

Project 1.1 Memory mechanisms in the ageing brain- alternative synaptic processes and neuronal networks.

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Background:

Synapses connecting neurons in the brain are constantly remodelled. Our group is interested in understanding the role of synaptic plasticity in the hippocampus.

Hippocampus is a key brain structure for spatial navigation and memory. Spatial memory formation (what is where?) activates hippocampal synapses, resulting in their remodelling – the process is known as synaptic plasticity. Accordingly, synaptic plasticity is believed to be a key mechanism for encoding new information, formation of spatial representation and bounding these two elements giving us the feeling of continuous being in time and space.

Surprisingly, our recent data indicate that synaptic plasticity in the hippocampus is required for spatial choice, i.e. choice that uses spatial information to suppress inappropriate behaviours, rather than spatial memory. Mice with impairment of hippocampal plasticity remember presence of reward but cannot use spatial information to decide about the location of the reward. We also observed that synaptic plasticity in the hippocampus of aged mice is necessary neither for formation of reward memory nor spatial choice ([Cały et al. 2021, J. Neurosci. 41\(11\):2329-2343](#)). It is therefore unknown how aged mice find reward in the complex environment and, therefore, how to improve this process for those with cognitive impairments.

Aim:

The exact nature of the project will depend on the skills, predispositions, and interests of the selected PhD student. The successful candidate may test one of two hypotheses: 1/ spatial choice in the aging brain involves aberrant hippocampal activity and plasticity; 2/ spatial choice in the aging brain involves alternative behavioural strategies and neuronal networks.

We will introduce cutting-edge technologies that allow for whole-brain imaging *ex vivo* (iDISCO and light-sheet microscopy) and *in vivo* imaging of the hippocampus of the living mouse (by Inscopix minioscope). This project will be performed in collaboration with experts in brain imaging: dr. Xiaoke Chen (Stanford University) and Alessio Attardo (Max Planck Institute of Psychiatry).

Requirements:

- Master's degree in biology, psychology or related field
- Eligibility for PhD studies in Poland
- Highly talented individuals who are passionate about research and are full of scientific curiosity
- Experience in animal models will be a clear benefit
- Written and spoken fluency in English
- Willingness to learn and take new challenges, ability to work independently, analytical thinking
- Good interpersonal skills and a collaborative attitude.