

# Does that hurt? Objective way to measure pain being developed at Stanford

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Researchers from the Stanford University School of Medicine have taken a first step toward developing a diagnostic tool that could eliminate a major hurdle in pain medicine — the dependency on self-reporting to measure the presence or absence of pain. The new tool would use patterns of brain activity to give an objective physiologic assessment of whether someone is in pain.

The scientists used functional magnetic resonance imaging scans of the brain combined with advanced computer algorithms to accurately predict thermal pain 81 percent of the time in healthy subjects, according to a study that will be published Sept. 13 in the online journal *PLoS ONE*.

"People have been looking for a pain detector for a very long time," said Sean Mackey, MD, PhD, chief of the Division of Pain Management and associate professor of anesthesiology. "We're hopeful we can eventually use this technology for better detection and better treatment of [chronic pain](#)."

Researchers stressed that future studies are needed to determine whether these methods will work to measure various kinds of pain, such as chronic pain, and whether they can distinguish accurately between pain and other emotionally arousing states, such as anxiety or depression.

"A key thing to remember is that this approach objectively measured thermal pain in a controlled lab setting," Mackey said. "We should take care not to extrapolate these findings to say we can measure and detect

pain in all circumstances."

The need for a better way to objectively measure pain instead of relying on the current method of self-reporting has long been acknowledged. But the highly subjective nature of pain has made this an elusive goal.

Advances in neuroimaging techniques have re-invigorated the debate over whether it might be possible to measure pain physiologically, and, in fact, led to this current study.

"We rely on patient self-reporting for pain, and that remains the gold standard," said Mackey, senior author of the study. "That's what I, as a physician, rely on when I take care of a patient with chronic pain. But there are a large number of patients, particularly among the very young and the very old, who can't communicate their pain levels. Wouldn't it be great if we had a technique that could measure pain physiologically?"

A study released by the Institute of [Medicine](#) in June reported that more than 100 million Americans suffer chronic pain, costing around \$600 billion each year in medical expenses and lost productivity. (Mackey was a member of the committee that produced the report.) What's more, it found that cultural bias against chronic pain sufferers as being weak or even worse — they are often perceived as lying about their pain — complicates the delivery of appropriate treatment. Similar biases crop up in the legal field, with hundreds of thousands of cases each year that hinge on the existence of pain, said Stanford law professor Hank Greely, an expert on the legal, ethical and social issues surrounding the biosciences.

"A robust, accurate way to determine whether someone is in pain or not would be a godsend for the legal system," said Greely, who did not participate in the study.

The idea for this study germinated at a 2009 Stanford Law School event organized by Greely that brought together neuroscientists and legal scholars to discuss how the neuroimaging of pain could be used and abused in the legal system. Mackey and two of his lab assistants attended.

"At the end of the symposium, there was discussion about the challenges of creating a 'painometer.' I discussed hypothetically how we could do this in the future," Mackey said. "These two young scientists in my lab came up to me after and said, 'We think we can do this. We would like to try.' I was skeptical."

The two scientists — Neil Chatterjee, currently a MD/PhD student at Northwestern University, and first author of the study Justin Brown, PhD, now an assistant professor of biology at Simpson College — came up with the concept in a discussion after the symposium.

"It was very much on a whim," said co-author Chatterjee. "We thought, maybe we can't make the perfect tool, but has anyone ever really tried doing this on a very, very basic level? It turned out to be surprisingly simple to do this."

Researchers took eight subjects, and put them in the brain-scanning machine. A heat probe was then applied to their forearms, causing moderate pain. The brain patterns both with and without pain were then recorded and interpreted by advanced computer algorithms to create a model of what pain looks like. The process was repeated with a second group of eight subjects.

The idea was to train a linear support vector machine — a computer algorithm invented in 1995 — on one set of individuals, and then use that computer model to accurately classify pain in a completely new set of individuals.

The computer was then asked to consider the brain scans of eight new subjects and determine whether they had thermal pain.

"We asked the computer to come up with what it thinks [pain](#) looks like," Chatterjee said. "Then we could measure how well the computer did." And it did amazingly well. The computer was successful 81 percent of the time.

"I was definitely surprised," Chatterjee said.

Provided by Stanford University Medical Center

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