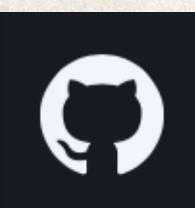


Neuropsychiatric Brain States

Presenter: Jacob DeRosa

Collaborators: McKenzie Hagen, Romina Abrosini, Meishan Ai, Alice Patania

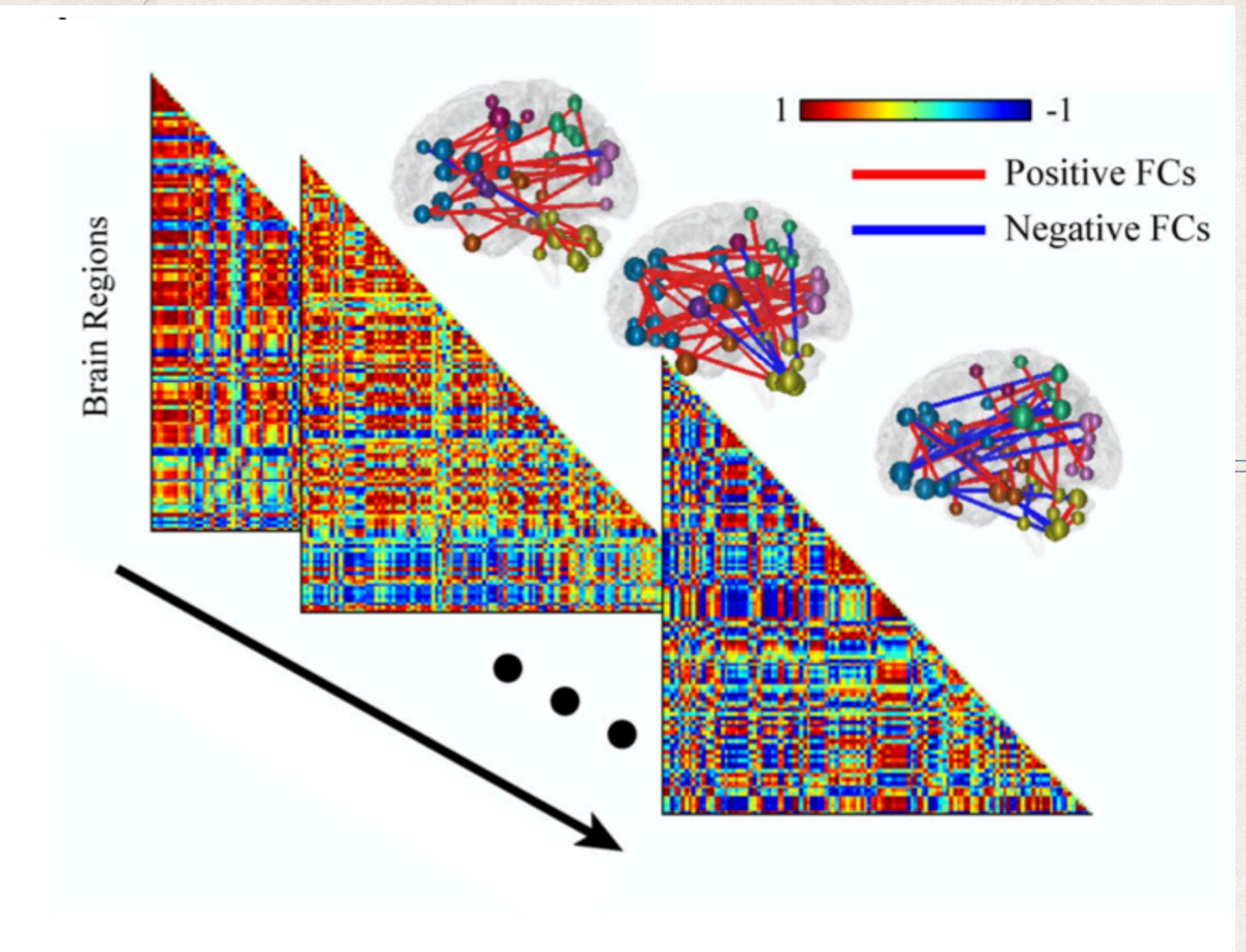


https://github.com/jakederosa123/neurohack_brainstates

What is a brain state?

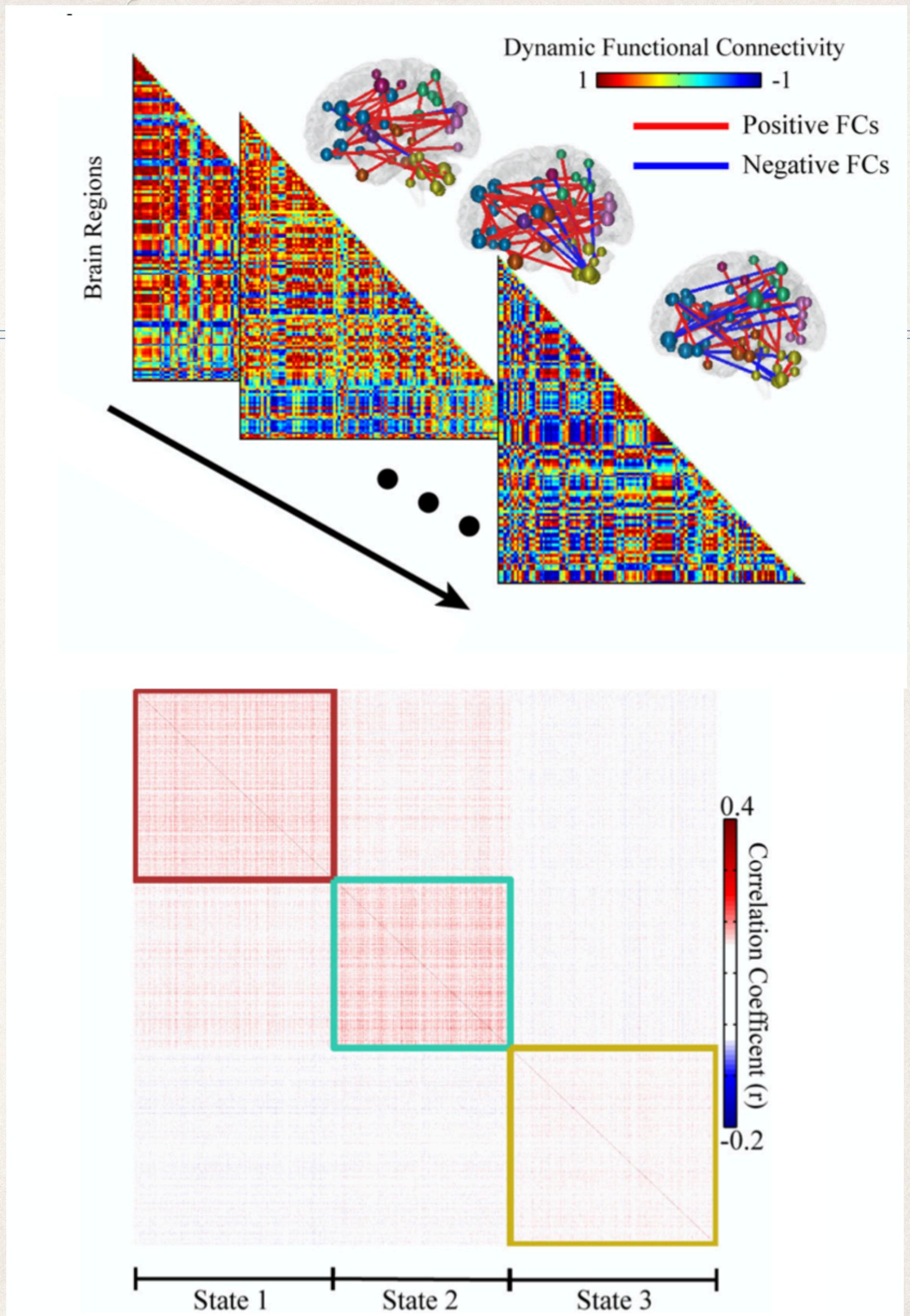
What is a brain state?

- Dynamical changes have been tracked from resting-state functional magnetic resonance imaging when a person is conscious but not carrying out a directed task during scanning.



What is a brain state?

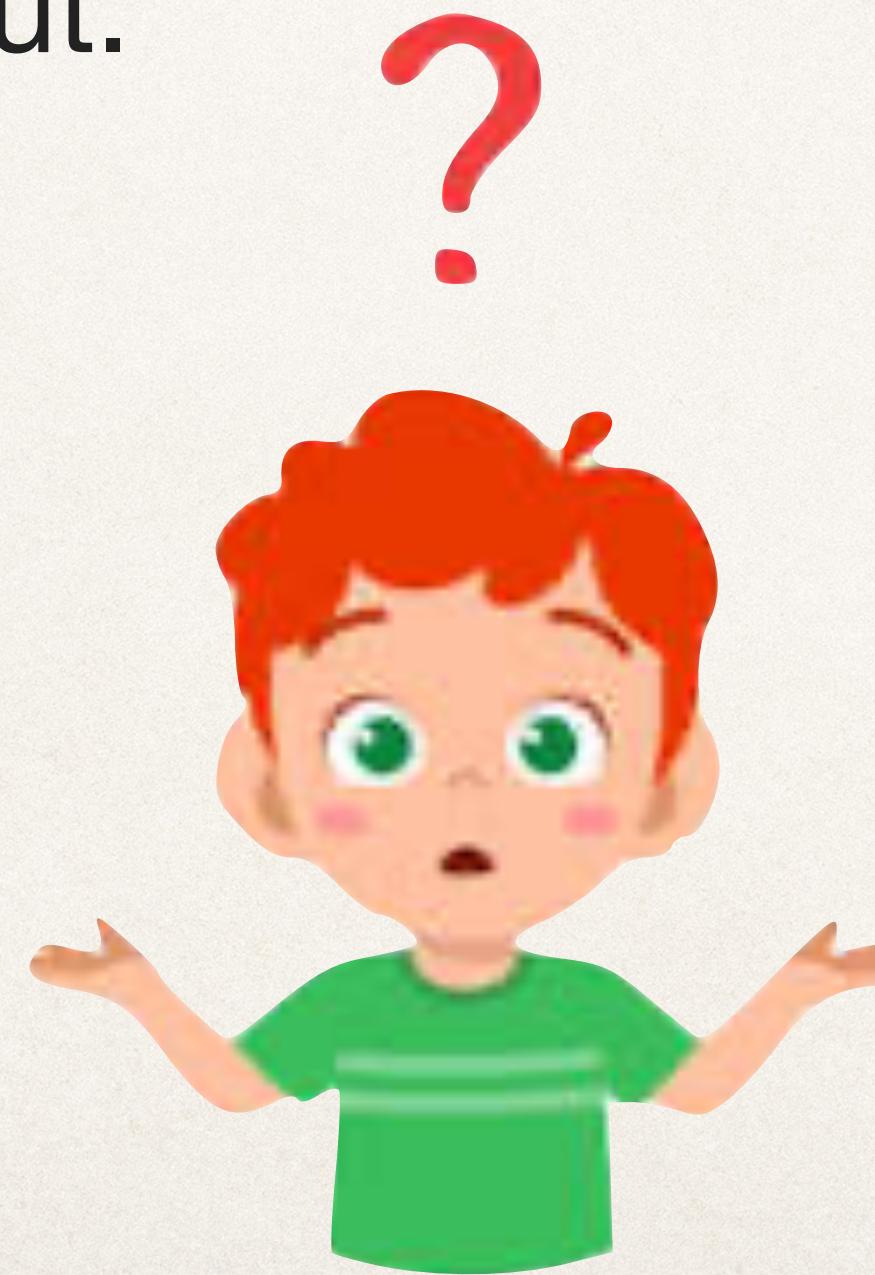
- Dynamical changes have been tracked from resting-state functional magnetic resonance imaging when a person is conscious but not carrying out a directed task during scanning.
- These diverse dynamical states are believed to represent different internal states of the brain, in terms of brain-regional interactions.



Why investigate brain states?

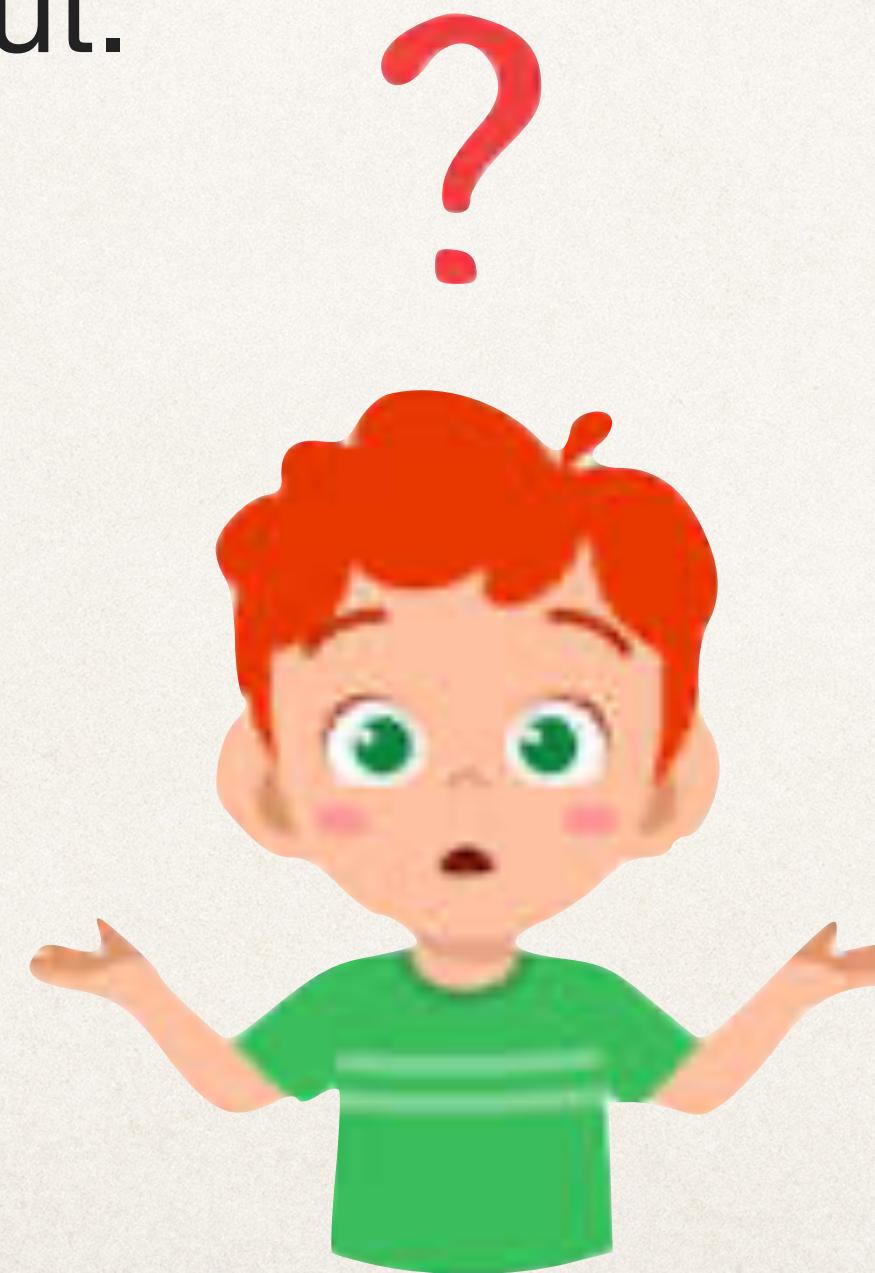
Why investigate brain states?

An elusive goal of computational neuroscience is to describe the brain as a dynamical system with a predictable natural temporal evolution and response to input.



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Such models would be invaluable to clinicians as a generalizable tool for identifying optimal brain stimulation approaches to drive the brain from various states of disease to states of health.



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Question: Can brain states during resting state fMRI accurately classify diagnosis?

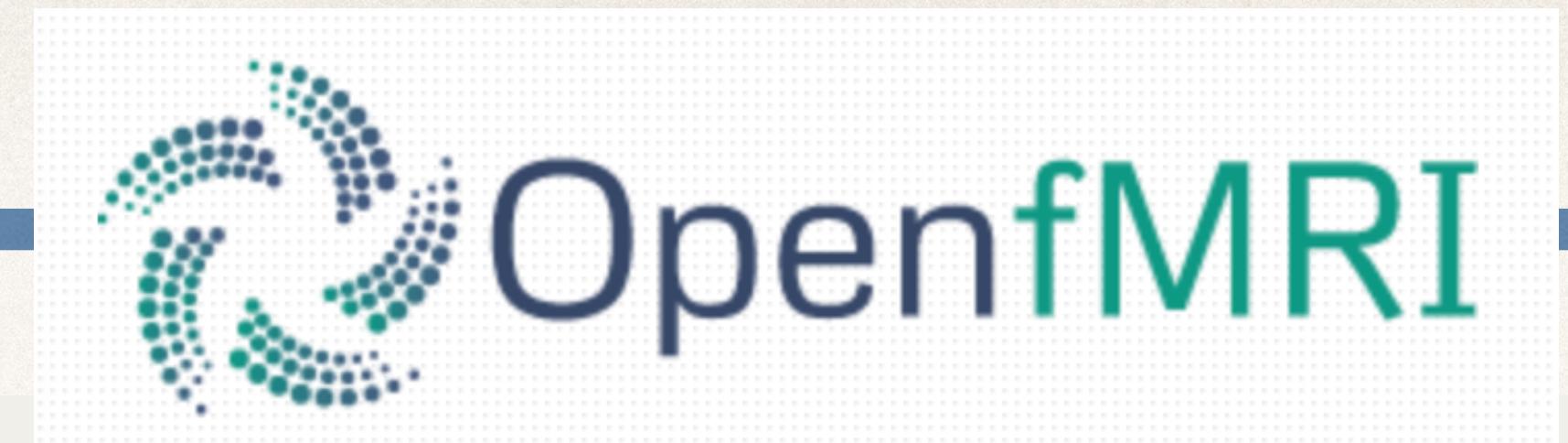
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- ❖ **Missing data:** Three subjects were removed due to missing or incomplete data.

