

*The Waisman Laboratory
for Brain Imaging and Behavior*



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

Effect of Income Level on Hippocampus Growth: Longitudinal Study

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Motivation



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NeuroImage

journal homepage: www.elsevier.com/locate/ynimg



General multivariate linear modeling of surface shapes using SurfStat

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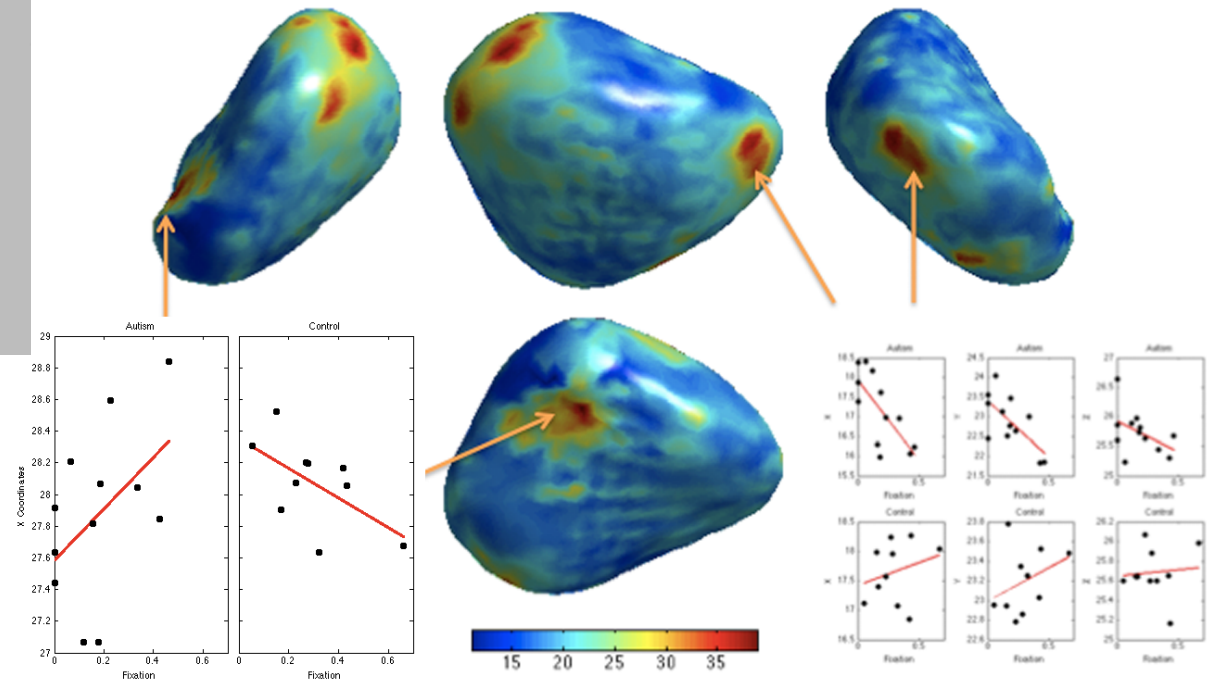
^c Department of Psychology and Psychiatry, University of Wisconsin, Madison, WI 53706, USA

^d Department of Mathematics and Statistics, McGill University, Montreal, Canada

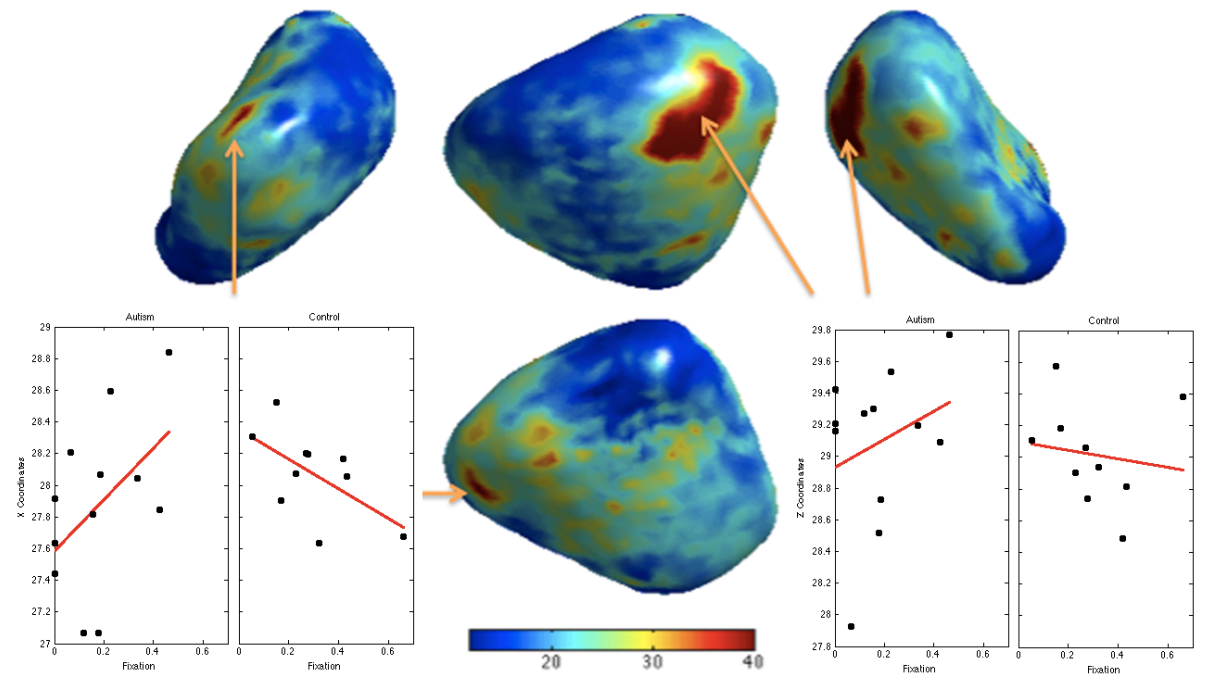
^e Department of Brain and Cognitive Sciences, Seoul National University, Republic of Korea

