ON THE CELLULAR MECHANISMS UNDERLYING WORKING MEMORY CAPACITY IN HUMANS

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Abstract: The cellular processes underlying individual differences in the Working Memory Capacity (WMC) of humans are essentially unknown. Psychological experiments suggest that subjects with lower working memory capacity (LWMC), with respect to subjects with higher capacity (HWMC), take more time to recall items from a list because they search through a larger set of items and are much more susceptible to interference during retrieval. However, a more precise link between psychological experiments and cellular properties is lacking and very difficult to investigate experimentally. In this paper, we investigate the possible underlying mechanisms at the single neuron level by using a computational model of hippocampal CA1 pyramidal neurons, which have been suggested to be deeply involved in the recognition of specific items. The model makes a few experimentally testable predictions on the cellular processes underlying the cumulative latency in delayed free recall experimentally observed in humans under different testing conditions. The results suggest, for the first time, a physiologically plausible explanation for individual performances, and establish a proof of principle for the hypothesis that HWMC individuals use a larger portion of the apical tree with a correlated higher level of synaptic background noise.

Key words: *working memory capacity, CA1, hippocampus, data analysis*

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1. Introduction

Several experimental studies have convincingly demonstrated that individual differences in the Working Memory Capacity (WMC) of humans is related to differences in many abilities [7, 11, 32, 34], especially those related to the processes underlying the retrieval of information under conditions of interference [19, 38], and it has been related to a number of higher brain functions [12]. Individual who score in the upper or lower quartile on a variety of working memory capacity tasks such as the reading span and operation span tasks are usually classified as high (HWMC)

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