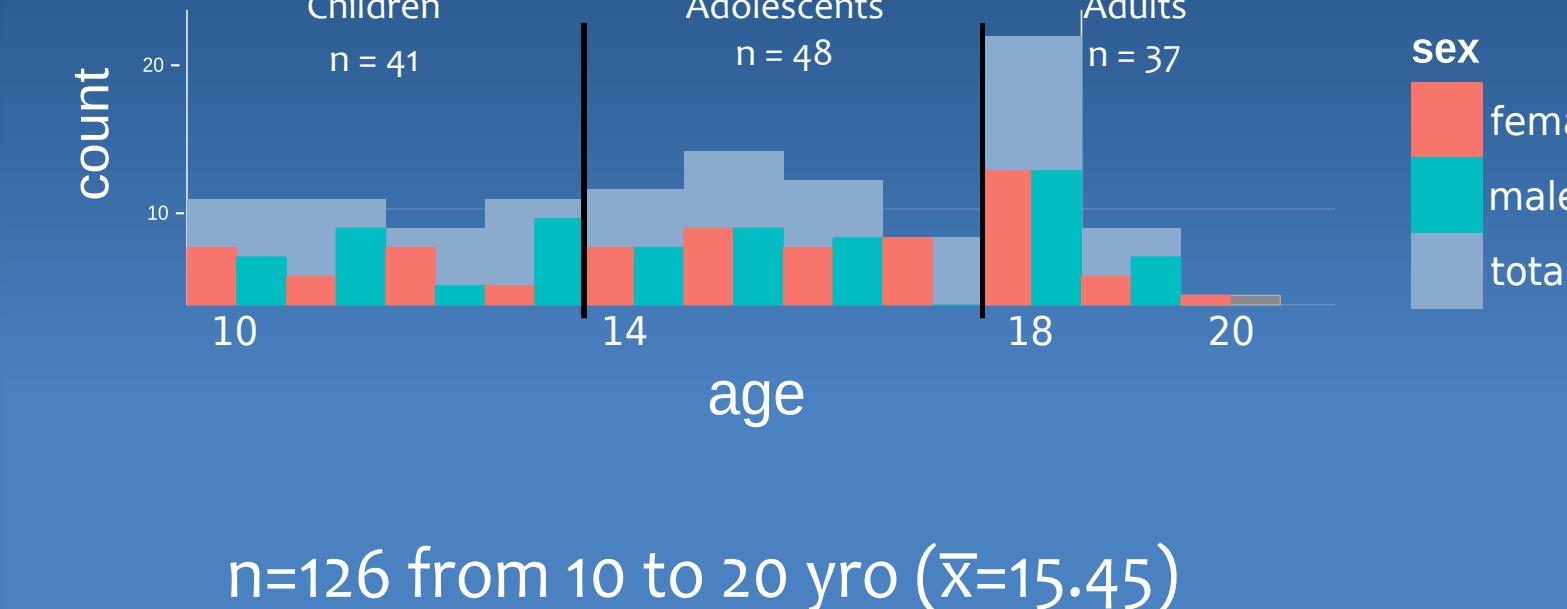


## Intro

- Existing evidence suggests that resting-state fMRI connectivity can be confounded by physiological parameters (Birn et al., 2008; Chang et al., 2009).
- Controlling for physiological noise is particularly important for developmental studies because respiration and heart rate could systematically differ across age groups, potentially reflecting age-related differences in physiological reactivity to the MR environment.
- The goal of the current study is to investigate whether or not correcting for physiological noise could alter developmental changes in resting-state correlations.

## Participants



# The Importance of Applying Physiological Regression to rsfMRI

W. Foran<sup>3</sup> K. Hwang<sup>1</sup> A. Padmanabhan<sup>1</sup> M. Hallquist<sup>1</sup> B. Luna<sup>1,2</sup>

Department of Psychology<sup>1</sup>  
Department of Psychiatry<sup>2</sup>  
University of Pittsburgh and  
University of Pittsburgh Medical Center<sup>3</sup>  
Pittsburgh, PA

## Physiological Recordings

Respiration and heartbeat were continuously recorded using a respiration belt and a pulse oximeter attached to the left index finger.

