A MODERN LOOK AT PAIN

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Abstract

Pain scientists have learned a great deal in the past fifty years, but most of this information remains in the separate sphere of academia rather than on the frontlines of pain treatment. This paper addresses the question of how to take theoretical information from the medical literature and implement it in the clinic. In my fifteen years as a Rolfer, I have found this information taking an increasingly central role in my decision-making, especially when a client has pain that might be termed "chronic" or "persistent." This article, using a growing body of literature from researchers such as David Butler, Clarissa Hsu, and Lorimer Moseley, combined with my own observations and experiences, explores the idea that when therapists learn about pain and then teach their patients about pain, more effective treatments will follow.

Introduction

What is pain? A simple definition is not simple. It is easier to start defining what pain is not. One of our biggest challenges is understanding that pain and nociception (the experience of pain) are not the same thing. We do not have "pain receptors," "pain nerves," "pain pathways," or "pain centers." There are, however, some neurons in our tissues that respond to stimuli considered "dangerous." For example, dropping a 40-kg. kettlebell on your foot will send a prioritized signal to your spinal cord, which then is interpreted by your brain. Activity of this type in these nerves is called "nociception," which literally means "danger reception." According to David Butler, "we all have nociception happening all the time – only sometimes does it end in what we define as pain."[1] Looking across various health professions, and in their literature, one could easily infer that nociception, in some cases, is equivalent to pain, as these two terms are often used as if they were interchangeable. However, this couldn't be farther from the truth!

1 David Butler, Explain Pain, page 32

Pain is an Output from the Brain, not an Input from the Body

The fundamental paradigm shift that has recently occurred in pain science is the understanding that pain is created by the brain, not a "pre-formed" sensation that arrives from the body and is passively perceived by the brain. When a body part is damaged, nerve endings send a signal to the brain containing information about the nature of the damage – but no pain is felt until the brain interprets this information, then decides that pain would be a good way to encourage you to take action that will help protect the body and heal the damage. The brain considers a huge amount of information in making this decision, and no two brains will decide precisely the same thing. Many different parts of the brain help process the pain response, including areas that govern emotions, past memories, and future intentions. An injured hand means something very different to a professional musician than it does to a professional soccer player. One can expect they will have very different pain experiences from the same injury. The bottom line is: pain is in the brain, not the body.

At one time, it was assumed "pain" was conducted to the brain with "pain nerves," and once it got up to the brain, some "pain center" would be activated, and, voilá, you would feel something identified as "pain." This assumption was based on the general conclusion that all senses worked this way – light coming into the eyes stimulated vision centers and resulted in "sight." Sound coming in the ears stimulated auditory centers, which resulted in "hearing." Touch coming in stimulated kinesthetic centers and resulted in "sensation," so "pain" was assumed to be a certain type or quality of touch. It was also assumed, by scientists as well as many lay people, that eventually these centers would be found. While lots of new information has been discovered, pain centers have not. Though deductive science continues to make advances, a fairer conclusion might be: pain centers, if they exist, are mercurial at best.

Pain response is the combination of remarkable circuitry, made up of billions of neurons and glia with receptor sites that can alter what they are sensitive to, thanks to "synaptic plasticity." There are convergence zones and new arborizations, ascending and descending fibers creating interplay between the peripheral nervous system and the brain. Perhaps the most well-understood are somatotopic representational areas (brain maps of body parts) that change with experience. Other contributing factors include, but are not limited to, gene expression in relation to environmental influences. Like the Humpty Dumpty story, there are all sorts of clues and truths, but so far, no single integrated "pain center."

The brain often "thinks" the body is in danger even when it isn't. A dramatic example of this is phantom limb pain, when the victim feels pain in a missing body part. Although the painful limb has been gone for years and can no longer send signals to the brain, the part of the brain devoted to sensing the limb can be activated by cross talk from nearby neural activity. When this occurs, victims can experience incredibly vivid and painful sensations in the missing limb. Amazingly, phantom pain can sometimes be relieved by tricking the brain. For example, in the case of a missing hand, placing the remaining hand in a mirror box can trick the brain into thinking the missing hand is alive and well. This is extraordinary example shows how pain relief is brain-based, not body dependent.

Other Examples

Stranger still are tales of severe pain without injury, illustrating that pain can be entirely in the mind (technically, it always is.) One of the strangest of these was reported in the British Medical Journal in 1995:

A builder aged 29 came to the accident and emergency department having jumped down on to a 15 cm nail. As the smallest movement of the nail was painful, he was sedated with fentanyl and midazolam. The nail was then pulled out from below. When his boot was removed, a miraculous cure appeared to have taken place. Despite entering proximal to the steel toecap the nail had penetrated between the toes: the foot was entirely uninjured. (Butler, 2008)

In this case, his pain was a "nocebo" — the opposite of a placebo. (Nocebo refers to the harmful effect of … nothing but the belief in or fear of a harmful effect.) Extreme examples like this are rare, but for every case like this, there must be many more where even though the injury is real, the patient is convinced that the damage is much worse than it really is, resulting in proportionately exaggerated pain. Happily, it also works the other way, and people may feel much less pain than they "should" when they don't realize how bad the damage is.

