Bonn Lecture Series in Neuroscience

Neuromodulatory control of simple and skilled movements: from in vivo single-cell recordings to behaviour

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Life & Brain, Seminar Room, Ground Floor

The aim of my research is to understand how neuromodulators shape neuronal activity in the basal ganglia and thalamocortical networks in health and disease. Together these networks play a pivotal role in the control of body movements, which are crucial for all aspects of our daily life. However, the specific cellular and circuit mechanisms that underlie neuromodulation of neuronal activity within and the interplay between the basal ganglia, motor thalamus and motor cortex remain largely unknown.

In my talk I will focus on two neuromodulatory systems: the physiology and pathophysiology of the dopamine systems and the role of noradrenaline for motor cortex coding. To probe and selectively manipulate neural circuit function I employ a range of multi-level systems neuroscience strategies such as in vivo single-cell electrophysiology and in vivo calcium imaging in awake mice during movement execution. Combining these techniques with in vivo pharmacology, virus-based circuit mapping and optogenetics enables me to directly link the activity of defined neuronal subpopulations to behaviour.

I will discuss how phasic burst firing in identified substantia nigra dopamine neurons is controlled by ATP-sensitive potassium channels and affects novelty coding in mice and potentially neurodegeneration in human Parkinson's disease (Schiemann et al. (2012), Nature Neuroscience). By moving one step further in the network and focussing on the effects of neuromodulation on target cells, I will address the cellular and circuit mechanisms of how noradrenaline shapes neuronal activity in the primary motor cortex (Schiemann et al. (2015), Cell Reports) during simple motor behaviour (i.e. running on a treadmill). To also study noradrenergic control of skilled motor movements we recently developed a dexterous motor task in which awake, head-restrained mice execute a goal-directed lever push (Schiemann et al., in preparation; Dacre, Schiemann et al., in preparation).

Selected Publications

Schiemann et al. (2012), KATP channels in dopamine substantia nigra neurons control bursting and novelty-induced exploration, Nature Neuroscience

Schiemann et al. (2015), Cellular mechanisms underlying behavioral state-dependent bidirectional modulation of motor cortex output, Cell Reports

Schiemann et al., Noradrenergic control of skilled movements, in preparation

Dacre, **Schiemann** et al., Thalamocortical control of skilled motor behaviour, in preparation

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