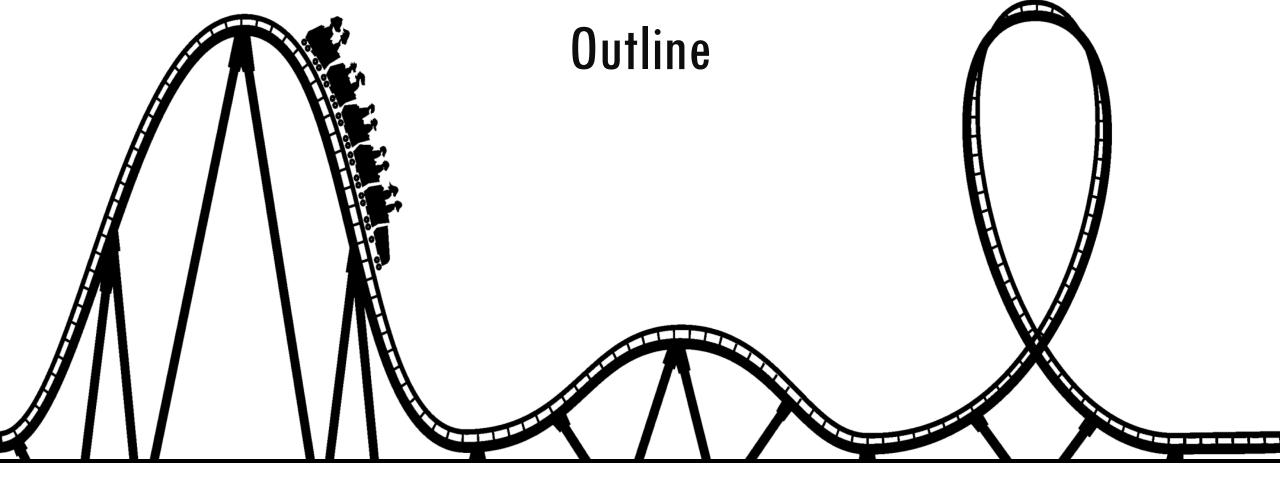
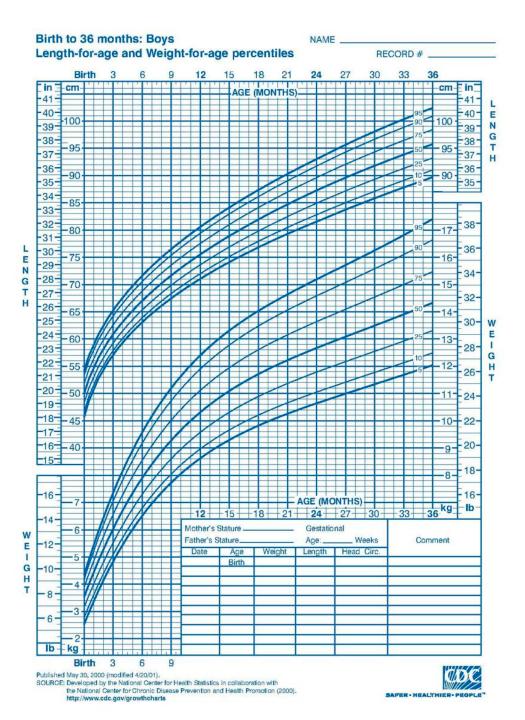


## ADOLESCENT BRAIN DEVELOPMENT AND MENTAL HEALTH

Kate Mills, Jenn Pfeifer, and Nick Allen Department of Psychology University of Oregon

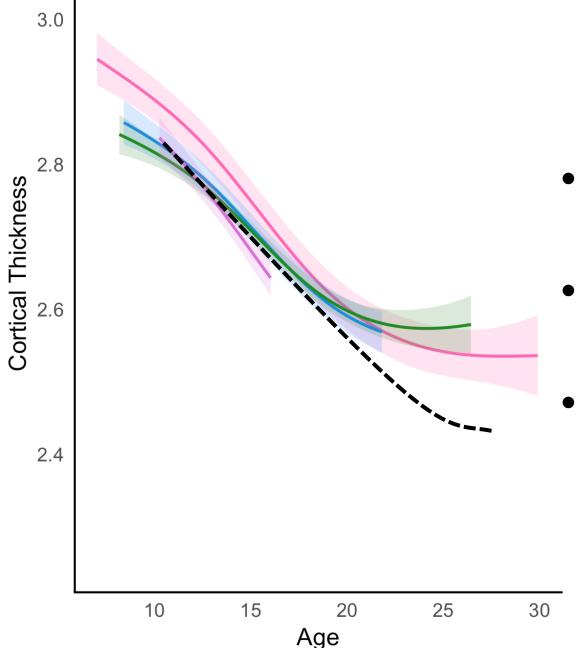


- 1. Structural brain development and individual differences
- 2. Task-based fMRI and puberty-related theories of mental health
- 3. Relating brain development patterns to mental health outcomes



## **Body Development**

- Characterizing typical growth
- Identifying atypical growth
- Example: Failure to Thrive

