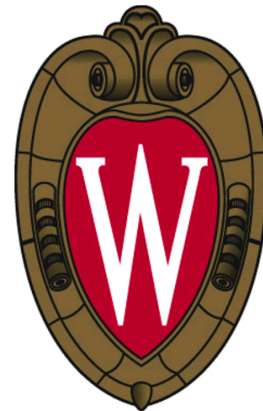


*The Waisman Laboratory
for Brain Imaging and Behavior*



University of Wisconsin
**SCHOOL OF MEDICINE
AND PUBLIC HEALTH**

Multivariate Tensor-Based Morphometry and Its Application to Detecting White Matter Abnormality in Abused Children: Persistent Homological Approach

Moo K. Chung

Waisman Laboratory for Brain Imaging and Behavior
University of Wisconsin-Madison

www.stat.wisc.edu/~mchung

Acknowledgements

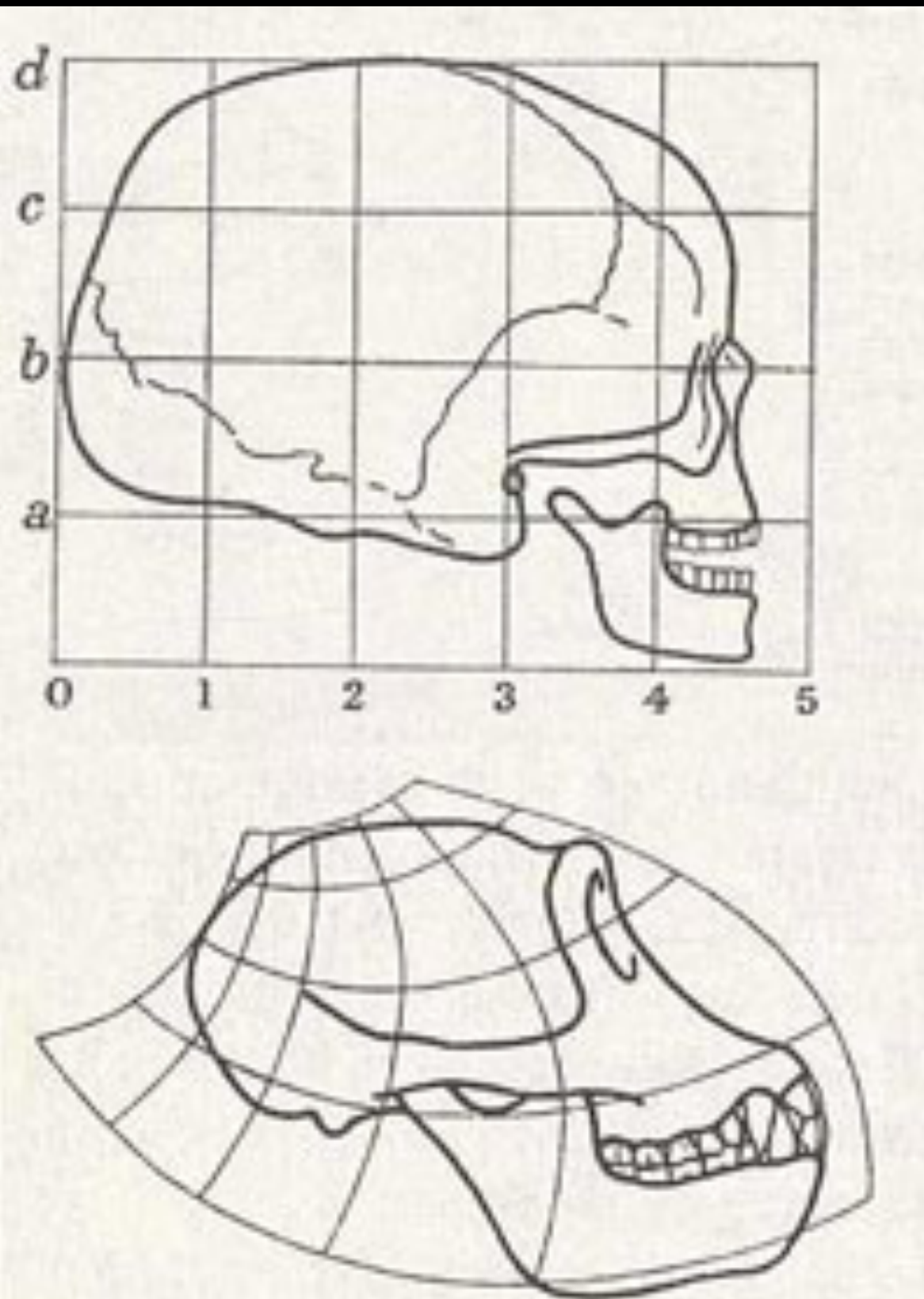
Jamie Hanson, Richard Davidson, Seth Pollack
University of Wisconsin-Madison

Hyekyung Lee
Seoul National University

Brian Avants, James Gee
University of Pennsylvania

Deformable grid system

D'Arcy Thompson 1860-1948



figuratively speaking, the 'f

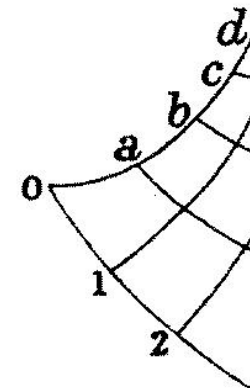


Fig. 178. Co-ordinates of the Cartesian

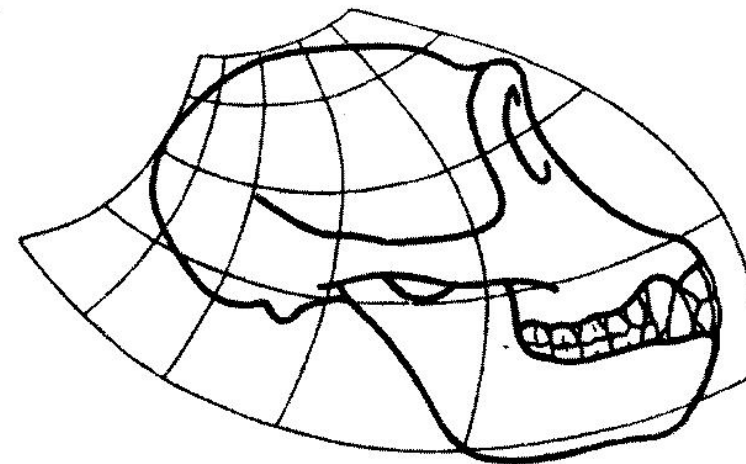


Fig. 179. Skull of chimpanzee.

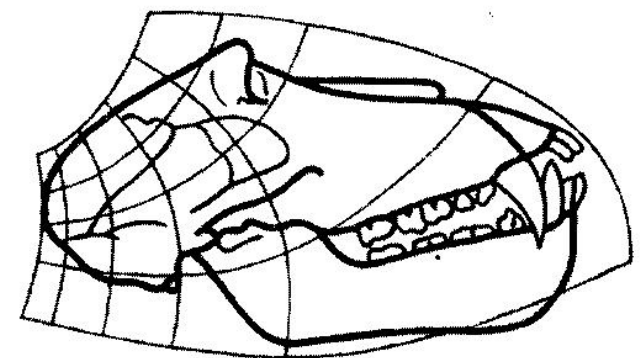
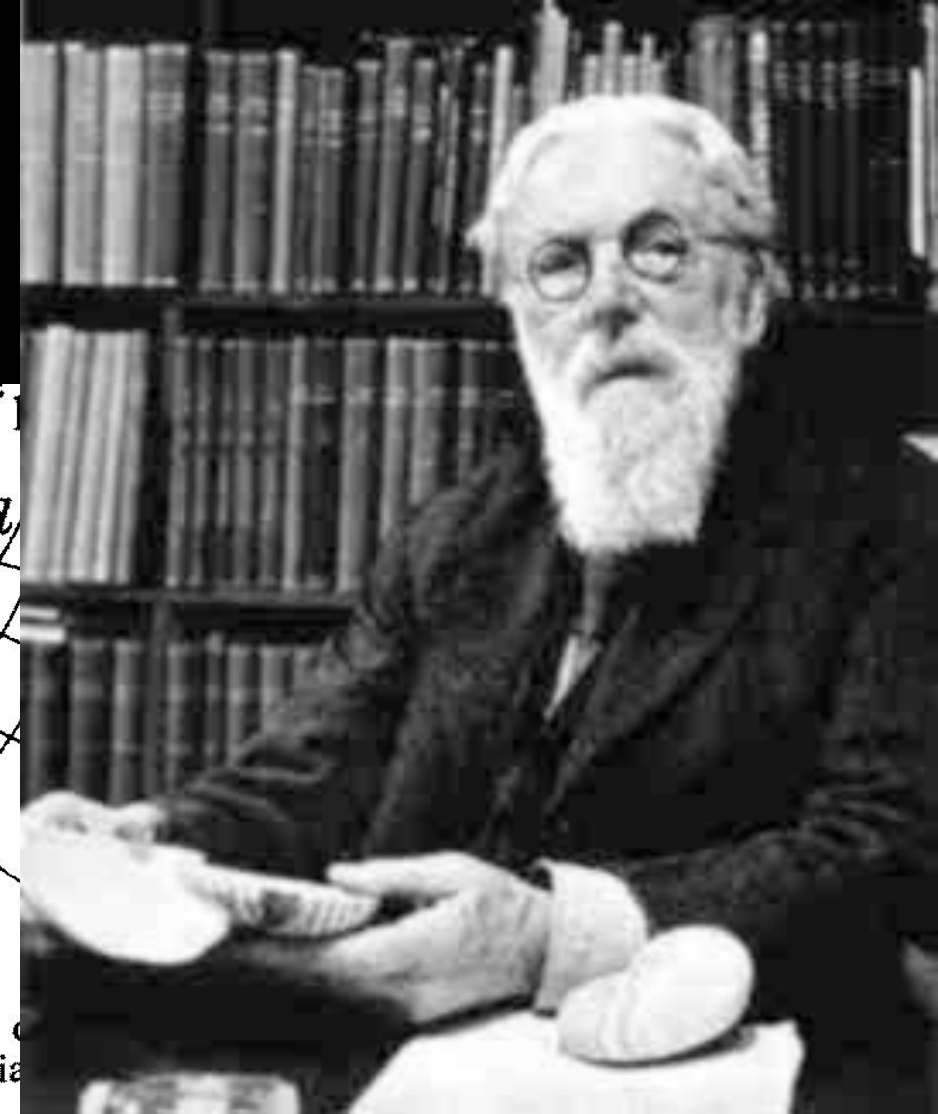


Fig. 180. Skull of baboon.

