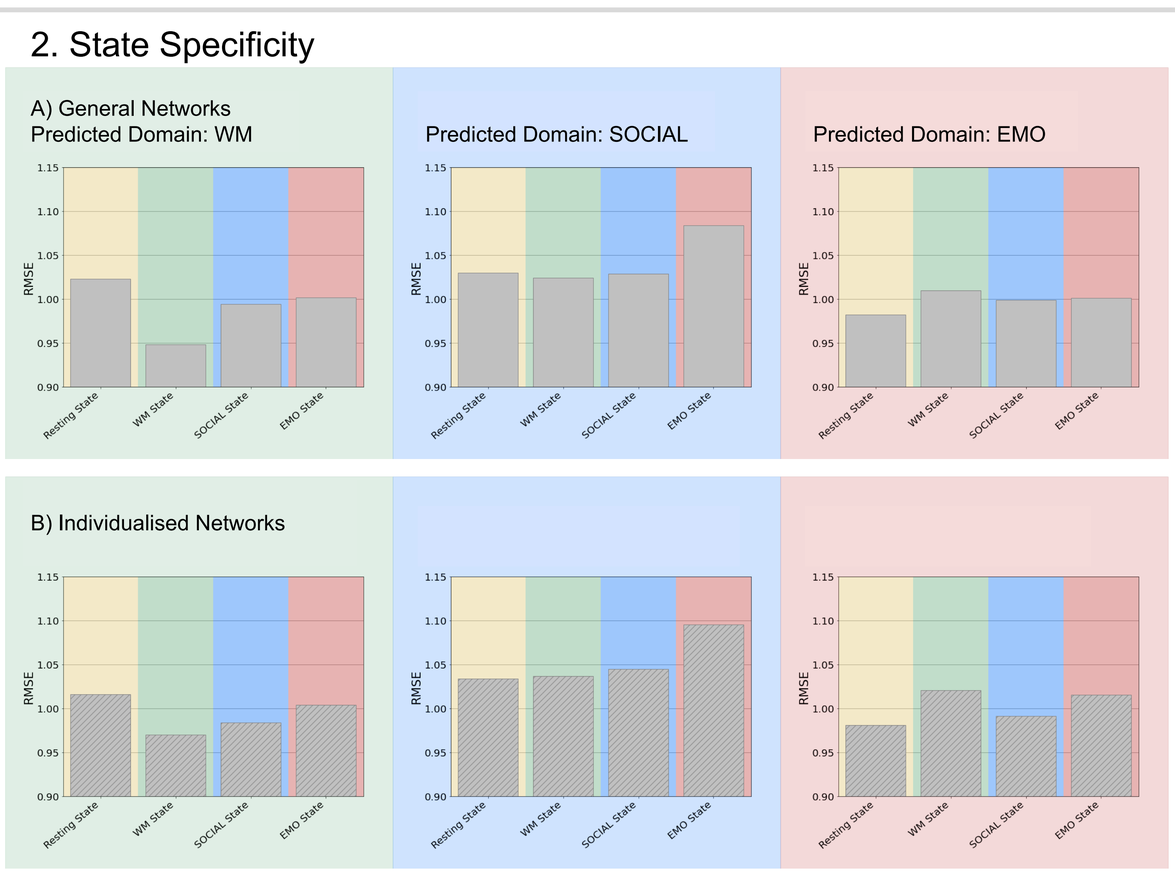


Fig. 1) Average prediction performance of general (solid columns) and individualized (hatched columns) networks.
Fig. 2) Specificity of FC state for A) general and B) individualized parcels.
Fig. 3) Specificity of network for A) general and B) individualized parcels. Yellow: resting state, green: WM, blue: SOCIAL, red: EMO, white: whole-brain 400 Schaefer parcels.



Discussion

- In line with our previous study[5], **prediction accuracies** were rather **low**
- In contrast to previous results[4,6,7], **individualization did not improve prediction** performance
- Prediction was slightly **improved in task fMRI**, though **no state specificity** was observed
- **No influence** of selection of task-related parcel **networks** was observed
- **Whole-brain** Schaefer parcellation performed slightly **better** than *a priori* task-based feature selection
- No improvement of prediction may be due to rather small sample size[4,6,7,9]
- **Discrepancy** between current results indicating no improvement after individualisation and literature **needs further investigation**
- **Predicting complex behaviour based on FC remains a significant challenge**

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