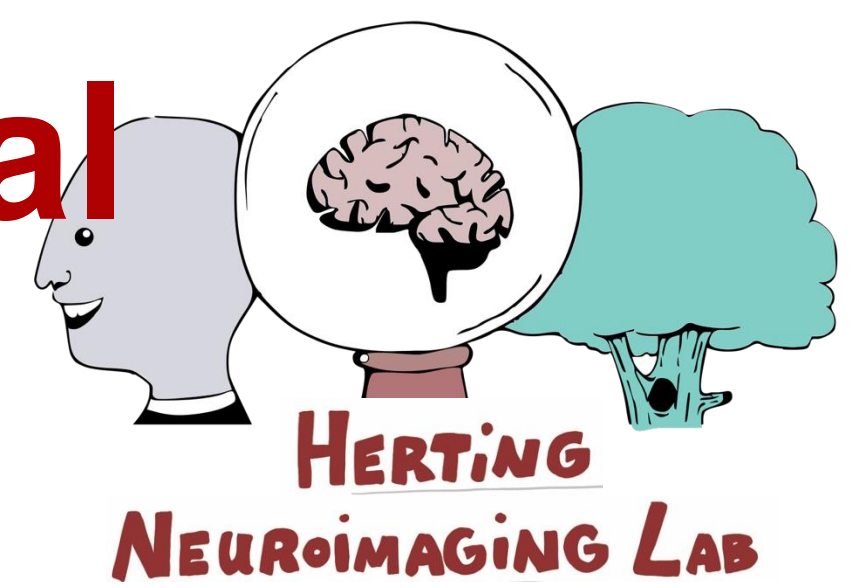




USC University of
Southern California

Ambient air pollution does not modify early life adversity effects on hippocampal structure in preadolescents



Michael A. Rosario^{1,2}, Amanda C. Del Giacco¹, Alan Wen¹, Kirthana Sukumaran¹, Carlos Cardenas-Iniguez¹, Jacob Pine³, Deanna Barch³, Hedyeh Ahmadi¹, Megan M. Herting¹

¹Department of Population and Public Health Sciences, USC, ²Leonard Davis School of Gerontology, USC, & ³Department of Psychological and Brain Sciences, Washington University in St. Louis

Background

The hippocampus is a brain region important for learning, memory, and spatial representations [1] with functionally and structurally distinct subregions [2]

Exposure to fine ambient particulate matter (<2.5 diameter of 2.5 micrometers; PM_{2.5}) and its chemical components is associated with poorer episodic memory ability and hippocampal architecture in late childhood [3]

Early life adversity (ELA) is additionally associated with reduced hippocampal volume in late childhood and early adolescence [4]

A current gap is whether air pollution exposure modifies ELA's link to hippocampal structure and function.

Methods

Table 1. Sample Demographics			Hippocampus (n=6822)	Cognition (n=7939)	Adolescent Brain Cognitive Development (ABCD) Study Data from ABCD's 6.1 Release
Age, months	mean (SD)		119.50 (7.43)	119.32 (7.44)	
Sex	Female		3238 (47.5%)	3735 (47.0%)	
Race/ Ethnicity	AAP (non-Hispanic)		149 (2.2%)	179 (2.3%)	
	Black (non-Hispanic)		853 (12.5%)	1126 (14.2%)	
	Hispanic		1204 (17.6%)	1462 (18.4%)	
	Multiracial (Black)		336 (4.9%)	417 (5.3%)	
	Multiracial (Non-Black)		392 (5.7%)	468 (5.9%)	
	Other (non-Hispanic)		56 (0.8%)	67 (0.8%)	
	White (non-Hispanic)		3832 (56.2%)	4220 (53.2%)	
Household income	<50k		1684 (24.7%)	2061 (26.0%)	
	50-100k		1862 (27.3%)	2101 (26.5%)	
	>100k		2758 (40.4%)	3147 (39.6%)	
	Decline to answer		265 (3.9%)	317 (4.0%)	
	Don't know		253 (3.7%)	313 (3.9%)	

FreeSurfer 7.0 Segmentation of Hippocampal Subregions (ABCD 5.1)