Analysis Pipeline



Find dataset

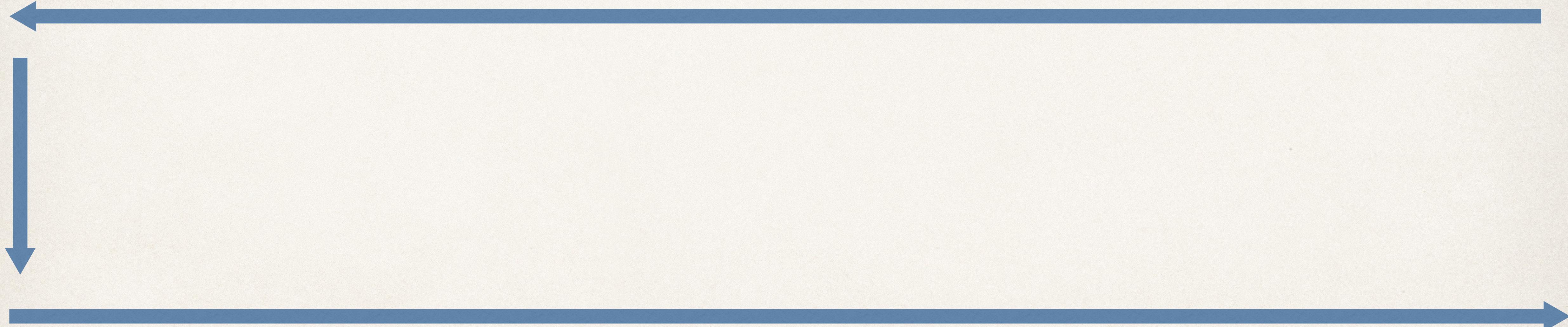
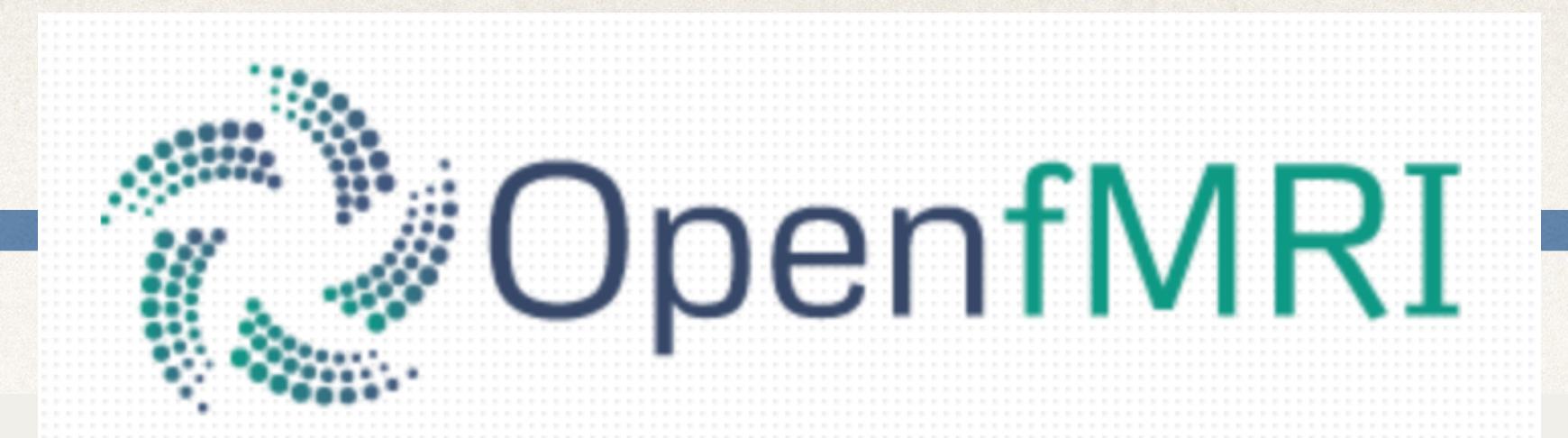
Analysis Pipeline



Analysis Pipeline

Find dataset

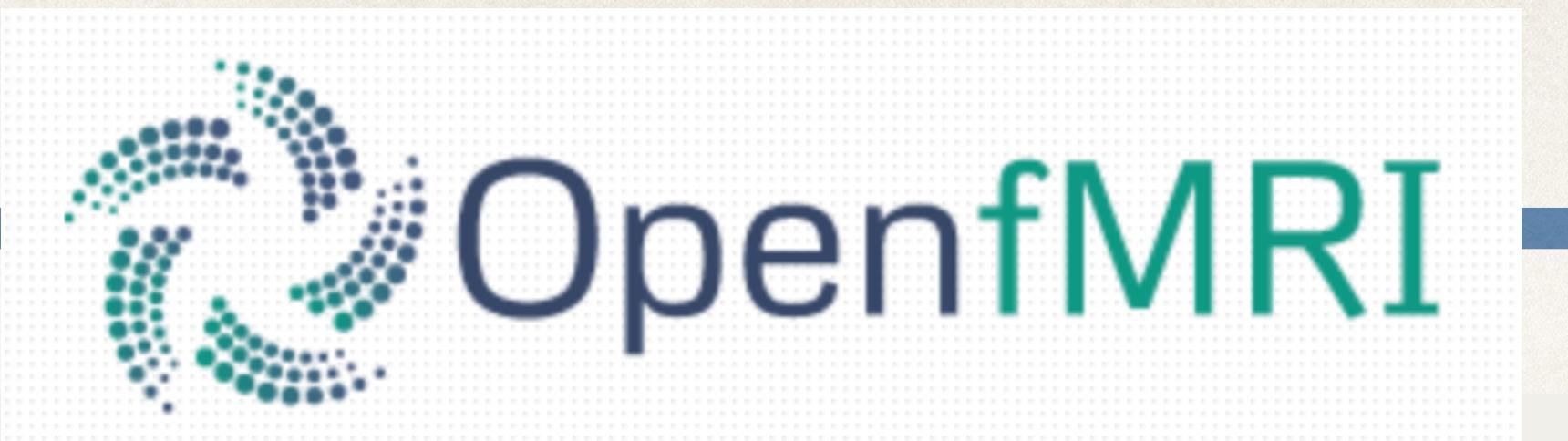
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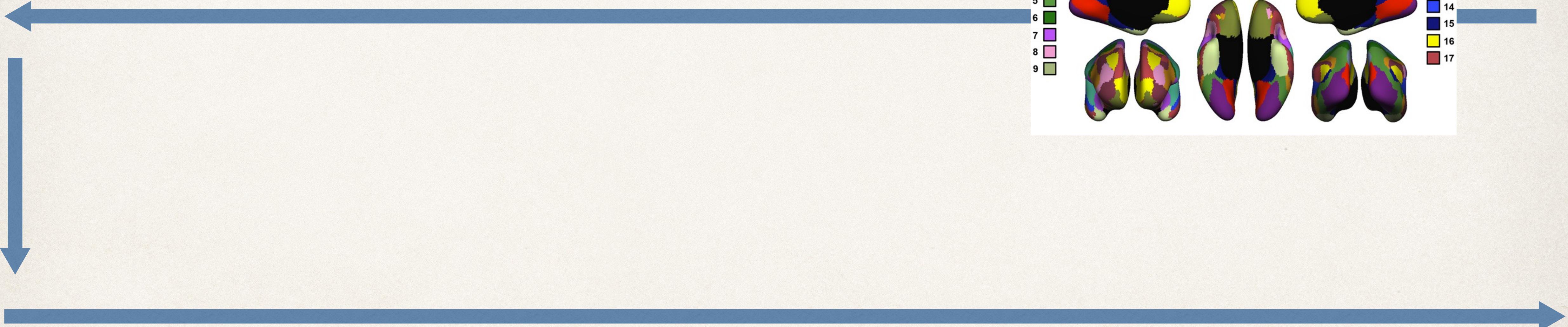
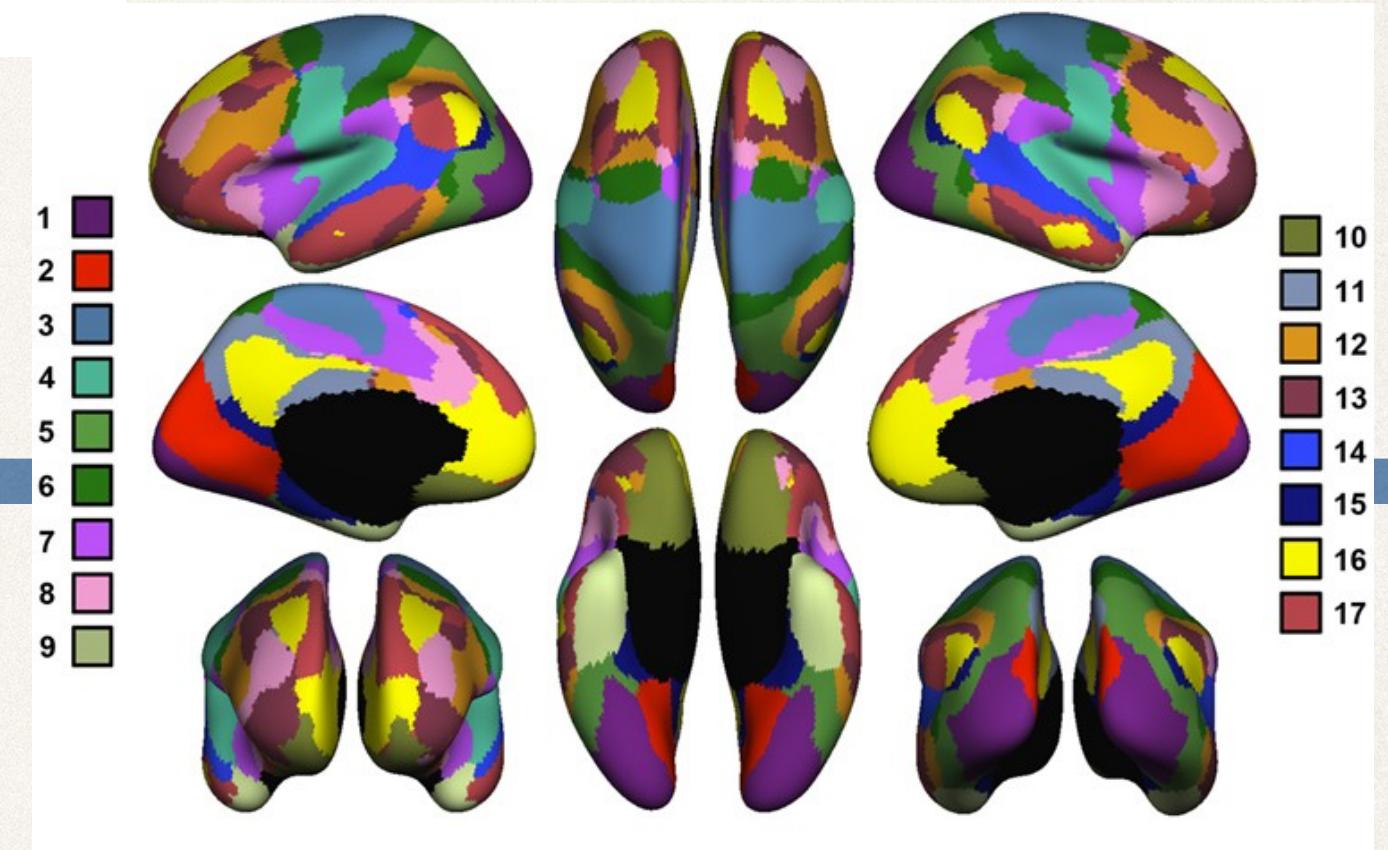
Analysis Pipeline

Find dataset

Download data



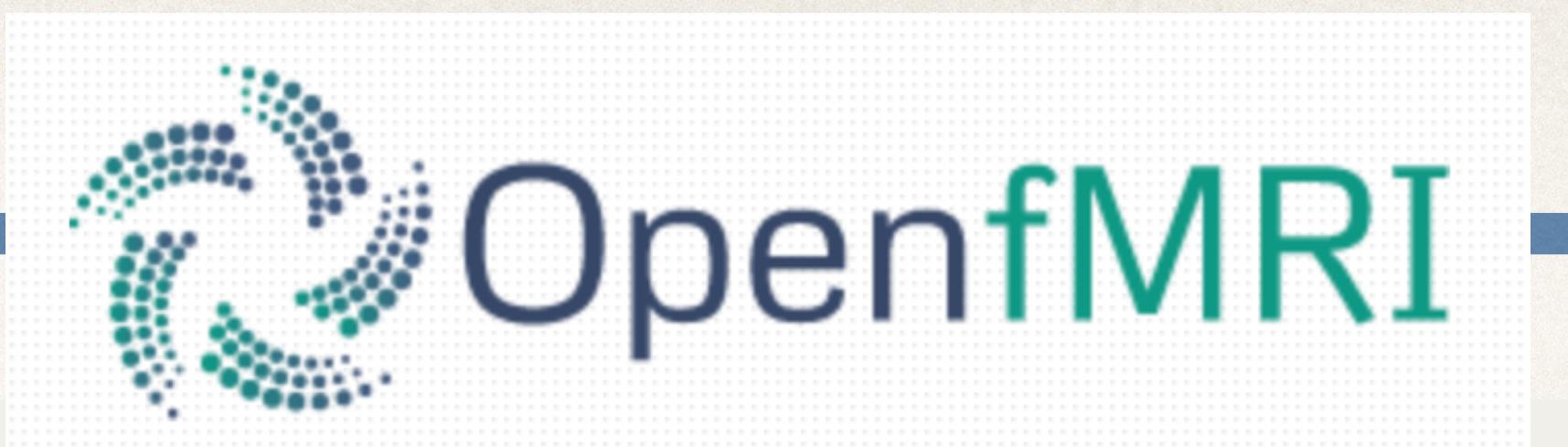
Use Yeo 17 atlas mask from nilearn



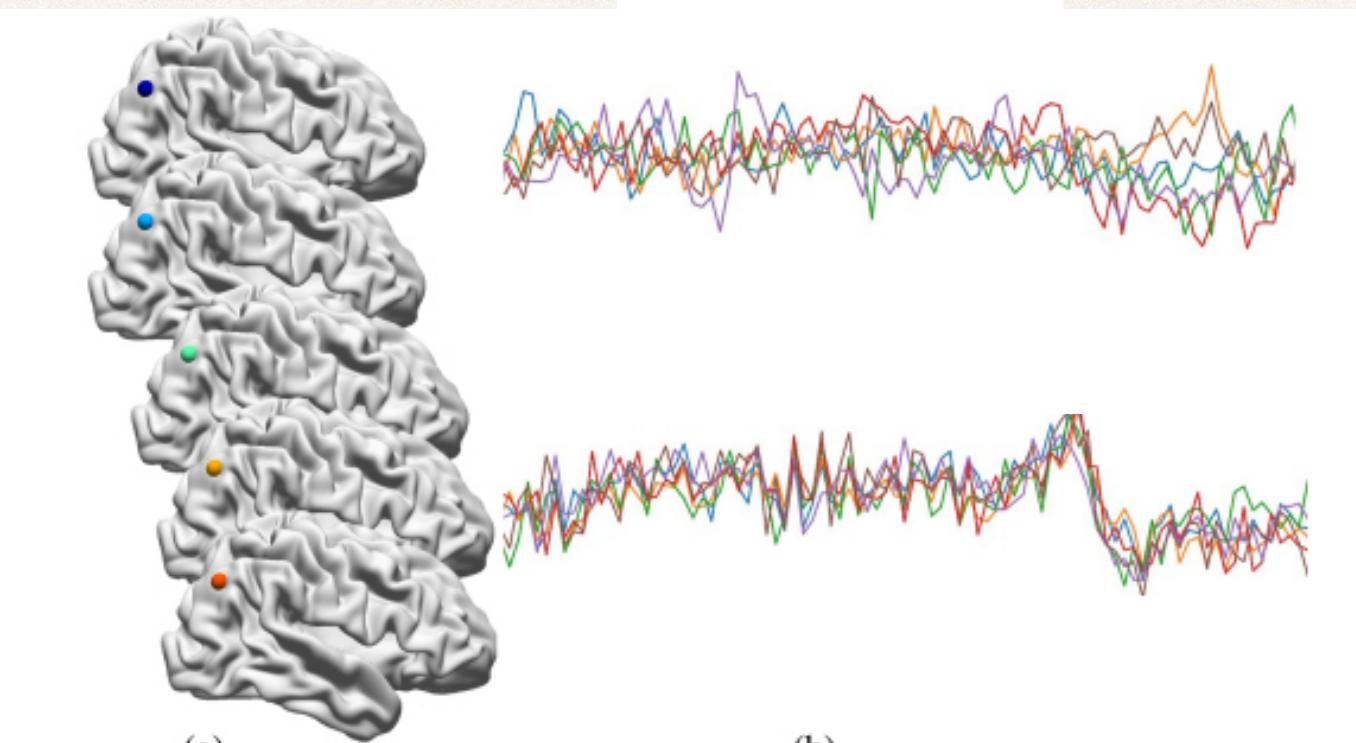
Analysis Pipeline

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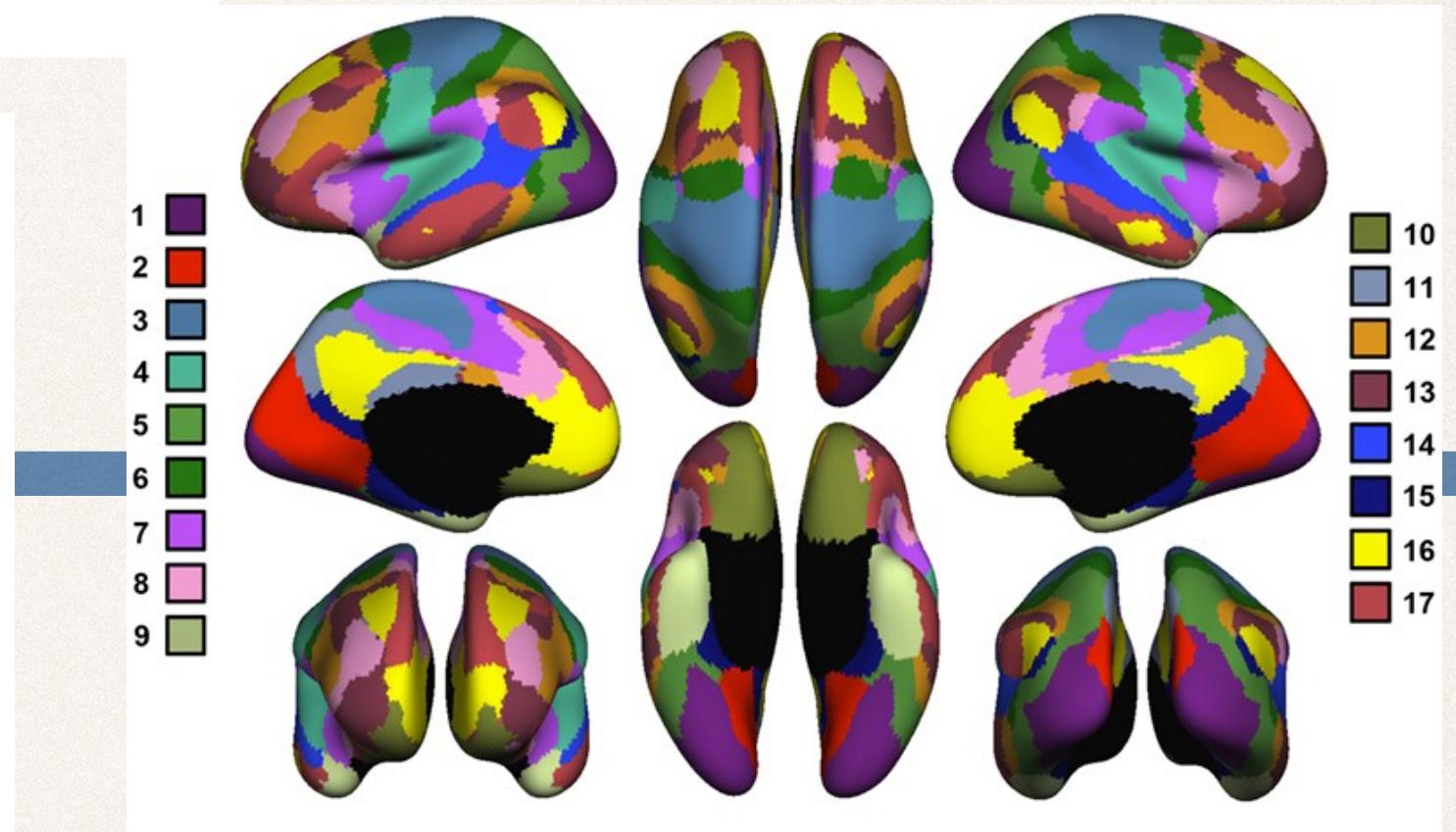
Download data



