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Pain science has revealed a great deal in the last fifty years, but most of this information has had seemingly little impact on the way pain is commonly treated. Modern pain research supports new ways of thinking and can lead to better treatment for persistent pain. If you have pain, this is stuff you should know. By the time you are done reading this, you will know more than many medical providers about pain mechanisms, and maybe even feel a little better as a result, because ***research shows that pain education can improve outcomes***.

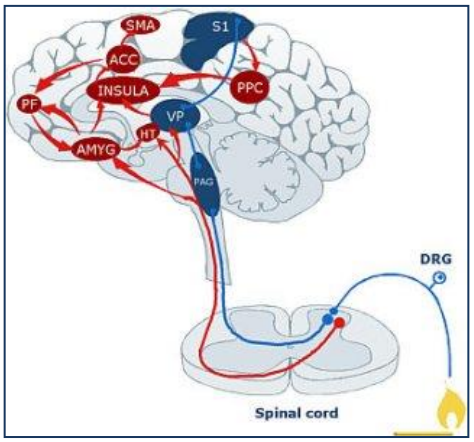
Here are the basics of pain science:

1. Pain is a Survival Mechanism Designed to Protect the Body

Pain is defined as an unpleasant subjective experience whose purpose is to motivate you to do something, usually to protect body parts that the brain thinks (rightly or wrongly) are damaged. If you feel pain, it means that your central nervous system ("CNS") thinks the body is under threat, and that something has to be done about it. In this sense, pain is a survival mechanism of fundamental importance. People born without the ability to feel pain (yes, they really exist) don't live very long. Your CNS takes its job of creating pain very seriously, and therefore you can expect that when it thinks a part of the body is being damaged or is in danger, it will err on the side of giving you a clear incentive to do something about it.

2. Pain is an Output of the Brain, Not an Input from the Body

This is the fundamental paradigm shift that has recently occurred in pain science. Pain is created by the brain. Pain is **not** something passively received by the brain as a sensation sent from the body. When a body part is damaged, nerve endings send a signal to the brain containing information about the nature of the damage (or potential danger). No pain is felt until the brain evaluates this information and decides that pain would be a good way to encourage you to take action. Most of the time, the desired action is something that will help protect and heal the damage. The brain considers a huge amount of factors in making this decision and many parts of the brain are activated at once. Since we all have different life experience, no two brains will decide the same thing. Those multiple parts of the brain that help process the pain response include areas that govern emotions, past memories, and future intentions or expectations. Therefore, pain is not an accurate measurement of the amount of tissue damage in the body; it is a signal encouraging action. When a professional musician hurts his hand, his brain might consider very different actions than a soccer player with the same injury. And therefore you can believe that he may get a very different pain response. .



3. Physical Harm Does not Equal Pain. And Vice Versa.

If you are in pain (hurt), you are not necessarily injured (harm). And if you are hurt, you will not necessarily feel pain. Some very dramatic examples of tissue damage without pain are when a solider is wounded in battle, or a surfer gets an arm bitten off by a shark. In these situations, the victims report that they did not feel any pain at all until the emergency is over. Pain is a survival mechanism, and in cases where pain makes survival even harder, we shouldn't be surprised that there is no pain. Although most of us have never had our arms bitten off by sharks, we have likely experienced bumps or falls during a sports match or some other minor emergency that we didn't feel until the game was over. Furthermore, many studies have shown that large percentages of people with pain free backs,

shoulders and knees have significant tissue damage in these areas that can be seen on MRI, such as herniated discs and torn rotator cuffs.

How can you have damage without pain? Because for some reason the brain doesn't think that the damage calls for action. One possible explanation is that the damage occurred slowly over a long period of time in a way that the brain did not find threatening, or maybe the brain just figured the damage was healed as well as possible, and concluded that pain no longer served a useful function. If no action is useful or necessary, or if the action has already been taken, then there is no reason for pain. Have you ever gone to the doctor for pain that disappeared as soon as you walked into the doctor's office? Perhaps this is the result of the brain concluding that the danger signal has been appropriately processed and that the right action has been taken. Some common back pain myths, such as the ideas that bulging discs, "bad" posture, or lack of core strength are still considered major causes of back pain. The evidence just doesn't support those claims, which is somewhat surprising and counterintuitive.

On the other hand, many people suffer from pain when there is no tissue damage at all. There is a condition called allodynia, where even normal stimuli such as lightly touching the skin can cause excruciating pain. This is an extreme example of something that might occur quite commonly on a much smaller scale – the brain misinterprets harmless sensory information as evidence of tissue damage, and causes unnecessary pain.