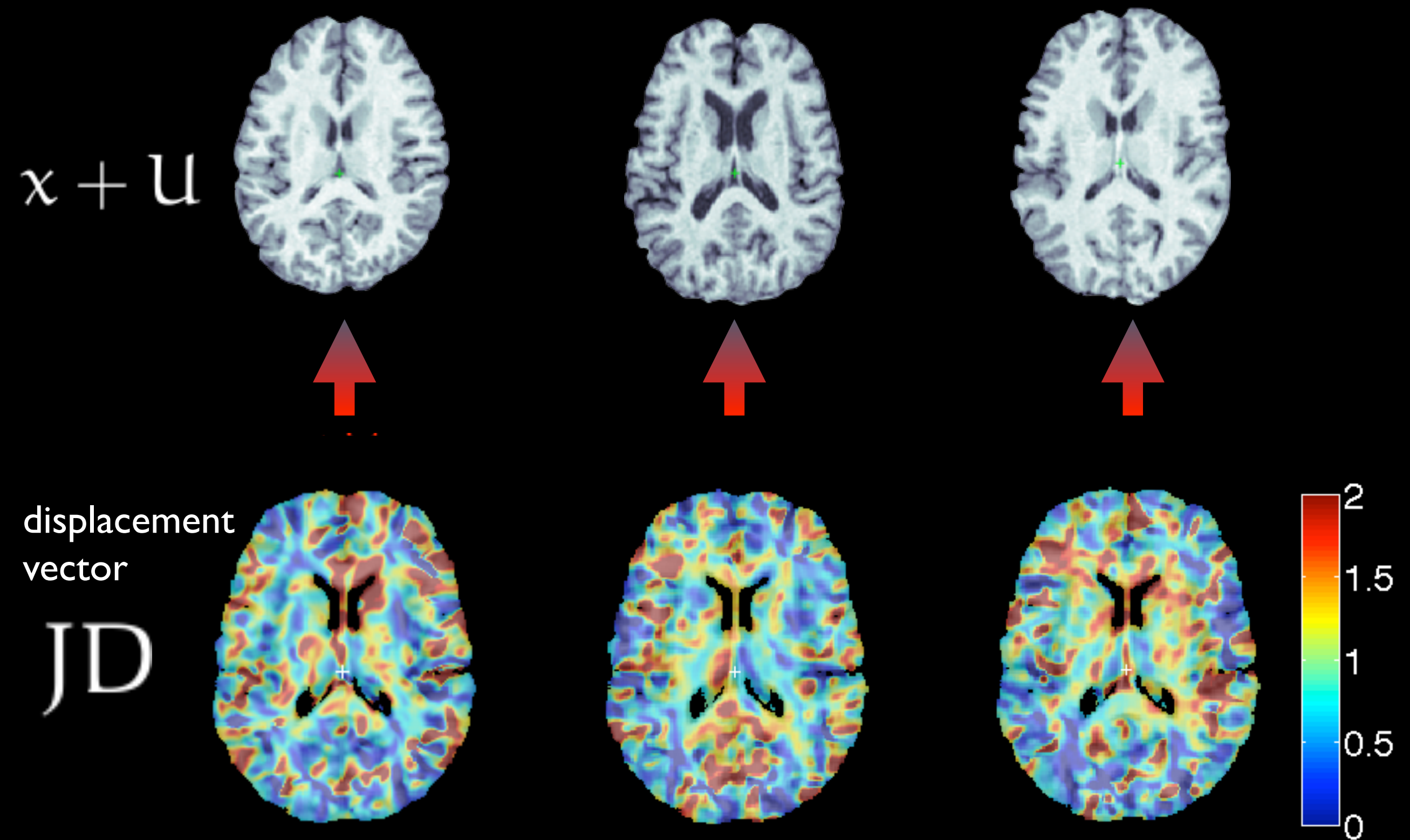
diagram
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On Growth and Form
D'Arcy Thompson

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Jacobian determinant



Development/Plasticity/Repair

Early Stress Is Associated with Alterations in the Orbitofrontal Cortex: A Tensor-Based Morphometry Investigation of Brain Structure and Behavioral Risk

Jamie L. Hanson,^{1,2} Moo K. Chung,¹ Brian B. Avants,³ Elizabeth A. Shirtcliff,¹ James C. Gee,³ Richard J. Davidson,^{1,2} and Seth D. Pollak^{1,2}

¹Waisman Center, University of Wisconsin-Madison, Madison, Wisconsin 53705, ²Department of Psychology, University of Wisconsin-Madison, Madison, Wisconsin 53703, and ³Penn Image Computing and Science Laboratory, Department of Radiology, University of Pennsylvania, Philadelphia, Pennsylvania 19104

Hanson et al., 2010. Journal of Neuroscience 30:7466-7472

Behavioral/Systems/Cognitive

Structural Variations in Prefrontal Cortex Mediate the Relationship between Early Childhood Stress and Spatial Working Memory

Jamie L. Hanson,¹ Moo K. Chung,¹ Brian B. Avants,² Karen D. Rudolph,³ Elizabeth A. Shirtcliff,⁴ James C. Gee,¹ Richard J. Davidson,¹ and Seth D. Pollak¹

¹Department of Psychology, University of Wisconsin-Madison, Madison, Wisconsin 53706, ²Penn Image Computing and Science Laboratory, Department of Radiology, University of Pennsylvania, Philadelphia, Pennsylvania 19104, ³Department of Psychology, University of Illinois at Urbana-Champaign, Champaign, Illinois 61820, and ⁴Department of Psychology, University of New Orleans, New Orleans, Louisiana 70148

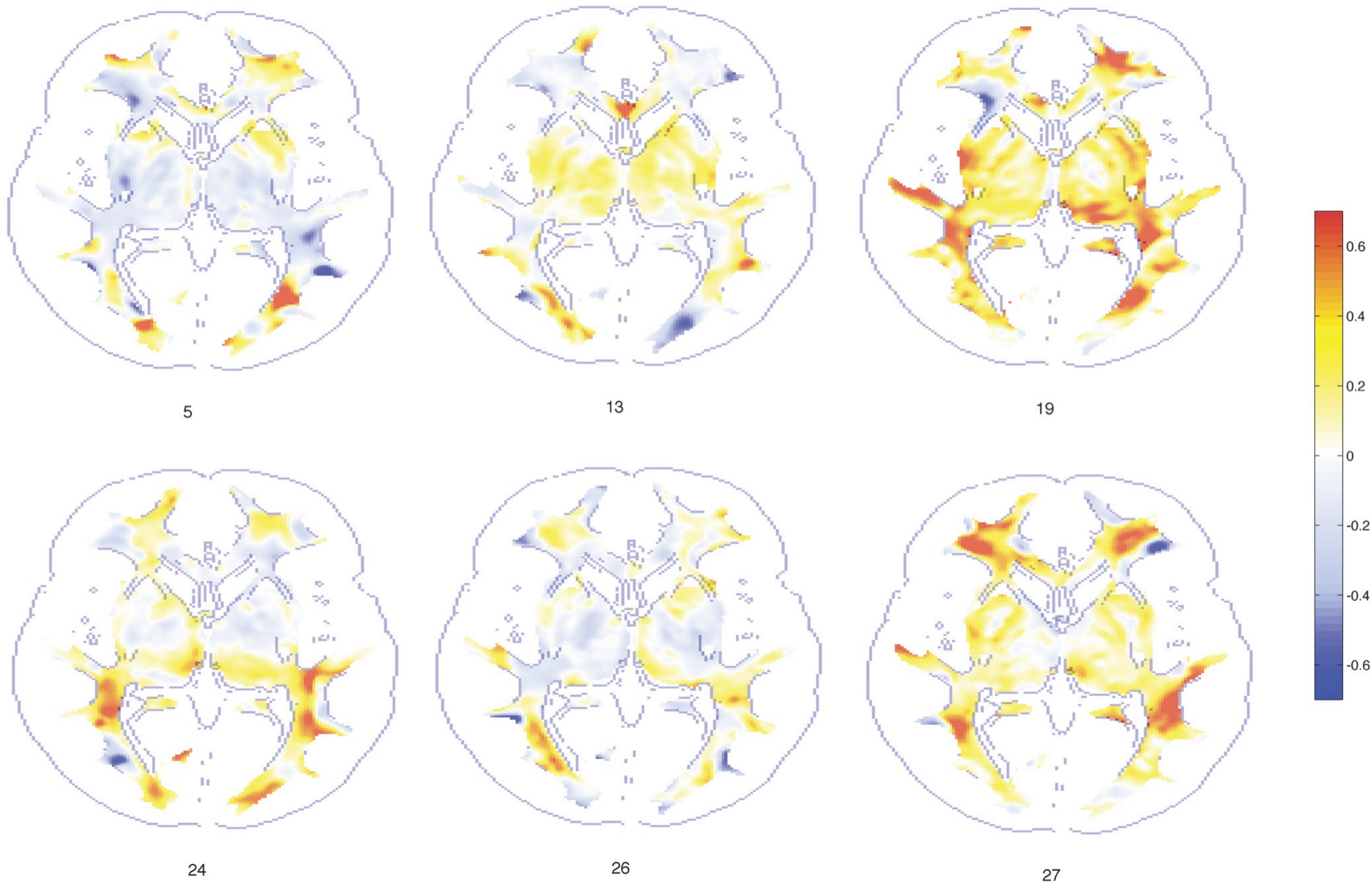
Hanson et al., 2012. Journal of Neuroscience 32:7917-7925

Multivariate-TBM

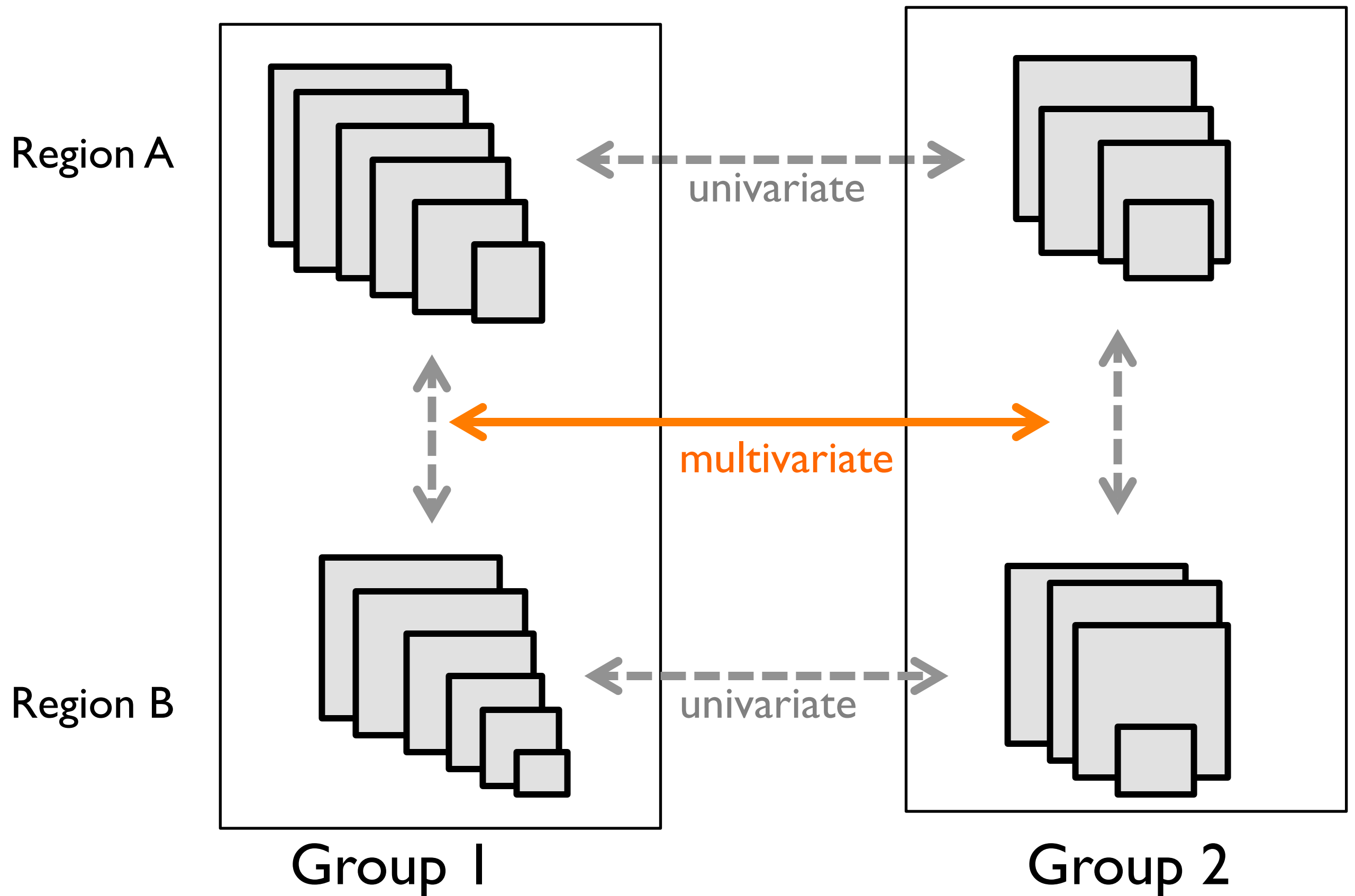
Data

- T1-weighted MRI were collected using a 3T GE SIGNA scanner.
- 23 maltreated children who have been post-institutionalized (PI) in orphanages in East Europe and China but later adopted to the families in US.
- Age-matched 31 normal control subjects.
- Age: PI : 11.26 ± 1.71 , Controls : 11.58 ± 1.61 years.
- Gender PI: 10 boys and 13 girls, Controls: 18 boys and 13 girls.

