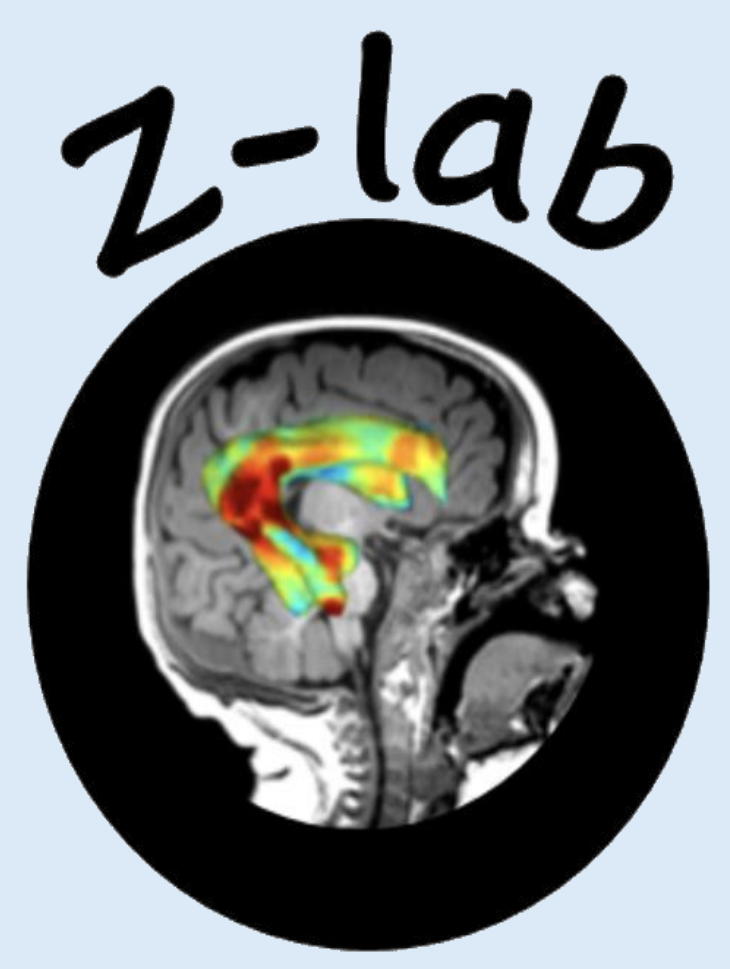




Unraveling Developmental Variability in Functional Selectivity and Spatial Localization of High-Level Visual Regions of the Ventral Temporal Cortex

Anna L. Quatrala*, Kelly J. Hiersche, Zeynep M. Saygin, PhD

Department of Psychology, The Ohio State University



Introduction

- Some of the most robustly identified and studied regions of the brain include high-level visual areas within the ventral temporal cortex (VTC)

Word-Selective Visual
Word form Area (VWFA)
Face-Selective Fusiform
Face Area (FFA)
Object-Selective Posterior
Fusiform Sulcus (PFS)



- These regions vary in precise location, cortical thickness, and specialization across individuals^{1,2}, especially in experience-dependent regions like the VWFA, which develops after literacy is acquired³.

Research Question

Does variability in functional organization of the VTC converge or diverge over development?