Extract time series for
each Yeo parcel



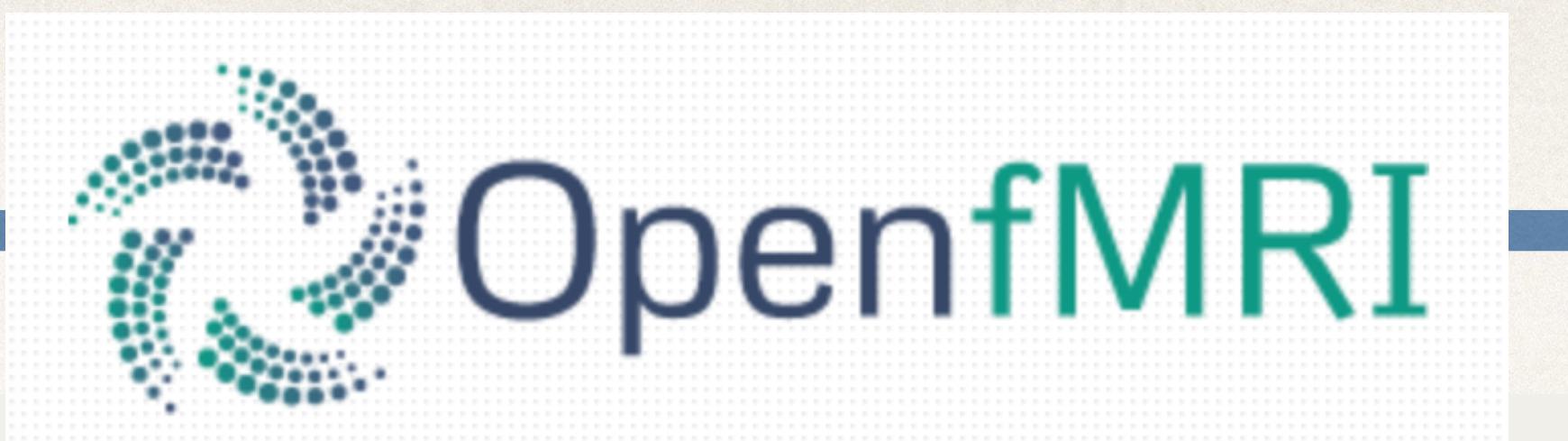
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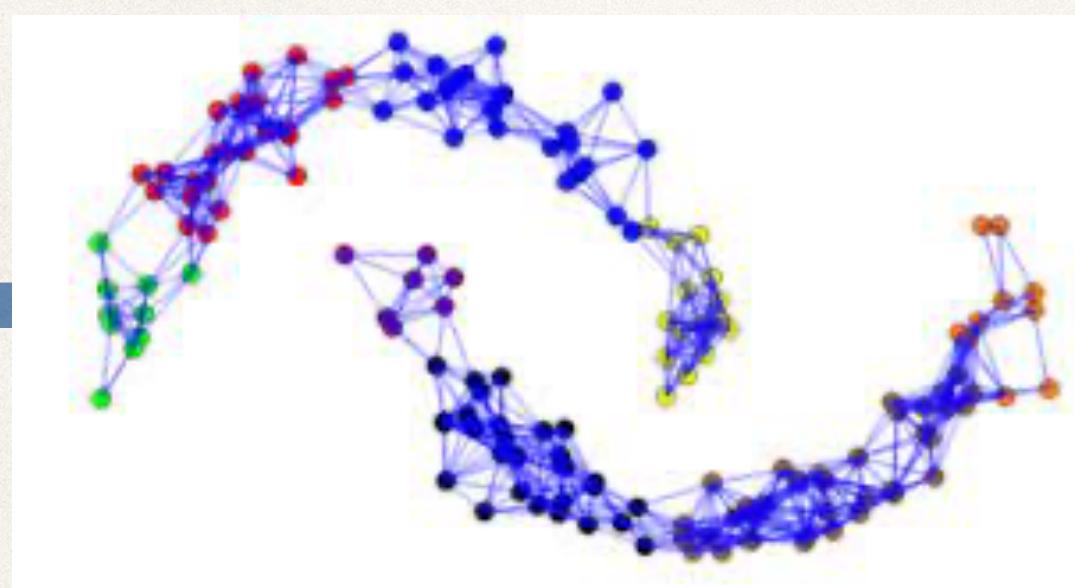
Analysis Pipeline

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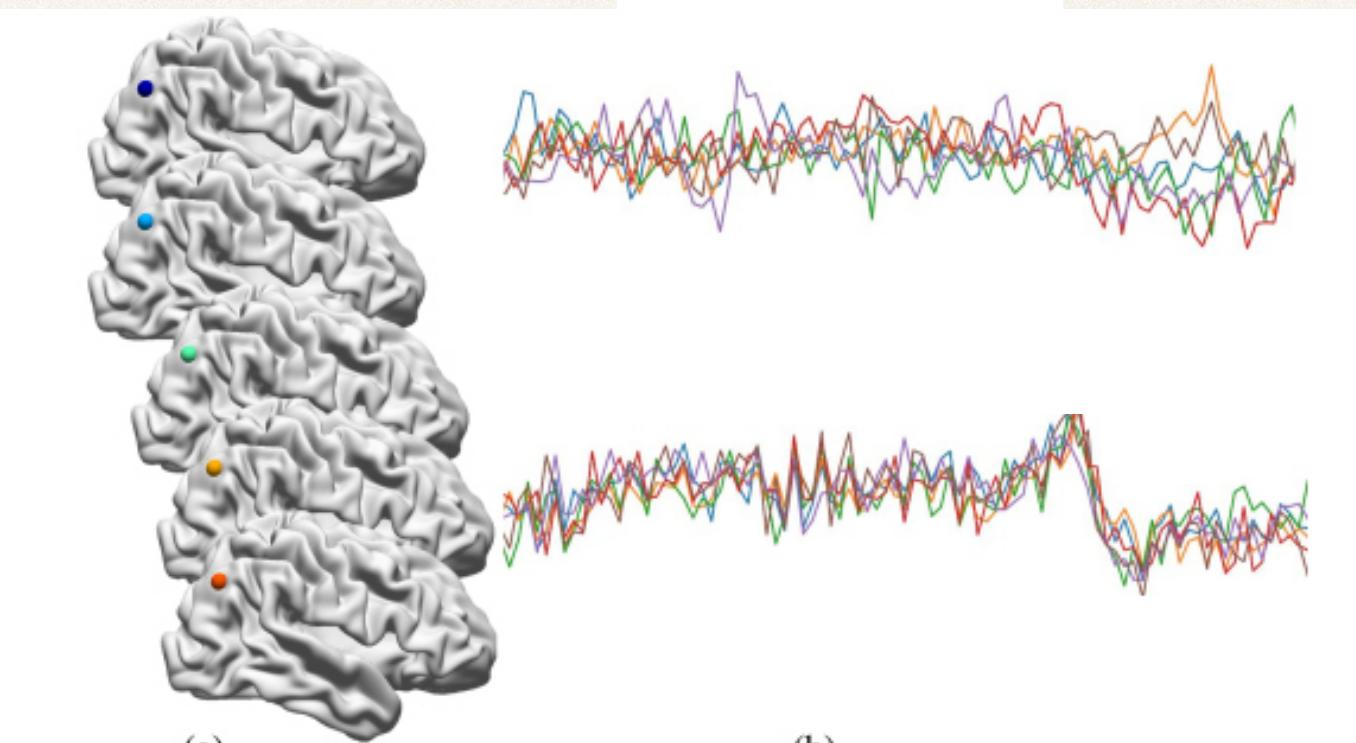
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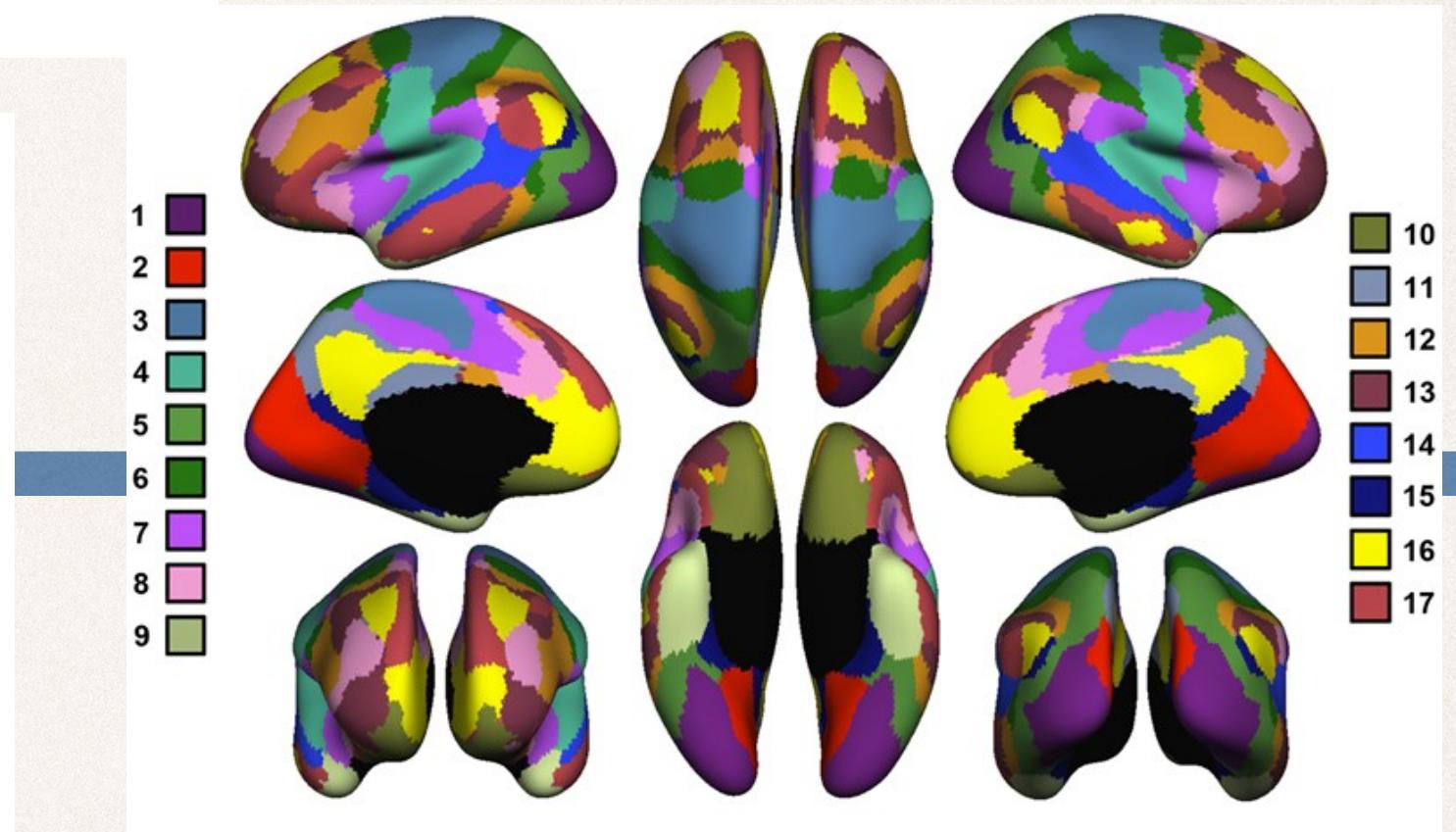
Apply Spectral clustering
to obtain 5 brain states



Extract time series for
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Use Yeo 17 atlas mask from nilearn