### Regressors

- 5 RVT regressors, time shifted versions of one another (Birn et al., 2008)
- 8 Retroicor, 2 sine and 2 cosine for each card and resp (Glover et al., 2000)



## Regions of Interest

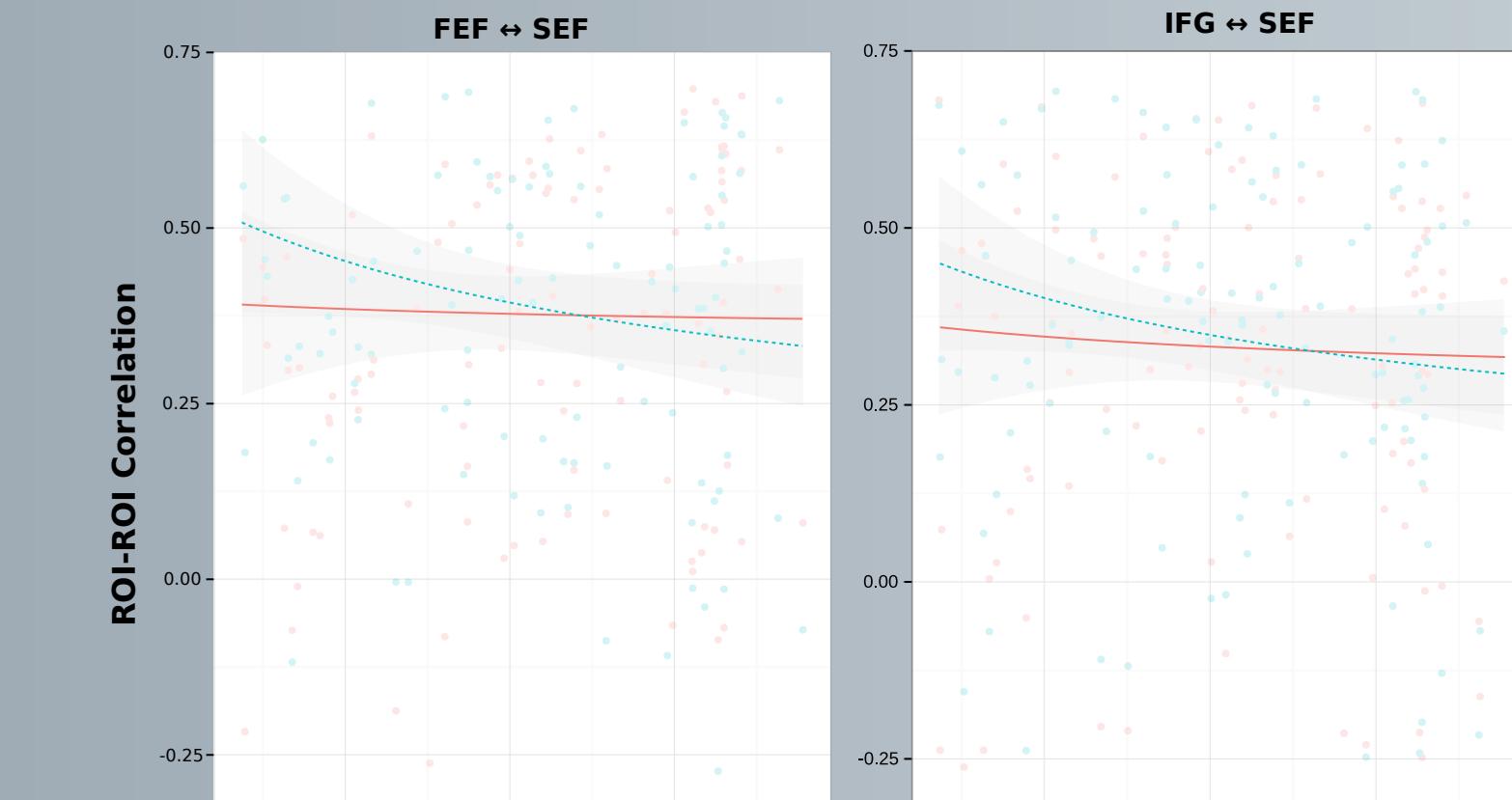
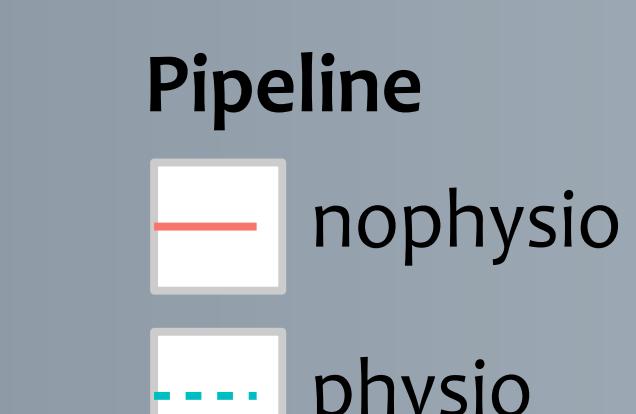
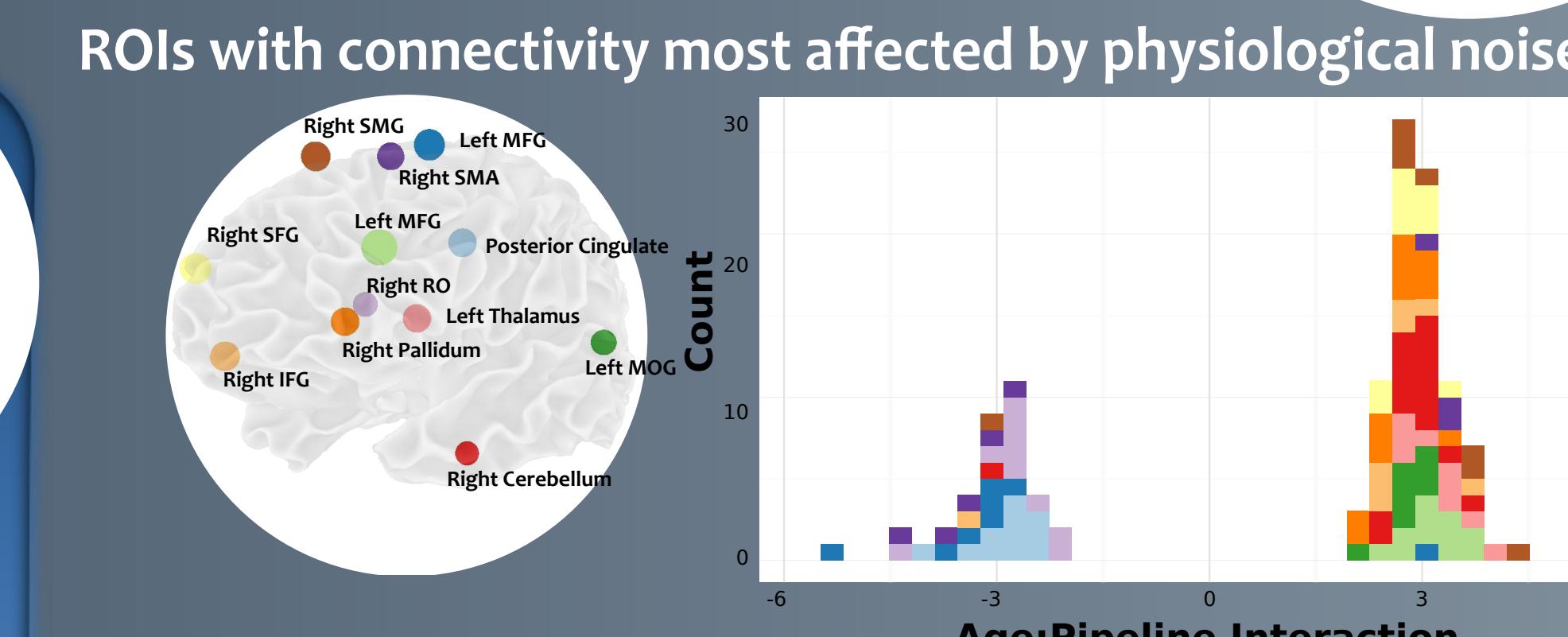
### ROIs for full brain coverage

