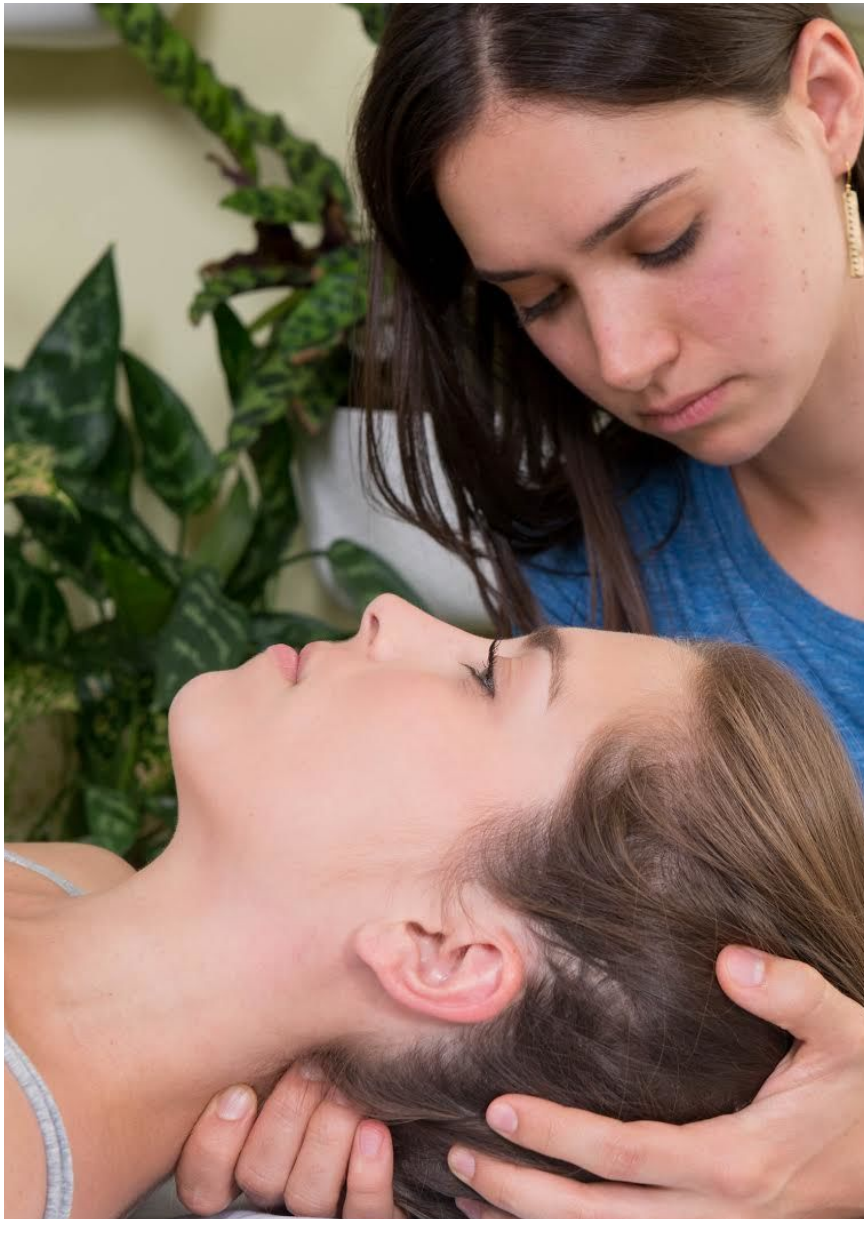


Understanding Pain

By Rey Allen and Marie Zahn, certified Rolfers

Whether you're new to your practice or well-seasoned, treating chronic pain can be tricky. Many practitioners account pain as an aporia; within these examples, the same region of pain in multiple individuals can be resolved with numerous different treatment methods. So how do we practitioners know what treatment to use? Here, we start with an example where Rey Allen worked with a 20 year-old, "Emily," who had pain in her right foot.

Two years prior to treatment, a fellow ballet dancer stretched Emily's foot and toes in plantar flexion but went too far to a point where she felt something was off. It wasn't until a few days later that diffused pain began to develop on the dorsolateral part of her right foot and continued to increase in severity over weeks to a debilitating state where she stopped dancing. X-rays and an MRI showed nothing abnormal, but for two years she couldn't walk for more than ten minutes without her pain becoming intolerable.

