



The Pain PT

The Science of TMS

TMS, or tension myositis syndrome, as coined by Dr. Sarno, is a condition of the brain and nervous system and not caused by structural pathology in the body. When Dr. Sarno started diagnosing TMS many years ago, the science wasn't there yet to support his theory that many chronic conditions are caused by repressed unconscious emotions that manifest in the form of physical symptoms. His theory developed from treating thousands and thousands of clinical cases over 30 plus years of practice, which ultimately led to his successful treatment model. He would be proud to know that the science now supports what his clinical observations led him to believe, that many chronic conditions like chronic pain, have their root in the brain and nervous system and in the psychosocial phenomena of emotions and thoughts. I'm going to show you the latest science here to prove the theory of TMS with chronic pain. As they would say, the proof is in the pudding.

Let's start with pain. So what is pain? You know pain by feeling it but what is it really? The *International Association for the Study of Pain*, which brings together international scientists, clinicians, health-care providers, and policymakers to stimulate and support the study of pain, defines it as:



“An unpleasant sensory and emotional experience with actual or potential tissue damage, or described in terms of such damage. Pain is always subjective. Each individual learns the application of the word through experiences related to injury in early life. It is unquestionably a sensation in a part or parts of the body, but it is also always unpleasant and therefore also an emotional experience. Experiences, which resemble pain but are not unpleasant, e.g., pricking, should not be called pain. Many people report pain in the absence of tissue damage or any likely pathophysiological cause; usually this happens for psychological reasons. There is usually no way to distinguish their experience from that due to tissue damage if we take the subjective report. If they regard their experience as pain, and if they report it in the same ways as pain caused by tissue damage, it should be accepted as pain.”



So pain is both a *sensory* and *emotional* experience, and can occur with a physical injury in the tissues or without an injury at all. If you can remember one thing, remember this: “pain is both an unpleasant *sensory* and *emotional* experience.” This has been lost on most healthcare practitioners as many of them just focus on the physical sensory aspect of pain and never ask any questions about the emotional side of pain. It would be like looking at only one side of a coin instead of looking at both sides. In fact, when it comes to chronic pain the emotional side of pain becomes more dominant than the sensory side. The sensory side of pain is typically more dominant in acute or subacute pain with physical trauma or injury. The thing is, the body heals from injuries and most acute pain goes away with the passage of time. However there are a percentage of people where the pain persists beyond the body’s normal healing timeframe. For many years, researchers have hypothesized why this occurs and have inherently known psychosocial factors are involved with pain and other conditions. But now with the advent of new technology, scientists have been able to scan the brain versus just scanning the tissues of the body with x-rays and MRIs. The evidence coming out is showing that it is actually the changes in the brain and nervous system that predict and sustain pain, not the so-called abnormal x-ray and MRI findings that are mostly benign and age related.

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Corticostriatal functional connectivity predicts transition to chronic back pain

- [Marwan N Baliki](#)
- , [Bogdan Petre](#)
- , [Souraya Torbey](#)
- , [Kristina M Herrmann](#)
- , [Lejian Huang](#)
- , [Thomas J Schnitzer](#)
- , [Howard L Fields](#)
- & [A Vania Apkarian](#)

Nature Neuroscience **volume15**, pages1117–1119 (2012)

Over the past 20 years, A.Vania Apkarian, who is a neuroscientist at Northwestern School of Medicine in Chicago, has run many studies comparing the brains of patients with chronic back pain with those of healthy people. He has found differences in brain anatomy and the function of certain regions of the brain with pain. His breakthrough brain imaging study came in 2012, where he was able to predict with 85% accuracy, yes I



said 85% accuracy, who would develop chronic low back pain after an acute pain episode began. Apkarian and his colleagues tracked the brains of back pain patients over time rather than comparing single neural snapshots. His team began with 39 people who had experienced moderate back pain—a five or six on a self-described scale of 10—for 1 to 4 months. Over the next year, the team scanned the patients' brains four times and followed their pain. By year's end, 20 of the patients had recovered, while 19 continued to hurt, meeting the criteria for chronic pain.