5mm radius around 244 coordinates  
adapted from Power et al. (2011)



### A priori ROIs

Subset of ROIs preselected with expectation of correlation changes along developmental



## References

- Birn RM, Smith MA, Jones TB, Bandettini PA (2008) The respiration response function: the temporal dynamics of fMRI signal fluctuations related to changes in respiration. NeuroImage 40:644-654.  
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RW Cox. (1996) AFNI: Software for analysis and visualization of functional magnetic resonance neuroimages. Computers and Biomedical Research, 29: 162-173.  
Glover GH, Li TQ, Ress D (2000) Image-based method for retrospective correction of physiological motion effects in fMRI: RETROICOR. Magn Reson Med 44:162-167.  
Jenkinson, M., Bannister, P., Brady, J. M. and Smith, S. M., (2002) Improved Optimization for the Robust and Accurate Linear Registration and Motion Correction of Brain Images. NeuroImage, 17(2), 825-841.  
H. Jo, ZS. Saad, WK. Simmons, LA. Milbury, RW. Cox (2010), Mapping sources of correlation in resting state fMRI, with artifact detection and removal, NeuroImage, Vol 52 (2), 571-582.  
Power, J. D., Cohen, A. L., Nelson, S. M., Wig, G. S., Barnes, K. A., Church, J. A., ... & Petersen, S. E. (2011). Functional network organization of the human brain. Neuron, 72(4), 665-678.