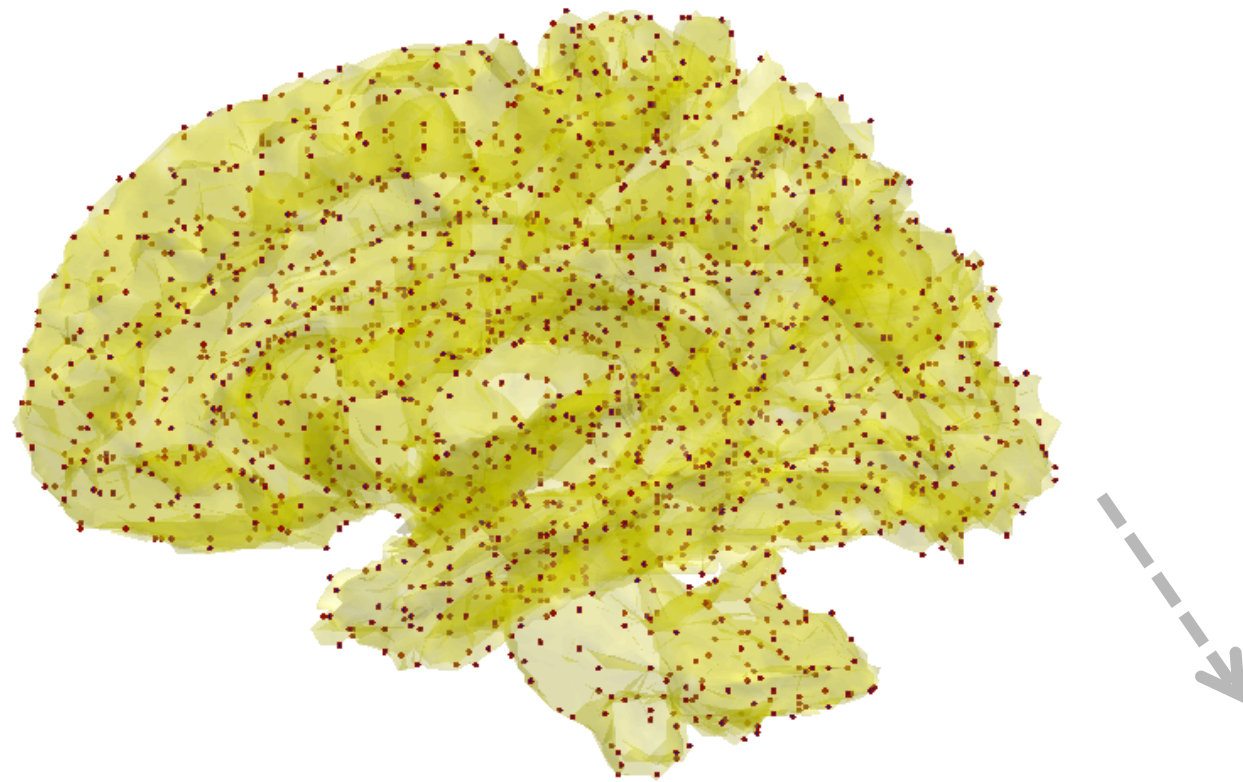
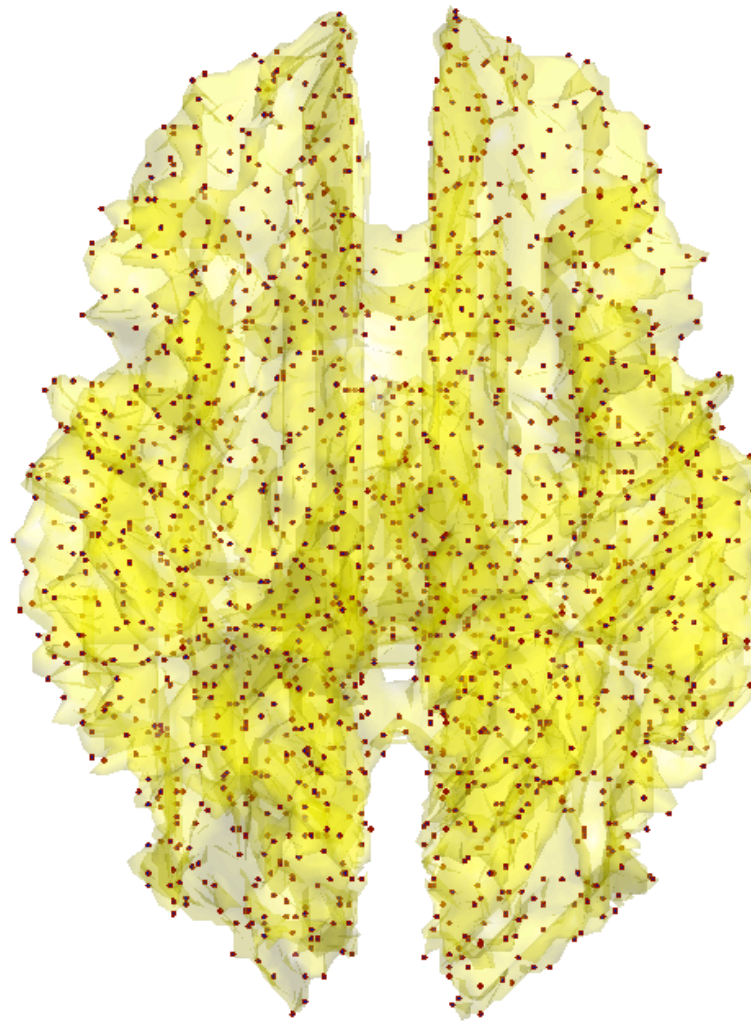
Jacobian determinant (tissue volume change) with respect to the template



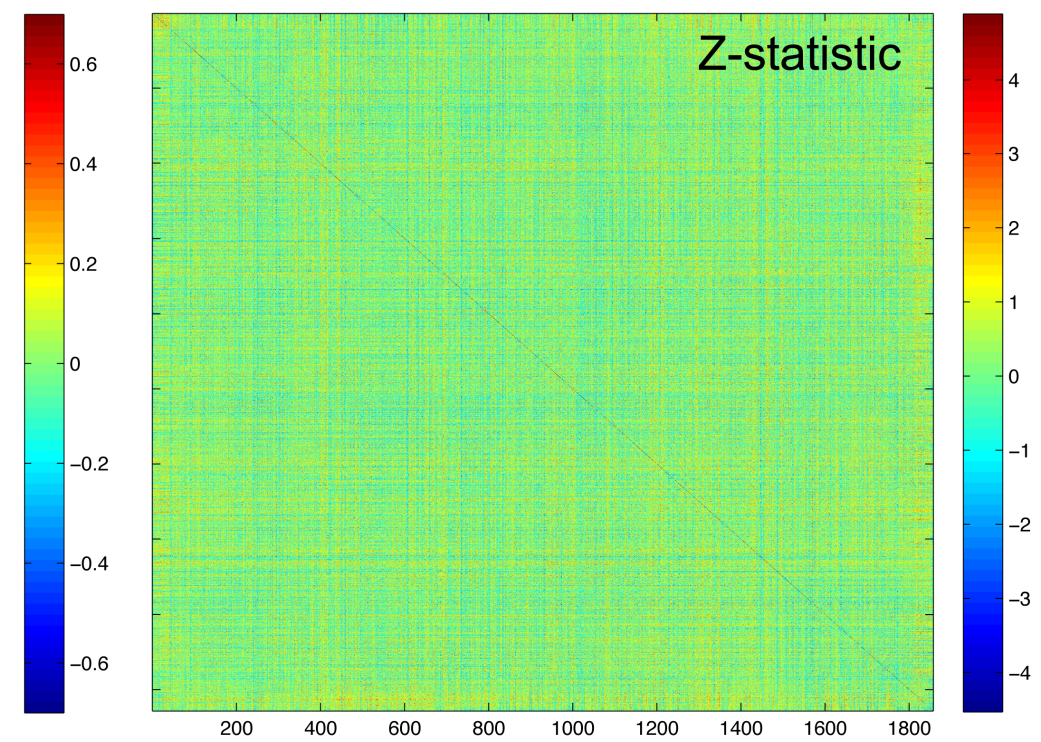
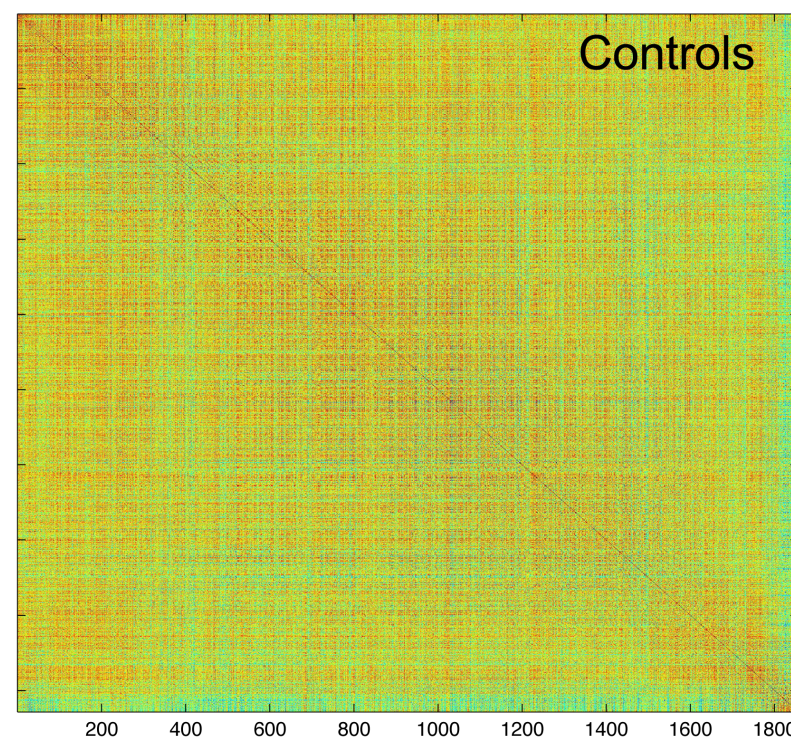
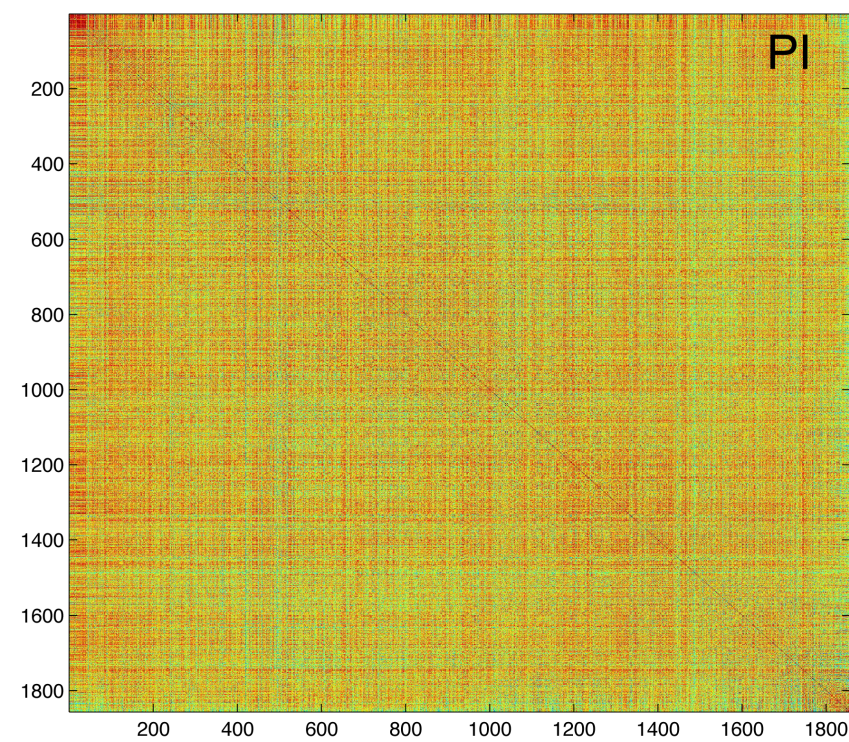
Massive univariate vs. multivariate