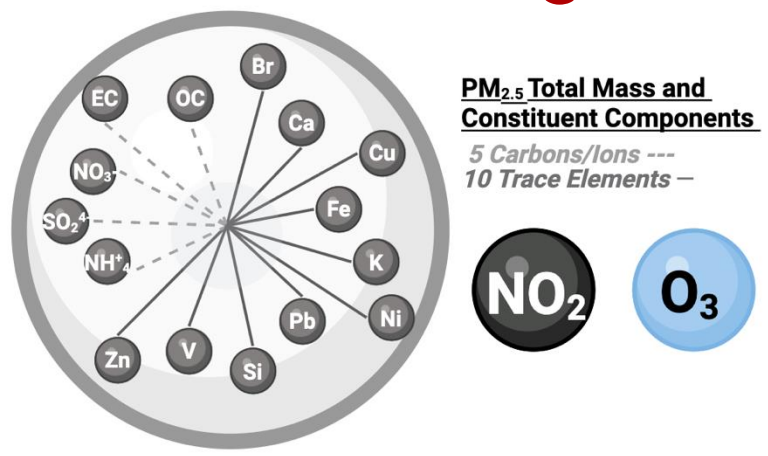
Rey Auditory Verbal Learning Test (RAVLT)
Higher scores = more words recalled [5]

NIH Toolbox Picture Sequence Memory Test (PSMT)
Higher scores = higher correct sequence of recalled events [5]

Little Man Task (LMT) Efficiency
Higher scores = more accurate and correct across trials [5]

Linear Mixed Effect (LME) Models and Weighted Quantile Sum (WQS) analyses
Adjusting for demographic, imaging, and environmental covariates

Annual Average Ambient Air Pollution

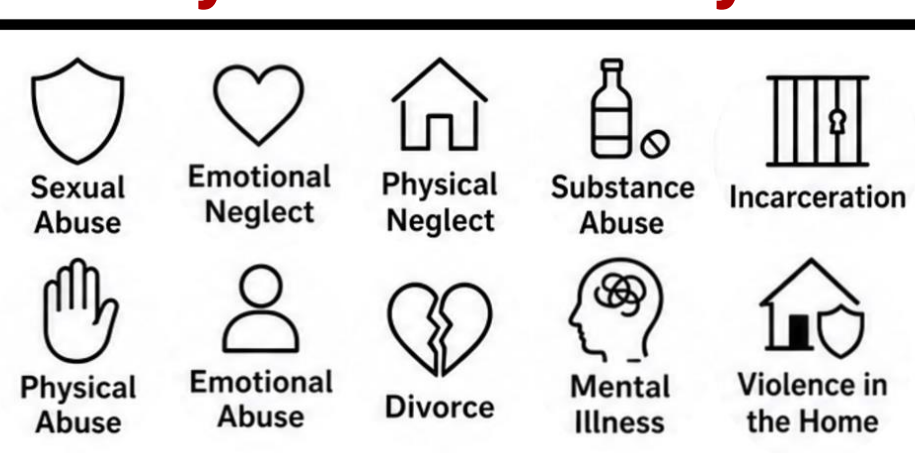


Air Pollution Exposure: Hybrid spatiotemporal models estimated ambient PM_{2.5} levels for the 2016 calendar year across the U.S. at a 1-km² resolution and PM_{2.5} components (ng/m³) at a resolution of 50m² [6, 7]

- Linked to primary residential addresses

PM_{2.5}, ug/m³ mean (SD): 7.67 (1.55)