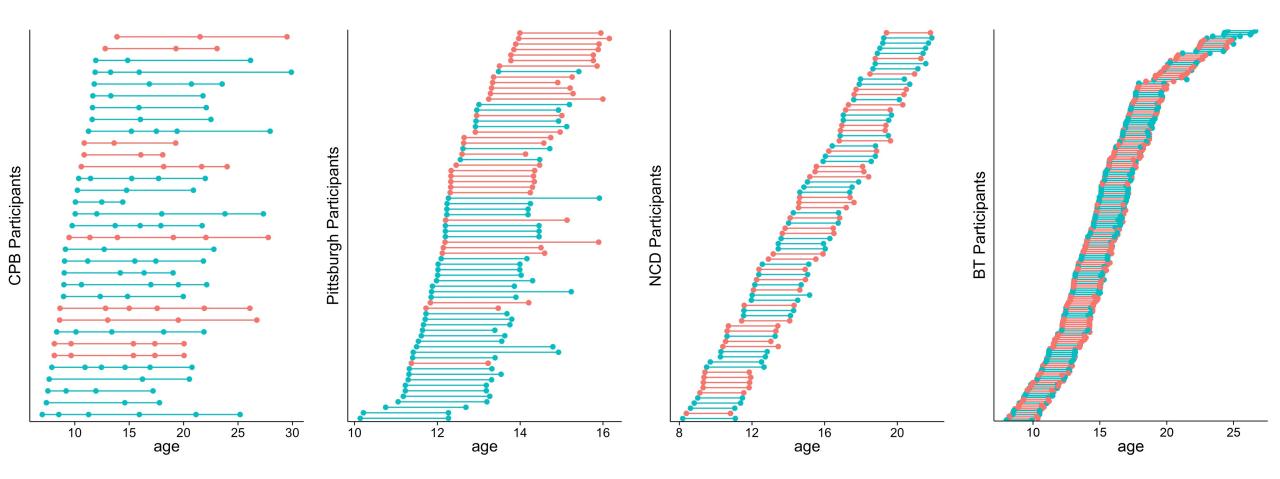


## **Brain Development**

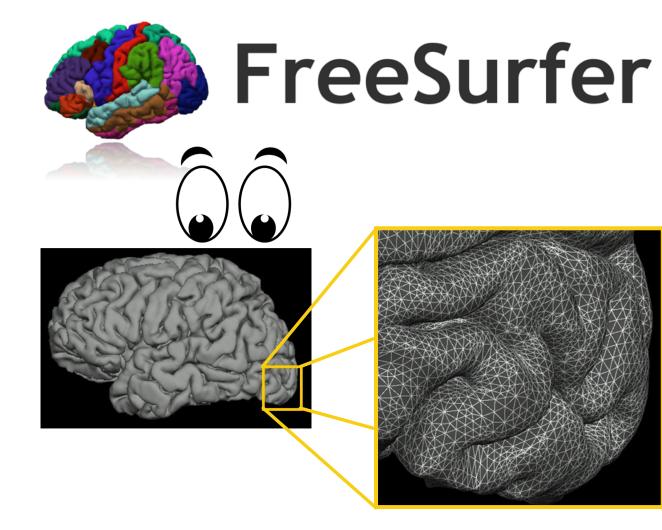
- Characterizing typical growth
- Identifying atypical growth
- Example: Schizophrenia

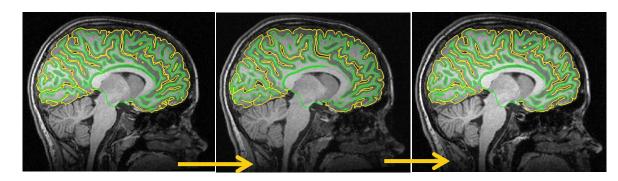
Tamnes et al., 2017 Data from Four Labs Collaboration

# Establishing replicable patterns of typical brain development Samples



# Establishing replicable patterns of typical brain development <u>Methods</u>

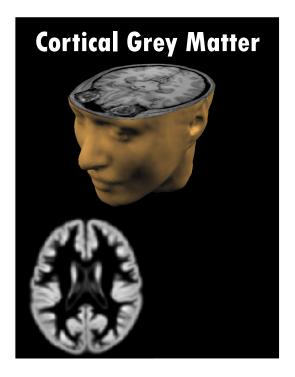




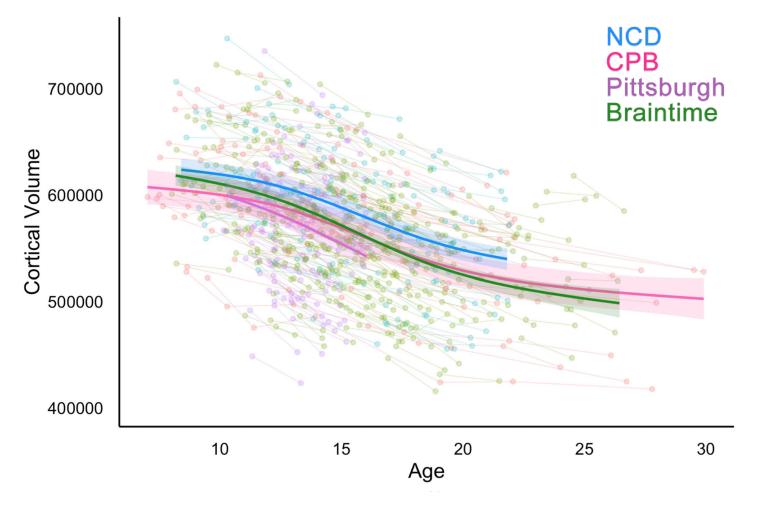
- Mixed-effects models in R
- Best fitting model selected by AIC
- Code available on Open Science Framework