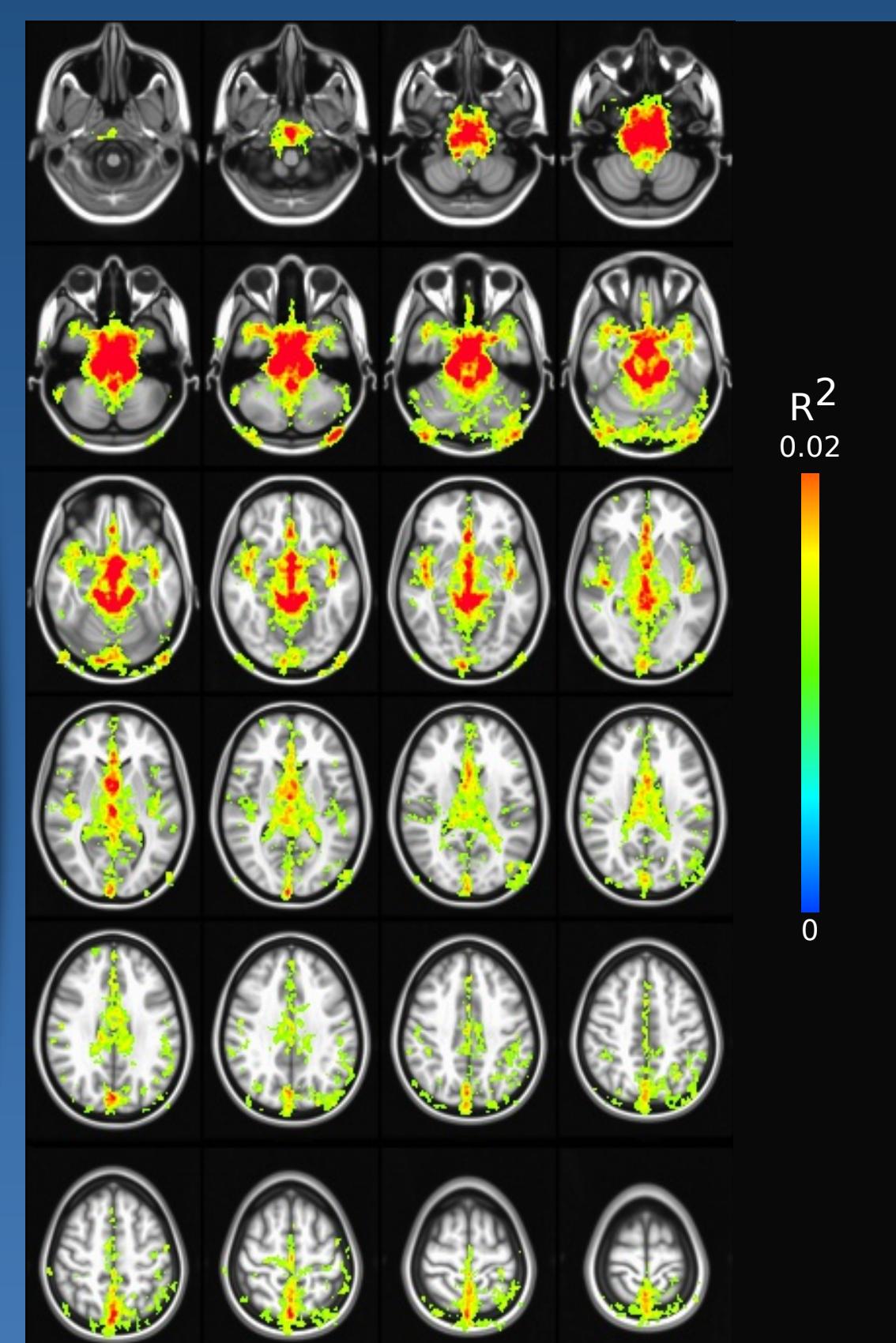
## Support

NIMH MH080243

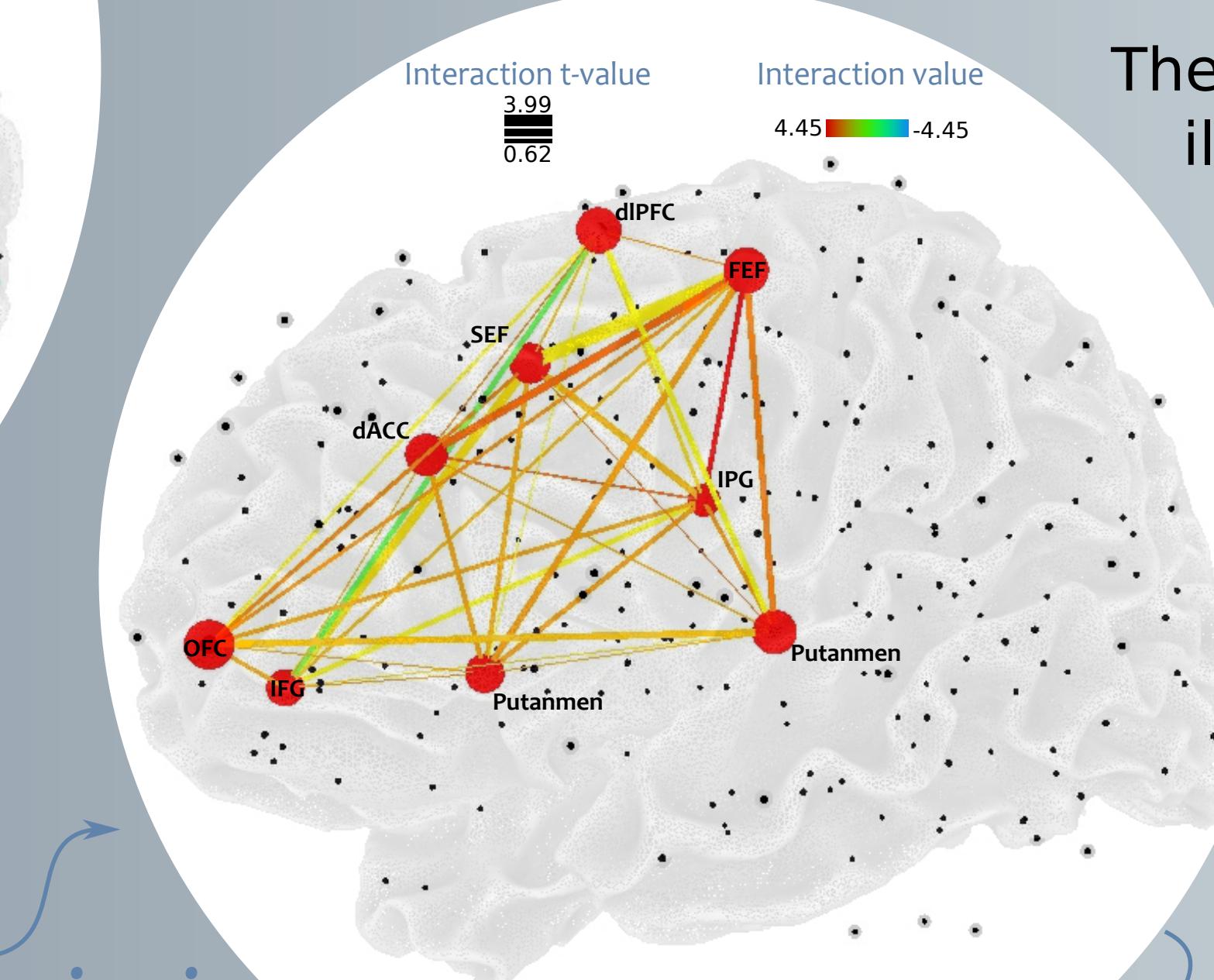
## Results and Conclusions

- Physiological noise is most prominent in subcortical, cerebellar, and midline structures, explaining up to 2% of signal variance
- However, including physiological regressors into the regression model significantly alters developmental conclusions of age-related changes in rsfMRI connectivity
- Cerebellar-cortical, subcortical-cortical connections are most affected. Including connections with important ROIs such as the cerebellum, the putamen, the thalamus, midline structures, and multiple frontal regions.
- Including physiological regressors could reduce false age-related decrease in functional connectivity, or increase sensitivity in finding age effects.

