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## ***It Hurts: How We Biologically Experience Physical and Emotional Pain***

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*"Who does it hurt? That's who the story is about." -Harlan Ellison, on writing*

Pain is a fascination for me, but increasingly I realize I know only minuscule amounts about how it works biologically. I could go on for hours, despite audience rejection, about hurtin' for my baby; however, where exactly does this emotional pain come from? My heart may be metaphorically cut, but it is not bleeding. The traditional "physical" definition of pain - that pain is, for example, "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" [1] - doesn't always work. I've gotten much more emotional pain from a loved one's rejection than from shoulder dislocation, but the first involves no tissue damage or threat of tissue damage. I discovered I needed to do research on what pain was before I could understand emotional pain.

Don Ranney says in his "Anatomy of Pain" that:

...pain is a perception, not really a sensation, in the same way that vision and hearing are. It involves sensitivity to chemical changes in the tissues and then interpretation that such changes are harmful. This perception is real, whether or not harm has occurred or is occurring. Cognition is involved in the formulation of this perception. There are emotional consequences, and behavioral responses to the cognitive and emotional aspects of pain. [1]

pain.com uses essentially the same definition, but adds: "Pain is a complex perception that takes place only at higher levels of the central nervous system." [2]

Dr. Pennal pulls from a textual definition in "The Personality of Pain:"

[Pain is] an abstract concept which refers to (1) a personal, private, sensation of hurt; (2) a harmful stimulus which signals current or impending tissue

damage; (3) a pattern of responses which operate to protect the organism from harm. These responses can be described in terms which reflect certain concepts, i.e., in neurological, physiological, behavioral, and affective "languages." [3]

The Web version of the [Encyclopaedia Britannica](#) defines pain as:

...a complex experience consisting of a physiological (bodily) response to a noxious stimulus followed by an affective (emotional) response to that event. Pain is a warning mechanism that helps to protect an organism by influencing it to withdraw from harmful stimuli; it is primarily associated with injury, or the threat of injury, to bodily tissues.

It's interesting to notice that of the three definitions, only the Encyclopaedia does not mention "personal, private" or "perception." For the two doctors, pain involves the mind; pain is a perception, and the mind makes a conscious analysis of an event and decides that the individual perception of it means that pain should result from the event. "Cognition is involved in the formulation of this perception." This is interesting, because until now I thought that, vaguely, some neuron or other would float up from my arm and tell my brain that my arm was hurting. These doctors are telling me that this happens, but it is my mind which interprets the situation as pain.

The definitions above, however, are not really enough for me to understand the process of pain. What part of the mind is used to interpret a situation as painful? What is the "noxious stimulus" from the injury to the mind? And, of course, if the mind requires this specific stimulus to experience pain, where does it come from when we ask about emotional pain? This is a really tough question to ask in the face of modern thought, which states that "pain is a totally subjective experience which cannot be simultaneously shared and reported by another individual," and that "clinical pain as we know it is a unique experience peculiar to the human." [3] This frame of thinking is the one I found most common on the Internet and it seemed to preclude any discussion of the actual biological processes involved in pain. While I am happy to view the development of a concern in the medical community for accepting all types of pain on equal terms and not taking physical evidence as the only signifier of extant pain, I am interested in seeing what happens biologically when pain is present, whether psychosomatic or not. The only definition involving physical elements other than the vague term "body tissues" was "central nervous system" from pain.com.

The reason there is a brevity in the definition and a lack of explanation to the exact physical elements involved is that there is as much difference between different types of physical pain as there is between physical and emotional pain. I will focus here however on a brief analysis of what happens with peripheral pain, then try to compare it with what happens where emotional pain is concerned.

First, peripheral pain. This pain "originates in muscles, tendons, etc., or in the peripheral nerves themselves." [1] The procedure which begins when "danger to tissues" of some sort occurs is this: the amount of pH drops and chemicals are released, called **histamines** and **bradykin**. Bradykinin seem to be receptor cells of some kind, but I have been unable to discover more than that about them. Histamines are organic substances stored within and released from cells in response to irritation; they cause contractions in certain body parts, like the stomach or lungs. Small non-myelinated C fibres are sensitive to these chemicals (myelinated fibers specifically perform this

purpose, as well as sensing heat.) When they sense histamines and bradykinin, the C fibres send an electrical charge along the spinal cord. It goes to the **dorsal horn** of the spinal cord, the part of the spine which receives afferent information.

What happens at the dorsal horn is really complex and not fully understood, but it is called the "Pain Gate" by many doctors. From what I as a layman have been able to comprehend, more neurotransmitters are released when the dorsal horn senses the electrical charges sent to it.