The scientists then looked at a number of brain characteristics, including the amount of communication between two areas of the brain previously seen to have altered activity in back pain patients: the insula and the nucleus accumbens. These regions are involved in emotional responses to a person's environment and in how the brain learns. Not only did they measure more communication between these two areas in chronic back pain patients than in those whose pain subsided, but the increased crosstalk was seen as far back as the start of the study. This is massive because it shows the emotional centers of the brain were overactive at the time the pain started, which suggests it is the emotional factors which predict the continuation of pain, not physical injury or the pain itself. This is exactly what Dr. Sarno says with his TMS diagnosis, that repressed unconscious emotions underlie chronic pain, not structural irregularities.

The neuroscientist Apkarian, in relation to his ground-breaking study findings, states: "This is the very first time we can say that if we have two subjects who have the same type of injury for the same amount of time, we can predict who will become a chronic pain patient versus who will not. The injury by itself is not enough to explain the ongoing pain. It has to do with the injury combined with the state of the brain."

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The Emotional Brain as a Predictor and Amplifier of Chronic Pain

[E. Vachon-Preseau,¹ M.V. Centeno,¹ W. Ren,¹ S.E. Berger,¹ P. Tétreault,¹ M. Ghantous,¹ A. Baria,¹ M. Farmer,¹ M.N. Baliki,¹ T.J. Schnitzer,¹ and A.V. Apkarian¹](#)

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Since that study, the science is continuing to come in, showing indeed it is the emotional brain that is a predictor and amplifier of chronic pain. In fact in 2016, Preseau wrote a research article titled exactly that,



“The emotional brain as a predictor and amplifier of chronic pain”. He states: “It should be noted that earlier clinical studies have identified a long list of risks for chronic pain, such as demographics, affective states, lifestyle, comorbidities, and others, yet collectively such parameters account for a relatively small amount of variance for chronic pain- about 10-20%. In contrast, the brain’s anatomic and functional properties predict the development of chronic pain with 80-100% accuracy.” This is the same thing that Apakarian (2012) found in his brain study mentioned above. Eighty to 100% accuracy is a pretty strong finding if you ask me. The crazy thing is these findings are almost never put into clinical practice throughout the mainstream medical community. If only we were able to take a brain scan of every patient instead of an x-ray or MRI, the world might be different place when it comes to treating chronic pain disorders and other chronic problems. The good news is we don't need a brain scan of every patient, the scientific evidence is strong enough to back what Dr. Sarno clinically discovered and treated successfully a long time ago. That TMS, and not structural anomalies, is responsible for chronic pain and other chronic issues.

Presseau in his 2016 research article, goes on to say: “we hypothesize the persistence of pain is likely mediated through the reorganization of the cortex by cortico-limbic learning mechanisms. We posit that chronic pain is a complex web of sensory and emotional experiences, coupled with behavioral adaptations. Specifically, we posit that the chronic pain state is a consequence of a change in value related to nociceptive afferent information impinging on the cortex, with limbic emotional learning mechanisms underlying this shift in value with little opportunity to extinguish these emotional memories.” In plain language, he is saying that emotional processes, not the sensory message of the pain, is what creates a chronic pain state. His conclusion is: “the fact that chronic pain seems to be critically dependent on the brain limbic properties expands the general notion of pain, placing it within the proximity of negative emotions and negative affective states.” He goes on to say: “It seems we are on the cusp of a paradigm shift in concepts and mechanisms of chronic pain.” He is absolutely right about a paradigm shift, we just haven’t seen it yet in mainstream medicine. It takes a lot of time for research to translate into new clinical practice guidelines. Dr. Sarno was certainly ahead of his time, helping thousands of people overcome pain and other problems, while at the same time being maligned by his colleagues in the medical community because they thought what he was doing had no merit. Let’s add more merit to discussion here with another study.



