MODULATING EPISODIC MEMORY THROUGH EGICENTRIC NAVIGATIONAL TRAINING (MEMENT)

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Background: According to the phylogenetic continuity hypothesis (Buzsáki & 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.

Aims: 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.

Method: We first submitted healthy participants (*N* = 60) to classic versions of EN (path integration) and EM/SM (Study 1), and then stressed the dynamic component of sequential updating of information for EN/EM/SM (*N* = 141) (Study 2). In Study 3 we studied the complete 4-components model by using navigational (EN/route, AN/survey) and memory (EM, SM) tasks based on the same audio-visual material (*N* = 74). To assess a causal relationship between navigation and memory, we employed a navigational vs. control training protocol (Study 4). Finally, we explored the neurophysiological similarities between spatial navigation and memory through EEG (Study 5).

Results: In Study 1 we observed a specific correlation and predictive relationship 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, results indicated that route-based navigation specifically predicted EM performance while survey navigation specifically predicted SM performance. In Study 4, the results indicated a significant improvement of EM but not SM or short-term memory following the navigational but not the control training. In Study 5 we found 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 shared pattern of alpha/beta strong desynchronization for the processing of spatial and conceptual information support recent frameworks of a spatial representational format for high-level cognition (Bellmund 2018).

Conclusions: The results of the whole granted project 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, Path integration, Episodic memory, Semantic memory, Cognitive training, Empowerment

Publications:

Committeri, G., Fragueiro, A., Campanile, M. M., Lagatta, M., Burles, F., Iaria, G., Sestieri, C., & Tosoni, A. (2020). Egocentric navigation abilities predict episodic memory performance. *Frontiers in Human Neuroscience*, *14*, 574224. https://doi.org/10.3389/fnhum.2020.574224

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. https://doi.org/10.1177/14747049211040823

Fragueiro, A., Tosoni, A., Di Matteo, R., & Committeri, G. (2023). Empowering episodic memory through a model-based egocentric navigational training. *Psychological Research*, *87*(6), 1743–1752. https://doi.org/10.1007/s00426-022-01777-6

Fragueiro, A., Tosoni, A., Boccia, M., Di Matteo, R., Sestieri, C., & Committeri, G. (2023). Reference frames for spatial navigation and declarative memory: Individual differences in performance support the phylogenetic continuity hypothesis. *Evolution and Human Behavior*, *45*(1), 1090-5138. https://doi.org/10.1016/j.evolhumbehav.2023.08.001

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