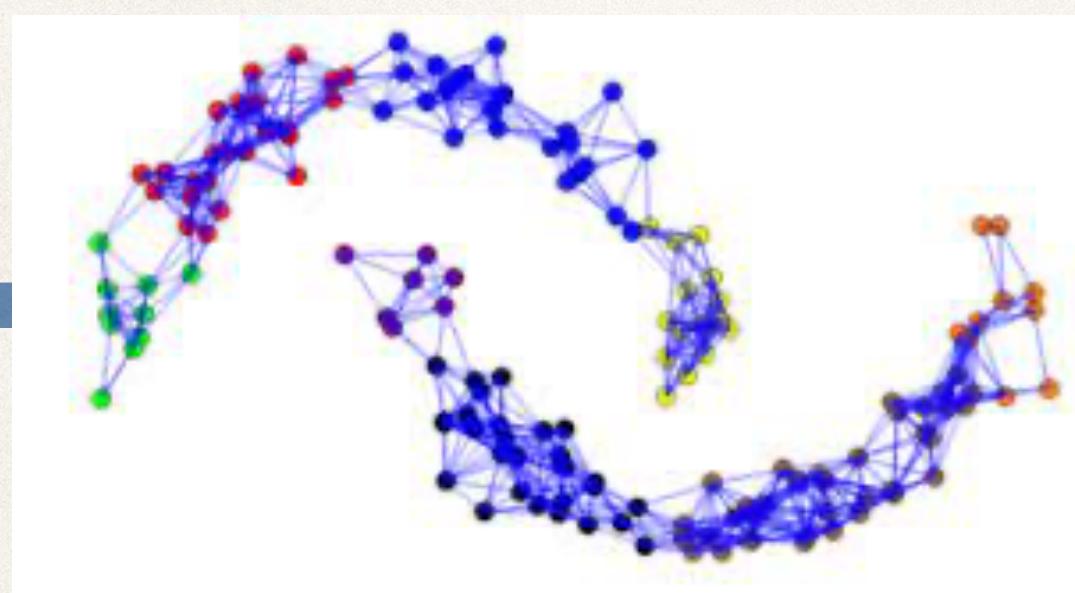


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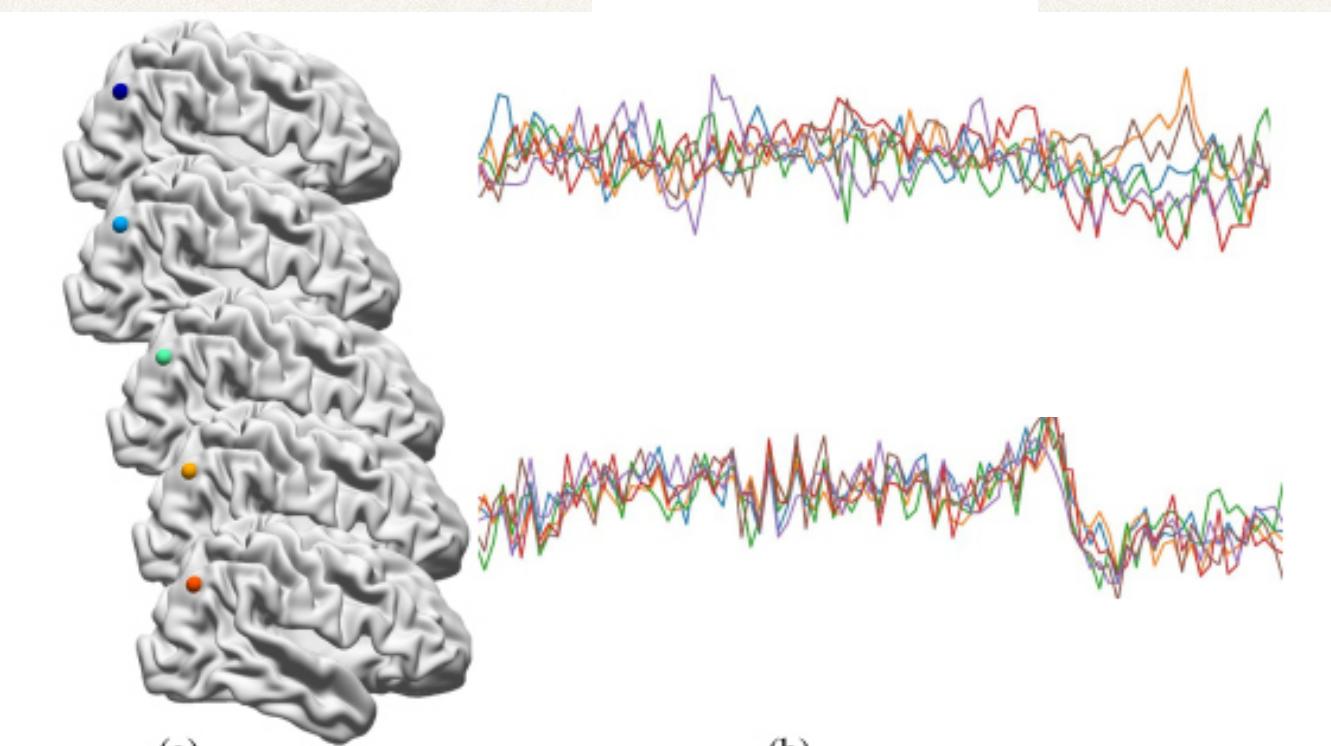
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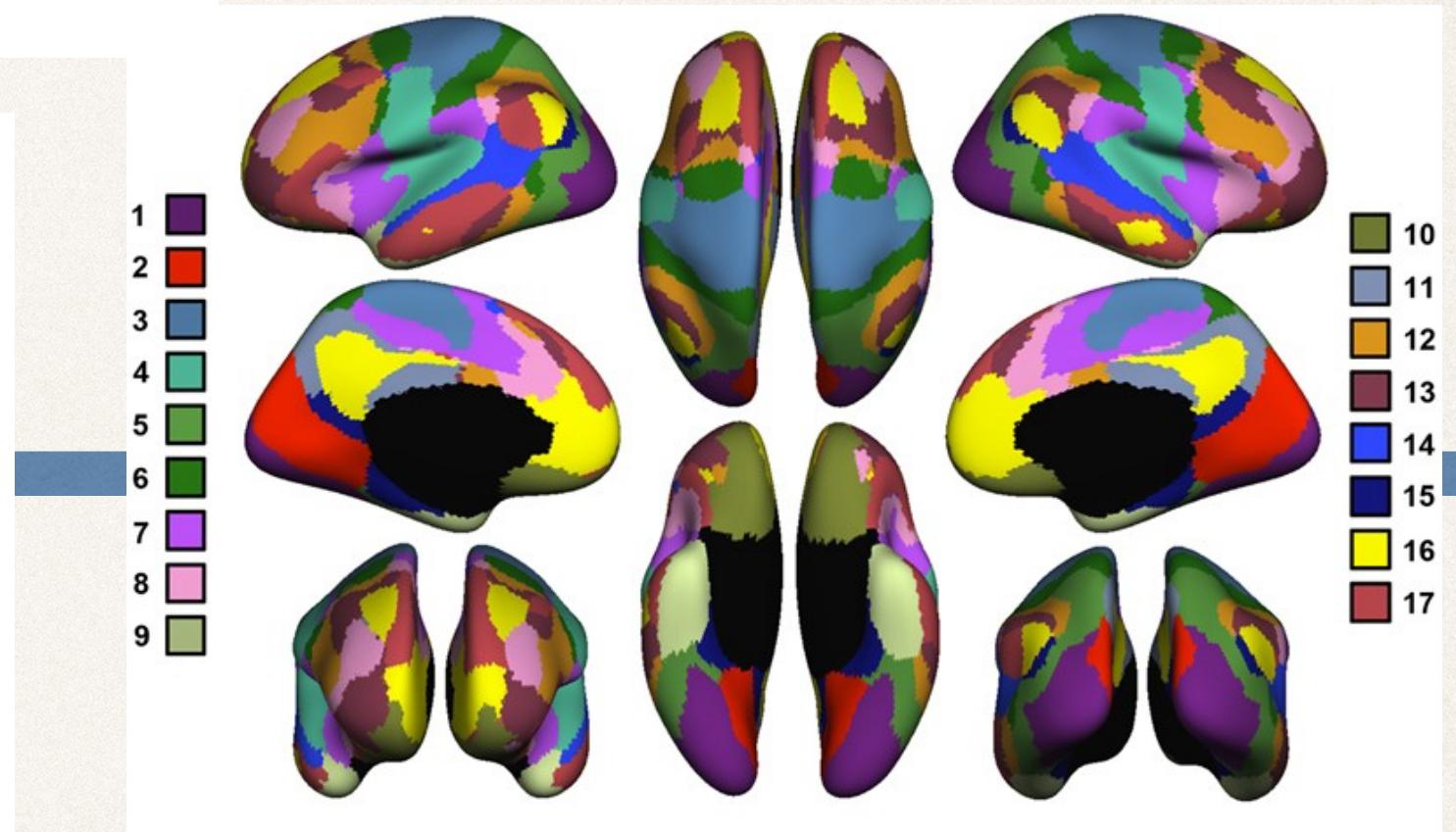
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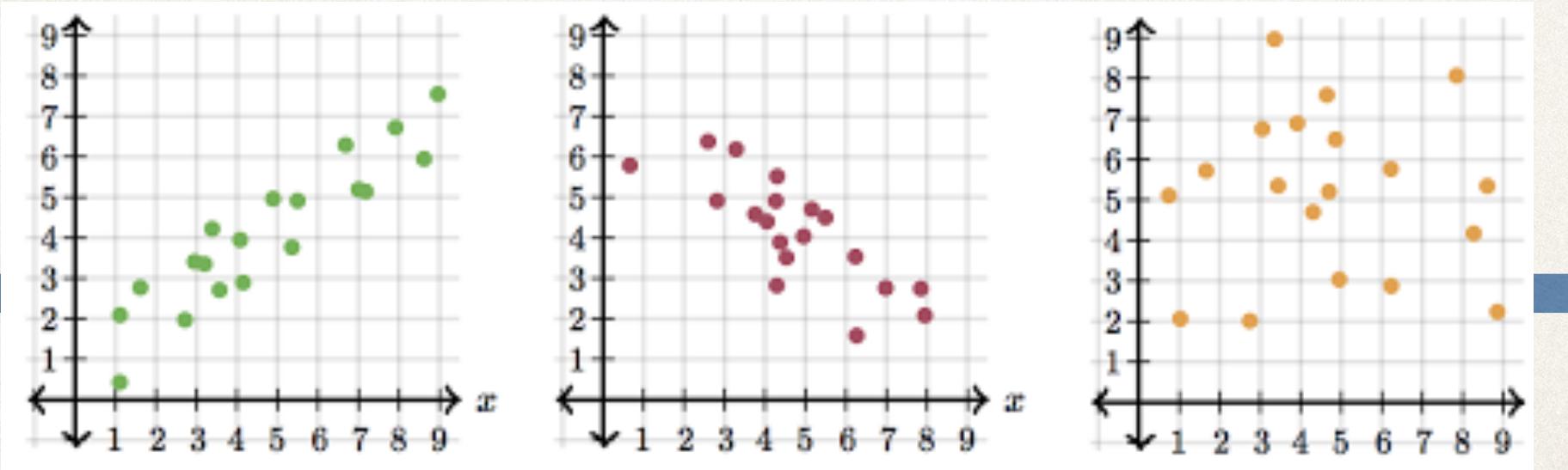
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Use Yeo 17 atlas mask from nilearn



Correlate states across subjects

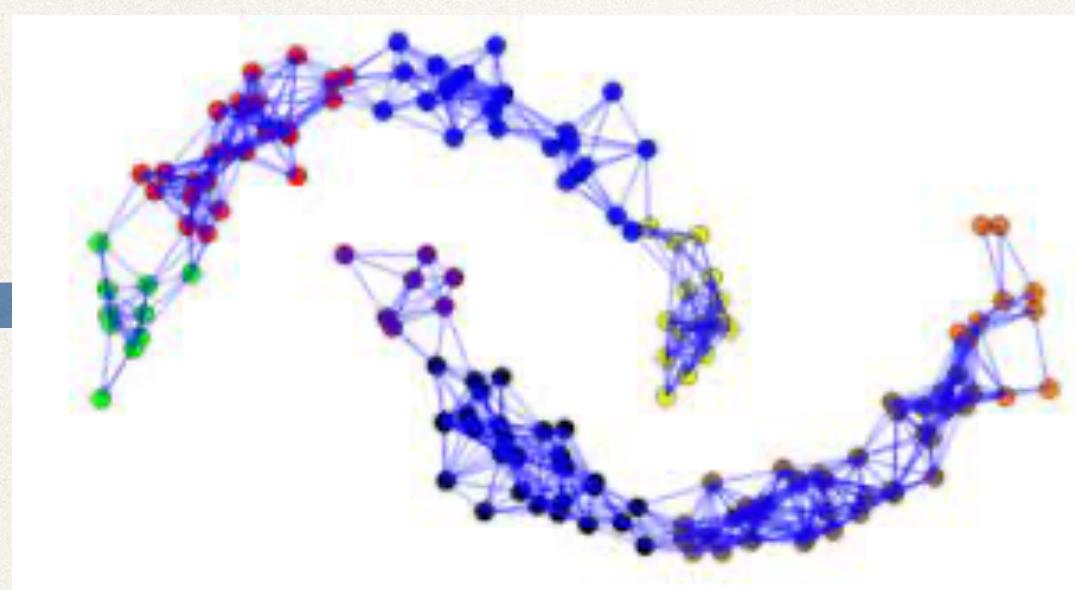


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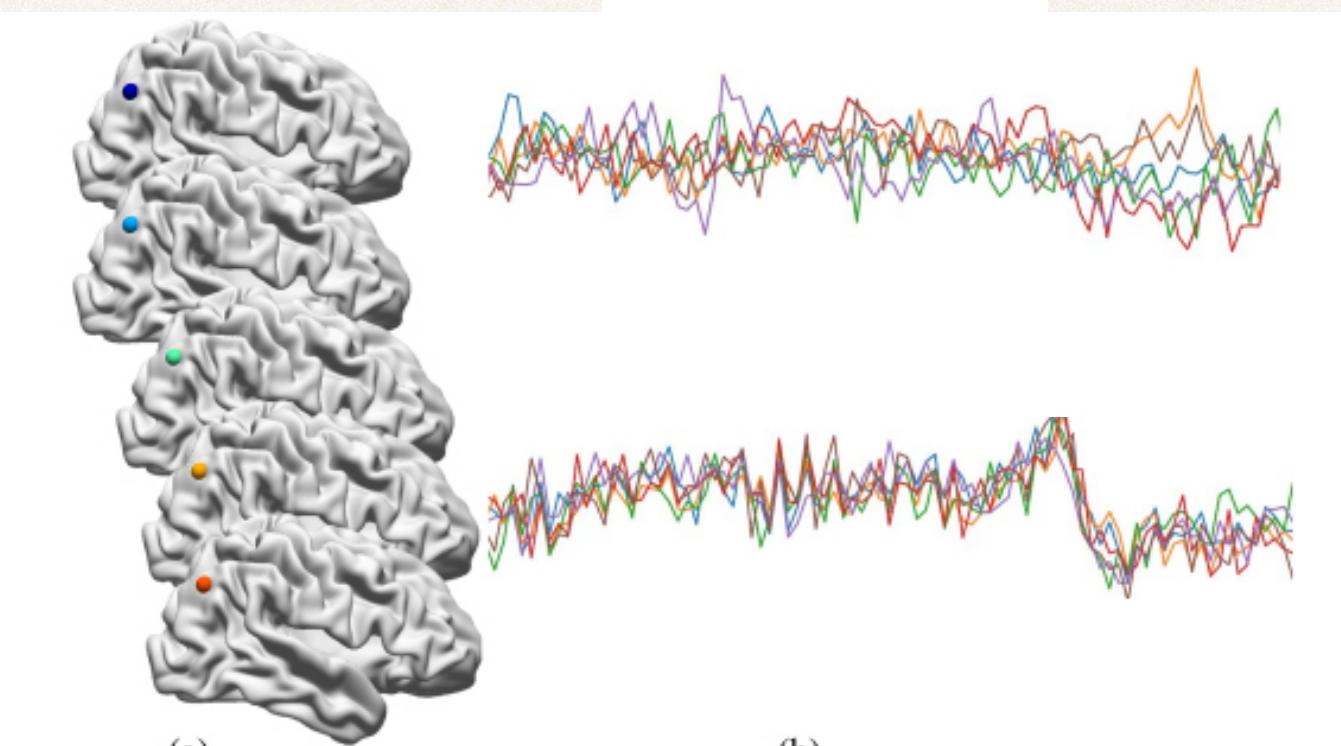
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Analysis Pipeline

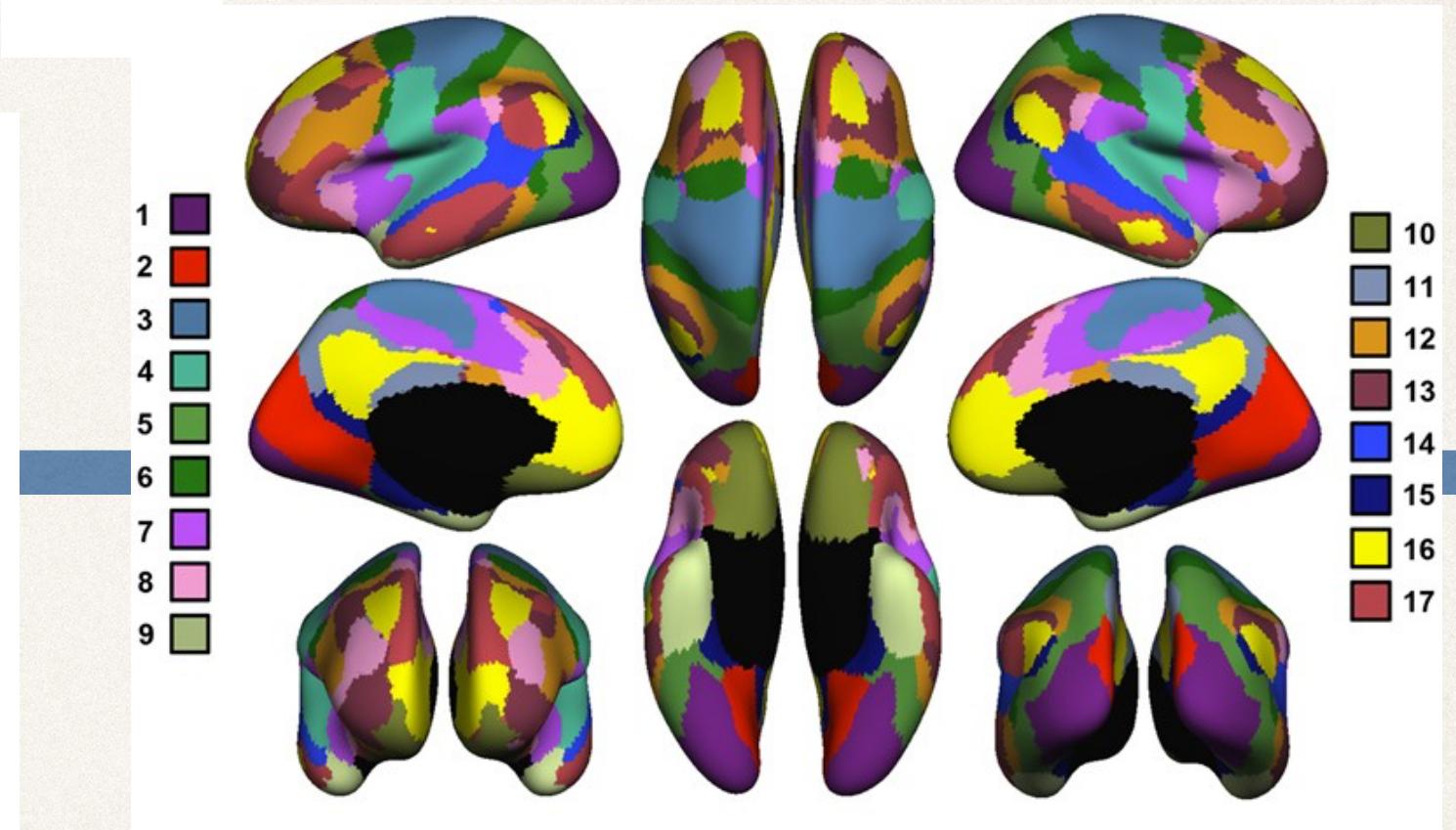
Apply Spectral clustering
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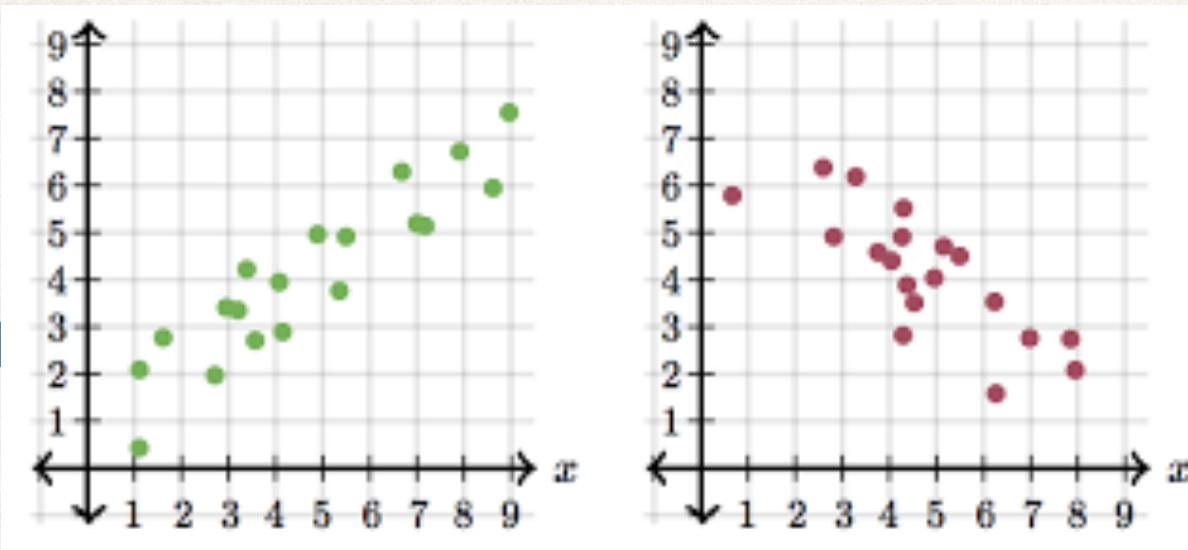
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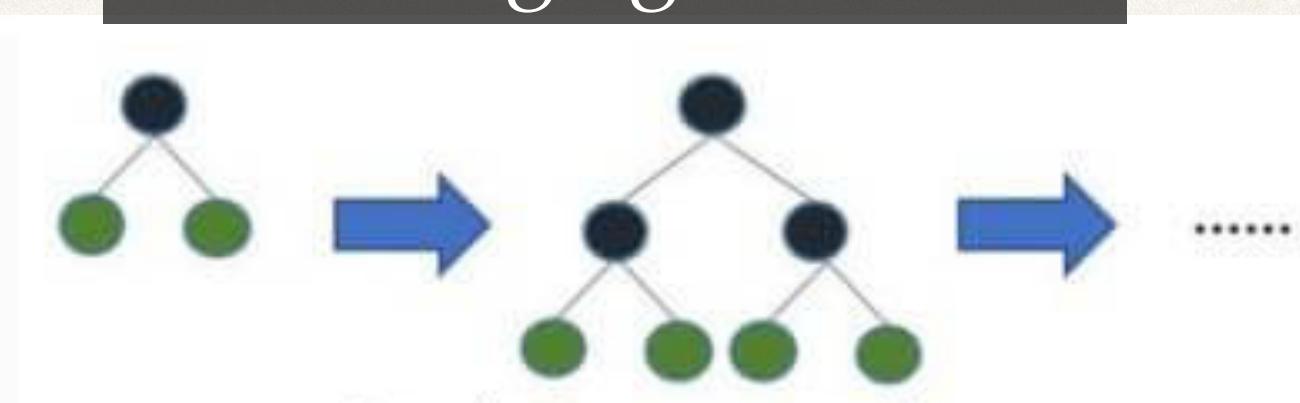
Use Yeo 17 atlas mask from nilearn



