ERC Starting Grant

Panayiota Poirazi, a researcher in the Institute of Molecular Biology and Biotechnology (IMBB) at the Foundation for Research and Technology-Hellas (FORTH), was recently awarded the prestigious Starting Grant of the European Research Council (ERC) for her proposal entitled "**Dissecting the role of dendrites in memory**".

ERC Starting Grants are highly competitive and allow exceptional young researchers with a proven potential for excellence in any field of science, engineering and scholarship to pursue frontier research of their choice. ERC Starting Grants aim to support promising researchers who have the proven potential of becoming independent research leaders and to create excellent new research teams. It should be noted that since the establishment of the ERC grant scheme in 2007, a total of 20 scientists working in Greek Institutions have been awarded with such prestigious grants and 5 of them are located in Institutes of FORTH. The research activity of Dr. Poirazi, which is financed with 1.4 million Euros for 5 years, focuses on characterizing the role of dendrites in the formation, storage and retrieval of new information, namely the creation of new memories.

While memory is a function that has attracted the interest of the scientific community for several years, little is known about the rules underlying memory formation in the brain. Until recently, the single neuron was considered the main processing unit of the brain and memories were believed to be stored exclusively through plasticity modifications that take place in the synapses, the connecting sites between neurons. Over the last decade however, emerging evidence suggests that the neuron is no longer the key (and smallest) processing unit of the brain. The dendrites of individual neurons, which were thought as merely passive devices that allow neuronal communication, are currently the no 1 candidate for this role. The goal of Dr. Poirazi�s research is to investigate the role of dendrites in learning and memory processes via the use of computational approaches.

Towards this goal, computational models in three memory-related brain regions and three abstraction levels will be developed: a single pyramidal neuron in the hippocampus, a small microcircuit in the prefrontal cortex and a large scale network model of the amygdala. All models will incorporate dendrites that vary in their degree of biophysical and anatomical detail and will express memory functions relevant to the regions they represent. For example, the hippocampal single cell model will be able to "learn" when a given input represents previously known or entirely new information and change its response pattern accordingly. The prefrontal cortex microcircuit model will be able to learn when a given input is important and should be kept in memory by prolonging its activity for several seconds. Finally, the network model of the amygdala will be able to learn to associate a fearful stimulus (e.g. electrical shock) with a neutral stimulus (e.g. sound) and to respond with "fear" upon presentation of the sound alone.

The role of dendrites in the mnemonic capabilities of the three models will be investigated by performing a systematic manipulation of their anatomical, biophysical and plasticity properties and tracking the effect of these manipulations on the respective memory functions. This exercise is expected to identify the key properties and rules according to which dendrites contribute to memory formation, based on which new theoretical models of trainable neurons with dendrites will be developed.

In conclusion, this research activity aims to cause a paradigm shift in the way we currently understand learning and memory processes, whereby the dendrites, as opposed to the single neuron, are the key players. The results of this work will have a major impact in fields such as artificial intelligence and machine learning but also in the way memory deficits are currently treated, as they will pinpoint new mechanisms that are involved in memory formation.

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