



# Increased Neural Differentiation after a Single Session of Aerobic Exercise in Older Adults

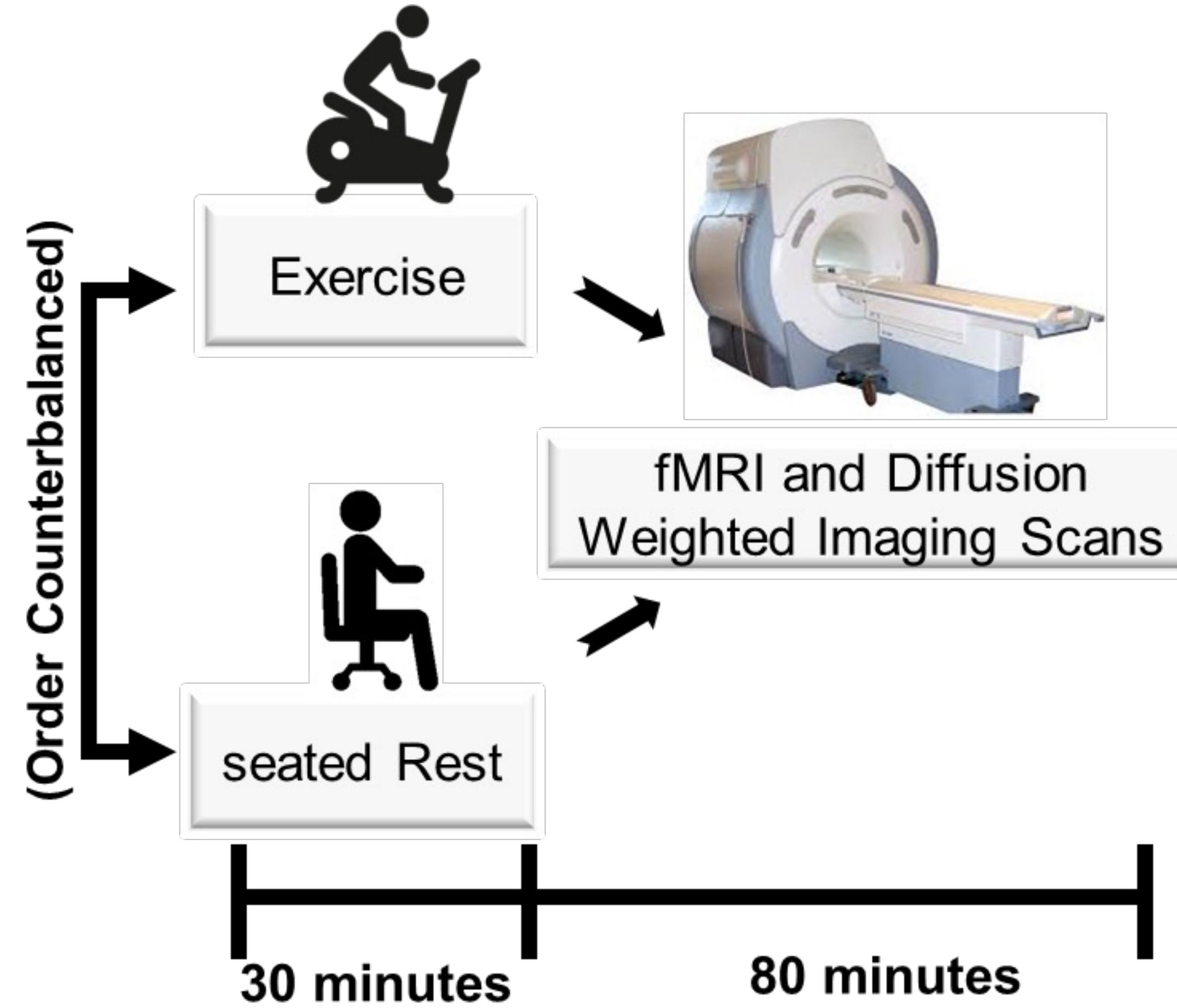
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## Background and Methods

- Healthy neural systems for motor, sensory, and cognitive function have well differentiated neural signals.
- Aging is associated with neural de-differentiation (e.g., Carp et al., 2011), including the hippocampal formation (Koen and Rugg, 2019).
- Research suggests that there are neural functional improvements immediately after exercise (Won et al., 2021).
- It has not yet been shown that there is increased neural differentiation in older adults immediately after exercise.
- Hypotheses immediately after 30 minutes of exercise:
  - There will be higher neural differentiation within the hippocampal formation.
  - These increases in neural differentiation will be age dependent.