Effect of gaze fixation duration on amygdala shape in autism

Left amygdala



Right amygdala



Hippocampus Data Set

Sample size = 124

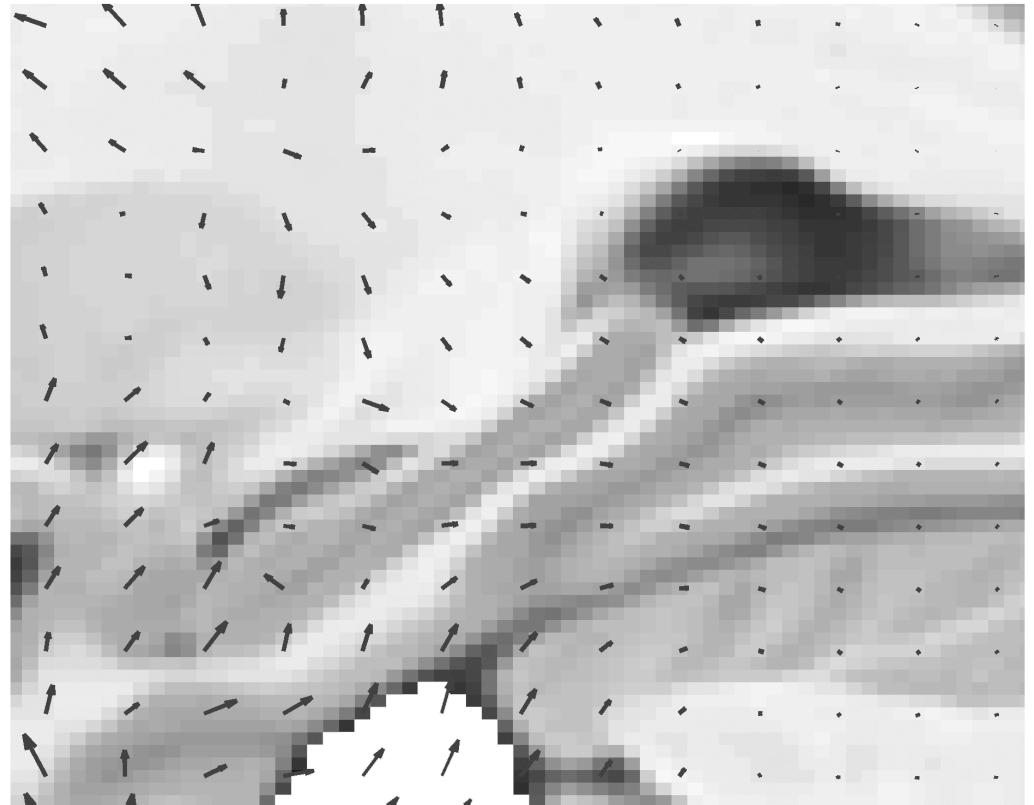
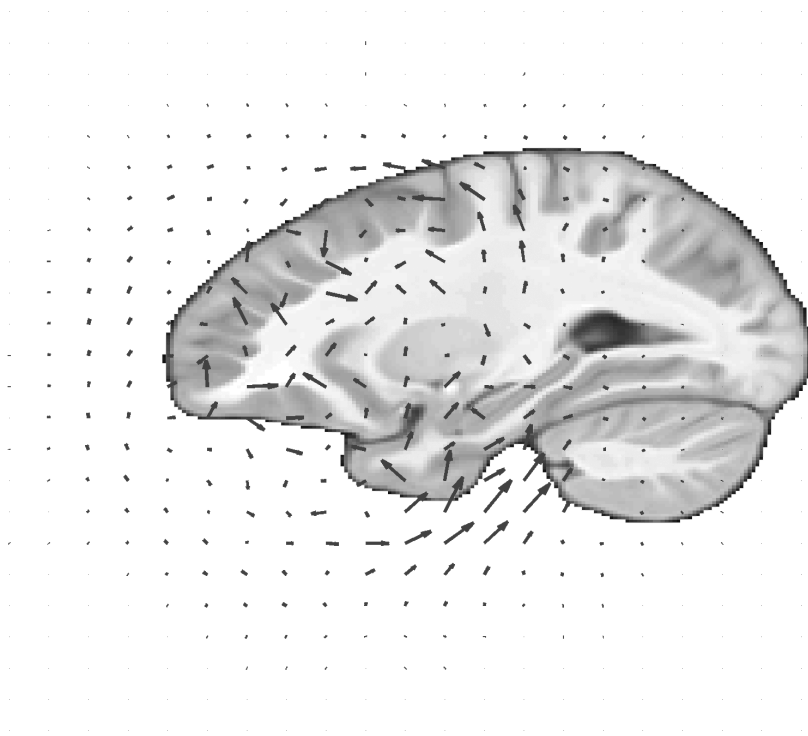
High income family 86 = 24 males + 62 females
Average age = 12 +/- 4 years old

Low income family 38 = 13 males + 25 females
Average Age = 12 +/- 4 years old

Each subject has multiple MRI scans (1-2 scans).