http://surfer.nmr.mgh.harvard.edu/

### **Cortical Grey Matter Volume**

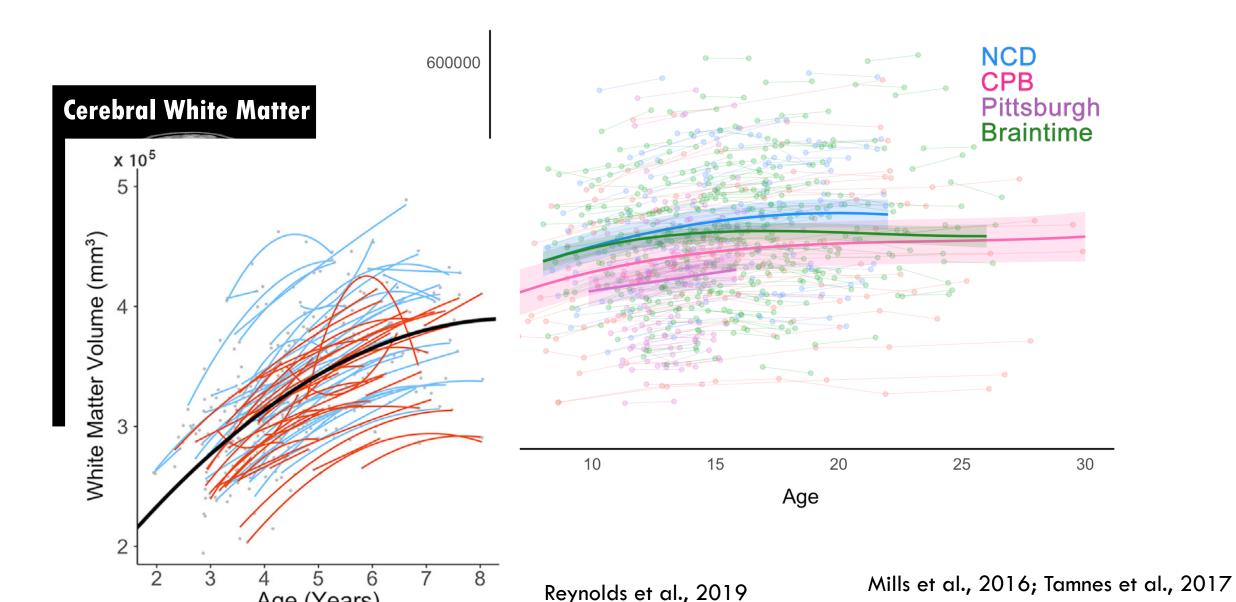


391 participants852 scans51% female

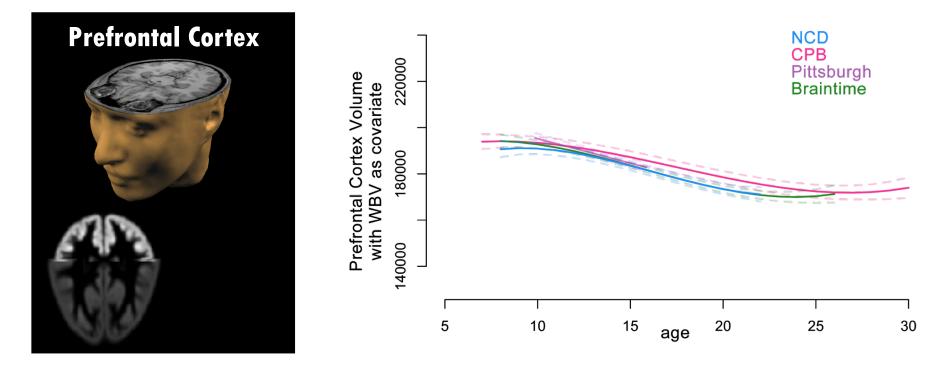


Mills et al., 2016; Tamnes et al., 2017

#### **Cerebral White Matter Volume**

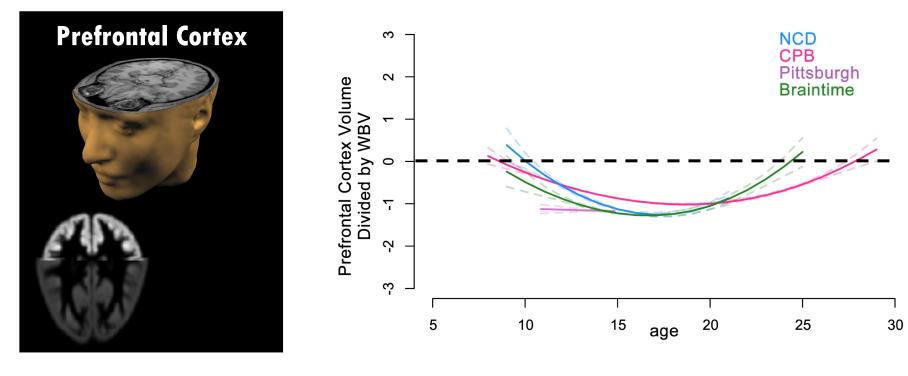


#### Statistical analysis: Raw vs. corrected measures



391 participants852 scans51% female

#### Statistical analysis: Raw vs. corrected measures



391 participants852 scans51% female

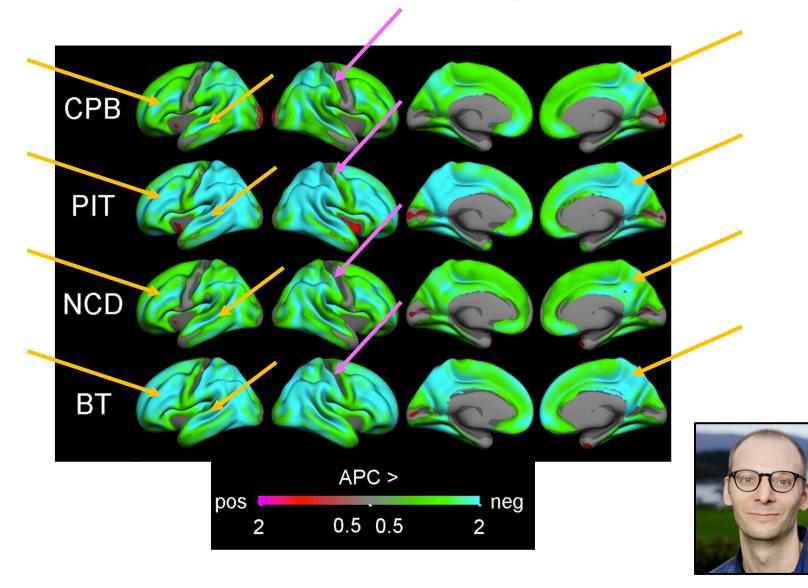
• Controlling for whole brain volume reduces magnitude of cortical volumetric development