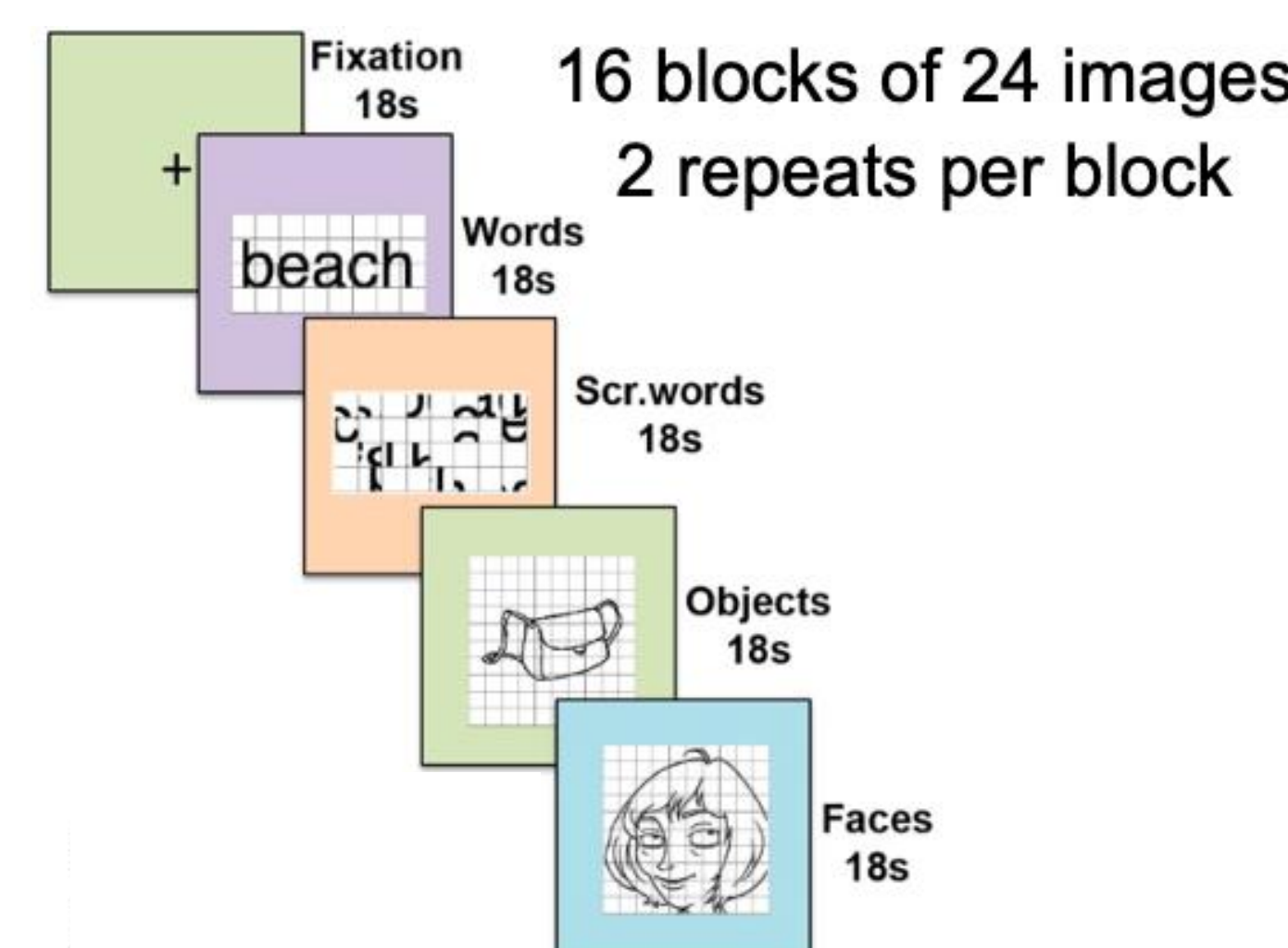
Methods

Participants:

- Kids: N=72 (N=24 each group: Age 3-6, 6-9, 9-12 yrs)
- Adult reference: N=17
- All groups motion matched

fMRI Visual Localizer Task⁴:

- Each participant completed 2 runs
- Images presented from four high-level visual categories to localize the VWFA, FFA, and PFS.
- fROIs defined & selectivity extracted from independent runs.



$$\text{Selectivity} = \frac{PSC_{\text{Preferred}} - \text{mean}(PSC_{\text{Non-Preferred}})}{\Sigma PSC_{\text{All}}}$$

$$\text{Center of Mass} = \frac{\sum_{\text{slice}=1}^{\text{total slices}} \text{mass}_{\text{slice}} * \text{distance}_{\text{slice}}}{\text{Mass of all slices}}$$

$$CV = \frac{STD_{\text{kid-adults}}}{\text{Mean Distance}_{\text{kid-adults}}}$$

fROI: Most significantly responding 150 voxels, calculate selectivity w/ independent run

