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

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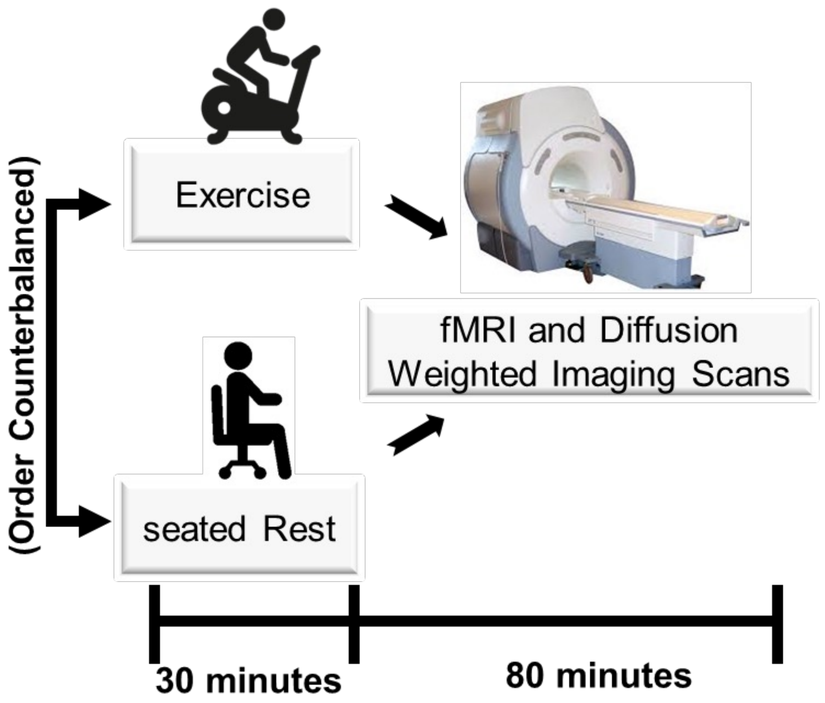
Background and Methods

- 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.
- <u>Hypotheses immediately after 30 minutes of exercise:</u>
  1. There will be higher neural differentiation within the hippocampal formation.
  2. These increases in neural differentiation will be age dependent.

Methods



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

Age: 66.4±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.

<u>Manipulation Check</u>

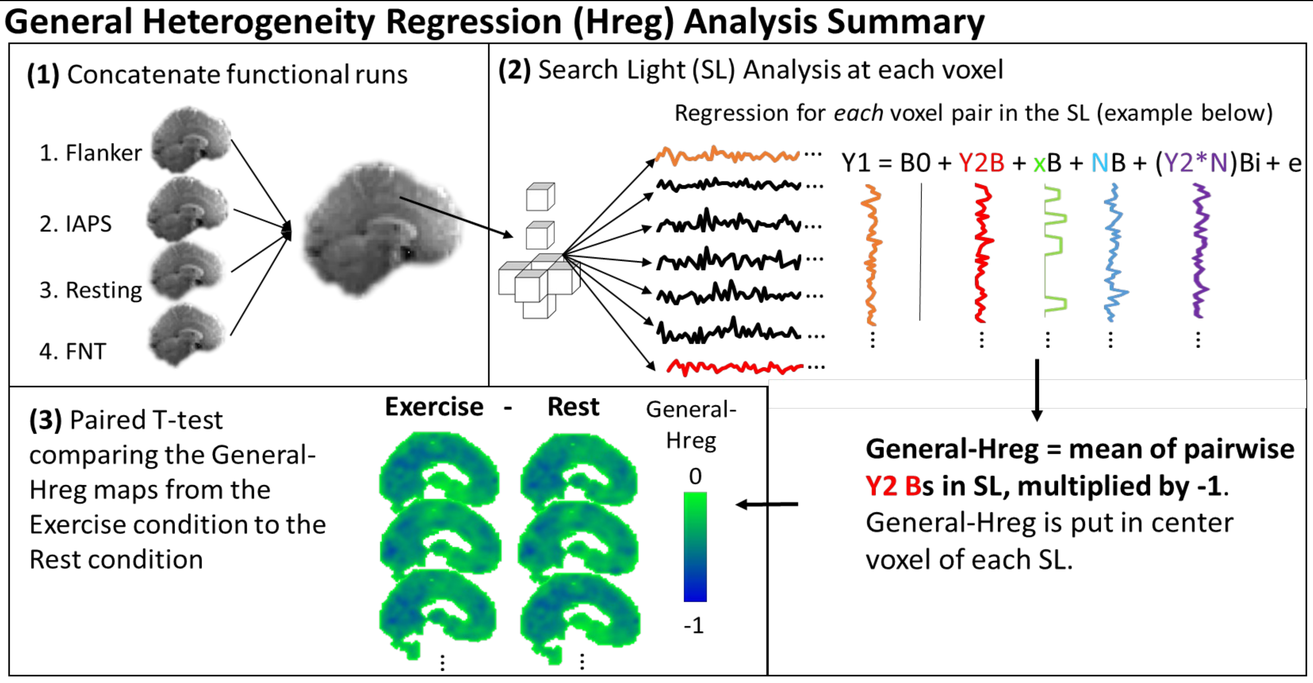
HR and RPE were significantly higher during the exercise (133.6±19.0 bpm and 14.0±1.1) session compared to the rest (66.5±8.7 bpm and 6.1±0.4), suggesting that our exercise intervention was sound.