### Regional differences in cortical development



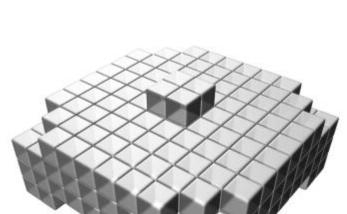


388 participants 854 scans 51% female



Tamnes et al., 2017

#### Grey matter volume is the product of cortical thickness and surface area



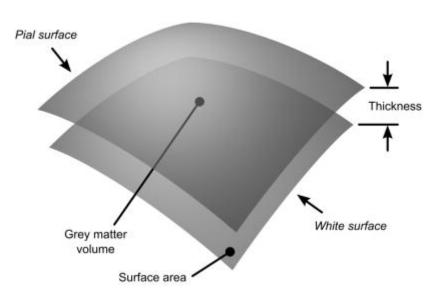
Grey matter

volume

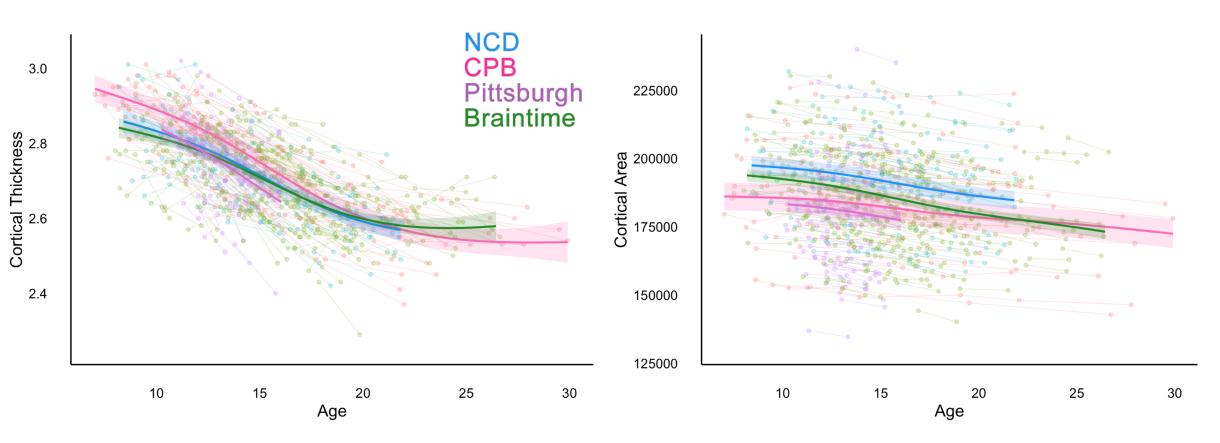
Volume-based representation



#### Surface-based representation

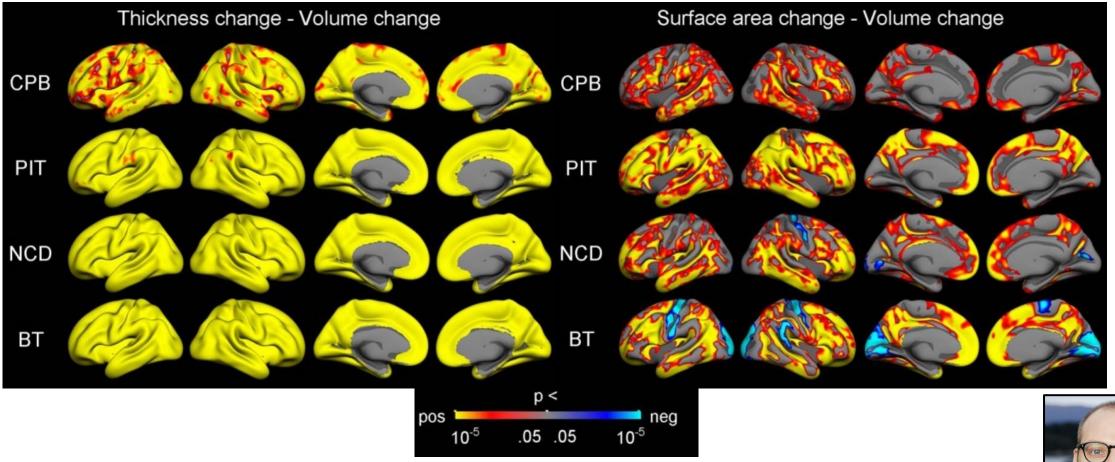


#### Cortical Thickness vs. Surface Area



 There is less inter-individual variability in cortical thickness than in surface area

### Cortical Thickness vs. Surface Area

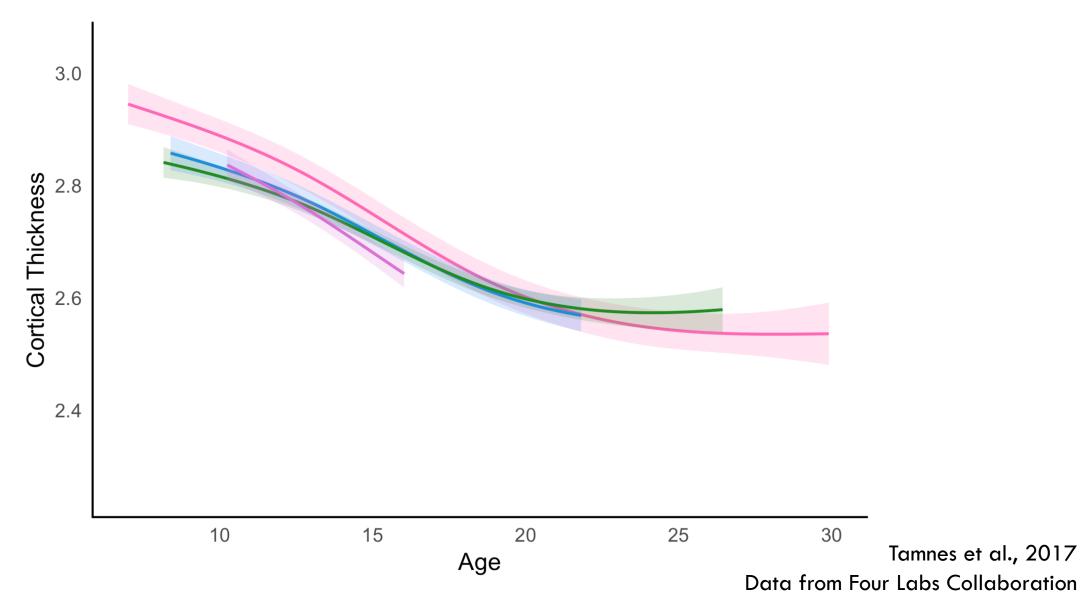


Cortical thinning is the dominant contributor to cortical volume reductions during adolescence