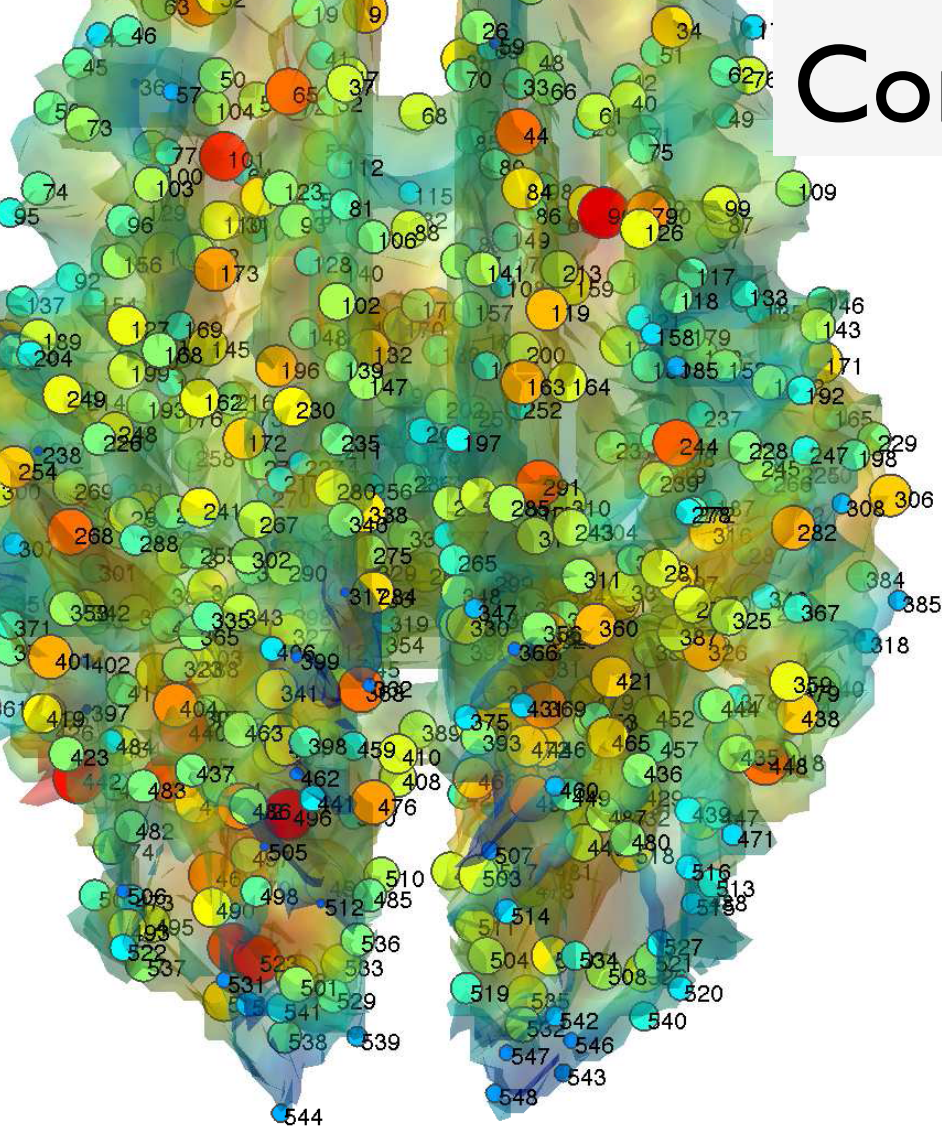
Correlation map of Jacobian determinants