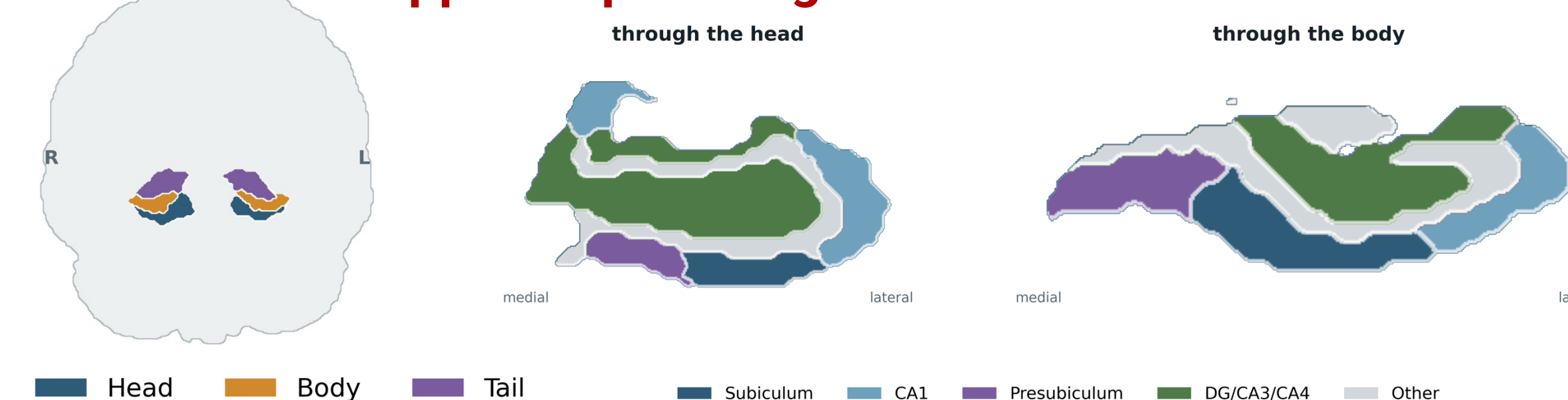
Early Life Adversity



Early life adversity (ELA): created as a proxy of Adverse Childhood Experiences [8]
Higher Scores = More adversity

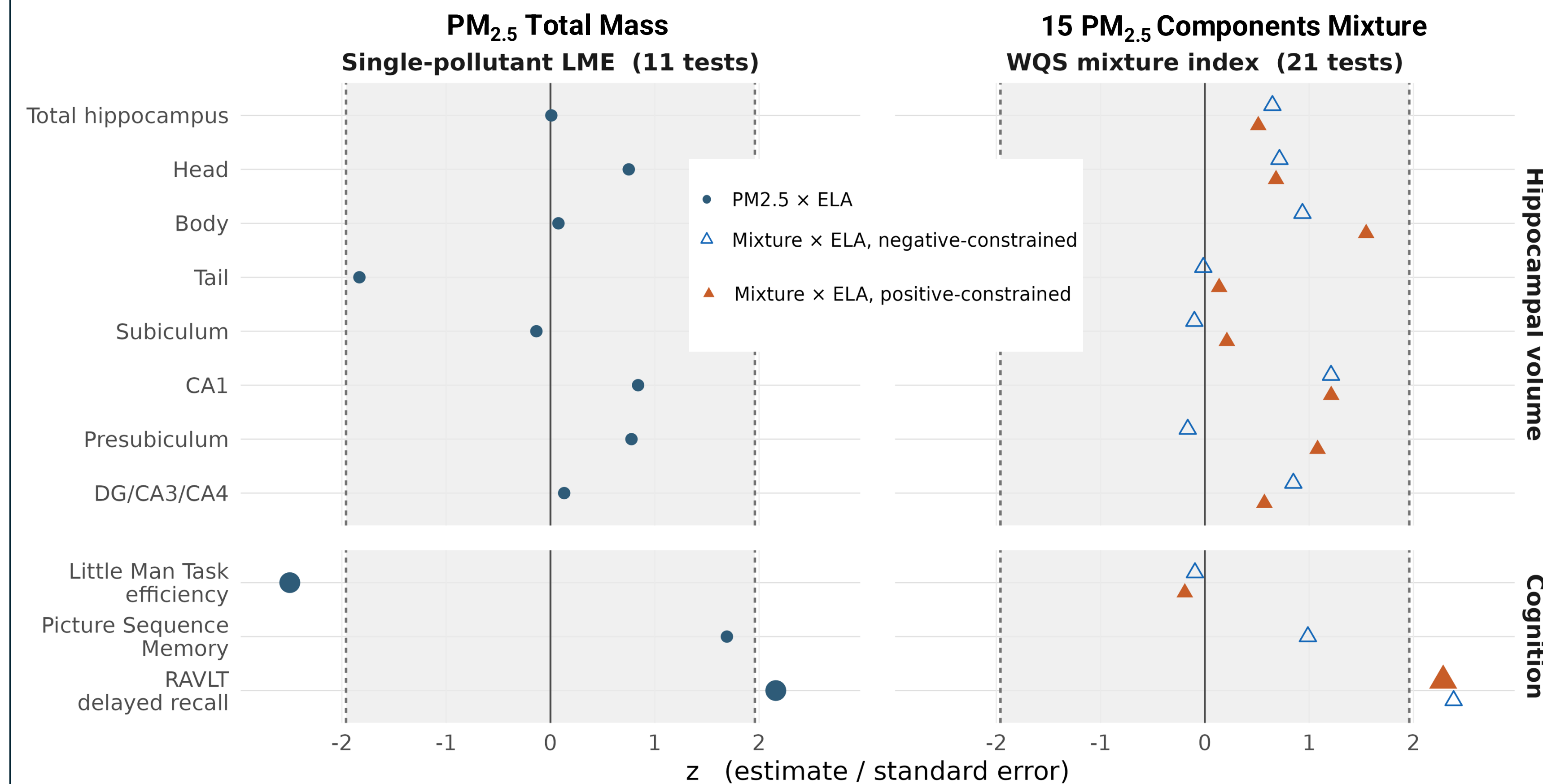
ELA mean (SD): 1.44 (1.46) | 1.46 (1.48)