REVIEW ARTICLE

The Relationship Between Structural and Functional Brain Changes and Altered Emotion and Cognition in Chronic Low Back Pain Brain Changes

A Systematic Review of MRI and fMRI Studies

Sin Ki Ng, BBNSc (Hons),*† Donna M. Urquhart, B.Physio (Hons), PhD,† Paul B. Fitzgerald, MBBS, MPM, PhD, FRANZCP,*Flavia M. Cicuttini, MBBS, FRACP, PhD,† Sultana M. Hussain, MBBS, MPH,† and Bernadette M. Fitzgibbon, BA (Hons), MSc, PhD*

The researcher Sin Ki Ng and colleagues published in the Clinical Journal of Pain in 2018 a systematic review of MRI and fMRI studies of the brain in relation to chronic low back pain. What's great about a systematic review is that it looks at all the studies that have been done over the years and takes the best quality ones to determine the most consistent findings across all the studies. The literature search yielded a total of 1003 research papers. After the removal of duplicates, there were 715 unique articles remaining. After the first phase of screening based on title and abstracts, 633 articles were excluded with a further 27 articles excluded when screened using full-text based on the inclusion criteria. During the second screening phase, articles were excluded if full-texts could not be found, or if they were conference abstracts. After the 2 screening phases, 55 final papers were included.

After reviewing all the brain MRI data in the 55 studies, the authors conclude: “this study has systematically reviewed the literature demonstrating that there are widespread structural and functional brain changes in individuals with chronic back pain. The brain changes in chronic low back pain groups were mainly observed in areas and networks important in emotion and cognition, rather than those typically associated with nociception (sensory aspect of pain). This supports the understanding that emotional and cognitive processes may be the core contributor to the chronic low back pain experience.”



So after narrowing down over 1000 studies to the 55 best ones, the conclusion is again, brain changes in the area of emotion and cognition are what cause chronic pain and specifically chronic low back pain in this example. I can't state enough the powerful message from these studies demonstrating that it's the brain and nervous system, not structural changes, which contribute to chronic pain and other chronic disorders. We need this evidence to repudiate the inaccurate messages people receive from their doctors or other healthcare providers. This supporting evidence, or knowledge as Dr. Sarno likes to call it, when accepted, is what leads to pain resolution. Dr. Sarno back in his day, had to convince people what he was saying was true without the evidence that we have here today. I believe his job would have been much easier if he had the data that we have here now. Let's look at another piece of evidence for TMS.

JEP
SYSTEMATIC REVIEW

Brain changes associated with cognitive and emotional factors in chronic pain: A systematic review

A. Malfliet^{1,2,3,4}, I. Coppieters^{2,4}, P. Van Wilgen^{1,2,5}, J. Kregel^{2,4}, R. De Pauw⁴, M. Dolphens⁴, K. Ickmans^{1,2,3}

1 Department of Physiotherapy, Human Physiology and Anatomy (KIMA), Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussels, Belgium 2 Pain in Motion International Research Group, Brussels, Belgium 3 Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Belgium

4 Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, Ghent University, Belgium 5 Transcare, Transdisciplinary Pain Management Centre, Groningen, The Netherlands

This study in the European Journal of Pain is another review of the literature and was completed in 2017 by Malfliet and his colleagues. The authors whittled down over a thousand studies to 28 studies that met the scientific criteria. Here's the takeaway written conclusion by the authors: "This review shows that maladaptive cognitive and emotional factors are associated with several brain regions involved in chronic pain. Targeting these factors in these patients might normalize specific brain alterations." It's interesting that they mention targeting these cognitive and emotional factors could normalize the brain. That's exactly what we do in the treatment of TMS, we treat the brain and nervous system not the structural tissues. It's the power of knowledge, combined with the right cognitive thoughts and the awareness of emotions, that leads to a change in the brain, which causes a change in the pain.



How the Mind Processes Pain

ANTERIOR CINGULATE CORTEX

Registers unpleasant feelings when things go wrong, either physically or emotionally.

