Relief

October 30, 2015

Whether it’s from an unrelenting backache, a persistently stiff neck, or arthritis in the knee, chronic pain — pain that lasts more than 12 weeks — is considered a disease by the US government’s National Institutes of Health.

Chronic pain from any source affects mood along with physical and mental functioning, making it the most common cause of long-term disability in the United States. As baby boomers everywhere get older, “chronic pain is arguably the biggest health burden our species faces at the moment in terms of years lived with disability and economic load,” says Lorimer Moseley, a clinical neuroscientist at the University of South Australia.

Because pain is unique to every person, it’s difficult to quantify and treat, making it a major ongoing focus of study for psychological science. Clinicians already deliver a range of mind-based treatments, from guided relaxation, stress management, and self-hypnosis to cognitive-behavioral therapy (CBT), which helps patients challenge catastrophic thoughts about their pain. Increasingly, scientists are using new insights into the brain to devise new forms of pain relief. In pilot studies that involve interventions ranging from placebos to virtual-reality technology, they’re building a solid body of evidence on the power of perception to muffle pain.

The Path of Danger Signals

Pain results from signals that travel a specific circuit in the brain, moving from sensation to feeling to action through multiple cortical and subcortical pathways, says psychological scientist Tor Wager, director of the Cognitive and Affective Neuroscience Laboratory at the University of Colorado Boulder.

The brain’s somatosensory cortical area ordinarily responds to a real-world “painful” stimulus by generating danger signals. These new signals move to the midbrain’s periaqueductal gray area, which (with the thalamus) modulates pain by releasing opioids, the body’s natural painkillers. From there, the signals move deeper into the brain, where the cingulate and anterior insula offer guidance on whether and how to take action.

Next, the frontal lobes appraise the signal and give it meaning: Via a secondary pathway, the ventromedial prefrontal cortex and striatum evaluate the signal, attach emotions to the experience, and decide what to do — making this adjunct pathway a potentially important intervention point.

Depending on the individual and the circumstances, this frontal-lobe evaluation can make things better or worse. Wager says, “In chronic pain, the meaning signals get amplified. It’s not necessarily conscious, but it can lead to a maladaptive response,” and people might avoid physical activity that could help prevent a downward spiral.

Neuroimaging techniques such as fMRI are central to research into the brain circuitry that ultimately produces pain, but they are not yet useful for making diagnostic or therapeutic decisions. Not only are most neuroimaging scans expensive to conduct and uncomfortable for the patient, they have not yet been demonstrated to be clinically useful for reaching conclusions about any given person’s subjective experience of pain. In this regard, self-report remains essential to assessing individual pain experiences. But the addition of other, more objective measurements could help to dispel the erroneous notion of “psychosomatic pain.”

“There’s a long history of equating ‘It’s in your head’ with ‘It’s not real,’” says Wager. “We don’t listen to or believe people in pain. That’s a problem, especially for women and members of minority groups whose pain is underdiagnosed and undertreated.

“You don’t want to use something as a pain lie detector,” he says, “but an objective measure could corroborate pain and also help show how much is coming from the spinal cord, how much from muscle tension, how much from cognitive evaluation, and so on.”

Objective measures also could help in clinical trials of pain medications, allowing researchers and clinicians to assess the physiological components of pain and identify which drugs work best for different types of pain. Some measures currently under investigation include skin-punch biopsies of soft tissue to check for abnormalities, blood tests for inflammatory chemicals released during episodes of pain, and even computerized facial-expression tests.

Researchers hope to assess whether these and other measuring techniques can at least give enough information to make sound clinical decisions.

Placebos and Perception

While many researchers are trying to get a better grasp on how to measure pain, others are investigating mind-based approaches to reducing and managing pain, including some simple perceptual “tricks.”

The power of placebo has been scientifically supported as a strategy for managing pain for more than 15 years. It’s typically thought of as a phenomenon that results from our expectations about the effects that certain medications or treatments will have, but newer research suggests that conditioned learning may play as much of a role as the power of expectation in the response to a pretend “treatment.”

Using a heated probe placed on a participant’s forearm — a standard laboratory pain stimulus — Wager and his colleagues found that the placebo effect remained even after study participants were told and shown that a blue-colored “analgesic” cream was actually fake.

In the study, researchers first set a positive expectation for the placebo by subjecting placebo recipients to lower heat than they realized. Once these participants associated the placebo with less pain, they reported that it worked significantly better than the white control cream.

The researchers then told participants that the “active ingredient” cream was a sham, showing how they had used blue food coloring to turn the inactive white cream into the “active” cream. Yet in subsequent experimental trials, even after participants said they understood that the blue cream was a fake, they continued to report that it offered significant pain relief.

This means that the participants retained the association they learned early in the experiment — for several days, a long time for this kind of study. The implication is exciting: If people can connect a stimulus (placebo) with pain relief and understand that they have some control over their pain, their hopeful belief could spur a positive feedback cycle — the exact opposite of the negative spiral into chronic pain. Importantly, the “active ingredients” of placebos include factors — such as social support, medical rituals, and a sense of self-efficacy — that may indeed help reduce pain. This “power of placebo” can be harnessed in treatment not so much by giving people fake drugs, but by ramping up and systematically using these natural pain-mitigating processes.