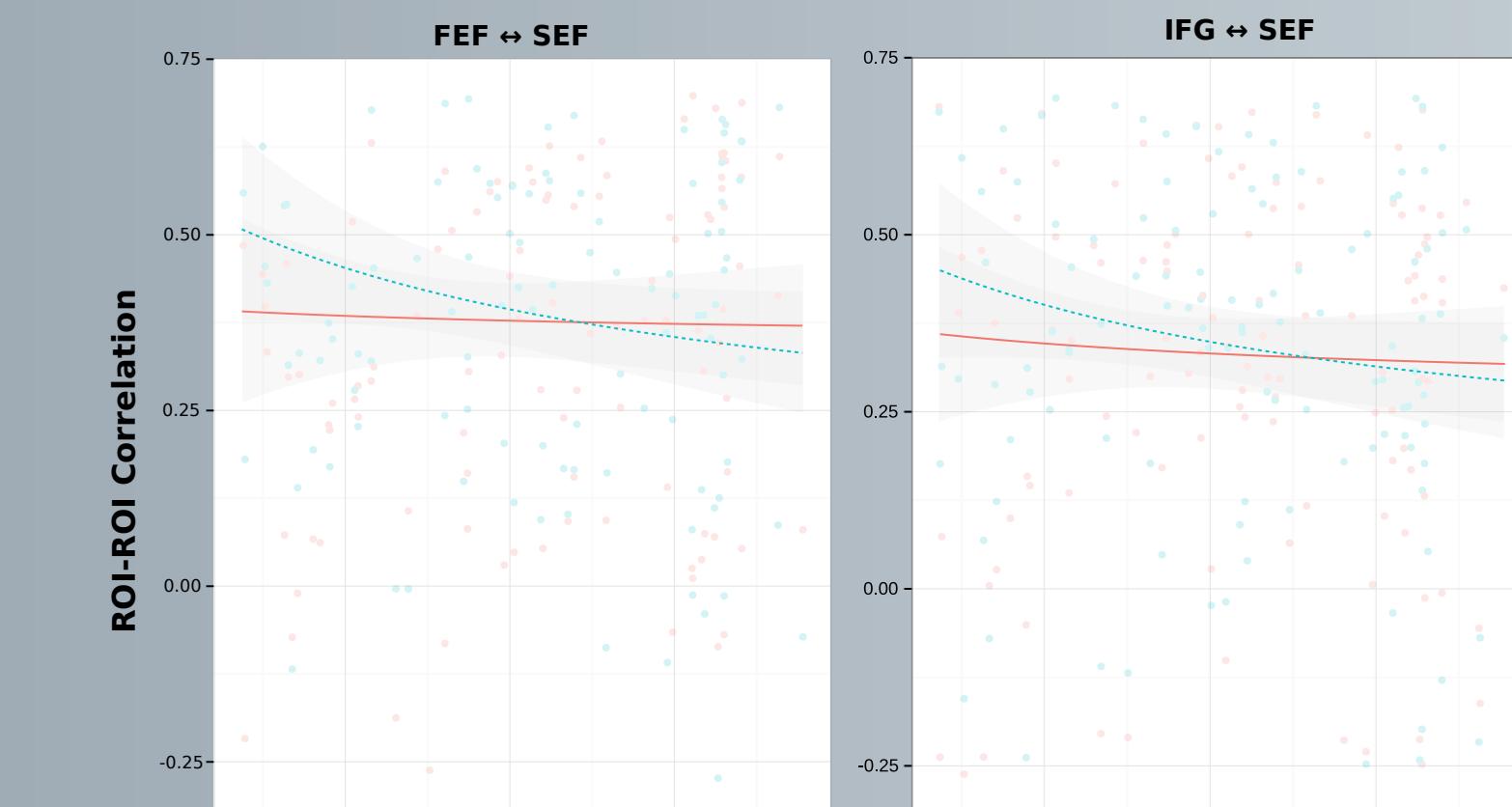
## Physiological noise is most prominent in brain stem, subcortical, cerebellar, and midline structures



The a priori ROI graph illustrates the effect of accounting for respiration and cardiac measures has on modeling connectivity over development



## Developmental changes in connectivity found after correcting for physiological noise



2% of the variance in rsfMRI signal is explained by physiological parameters. There is no developmental change in the signal explained by physiological parameters across age groups

## Future Directions

- Test the effectiveness of using physiological signal estimation software (PESTICA) in absence of real physiological signal recordings
- Test if physiological noise removal alters graph theory metrics

## Source Code

<https://github.com/WillForan/physioCompare>