Image registration

Deformation from the template to a subject.

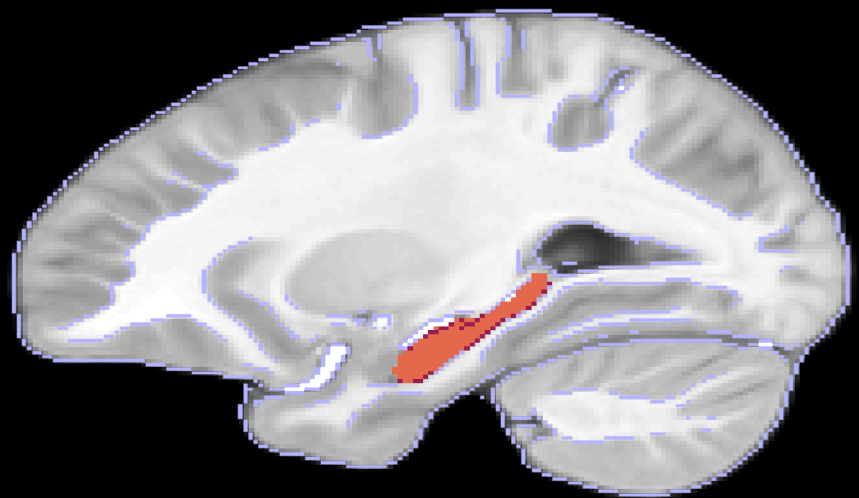
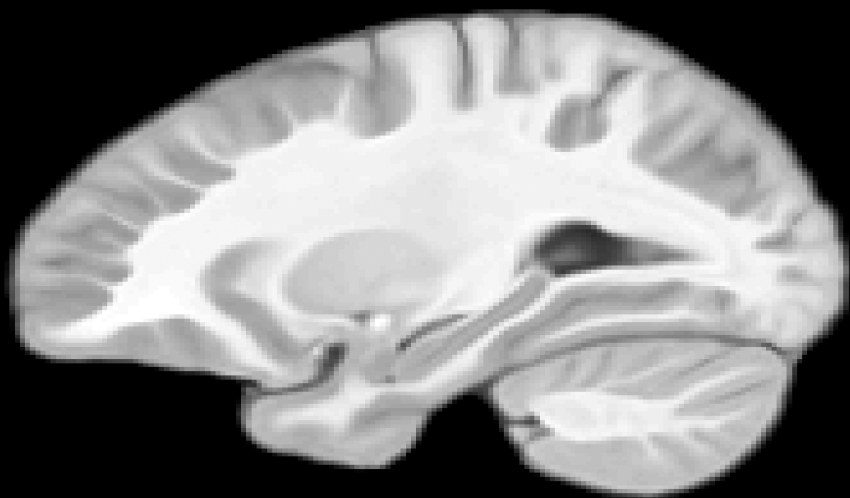


