JUDIT MAKARA

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RESEARCH AREA

The focus of our research is to understand the principles of information processing by neurons. Nerve cells receive thousands of synaptic inputs onto their thin and long processes called dendrites and transform the integrated information to an output signal at the cell body. Processing of inputs takes place primarily in the dendrites that express a variety of voltage dependent ion channels, allowing them to perform diverse forms of nonlinear summation and input-output transformation. Furthermore, the fine regulation of ion channel function makes this processing dynamic. We use cutting edge microscopic and electrophysiological methods in brain slices and awake behaving rodents to elucidate the basic principles and regulation of dendritic function in neurons of the hippocampus (a brain region important for episodic memory) as well as the possible roles of these cellular information processing mechanisms in learning and memory guiding behaviour.

TECHNIQUES AVAILABLE IN THE LAB

In vitro patch-clamp electrophysiology in brain slices, two-photon microscopy in brain slice and in awake behaving animals.

SELECTED PUBLICATIONS

Magó, Á., Kis, N., Lükő, B, **Makara, J.K.** (2021) Distinct dendritic Ca2+ spike forms produce opposing input-output transformations in rat CA3 pyramidal cells. **eLife 10:** e74493.

Ujfalussy, B.B., **Makara, J.K.** (2020) Impact of functional synapse clusters on neuronal response selectivity. **Nature Communications 11:** 1413.

Magó, Á., Weber, J.P., Ujfalussy, B.B., **Makara, J.K.** (2020) Synaptic plasticity depends on the fine-scale input pattern in thin dendrites of CA1 pyramidal neurons. **J. Neuroscience 40:** 2593-2605.

Raus Balind, S., Magó, Á., Ahmadi, M., Kis, N., Varga-Németh, Z., Lőrincz, A., **Makara, J.K.** (2019) Diverse synaptic and dendritic mechanisms of complex spike burst generation in hippocampal CA3 pyramidal cells. **Nature Communications, 10:** 1859.

Harnett, M.T.*, **Makara, J.K.***, Spruston, N., Kath, W.L., Magee, J.C.† (2012) Synaptic amplification by dendritic spines enhances input cooperativity. **Nature, 491:** 599-602. *shared first authors.