In his assessment, Rey palpated Emily's right and left foot separately and was surprised to find her unaffected left foot felt more restricted, or hypertonic, than her right. In fact, Rey couldn't find any noticeable imbalances in her right foot or lower leg. He asked a series of questions about Emily's sensorial experience of her feet as well as what was going on in her life at the time of the initial onset of pain. Emily reported that in comparison to her asymptomatic left foot and leg, her right side felt like a wooden leg. Also, Emily mentioned that her father had passed away right before the pain started. Rey explained the contextual nature of pain, where multiple factors, like emotional stress, will contribute to the presence of pain.

He mirrored back to her that perhaps her tissues on her right side were not suffering from something being misaligned or "wrong" in her foot, but instead a lack of discrimination. In other words, she didn't have a clear perception, or body map, of her right foot.

Given these conclusions, Rey decided to begin treatment using graded motor imagery, specifically mirror therapy, instead of manual therapy. Emily sat on the table and Rey placed a mirror along her midline to reflect her left side while hiding the right. This allowed Emily to see the reflection of her left side as her right. For twenty minutes, Rey guided her through a series of exploratory movements while he simultaneously touched her feet in the same places at the same time. Once Emily stood up, she was pain-free for the first time in two years.

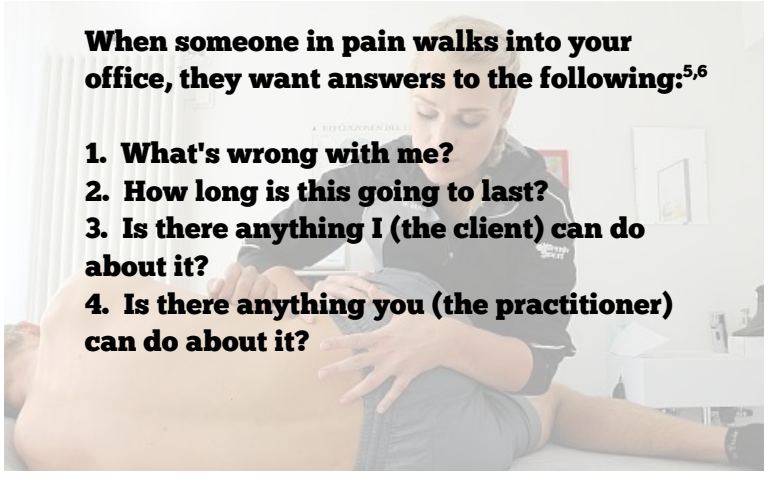
The example with Emily demonstrates the notion that chronic pain is complex and does not solely come from a tissue abnormality. During the past twenty years, research on chronic pain has increased significantly, with considerable advances in understanding its etiology, assessment, and treatment. These discoveries have important healthcare implications as pain is one of the leading causes for why people seek out medical care, even more so for movement and manual therapies.


Photo: Marie Zahn

Whether or not pain relief is your immediate goal, the fact remains that the majority of people who walk into your office experience some degree of pain and/or tension; as such, we must understand what pain is, and more importantly, what pain is not. For manual and movement therapists, it is no less important than knowing the anatomy of the body.

What Patients Want to Know From You About Pain

Neuroscience and pain science have discredited the belief that pain reflects the state of physical tissues (i.e. pain = tissue damage), a purely biomechanical explanation for pain.[1,2] It is a major falsification of what we once believed. The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." Simply put, pain is the brain's *perception* of tissue damage.[3] Perception is key because pain is about how a person consciously and unconsciously creates meaning of his or her physical reality. This perception of tissue damage is modulated by a number of cognitive, emotional, and sensory inputs.[1,4]



These questions are prompted by the underlying assumption that pain is the indicator for something "wrong" in the physical body. A number of hypotheses will be made (joint misalignment, degeneration, compression) so that a treatment regime is identified to "fix" these physical morbidities. When experiencing pain we sensibly, but mistakenly, place all of our attention in the physical domain. Today, we see the falsification of the conclusion that pain predictably represents tissue damage.