From the dorsal horn, pain goes to the brain. But which part of the brain? No specific part, apparently. "Unfortunately there is no discrete centre where pain is recognised. Pain is so important to survival that almost the whole brain is involved. Pain involves cognition, emotion, and behaviour... All of this supports Dennis Turk's claim that "the reign of pain is mainly in the brain". But there is no one centre "in control". Rather we see that pain can be all-pervasive, affecting our thoughts and memories, attitudes and emotions, movements and behaviour -- and in turn be affected by each and all of them." [1]

It was difficult to find a concrete analysis of emotional pain on the Web. However, on a page called "The biology of emotional disorders with the self help measures," I found this interesting statement:

The toxicosis consists of excess neurotransmitters and other neurochemicals. When this develops in the brain, the neurons cannot release enough neurotransmitter molecules to excite the rest of the nervous system, and symptoms of depression occur. Depression is also caused by the clogging of receptors with endogenous neurochemicals and with substances from the environment such as unmetabolized food substances, drugs, and other toxins. [5]

The paper goes on to say:

But neurons generally do not replace themselves, so when they become toxic a portion of the neuron breaks open and releases the toxins during what might be called a detoxification crisis. A detoxification crisis is an excitatory nervous symptom such as intense anxiety and many other symptoms. During a detoxification crisis excess neurotransmitter molecules and other neurochemicals flood the synapses. These toxins include excessive amounts of the neurotransmitter noradrenaline, also adrenaline, dopamine, serotonin, GABA, endorphins and other substances. The excess neurotransmitter overexcites the nervous system causing excitatory nervous symptoms that can range from mild anxiety to mania and to extreme acts of violence. [5]

Depression is a toxic situation built up over time in the brain's neurons, sometimes beginning as early as childhood. The chemicals and neurotransmitters which are affected cannot perform their function well enough to bring the person out of depression. Eventually, the neurons become too

toxic and need to detoxify, and they flood the nervous system with neurotransmitters, overexciting what was once underexcited.

This seems to be an extreme case, however. What about temporary grief, rejection maybe from a date, that sort of pain? There doesn't seem to be much literature on the subject - perhaps because it's too difficult to study.

Comparing the two sorts of pain - the analysis of the biology of depression and the analysis of the biology of peripheral pain - opens up some really interesting points for discussion. I find it fascinating how the two sorts of pain seem to react to and interact with each other. Many of the websites I researched on peripheral and physical pain indicate or state directly that the emotions have a direct impact on how the individual experiences pain. And some of the readings I've done on the side state that pain can be used to enhance a person's emotional state. Many people who engage in self-mutilation, for example, do so because they want to feel emotional pain, not physical pain. Forms of Eastern medicine teach that treating the mind is as important as treating the body - the two interface. So I am left with the distinct impression, not that emotional pain and physical pain are different sorts of pain (after all, biologically they are both the reaction of the brain to neurotransmitters), but that they somehow work together to keep the body in order. We need emotional stability as well as physical safety in order to achieve equilibrium and get rid of pain. This raises even more interesting questions for me. Did this evolve as a survival tactic? Why would emotions be important to survival? Does emotional connectivity resulting in grief at the loss of a loved one, for example, represent a way the body evolved to protect the person, since people working in groups are safer than individuals alone? I was really frustrated by the confusion of materials available online. People seemed afraid to define pain, mostly because they were afraid that defining pain would invalidate forms of pain which didn't fall under their definition. I view this almost as a cop-out, because it allows people to keep going without analyzing each individual type of pain and maybe learning more about the body and about pain as a whole.

*Note: The hardest part of this paper was the looking up of every other word in each of the documents I read online. The Encyclopaedia Britannica was invaluable in helping me do this, but I think this wordiness represents another problem. I never saw a website in all my searches which tried to explain pain to a patient or layman. The assumption is that the patient is always looking for a cure. While this is no doubt true, sometimes it feels good to a patient to know what exactly is happening to their bodies and this needs to be respected.*

#### **postscript:**

*I e-mailed Don Ranney, whose work I quoted in this paper, and asked him about emotion-caused pain. He sent me the following response:*

Dear Joseph,

I have not run across anything that describes neuroanatomical pathways in emotional pain AS DISTINCT FROM physical pain. Emotion is inseparably involved in all pain because the limbic system is always affected to some degree or another in any pain, and the limbic system ( especially the mammillary body, anterior nucleus of the thalamus, cingulate gyrus, amygdala and hypothalamus ) is the say of emotions.

Of course you are asking about suffering due to cognitive processes, ideas that are present in the mind. In this there should not be any activity in the peripheral sensory system. Chemical mediators in the CNS would be active, e.g., serotonin and I don't

know what else. But I don't think substances like bradykinin and histamine or even substance P would be released.

All this is not very much but I hope it helps.

Don Ranney, MD, FRCS

**This e-mail basically states that there has not been any work done on emotion-caused pain as opposed to physically-caused pain. That would explain the difficulty in finding information. I believe work on emotionally-caused pain needs to be done. It might lead to new understanding of the mind-body balance, for one thing.**

**bibliography:**

[1] Don Ranney, M.D. [The Anatomy of Pain.](#)

[2] Aghabeigi: [The pathophysiology of pain.](#) at pain.com

[3] Billy E. Pennal, Ph.D. [The Personality of Pain](#)

[4] The [Encyclopaedia Britannica Online](#)

[5] Van Winkle, Elnora. [The biology of emotional disorders: self help for mood disorders, major depression, bipolar depression, manic depression, mental illness, psychosomatic disorders, alcoholism, addiction, and aggressive or violent behavior](#)

**other helpful websites not cited in this paper:**

- [What Is Pain?](#)
- [University of Toronto Centre for the Study of Pain](#)
- [How do Physicians Recognize Somatization?](#)
- Holt, Doug. [The Role of the Amygdala in Fear and Panic.](#) [Note: this guy used to be in Biol. 202 and his paper's on Serendip! I found it in a search online... cool!]

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