There are other, more commonplace instances, where the brain interprets sensation going on in the body and creates pain in an area that is clearly not under threat. Any kind of referred pain, where pain is felt a distance from the actual problem, is an example of this. Some people have a condition called allodynia, where even normal stimuli such as lightly touching the skin can cause excruciating pain. This disorder is an extreme example of something that might occur quite commonly on a much smaller scale – the brain misinterprets innocuous sensory information as evidence of tissue damage, and causes responses based on the misinterpreted information.

In contrast, even when nociception does exist (i.e., there is an existing physical limb or neck or back involved that "hurts,") the brain can ignore it if there is something else more important which needs to be dealt with in a given moment. Sometimes, more nociception actually helps to decrease pain perception for a while, so in some ways, they may be reciprocally related. For example, rubbing your head after hitting it on something increases incoming sensory information, and gives the brain different context; in other words, the local activation of sensory neurons dilutes the experience of the "pain" by giving the brain something else to focus on.

Generally, receiving initial input through nociception is required for the developing brain of an infant to learn how to construct a pain experience. For example, children born without the ability to "nocicept" (a condition known as congenital analgesia) never learn to feel ordinary "pain" because their brains never learn to construct a pain "experience." As a general rule, those with this disorder do not live long, and must be watched closely by their caregivers to avoid grievous injury.

The Role of Neuroplasticity

By now, it should be clear that "pain" is like no other sense, no other feeling we have. In fact, it's not even a "sense" strictly speaking, but more accurately, a perceptual construct. So, where does "pain" come from? Assuming the appropriate type and array of receptors exist, as they do in most people, pain is a framework the brain constructs out of information it receives, . Once the brain has made the construct, it elevates it to the consciousness, the part you ordinarily think of as "you." Building constructs all the time, out of everything around it, is the way our brains make sense out of an overwhelming amount of information. This is known as "neuroplasticity." Most of what the brain makes is useful; pain is useful too, and the brain usually creates it to slow you down when the body needs time to heal. In the book, The Brain that Changes Itself(2007), Norman Doidge calls pain "the downside of neuroplasticity."

When pain persists long past tissue healing, a conscious process of deconstruction may be needed. The brains of most people with persistent pain have no problem de-constructing pain production with treatment – usually this is a quite straightforward process once treatment is initiated. With a bit of pain education as a focus, and some judicious, well-thought-out manual therapy to provide novel input to the brain (see neuromatrix model below), the brain is usually more than happy to return to normal output. It downregulates itself (similar to the head-rubbing example above), and the peripheral nervous system follows suit.

The Importance of Language Pain Education

To really treat pain, we, as practitioners, need to focus just as much on the brain as we do on the spine, muscles, and/or joints. When the treatment approach takes an integrative view (e.g., helping to educate, evaluate, and work with each client's cognition in light of his/her pain response), damaged tissues will heal to the best extent possible in a few weeks or months, often ending pain. When pain continues for long periods of time without any real source of continuing harm or damage, there might be a problem with the pain processing system, rather than the body.

Listening to the client describe their pain is incredibly important. The single most important factor linked to client improvement is whether or not they feel the practitioner has carefully listened to their descriptions of their condition on the first visit. (Häuser W., E. Hansen, P. Enck (2012).

It is very important to help deconstruct a client's false beliefs about their condition. Often, clients have been told things by other practitioners or friends, or read things online that just aren't true about their situation. If these falsehoods continue to swirl around in a client's head, they upregulate the nervous system, and it can be very difficult to make forward progress. It is also very important to monitor the language that you use with clients. Avoid terms like "bone on bone," or "herniated." Put yourself in the client's shoes, and use language they can understand. Let's say a person is told they have "a degenerate L4 disc pressing on a nerve root and the thecal sac." They may repeat that phrase many times and internalize it even many more times. Googling "thecal sac" will reveal that the problem is close to the spinal cord and notions of paraplegia may emerge. All of this contributes to upregulation of the nervous system: increased adrenaline, cortisol and muscle tone; all things that increase pain.

The Neuromatrix Model

Descartes theorized that the body was more similar to a machine, and that pain was a disturbance that passed down along nerve fibers until the disturbance reached the brain. Thanks to the self-righting capacity of the scientific method, the meticulous research of Ronald Melzack and Patrick Wall, the scores of people in pain who have contributed to advancing science, not to mention the many lab animals sacrificed to the cause, Descartes' pain theory has now been laid to rest.