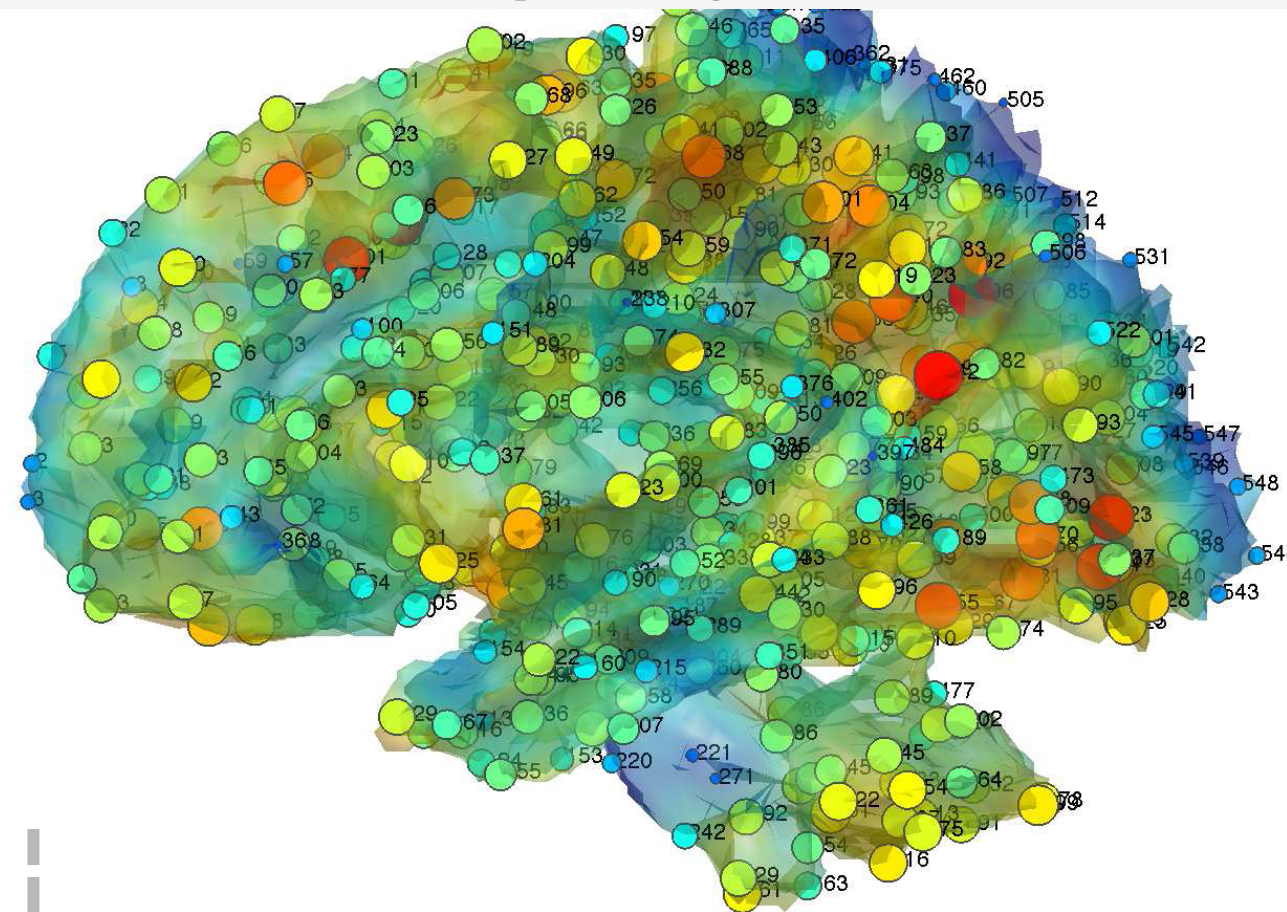
1856 nodes correlation



Correlation map of Jacobian determinants



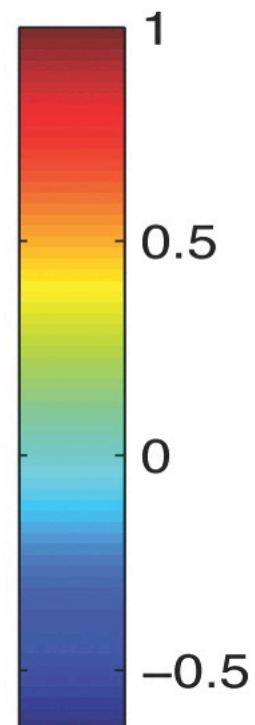
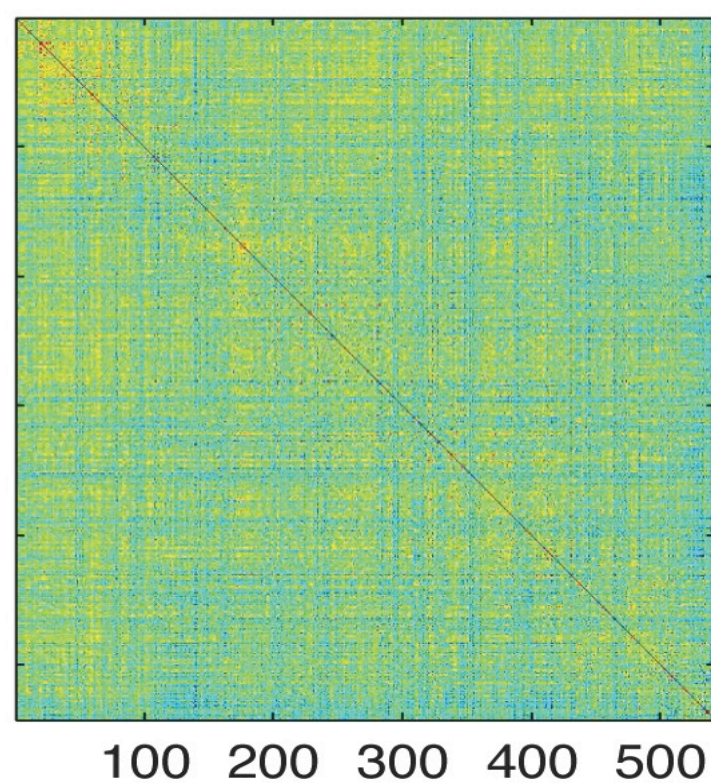
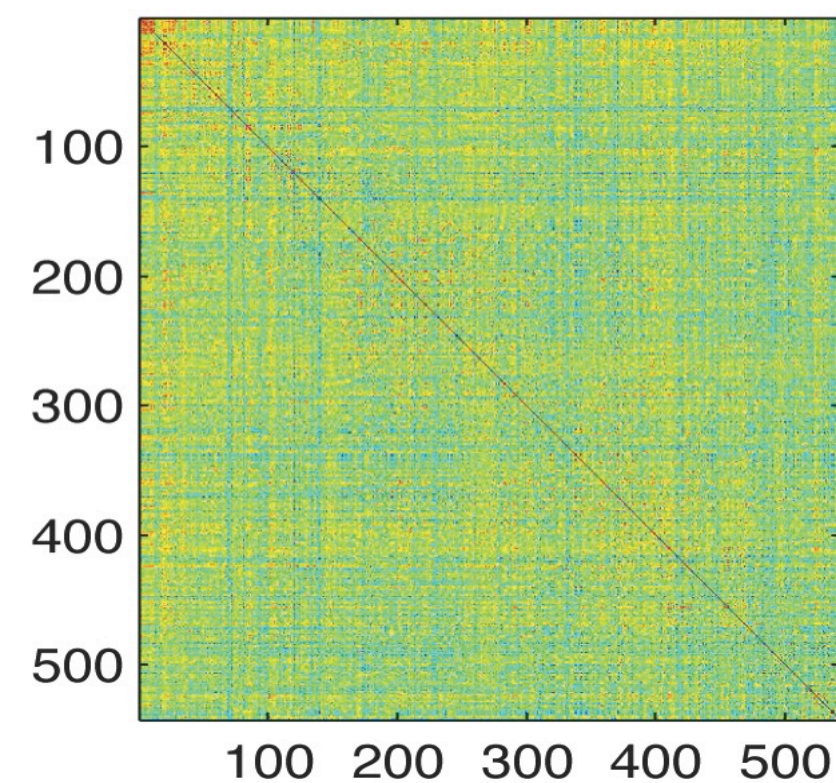
PI



