Impact of interrupted schooling on functional connectivity for reading in resettled Syrian refugee children in Canada

Hassan Abdulrasul[1], Angela Capani[1], Henry Brice[1], Kaja K. Jasińska[1,2]

[1]University of Toronto, [2]Haskins Laboratories

UNIVERSITY OF TORONTO

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Ensuring Full Literacy
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INTRODUCTION

Proficient reading is supported by a largely left hemisphere network, including temporo-parietal (e.g. STG) and frontal (e.g, IFG) language regions.[1,2]

Interactive Specialization theory posits that the development of cognitive neural networks–including the reading network–is dynamically shaped through interactions between experience and the developmental trajectory of the brain[3]. The key experience for forming the brain's reading network is formal reading instruction[4].

Reading instruction typically coincides with the start of school, making it hard to disentangle the effects of experience and brain maturation on the reading network's development [4,2].

Refugee children's schooling is interrupted by displacement and migration, providing a means to explore how the timing of exposure to reading instruction affects the development of functional connectivity in the reading network. Notably, despite years after re-enrollment in formal education following displacement, refugee children continue to face reading challenges[5].

RQ: How does the age at which refugee children re-enroll in school affect the functional connectivity of the reading network?

METHODS (N = 36; Ages 8-18)

Functional Near Infrared Spectroscopy (fNIRS):
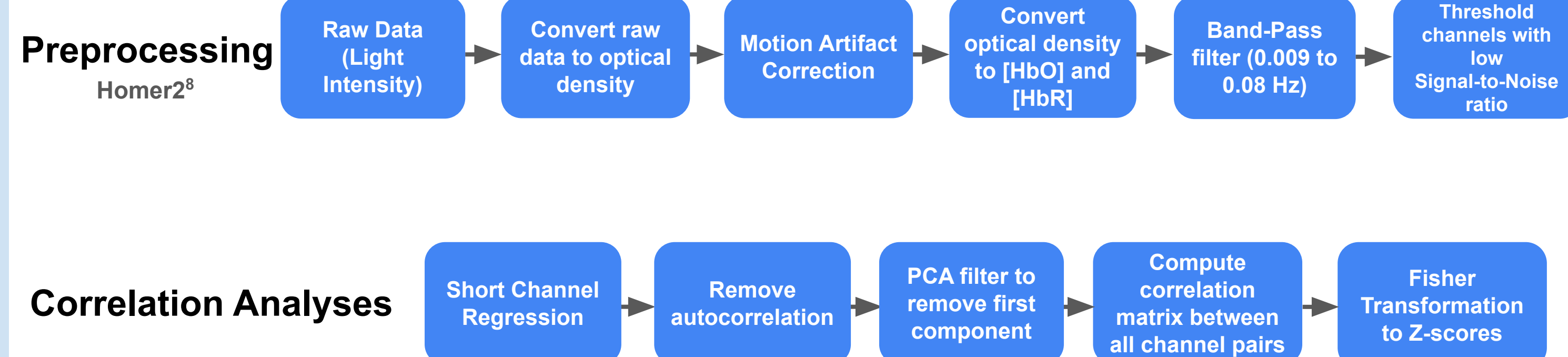6 min Resting State Scan collected from 47 channels
Background Questionnaire:
Migration, education, language history[6]
Reading Assessments
Word & Pseudoword Reading, Reading Comprehension[7]

fNIRS PROCESSING PIPELINE

Preprocessing
Homer2[8]

Raw Data (Light Intensity) → Convert raw data to optical density → Motion Artifact Correction → Convert optical density to [HbO] and [HbR] → Band-Pass filter (0.009 to 0.08 Hz) → Threshold channels with low Signal-to-Noise ratio

Correlation Analyses

Short Channel Regression → Remove autocorrelation → PCA filter to remove first component → Compute correlation matrix between all channel pairs → Fisher Transformation to Z-scores

Reading Scores Marginally Associated with Increased Functional Connectivity in the Reading Network