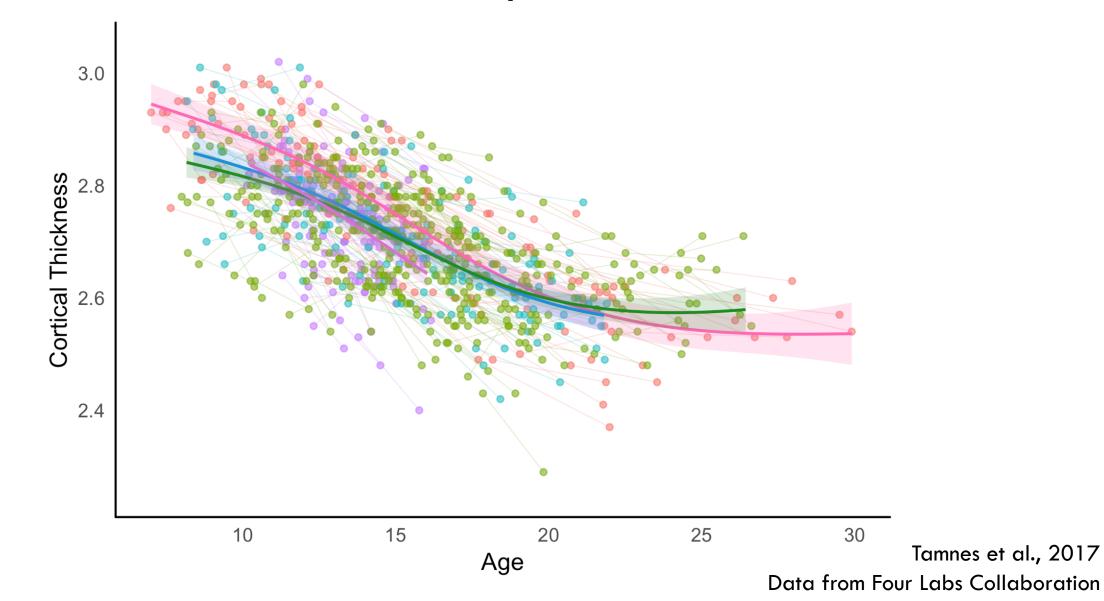


Tamnes et al., 2017

#### Cortical thickness decreases across adolescence



#### Inter-individual variability in cortical thickness



# Drawing inferences about brain development from cross-sectional data

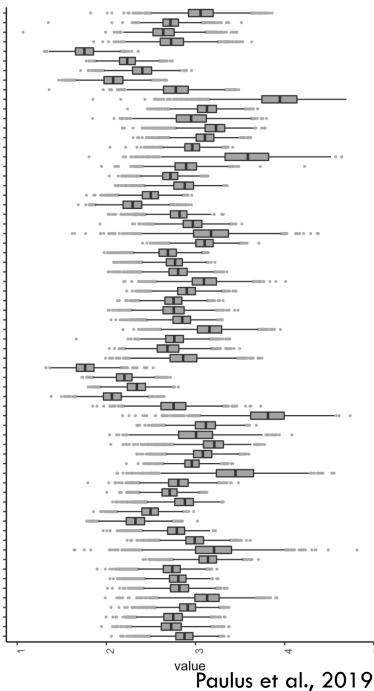


60 Minutes, December 2018

#### Right Rostral anterior cingulate cortex TH Right Posterior cingulate cortex TH Right Isthmus cingulate cortex TH Right Caudal anterior cingulate cortex TH Right Pericalcarine cortex TH Right Lingual gyrus TH Right Lateral occipital cortex TH Right Cuneus cortex TH Right Transverse temporal cortex TH Right Temporal pole TH Right Superior temporal gyrus TH Right Parahippocampal gyrus TH Right Middle temporal gyrus TH Right Inferior temporal gyrus TH Right Fusiform gyrus TH Right Entorhinal cortex TH Right Banks superior temporal sulcus TH Right Precuneus cortex TH Right Supramarginal gyrus TH Right Superior parietal cortex TH Right Postcentral gyrus TH Right Inferior parietal cortex TH Right Lateral orbital frontal cortex TH Right Frontal Pole TH Right Superior frontal gyrus TH Right Rostral middle frontal gyrus TH Right Precentral gyrus TH Right Pars triangularis TH Right Pars orbitalis TH Right Pars opercularis TH Right Paracentral lobule TH variable Right Medial orbital frontal cortex TH Right Caudal middle frontal gyrus TH Left Rostral anterior cingulate cortex TH Left Posterior cingulate cortex TH Left Isthmus cingulate cortex TH Left Caudal anterior cingulate cortex TH Left Pericalcarine cortex TH Left Lingual gyrus TH Left Lateral occipital cortex TH Left Cuneus cortex TH Left Transverse temporal cortex TH Left Temporal pole TH Left Superior temporal gyrus TH Left Parahippocampal gyrus TH Left Middle temporal gyrus TH Left Inferior temporal gyrus TH Left Fusiform gyrus TH Left Entorhinal cortex TH Left Banks superior temporal sulcus TH Left Precuneus cortex TH Left Supramarginal gyrus TH Left Superior parietal cortex TH Left Postcentral gyrus TH Left Inferior parietal cortex TH Left Lateral orbital frontal cortex TH Left Frontal Pole TH Left Superior frontal gyrus TH Left Rostral middle frontal gyrus TH Left Precentral gyrus TH Left Pars triangularis TH Left Pars orbitalis TH Left Pars opercularis TH Left Paracentral lobule TH Left Medial orbital frontal cortex TH