Wager hopes that psychological scientists can continue to learn the true benefits of placebo and work them into pain treatments in a way that is acceptable to patients — and effective. “The psychological context for introducing pain treatment matters potentially quite a lot,” he says.

A 2014 study conducted by a multidisciplinary team of researchers that included University of Luxembourg psychological scientist Fernand Anton provided converging evidence for the role of conditioning in pain experiences. Participants experienced a painful electric pulse to one foot while they simultaneously put one hand in a bucket of ice water, the bracing sensation of the ice water actively mitigating the pain of the shock. The researchers found that participants who heard a telephone ringtone while engaging in this active pain reduction strategy came to associate the ringtone with pain reduction; they subsequently reported significantly lower pain from the pulse when exposed only to the ringtone. The finding reinforces how learned associations can help people regulate pain.

Meanwhile, a study published early this year in *Psychological Science* revealed the potential for virtual reality to help us understand and alleviate chronic pain. Virtual reality has been employed in related ways, such as by using mirrors to reduce phantom-limb pain and to distract during painful procedures. The new study investigated whether a decidedly more high-tech solution might also be effective in managing pain.

Moseley, coauthor Daniel Harvie (also of the University of South Australia), and colleagues recruited 24 people with chronic neck pain. Each sat in a chair, strapped in by a seat belt, while wearing a virtual-reality head-mounted display plus headphones to block out incidental noise. The headgear also recorded participants’ head movements using gyroscopes. With this setup, the researchers were able to manipulate various virtual indoor and outdoor scenes relative to how far participants rotated their necks.

In a baseline condition and in all experimental trials, participants reported the point at which they felt neck pain. On some trials, visual feedback misled participants by showing them scenery moving either faster or slower than would be expected based on their actual movements.

Consistent with the researchers' hypothesis, learned cues from the virtual world altered the onset of pain in a robust and predictable way.

Using faster-moving scenery to trick the brain into thinking the head turned more than it actually had led to earlier onset of pain, at an average of 7% less rotation compared with baseline. Conversely, tricking the brain into thinking the head turned less than it actually had gave participants on average 6% more pain-free movement. Both changes were at the level of significance.

Given that normal left–right neck rotation is 70 degrees, these results indicate that the manipulated visual feedback allowed participants to gain a significantly greater pain-free range of motion without medication or physical intervention.

If chronic pain can be conditioned by virtual cues, the implications could be far-reaching. The technology is still relatively new, and cost and safety considerations will have to be addressed, but Moseley believes that these findings represent "the start of a journey that might lead to real impact at a therapeutic level."

The ability to induce lasting reductions in pain even after patients take off the headsets would be an important first step on this journey. "If we can do that," Moseley says, "then we could devise a treatment protocol, test it, and if it still works, we could attempt a randomized controlled trial. It is absolutely critical that we take that journey before we start using virtual reality clinically."

Other intriguing research also revolves around perceptual tricks that alter pain. For example, in a study published in *Psychological Science*, European researchers led by Flavia Mancini of University College London, United Kingdom, found that when they placed a heat probe on participants' hands and raised the temperature, participants perceived pain at temperatures that were about 3 degrees Celsius higher (5.4 degrees Fahrenheit higher) when they looked at that hand compared with when they looked at another object.

Healthy participants perceived pain at even higher temperatures when they looked at their hands in special mirrors that made their hands look bigger. When their hands looked smaller, they experienced a reduced pain threshold.

It is not fully understood exactly why and how looking at our body (in the absence of injury) can modulate pain, but further research (led by Matthew Longo of Birkbeck, University of London, United Kingdom) has shown that it involves communication between visual and somatosensory brain regions.

"Pain is an alarm signal of danger," says Mancini. "It is bad news for us and for our brain. To ensure appropriate responses to pain, our brain interprets painful sensations in relation to the context. In our experiment, the context was the view of one's own hand without any sign of injury. This is good news — there is no damage. So our brain uses this information to down-regulate pain."

These results also underscore the ease with which psychological manipulations can alter the experience of pain.

Next-Generation Treatments

Mark Jensen of the University of Washington, a pioneer in psychosocial pain management, says that because the biomedical model of pain has been hard to dislodge, both traditional and investigative psychological pain-relief techniques continue to seem new and surprising. Yet the evidence in their favor continues to mount.

“We have known about their potential for decades,” Jensen says.

Guided by insights from psychological science, front-line practitioners such as primary-care doctors and physical therapists could benefit from being familiar with the research, Jensen adds.

“These are the people,” he argues, “that need the most education regarding contemporary biopsychosocial models of chronic pain, and [who need] to learn how to communicate with patients to encourage them to engage in activities that will lead to healing, such as exercise and other ongoing activities, while avoiding prescription and over-the-counter pain relievers.”

At the same time, it’s crucial to curtail the development of chronic pain in the first place. One important strategy, says Jensen, would be to begin medical treatment by making a “pain plan” for acute pain patients at risk of lapsing into chronic pain. Red flags could include such variables as patient-reported fear of pain and depression, as well as pain that doesn’t fade within weeks of an injury, he says.

As Jensen envisions it, bringing basic-science research on pain into clinical settings will allow for the emergence of a holistic treatment model involving interdisciplinary teams of physicians, physical therapists, nurses, occupational therapists, psychologists, and social workers communicating with one another as they provide treatment.

Further Reading

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