Longitudinal processing pipeline

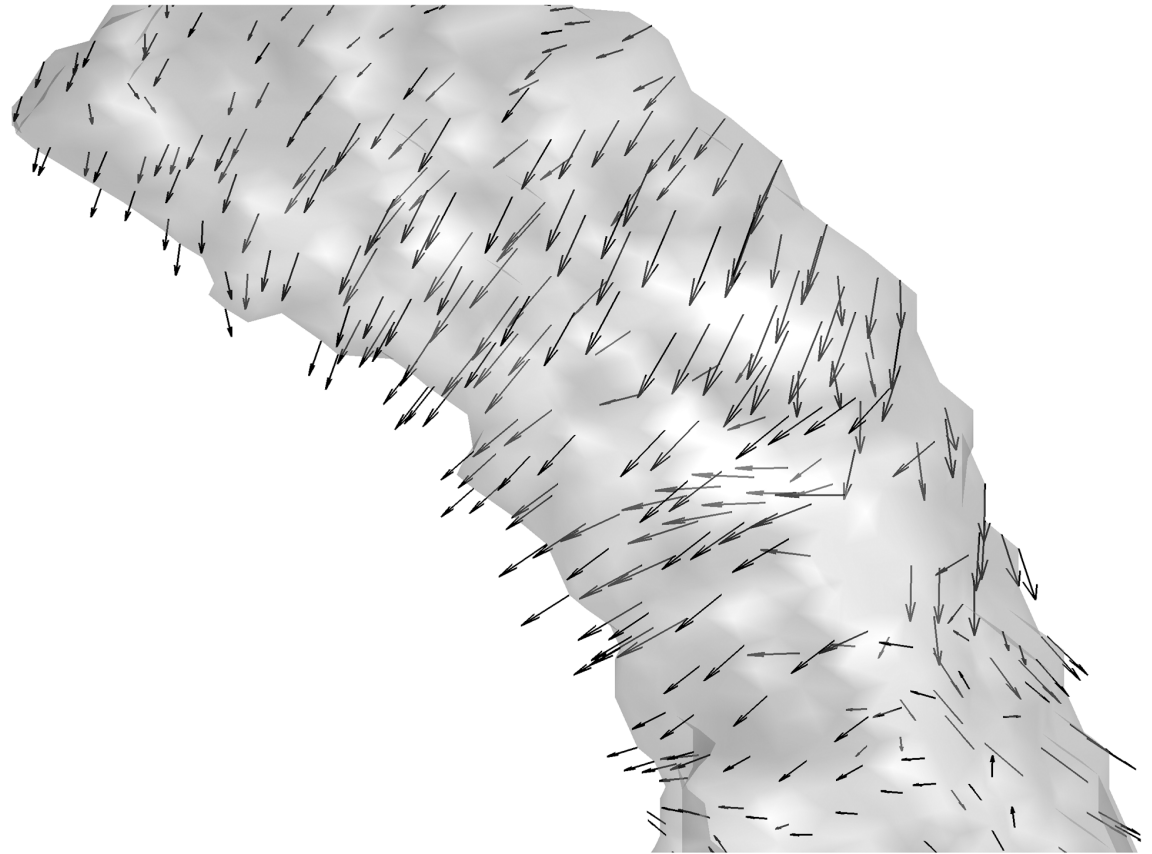
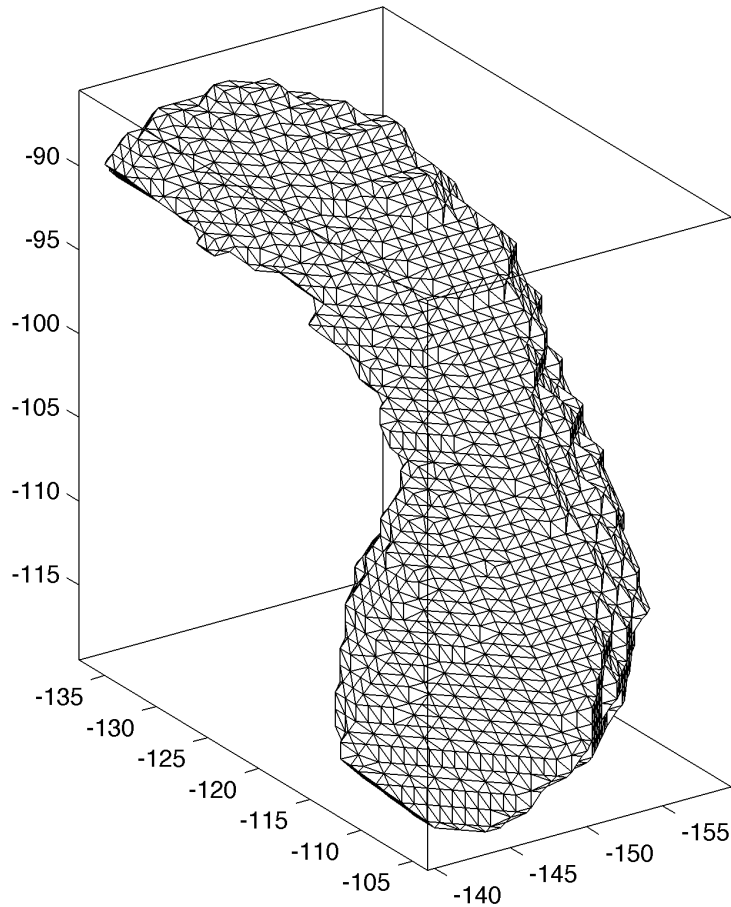


Deformation from the template to Scan2 is given by $\text{warp1} + \text{warp2}$.

Manual hippocampus segmentation on MRI template done



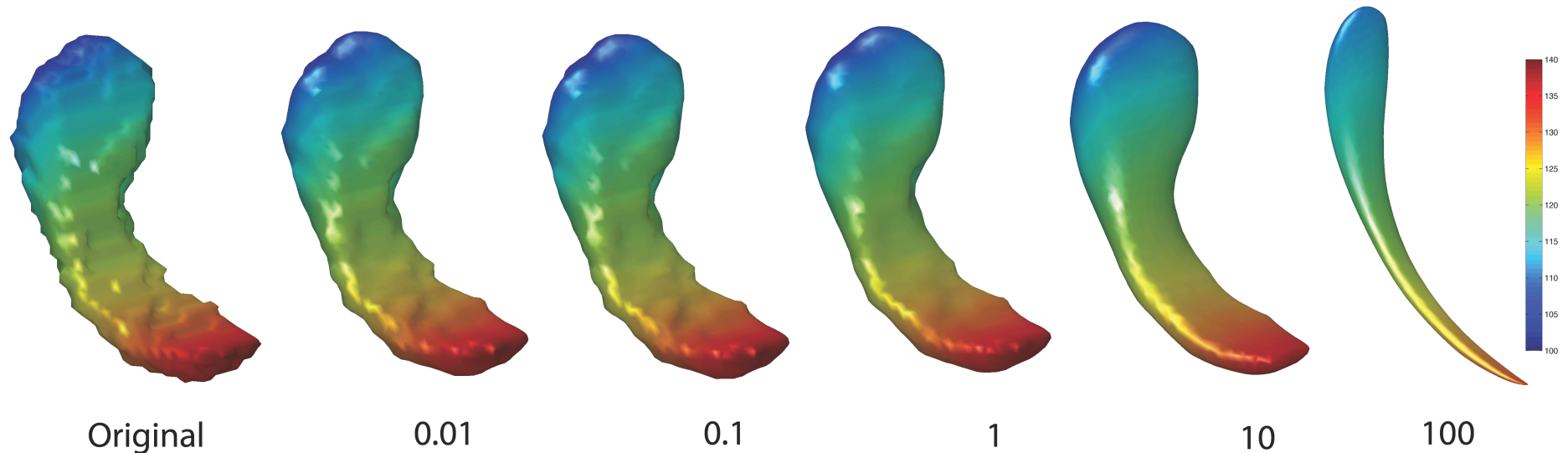
surface template & deformation on template



