

# Four questions—chronic pain and how it affects the brain

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Credit: University of Arizona

Chronic pain affects an estimated 100 million Americans, and its impact goes beyond physical discomfort.

New research, led by University of Arizona psychologist Stephen Cowen, illustrates how chronic [pain](#) may impact cognitive abilities, such as [decision making](#), as well.

Cowen and UA professor of pharmacology Frank Porreca, along with their collaborators at Eli Lilly, investigated how pain impacts [cognitive flexibility](#), or the ability of the brain to learn new information. The study, recently published in the journal *Pain*, revealed that the ability to adapt to changing situations may be hindered in those with chronic pain.

"Cognitive flexibility is a broad term, but overall, it's your ability to adapt to new information, being flexible with your learning," said Cowen, an assistant professor in the UA Department of Psychology. "For example, you might initially learn one route to work, and you do that day after day, and then the next two days in a row there's construction. You should be able to reroute yourself and not, out of habit alone, keep going down that path that always makes you late for work."

In Cowen's study, rats with neuropathic pain were able to learn a basic task—pulling a designated lever to receive a food reward—at the same rate as control groups. However, they were much slower than rats without pain to adapt when conditions changed, and a new lever was introduced that produced more food.

The findings provide insight into how pain may hinder cognitive flexibility in humans, Cowen said.

## **Q: What motivated you to look at chronic pain as it relates to decision making?**

A: Traditionally, what we're mostly concerned about with chronic pain is the pain itself—the emotional component of the pain or the physical feeling of pain. Those are the things we usually focus on, and rightly so, but there are also other consequences of having chronic pain that affect your ability to learn and make decisions, and that's what we focused on with this study. We wanted to see what types of learning deficits or

alterations in your ability to adapt to new information are affected by chronic pain, and that's something that's very rarely been looked at in the field.

**Q: What are the implications of your findings for people suffering with chronic pain?**

A: It's something to be aware of and think about. If you're suffering from chronic pain, your ability to make good decisions or adapt to new information might be compromised. You might not realize it, but your friends and others might notice that you're sticking to what you know. You're not venturing out, you're not trying new things, you're not learning new information. You're kind of on autopilot. So this might be an unforeseen consequence of chronic pain that we don't study enough. In the past, we've focused more on the immediate effect of just the pain itself, which is very important, but some of the more detrimental consequences may be in the poor decisions that are made.

With most of the therapies we test for chronic pain, nobody looks at the effects on treating the cognitive or learning deficits that perhaps are accompanying chronic pain. In our study, we found maybe we should start looking at that. If, for example, one therapy can reduce chronic pain but makes the learning deficits bad or worse, then we need alternative therapies. Ideally, we need to find approaches that treat the pain and improve the ability to learn.

**Q: Why do we see the connection between chronic pain and cognitive flexibility, and what are the next steps for this research?**

A: I study the frontal cortex, the frontal part of the brain that we think is so important for decision making and cognitive flexibility. The frontal

cortex is really important for the ability to override our basic instincts, in a sense, and to be more adaptive to new information. There's also considerable evidence that the activity of the frontal cortex, especially in an area called the anterior cingulate cortex in the middle of the frontal cortex, is very much associated with chronic pain—so much so, that in extremely severe cases of chronic pain that are resistant to other treatments, doctors can actually lesion or destroy that region of the brain, and it can relieve the pain in humans. There may be other negative consequences of this radical approach, but in rare cases, this can provide an option for chronic pain that allows someone to lead a remotely normal life.

When you have chronic pain, the neuronal activity in the frontal cortex changes considerably. We thought that these changes would result in an inability to adapt to new information, and, sure enough, that's what we found. We didn't directly measure frontal activity—we didn't look at the neuroscience—so that's what we really would like to do next, and that's what my lab's specialty is: recording the activities of neurons in the brain during decision making and during learning. So one of our next steps is to collaborate on studies looking at the neural basis for these changes in chronic pain and decision making.

## **Q: What excites you most about this work?**

A: The reason I love doing this stuff is that it gives you brief glimpses into mechanisms. If I can get a glimpse into how this great machine of ours called the brain works and understand how interactions between groups of neurons lead to a memory, lead to an action, lead to a decision—that's the most exciting thing. I really want to look under the hood and get a glimpse of what the system is doing. I'm very interested in the translational component too: How do we take what we're doing and help patients? A very important component of that is to figure out the mechanism, and that might be without any disease in mind at

all—looking at how we make decisions, regardless of whether or not it's somebody with chronic pain. The neural basis of decision making is not understood, so I'm very interested in these core mechanisms involved in how neurons wire up during learning, or how they change their activity during [decision](#) making under normal conditions or in disease states, including [chronic pain](#).

**More information:** Stephen L. Cowen et al. Chronic pain impairs cognitive flexibility and engages novel learning strategies in rats, *PAIN* (2018). [DOI: 10.1097/j.pain.0000000000001226](https://doi.org/10.1097/j.pain.0000000000001226)

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