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Rewiring the Brain to Ease Pain

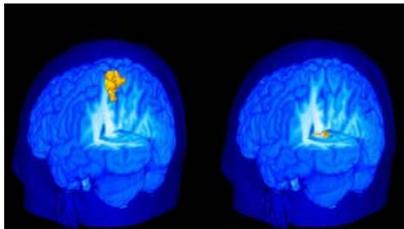
Brain Scans Fuel Efforts to Teach Patients How to Short-Circuit Hurtful Signals



By MELINDA BECK

How you think about pain can have a major impact on how it feels.

That's the intriguing conclusion neuroscientists are reaching as scanning technologies let them see how the brain processes pain.



Alternative remedies for relief of chronic pain are getting new attention and respect these days. Melinda Beck has details on Lunch Break.

That's also the principle behind many mind-body approaches to chronic pain that are proving surprisingly effective in clinical trials.

Some are as old as meditation, hypnosis and tai chi, while others are far more high tech. In studies at Stanford University's Neuroscience and Pain Lab, subjects can watch their own brains react to pain in real-time and learn to control their response—much like building up a muscle. When subjects focused on something distracting instead of the pain, they had more activity in the higher-thinking parts of their brains. When they "re-evaluated" their pain emotionally—"Yes, my back hurts, but I won't let that stop me"—they had more activity in the deep brain structures that process emotion. Either way, they were able to ease their own pain significantly, according to a study in the journal *Anesthesiology* last month.

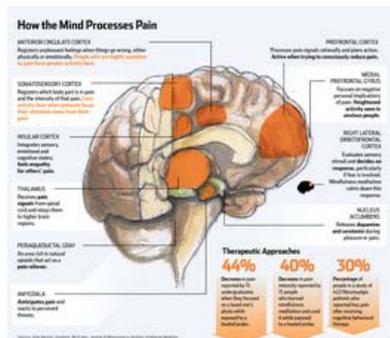
While some of these therapies have been used successfully for years, "we are only now starting to understand the brain basis of how they work, and how they work differently from each other," says Sean Mackey, chief of the division of pain management at Stanford.

He and his colleagues were just awarded a \$9 million grant to study mind-based therapies for chronic low back pain from the government's National Center for Complementary and Alternative Medicine (NCCAM).

Some 116 million American adults—one-third of the population—struggle with chronic pain, and many are inadequately treated, according to a report by the Institute of Medicine in July.

Yet abuse of pain medication is rampant. Annual deaths due to overdoses of painkillers quadrupled, to 14,800, between 1998 and 2008, according to the Centers for Disease Control and Prevention. The painkiller Vicodin is now the most prescribed drug in the U.S.

"There is a growing recognition that drugs are only part of the solution and that people who live with chronic pain have to develop a strategy that calls upon some inner resources," says Josephine Briggs, director of NCCAM, which has funded much of the research into alternative approaches to pain relief.



Already, neuroscientists know that how people perceive pain is highly individual, involving heredity, stress, anxiety, fear, depression, previous experience and general health. Motivation also plays a huge role—and helps explain why a gravely wounded soldier can ignore his own pain to save his buddies while someone who is depressed may feel incapacitated by a minor sprain.

"We are all walking around carrying the baggage, both good and bad, from our past experience and we use that information to make projections about what we expect to happen in the future," says Robert Coghill, a neuroscientist at Wake Forest Baptist Medical Center in Winston-Salem, N.C.

Dr. Coghill gives a personal example: "I'm periodically trying to get into shape—I go to the gym and work out way too much and my muscles are really sore, but I interpret that as a positive. I'm thinking, 'I've really worked hard.'" A person with fibromyalgia might be getting similar pain signals, he says, but experience them very differently, particularly if she fears she will never get

better.

Dr. Mackey says patients' emotional states can even predict how they will respond to an illness. For example, people who are anxious are more likely to experience pain after surgery or develop lingering nerve pain after a case of shingles.

That doesn't mean that the pain is imaginary, experts stress. In fact, brain scans show that chronic pain (defined as pain that lasts at least 12 weeks or a long time after the injury has healed) represents a malfunction in the brain's pain processing systems. The pain signals take detours into areas of the brain involved with emotion, attention and perception of danger and can cause gray matter to atrophy. That may explain why some chronic pain sufferers lose some cognitive ability, which is often thought to be a side effect of pain medication.

The dysfunction "feeds on itself," says Dr. Mackey. "You get into a vicious circle of more pain, more anxiety, more fear, more depression. We need to interrupt that cycle."

One technique is attention distraction, simply directing your mind away from the pain. "It's like having a flashlight in the dark—you choose what you want to focus on. We have that same power with our mind," says Ravi Prasad, a pain psychologist at Stanford.

Guided imagery, in which a patient imagines, say, floating on a cloud, also works in part by diverting attention away from pain. So does mindfulness meditation. In a study in the *Journal of Neuroscience* in April, researchers at Wake Forest taught 15 adults how to meditate for 20 minutes a day for four days and subjected them to painful stimuli (a probe heated to 120 degrees Fahrenheit on the leg).

Brain scans before and after showed that while they were meditating, they had less activity in the primary somatosensory cortex, the part of the brain that registers where pain is coming from, and greater activity in the anterior cingulate cortex, which plays a role in handling unpleasant feelings. Subjects also reported feeling 40% less pain intensity and 57% less unpleasantness while meditating.

"Our subjects really looked at pain differently after meditating. Some said, 'I didn't need to say ouch,' " says Fadel Zeidan, the lead investigator.

Techniques that help patients "emotionally reappraise" their pain rather than ignore it are particularly helpful when patients are afraid they will suffer further injury and become sedentary, experts say.

Cognitive behavioral therapy, which is offered at many pain-management programs, teaches patients to challenge their negative thoughts about their pain and substitute more positive behaviors.

Even getting therapy by telephone for six months helped British patients with fibromyalgia, according to a study published online this week in the *Archives of Internal Medicine*. Nearly 30% of patients receiving the therapy reported less pain, compared with 8% of those getting conventional treatments. The study noted that in the U.K., no drugs are approved for use in fibromyalgia and access to therapy or exercise programs is limited, if available at all.

Anticipating relief also seems to make it happen, research into the placebo effect has shown. In another NCCAM-funded study, 48 subjects were given either real or simulated acupuncture and then exposed to heat stimuli.

Both groups reported similar levels of pain relief—but brain scans showed that actual acupuncture interrupted pain signals in the spinal cord while the sham version, which didn't penetrate the skin, activated parts of the brain associated with mood and expectation, according to a 2009 study in the journal *Neuroimage*.

One of Dr. Mackey's favorite pain-relieving techniques is love. He and colleagues recruited 15 Stanford undergraduates and had them bring in photos of their beloved and another friend. Then he scanned their brains while applying pain stimuli from a hot probe. On average, the subject reported feeling 44% less pain while focusing on their loved one than on their friend. Brain images showed they had strong activity in the nucleus accumbens, an area deep in the brain involved with dopamine and reward circuits.

Experts stress that much still isn't known about pain and the brain, including whom these mind-body therapies are most appropriate for. They also say it's important that anyone who is in pain get a thorough medical examination. "You can't just say, 'Go take a yoga class.' That's not a thoughtful approach to pain management," says Dr. Briggs.

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