Deformation field
of warping the template
to a subject

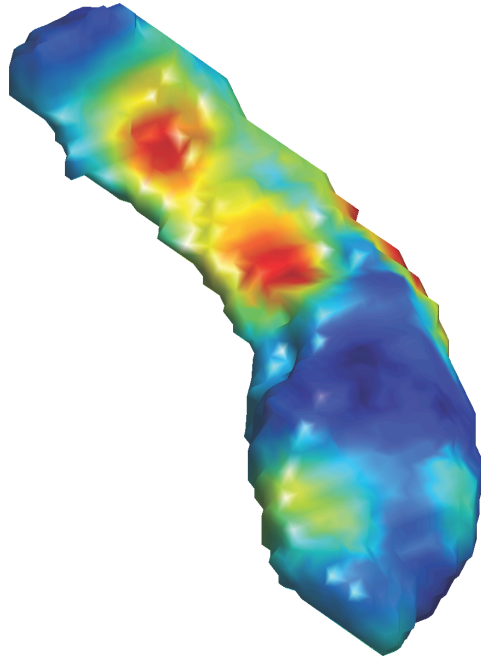
Data smoothing on surface models

Heat kernel smoothing of hippocampus

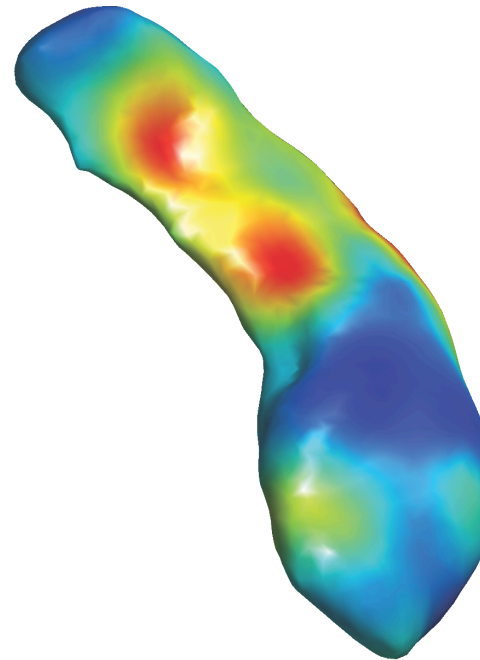


Smoothing scale
used in the study

Smoothing of measurement on hippocampus



Original
deformation field



Heat kernel
smoothing with
 $\sigma=1$

Mixed Effect Modeling

y_{ij} i -th subject, j -th scan ($j=1,2$)

Fixed effect model:

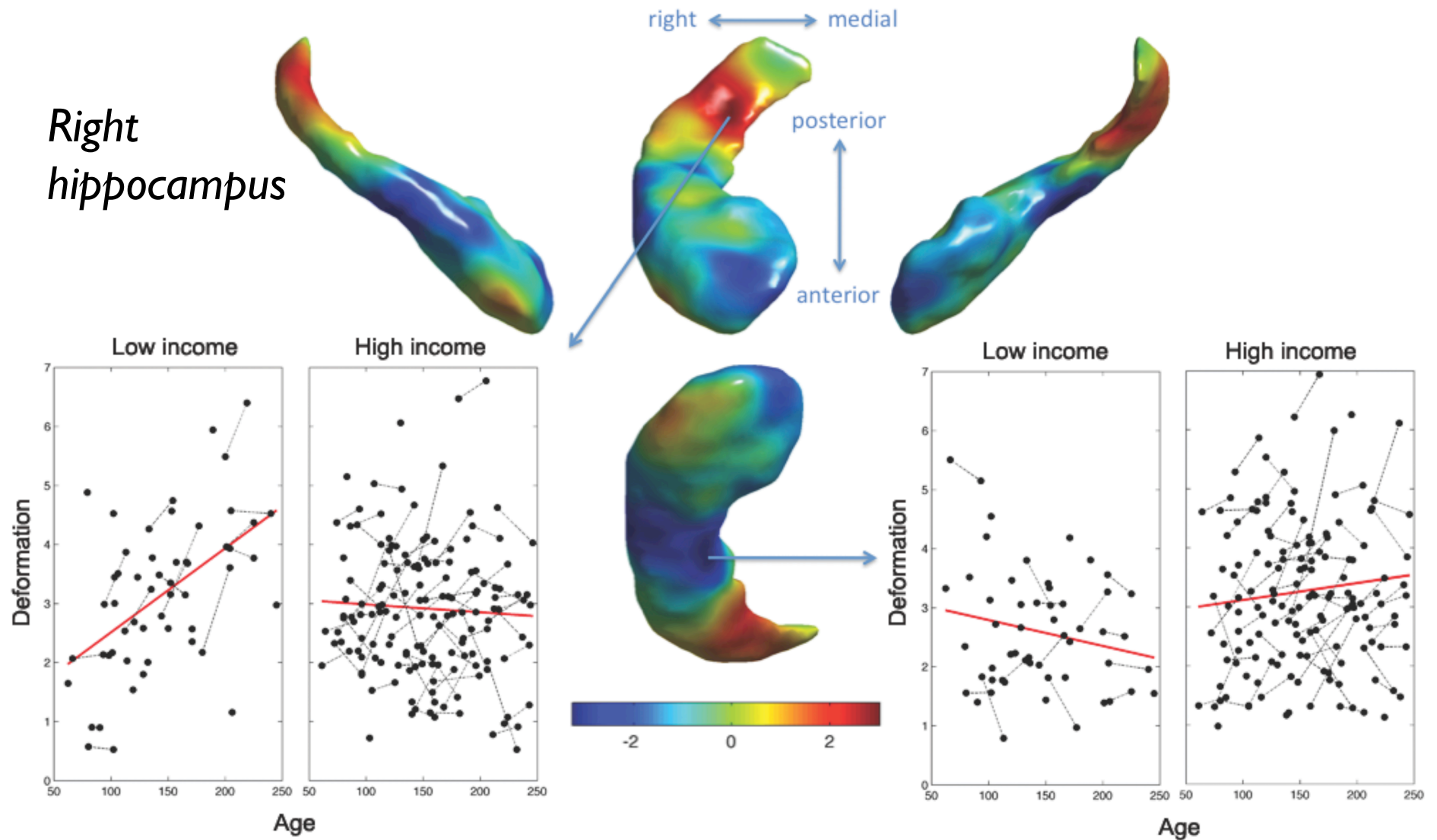
$$y_{ij} = \beta_0 + \beta_1 age_{ij} + \epsilon_{ij}$$

