Study identifies brain regions activated when pain intensity doesn't match expectation

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Nurse gives injection to woman, New Orleans, 1941. Credit: Wikipedia.

Picture yourself in a medical office, anxiously awaiting your annual flu shot. The nurse casually states, "This won't hurt a bit." But when the needle pierces your skin it hurts, and it hurts a lot. Your expectations have been violated, and not in a good way.

In a study published in the early online edition of the journal *Pain*, researchers at Wake Forest Baptist Medical Center have identified through imaging the part of the brain that is activated when a person expects one level of pain but experiences another.

"This finding gives us a better understanding of the importance of how our expectations of pain affect the experience of pain," said Fadel Zeidan, Ph.D., assistant professor of neurobiology and anatomy at Wake Forest Baptist and first author of the study. "This effect shows us how important it is to manage people's expectations when it comes to pain."

Previous studies have shown that the expectation of intense pain can make pain feel worse while the expectation of milder pain can make it hurt less. However, the brain mechanisms associated with processing mismatches between expected and experienced pain have been poorly understood.

This Wake Forest Baptist study found that activation of the parietal lobe and insular cortex are involved in processing real-time mismatches between expected and experienced pain.

First, 15 healthy participants were trained to expect mild or intense levels of pain when showed visual cues of the words "low" and "high." Heat was applied to the participants' legs with thermal probes. The heat stimuli—47 degrees C (116.6 F) or 50 degrees C (122 F)—were designed to elicit markedly different experiences of pain intensity. Participants used a plastic sliding scale to indicate pain intensity and unpleasantness.

Next, the participants underwent functional neuroimaging scanning to measure their brain activity while they received the different levels of heat following both correct and incorrect cues.

Brain activity during the exact moment when the subjects realized the cues were incorrect was identified. This allowed the researchers to assess how the experience of pain overrides the very powerful influence of expected pain when there was a difference between cues and ensuing thermal stimulation.

"We found that multiple regions within the left posterior parietal cortex are differentially engaged when the expectation of an impending painful stimulus is violated," said the study's senior author, Robert Coghill, Ph.D., director of anesthesiology research at Cincinnati Children's Hospital. "These brain regions also have been found to be associated with violated expectations to visual, auditory and taste stimuli."

These findings demonstrate that the powerful influence of expectations on the subjective experience of pain can be dramatically altered when there is a substantial difference between expected and experienced pain.

"Knowing how vital trust is to the doctor-patient relationship, we hope these findings will help physicians and other caregivers have a better understanding of the importance of how what patients expect affects their experience of pain," Zeidan said.

Provided by Wake Forest University Baptist Medical Center