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

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Background

- Diffusion MRI measures tissue properties of white matter, which contains long-range connections between different brain regions.
- Raw diffusion data can be engineered into different "feature sets" for use in predictive models.
- Comparison of a variety of feature sets and models for both accuracy of predicutions and variance/bias of beta coefficients can help determine which models are more optimal for different feature sets.

Methods

- We used diffusion data from 1041 participants from the Human Connectome Project, processed into "tract profiles" using pyAFQ (cite) and "local connectome" features using DSI-Studio (cite).
- LASSO models were run on both tract profiles and local connectome to predict a variety of cognitive outcomes.
- Sparse Group LASSO (SGL) models were run on only tract profiles, to take advantage of the inherent tract groupings.
- Models were implemented in `R` and trained using nested cross-validation and boostrap resampling (link to code).
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Conclusions (rough wording)

- The selection of model and feature set might not be influential on the accuracy, but may result in less variable, more interpretable models.
- Tract profiles and local connectome have similar accuracies, but the grouping of tract profiles combined with SGL is good*
- Splitting families across the train/test splits is bad practice, but didn't have a large effect on the outcome.

Additional Results

- The inclusion of bootstrapping in our analytic pipeline appeared to decrease the accuracy of the models.** maybe
- Avoiding leakage by not splting realted subjects across the train/test splits did not have a significant effect.
- Relevant figure here:

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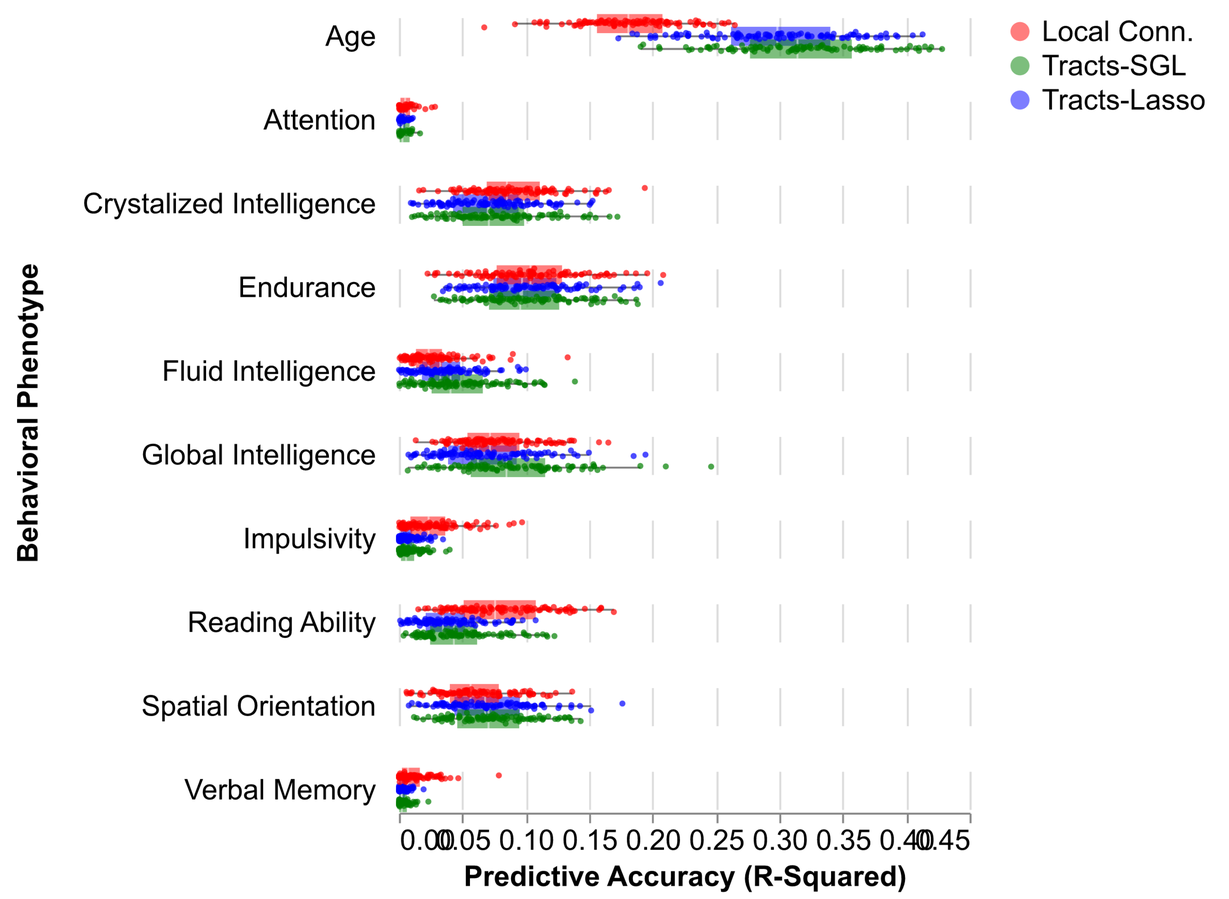

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Acknowledgements

- Krell funding
- This is another funding logo
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References

Created with (Allaire et al. 2024)

Allaire, JJ, Yihui Xie, Christophe Dervieux, Jonathan McPherson, Javier Luraschi, Kevin Ushey, Aron Atkins, et al. 2024. *Rmarkdown: Dynamic Documents for r*. https://github.com/rstudio/rmarkdown.