# New study finds thalamus wakes the brain during development

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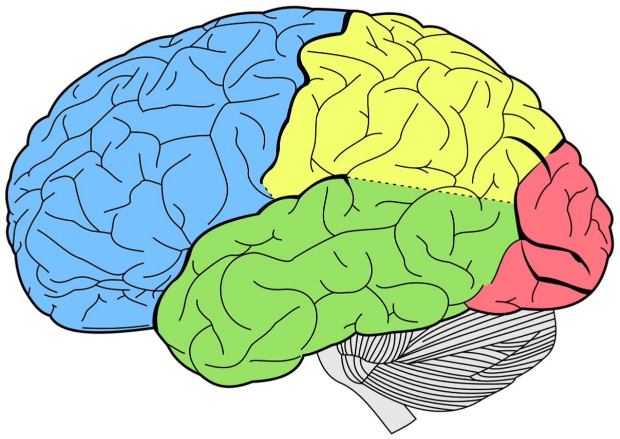

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Consciousness requires continuous, internally generated activity in the brain. The modulation of this activity is the basis of the electroencephalogram (EEG) and of generation of sleep, dreams, and perception. Achieving such activity is thus an important milestone in normal brain maturation, which occurs around birth. Successful transition to this activity indicates a good prognosis for babies born prematurely and/or suffering from damage to the brain.

To be functional as a dreaming, seeing, and thinking entity the brain need to achieve two milestones: continuity, which means that the brain is always active and state dependence, meaning brain activity is modulated by sleep, waking, and attention. The circuit mechanisms behind the development of continuity and state dependence in the brain have remained unknown, but have been widely assumed to be located in the cerebral cortex, the convoluted brain structure responsible for thought and perception.

A team from the George Washington University (GW) has published a study in the *Journal of Neuroscience* suggesting instead that the thalamus, a tiny nucleus deep in the brain, actually controls the development of state dependence and continuity.

"Our results indicate that cellular changes in the thalamus relay function may be critical drivers for the maturation of background activity," Matthew Colonnese, Ph.D., associate professor of pharmacology and physiology at the GW School of Medicine and Health Sciences, said. "Humans undergo developmental transitions in brain activity before and near birth."

Drawing on previous work by Colonnese, his team used advanced techniques to record simultaneously from multiple brain regions to pinpoint the circuit change responsible for the acquisition of continuity and state dependence measured in the sensory cortex. They were surprised to learn that activity changes in the thalamus, rather than the local cortical circuitry or the interconnectivity of two structures, can explain most of these critical developmental milestones.

"From a clinical perspective, certain things can go wrong in birth, like hypoxic-ischemic encephalopathy, brain injury caused by lack of oxygen to the brain, and the brain can revert to a state of discontinuity or never develop continuity," said Colonnese. "These findings could help us understand the circuit basis of human EEG development to improve diagnosis and treatment of infants in vulnerable situations. By putting the development of the EEG on a mechanistic basis we hope to increase its utility in the clinic."

Colonnese and his team, which includes Yasunobu Murata, Ph.D., a research scientist in Colonnese's lab at GW and co-author of the study, are working to develop a comprehensive atlas of EEG patterns and brain lesions that cause them to aid in this process.

Now that they have established the thalamus is in control, he said, the next step is to further define what circuit changes occur in brain development so clinicians can pinpoint from an EEG what's gone wrong in cases like hypoxic-ischemic encephalopathy.

The study, titled "Thalamus Controls Development and Expression of Arousal States in Visual Cortex" is published in the *Journal of Neuroscience*.

**More information:** Yasunobu Murata et al, Thalamus Controls Development and Expression of Arousal States in Visual Cortex, *The Journal of Neuroscience* (2018). DOI: 10.1523/JNEUROSCI.1519-18.2018

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