Hippocampus Longitudinal Axis and Subfields

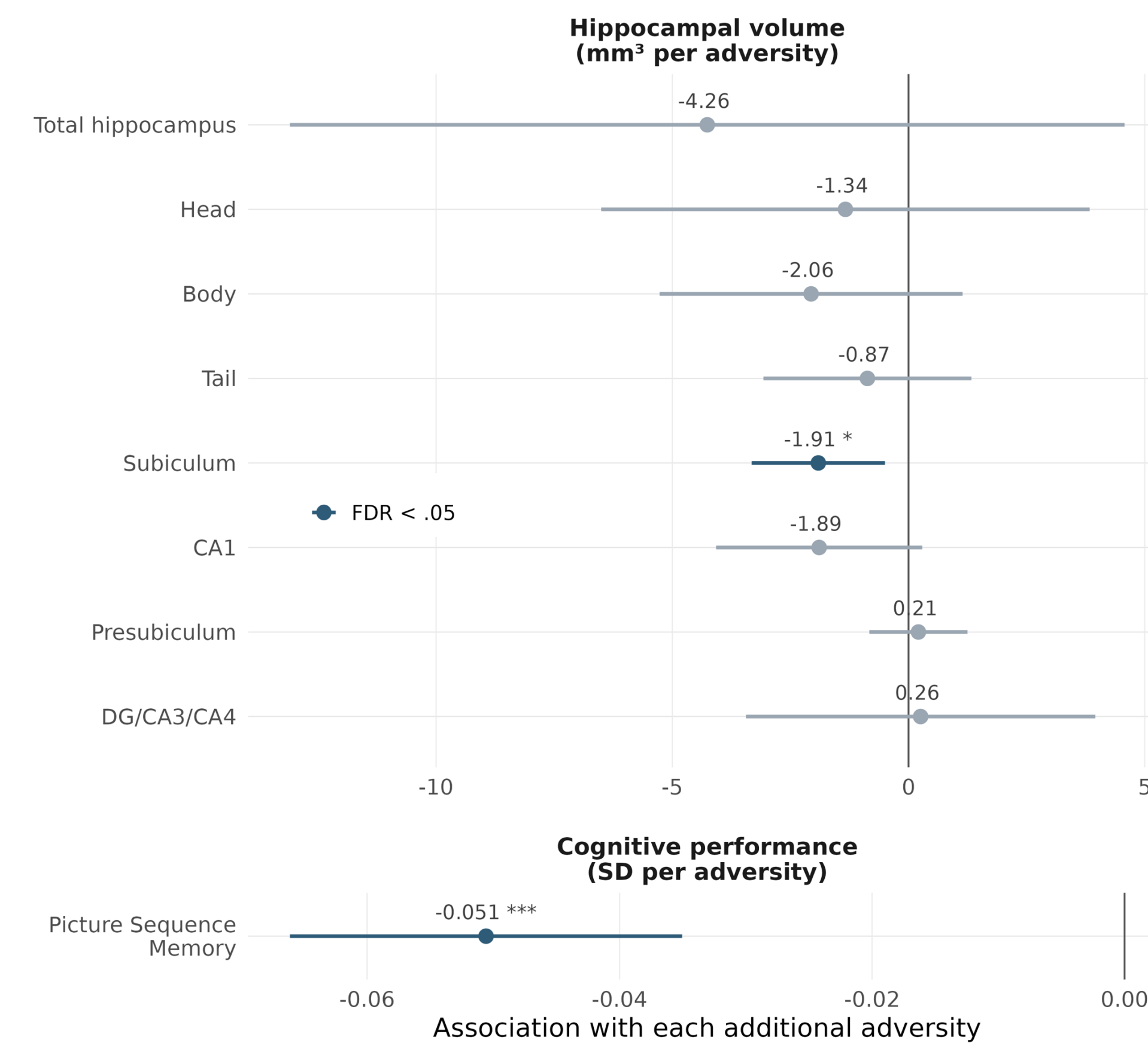


Results