Mixed effect model:

$$y_{ij} = \beta_0 + \gamma_{i0} + (\beta_1 + \gamma_{i1})age_{ij} + \epsilon_{ij}$$

Each subject has its own growth intercept and slope.

Effect of family income on hippocampus growth

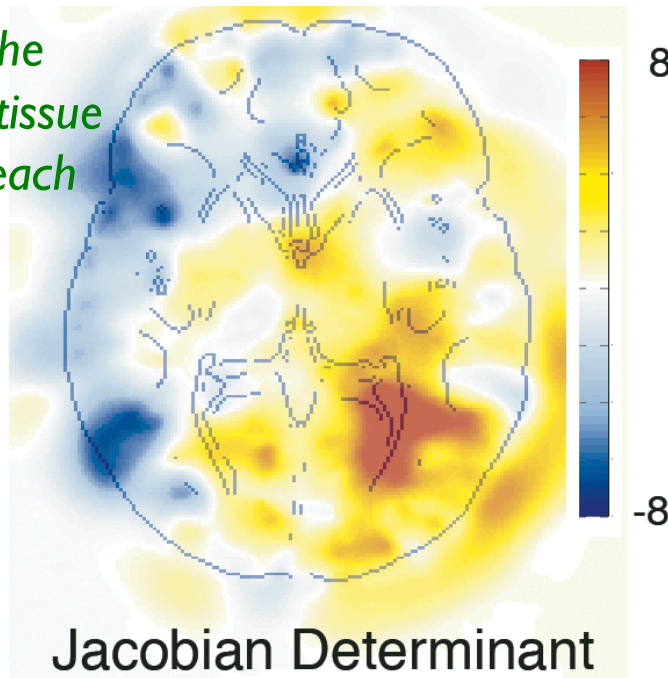


HBM 2011 submitted

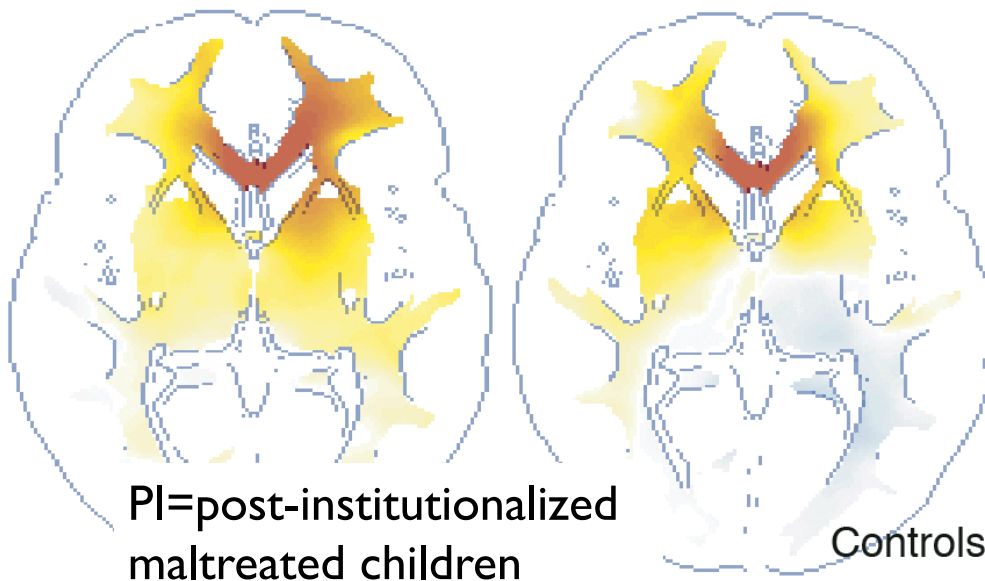
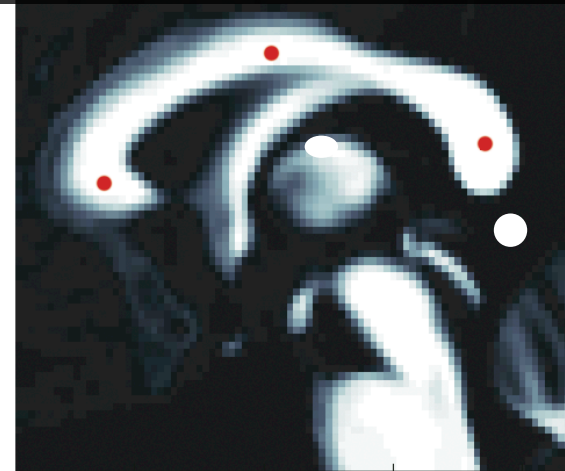
What Next?

