Evaluating Accuracy and Reliability of Brain-Behavior Models Using Diffusion MRI

McKenzie Paige Hagen[1], John Kruper[1], Keshav Motwani[2], Eardi Lila[2], Jason Yeatman[3], Ariel Rokem[1]

[1] Department of Psychology, University of Washington [2] Department of Biostatistics, University of Washington [3] Graduate School of Education, Stanford University

Background

- Diffusion MRI (dMRI) measures tissue properties of white matter, which contains long-range connections between different brain regions.
- Brain-behavior models can be used link neuroimaging features and phenotypes.
- dMRI can be processed into model input features in several ways.
- There are a multitude of different regularization methods for predictive models.

Question: How do sets of features derived from different dMRI processing methods compare in model accuracy and variability?

Methods

- Diffusion MRI from 1041 Human Connectome Project participants.
- Processed into "tract profiles" (2400 features) using pyAFQ and "local connectome fingerprint" (100,000) using DSI-Studio (cite).
- LASSO regularizated models fit to tract profiles and local connectomes seperately.
- Sparse Group LASSO (SGL) models fit to tract profiles, grouped by tract.
- Prediction targets were various cognitive phenotypes.
- Models implemented in R and trained using nested cross-validation and boostrap resampling.
- Placeholder for more details?
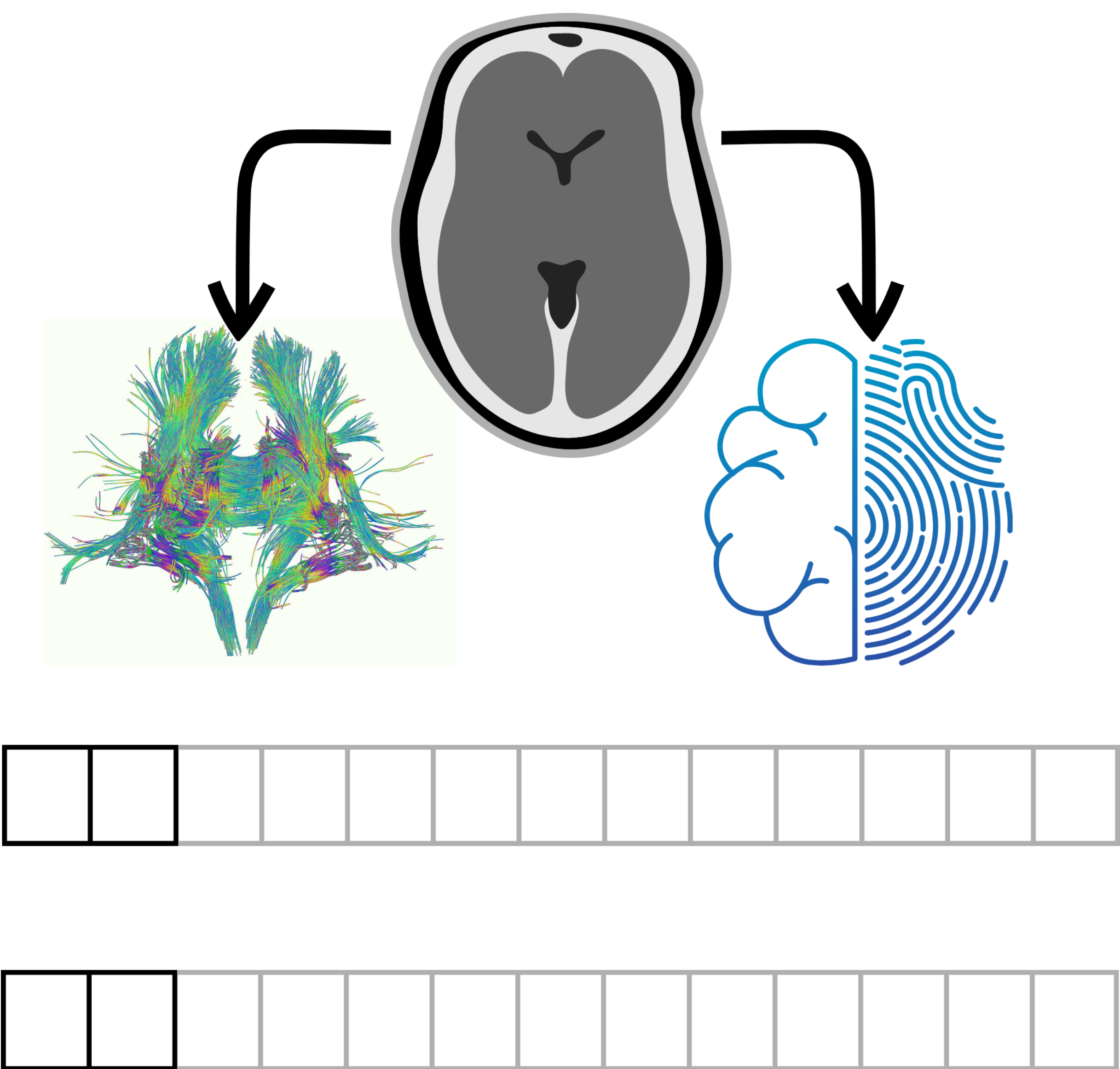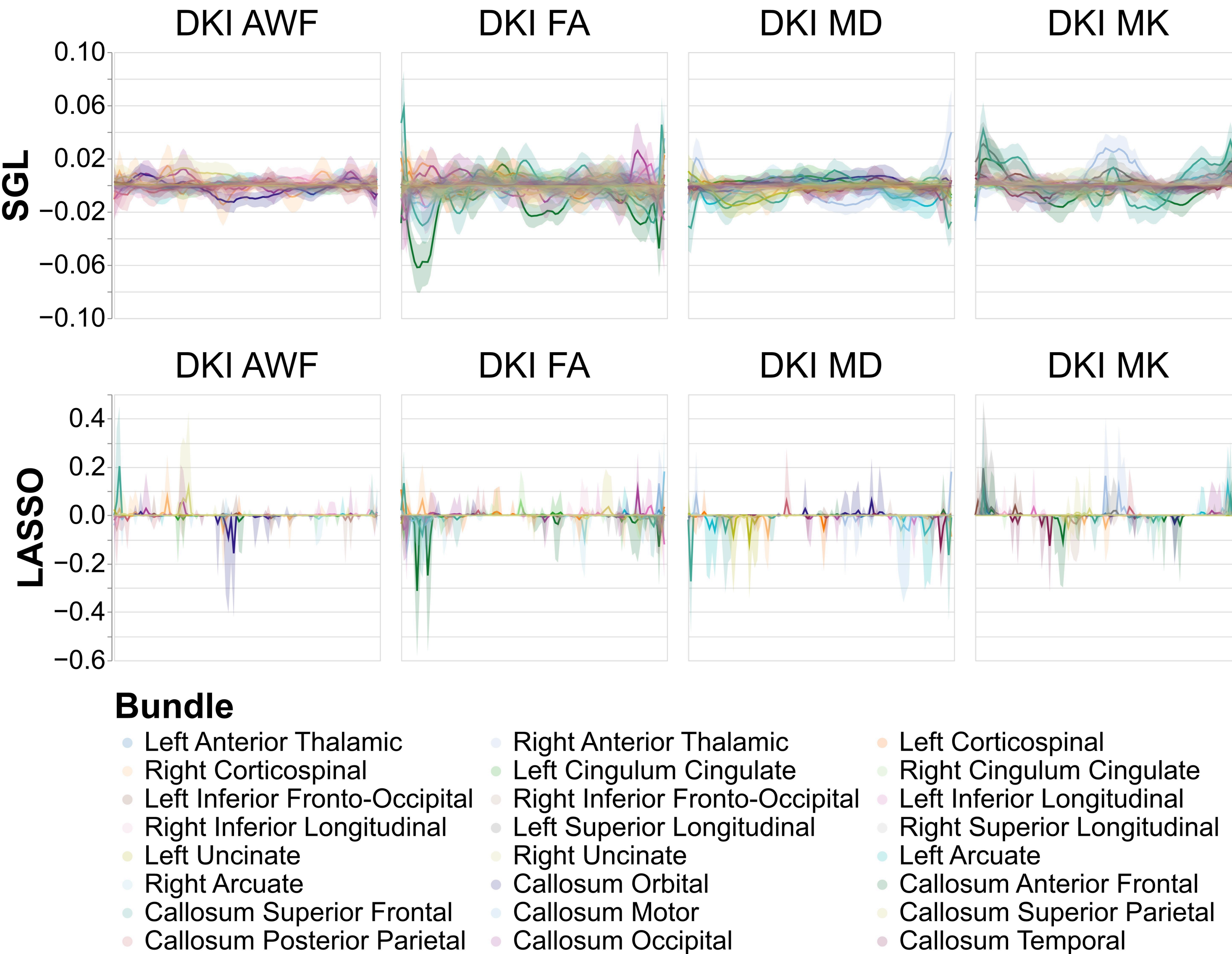

Caption for the picture.

