Is emotional pain worse than physical pain?

Isabella Noelle Chiong
BSc Biomedical Sciences, UCL
STEM People Research team
Table of Contents

Introduction .................................................................................................................................................. 2
What is pain? ............................................................................................................................................... 3
Pathways of Pain ......................................................................................................................................... 4
Can we distinguish between emotional and physical pain? .............................................................. 8
Emotional pain vs. Physical pain - Which is worse? ............................................................................. 9
Conclusion .................................................................................................................................................. 10
References ................................................................................................................................................. 11
Introduction

There are two different types of pain that we feel. The first type is known as physical pain and is usually associated with physical injuries to our body. For example, when you sprain your ankle or when you scratch your knee and it starts bleeding, you say that you feel “pain”. This form of pain is easier to identify, and the biological pathways involved in the sensation of pain are more well-understood than the second type of pain, which is known as emotional pain. This type of pain is more abstract, and can be felt from a range from experiences such as losing a loved one, to being socially rejected by your peers. How emotional pain is felt, and why some people experience more severe emotional pain is a very difficult question to answer. This research paper aims to describe the differences between the two types of pain, and to answer the question of whether or not emotional pain is worse than physical pain on a biological level.

What is pain?

Through personal experiences, everyone has an idea of what pain is, yet different individuals have different interpretations of pain and feel it to different extents. The following table outlines the different definitions of pain:

<table>
<thead>
<tr>
<th>Dictionary</th>
<th>Definition of Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merriam-Webster[1]</td>
<td>1) localized physical suffering associated with bodily disorder (as a disease or an injury)</td>
</tr>
<tr>
<td></td>
<td>2) a basic bodily sensation induced by a noxious stimulus, received by naked nerve endings, characterized by physical discomfort (as pricking, throbbing, or aching), and typically leading to evasive action</td>
</tr>
<tr>
<td></td>
<td>3) acute mental or emotional distress or suffering</td>
</tr>
<tr>
<td>International Association for the Study of Pain[2]</td>
<td>An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.</td>
</tr>
<tr>
<td>Anatomy of Pain[3]</td>
<td>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.</td>
</tr>
</tbody>
</table>

Comparing the three definitions of pain, it can be summarised that pain involves both a sensory experience, and perception. It is sensory as it can be induced by a stimulus, such as the pricking of a pin, that activates pain receptors. However, it is also a perception as we can perceive this stimulus as “painful” or not, and whether or not we feel experiences as “painful” or not. Some people find experiences such as relationship breakups as painful, while some don’t. This renders pain as to be a very subjective experience that is influenced by a wide variety of psychological factors. Emotional pain sometimes does not even need a stimulus, like the absence of tissue damage or any pathophysiological cause, making it entirely subjective and a personal experience.
Pathways of Pain

Nociceptive Pathway

Physical pain and tissue damage are detected by the activation of several pain pathways, one example is the nociceptive pain pathway. This pathway includes three main components: 1) unpleasant (noxious) stimulus 2) nociceptors 3) central nervous system.

Figure 1. The nociceptive pain pathway[4]
When a noxious stimulus is applied, nociceptors which are the peripheral pain receptors present on the skin surface, are activated. The activation is brought about by reaching a threshold through the release of inflammatory mediators such as bradykinin, prostaglandins and hormones such as serotonin, from damaged tissue. The stimulus is then transformed into electrical signals and travels down sensory neurones, which are the nerve cells transmitting signals to the central nervous system. More specifically, the signals travel to the dorsal horn of the spinal cord through the dorsal root ganglion, which is a collection of the cell bodies of sensory neurones. To be able to feel pain, the signals from the spinal cord travel along the ascending pain pathway known as the spinothalamic tract and arrive at various regions of the brain including the cortex and thalamus. More complex systems and pathways are then involved after the signal arrives these regions, to determine how we perceive pain. The efficacy of these systems is responsible for the variabilities in response to pain. In addition, studies have shown that the recognition involves many different parts of the brain as shown in Figure 2[5], and that no single centre can be identified as the sole site of pain recognition. This explains why pain is so complex, and can be influenced by a wide range of factors include environmental factors and past experiences[6].

As well as perceiving pain, the brain is also responsible for modulating pain. This is carried out via pain-inhibiting and pain-facilitating neurones. Descending signals from the brain transmit to the spinal cord, and can modulate activity in the dorsal horn by regulating the transmission of pain in the spinal cord. This involves the release of chemicals such as endorphins when you’re in pain so that pain is reduced[7].
Depression: an example of emotional pain

There are many experiences that fall under the umbrella of emotional pain, for example social rejection, anxiety, depression, etc. For this reason, it is difficult to generalise the pathway involved in emotional pain. In this research article, I will focus on a specific example of emotional pain which is depression, known as major depressive disorder (MDD).

MDD is predominantly characterised by two symptoms - the loss of the feeling of pleasure and a depressed mood. To the present day, research is unable to completely determine the biological pathways involved in depression, and can only generate theories. One widely accepted theory is the monoamine theory of depression. This theory states that depression is brought about by the reduced neurotransmission of monoamines, such as serotonin through 5-hydroxytryptamine (5-HT) neurons in the prefrontal cortex. The depletion of norepinephrine is also suggested to play a role in the development of MDD. These are outlined in Figure 3 below.