L-IFG
L-STG
R-STG
Reading Composite: β: 0.007 †
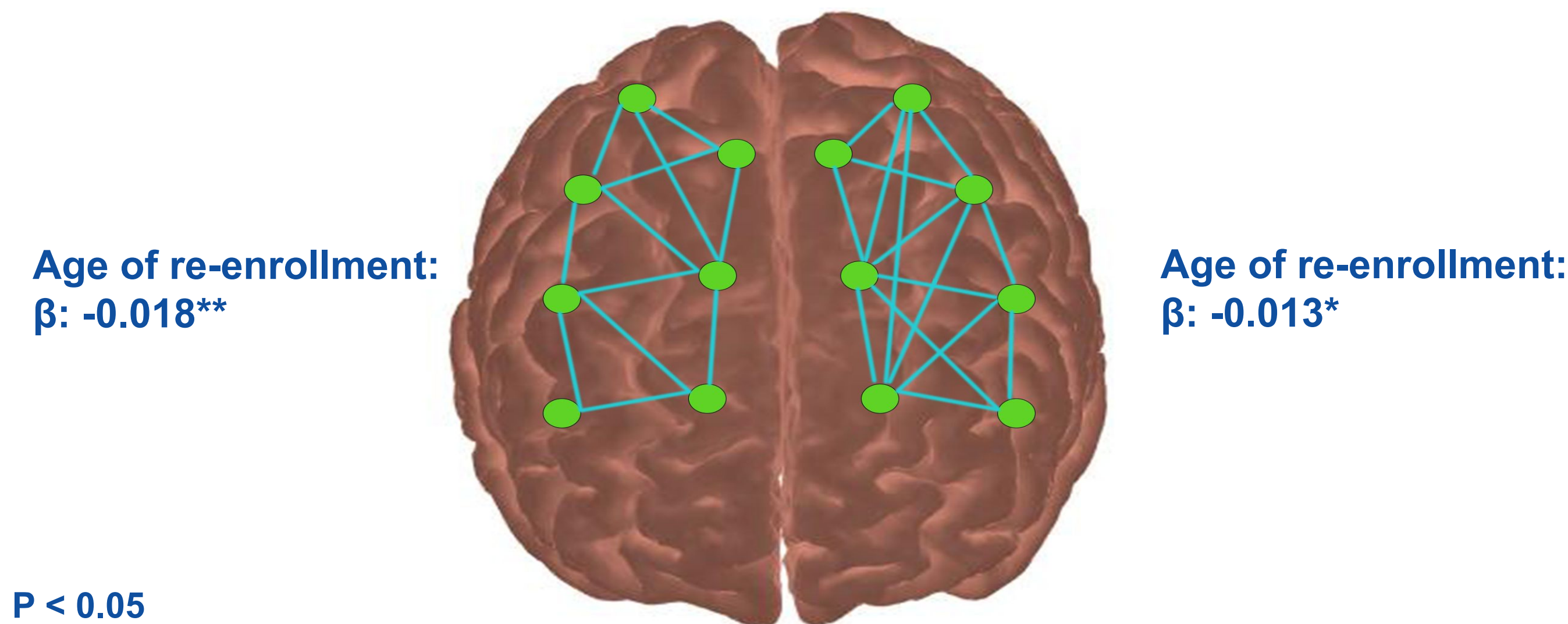Age of re-enrollment: β: -0.04 †