Correlate states across subjects



Multiclass classification
using xgboost

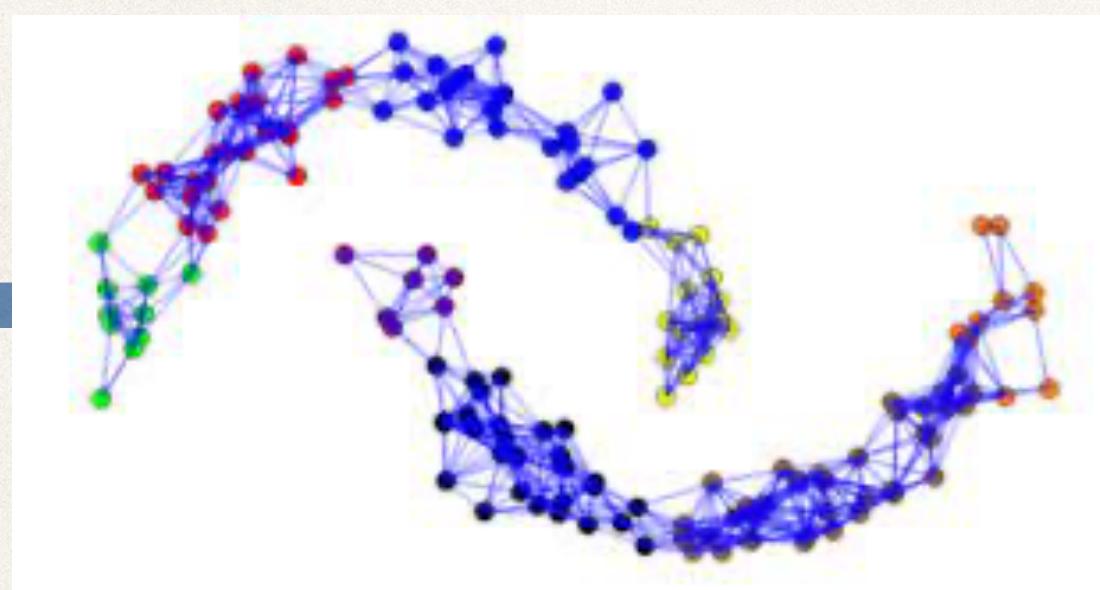


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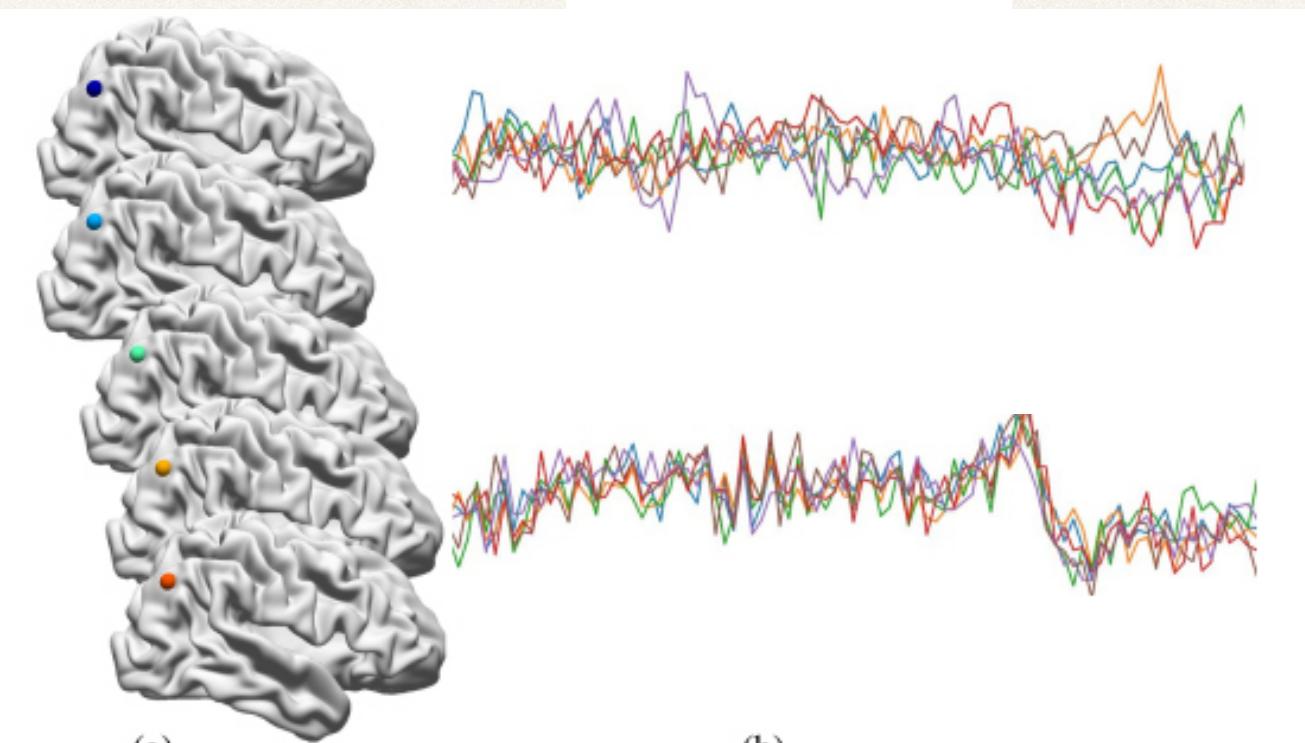
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Analysis Pipeline

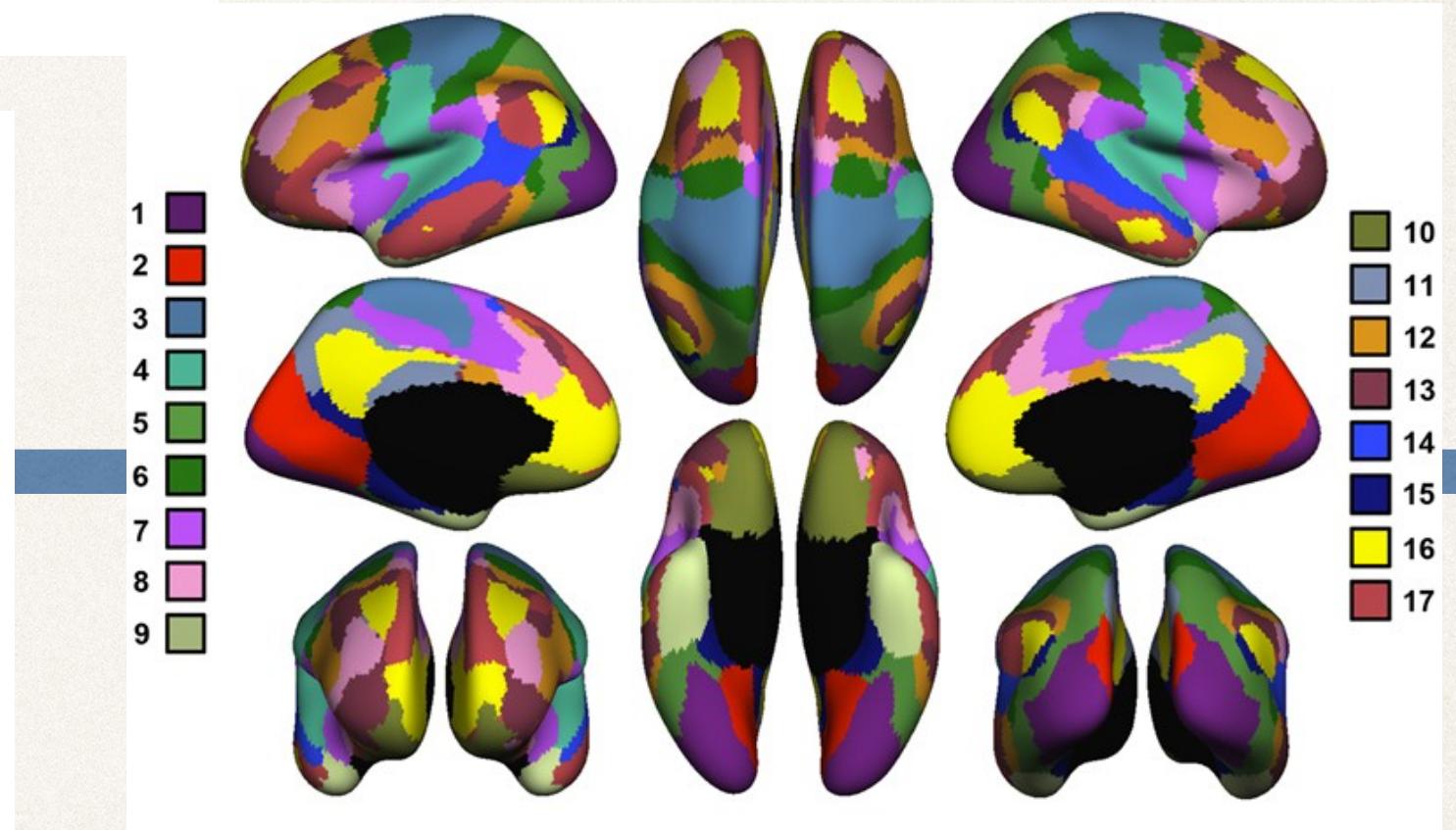
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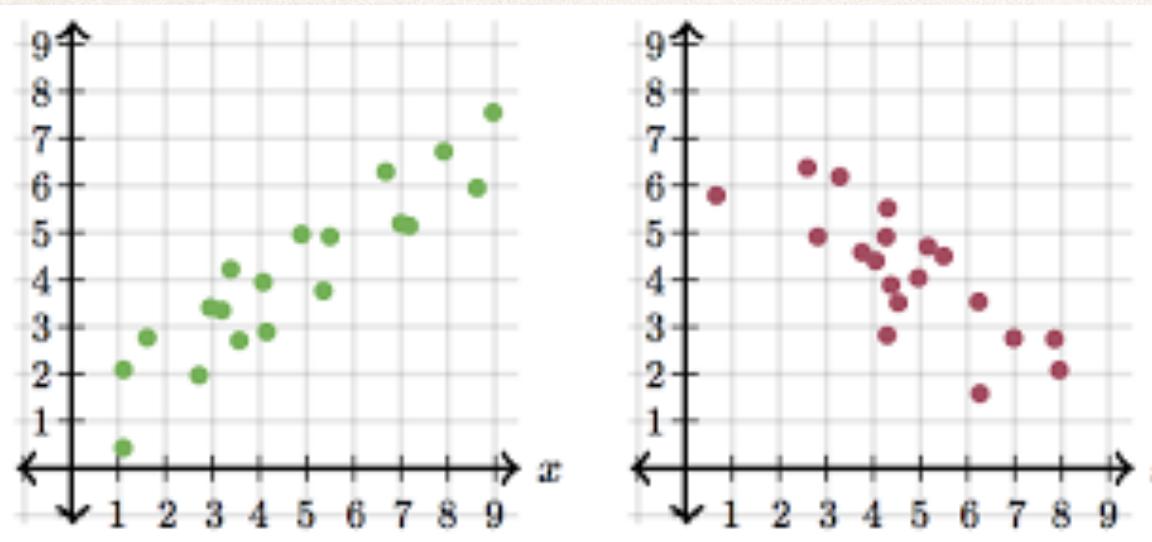
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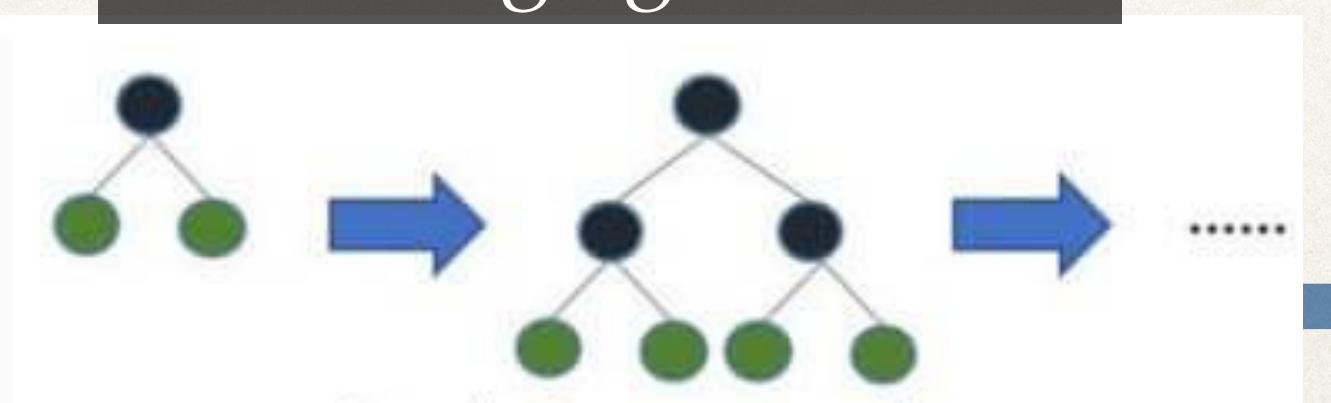
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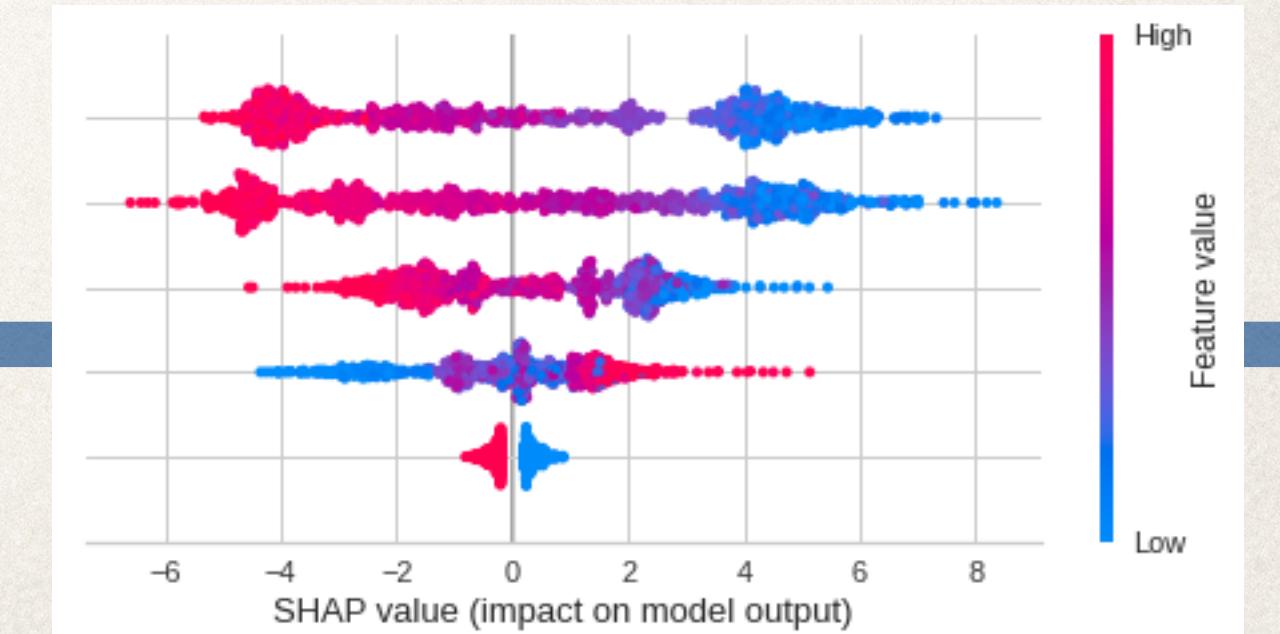
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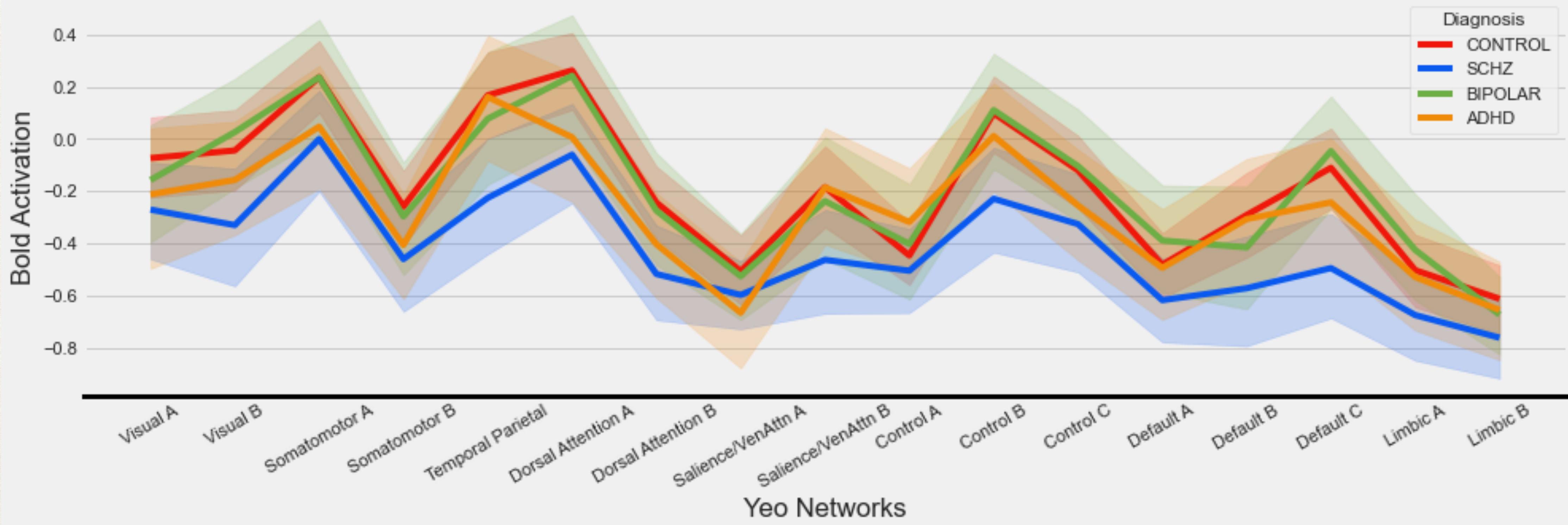
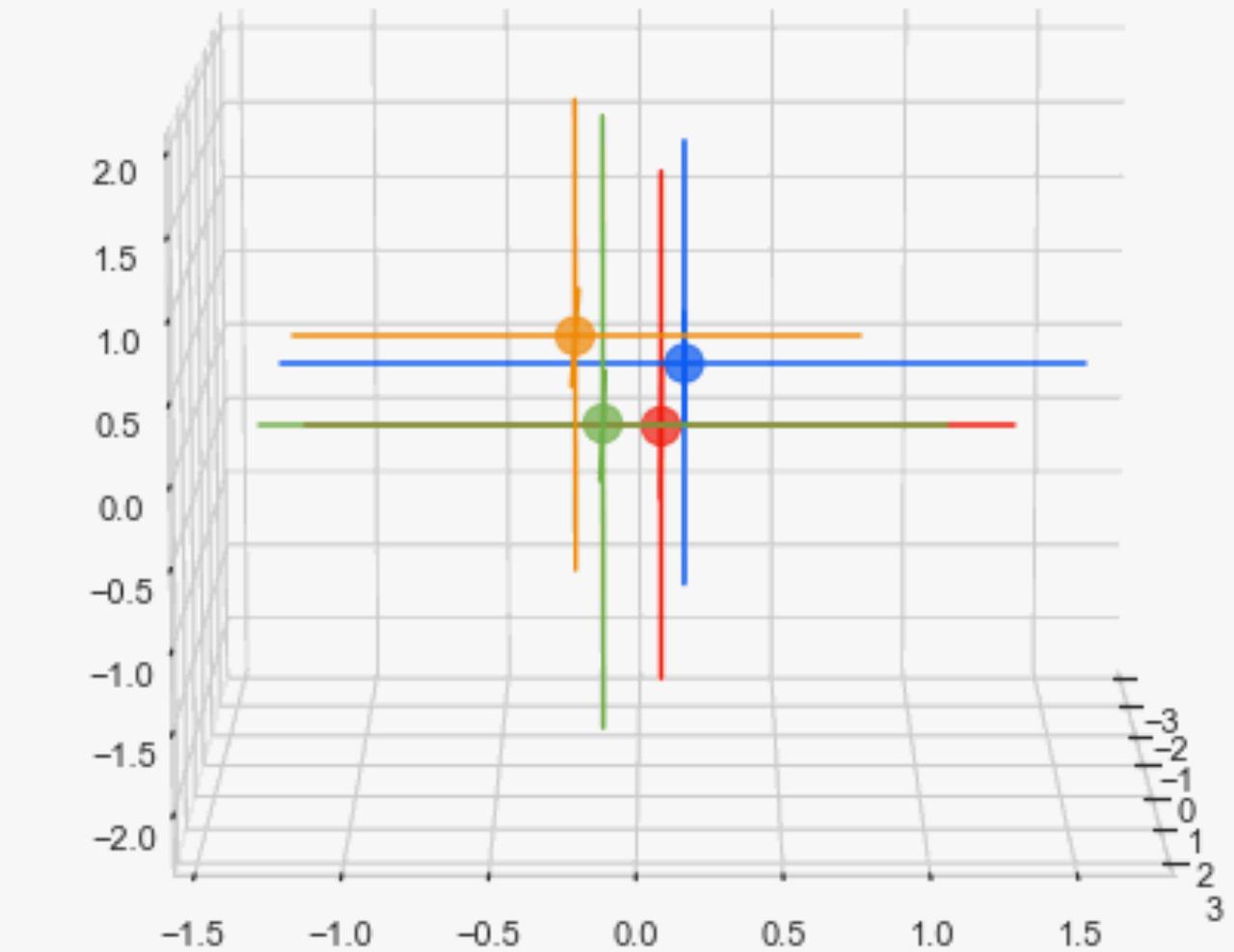
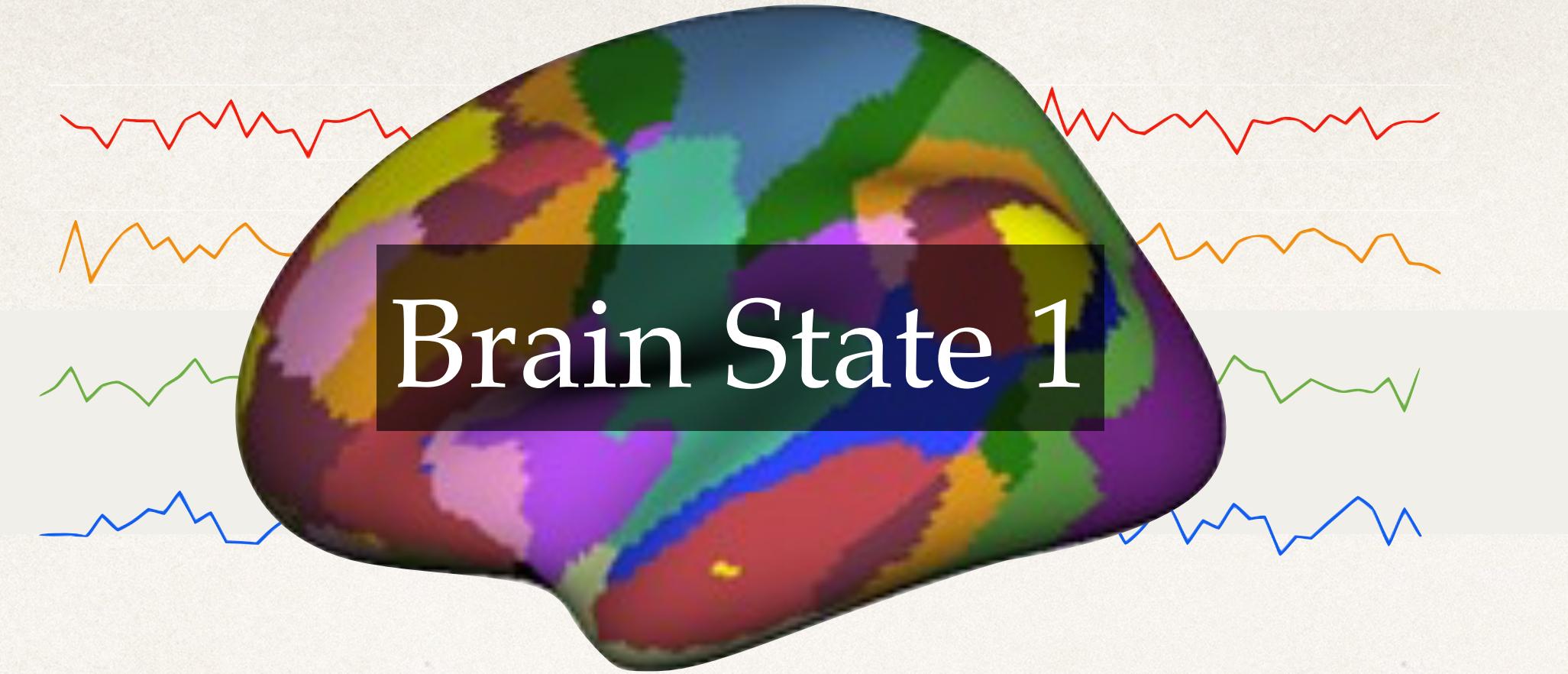


