Pathways for regulating escape decisions through the ventral lateral geniculate nucleus

To make decisions, humans and animals have to select appropriate actions after evaluating all available information. This is also true for instinctive, defensive decisions in response to imminent threats, for instance when deciding whether to escape or not. These reactions are adaptive and can be shaped by experience and the internal state, allowing animals to react differently to the same environmental stimuli depending on circumstance. However, how sensory information, previous knowledge and internal state are integrated by neural circuits to allow flexible behavioural decisions is still unknown.

Inhibition is thought to play a key role in enabling flexible control of behaviour, by suppressing inappropriate reactions and – through disinhibition – selecting appropriate actions. Long-range inhibition from subthalamic nuclei has recently been identified to play an important role in the regulation of instinctive behaviours, and these subthalamic circuits have been suggested to integrate external and internal signals.

The ventral lateral geniculate nucleus (vLGN) is an inhibitory, subthalamic nucleus that has been shown to provide strong, bidirectional inhibitory control over visual threat-evoked escape behaviour. Moreover, vLGN activity is modulated by previous threat experience and the anxiety state of the animal.

We have identify visual cortex and ventromedial hypothalamus provide inputs to the vLGN during visual threat signals. Furthermore, using electrophysiological recordings, calcium imaging, and optogenetic manipulations, we have tested the influence of these inputs to vLGN over instinctive defensive reactions on paradigms that allow to test the animal's behaviour depending previous knowledge and internal state.

Further characterization of these outcomes will elucidate important pathways and mechanisms by which the brain can control the generation of flexible behavioural responses to environmental stimuli depending on the behavioural context. Understanding the brain mechanisms of behavioural control is fundamental for identifying causes for inappropriate or maladaptive responses in psychiatric disorders.