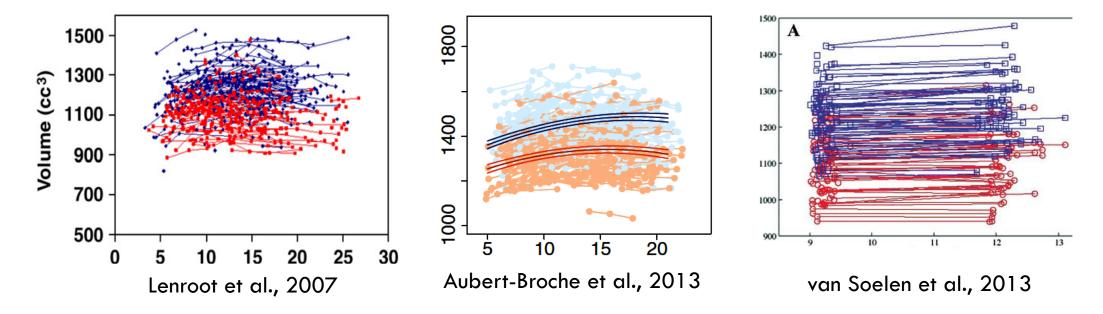
Left Caudal middle frontal gyrus TH

#### **Cortical Thickness**

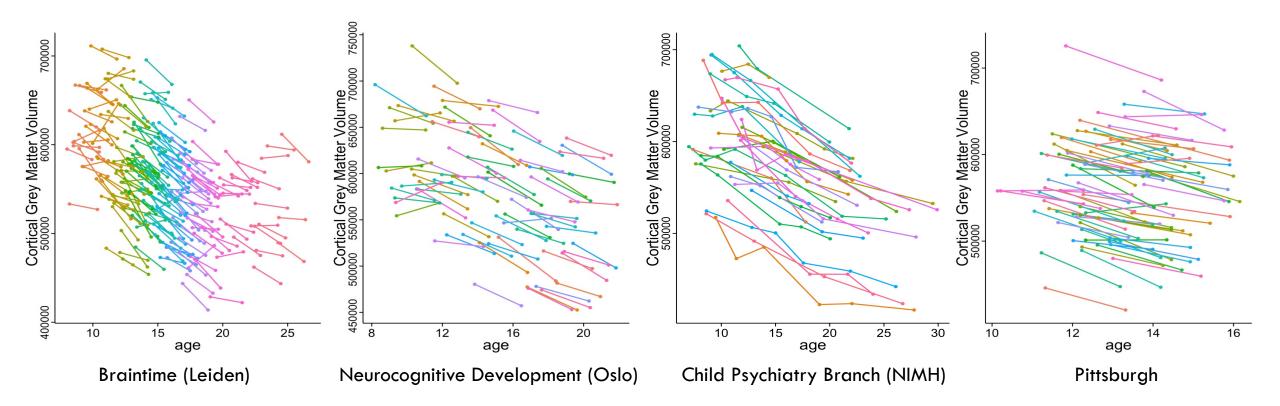


#### Variability between individuals > Variability within individuals

#### **Total Cerebral Volume**

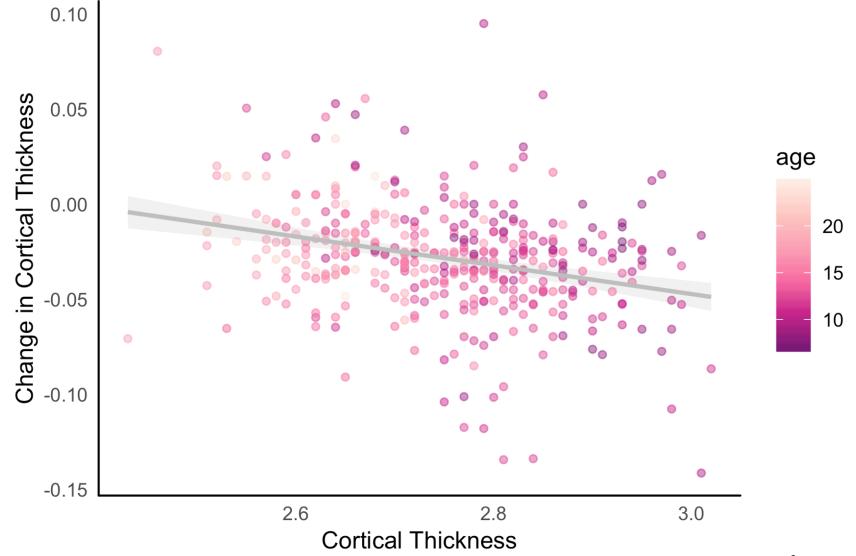


#### Individual Variability in Cortical Grey Matter



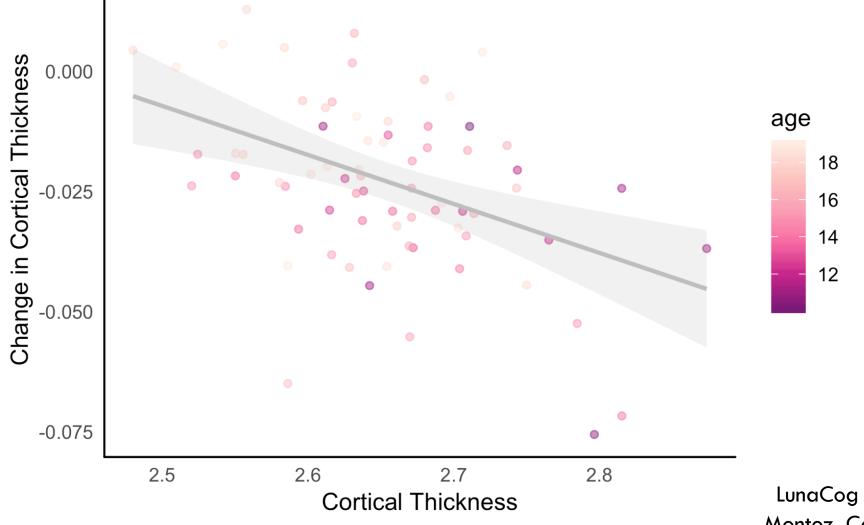
Mills et al., 2016 Data from Four Labs Collaboration

