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## RESEARCH AREA

The current theories of the broader hippocampal network explain its memory functions based on the firing of individual neurons. However, the cellular mechanisms that underlie these functions are elusive. We are interested in the functions that determine the activity of dentate gyrus granule cells (DG GC). DG GCs translate diverse inputs into highly different specific codes, which underlies the so-called pattern separation that allows us to distinguish similar events, objects. We focus on the principles that govern how single GCs extract information from the activity of single upstream neurons from the four major input pathways using direct patch clamp recordings and voltage-sensitive dye/protein imaging of single small axon terminals together with anatomical and computational approaches. The two perforant paths (PPs) that originate from the medial and lateral entorhinal cortices convey spatial context (such as the famous grid cell activity) or specific information content (for example certain objects). Inputs from hilar mossy cells distinguishes subtle differences and inputs from the hypothalamic supramammillary nucleus synchronizing GC activities during attention.

## TECHNIQUES AVAILABLE IN THE LAB

Patch clamp electrophysiology, in vitro  
Voltage imaging  
Calcium imaging  
Light microscopy  
Neuronal simulations

## SELECTED PUBLICATIONS

Oláh, V.J., Lukacsovich, D., Winterer, J., Arszovszki, A., Lőrincz, A., Nusser, Z., Földy, C., **Szabadics, J.** (2020) Functional specification of CCK+ interneurons by alternative isoforms of Kv4.3 auxiliary subunits. **eLife**, **9**: e58515.

Neubrandt, M., Oláh, V.J., Brunner, J., Marosi, E., Soltesz, I., **Szabadics, J.** (2018) Single bursts of individual granule cells functionally rearrange feed-forward inhibition. **J. Neurosci.** **38**: 1711-1724.

Neubrandt, M., Oláh, V.J., Brunner, J., **Szabadics, J.** (2017) Feedforward inhibition is randomly wired from individual granule cells onto CA3 pyramidal cells. **Hippocampus** **27**: 1034-1039.

Brunner J, **Szabadics J** (2016) Analogue modulation of back-propagating action potentials enables dendritic hybrid signalling. **Nat Commun** **7**: 13033.

Luo, W., Egger, M., Domonkos, A., Que, L., Lukacsovich, D., Cruz-Ochoa, N.A., Szócs, S., Seng, C., Arszovszki, A., Sipos, E., Amrein, I., Winterer, J., Lukacsovich, T., **Szabadics, J.**, Wolfer, D.P., Varga, C., Földy, C. (2021) Recurrent rewiring of the adult hippocampal mossy fiber system by a single transcriptional regulator, Id2. **Proc Natl Acad Sci USA** **118**: e2108239118.