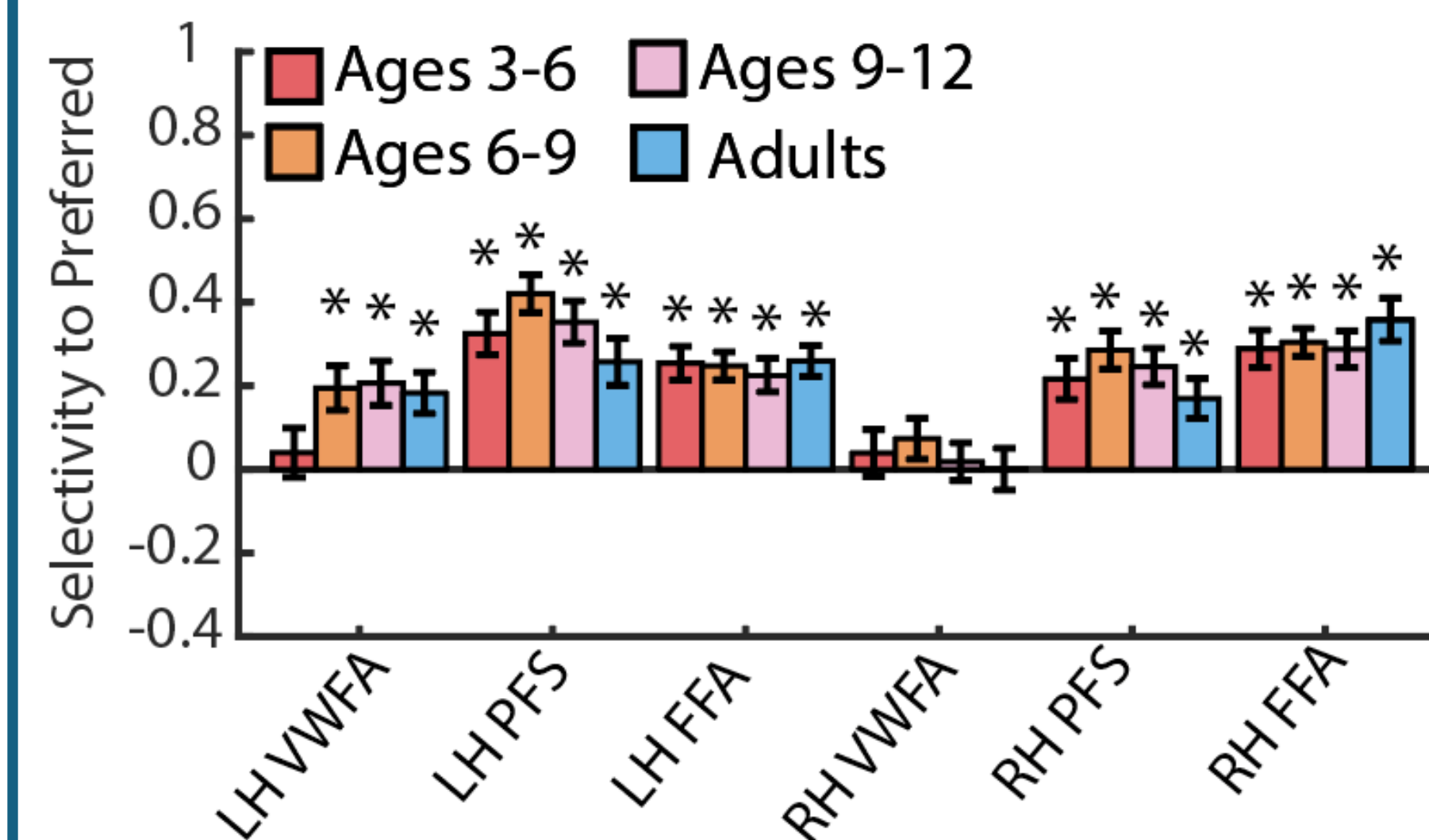
Center of Mass (CoM): Measure of the location each fROI

Coefficient of Variation (CV): Does each child's selectivity or CoM value vary compared to reference adult group?