#### Cortical thickness correlates with subsequent change



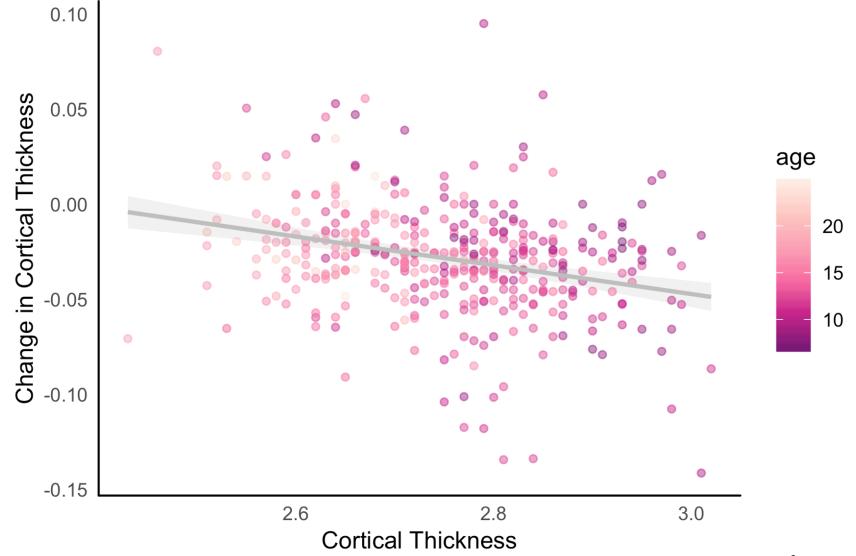
Data from Four Labs Collaboration

## Cortical thickness correlates with subsequent change: Replication with LunaCog data



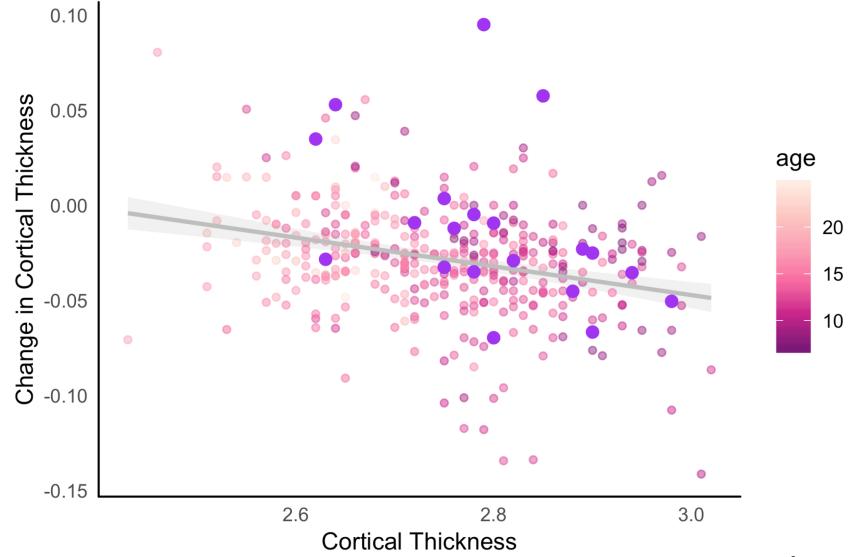
LunaCog data on Data Dryad Montez, Calabro, & Luna 2017

