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RESEARCH AREA

We live in an ever-changing world. Our survival and well-being depend on how we can adapt to it by momentarily readjusting our actions. In order to do so, we have to filter out unimportant inputs and store only relevant information. Then, based on the combination of freshly acquired information and our memories, we select an action plan matching the actual situation. Subcortical modulation, by influencing all stages of cortical information processing, is indispensable for the selection, storage and recall of information and for carrying out the optimal action. Disruption of subcortical modulation leads to severe psychiatric illnesses. Our lab aims to unravel the operational principles of subcortical modulation. We aim to decipher the modulatory signal (or code) and how it influences information processing in target cortical circuits. We are also interested in the feedback from the cortex to subcortical regions whereby we would be able to uncover how cortical circuits control their modulation.

TECHNIQUES AVAILABLE IN THE LAB

In vivo electrophysiology: juxtacellular and patch clamp recording, registration of large population of neurons by high channel count silicone probes in head-fixed and freely moving mice;

Manipulation of neuronal activity by optogenetics;

High temporal and spatial resolution behavior tracking;

Surgery: electrode implantation, injection of viral vectors and tracers;

Data analysis.

SELECTED PUBLICATIONS

Jelitai, M., Barth, A.M., Komlósi, F., Freund, T.F., **Varga, V.** (2021) Activity and coupling to hippocampal oscillations of median raphe GABAergic cells in awake mice. **Front Neural Circuits 15**: 784034.

Barth, A.M., Domonkos, A., Fernandez-Ruiz, A., Freund, T.F., **Varga, V.** (2018) Hippocampal network dynamics during rearing episodes. **Cell Reports 23**: 1706-1715.

Domonkos, A., Ledri, L.N., Laszlovszky, T., Cserép, C., Borhegyi, Z., Papp, E., Nyiri, G., Freund, T.F., **Varga, V.** (2016) Divergent in vivo activity of serotonergic and non-serotonergic VGlut3-neurons in the median raphe region. **J Physiol (London) 594**: 3775-90.

Vandecasteele, M., **Varga, V.**, Berényi, A., Papp, E., Bartho, P., Venance, L., Freund, T.F., Buzsáki, G. (2014) Optogenetic activation of septal cholinergic neurons suppresses sharp wave ripples and enhances theta oscillations in the hippocampus. **Proc Natl Acad Sci USA 111**: 13535-13540.

Varga, V., Losonczy, A., Zemelman, B.V., Borhegyi, Z., Nyiri, G., Domonkos, A., Hangya, B., Holderith, N., Magee, J.C., Freund, T.F. (2009) Fast synaptic subcortical control of hippocampal circuits. **Science 326**: 449-453.