Statistics:

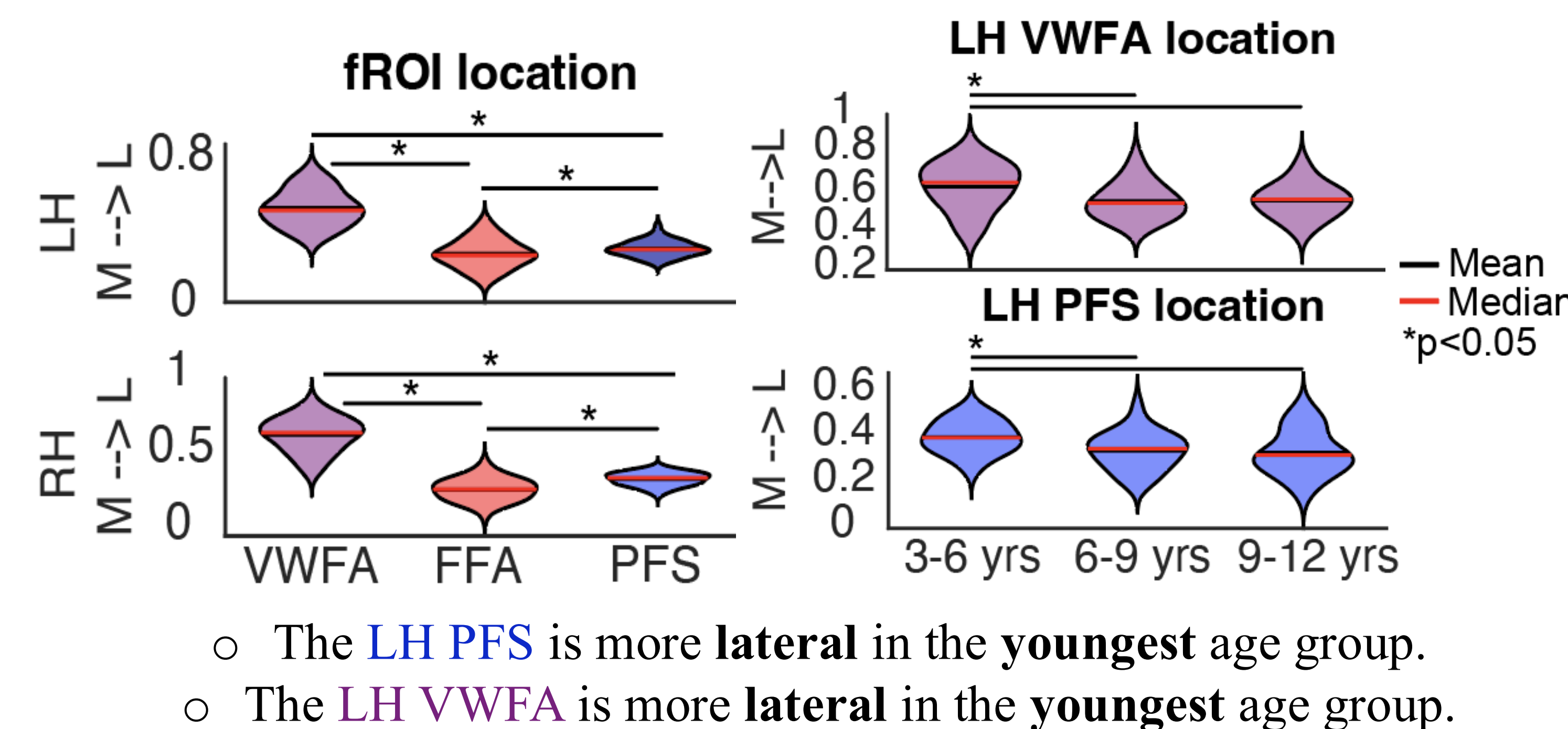
- ANOVAs: examine fROI and age effects in selectivity, CoM, & CV
- Post-hoc t-tests and correlations to parse interactions