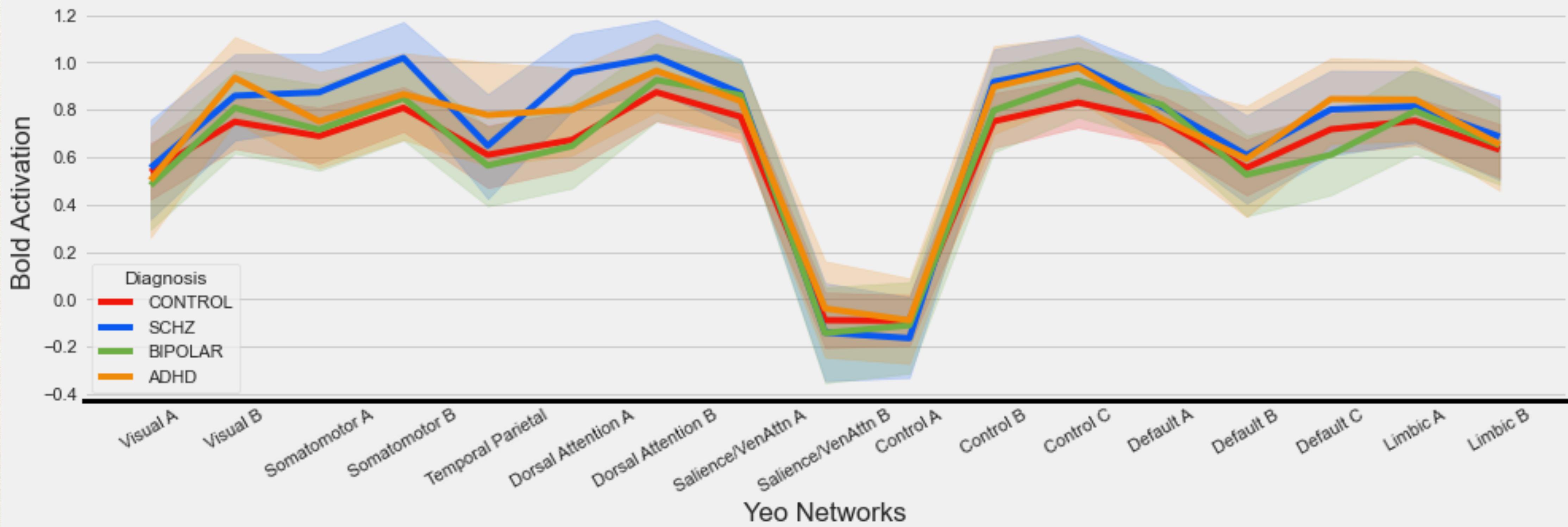
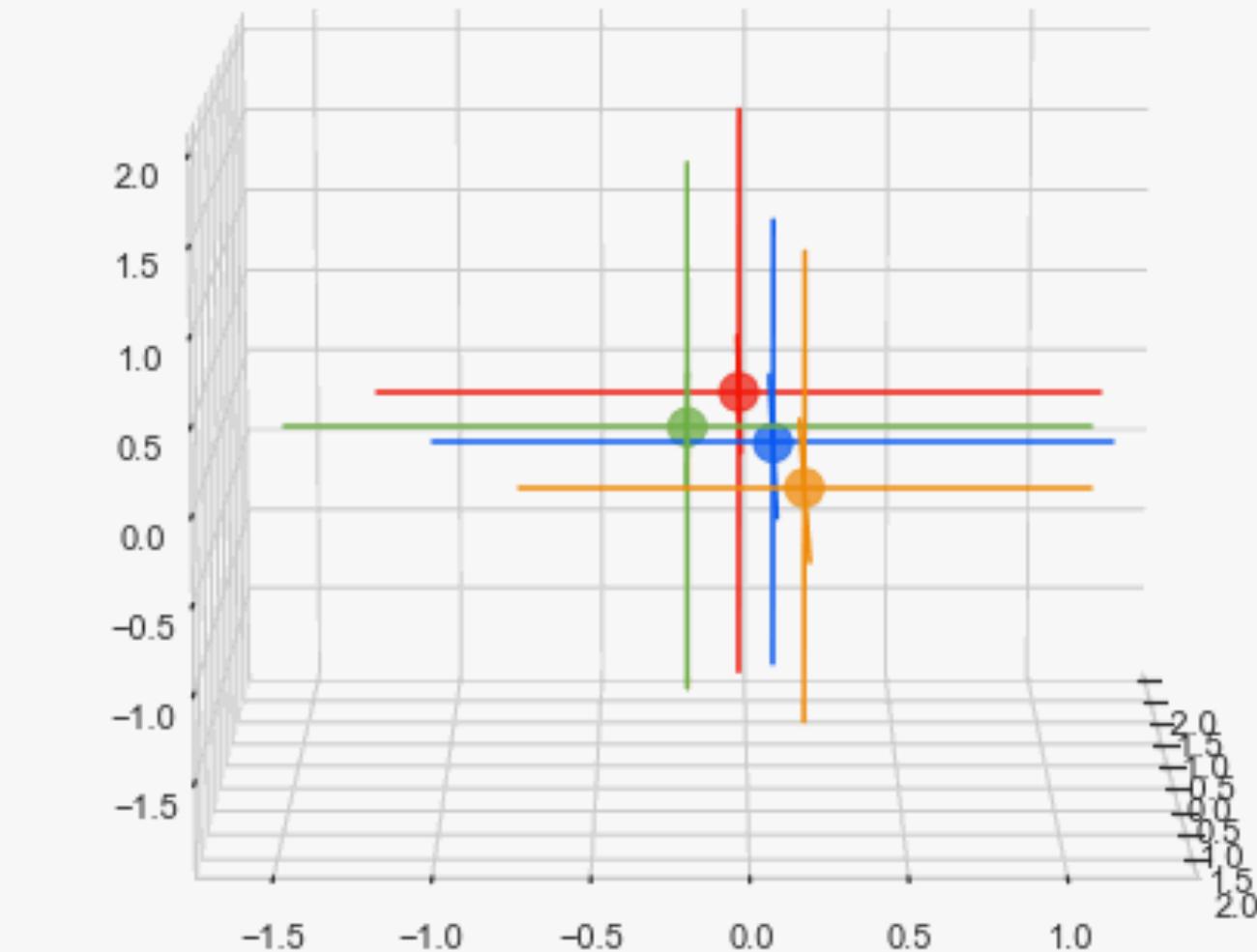
Multiclass classification
using xgboost

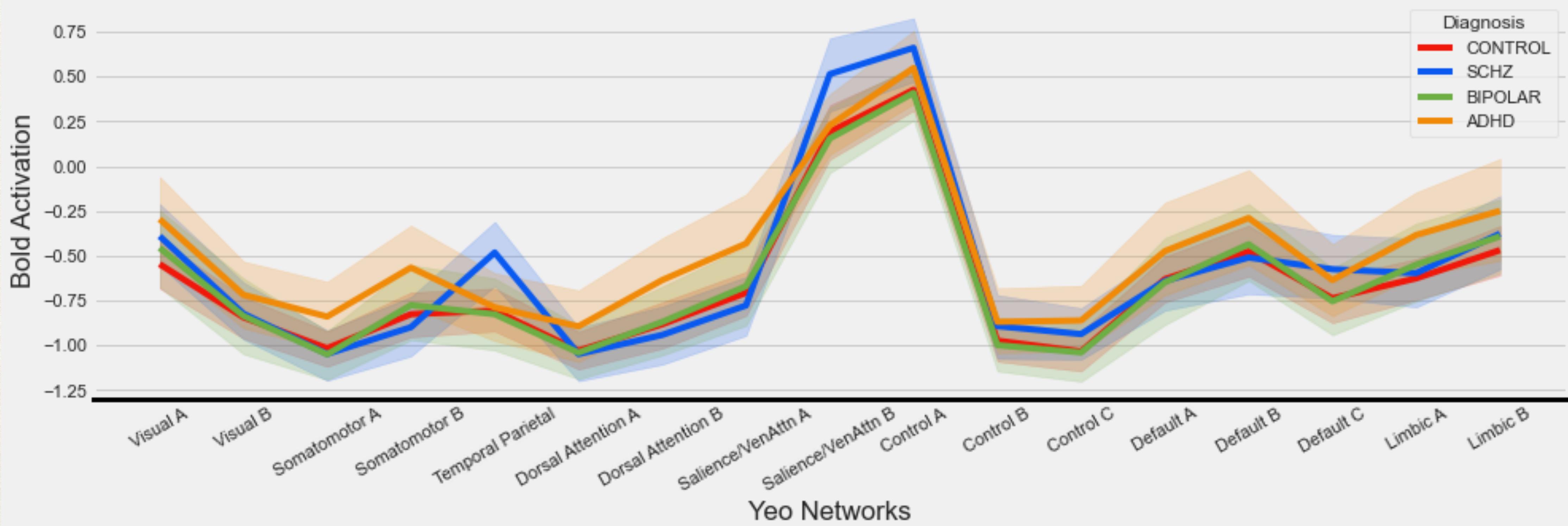
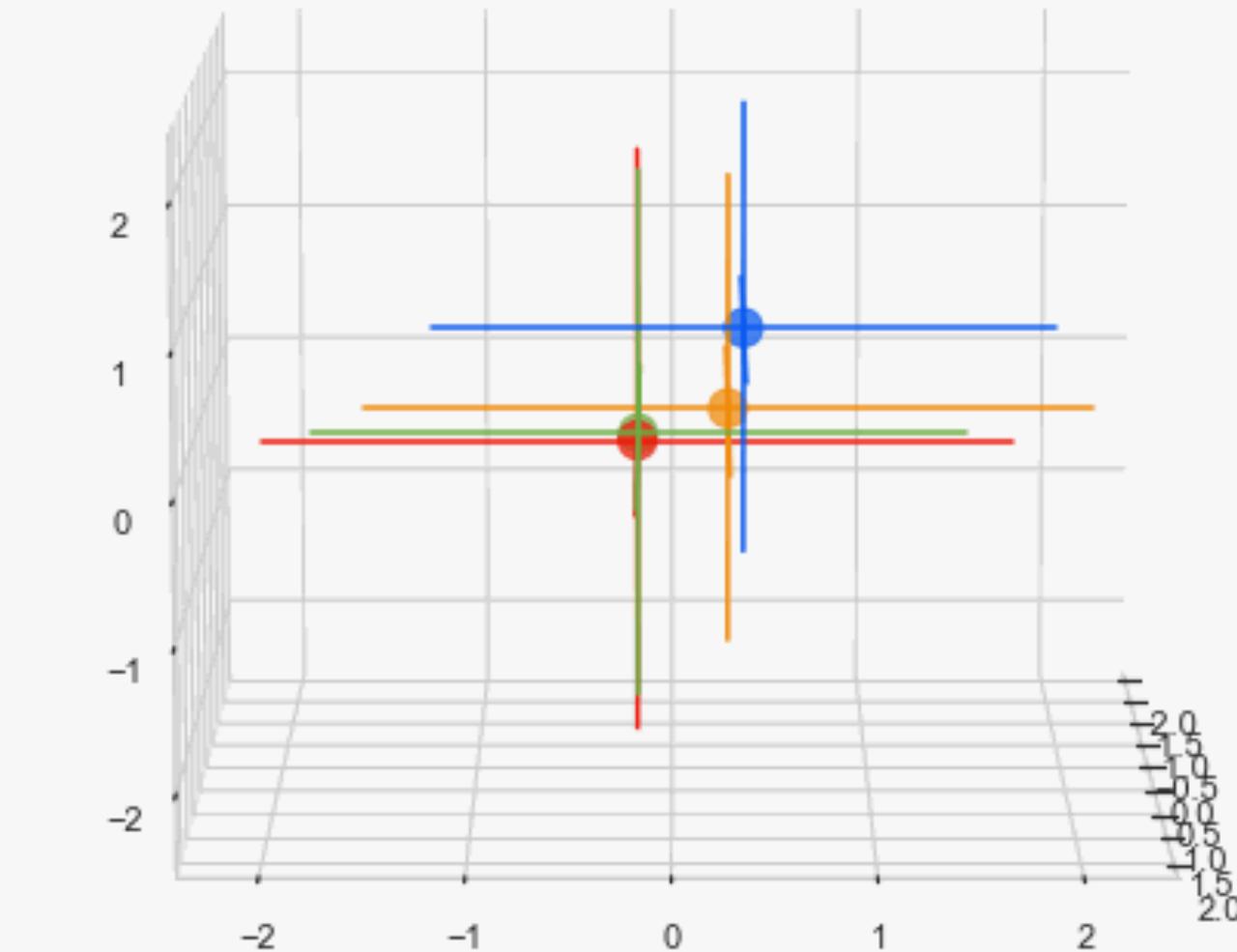