## Methods



**Participants:** 32 physically active older adults (23 females).

**Age:**  $66.4 \pm 7.5$  years.

**Interventions:** Within-subject design, 1) 30-min aerobic exercise on Monark cycle ergometer (RPE: 15) 2) 30-min seated rest

**Functional MRI:** 4 Scans: (1) Flanker Task, (2) International Affective Picture System (IAPS) task; (3) Resting State, and (4) Famous Names Task (FNT). Approximately 31 min. of combined fMRI data.

### Manipulation Check

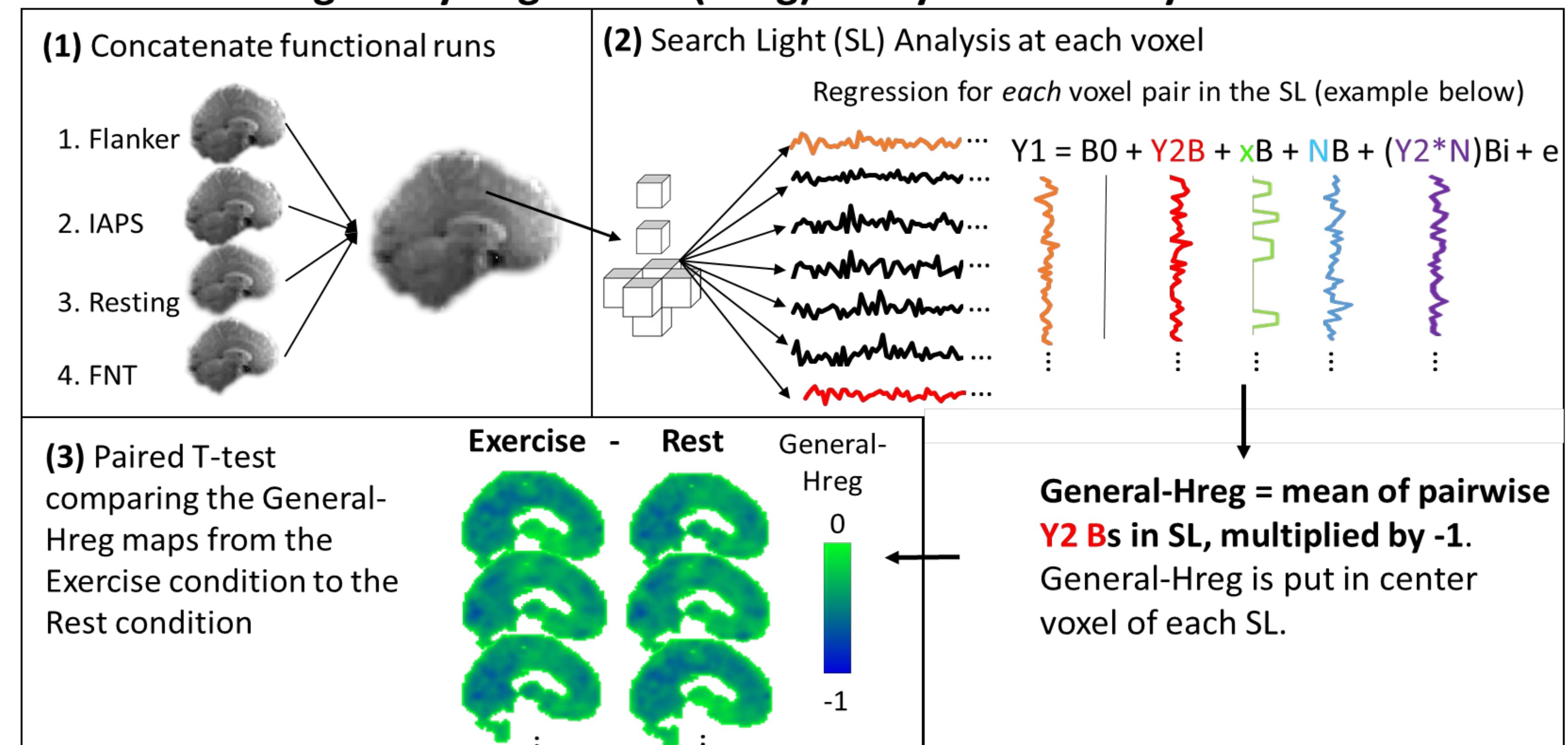
HR and RPE were significantly higher during the exercise ( $133.6 \pm 19.0$  bpm and  $14.0 \pm 1.1$ ) session compared to the rest ( $66.5 \pm 8.7$  bpm and  $6.1 \pm 0.4$ ), suggesting that our exercise intervention was sound.