Perception Vs. State of Tissues

One of the brain's chief priorities is to keep us safe and protected. Pain warns us of danger and compels us to take action to relieve and/or avoid that danger. Thus, the experience of pain is based on a prediction of danger that we are physically in, not how much we are actually in. Even if there are no problems in the tissues, nerves, or immune system, you can still hurt if your brain concludes that you are in danger.[3]

Historically, a class of sensory receptors called nociceptors were once incorrectly referred to as pain receptors. These are receptors that require higher thresholds of stimuli to trigger an action potential, which in turn sends larger, more amplified signals to the central nervous system (CNS). These larger

*"**Pain** is an opinion on the organism's state of health rather than a mere reflexive response to injury. The brain gathers evidence from many sources before triggering pain."*

~ V.S. Ramachandran, Director of the Center for Brain and Cognition, UCSD

signals serve to get a person's attention by acting as warning signals. The brain, though, can ignore input from the body, large or small, if the brain is either distracted enough or does not value the incoming messages.

Pain is context-dependent. A notable example of this is seen with soldiers in the heat of battle who are shot but don't feel pain until much later, once they are out of the dangerous environment.

Nociception is quantitative, not qualitative. This means the body's sensory system simply provides raw data to an individual's CNS. It is the brain that then interprets the data's meanings through predictive coding, resulting in a physical sensation (a perception) which may or may not include pain. While nociception is not an essential part of one's pain experience, it unmistakably can be a very powerful contributor.

If a person's nervous system has not attenuated after the determinant time for healing of the injured tissue, the brain continues to conclude a state of threat and what formerly was acute pain is now chronic.[7] The healing of damaged tissue is a complex and dynamic process, consisting of four primary phases blood clotting (hemostasis), inflammation, tissue growth (proliferation), and tissue remodeling (maturation).[8,9]

Typically, most tissues heal within 1-6 months. Soft tissue, such as skin, takes around 10 days to two weeks. Deeper soft tissue can take 3-6 months, and depending on the type of deeper tissue, it may take up to a year to regain full tensile strength. Bone takes up to 3-6 months to heal and up to a year to fully remodel. Recovery from tissue damage includes the resolution of healing (particularly inflammation) and attenuation of nociceptive excitation.

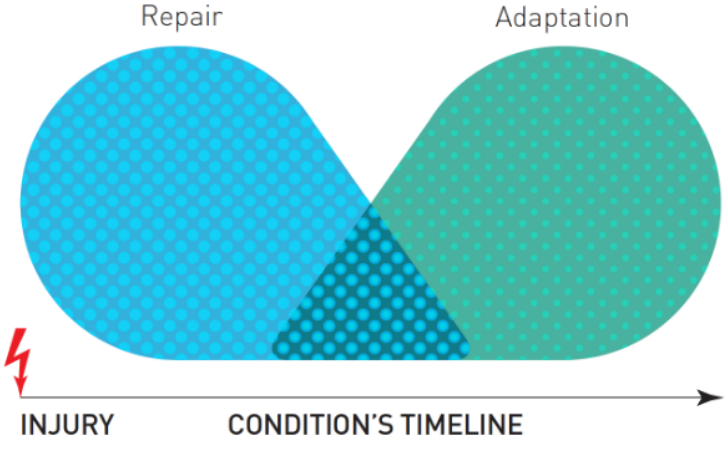
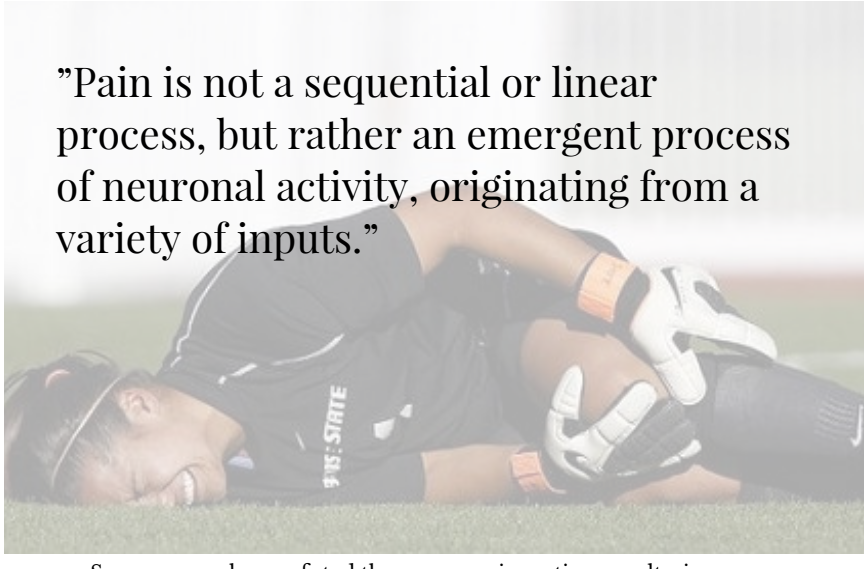