People who are highly sensitive to pain have greater activity here

SOMATOSENSORY CORTEX

Registers which body part is in pain and the intensity of that pain.

Less Activity here when patients focus their attention away from their pain

INSULAR CORTEX

Integrates sensory, emotional and cognitive states;

Feels empathy for others' pain

THALAMUS

Receives pain signals from spinal cord and relays them to higher brain regions.

PERIAQUEDUCTAL GRAY

An area rich in natural opioids that act as a pain reliever.

AMYGDALA

Anticipates pain and reacts to perceived threats.

PREFRONTAL CORTEX

Processes pain signals rationally and plans action.

Active when trying to consciously reduce pain

MEDIAL PREFRONTAL GYRUS

Focuses on negative personal implications of pain. |

Heightened Activity seen in Anxious people

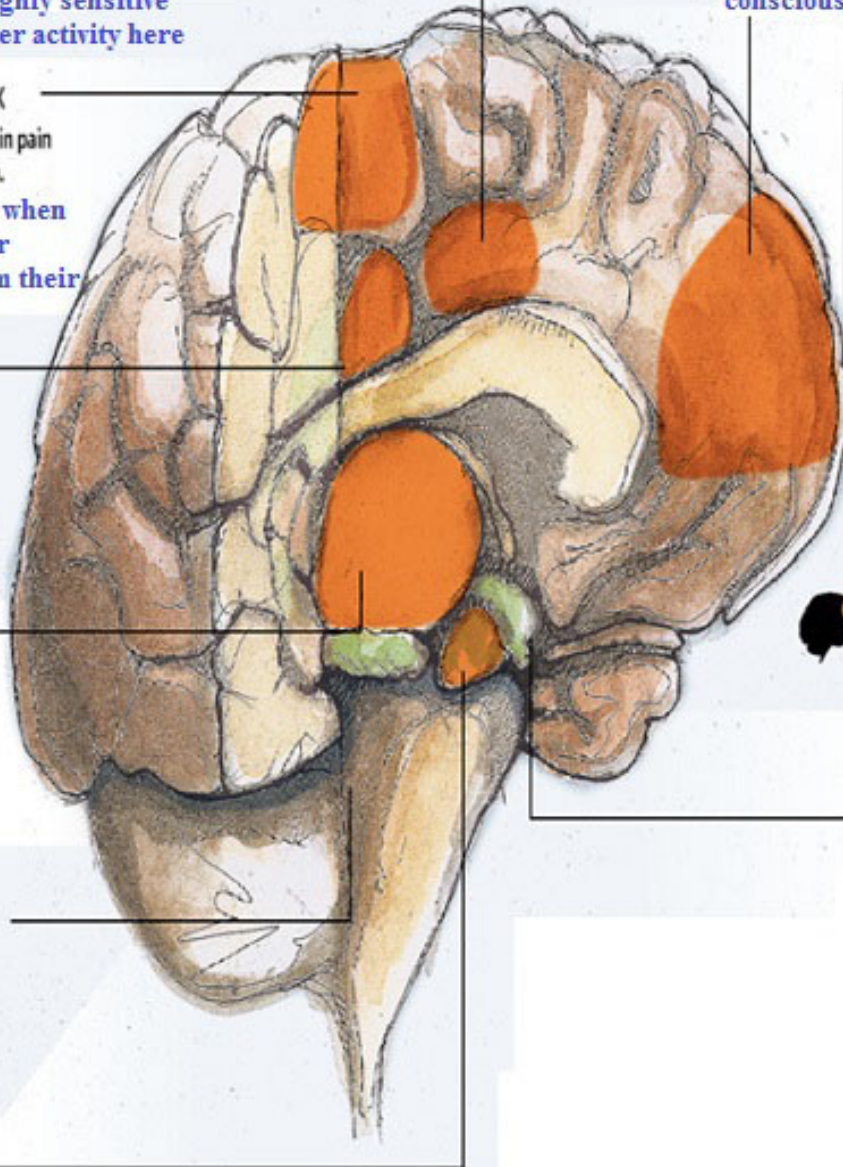
RIGHT LATERAL ORBITOFRONTAL CORTEX

Evaluates sensory stimuli and decides on response, particularly if fear is involved.