### References

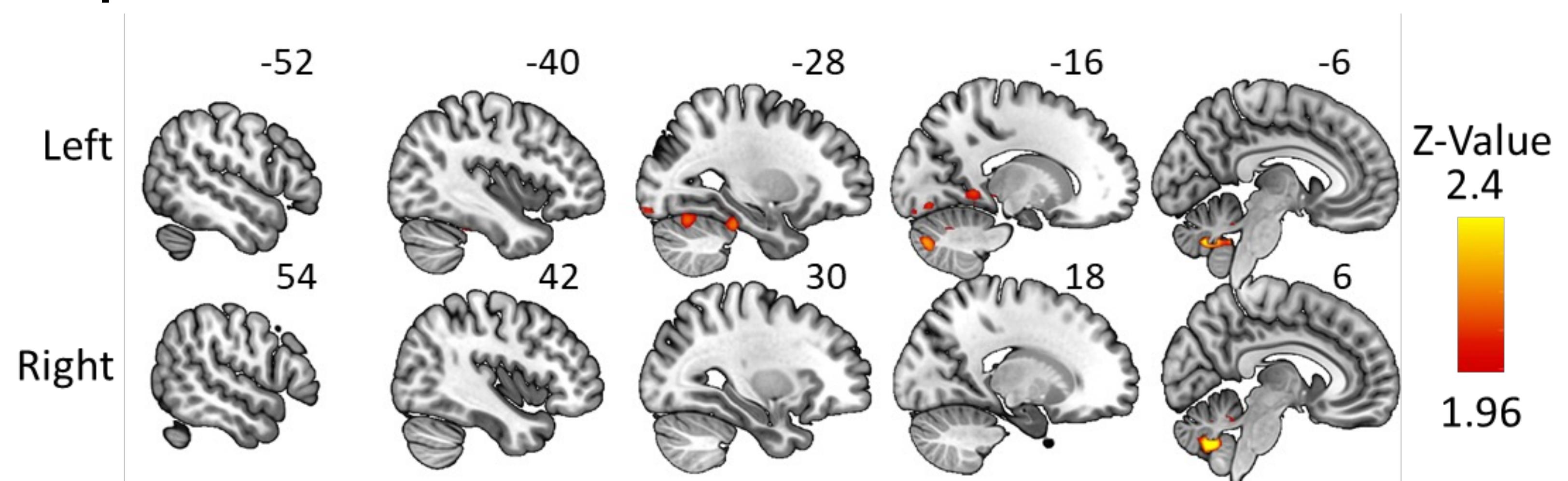
- Carp, Joshua, Joonkoo Park, Thad A. Polk, and Denise C. Park. 2011. "Age Differences in Neural Distinctiveness Revealed by Multi-Voxel Pattern Analysis." *NeuroImage* 56 (2): 736–43.
- Koen, Joshua D., and Michael D. Rugg. 2019. "Neural Dedifferentiation in the Aging Brain." *Trends in Cognitive Sciences* 23 (7): 547–59.
- Won, Junyeon, Daniel D. Callow, Gabriel S. Pena, Leslie S. Jordan, Naomi A. Arnold-Nedimala, Kristy A. Nielson, & J. Carson Smith. 2021. "Hippocampal Functional Connectivity and Memory Performance After Exercise Intervention in Older Adults with Mild Cognitive Impairment." *Journal of Alzheimer's Disease*