Controls

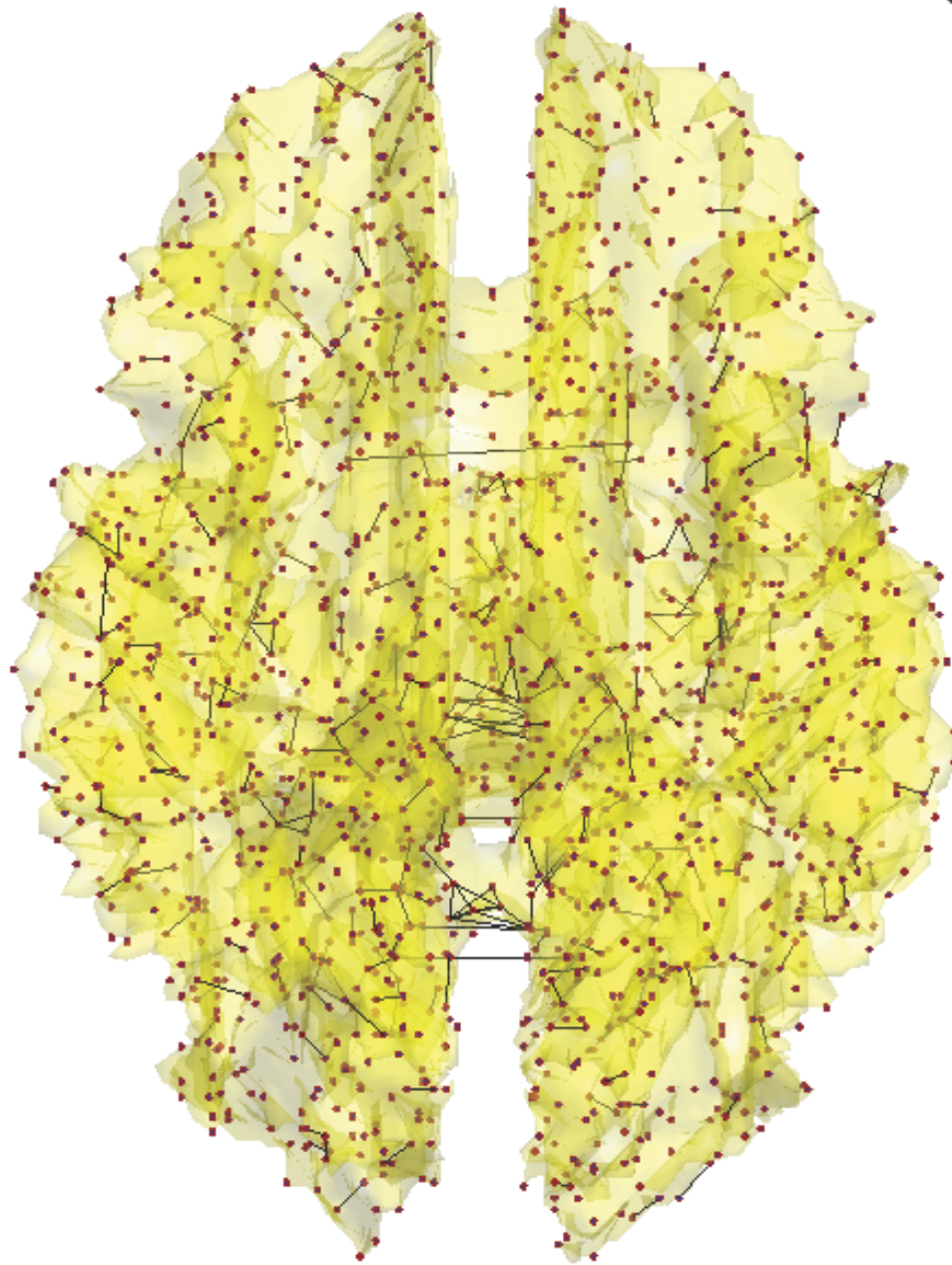
15.7mm
internodal
distance

548 nodes correlation

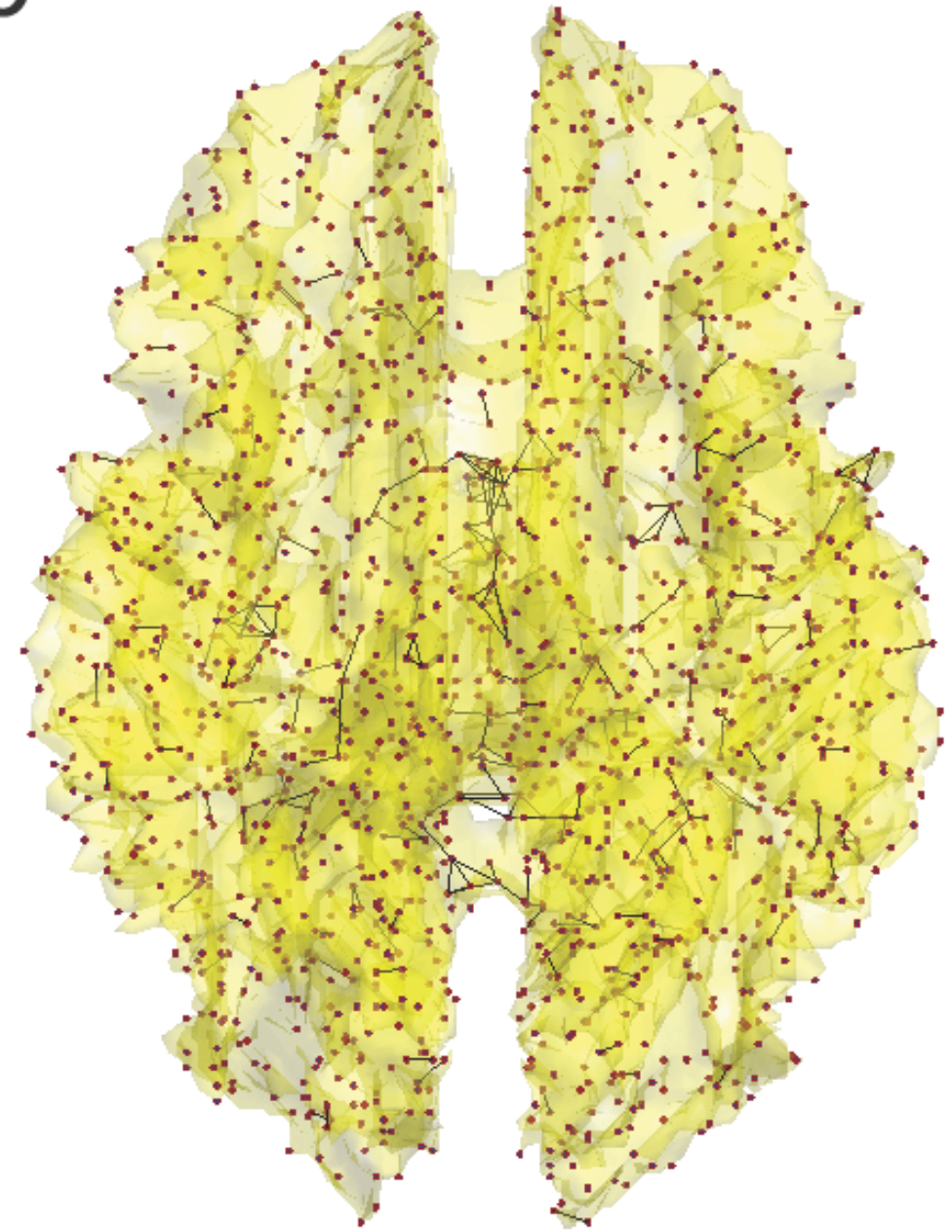


Graph representation of thresholded correlation

0.9

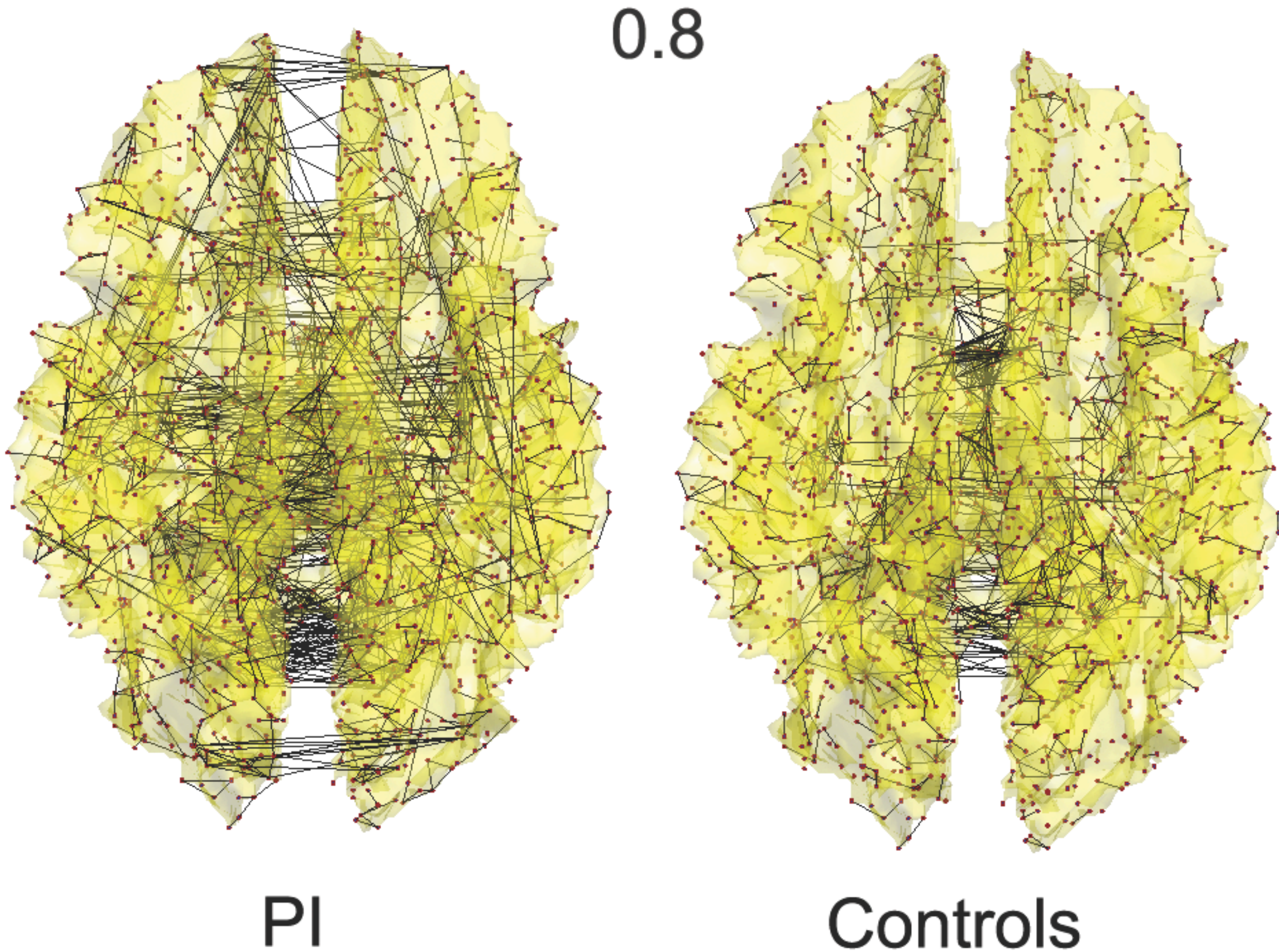


PI

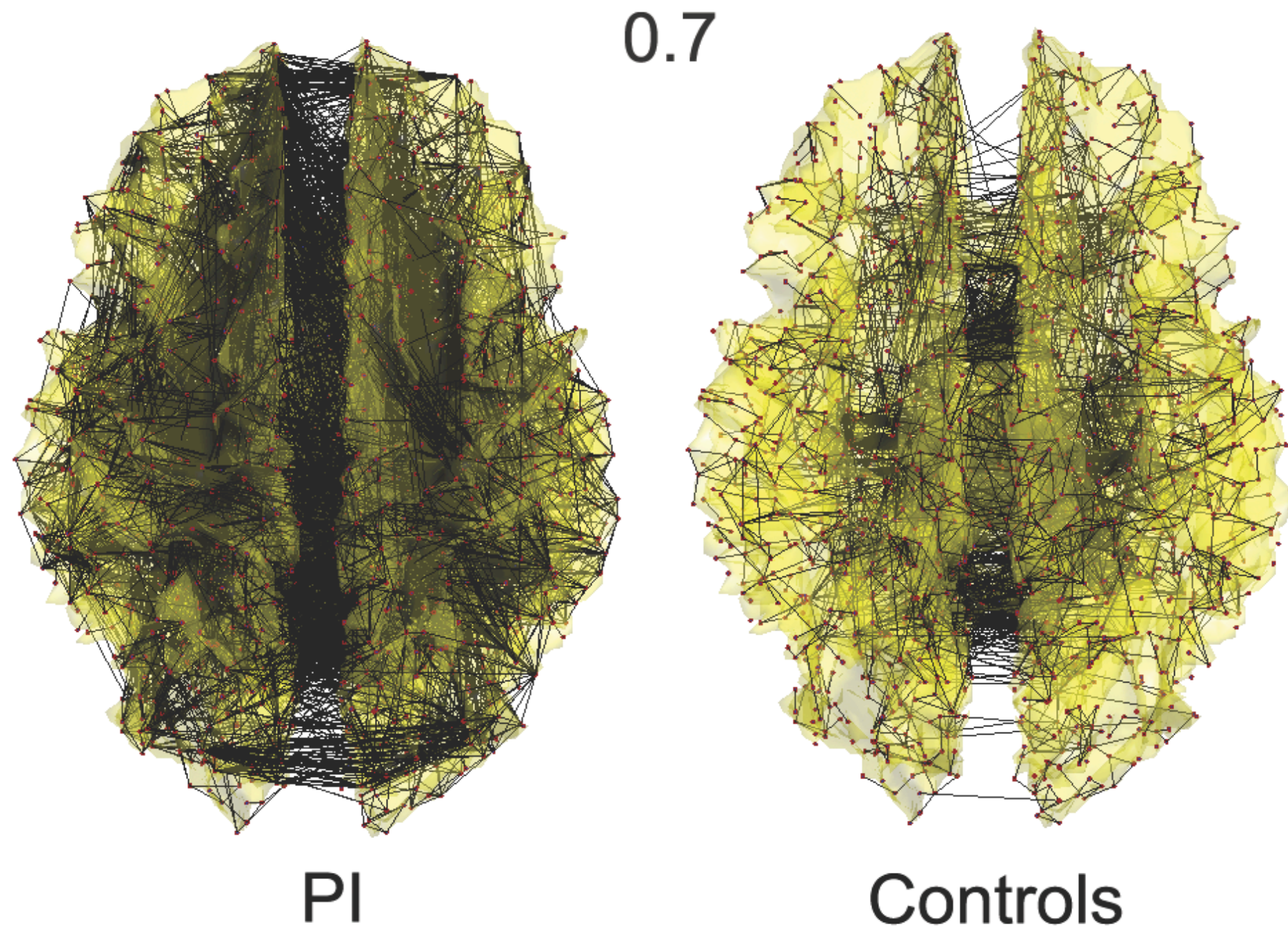


Controls

Graph representation of thresholded correlation

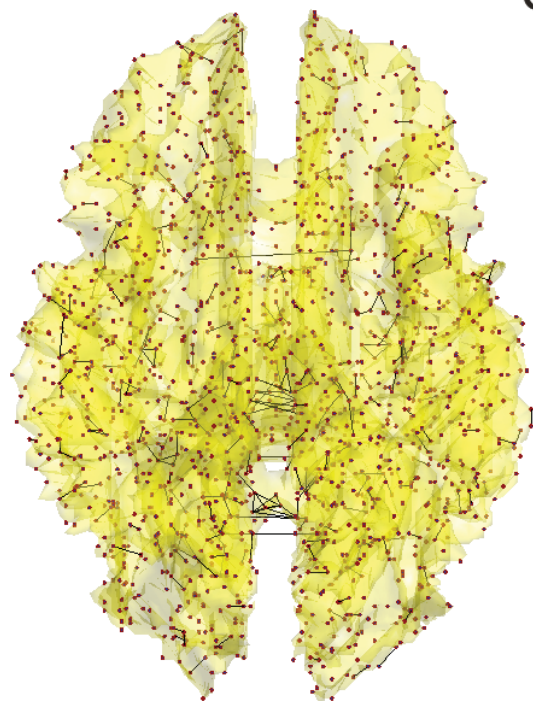


Graph representation of thresholded correlation

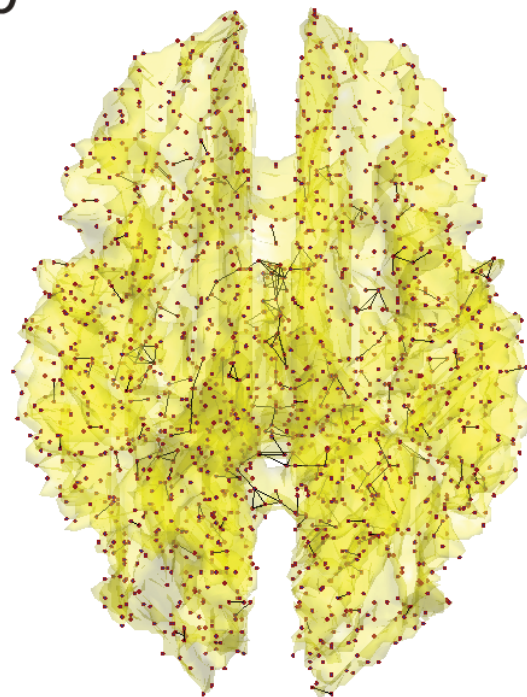


Interpretation: PI is structurally more homogenous than the controls.