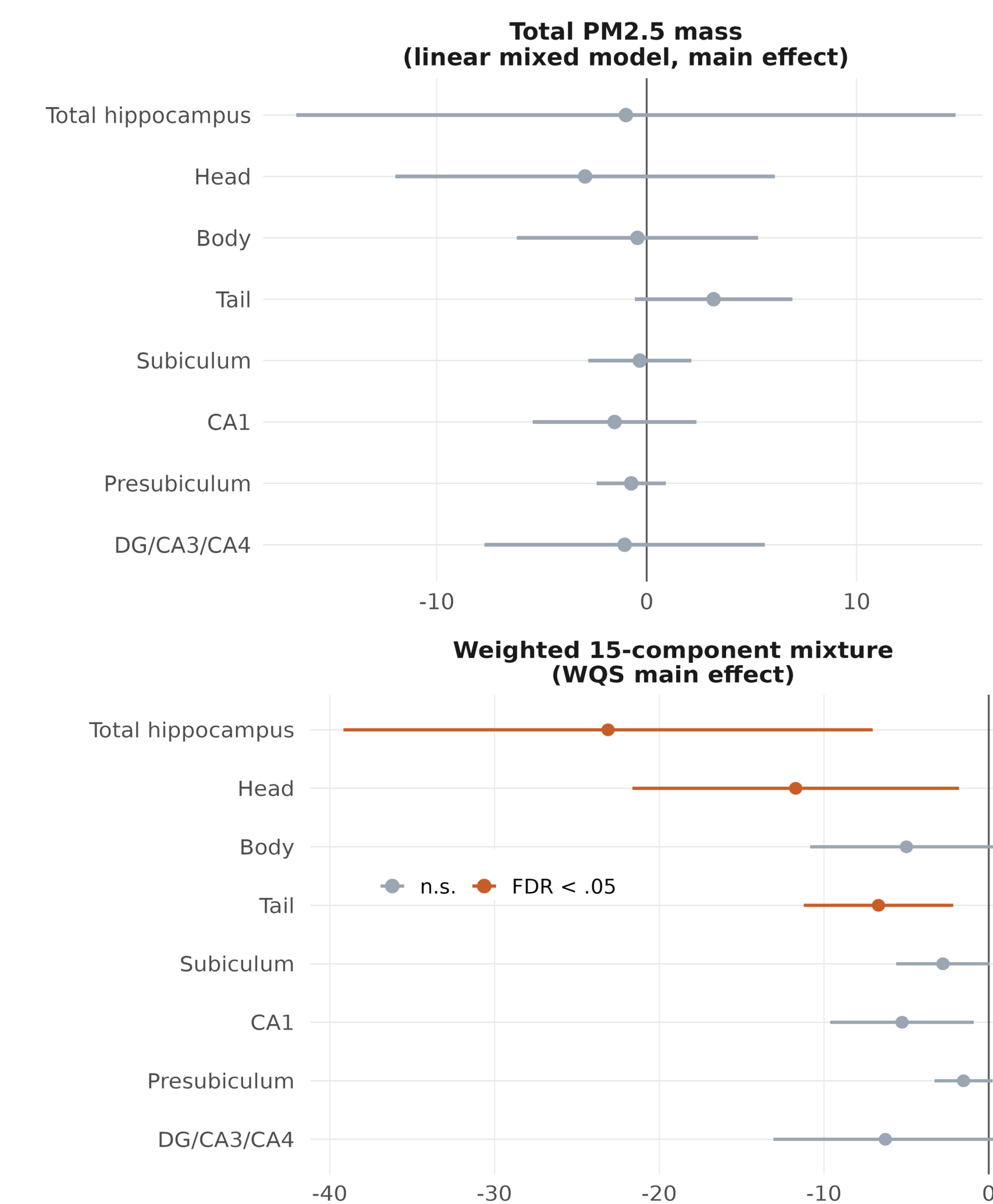
ELA modifies PM_{2.5}'s relationship with hippocampus-dependent cognition but not structure