Although not the final word, I am sure, pain is now believed to be a neurologically and neurochemically enacted sensorimotor "perception" that the brain constructs as a response to various kinds of input as well as a single output to the following:

1. The sensor array of the body,
2. Our conscious awareness,
3. Its own internal representational maps of the body.

I have found the neuromatrix model of pain helpful (see Figure 1). More than a reductionist biological

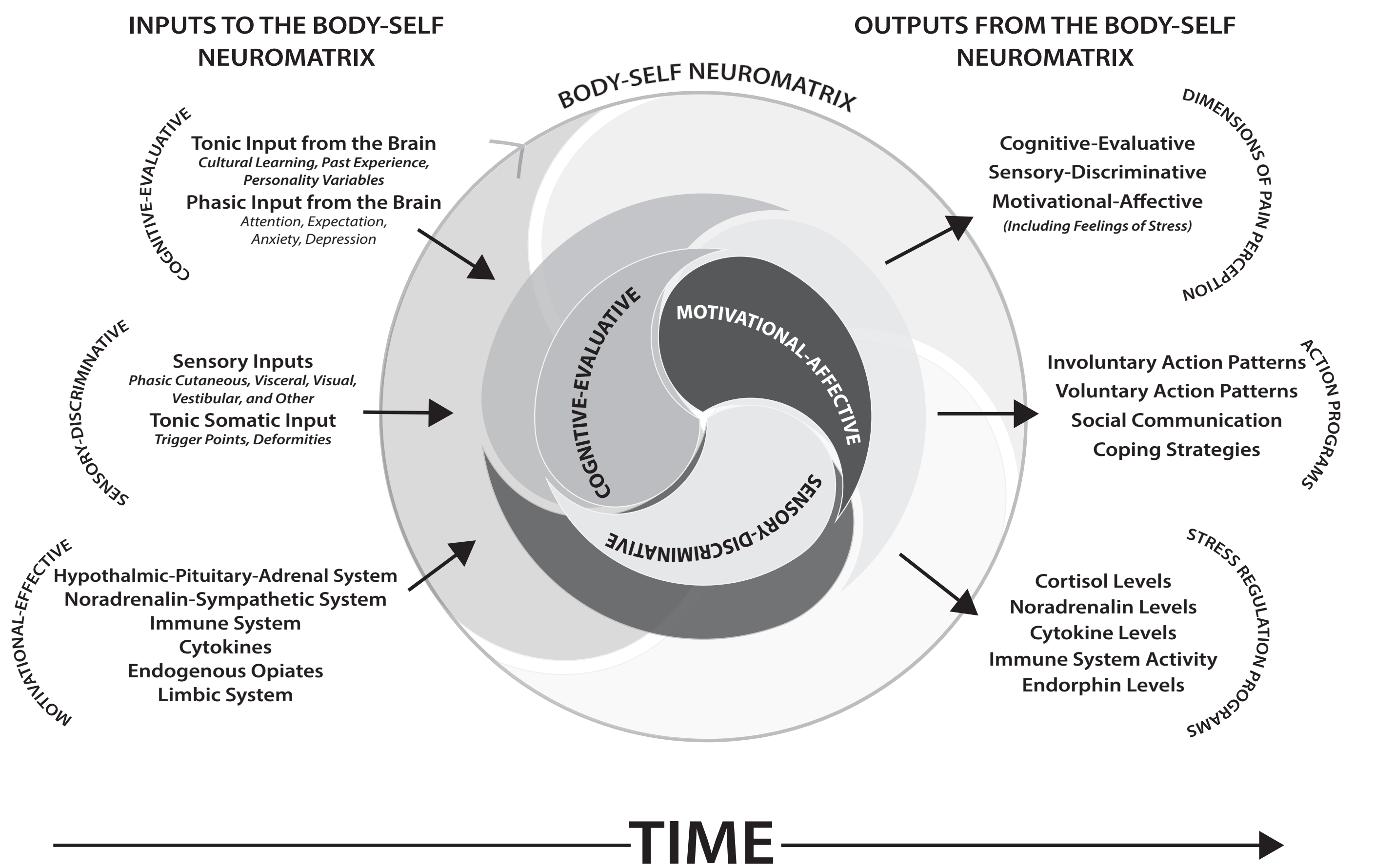

Figure 1: The Neuromatrix Model of Pain, Adapted from Melzack, 2001; Used with kind permission

view, it is a contextual view with the client in the center. In this model, it's harder to quantify or integrate the pain experience, as there are many inputs to the brain that can create, or later, trigger, a pain imprint on the brain (neurosignature). These inputs include movement, thoughts, emotions, touch, memories, fear, and visual stimuli—to name a few. Interestingly, the neuromatrix requires no actual sensory input for a person to experience pain, only the activation of a pain neurosignature. Phantom limb pain is explained by this fact (Melzack, 2001). Factors contributing to patterns of activity are generated by the body-self neuromatrix, which comprise sensory, affective, and cognitive neuromodules. The output patterns from the neuromatrix produce the multiple dimensions of pain experience as well as concurrent homeostatic and behavioral responses.

