

Research-Inspired Cognitive Empowerment: Modulating Episodic Memory through Egocentric Navigational Training (MEMENT)

ABSTRACT:

According to the phylogenetic continuity hypothesis (Buzsáki and Moser, 2013), mechanisms supporting declarative memory (episodic-EM and semantic-SM) might have evolved from mechanism of navigation (egocentric-EN and allocentric-AN) in the physical world. In a series of studies, using measures of human performance, we tested if traces of this phylogenetic continuity may be observed in human behavior and its neural underpinnings. Using classic versions of navigational and memory tasks, a specific correlation and predictive relationship was observed in Study 1 between EN and EM, but not SM, abilities. In Study 2, we extended the observed association between EN and EM to the dynamic component of sequential updating of information. An indirect relationship was also described between EN and SM mediated by EM. In Study 3, the complete 4 - components model was assessed using navigational (egocentric/route, allocentric/survey) and memory (EM, SM) tasks based on the same audio-visual material. Results indicated that route-based navigation specifically predicted EM performance while survey navigation specifically predicted SM performance. In Study 4, a navigational vs. control training protocol was employed to assess a causality relationship between navigation and memory. The results indicated a significant improvement of EM but not SM or short-term memory following the navigational but not the control training. Study 5 explored the neurophysiological similarities between spatial navigation and memory through EEG, finding a specific theta band modulation during temporal memory and, on the other side, an alpha and beta band modulation during the spatial and semantic tasks. Of relevance, the observation of a shared pattern of alpha/beta strong desynchronization for the processing of spatial and conceptual information support the recent conceptual framework of a spatial representational format for high-level cognition including memory and knowledge representation (Bellmund 2018). In summary, the results provide consistent support to the phylogenetic continuity hypothesis between mechanisms of spatial navigation and declarative memory and offer new insights for application of navigational training programs for memory rehabilitation and empowerment.

Keywords

Spatial navigation, Egocentric navigation, Episodic memory, Empowerment

Published Work:

Altomare, E. C., Committeri, G., Di Matteo, R., Capotosto, P., & Tsoni, A. (2021). Automatic coding of environmental distance for walking-related locomotion in the foot-related sensory-motor system: A TMS study on macro-affordances. *Neuropsychologia*, 150: 107696. doi: 10.1016/j.neuropsychologia.2020.107696

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Fragueiro, A., Tosoni, A., Frisoni, M., Di Matteo, R., Sestieri, C., & Committeri, G. (2021). Travel in the Physical and Mental Space: A Behavioral Assessment of the Phylogenetic Continuity Hypothesis Between Egocentric Navigation and Episodic Memory. *Evolutionary Psychology, 19*(3), 14747049211040823. doi: 10.1177/14747049211040823

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