![Figure 3. The monoamine hypothesis of depression.](image-url)
Serotonin is synthesised from its precursor tryptophan, with the first step in the pathway catalysed by an enzyme known as tryptophan hydroxylase. Norepinephrine is formed from tyrosine, and this reaction is catalysed by tyrosine hydroxylase. After synthesis, the two neurotransmitters are stored in vesicles in the presynaptic neurone. Vesicular content is also regulated by monoamine oxidase A (MAO-A) which breaks down monoamines presynaptically. When the vesicles move towards and fuse with the membrane of the neurone, the neurotransmitters are released into the synaptic cleft and bind with the receptors on the postsynaptic neurones. Postsynaptically, both serotonin and norepinephrine bind two types of proteins known as G-proteins which are involved in different signalling pathways.

Neurotransmission across the synaptic cleft can be stopped by the reuptake of serotonin and epinephrine by specific serotonin and norepinephrine transporters respectively. There is also feedback control of neurotransmitter release through the presynaptic α2-noradrenergic autoreceptors for norepinephrine and the 5-hydroxytryptamine (5-HT1) regulatory autoreceptors for serotonin. The activity of 5-HT1 is also increased by binding of the protein p11.

Research shows that in patients with MDD, there are decreased levels of serotonin and epinephrine through the inhibition of tyrosine hydroxylase or insufficiency of tryptophan. There is also an increased frequency of a mutation affecting tyrosine hydroxylase (TPH-2) impairing its catalytic activity, and increased breakdown of neurotransmitters through increased specific ligand binding to MAO-A. There is reduced activity of the 5-HT1 receptors and decreased levels of p11. Finally, reuptake of serotonin and epinephrine from the synaptic cleft increases through the serotonin-reuptake transporter. All these findings support the monoamine theory of depression and explain how depression arises[8].

However, there may still be questions may still be lingering in your mind. Like the nociceptive pain pathway, what is the stimulus of depression? Up to this day these questions remain difficult to be answered, and sadly, there is insufficient research carried out on emotion-caused pain to fully understand the causes behind emotional pain. For now, we can assume that personal experiences and various psychological factors play a huge role in emotional pain.
Can we distinguish between emotional and physical pain?

If both types of pain involve neurotransmitters or hormones such as serotonin, how does the brain distinguish between the two? Is it even possible that the brain can distinguish between the two? Recent ground-breaking research suggests that it is possible.

In a study published in the New England Journal of Medicine, 114 young, healthy adults were asked to participate in a series of tests. In the first study, thermal stimuli of varying intensities were applied to the left forearms of 20 participants, then they were asked to rate the level of pain. The heat intensities ranged from warmth to relatively painful, but both were not harmful to the participants in any way. While the stimuli is applied, the brains of the participants were scanned using a technique known as functional magnetic resonance imaging (fMRI). The second study involves a similar procedure to the first study, but this time, the scientists used any patterns observed from the fMRI scans of the first study to predict whether or not participants in the second study were experiencing pain. Astoundingly, the model that they created was able to accurately determine whether or not the participants were feeling pain or warmth 93% of the time, confirming that there are certain regions of the brain involved in the feeling of physical pain.

In the third study, the same thermal stimuli were applied to the participants, except that these participants had recently experienced a romantic breakup and continued to feel socially rejected. Their brains were also scanned while they were viewing a picture of their ex-partner, and an image of a close friend. The results conclude that there were differences in the activity patterns in regions activated by physical and emotional pain. This difference in the pattern of activation allows the two types of pain to be distinguished from one another.⁹
Emotional pain vs. Physical pain - Which is worse?

Now that we have an understanding of the basis of pain, and the differences in the two types of pain, it is time to go back and answer the question of this research article - is emotional pain worse than physical pain? The simple answer to the question is yes. A study carried out in 2008 confirmed that emotional, or social, pain is more easily relived and reexperienced by individuals than physical pain. At the time that the event happened, physical pain may be equally, or even more painful than emotional pain. However, the after-effects of emotional pain are more severe than physical pain.

The research carried out consists of 4 studies in total. In the first two studies, participants were asked to recount, in as much detail as possible, both physical and emotional pain experiences that occurred within the past 5 years. Before writing the accounts, they were also asked to write down how long ago the event had happened, and to rate the intensity of pain they had felt at that time, and then rate the degree of pain they were currently experiencing. The chart below summarises the results.

![Chart](image.png)

Figure 4. Summary of the results of Studies 1 and 2, where the pain slide is an indication of the level of pain.

The results show that the pain the participants experienced when they recalled emotionally painful experiences is always greater than the physically painful experiences. The differences in the initial level of pain between the two types of painful experiences are minimal and can be ignored.
To further support that emotional pain has more detrimental effects than physical pain, studies 3 and 4 were carried out where the participants were asked to carry out various cognitive tasks after reliving their painful experiences. The rate of correct responses and the reaction times when carrying out each cognitive task were measured as an indicator of their performance. Figure 5 summarises the results of Study 4, and appear to be consistent with the results of studies 1 and 2.

The results show that the proportion of correct responses after reliving emotional pain is always lower than that for physical pain. This supports that emotional pain indeed has a more detrimental effect than physical pain[10].

Figure 5. Summary of participants’ performance on the Remotes Associates Test carried out in Study 4 as a measure of performance in cognitive tasks after reliving a painful experience.

Conclusion

Pain is a very complex, and abstract topic that can be defined and influenced by a wide variety of environmental and psychological factors. Each individual experiences pain at varying intensities although presented with the same situation. Interestingly, the biological pathways that occur when a person is in pain, are the same in all individuals. It is the psychological factors that influence how a person perceives pain, therefore rendering pain to be a highly subjective experience. Various studies have been carried to discriminate between emotional and physical pain through the difference in the regions of activation in the brain. Through asking participants to recount painful experiences, researchers have also proven that emotional pain has a longer-lasting, and a more severe effect than physical pain. However, more research needs to be carried out to figure out the underlying reasons, and molecular basis behind this.
References