0.9

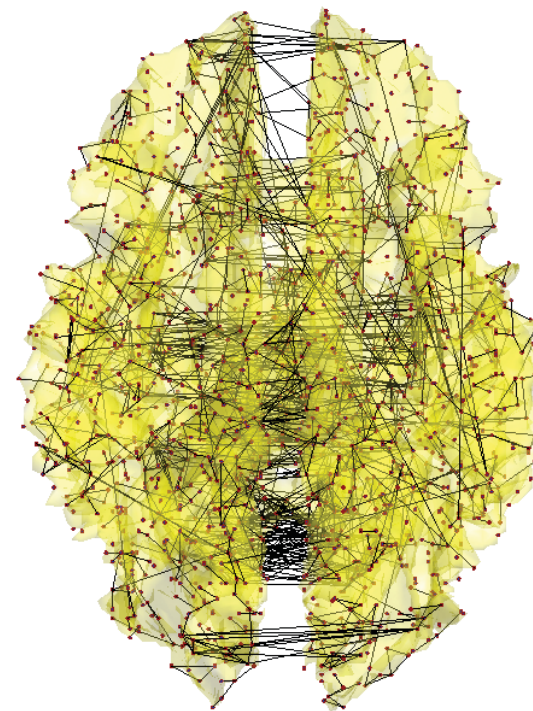


PI

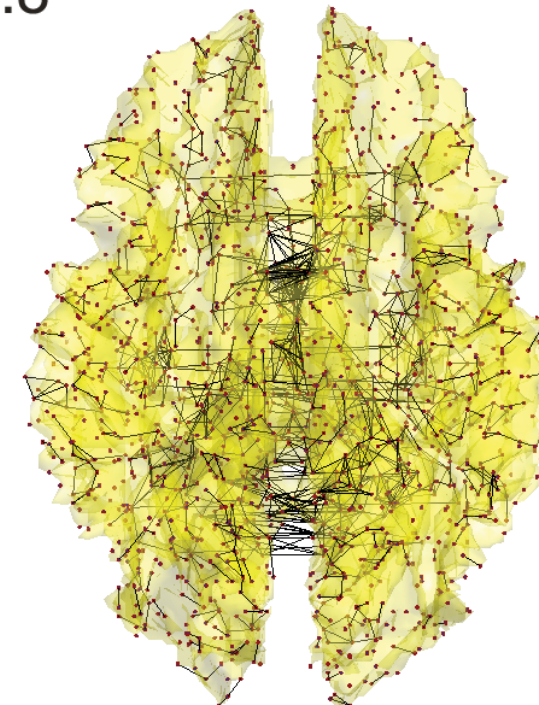


Controls

0.8

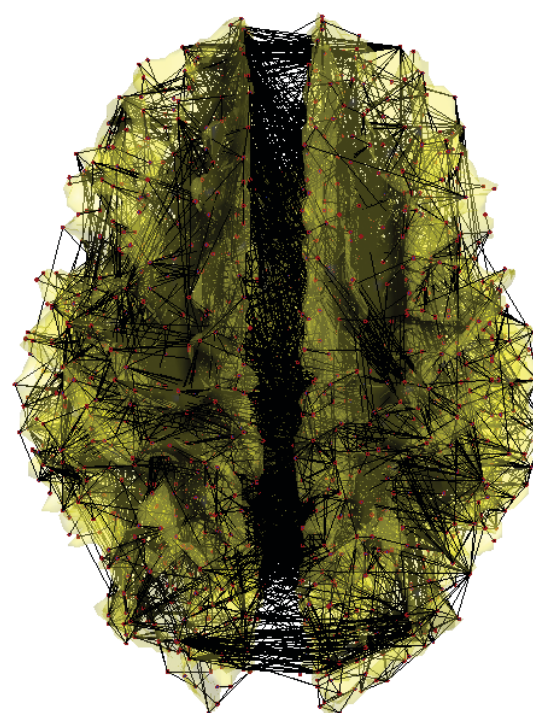


PI

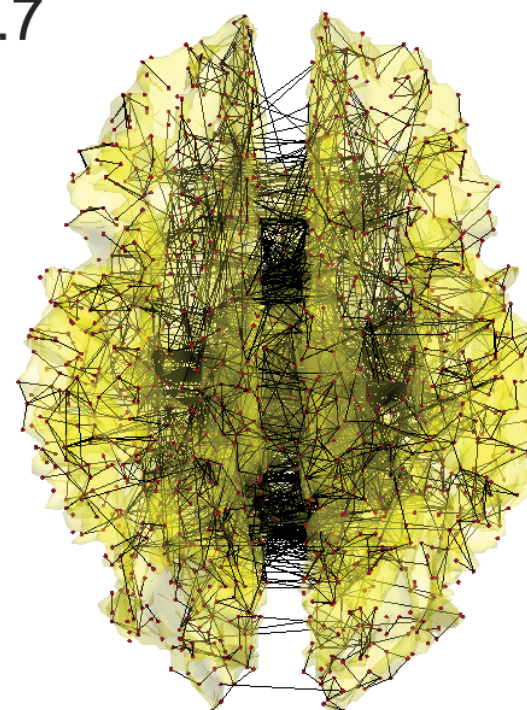


Controls

0.7

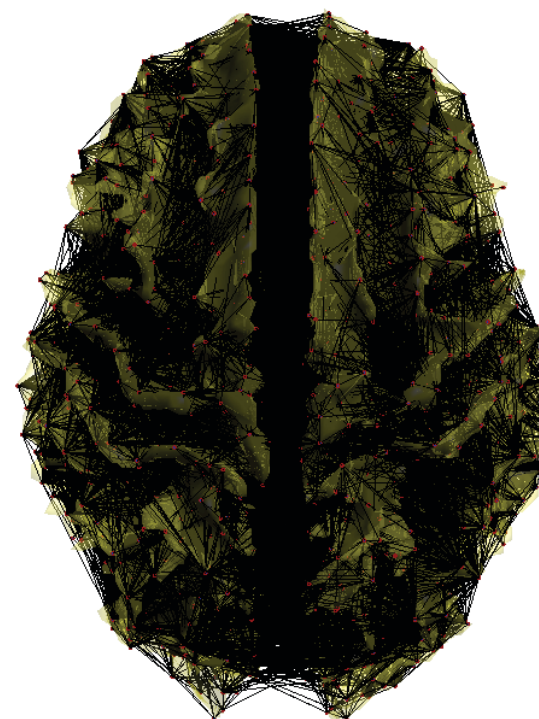


PI

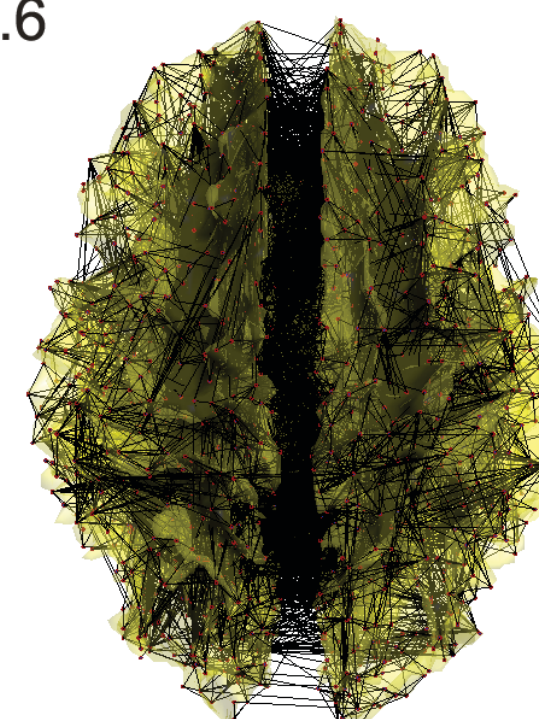


Controls

0.6



PI



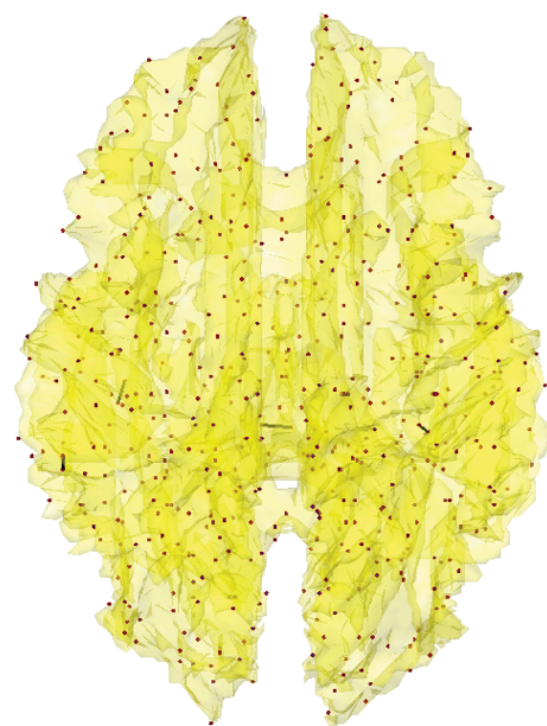
Controls

1856 nodes thresholding

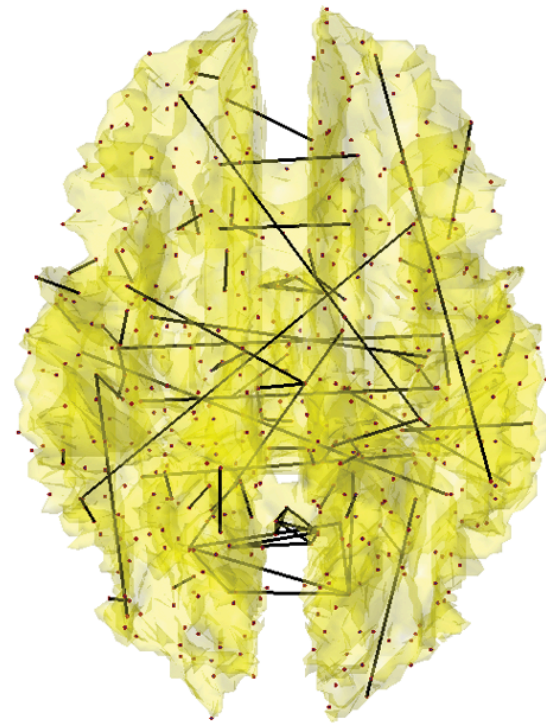


PI

0.9

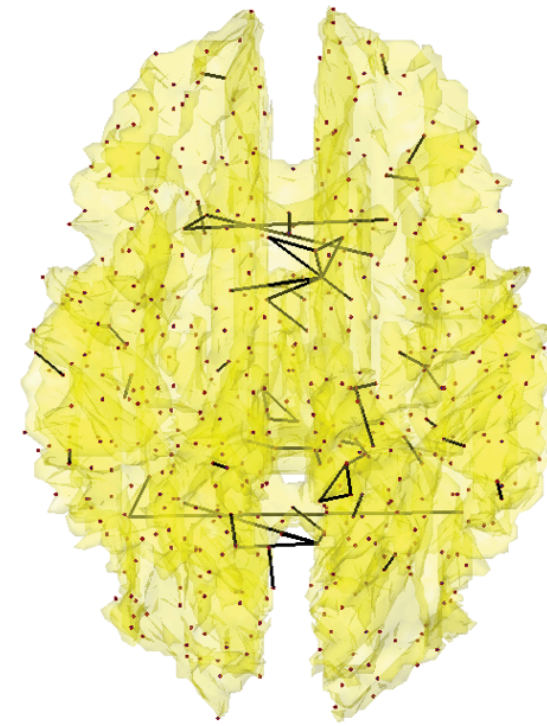


