Introductory Remarks to Symposium 6

Cerebellum and mushroom body: common circuit motifs for learning and adaptive behaviour?

Dagmar Timmann, Johannes Felsenberg and Bertram Gerber, Essen, Basel (Switzerland) and Magdeburg

The symposium will discuss the role of the cerebellum in reinforcement learning in rodents and humans and how the proposed circuit principles relate to the function of circuit motifs uncovered from the full connectome of a cerebellum-like structure in insects, the mushroom body.

Many beliefs about how the cerebellum works have recently been challenged. In particular, new evidence from animal studies suggests that the cerebellum contributes to reinforcement learning. Here, the difference between actual and expected reinforcement is used to guide learned behavior. In the appetitive domain, the required error signals have been found in dopaminergic neurons in the substantia nigra pars compacta and the ventral tegmental area. Interestingly, recent work showed that the climbing fiber signals recorded from cerebellar Purkinje cells in mice during eyeblink conditioning also follow these learning rules in the aversive domain and that the cerebellum receives reward-related information (Ohmae et al Nat Neurosci 2015, Hull eLife 2020). This parallels recent insights from the memory center in insect brains, the mushroom body. The full chemical-synapse connectome and the genetic access to the key components of the mushroom body allowed detailed analysis of the circuits that establish aversive and appetitive reinforcement learning in *Drosophila*. Functional studies have revealed that olfactory memories are established as dopamine-driven changes at synapses between odor coding Kenyon cells and distinct output neurons that drive appetitive or aversive behavior (Aso et al eLife 2014, Owald et al Neuron 2015, Eschbach et al eLife 2021). Notably, prominent feedback connections originate from these output pathways back towards the dopamine system, possibly underlying complex forms of learning including second order conditioning and extinction (Felsenberg et al Cell 2018, König et al Biol Lett 2019, Eschbach et al Nat Neurosci 2020). Despite the obvious differences in the morphology of cerebellum and mushroom body it is the specific aim of the symposium to explore whether and how far circuit and functional principles are shared.

Symposium 6

Wednesday, March 22, 2023
15:15 - 17:15, Lecture Hall 102

Chairs: Dagmar Timmann, Johannes Felsenberg and Bertram Gerber, Essen, Basel (Switzerland) and Magdeburg

15:15 **Opening Remarks**

15:20 Dagmar Timmann, Essen
CEREBELLUM AND REINFORCEMENT LEARNING IN HUMANS AND RODENTS (S6-1)

15:45 Johannes Felsenberg, Basel, Switzerland
RECENT ADVANCES IN UNDERSTANDING THE NEURAL CIRCUITS OF ASSOCIATIVE LEARNING IN *DROSOPHILA MELANOGASTER* (S6-2)

16:10 Claire Eschbach, Saclay, France
THE FUNCTIONAL ORGANIZATION OF MUSHROOM BODY OUTPUT PATHWAYS IN LARVAL *DROSOPHILA* (S6-3)

16:35 Daniela Popa, Paris, France
THE FUNCTIONAL ORGANIZATION OF CEREBELLUM OUTPUT PATHWAYS IN RODENTS (S6-4)

17:00 Fatima Amin, Magdeburg
ACTION, VALENCE, DOPAMINE- *DROSOPHILA* AS A STUDY CASE (S6-5)

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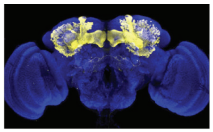

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