Cyprus University of Technology

Faculty of Health Sciences

Doctoral Dissertation

EXPLORING THE SENSORY RECRUITMENT FRAMEWORK: THE ROLE OF THE SENSORY VISUAL CORTEX IN VISUAL SHORT-TERM MEMORY

PHIVOS PHYLACTOU

Limassol, May 2023

CYPRUS UNIVERSITY OF TECHNOLOGY

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF REHABILITATON SCIENCES

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Approval Form

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Acknowledgements.

One of the first ever books that I started reading was called "*Rich Dad Poor Dad*" by Kiyosaki and Lechter (2021). It was a terrible book and I hated it. In fact, I never even finished it. In any case, I'm borrowing their idea to acknowledge my "*Academic Dad*", Dr. Nikos Konstantinou, who happened to be my supervisor during this amazing start of my academic journey. Nikos has been a mentor, a role-model, and a friend. Without his passion, effort, and contribution, I would have never been able to produce any of the work presented here. That does not mean that I will finish reading "*Rich Dad Poor Dad*", though.

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ABSTRACT

The sensory visual cortex (SVC) is involved in encoding information in visual short-term memory (VSTM). Yet, it remains unclear if the SVC is a necessary component of the brain network necessary for maintaining information in VSTM. The aim of this thesis was to shed light on the debated role of the SVC in VSTM. Thus, I focused on transcranial magnetic stimulation (TMS). TMS uses a coil to transfer electromagnetic stimulation at localized brain areas making the exploration of causal evidence plausible. Through a systematic review and meta-analysis of previous SVC TMS studies I indicated that the SVC is similarly involved in both the encoding and maintenance VSTM phase, and that the controversy was likely due to methodological issues in TMS studies. Building on these findings I conducted two TMS experiments that covered the previous methodological oversights by ensuring the monocular presentation of orientation stimuli. TMS was delivered at different times during the maintenance phase of a delayed change-detection VSTM task, on one side of the occipital hemisphere. Decreased VSTM performance in the ipsilateral occipital hemisphere to visual hemifield, and in the real TMS (compared to sham TMS) condition indicated inhibitory TMS effects, and thus, a causal involvement of the SVC during VSTM maintenance. After establishing the role of the SVC in VSTM maintenance through TMS, I turned to memory load manipulations to further investigate the relationship between short-term memory and perception. I combined short-term memory tasks with perceptual detection tasks, where I manipulated the sensory load of the memory items and measured the effect of this load manipulation on perceptual detection. A combined VSTM and visual perception task provided additional evidence in favor of the sensory recruitment framework, since visual detection was reduced due to the increased VSTM load. Evidence against any cross-modal effects between VSTM and auditory perception was found, and evidence from a combined auditory short-term memory and auditory perception task indicated that sensory recruitment was not supported for the auditory modality. Overall, my findings support the sensory recruitment framework of VSTM, which proposes that sensory visual areas have a dual function: they are involved in the precise sensory encoding of elemental visual features and the short-term maintenance of this information.

Keywords: visual short-term memory, working memory, sensory visual cortex, sensory recruitment, visual cortex