Meditation calms down this response

NUCLEUS ACCUMBENS

Releases dopamine & serotonin during pleasure or pain



Sources: Sean Mackey, Stanford; PLoS One; Journal of Neuroscience; Archives of Internal Medicine



Another take away from this 2017 study is that the researchers found pain catastrophizing, which is negative thinking and beliefs around pain, may account for 47% of the variance in predicting the development of chronic pain after an episode of acute pain. The authors state: “the key finding of this systematic review is that there is clear evidence that brain alterations, including gray matter volume, functional connectivity and resting state network, and task-related brain activity, are undeniably associated with self-reported pain catastrophizing.” So negative thinking about pain changes the brain and not in a good way. That's why it's so important to send the right messages into your brain and nervous system that you are okay and not damaged. The reality is that you are not damaged with TMS, it's just that the brain may still think something's wrong and reacts with negativity.

[Brain](#). 2013 Sep; 136(9): 2751–2768.

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Shape shifting pain: chronification of back pain shifts brain representation from nociceptive to emotional circuits

[Javeria A. Hashmi](#),¹ [Marwan N. Baliki](#),¹ [Lejian Huang](#),¹ [Alex T. Baria](#),¹ [Souraya Torbey](#),¹ [Kristina M. Hermann](#),¹ [Thomas J. Schnitzer](#),² and [A. Vania Apkarian](#)^{1,3,*}

I just want to throw out there some other research which adds further support that we need to look to treating the brain (TMS) and not the body when it comes to chronic pain and other chronic ailments. In 2013, the researcher Hashmi and colleagues found that the shift to chronic pain was related to the “strength of functional connectivity between medial prefrontal cortex and nucleus accumbens determined at the time of entry into the study.” This means people are predisposed to developing chronic pain based off what's happening in their emotional and cognitive centers of the brain. He further states: “that predisposing characteristics of mesolimbic (emotional) circuitry at time of pain inception initiates a cascade of emotionally-driven learning events that effectually reorganize the brain into a chronic pain state.” So it's the emotions again, and how we perceive the pain that reorganizes the brain into a pain state.

“For this is the great error of our day in the treatment of the human body, that physicians separate the mind from the body.” –Socrates



RESEARCH ARTICLE

Distinct Brain Systems Mediate the Effects of Nociceptive Input and Self-Regulation on Pain

• Choong-Wan Woo, Mathieu Roy, Jason T. Buhle, Tor D. Wager

Another study in 2015 (Woo) led by Tor Wagner at University of Colorado found the same emotional brain regions that were active in Apkarian's (2012) and Hashmi's (2013) studies were also active in his study volunteers (nucleus accumbens, ventro-medial prefrontal cortex, etc). He suggests that in chronic pain conditions, psychological pain overtakes physical pain as the main contributor to the overall sensation. Wagner found two distinct patterns in the brain with pain: one for the physical sensation of pain coming into the brain, and another for the thoughts and emotions surrounding the physical sensation. This is in-line with the definition of pain we looked at in the beginning: Pain is both a sensory and emotional experience. To get some context, Ben Seymour, a neuroscientist at the University of Cambridge says: "Pain has always been a bit of a puzzle. Hearing or vision, for example, can be traced from sensory organs to distinct brain regions, but pain is more complex, and incorporates thoughts and emotions. For example, studies have linked depression and anxiety to the development of pain conditions, and volunteers put in bad moods have a lower tolerance for pain." This all makes sense in light of the evidence we've learned today.