P < 0.1
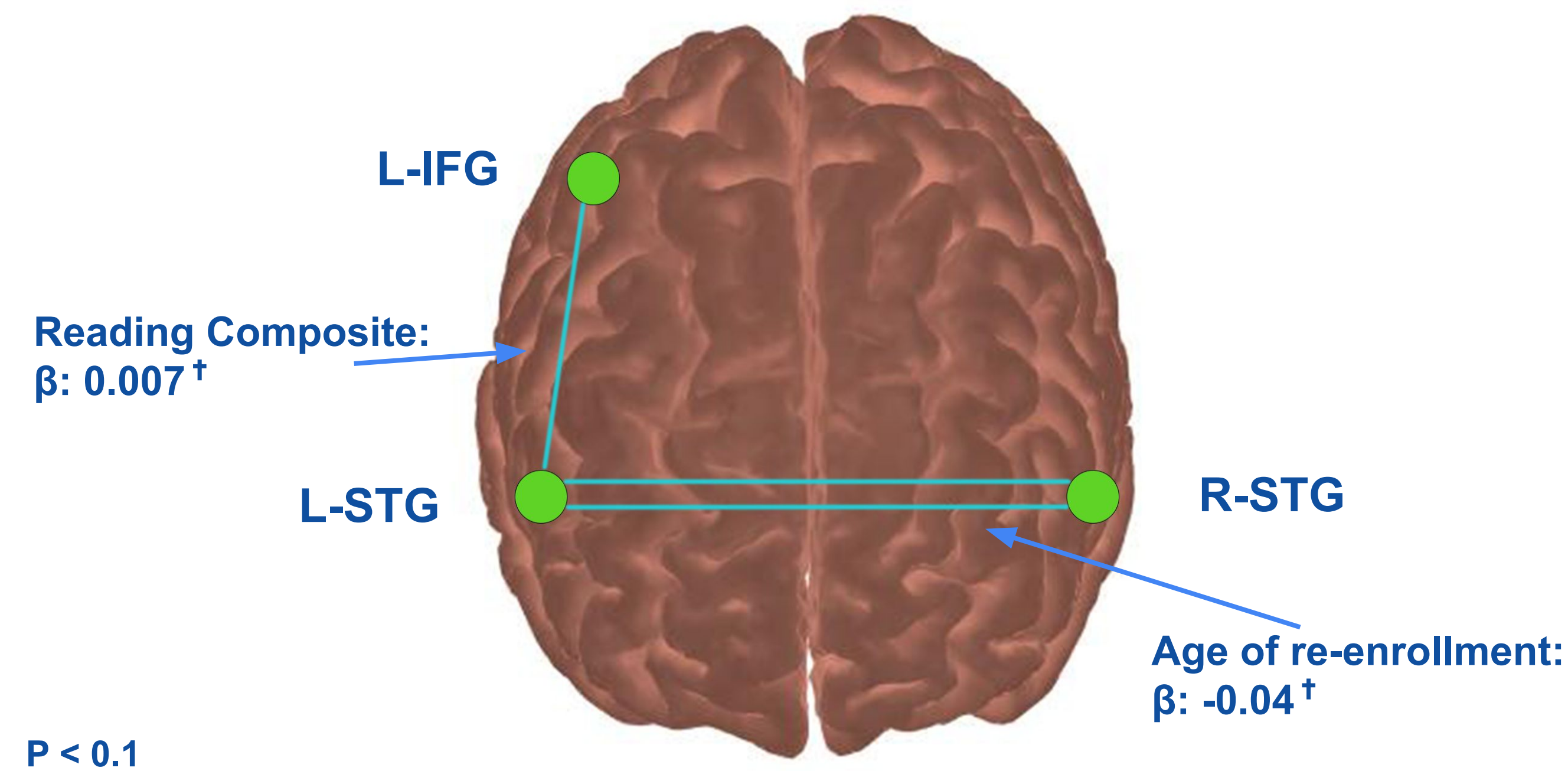
Re-enrollment Age Associated with Decreased Connectivity in Refugee Children