Figure 1: Overlap from repair to adaptation. Adapted from Fig. 3 in Lederman (2015).[7]

The point is that a time frame exists within which all tissues complete their healing phases. Pain serves an important role during healing to ensure the process is preserved, and to prevent further tissue damage in order to facilitate a full recovery (Figure 1).[7] If pain persists past the healing window, it is considered chronic. It's important to reiterate that one can experience an acute pain when no tissue damage is present. a full recovery.[7] If pain persists past the healing window, it is considered chronic. Thus, an individual can experience an acute pain when no tissue damage is present.

Unfortunately, many healthcare providers don't communicate well or adequately educate their clients that all tissues eventually heal and that the severity of pain and the state of tissue damage are not perfectly correlated.[10,11] Many clients and some clinicians wrongly believe that once a part of their body is injured, it will always be in a state of injury. In other words, experiencing episodic pain is considered to be an episodic injury, as seen with the term "re-injury." What instead is likely happening is the reoccurrence of neuronal excitation for a region of the body that was previously injured and/or painful as opposed to that region being damaged again.



Some researchers refuted the idea that there is a predictable, uniform increase in of muscle activity with the presence of pain. They propose pain has variable effects on an individual's motor output.[12] With the overall goal of protecting the painful part from further injury or danger, a redistribution of motor activity occurs that can be additive, competitive, or complementary within numerous sites of a motor pathway.[12]

In other words, a number of muscular adaptations may occur in response to pain and are also dependent on the individual and the given physical task, which include increasing or decreasing muscle activity, having poor proprioception, or altering coordination. They explain how physical adaptations to pain, like modified movement or stiffness, have short-term benefits but long-term consequences due to the changes in load distribution.[12]

A challenging aspect in understanding pain is how it is not a sequential or linear process, but rather an emergent process of neuronal activity, originating from a variety of inputs. Pain is a sensory and emotional experience that is modulated by psychological, social, and contextual factors—now defined by the "biopsychosocial" model.[4]

Photo: Maridav

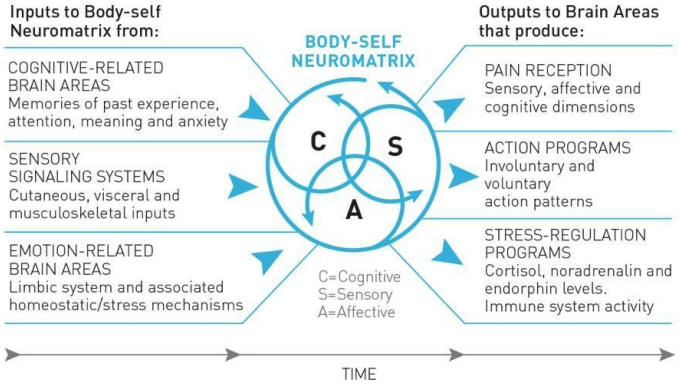
Release the Biopsychosocial Model (BPS)!

Pain should never be seen as context-free but rather context-dependent.[13,14,15] Research clearly shows that pain is a complex experience that never has a single stimulus. Pain may involve sensory, motor, autonomic, endocrine, immune, cognitive, affective, and behavioral components.[16] It's filtered through an individual's genetic composition, prior learning history, current psychological status, and sociocultural influences.[16] Thus, tissue damage can occur without pain.

