Toward an Integrated Understanding of the Generation of Place-Fields in the Different Sub-fields of the Hippocampal Region.

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Introduction

The generation of the "Place Fields" in the hippocampal region is a fundamental phenomenon for the processing of the declarative memory. The electrophysiological attributes are associated to the concomitant generation of theta-gamma activity, while, at the behavioral level, they are expressed as environmental exploration and attention phenomena, when studied in animals. However there were not described robust topographical pathways that sustain a direct association of the afferent pathways from hippocampus to specific cortical regions that would be recipients of the functional processes for the consolidation of memory and the navigational abilities.

Another topic refers to the generation of the "Place Fields" in the several sub-fields of the hippocampal region: the integrated role of these attributes still stays obscure.

Methods

In previous studies we developed a computational neural net based on mathematical attributes of the Gated Dipoles and the opponent processing for the modeling of the generation of place fields. We showed on this model that the temporary entrance of frequencies at the net, more than the topographical organization, would sustain a memory system for the construction of place fields. We used also attributes of self-organizing maps to construct the system.

In this work we expanded the developed net, with the integration of the several hippocampal sub-fields, based on anatomical and electrophysiological data, trying to get a more reliable model of the hippocampal function when working on the cited frequencies.

Results

In our results the concomitant generation of the Place Fields in different sub-fields and in an independent way would work in a combinatory system. So, while the afferent connections to the hippocampus show a progressive topographical condensation with a transduction for aleatory functional patterns in each sub-field, it happens a temporary filtration and accentuation of the developed information based on the temporal properties of the little variations on each frequency arriving the hippocampus. These attributes, associated with the internal abilities of frequency generation, could create a combinatory amplification of the capacities of storage of information that temporally would construct a diverse and accentuated basis for the efferent processes of the hippocampal system.

Conclusions

Finally, our suggestion is that the hippocampal complex functions as a transduction system from topographical to frequency-dependent abilities with a combinatory generation of memory traces based on the temporary weight of the established connections among cells and subfields to subserve the several roles attributed to it, as the participation on the memory consolidation, navigational abilities, emotional expressions, and so, adaptively timed learning.

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