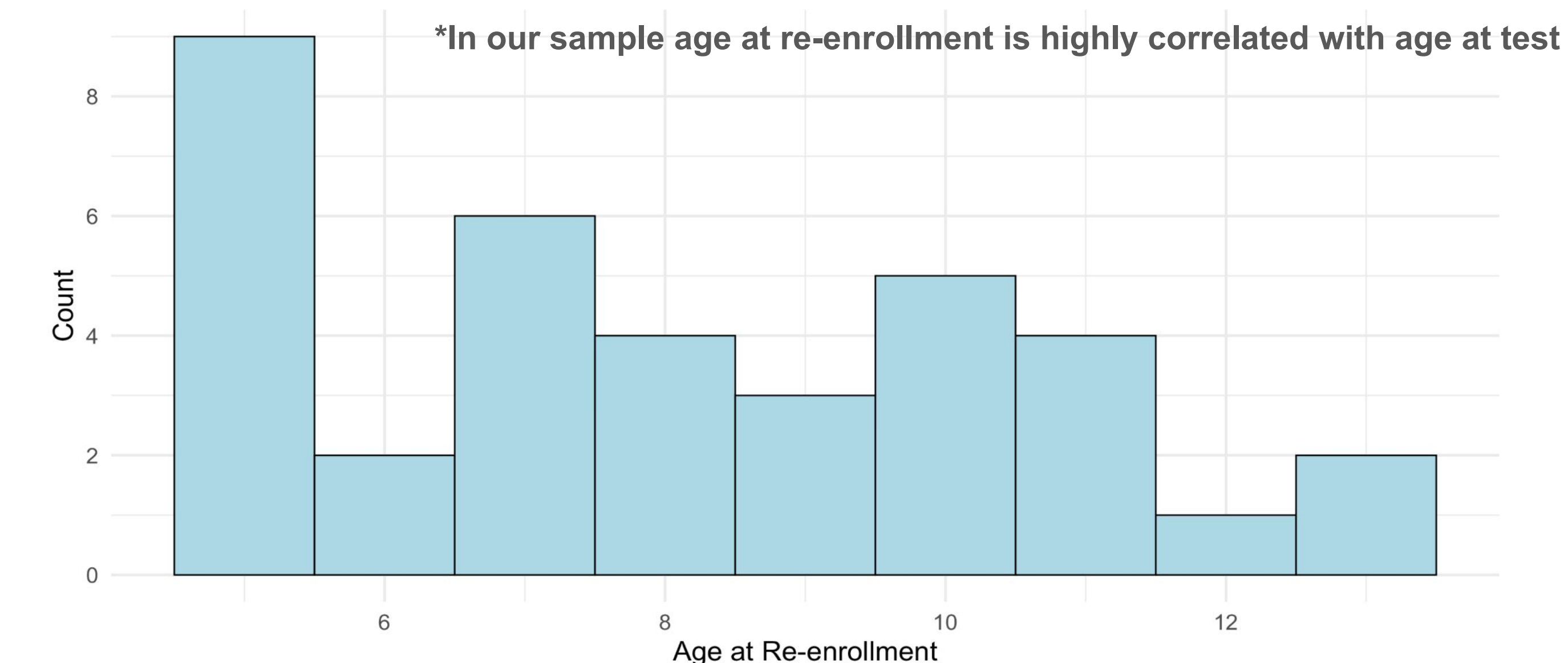|	L-STG:L-IFG	L-STG:R-STG	Right hemisphere	Left hemisphere
Age at Re-enrollment	<-0.001	-0.04 *	-0.013*	-0.018**
Reading Composite	0.007 †	0.002	<0.001	0.001
Sex	-0.072	-0.054	-0.016	0.005
SES	-0.007	-0.008	-0.004	-0.001

