

A Newly Discovered Neural Pathway Links Emotional Stimuli to Wakefulness

Researchers at the University of Tsukuba have identified a previously uncharacterized neural circuit that directly links emotional processing to arousal. In the pathway, GABAergic neurons in the bed nucleus of the stria terminalis (BNST)—part of the extended amygdala—promote wakefulness by activating glutamatergic neurons in the deep mesencephalic nucleus (DpMe) of the midbrain. This circuit may be a key mechanism underlying stress-induced sleep disturbances.

Tsukuba, Japan— Emotional states and stress strongly influence sleep–wake regulation. The amygdala and its related structures have long been implicated in regulating arousal. However, the underlying neural mechanisms remain unclear.

In this study, the researchers examined how GABAergic neurons in the BNST interact with glutamatergic neurons in the DpMe to induce rapid arousal from non-rapid eye movement (NREM) sleep in mice. Optogenetic stimulation of BNST GABAergic neurons during NREM sleep resulted in immediate arousal, accompanied by a robust increase in DpMe neuronal activity. Conversely, selective ablation of glutamatergic neurons in the DpMe significantly reduced this response, demonstrating their essential role in the process.

This study was the first to thoroughly describe a BNST–DpMe neural pathway mediating emotional signals to arousal centers. In addition, the findings offer novel insights into how mental stressors such as fear and anxiety can disrupt sleep and highlights potential therapeutic targets for stress-related insomnia and mood disorders.

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