Controls

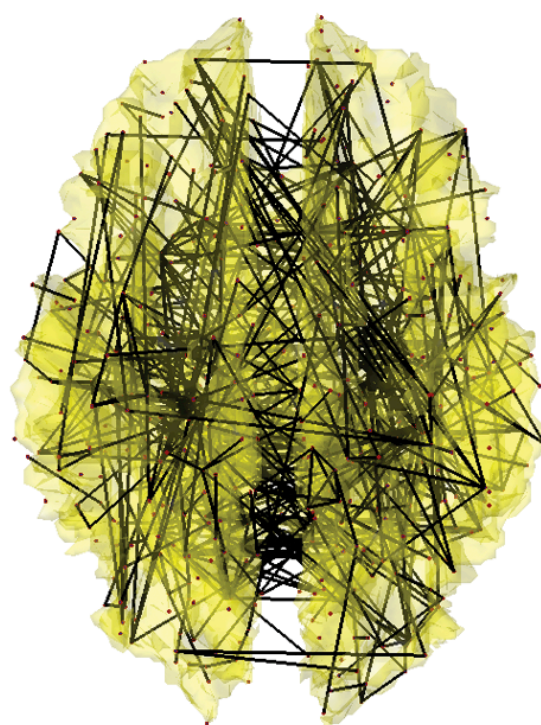


PI

0.8

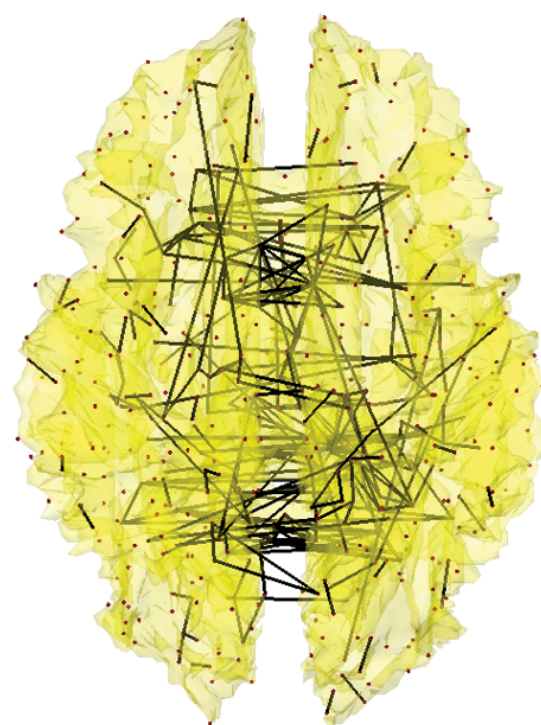


Controls

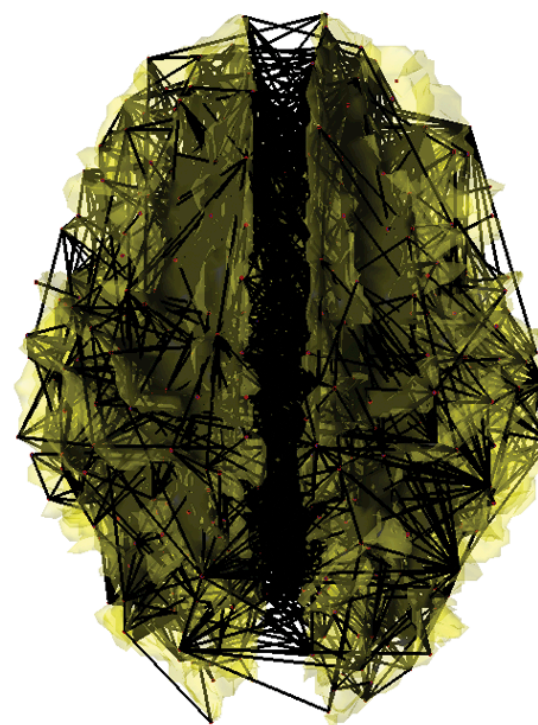


PI

0.7

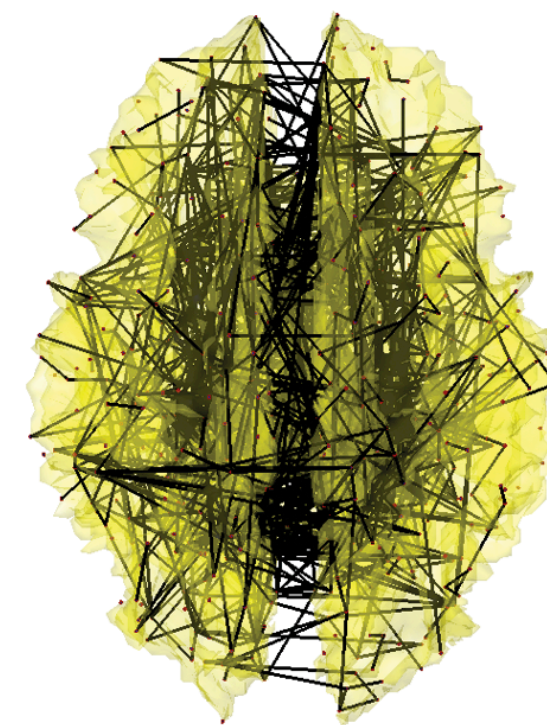


Controls



PI

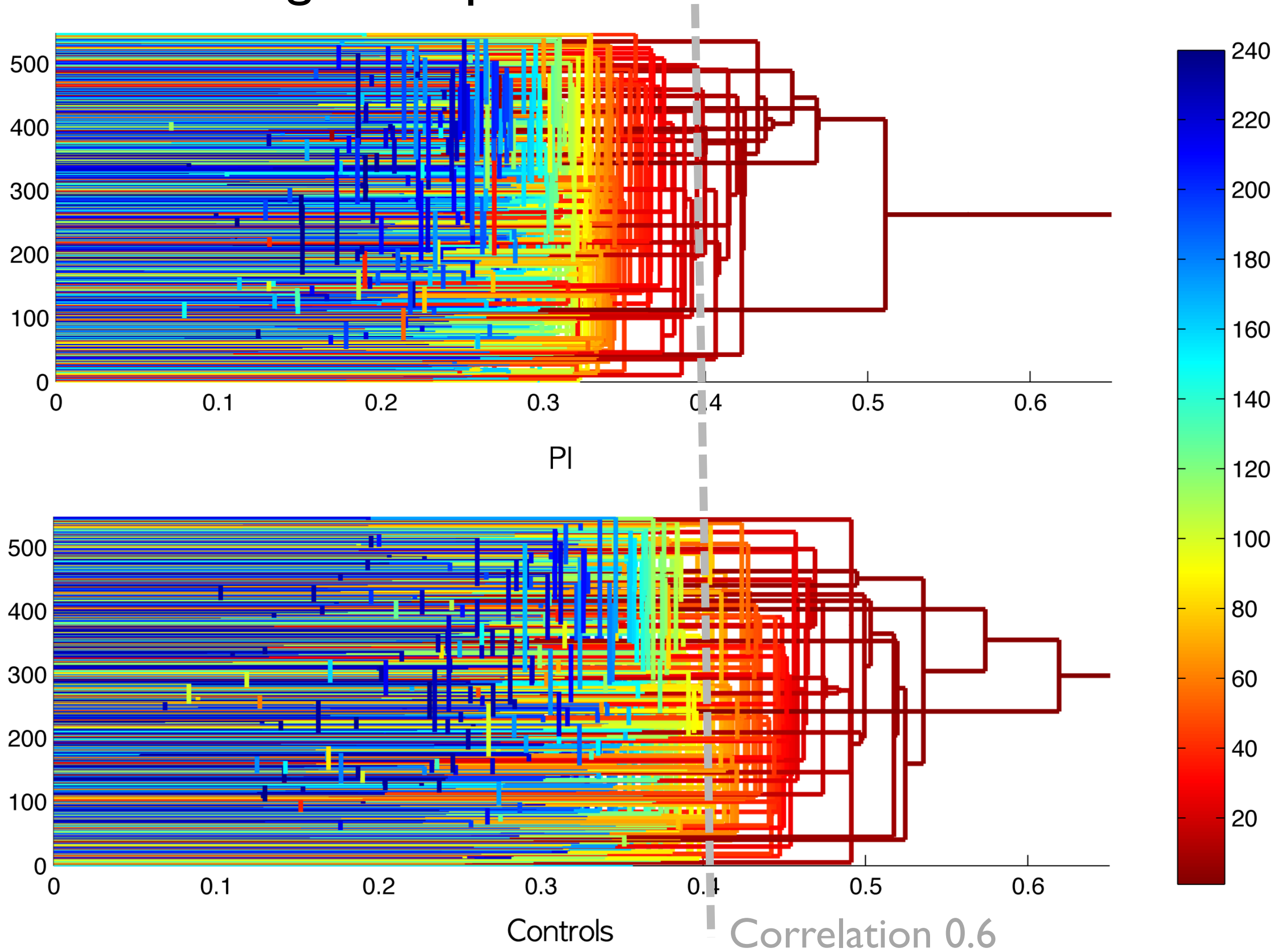
0.6

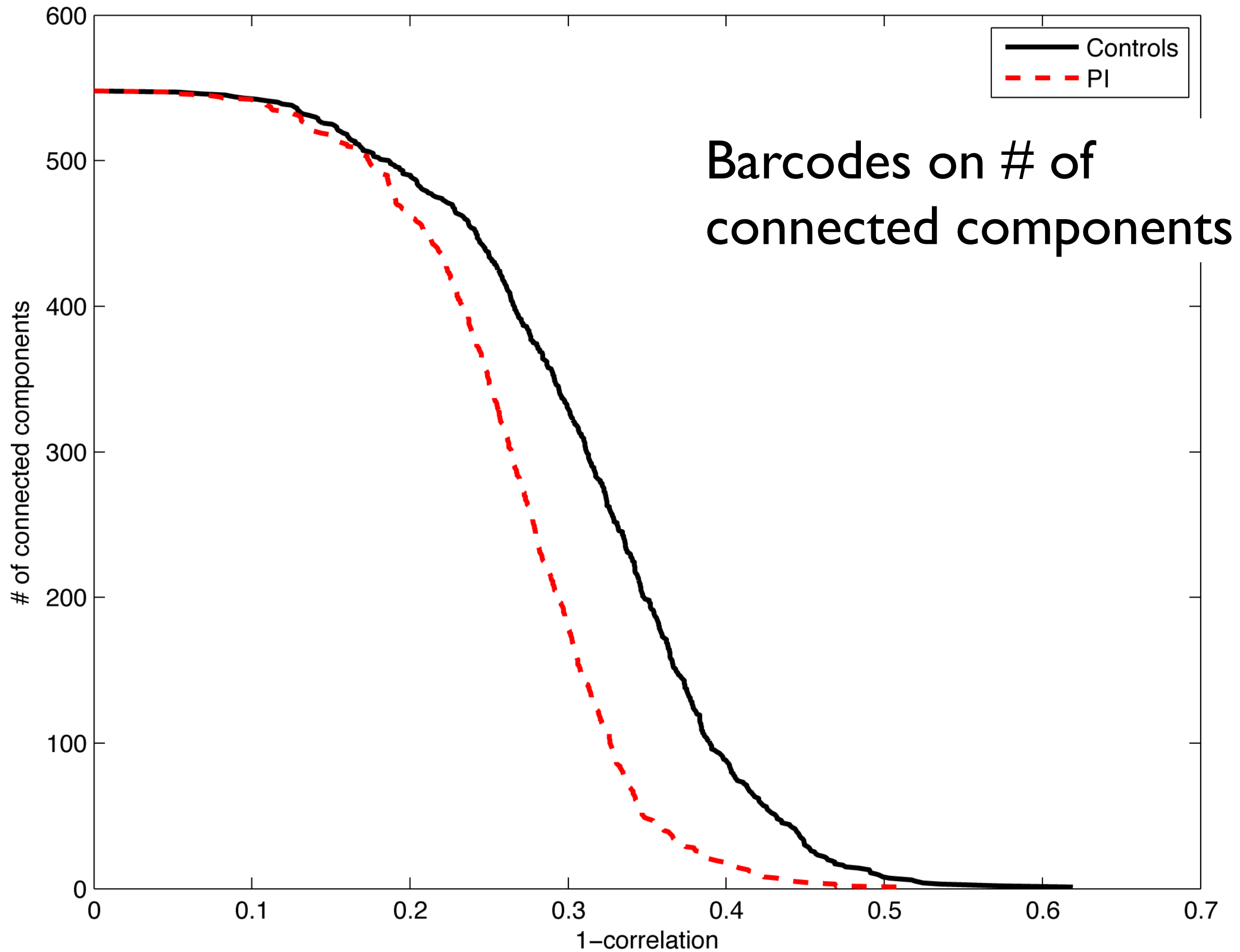


Controls

548 nodes thresholding

Dendrogram representation on I- correlations





What next?

Trying to check the
strength of DTI
connections
in those nodes showing
the group difference