Conclusions

- Tractometry contains equivalent predictive information as compared to local connectome, with much fewer features.
- Utilizing a variety of regularization methods and feature engineering can maximize interpretability of models.
- this is more conclusions
- testing page limits
- This will be replaced with an insightful comment about the results
- Lots of space for conclusions
- Placeholder
- I just want the results to wrap to the other side
-

Results
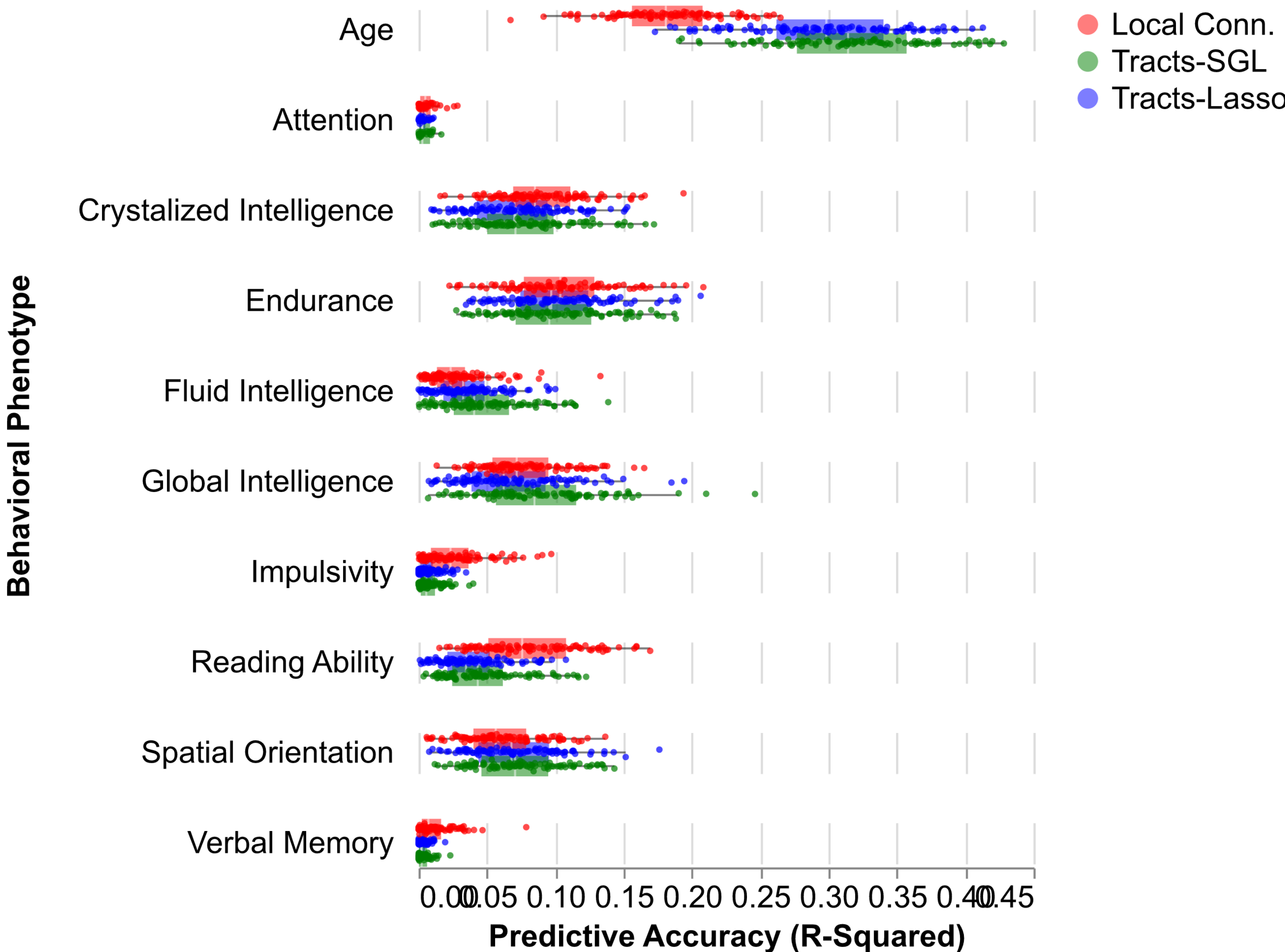
Model accuracies for behavioral phenotypes. All models, regardless of regularization method or feature set performed statistically equivalently.

Bundle
- Left Anterior Thalamic
- Right Corticospinal
- Left Inferior Fronto-Occipital
- Right Inferior Longitudinal
- Left Uncinate
- Right Arcuate
- Callosum Superior Frontal
- Callosum Posterior Parietal
- Right Anterior Thalamic
- Left Cingulum Cingulate
- Right Inferior Fronto-Occipital
- Left Superior Longitudinal
- Right Uncinate
- Callosum Orbital
- Callosum Motor
- Callosum Occipital
- Left Corticospinal
- Right Cingulum Cingulate
- Left Inferior Longitudinal
- Right Superior Longitudinal
- Left Arcuate
- Callosum Anterior Frontal
- Callosum Superior Parietal
- Callosum Temporal

"Age" prediction model weights across tracts for SGL and LASSO. Solid lines show the mean model weight across bootstraps for every tract, across every node, and the shaded areas show the 95% confidence intervals of the model weights. Note the reduced y-axis range for SGL.

Acknowledgements

References

This is a reference.