Institute: Institute of Zoology and Biomedical Research

Topic: The neuronal mechanism of the influence of light on motivation and decision making

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Background information:
Light has a significant impact on the level of our motivation and the decisions we make. The exact brain circuits that mediate the effects of light on animal behaviour are not well understood. Little is known about the neural mechanisms by which the intensity of light and the direction it comes from affect the animal's level of behavioural invigoration and decisions it makes about e.g., approach vs. withdrawal, or orientation/turning in a specific direction with respect to the incident light. In recent years, there have been scientific reports suggesting that the activity of the midbrain dopaminergic system, which is the most important element of the reward system in the brain of animals, may be influenced by light [1, 2].

The main question and tasks:
How light affects the activity of the midbrain dopaminergic system of the rat. In particular: 1) what neural circuits and how are they involved; 2) what effect light has on the elements of the studied circuits; 3) how light conditions and experimental manipulation of involved neuronal pathways influences behaviour of the animals.

Information on the methods/description of work:
The studies will be performed on adult male rats. The following experimental techniques are planned to be used: 1) Neuroanatomy: neuronal tract-tracing with the use of anterograde, retrograde and transsynaptic viral vectors and classical chemical markers; 2) Electrophysiology: single and multi-channel extracellular recordings during exposure of the animal to the light stimuli of various intensity and direction, combined with optogenetic manipulation of the activity within the elements of the studied neural pathways; 3) Behaviour: testing of animal behaviours during light stimulation (different intensities and directions) and optogenetic manipulation of studied neuronal pathways.

Additional information:
The student should have experience in the following research techniques: injections of viral vectors into the selected structures of the rodent brain; single- and multi-channel recording of neuronal activity in an *in vivo* preparation of anesthetized rat; behavioural testing of laboratory animals (rats); preparation and microscopic analysis of the histological material of immunocytochemically stained nerve tissue. In addition, the student should have the following skills, training and qualities: training to perform procedures and experiments and to kill animals (in accordance with the applicable Act on the protection of animals used for scientific or educational purposes, of January 15, 2015); ability to analyse the electrophysiological signal using specialized software (Spike2, Kilosort); good command of the English language.

References:
Lu Huang, Yue Xi, Yanfang Peng, Yan Yang, Xiaodan Huang, Yunwei Fu, Qian Tao, Jia Xiao, Tifei Yuan, Kai An, Huan Zhao, Mingliang Pu, Fuqiang Xu, Tian Xue, Minmin Luo, Kwok-Fai So, Chaoran Ren (2019) A Visual Circuit Related to Habenula Underlies the Antidepressive Effects of Light Therapy. Neuron 102(1):128-142.e8.
Pradel Kamil, Drwięga Gniewosz, Błasiak Tomasz (2021) Superior Colliculus Controls the Activity of the Rostromedial Tegmental Nuclei in an Asymmetrical Manner. Journal of Neuroscience 41(18):4006-4022.