Network abnormality involving
hippocampus but without DTI

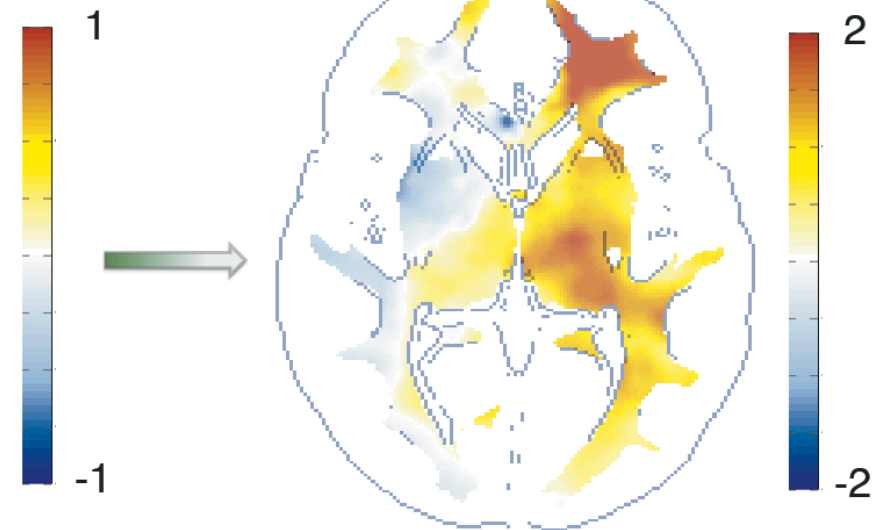
*Measures the
amount of tissue
volume at each
voxel*