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Functional Brain Network Mechanism of Hypersensitivity in Chronic Pain

• UnCheol Lee, Minkyung Kim, KyoungEun Lee, Chelsea M. Kaplan, Daniel J. Clauw,
• Seunghwan Kim, George A. Mashour & Richard E. Harris

Researchers from the University of Michigan and Pohang University of Science and Technology in South Korea report new evidence of what is called explosive synchronization (ES) or abnormal sensitivity in the brains of people with fibromyalgia, or widespread pain. The paper, published in *Scientific Reports*, in 2018, details only the second study of ES in human brain data. One of the authors Richard Harris, Ph.D., associate professor of anesthesiology at Michigan Medicine with the Chronic Pain and Fatigue Research Center, states: "For the first time, this research shows that the hypersensitivity experienced by chronic pain patients may result from hypersensitive brain networks." One of the other authors, UnCheol Lee, Ph.D., a physicist and



assistant professor of anesthesiology at Michigan Medicine, says: "As opposed to the normal process of gradually linking up different centers in the brain after a stimulus, chronic pain patients have conditions that predispose them to linking up in an abrupt, explosive manner." This new science coming out is fascinating and supports what we know from clinical practice, that many people suffering from chronic pain and other chronic ailments are highly sensitive people.

[Pain. 2017 Oct;158\(10\):1979-1991. doi: 10.1097/j.pain.0000000000001001.](#)

Brain signature and functional impact of centralized pain: a multidisciplinary approach to the study of chronic pelvic pain (MAPP) network study.

Kutch JJ¹, Ichesco E, Hampson JP, Labus JS, Farmer MA, Martucci KT, Ness TJ, Deutsch G, Apkarian AV, Mackey SC, Klumpp DJ, Schaeffer AJ, Rodriguez LV, Kreder KJ, Buchwald D, Andriole GL, Lai HH, Mullins C, Kusek JW, Landis JR, Mayer EA, Clemens JQ, Clauw DJ, Harris RE; MAPP Research Network.

The last study I want to present was published in the Journal Pain in 2017. The research team used data from 1,079 participants from the Multidisciplinary Approach to the Study of Chronic Pelvic Pain Research Network (MAPP) study. The participants included questionnaires capturing their pain severity and function and were also asked to draw on a body map where they were experiencing pain. Researchers then had a subset of the participants undergo functional and structural MRIs of the brain. The authors state: "Surprisingly, many of the individuals, in addition to having pain located in the pelvic region, had pain also widely distributed throughout their body. Interestingly, when we put these individuals into the brain imaging scanner, we found that those who had widespread pain had increased gray matter and brain connectivity within sensory and motor cortical areas, when compared to pain-free controls." These findings are similar to what we have seen in all the other studies and show it is the changes in the brain, and not in the body, that differentiate chronic pain from pain-free people.

The authors then nailed the takeaway message from their results when they said: "We think that this type of study will help treat these patients because if they have a central nerve biological component to their disorder, they're much more likely to benefit from targets that affect the central nervous system rather than from treatments that are aimed at the pelvic region." This is exactly what most of mainstream medicine does



not do. They are still treating the body instead of the brain. The evidence is clear we need to focus our treatment on the brain to have success in solving pain versus just managing it.

All the data we have seen here indicates TMS originates in the brain and nervous system and that emotions and thoughts underlie most chronic pain, not structural abnormalities. Because we are talking about the brain and the nervous system, the answer to getting better is found in what Dr. Sarno says in his books. First, it is gaining the knowledge so you understand the causes of TMS. Understanding leads to confidence in accepting the TMS diagnosis for yourself. Second, it is discovering what emotions you may be repressing, because these emotions cause your emotional brain to stay overactive or become hypersensitive, as we have learned with the studies above. Third, it is sending the right messages into your brain and nervous system to say you are okay and nothing is wrong. Catastrophizing or negative thinking, as we have learned, is significantly associated with brain changes and chronic pain.

I hope this evidence gives you confidence in your diagnosis of TMS. The best news is that TMS is reversible. This is because the brain is plastic and can change. It's called neuroplasticity. So let's change your brain to change your pain. Wishing you the best on your journey out of pain!