It helps to see the brain and the nervous system as the central scrutinizing center, continuously sampling (conscious and non-conscious) from its environment, body, and past experiences.[1]

The BPS model for chronic pain is a non-dualistic and integrated approach.[17] It's based on a systems approach as well as a way of understanding the client's subjective experience as an essential contributor to diagnostic accuracy, health outcomes, and human care.[1,14]

The biological system (bio-) deals with anatomical and molecular substrates of disease—the client's physiology. The psychological system (psycho-) includes the effects of psychodynamic factors like motivation, attitudes, and personality on the experience of and reaction to illness and pain. The social system (-social) examines the cultural, environmental, economic, familial, and social circumstances surrounding the expression and experience of illness and pain.[18]



Enter the Neuromatrix

The current widely accepted theory of pain is the neuromatrix theory of pain, developed by Dr. Ronald Melzack, who is a professor of psychology at McGill University.[22] It is model for the widespread neural network and processes that are sculpted by a multitude of sensory inputs. When there are repeated cyclical processes and syntheses of nerve impulses through the neuromatrix, a pattern emerges: a neurosignature, which is a specific neuronal pattern within the neuromatrix like a fingerprint. Thus, no two neurosignatures are identical.

The neuromatrix theory of pain proposes that pain is an imprint of nerve impulse patterns that are generated by the neuromatrix. [22] There are many inputs to the brain that can create or later trigger a pain neurosignature, including movements, thoughts, emotions, touch, memories, and fears.

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 an example of this.

The most important takeaway from the neuromatrix theory of pain is recognizing that pain is an output of the brain rather than being dependent on or a response to sensory input like damaged tissue.[16,22]

Age-specific prevalence estimates of degenerative spine imaging findings in asymptomatic patients.

	AGE (yr)						
IMAGING FINDING	20	30	40	50	60	70	80
Disk degeneration	37%	52%	68%	80%	88%	93%	96%
Disk signal loss	17%	33%	54%	73%	86%	94%	97%
Disk height loss	24%	34%	45%	56%	67%	76%	84%
Disk bulge	30%	40%	50%	60%	69%	77%	84%
Disk protrusion	29%	31%	33%	36%	38%	40%	43%
Annular fissure	19%	20%	22%	23%	25%	27%	29%
Facet degeneration	04%	09%	18%	32%	50%	69%	83%
Spondylolisthesis	03%	05%	08%	14%	23%	35%	50%

Spine images of asymptomatic people. Adapted from Table 2 in Brinjikji et al.

A Bulging Disc Does Not Always Equate to Pain

Do you recall an old saying, "Correlation does not imply causation?" Well, much of this idea can be applied to a common belief that structural "issues" or "abnormalities" are the cause of pain. However, research indicates that this belief has little support.

A recent systematic review of 33 papers with a total of 3,110 subjects published in the *American Society of Neuroradiology* found absence of pain associated with spine degeneration.[23] The occurrence of disc degeneration in healthy, pain-free individuals ranged from 37% of subjects in their 20s to 96% of those 80-year-olds. Similarly, 30% of those in their twenties had bulging discs. MRI findings of degenerative changes in the spine and discs are part of the normal aging process rather than a disease or the cause of pain. The results from Brinjikji et al. suggest that even in young adults, degenerative changes may be incidental and not causally related to presenting symptoms.[23] This study strongly suggests that when degenerative spine findings are observed, it may be normal age-related changes rather than a pathology.

Another study published in *Spine* observed MRI findings of cervical spines of 1,211 healthy, asymptomatic Japanese adults between the ages of 20-70.

Surprisingly, about 73% and 78.0% of males and females, respectively, in their twenties had bulging discs, though only about 5% of all of these asymptomatic subjects were diagnosed with spinal cord compression and increased signal intensity. The conclusion of this study was that it is dangerous to make interventional decisions based on findings in MRI images alone.[24] The lesson: it is a mistake for our treatment decisions to be based on image findings alone. Hurt doesn't always equal harm.

Finally, Del Grande et al. studied professional baseball pitchers without pain using high-resolution 3-T MRI and found substantial soft tissue abnormalities.[25] Out of the 19 asymptomatic individuals studied, 68% presented tendinopathy, 21% acromioclavicular joint osteoarthritis, and 32% showed partial thickness supraspinatus tendon tears.[25]

For professional athletes, MRI images are used widely to provide evidence for pathologies in order to inform the cause of their symptoms (typically pain or a decrease in performance) and effective treatment. Del Grande et al. provides further confirmation of how tissue abnormalities can exist—in this case, specifically 19 baseball pitchers — without the presence of pain.[25] Thus, the important takeaway is that lesions found in MRI reports can be misinterpreted for symptomatic pathologies.