## Local Neural Differentiation

### General Heterogeneity Regression (Hreg) Analysis Summary

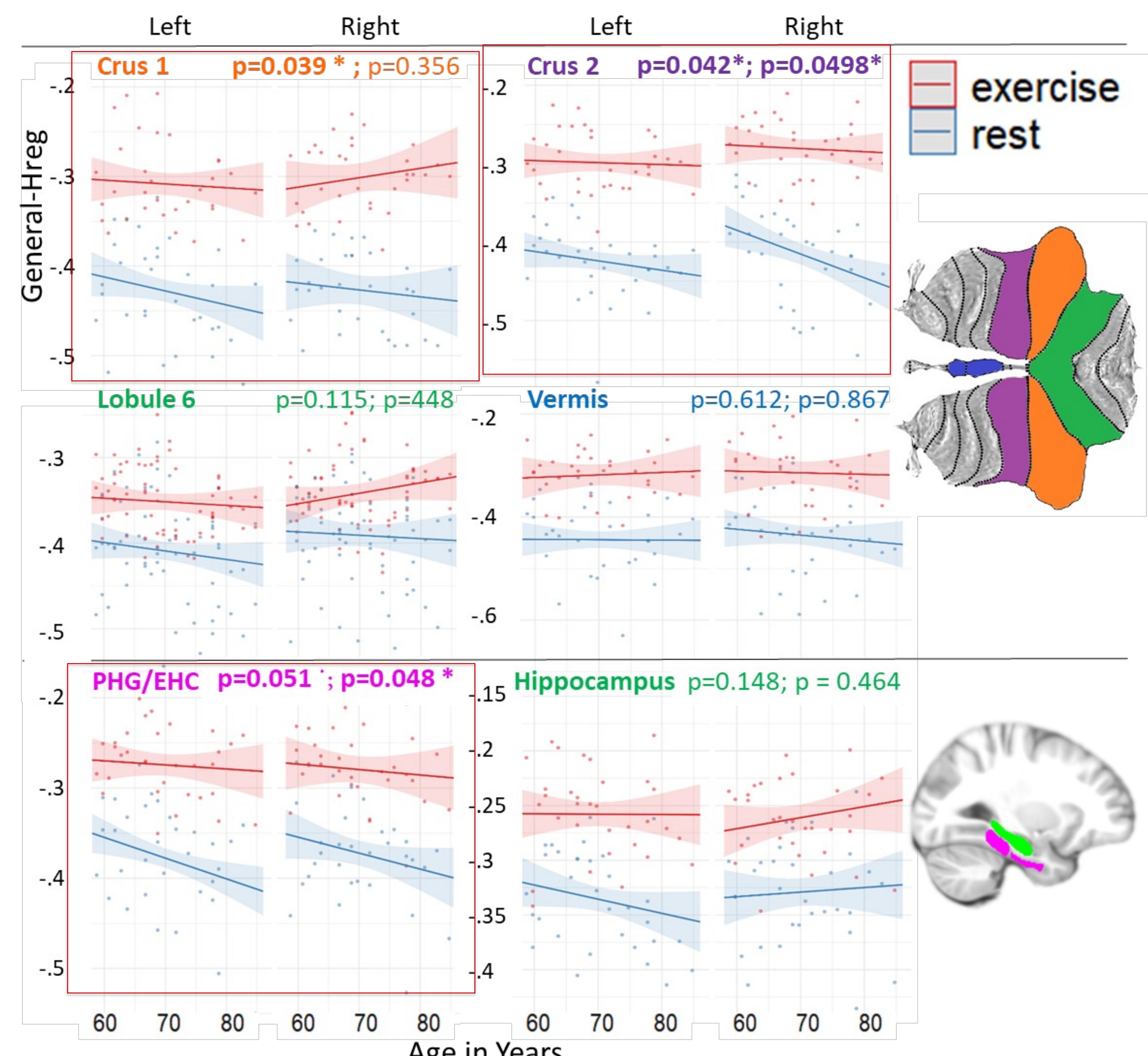


**Result 1: Increased neural differentiation immediately after exercise in the hippocampal formation and cerebellum.**



**Result 2: Age dependent higher neural differentiation after exercise**

- Mixed Model:**  $Dreg \sim Rest\_Exercise * Age * Hemisphere (1 + Rest\_Exercise + Hemisphere | Subject)$ .



### Summary:

- Acute Exercise led to increased neural differentiation in the hippocampal formation and cerebellum.
- Some of the greater effects of exercise were found with increased age, suggesting that acute exercise may help, at least transiently, to counteract age induced neural de-differentiation.