Exploring Recurrent Neural Network Dynamics in Tai-Chi Practitioners. Jonathan Cerna[1], Prakhar Gupta[2], Maxine He[1], Liran Ziegelman[1], Yang Hu[2], Manuel Hernandez[1,4-7], [1] Neuroscience Program, University of Illinois Urbana-Champaign,[2] Department of Electrical and Computer Engineering, University of Illinois Urbana-Champaign, [3]Department of Kinesiology, San Jose State University, [4]Department of Biomedical and Translational Sciences, Carle Illinois College of Medicine, [5]Department of Kinesiology and Community Health, [6]University of Illinois, Department of Bioengineering, University of Illinois, [7]Beckman Institute for Advanced Science and Technology, University of Illinois

Background: Although Tai Chi (TC) practice seems to benefit functional connectivity (FC), protecting cognitive function during aging , results are unclear due to insufficient granularity separating aging from practice effects . This study aims to separate the distinct contributions of each on recurrent neural network dynamics (RNNDs). We hypothesize that these variables will yield distinct effects on neural dynamics.

Methodology: EEG data were collected from older adult TC practitioners, age-matched controls, and younger adult controls (n=15/group) during resting-state conditions. Data were source-localized and fitted to a Hidden Markov Model to derive spatiotemporal features of RNNDs. Mixed-effects models assessed age and practice effects, controlling for physical function. Tukey's HSD post-hoc tests examined distinct contributions of age and practice to network differences.

Results: Significant age effects were found for within-network connectivity (β = -2.77E-05, t(40) = -2.03, p = 0.042). Post hoc tests revealed this to be driven by greater within-network connectivity in older adults (95% CI [-0.0026, -0.0004], p = 0.0015). A practice effect was found for within-network transition magnitude, showing greater magnitude (95% CI [0.0277, 0.1712], p = 0.0071) in participants without practice experience.

Conclusion: Results reveal distinct age- and practice-related RNND differences, likely stemming from executive function networks. However, further research is needed to corroborate these findings and enhance interpretability

References:
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