Know More, Less Pain

When a client understands how pain works, they can bring conscious awareness to the triggers of their pain, and in doing so, they can better manage and likely decrease their pain. Changes in opinion provides clients with more adaptive thoughts and behavior. Research conducted by Louw et al. showed that giving people a pain education lessens their pain experience post-surgery and reduces medical expenses by 45%.[26] They also showed that for patients, knowing how a surgical procedure will affect their symptoms is for them the most important. Some practitioners think that their clients cannot understand pain physiology.[11]

However, Moseley showed health professionals inaccurately estimate client's ability to understand the neurophysiology of pain and that despite clinicians' beliefs that patients aren't able to understand pain physiology, clients can and want to understand their pain.[10]

Photo: Iopolo

Understanding pain gives clients confidence and self-efficacy in knowing that their bodies are sensitive, not vulnerable or fragile. Self-efficacy for people with chronic pain is when they have the internal resources to carry out certain activities or achieve a desired outcome in spite of experiencing pain.[27] In other words, for a person seeking to engage in a particular behavior or activity, they're more likely to do that if they feel like they have the internal resources to perform, regardless of their pain.

With 172 subjects, Costa et al. examined whether pain self-efficacy and/or fear of movement mediated the relationship between pain intensity and the disability of pain.[28] What they found was that beliefs of pain self-efficacy and fear of movement partially mediated the effects of pain intensity and disability at the onset of pain. Also, 12 months after the onset of low back pain, subjects with high self-efficacy possessed less pain intensity and disability. Further studies support the relationship between higher patient self-efficacy and lower levels of pain and disability.[29,30,31]

These conclusions were supported in a systematic review and meta-analysis that involved almost 3,000 subjects where the research team tested what roles of fear, catastrophization, self-efficacy, and other variables such as psychological distress (depression and anxiety) have in determining disability with people with low back pain and neck pain. While all of these variables interrelate, they found that self-efficacy was the strongest mediator, followed by psychological distress, and then fear of pain.[27]

Rehearsing any task results in higher proficiency of that task. This is a rule of neuroplasticity. The same applies if our attention is always focused on our pain: the nervous system, at all levels, will alter itself physically and chemically to be more sensitive, also known as long-term potentiation. As pain persists, the nervous system becomes better at producing pain. What was previously considered to be an innocuous stimulus may now be perceived as noxious, making it harder for ordinary central nervous system inhibitory mechanisms to operate effectively.[32]

Teaching a person with chronic pain the science of their pain is a cognitive behavioral management tool and treatment target. If done well, it has the potential to reduce clients' fears, which likely decreases pain intensity and lowers overall disability.

Although a pain education may not necessarily reduce or eliminate pain, it supports the intended goals in all forms of therapies in motivating clients to play a more active role in their recovery.[33,34] Pain education is no easy task. It must be appreciated how deep-seated human beliefs are and the preconceived ideas we have of our bodies. Through a willingness to commit time and effort to properly educate clients, clinicians can have a profound effect on empowering clients to get back to living life more fully.[7]

Takeaway Points

Our experience of pain is a top-down process—always. In fact, there is no such thing as myofascial pain, bone pain, organ pain, or even the existence of nerve pain.

There's just pain.

This means damaged and pinched nerves do not have to hurt. Even in the presence of actual tissue damage—given pain is an output of the brain—it is our brain that concludes whether our tissues are in danger.

Pain is primarily a psychological experience.[35] This is not to say that pain is all in your head, as in your imagination, but it is a construct of the brain projected onto the body. Modern pain science does NOT imply people imagine their pain. Pain is real. Pain is *always* real. Pain literally changes our nervous system. The terms "acute" and "chronic" are temporal identifiers, not characteristic of whether tissue damage is present or not. In other words, someone can have acute pain without any tissue injury, and so their recovery from that acute pain is not comprised of tissue repair, but instead it is the attenuation of the pain itself.