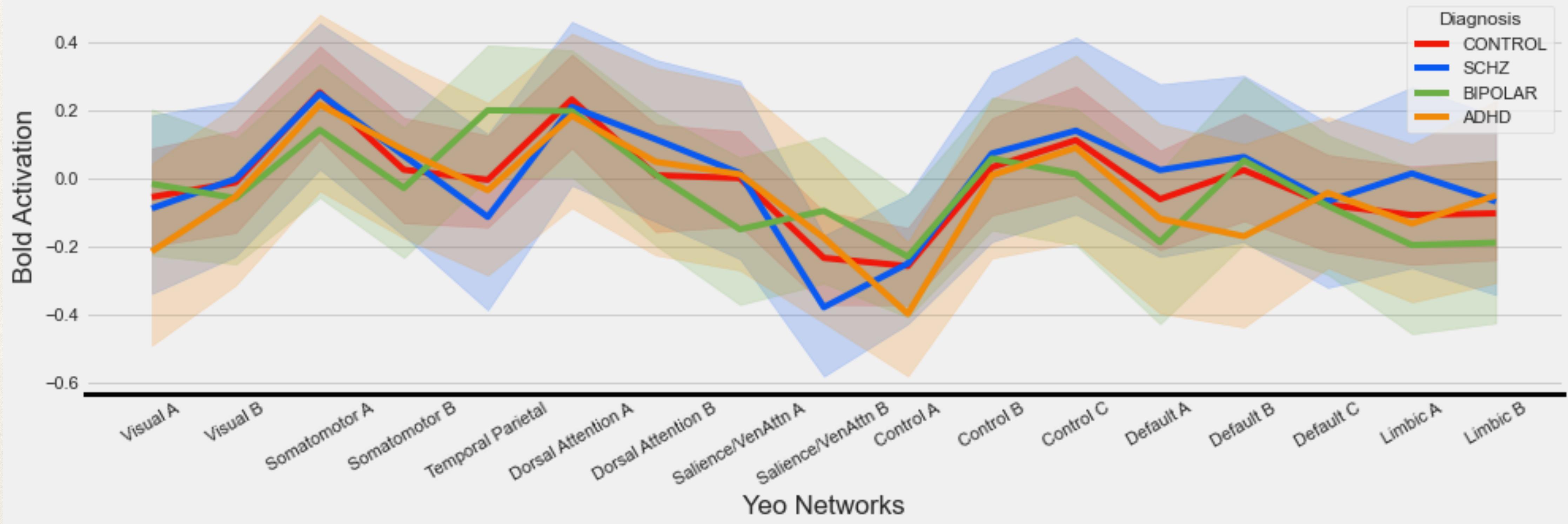
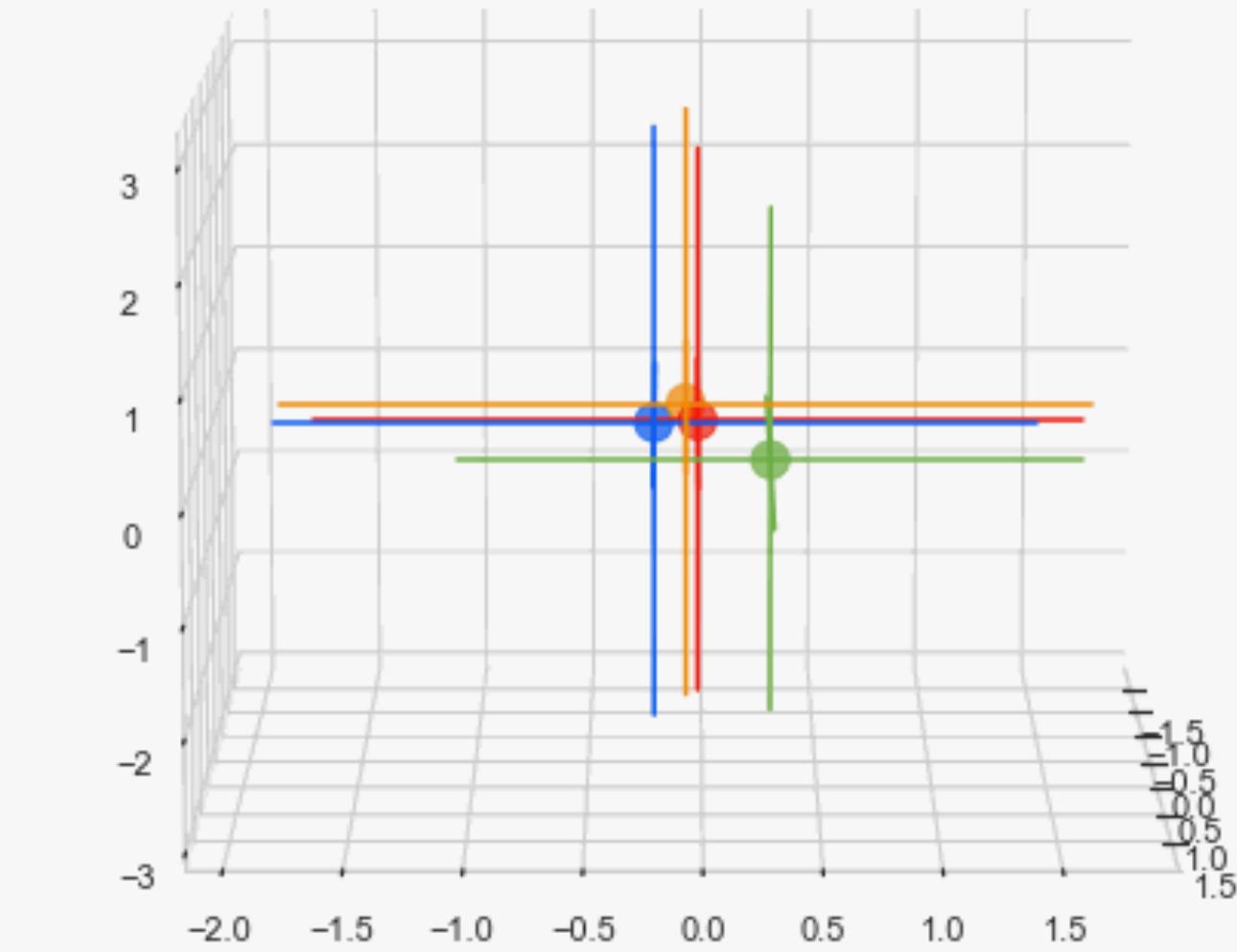
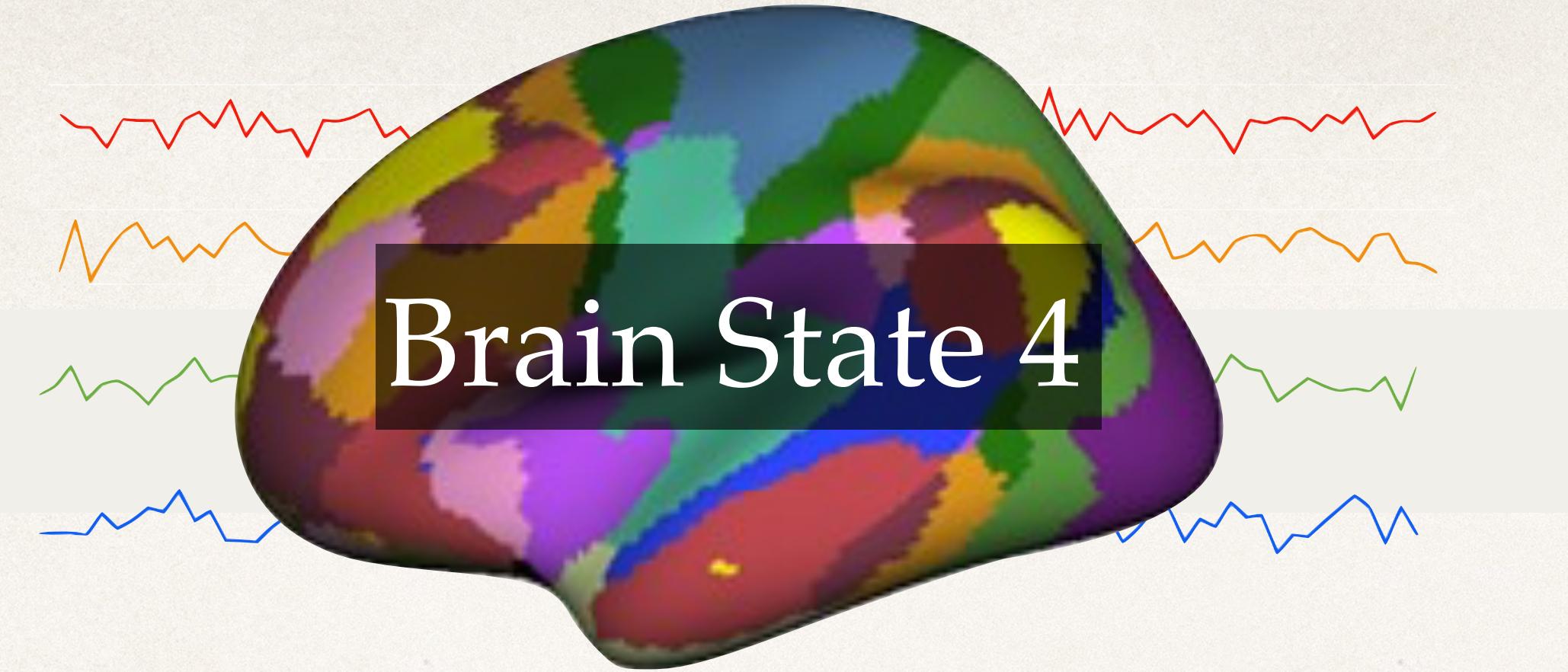
Shap feature importance

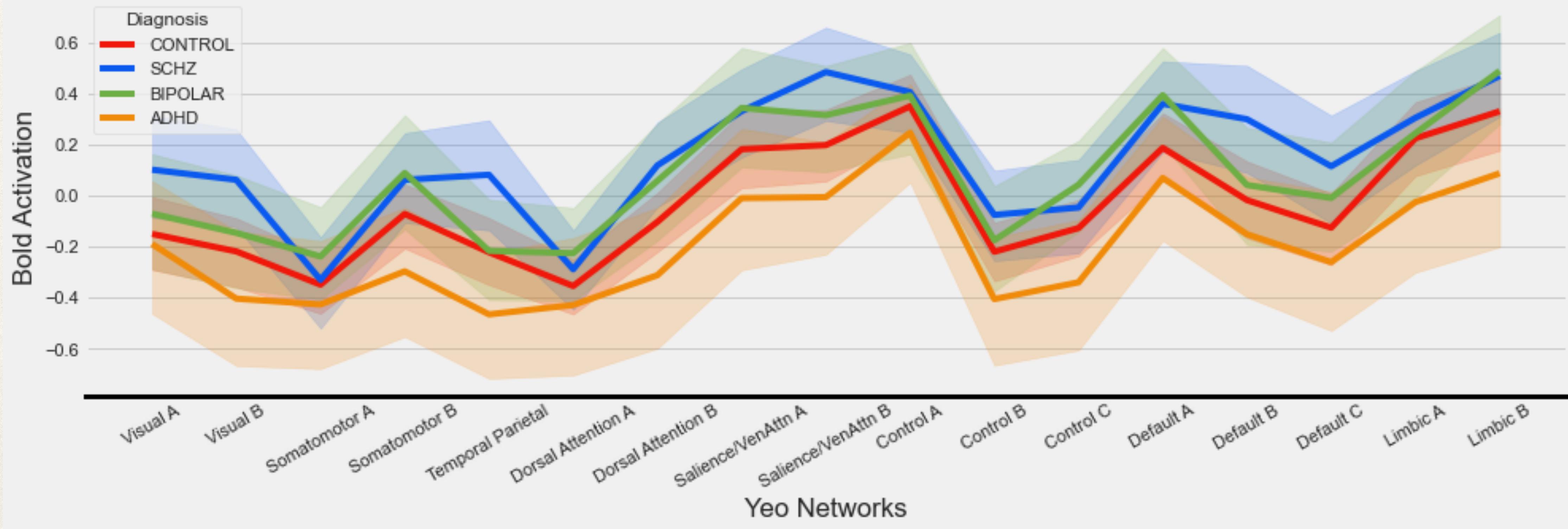
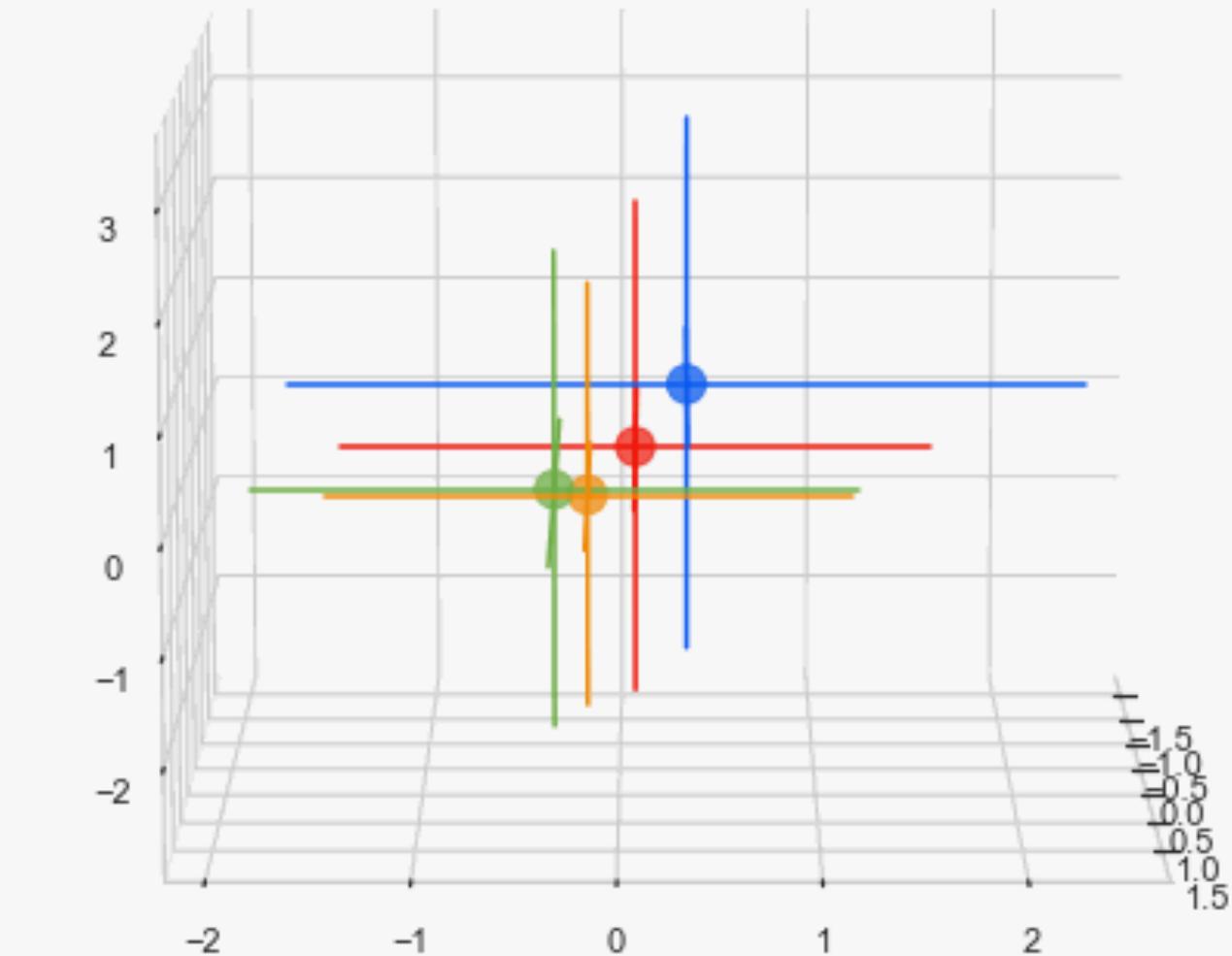
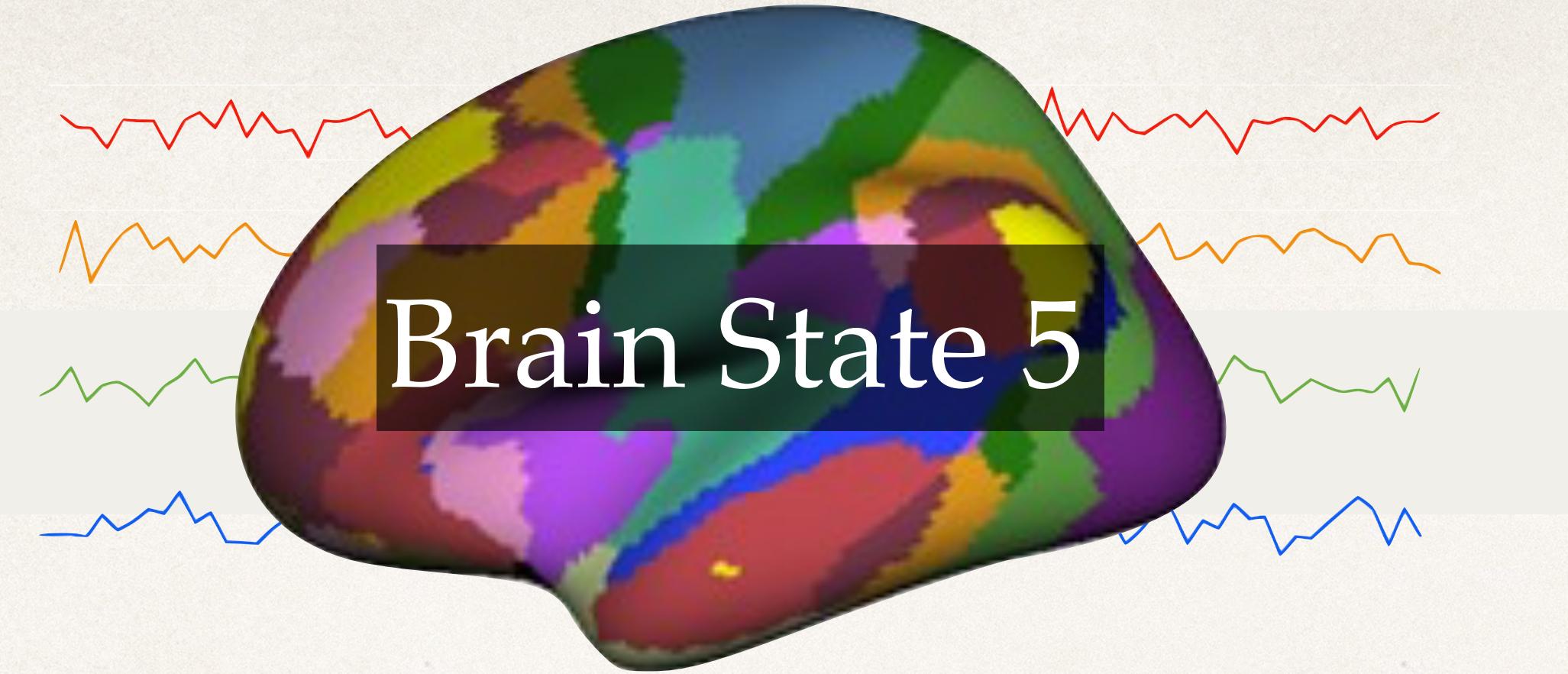