4. The Brain Often "Thinks" the Body is in Danger Even When It Isn't

The most 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 that senses the

limb remains, and it can be mistakenly triggered by cross talk from nearby neural activity. When this occurs, victims might experience incredibly vivid and painful sensations of the missing limb. Amazingly, phantom arm pain can sometimes be cured by placing the remaining hand in a mirror box in a way that tricks the brain into thinking the missing arm is alive and well! This is an extraordinary demonstration of the fact that the true target for pain relief is often the brain, not the body.

There are many other more commonplace instances where the brain does not know what is going on in the body and causes pain in an area that is clearly not under threat. Any kind of referred pain—where pain is felt some distance away from the actual problem—is an example of this.

5. Pain Breeds Pain

One unfortunate aspect of pain physiology is that the longer pain goes on, the easier it is for the brain to produce pain. This is a consequence of a very basic neural process called long term potentiation, which basically means that the more times the brain uses a certain neural pathway, the easier it becomes to activate that pathway again. It's like carving a groove through the snow while skiing down a mountain – the more times the same path is traveled the easier it is to fall into that same groove. This is the same process by which we learn habits or develop skills. In the context of pain, it means that the more times we feel a certain pain, the fewer stimuli are required to trigger the pain.

6. The CNS Can Change its Sensitivity Level to Input

There are numerous mechanisms by which the CNS can increase or decrease its sensitivity to a stimulus from the body. The most extreme example of desensitization occurs during an emergency situation as described above, when signals from the body are completely inhibited from reaching the brain.

Most of the time an injury will increase the level of sensitization, presumably so that the brain can more easily protect an area that is now known to be damaged. When an area becomes sensitized, we can expect that pain will be felt sooner and more strongly, so that even normally innocuous mechanical pressures can cause pain. There are many complicated mechanisms by which the level of sensitivity is increased or decreased which are far beyond the scope of this article to address. For our purposes, the key point is that the CNS is constantly adjusting the level of volume on the output (pain), depending on a variety of factors. For whatever reason, it appears that in many individuals with chronic pain, the volume has simply been turned up too loud and left on for too long. This is called **central sensitization**, and it probably plays at least some role in many chronic pain states. It is another example of how chronic pain does not necessarily imply continuing or chronic harm to the body.

7. Pain Can Be Triggered By Factors Unrelated to Physical Harm

You may have heard the phrase that "**neurons that fire together wire together."** The most famous example of this principle is Pavlov's experiment where he rang a bell each time his dogs ate dinner, then later found that he could cause the dogs to salivate at the mere sound of the bell. What happened at the neural level is that the neurons for hearing the bell became wired to the neurons for salivating, because they fired together consistently for some time. The same thing can happen with pain. Let's say that every time you go to work you engage in some stressful activity such as working on a computer or lifting boxes in a way that causes back pain. After a while your brain will start to relate the work environment to the pain, to the point where you can start feeling the pain just by showing up, or maybe even just thinking about work. It is no surprise that job dissatisfaction is a huge predictor of back pain.

Further, it has also been shown that emotional states such as anger, depression, and anxiety can make the experience of pain worse. Although it is hard to believe, research provides strong evidence that a significant portion of chronic back pain is caused more by emotional and social factors than actual physical damage to tissues. You may have noticed that when you return to a place you haven't been for many years, you quickly fall back into old patterns of speech, posture or behavior that you thought you had left behind permanently. Pain can be the same way, getting triggered or recalled by certain social contexts, feelings or thoughts that are associated with the pain. Ever notice that your pain went away went you went on vacation and came back when you returned?

CONCLUSION

Pain is normal, and usually sensible. When the body is working well, damaged tissues will heal to the best extent possible in a few weeks or months, and then typically pain tapers off and disappears. Why does it continue if the body has already done its best to heal it? The book, "Explain Pain" by Lorimer Moseley and David Butler summarizes this way: "Even when pain is chronic and nasty, it hurts because the brain has somehow concluded (often completely subconsciously) that you are threatened and in danger…

….the trick is finding out why the brain has come to this conclusion."

This information was primarily taken and edited from Todd Hargrove's blog www.bettermovement.org 7 THINGS YOU SHOULD KNOW ABOUT PAIN SCIENCE. It is largely based on work by Lorimer Moseley and David Butler, along with many other accomplished researchers in the world of pain science.