fROIs are selective

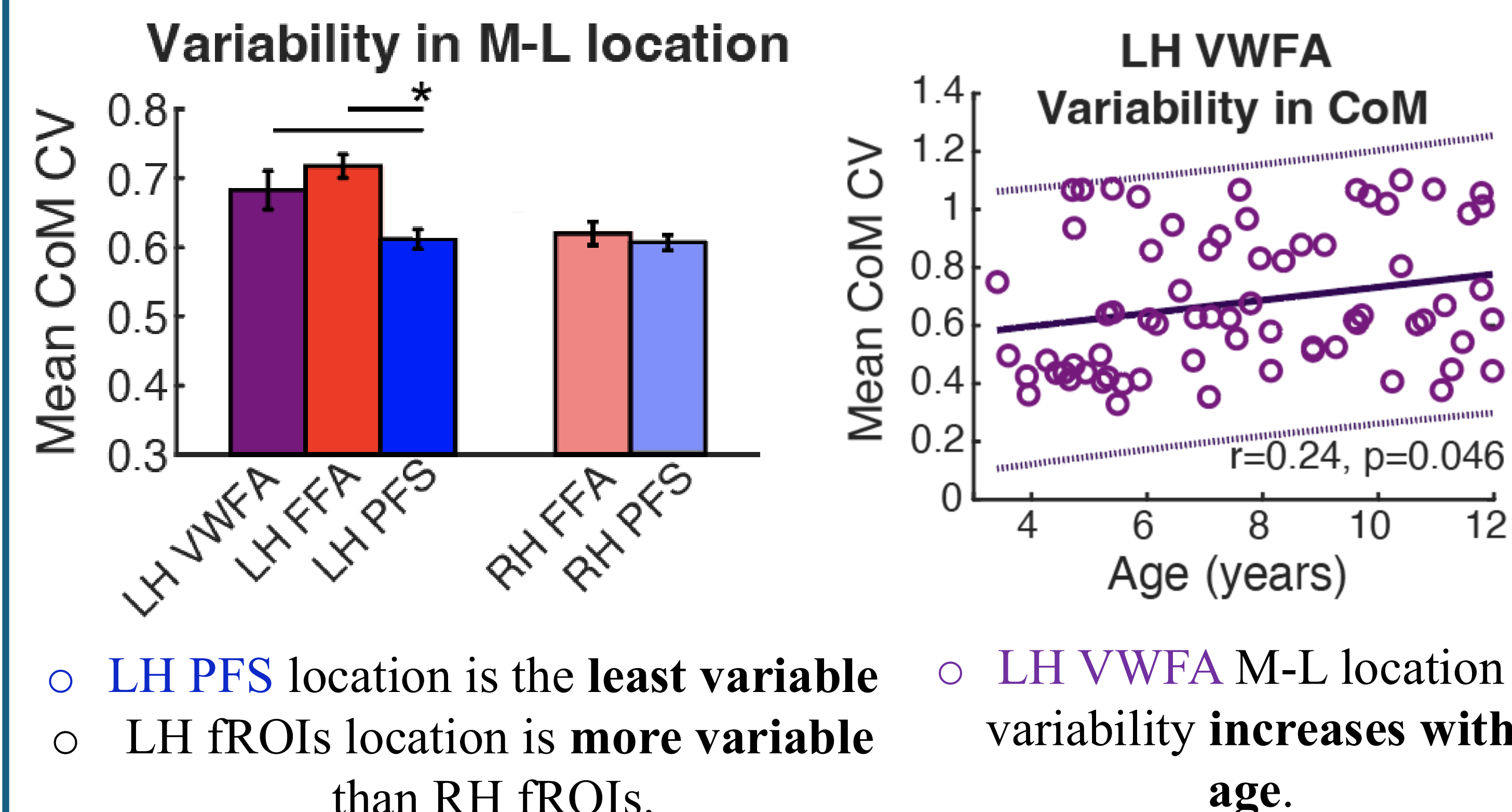


- All fROIs show expected selectivity (RH VWFA not selective, expected).
- The LH VWFA in the youngest group is not selective (expected, primarily pre-readers).