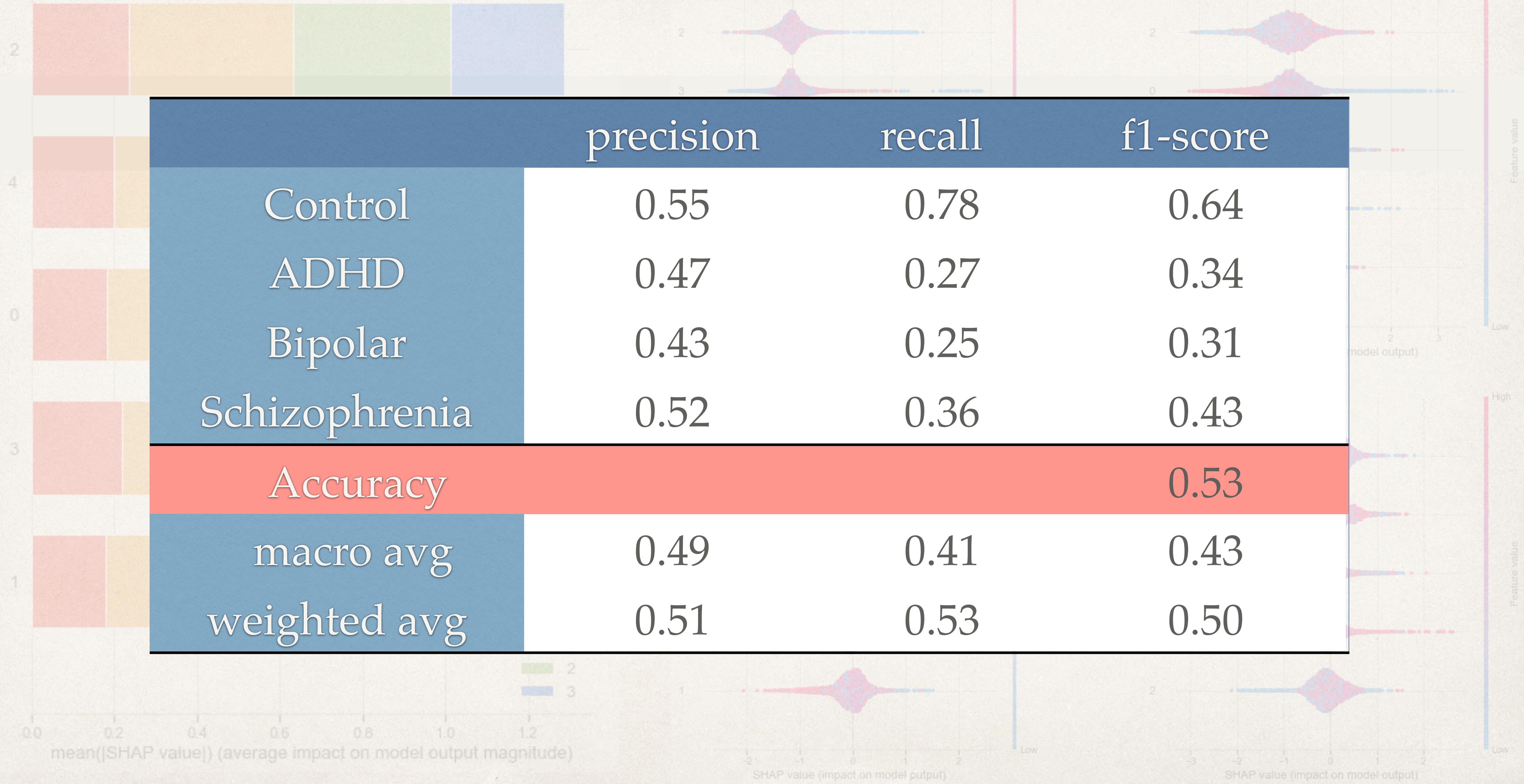




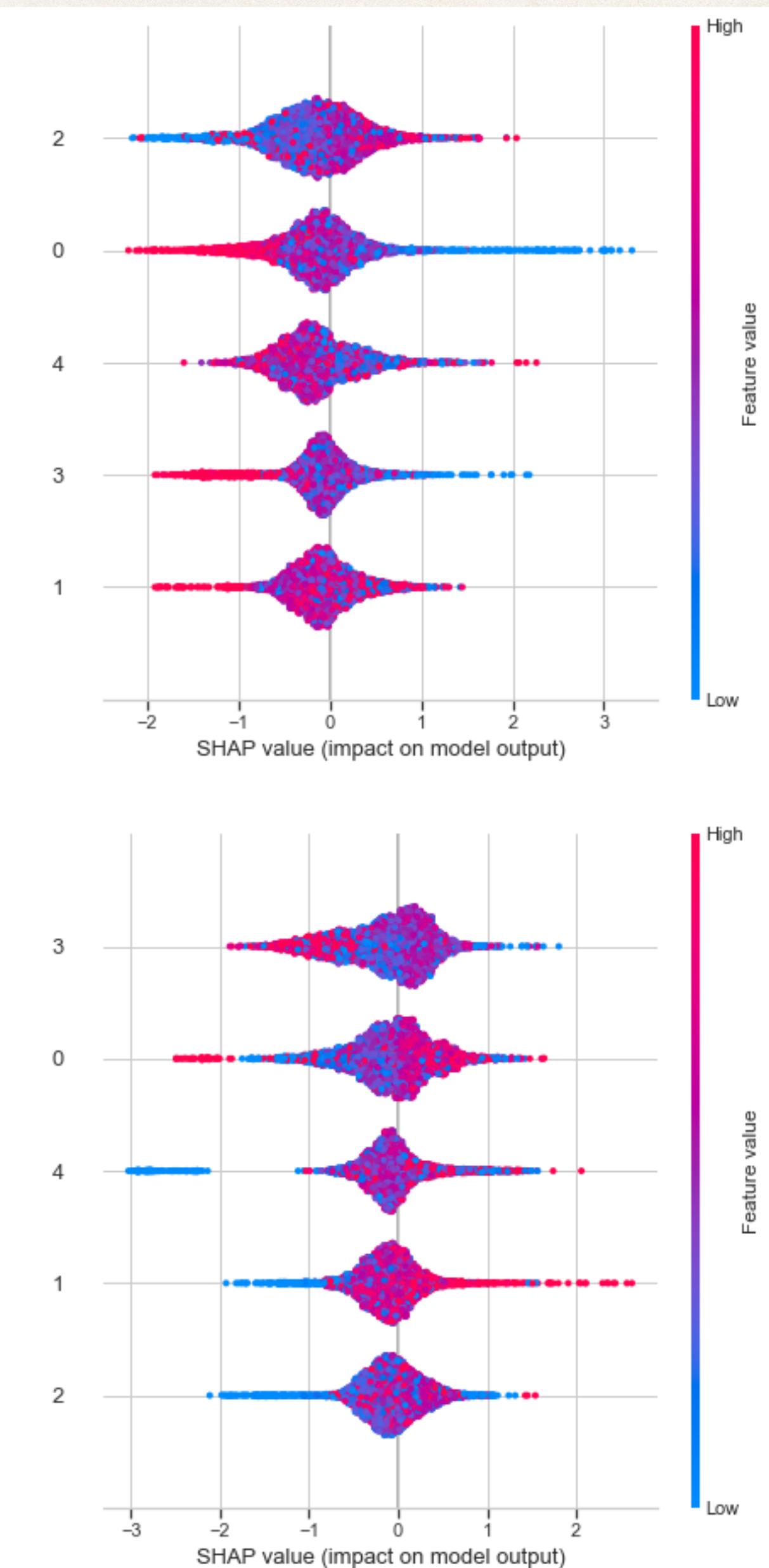
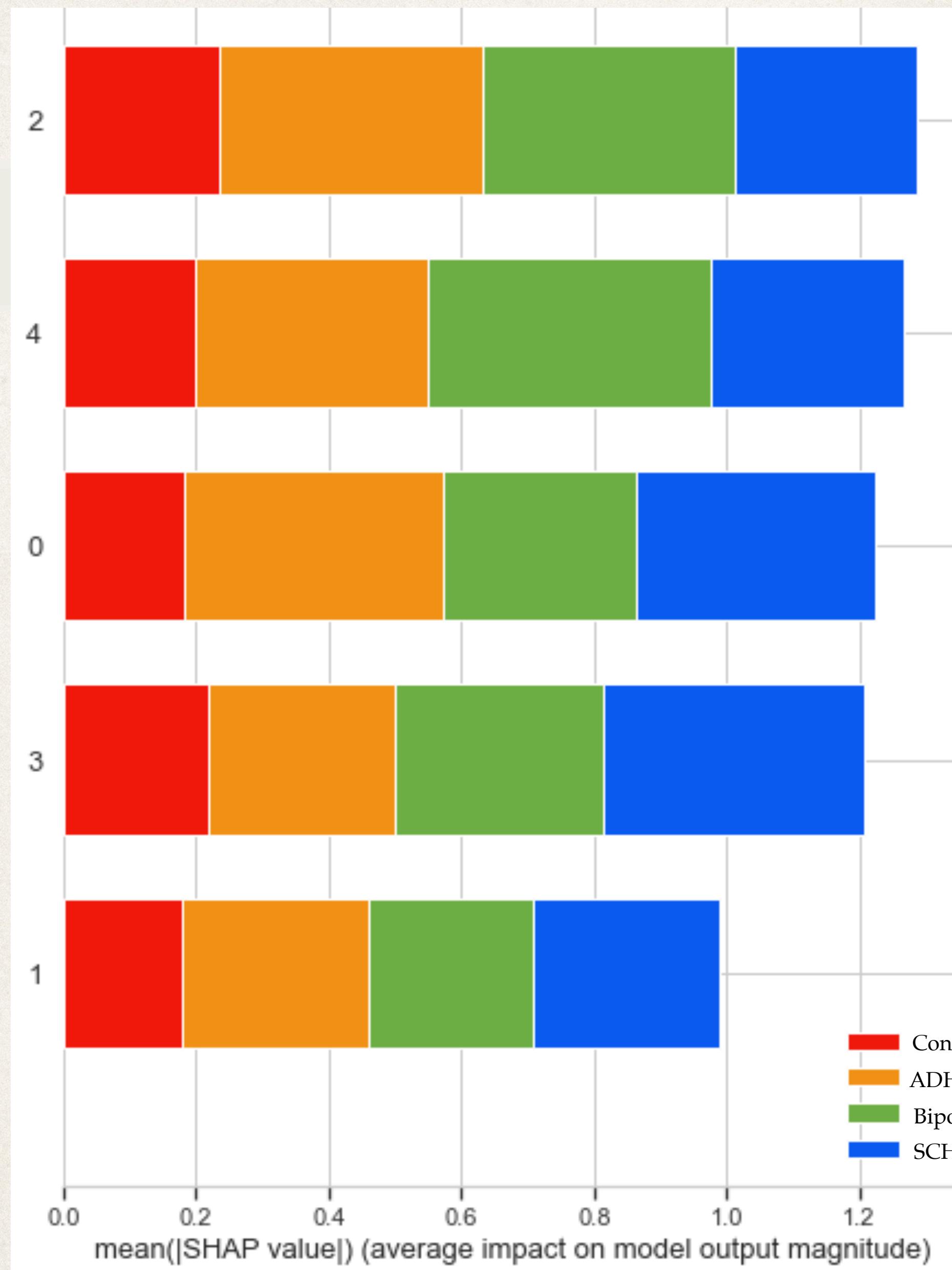




Diagnostic Classification: Brain States



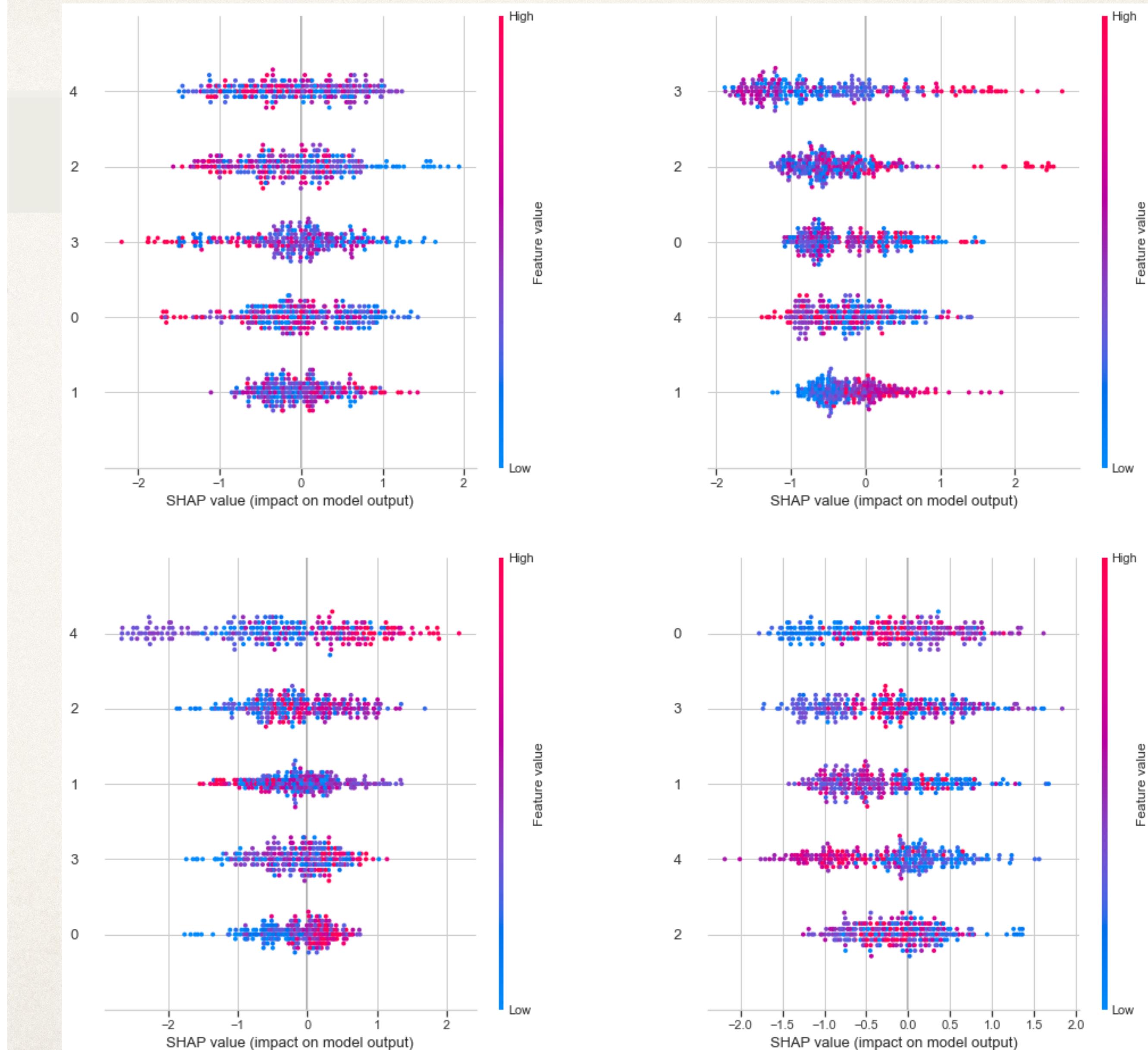
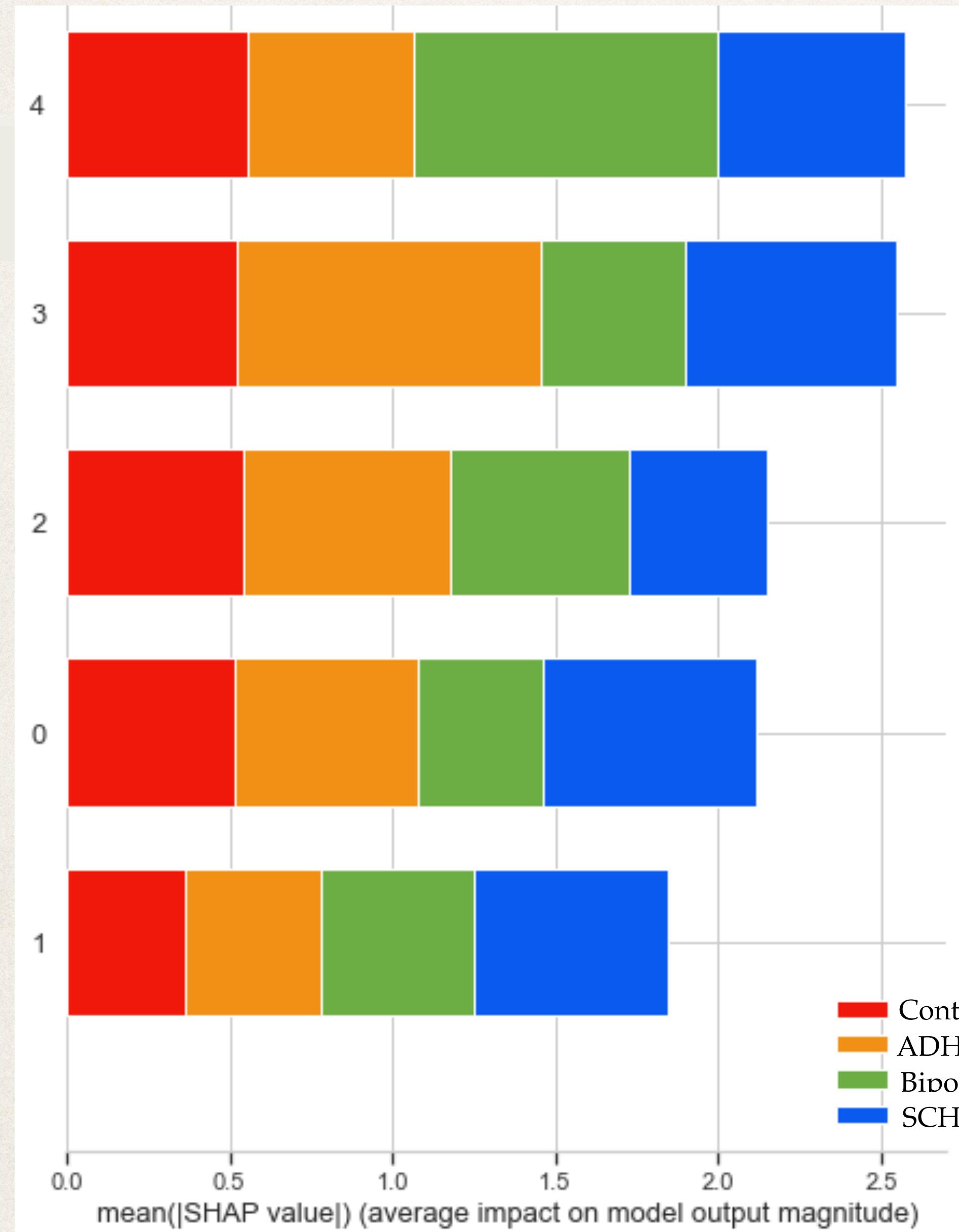
SHAP: Brain States Feature Importance



Diagnostic Classification: Time in Brain States



SHAP: Time in Brain States Feature Importance



Lessons Learned, Challenges Faced, and Future Directions

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Lessons Learned

- ❖ Learned more about nilearn and working with/processing resting state data
- ❖ Using Datalad to obtain datasets

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Challenges Faced

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- ❖ Correlating brain states across subjects
- ❖ Evaluating the specific brain states
- ❖ Using voxels for the brain state analyses (time constraints with loading data and running the classification pipeline)

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Future directions

- ❖ Making comparisons between different atlases, voxel, and task-based fMRI
- ❖ Examining a multiverse analysis with different algorithms and datasets
- ❖ Testing different numbers of brain states

Challenges Faced

- ❖ Obtaining multiple datasets
- ❖ Correlating brain states across subjects
- ❖ Evaluating the specific brain states
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