Diane Jacobs explains the neuromatrix this way:

1. There is a zone of circular action happening in the center which represents the nervous system. It is always working; constantly inputting, through-putting (processing), and outputting.

2. There is a line through time. The nervous system is continually active through time; even during sleep, it stays busy – e.g., keeps the heart beating and the lungs breathing, and performs its own systems checks and maintenance.

3. On the left side we can see three main classes of input, which represent everything from mental to physical to physiological. The brain receives all information, but doesn't necessarily act on every bit of it – it all depends on what's happening in a given moment.

4. On the right side, we see three main classes of output. Note that pain is on the output side of the neuromatrix.

5. Generally, both sides of the neuromatrix mix it up and affect each other.

6. The input and output at the bottom of the diagram are the most physiological, non-conscious ones.

7. Input and output in the middle zone are kind of a blend, mostly under nonconscious control but can be affected consciously. There are two kinds: Sensory-discriminative input – e.g., we are generally not aware of our clothing, but if we turn our attention to our body, we can immediately "feel" our clothing, and Action Programs – e.g., the breathing mechanism is usually nonconscious but one can deliberately override it and breathe consciously for a time.

The input and output at the top of the diagram are ones we are often most aware or conscious of (in the case of pain output, most would probably be less aware).

The neuromatrix model is a valuable tool for manual therapists, and relates many aspects of our work to pain science. It is clear, simple, and allows the client to see himself/herself in the center of the experience. The client is not peripheral to some biological theory of pain, but the one who will help his/her own brain turn itself around. The neuromatrix model can give us some conceptual leverage for spotting erroneous beliefs that the client may be holding about the body and about the pain they perceive. Erroneous beliefs can actually interfere with the brain's ability to relieve or stop its own pain production. The neuromatrix model provides a starting point for understanding. It is a place to begin to get a grip on pain, instead of feeling helpless and letting pain keep a grip on the system.

The Placebo Effect: Desirable or Not?

Sometimes, just the act of making an appointment can make a difference in pain levels. Perhaps the sense of getting down to it and taking a concrete step to start dealing with the pain raises one's mood a little. It may also affect cognitive-evaluative input somewhat, thereby creating a bit of a placebo response within the system. In recent work, Dr. Patrick Wall, a leading British neuroscientist, described the need to tread very carefully whe it comes to unraveling the placebo response. Roughly paraphrased: placebo is not something we do to brains, it's a response we must elicit from them. The brain can fix itself, but it needs to be taught to be an ally. In fact, the brain is the only thing that can turn itself around, it is in full control. In that synaptic connections in brains are mostly about the chemistry within them, a placebo response, i.e., a change for the better in terms of brain chemistry, is a good thing. Wall has also said that the placebo response the brain makes for itself is always dose-specific and duration-perfect for maximal and often permanent relief. Good treatments help elicit this response.

Conclusion

Probably the biggest push-pull within the research on therapeutic amount or type (I recognize this is a small number of studies) is defining how much of the therapeutic effect is direct or nonspecific. People who have learned/taught a lot of operator models and tissue-based examination schemes tend to say the primary issue is mechanical nociception, therefore specific effects like examination and treatment skill for the site of injury (e.g. periphery) are most important. People who have learned/taught a lot of interactor models and neuroscience tend to say the primary issue is central therefore nonspecific effects like placebo, education, or cognitive-behavioral features are most important.

For me, there's no way to reconcile these views other than to take what seems to be the most reasonable position – that the therapy should be tailored to the presentation and both views may be more or less operative in any client at any given time.

In my opinion, we should be comfortable enough with neuroscience to abandon the strict tissue-based explanations and reasoning, while being comfortable with mechanical nociceptive-origin pain explanations and treatments.

Like most things, the answer is probably somewhere in the middle. Structural Integrators realize the interconnectivity of the body and often take a decidedly global approach. I love this about our work. For me, applying some of the recent discoveries about pain science in my practice has been both orienting and helpful. It has allowed me to feel a bit more empowered about the reasons behind my therapeutic decision-making My clients feel more empowered when they understand how pain works. I find that the discussions I have with clients about pain lead to some deep and meaningful conversations. I believe educating myself and informing my clients about pain is a way to achieve the most facilitated (if there can be such a thing!) treatment result.

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