

Thalamus and cerebral cortex interactions influence the decision on sensory perceptions

2 April 2019



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When we receive a stimulus, sensory information is transmitted by the afferent nerves to the thalamus, which in turn, like a relay, forwards the information to the sensory cortex to process it and consciously perceive the stimulus. But, does this information travel only in the thalamus-cortex direction? And, is this journey a determining factor in the subsequent conscious perception of this stimulus?

To answer these questions, a study carried out between the Center for Brain and Cognition (CBC) of the Department of Information and Communication Technologies (DTIC) at UPF, and the Cellular Neurophysiology Group of the Autonomous University of Mexico, has determined the influence that [functional interactions](#) between the neurons in the thalamus and the [sensory cortex](#) have on the sensory perception of tactile stimuli. The authors published their work on 25 March in *Proceedings of the National Academy of Sciences*.

For the experimental phase of the study, the researchers recorded the [neural activity](#) of two monkeys within the same receptive field of the ventral posterolateral nucleus of the thalamus and of the primary somatosensory area simultaneously, while the subjects performed a vibrotactile detection task. This task consisted of the random presentation of trials in which the animal received a tactile vibration of variable intensity on the hand, and trials without vibration. At the end of each trial, the animal had to indicate the presence or absence of the stimulus by pressing a button. To dissociate sensory representation and decision phenomena, the recordings were repeated during a control task in which the monkeys received the same pattern of stimulation but did not have to indicate their decision.

During these paradigms, the researchers used 84 simultaneous pairs of neurons and over 10,000 trials to estimate the directional interdependencies established between the activity of neurons (action potential trains) in each area in each individual trial and how these interdependencies relate with experimental parameters such as the amplitude of the stimulus and the monkey's response.

The results show that during stimulus reception, the level of neuronal interactions in the thalamus-cortex direction ("feedforward") significantly increases, while this does not take place in the opposite direction ("feedback"). In addition, the authors show that the levels of "feedforward" interactions are statistically associated with the context of the task and the accurate perception of those stimuli that are at the subject's detection threshold."

As the first author of the work, Adrià Tauste says, "Previously, it was known that these two areas (thalamus and primary somatosensory area) were essentially sensorial in that their neural activity

represented [information](#) about stimuli, regardless of whether they were later detected by the subject or not. We now know that the functional connections established by the neurons in each area in the thalamus-cortex direction may also determine the decision taken by the monkey on the existence of the tactile stimulation received."

In addition, the authors have identified a second type of interaction that is cognitively relevant, which expresses the simultaneous synchronization of the two sensory areas. They only manifest when the [stimulus](#) appears, and must be processed to determine its existence. Authors Adrià Tauste and Gustavo Deco add, "These interactions may reflect the necessary participation of third cortical areas exerting a "top-down" influence in the two areas of the study, which shows that sensory perception is the result of a complex neural network from the time the [sensory information](#) reaches the brain."

More information: Adrià Tauste Campo et al, Feed-forward information and zero-lag synchronization in the sensory thalamocortical circuit are modulated during stimulus perception, *Proceedings of the National Academy of Sciences* (2019). [DOI: 10.1073/pnas.1819095116](https://doi.org/10.1073/pnas.1819095116)

Provided by Universitat Pompeu Fabra -
Barcelona

APA citation: Thalamus and cerebral cortex interactions influence the decision on sensory perceptions (2019, April 2) retrieved 6 June 2022 from <https://medicalxpress.com/news/2019-04-thalamus-cerebral-cortex-interactions-decision.html>

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