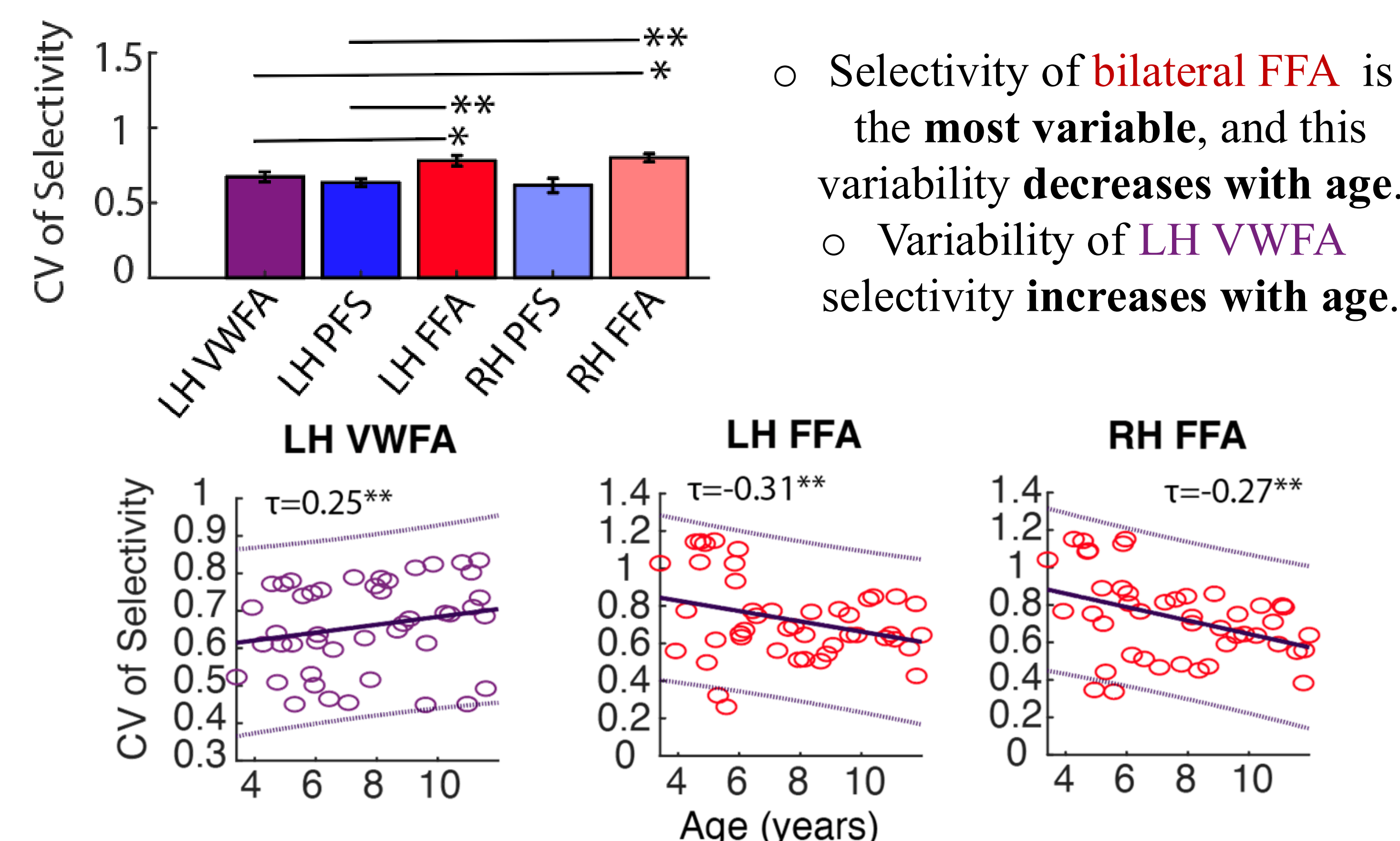
Does fROI location change with age?