#### Cortical thickness correlates with subsequent change



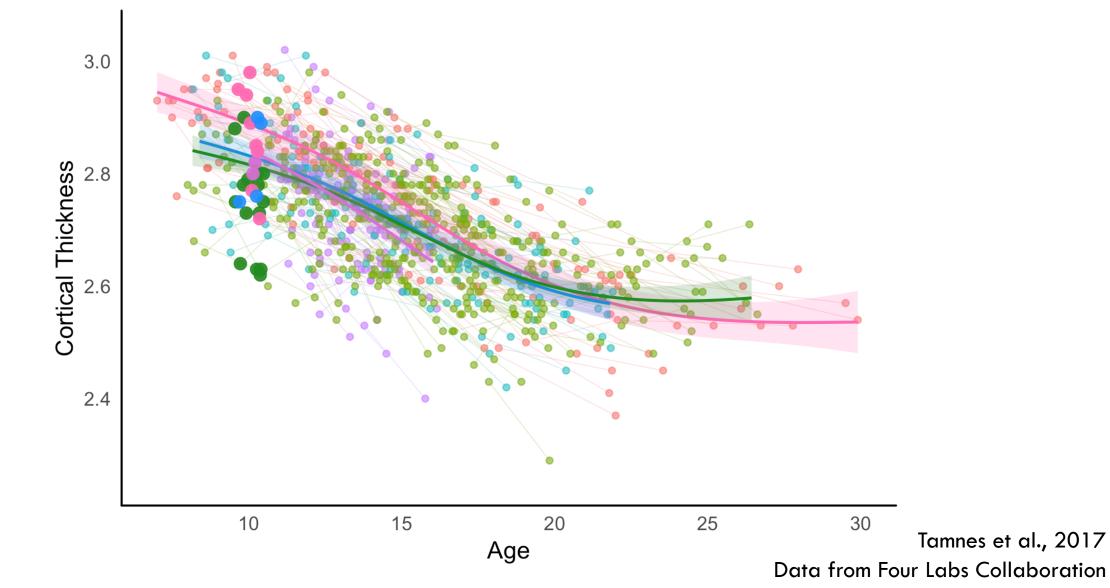
Data from Four Labs Collaboration

#### Cortical thickness correlates with subsequent change

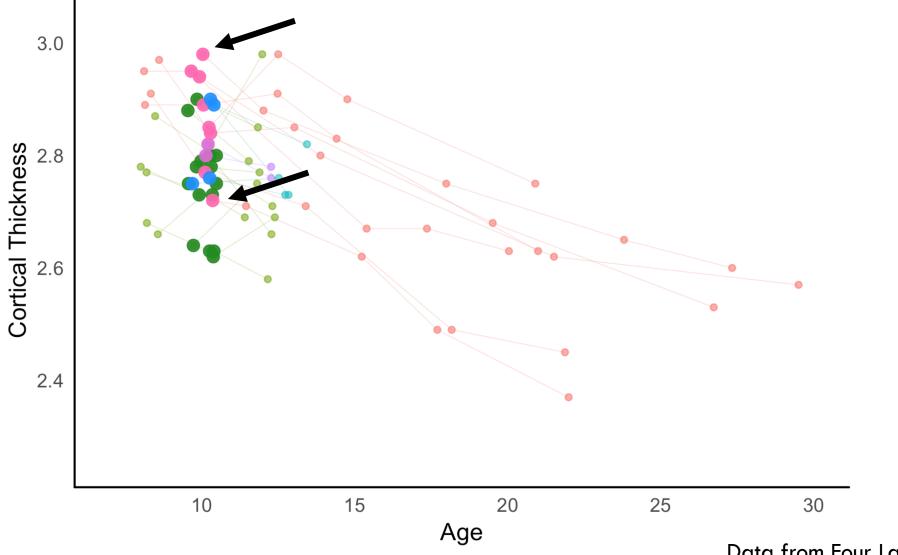


Data from Four Labs Collaboration

#### Inter-individual variability in cortical thickness development

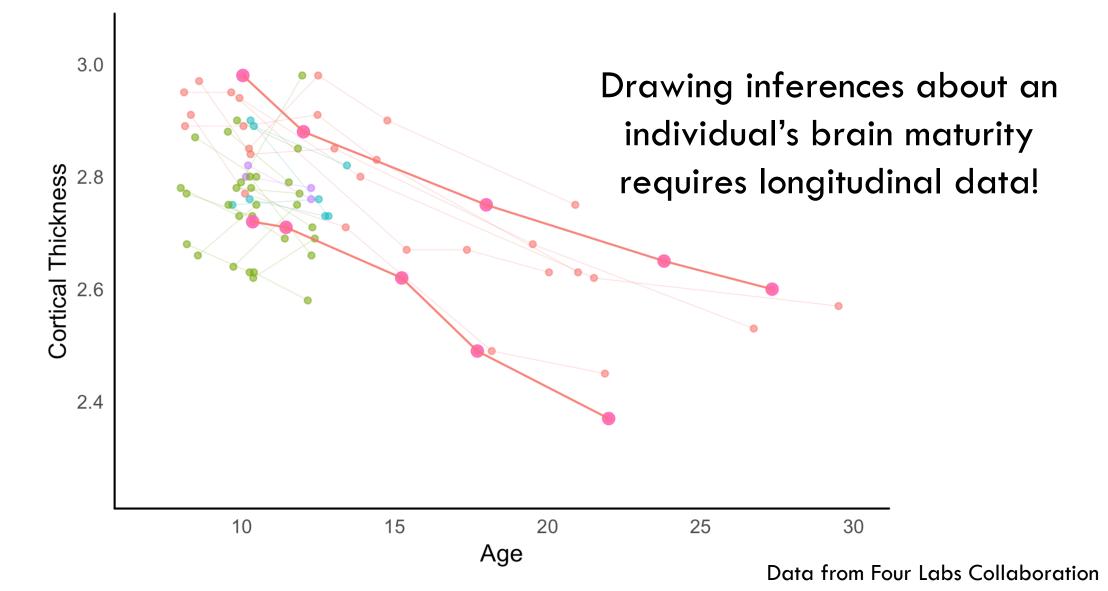


#### Inter-individual variability in cortical thickness development



Data from Four Labs Collaboration

#### Inter-individual variability in cortical thickness development

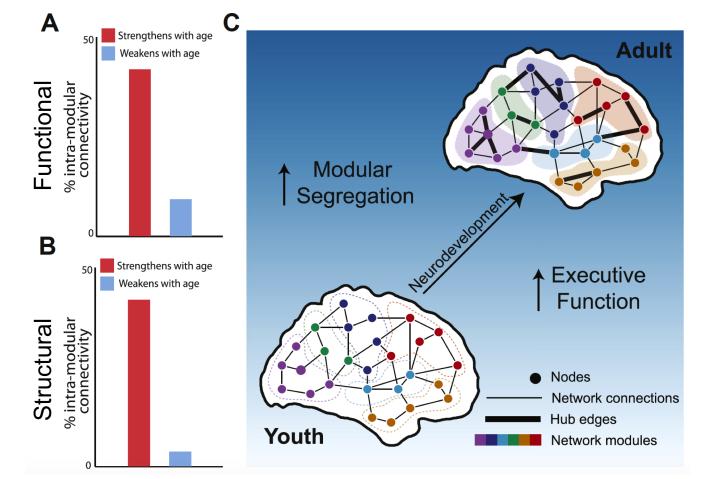


### Longitudinal brain development fMRI

- Inter-individual variability can be greater in fMRI than sMRI
  - Variability in overall size (intercept)
  - Variability in direction and magnitude of change (slope)

### General principles about connectivity

• Modular segregation in structural and functional connectivity



#### Bassett, Xia, and Satterthwaite, 2018

### Keep in Mind

- Maybe longitudinal data are not needed if baseline data provide the relevant information (and change does not)
  - We can only know if we test so please do!

## Thank you!

#### Four labs replicable brain development collaboration



Rosa

Megan Herting

Christian Meuwese Tamnes

Anne-Lise Goddings ★ Eveline Crone 🛛 Berna Güroğlu ★ ★ 🛛 Sarah-Jayne Blakemore 🔶 Armin Raznahan 🔺 \* Ron Dahl Elizabeth Sowell 🛧 **•** 



+ Bea Luna & lab for sharing LunaCog dataset