References

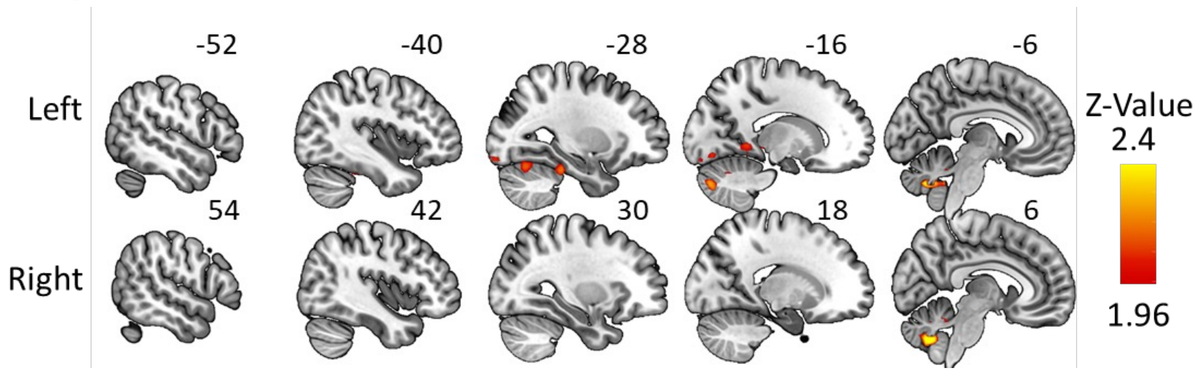
- Carp, Joshua, Joonkoo Park, Thad A. Polk, and Denise C. Park. 2011. "Age Differences in Neural Distinctiveness Revealed by Multi-Voxel Pattern Analysis." *NeuroImage* 56 (2): 736–43.
- Koen, Joshua D., and Michael D. Rugg. 2019. "Neural Dedifferentiation in the Aging Brain." *Trends in Cognitive Sciences* 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

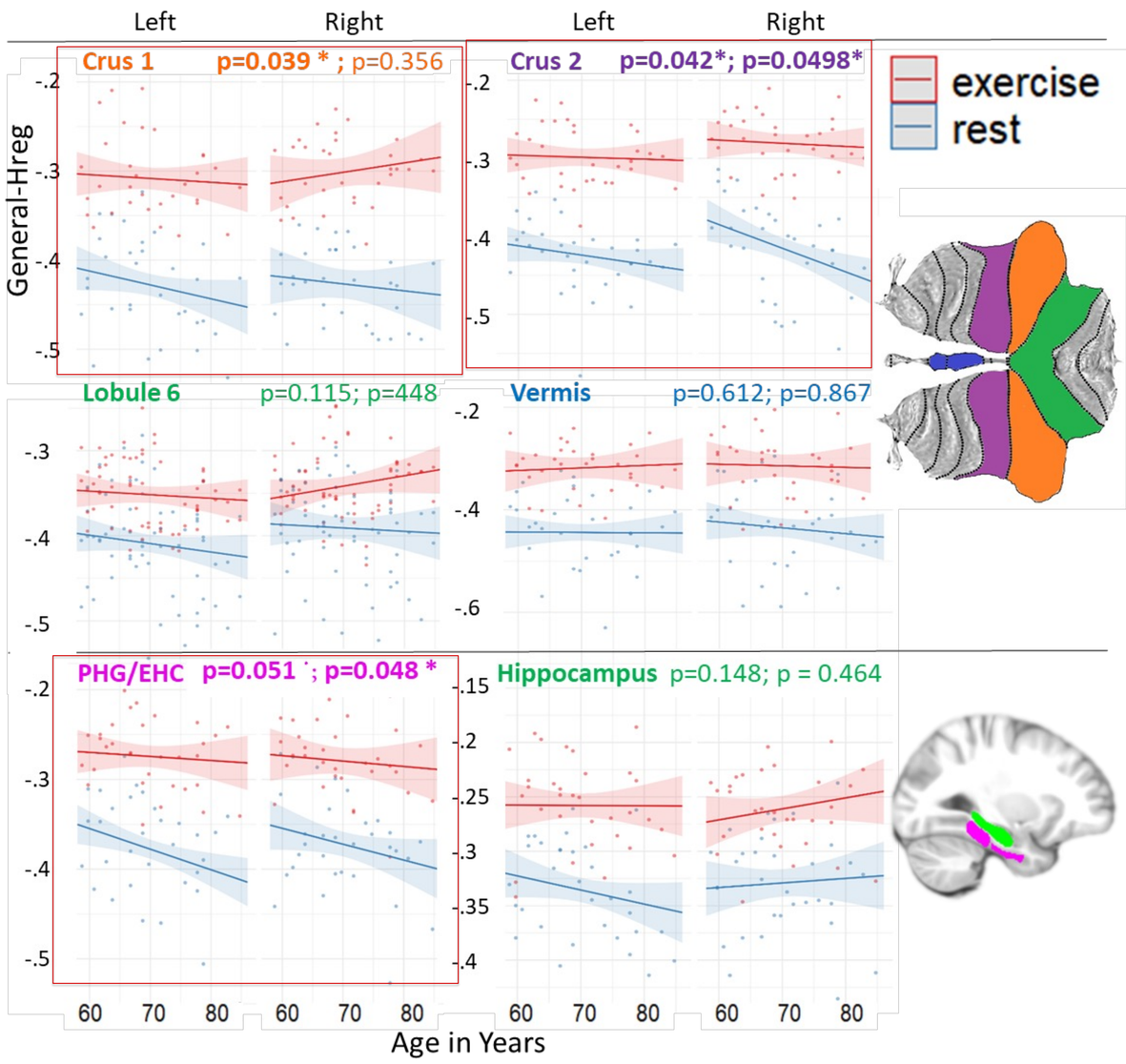


Result 1: Increased neural differentiation immediately after exercise in the hippocampal formation and cerebellum.



Result 2: Age dependent higher neural differentiation after exercise

- **Mixed Model**: Dreg ~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.