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GREEK MINISTRY OF EDUCATION, RESEARCH AND RELIGIOUS AFFAIRS.
ΓΕΝΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΕΡΕΥΝΑΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ

FORTH
FOUNDATION FOR RESEARCH AND TECHNOLOGY-HELLAS
INSTITUTE OF MOLECULAR BIOLOGY AND BIOTECHNOLOGY

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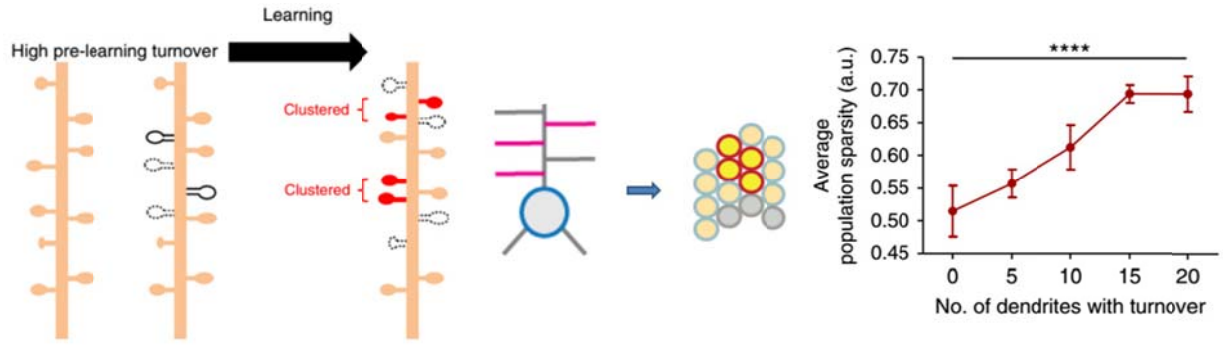
PRESS RELEASE

SUBJECT: NEW PUBLICATION

IMBB and UCLA researchers show how synaptic turnover facilitates learning and memory

The laboratory of Dr. Alcino Silva (www.silvalab.com) at the University of California Los Angeles (UCLA) joined forces with the lab of Dr. Poirazi (www.dendrites.gr) at the Institute of Molecular Biology and Biotechnology (IMBB) of FORTH in order to explain why the "banding together" of synapses in dendrites relates to better learning and memory. The work is published in the scientific journal Nature Communications and is likely to have important implications for memory-related dysfunctions.



The study of the spatially localized grouping of synapses in dendrites, termed *synaptic clustering*, has led to many discoveries about the way in which memories are encoded and the structure of the imprints of memory in the brain, called *memory engrams.* While early theoretical work supported the idea that memories are encoded by changing the conductance or strength of the connections between neurons in the brain, it is only recently that advances in imaging and molecular biology allowed scientists to precisely identify those changes, and to monitor how they change over time.

Using in-vivo two-photon microscopy, Dr. Frank and Dr. Huang, both scientists in the lab of Dr. Alcino Silva at the Brain Research Institute of UCLA were able to trace how new synapses between neurons formed, removed and remodeled for a number of days before and after learning memory episodes in genetically modified mice. Their findings showed increased spine generation and elimination (*spine turnover*) was correlated with enhanced synaptic clustering and enhanced learning and memory formation.

Based on these results, the postdoctoral fellow Dr. Kastellakis and the lab director Dr. Poirazi, both researchers at IMBB, created a biophysically realistic model of memory learning to explain the observed benefits of synaptic clustering. Their results showed that increased turnover of synapses leads to increased clustering due to a memory mechanism known as synaptic tagging and capture. This turnover-induced synaptic clustering, in turn, leads to increased network sparsity, namely it allows memories to be encoded in

a smaller population of neurons, and with better discriminability. These results suggest that increased turnover which is followed by increased clustering can lead to increased memory capacity.

The lab of Dr. Poirazi has pioneered the theoretical study of synaptic clustering, and has already made many predictions about the role of dendritic synaptic clustering in the encoding of memories. This work contributes to the cumulating evidence that synaptic clustering plays a key role in memory formation, and that it is a fundamental component of memory engrams. The predictions made by their work are expected to guide future research in the field of memory engram formation.

[1] Adam C. Frank, Shan Huang, Miou Zhou, Amos Gdalyahu, George Kastellakis, Tawnie K. Silva, Elaine Lu, Ximiao Wen, Panayiota Poirazi, Joshua T. Trachtenberg & Alcino J. Silva (2017) *Hotspots of Dendritic Spine Turnover Facilitate Clustered Spine Addition and Learning and Memory*. Nature Communications 2018 vol: 9 (1) pp: 422

More info:

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Relevant links: https://www.nature.com/articles/s41467-017-02751-2 & www.dendrites.gr