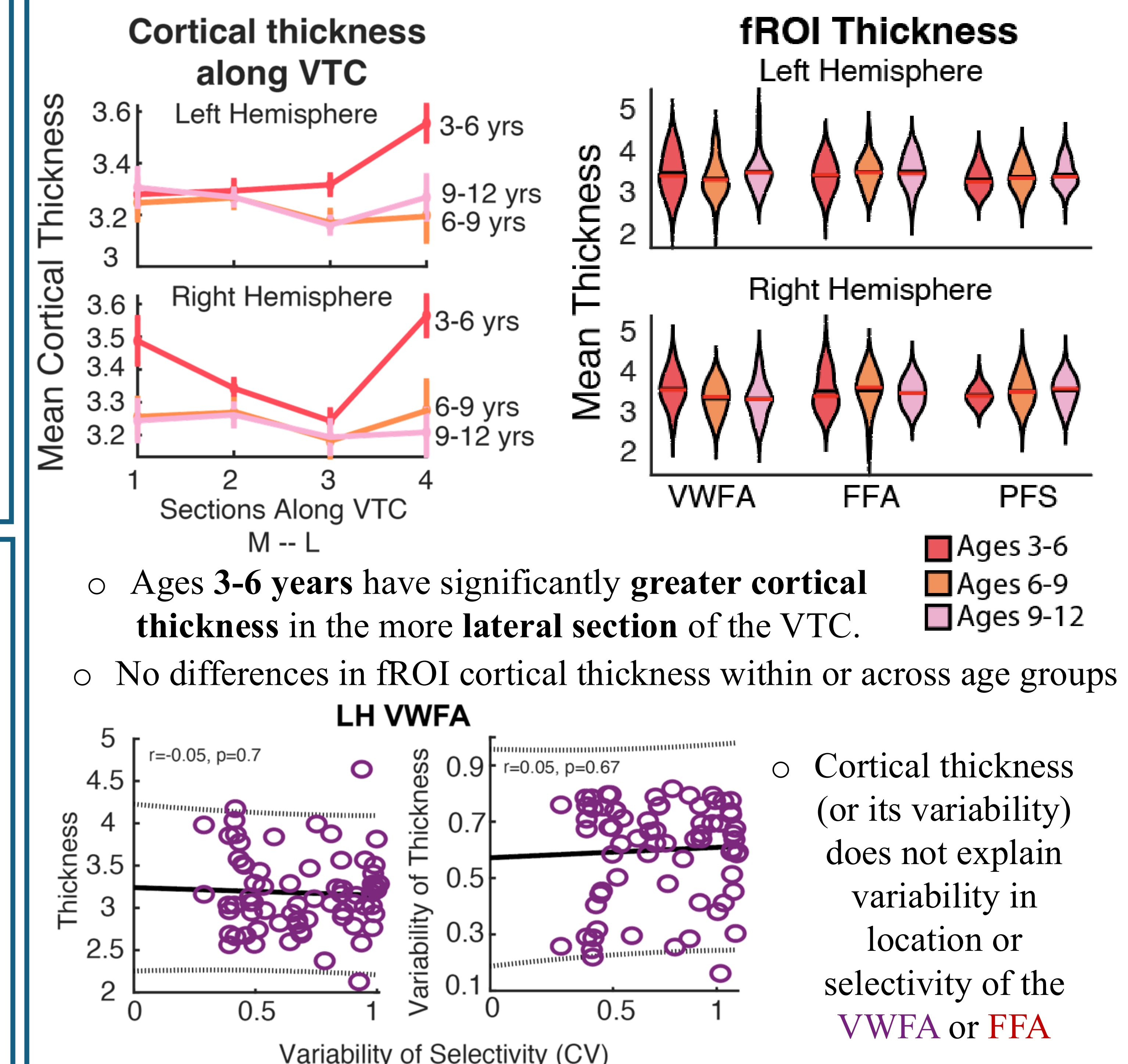
Does fROI variability of location change with age?



Does variability of functional responses differ across fROIs and age?



Does cortical thickness explain variability?



Conclusions

- Does fROI location vary with age?
 - Yes! The LH VWFA is the most lateral fROI, and there is a **medial shift** over the course of development
 - The LH PFS also shows a **medial shift** over development.
- Does fROI variability of location change with age?
 - Yes! LH VWFA variability of location **increases with age**.
- Does variability of function responds differ across age?
 - Face specialization **converges** towards adults over development
 - Word specialization **diverges** over development, becoming increasingly variable in location and selectivity.
- Does cortical thickness explain this variability?
 - The youngest children show **greater cortical thickness** in the **most lateral sections** of the VTC, perhaps explaining the medial shift of the VWFA and PFS
 - Cortical thickness** likely is important for large-scale organization and continued development but **does not account for variability** in responses (or fROI location) of words or faces.

References: 1. Grill-Spector, 2014, *Nat Review Neuro* 2. Li, 2024, *bioRxiv* 3. Dehaene-Lambertz, G, 2018, *PLoS biology* 4. Saygin et al., 2016, *Nature Neuroscience*

Contact: saygin.3@osu.edu