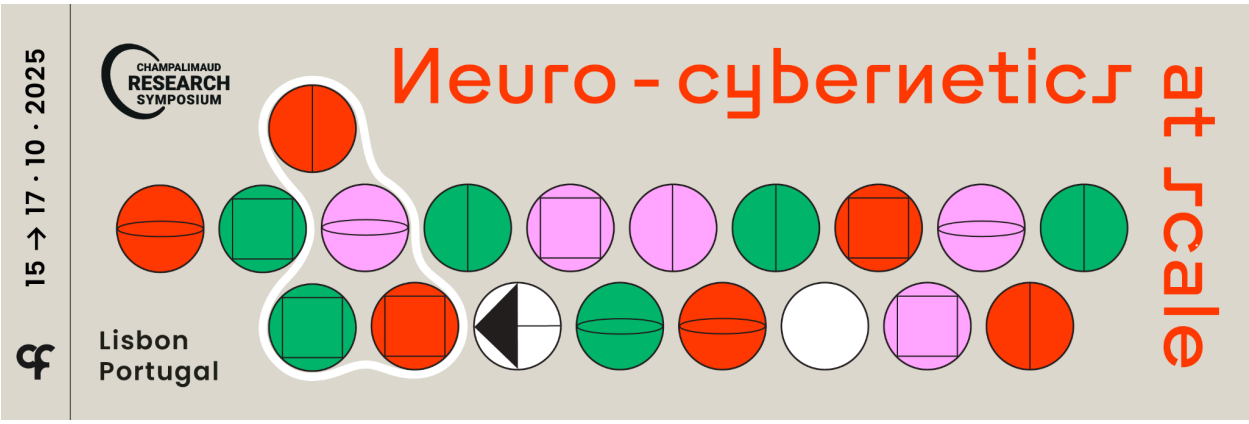

Modulation of Granule Cell Activity by Locomotion During Associative Learning

Marta Forcella 1, Merit Kruse 1, Romain Sala 1, N. Tatiana Silva 1, Megan R. Carey 1
1. Champalimaud Foundation, Lisbon, PT

Associative learning–the process by which organisms form predictive associations between events–enables behavioral adaptation to dynamic conditions [1]. This requires the representation of events (e.g. stimuli) and mapping them to appropriate responses. Such associations are often formed while animals are engaged in active behaviors like walking or running, which may influence the neural representations relevant for learning. Previous work from our lab has shown that locomotion facilitates the acquisition, consolidation and expression of delay eyeblink conditioning, a form of cerebellum-dependent associative learning [2], [3]. Specifically, increased locomotor speed accelerates the rate and amplitude of learning in mice. Locomotor state and task-related sensory inputs are conveyed via mossy fibers (MFs) to granule cells (GCs), the input layer of the cerebellum. Notably, optogenetic stimulation at the MF-GC synapses mimicking the enhanced synaptic transmission during locomotion [2], [4] has been shown to amplify the expression of conditioned responses [2]. In this project, we are investigating the mechanism by which the locomotor state influences GC activity, thus modulating learning. As an initial step, we collected two-photon calcium imaging data from cerebellar GCs before and after eyeblink conditioning, while the animals ran either on a motorized or self-paced treadmill. Early analyses suggest that stimulus processing at the GC population level differs depending on locomotor signals. These preliminary findings point to a potential modulatory mechanism by which behavioral state influences associative learning and lay the groundwork for more detailed future investigations.

cerebellar associative learning, granule cells, locomotion, two-photon calcium imaging