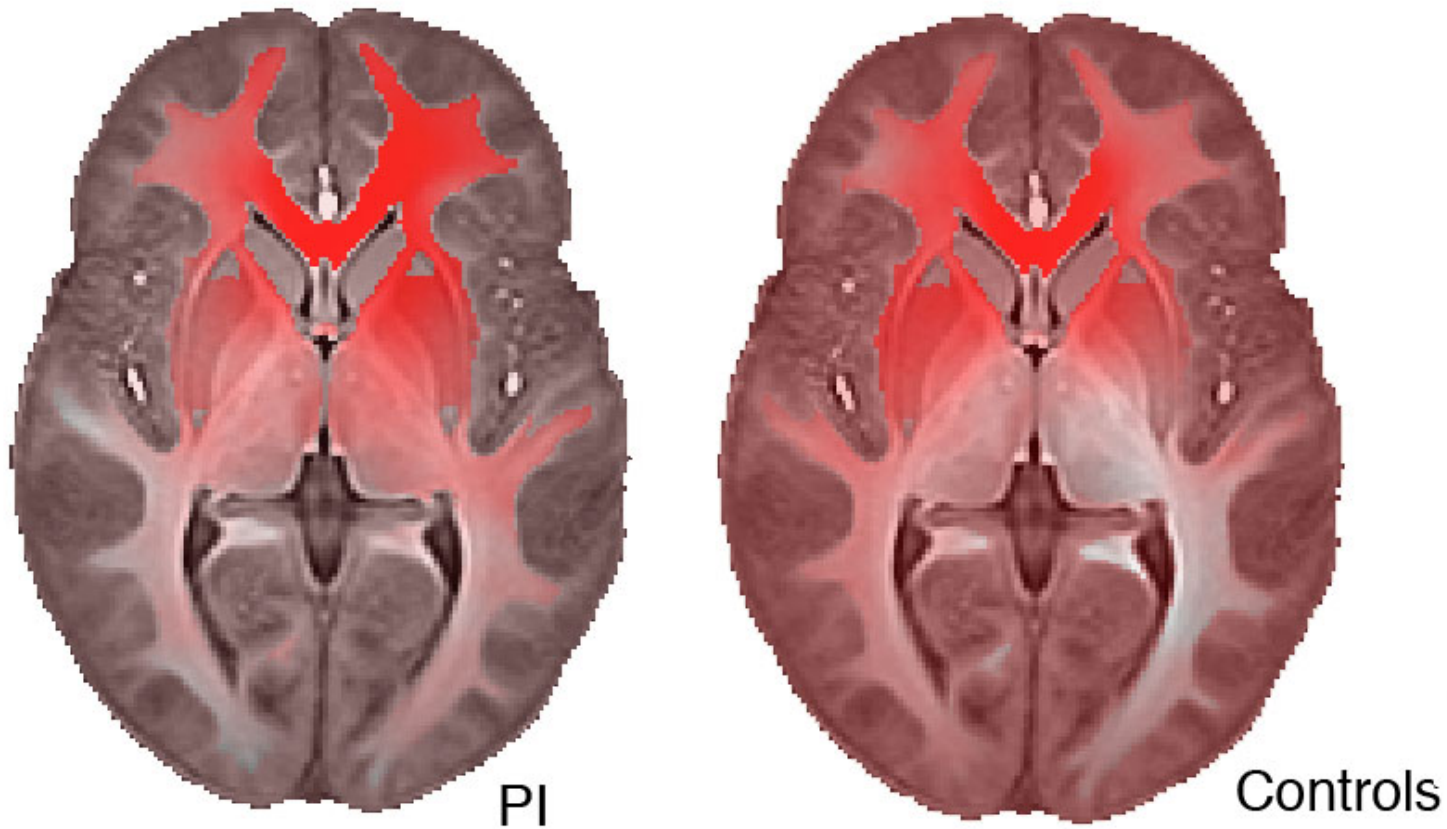
Connectivity without DTI



Connectivity Maps

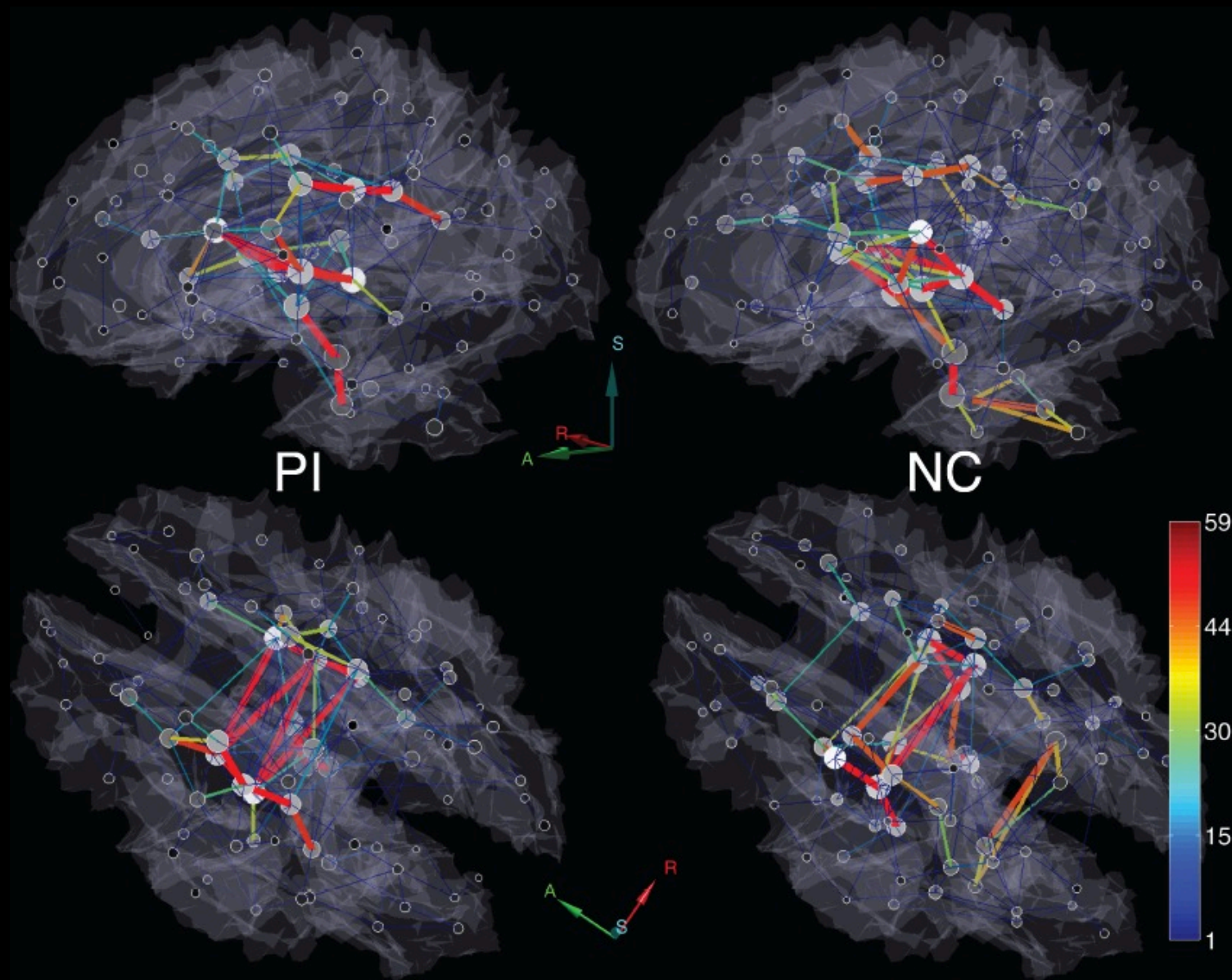


White matter connectivity map obtained using Jacobian determinant



Magically, this is similar to the probabilistic connectivity maps obtained from DTI.

MRI-based structural network model



ISBI 2011

Thank you



MATLAB codes can be downloaded from
www.stat.wisc.edu/~mchung