

A novel corticothalamic circuit through thalamic reticular nucleus mediates flight

With the support by the National Natural Science Foundation of China, the research team led by Prof. Li XiaoMing (李晓明) at the Center for Neuroscience and Department of Neurology of Second Affiliated Hospital, Zhejiang University School of Medicine recently reported a neural circuit from cortex to thalamus mediated by thalamic reticular nucleus (TRN) in regulating flight behavior induced by fear, which was published in *Nature Neuroscience* (2019, 22: 941—949).

Fear is a natural feeling that arises when facing threats, the survival of the animal depends on rapid response to the dangerous stimuli. Flight, as an active defensive response that is evoked when the stimulus is controllable or escapable while freezing, as a passive coping strategy, is elicited when the dangerous stimulus is inescapable. Thalamic reticular nucleus (TRN), a GABAergic nucleus integrating information from cortex and thalamus, filters information between the cortex and the thalamus. However, the functional roles of long-range inputs to TRN, as well as outputs from TRN, in the expression of active or passive defensive behaviors are poorly understood.

They used the fiber photometry system and found that the increased activity of parvalbumin-expressing (PV⁺) neurons in the limbic TRN is tightly coupled with flight onset and optogenetic activation/

inactivation of PV⁺ neurons in the limbic TRN bi-directionally regulates flight. Next, combining cell-type-specific input-output viral tracing with electrophysiology, their group demonstrated that the limbic TRN PV⁺ neurons projecting to the intermediodorsal thalamic nucleus (IMD) are selectively targeted by glutamatergic inputs from cingulate cortex (Cg). Furthermore, optogenetic activation of the Cg→limbic TRN→IMD tri-circuit mediated flight. This study elucidates an important role of the limbic TRN in flight via the corticothalamic pathway.

This research not only makes a remarkable breakthrough for understanding flight behavior, but also sheds light on the circuit underlying post-traumatic stress disorder (PTSD) on the aspect of concept, leading to a new direction of this field.

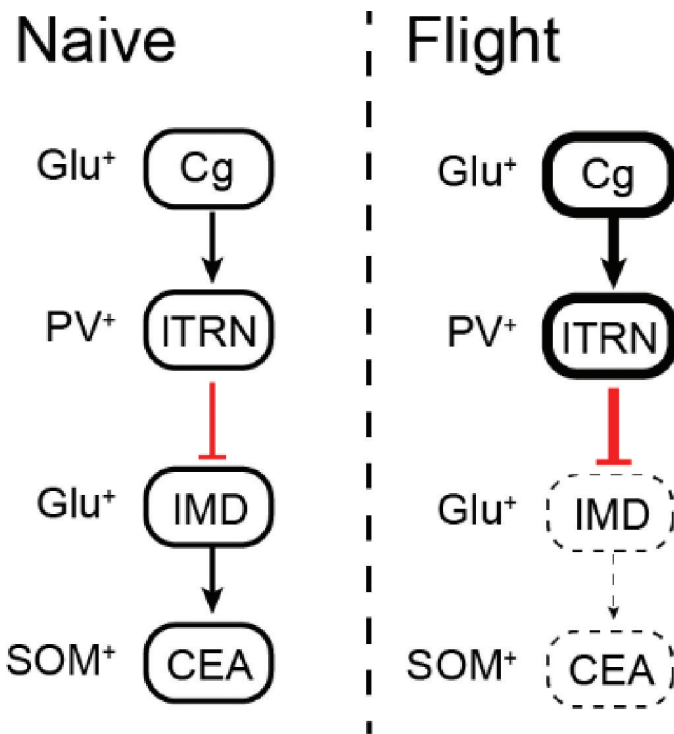


Figure Working model for the neural mechanism of the corticothalamic circuit through thalamic reticular nucleus, which mediates flight.