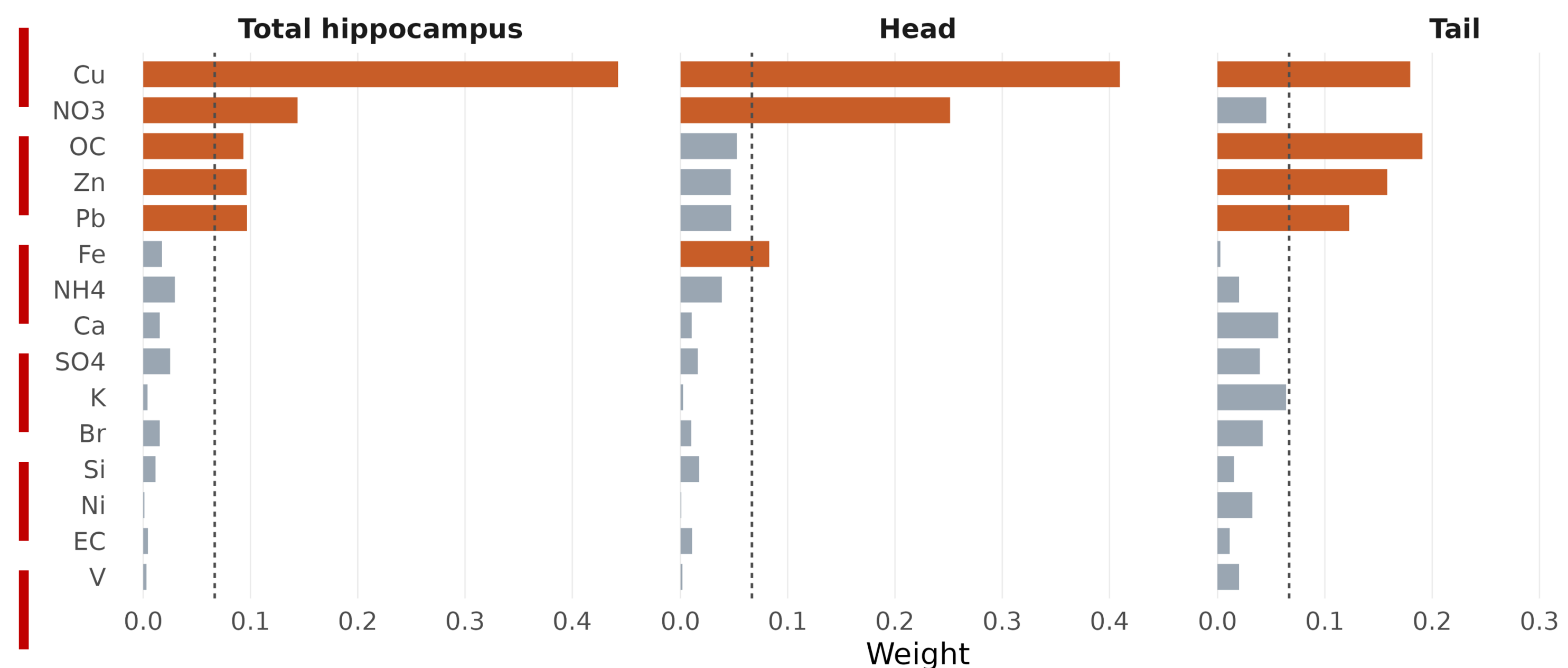
ELA is negatively associated with PSMT performance and subiculum volume



PM_{2.5} mixture but not total mass is linked to hippocampus



Metals, nitrates, and organic carbon drive association with hippocampus



Discussion & Conclusion

Air pollution **does not** modify early life adversity's relationship with total hippocampus or subregion volume.

Suggests that in these cross-sectional analyses, brain structure is independently related to type of exposure, ELA vs ambient air pollution (e.g., Subiculum ~ ELA vs Hippocampal head ~ mixture)

In line with previous work [3], PM_{2.5} component mixture, but not total mass, is negatively associated with hippocampus volume, and this is driven primarily by metals, nitrates, and organic carbon

Provides specificity on which components of PM_{2.5} hippocampal structure, which can provide future guidance on which sources of air pollution to target

ELA was independently associated with PSMT performance, whereas PM_{2.5} moderated ELA's impact on LMT and RAVLT performance.

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