One of the most important factors to demonstrate the difference between acute and chronic pain is injury healing times and their relevancy. The intensity of acute pain is commonly interpreted to reflect the severity of tissue damage. Any quick onset of pain is considered acute, with or without tissue injury. However, in both acute and chronic conditions, pain is still the brain's interpretation of physical danger. Pain science not only reveals our misunderstanding about how pain works but also examines how our common vernacular as practitioners can cause more hurt in the end.

First, we must be careful not to discount our client's pain experience, even if we think we already have an understanding of their false beliefs. Clinicians tend to

"To reduce pain, we need to reduce credible evidence of danger and increase credible evidence of safety." ~ Dr. Lorimer Mosely, Professor of Neuroscience, University of South Australia

feel rushed to get the educational portion of their treatment over with but this can only serve to further invalidate a client's pain experience. By not allotting time to fully listen to our client's complaints, stories, and values, we run the risk of invalidating their pain and truly misunderstand who they are as a victim of pain.[36]

Second, we should be mindful of our speech. Are we using terms that incite fear and worry? Additionally, if we refer to pain as an experience (verb) rather than a thing (noun), we signal to our clients that their pain is a state that has the ability to change. This encourages a more active enrollment from our clients in their recovery. This also provides insight for them to see that their thoughts and behaviors lead to positive or negative consequences.

Sadly, referring to pain as a noun misplaces the multi-factorial experience that pain is. Pain as a noun also can mislead both practitioners and clients to think pain is in tissues thus can be removed from their tissues (noun).

If we're speaking in wrong terms, then we're thinking in wrong terms. Whether experiencing chronic or acute pain, incessant worry, fear avoidance, and self-diagnosing only further sensitizes one's nervous system. When false beliefs are determined as the root of causing harm, providing client education is one of the most effective interventions. Likewise, we don't want to cause too much cognitive dissonance at first when explaining pain. We must take special care when educating clients who seem to use their pain to self-identify.

Above all, build self-efficacy and explain pain on purpose!

5 Simple Ways to Apply Pain Science to Your Practice

1. Listen to your clients and their stories, ensuring that they know you care. The most important factor to a client's improvement is not the thoroughness of the medical history or physical assessment; it's whether or not clients indicated that the practitioner had carefully listened to their descriptions of their condition on the first visit.

2. Provide reassurance that they and their bodies' tissues are okay because tissues are adaptable and resilient. Remember, all tissues complete their healing phase.

3. Correct any false beliefs about pain that you hear coming from the client throughout treatment, as this is a paradigm shift for most people. Know that not everyone will get it at first, so be kind, patient, and persistent.

4. Encourage clients to police their thoughts of worry and to strengthen their social network, seeking out fun and laughter.

Hurt doesn't necessarily equal harm. Remind your clients that an entirely pain-free life is an unreasonable expectation.

5. Advise that they have an exercise regime that matches their tolerances, grading their exposure to incrementally increase load over time. Exercise serves as an analgesia, building clients' confidence in their tissues.[37,38,39] You can refer to a physio or personal trainer who is up-to-date with pain science so that the message is confirmed and consistent.

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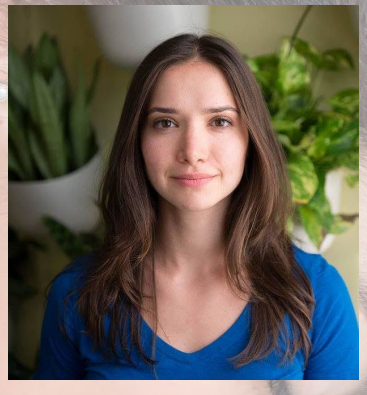

Rey Allen and Marie Zahn, both Certified Rolfers and DNM practitioners, live and practice in New York City where they have shared an office for the past five years. Together, they were introduced to pain science six years ago and have since continued to study and apply it in practice. Rey began the now active Facebook group page Explaining Pain Science that discusses scientific evidence and related topics pertaining to pain and how to relate it to clients.

Rey also instructs science-based courses for manual therapists and sometimes gives lectures discussing pain to clinicians and the public. Marie studies and applies science related to manual therapy, but she is also involved in environmental biology research projects; she is currently stationed in Antarctica for two months as a field team member conducting oceanic climate change research.

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