

# Pain: Perception and motor impulses arise in brain independently of one another

13 December 2018



Laura Tiemann, first author of the new study about pain perception, prepares together with Markus Ploner, Heisenberg Professor for Human Pain Research, a volunteer for the EEG-measurements. Credit: Kurt Bauer / Technical University of Munich

Pain is a negative sensation that we want to get rid of as soon as possible. In order to protect our bodies, we react by withdrawing the hand from heat, for example. This action is usually understood as the consequence of the perception of pain. A team from the Technical University of Munich (TUM) has now shown that perception, the impulse to act and provision of energy to do so, take place in the brain simultaneously, and not, as was expected, one after the other.

Led by Markus Ploner, Heisenberg Professor for Human Pain Research, scientists from the Department of Neurology of the university hospital TUM Klinikum rechts der Isar investigated in detail how a painful event is processed in the brain. For the first time, they were able to show that the brain yields at least three responses to a painful stimulus, and that these responses are simultaneous and independent of one another. The results may have fundamental repercussions for

the understanding of [pain](#) and treatment of patients.

Pain embodies at least three factors: Perception of pain, an action such as withdrawing the hand from a hot stove, and response of the autonomic nervous system, which provides the necessary energy for the action. The autonomic nervous system controls essential functions such as heart rate, breathing, digestion and metabolism.

In their experiments, the researchers applied short pain stimuli of varying strengths to the back of the hands of healthy volunteers. The perception of pain was determined based on the participants' evaluation of the stimulus on a rating scale. The team, led by Markus Ploner, investigated the action component based on the [reaction time](#) the subjects needed to withdraw their fingers in response to the stimulus. Moreover, to determine the response of the autonomic nervous system, the team measured the sweat production at the interior surface of the hand.

For the entire duration of the experiment, brain activity was measured using electroencephalography (EEG). This method provides highly precise information on when and how nerve cells react to pain stimuli.

## **Pain components arise independently of one another**

Ploner and his team applied a statistical method known as mediation analysis to the data. The method has been well established in the social sciences for some time ; however, this was its first application to EEG data. The team was thus able to find out which brain responses serve the three pain components, and when exactly they take place.

The results of the evaluations surprised the researchers: "For the first time we were able to see that the brain responses to the pain components did not take place one after the other, but rather in

part simultaneously. This means that the preparation for action and the provision of energy are not entirely dependent on the perception of pain; instead they are in part triggered independently of one another," explains Laura Tiemann, the study's lead author.

These findings could be of great importance to patients suffering from chronic pain. Ploner recommends considering all three components of pain in comprehensive pain therapy: "For chronic pain patients, it is possible that not only the perception of pain, but also the preparation and performance of actions against pain and the provision of the energy to do so are changed. Our findings are thus a biological argument for holistic pain therapy approaches that take different pain components into account. Such approaches would include psychotherapy and [drug therapy](#) as well as physiotherapy," Ploner says. This kind of therapy, referred to as multimodal pain therapy, is already being offered at the TUM Interdisciplinary Center for Pain Medicine.

**More information:** Laura Tiemann et al, Distinct patterns of brain activity mediate perceptual and motor and autonomic responses to noxious stimuli, *Nature Communications* (2018). [DOI: 10.1038/s41467-018-06875-x](#)

Provided by Technical University Munich

APA citation: Pain: Perception and motor impulses arise in brain independently of one another (2018, December 13) retrieved 15 August 2022 from <https://medicalxpress.com/news/2018-12-pain-perception-motor-impulses-brain.html>

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