β values (all SEs <0.01), ** p<.01, * p<0.05, † p<0.1, controlling for length of displacement

Age at Re-enrollment Negatively Associated with Intra-hemispheric Connectivity

Age of re-enrollment: β: -0.018**
Age of re-enrollment: β: -0.013*
P < 0.05

Distribution of Age at Re-enrollment

*In our sample age at re-enrollment is highly correlated with age at test

Count — Age at Re-enrollment

Implications and Future Directions

Refugee children who faced educational disruptions and re-enrolled in school at an older age presented broad reduced inter- and intra-hemispheric functional connectivity. This may explain the impact of educational disruption on the development of neural networks for cognitive functions.
However, the correlation with age at test is an important caveat

Reduced functional connectivity in the left reading network is not associated directly with educational disruption, but is marginally associated with lower reading proficiency. Potential evidence for the importance of timely experience on learning.

To better understand these connectivity changes, our next steps will be to increase our sample size to increase heterogeneity, and employ graph theoretical methods to assess network efficiency.

Refugee children exhibited highly variable performance on age-standardized reading measures and consistently scored below the standard mean.

Standard mean
Count — Reading Composite Score
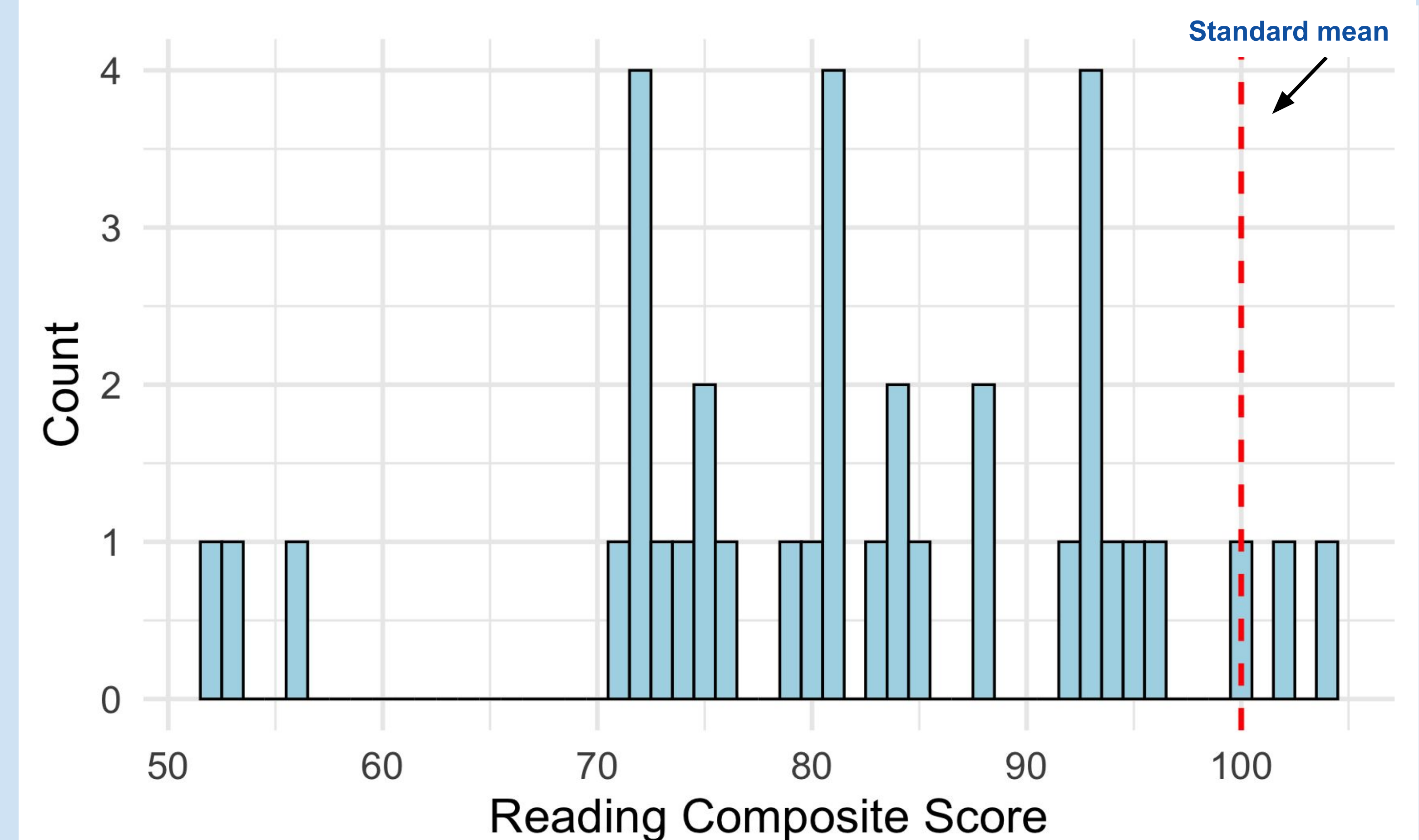
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