A Literature Review of Pain Research: Theories, Mysteries, and Future Directions

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Abstract

Pain is widely considered to be a universal human experience. No matter where you are in the world or what language you speak, cutting your hand on a sharp object should hurt. But what exactly does it mean to “hurt”? Where does pain come from?

The current understanding of pain comes from a combination of research findings from many areas. Instead of looking at pain as purely biological, psychological, or philosophical, a combination of these different vantage points forms a more comprehensive idea. It is important to note that the following is a review of secular, Western scientific theories of pain. The cultural theories of what pain is, where it comes from, and how to treat it are vast in number and rich in content. These theories are also a combination of biological, psychological, and philosophical ideas; however, they deserve the dedication of an entirely separate essay.

This paper is a literature review of pain research through a secular, Western lens, and will discuss and analyze theories of pain and different treatment approaches. Certain phenomena, such as phantom limb pain, which complicate our understanding of pain and sensation are explored. Also explored is the important role of language in the conceptualization of pain, especially in healthcare environments. Inequalities have been found in healthcare quality and health outcomes along axes of race and class, due in part to inaccessibility and implicit biases of healthcare professionals. This paper argues for a biopsychosocial model of pain for scientists and healthcare professionals, given these understandings of language, culture, and the psychological aspect of pain experience.

Theories of Pain

Biological basis of pain

It is important to make a distinction between nociception and pain. Nociception is the objective, biological processes of nerves sending warning signals to the brain of potential damage somewhere in the body. Pain is the subjective experience that results from “the transduction, transmission, and modulation of sensory information.” In everyday usage, “pain” is often conflated with nociceptive processes.

Bell and Magendie made significant contributions to our understanding of pain today; specifically, their findings explored nociceptoral mechanisms. Although their theories were not supported by later experiments, their conceptualization of the body’s sensory nerves served as the basis for the current understanding of the function of motion, the spinal cord, and pain. Magendie and Bell both provided rudimentary evidence of a separation between dorsal and ventral nerve systems in the spinal cord. Expanding on this discovery, Bell hypothesized that sensory nerves, motor nerves, and visceral nerves are distinct from each other, but seem to all come together at certain points in the body. Because the technology that existed today was not available, scientists were not able to fully test various physiological mechanisms. Despite this, Bell was able to reach an incredibly accurate conclusion; he believed that somehow color, taste, motion, and other external stimuli were able to be sensed by the body and transmitted through these nerve networks. We now have detailed insight into the physiological mechanisms of the nervous system that expands upon Bell and Magendie’s earliest conclusions.

Psychosocial basis of pain

In addition to these physiological aspects of pain, there is a psychosocial component that is equally as important. Early ideas in psychology treated the mind and body as distinct entities working independently of each other. Although later research has not supported this conceptualization, there is still conflict within literature as to the exact relationship between the mind, brain, and body. Engel called for a more holistic approach to pain, especially for sufferers of chronic pain. He stated that psychosocial factors such as emotional stress could affect reporting of symptoms and response to treatment; this newer biopsychosocial model focuses on disease and illness, with illness defined as “the complex interaction of biological, psychological, and social factors.” Disease is the objective, biological event that causes a disruption within the body, whereas illness is the subjective experience stemming from the presence of disease.

Pain can be separated into two categories: physiological pain and pathological pain. Researcher C.J. Woolf argued that the colloquial use of the word pain obscures the complex mechanisms behind it; using one word to describe a range of sensations incorrectly implies one mechanism driving it. Woolf defined physiological pain as the range of intermittent sensations experienced due to various stimuli that almost achieve threshold intensity to cause damage or injury; however, there is no significant inflammatory response or damage to the nervous system. Pathological pain describes the sensations experienced from actual significant inflammatory response due to tissue injury or damage to the nervous system. In other words, physiological pain is relatively harmless, while pathological pain is an indicator of significant trauma. The kind of pain one is experiencing would greatly affect how it is treated. For instance, someone could have low grade chronic joint pain, which can be classified as physiological pain, and be given an exercise regimen as treatment. Someone with more severe chronic joint pain such as that arising from advanced rheumatoid arthritis can be classified as pathological pain and therefore treated with more rigorous methods such as medication.

This biopsychosocial model highlights the importance of viewing the individual as a whole. Science, especially medical science, has a tendency to be overly objective; when studying human beings, complete objectivity is impossible. If one solely looked at objective, biological data, they would not have a full understanding of the mechanisms aris-
Self-efficacy has been found to be an effective treatment for pain tolerance.\(^5\) In various studies, when participants perceived control over the situation (receiving pain) was manipulated, there was a positive correlation between perceived control and pain tolerance.\(^4,5\) In other words, participants reported reduced pain levels when they believed they had more control over the situation.

Multidisciplinary treatments

A combined treatment approach has been found to be most efficacious for people experiencing chronic pain. Combining psychological treatments with pharmacotherapy would have a greater benefit for patients dealing with chronic pain than acute pain. Studies have shown that multidisciplinary treatment centers yield more successful outcomes for patients than receiving no treatment, pharmacotherapy alone, and other single-treatment options.\(^7\) Effects were seen in improvements of mood, pain experience, and readiness to return to work. It is possible that a lower dose of medication could be used if a patient is also receiving cognitive therapy. Because sustained use of drugs can have detrimental effects to physical health (especially the kidneys for certain medications) multidisciplinary treatment approaches offer the benefit of delaying these negative effects.

People dealing with chronic pain tend to avoid certain situations that make pain worse; for instance, those with arthritis are likely to avoid physical activity, although sustained exercise actually helps with arthritic pain. In vivo treatments have cognitive and behavioral components; this is a form of multidisciplinary treatment that has been shown to be more effective than any single-modality treatment.\(^8\) In various treatment conditions, patients were either placed on a waitlist and received no treatment, received education about pain as their treatment, did exercise, or received a combination of education and exercise therapy. Results showed that the combination was most effective, and the other three conditions were comparatively not significantly effective.

Language and pain

Pain is a difficult sensation to accurately verbalize; it is not uncommon for people to use phrases such as “the pain I’m feeling is like when you smash your finger in a door” or “it feels like pins and needles.” These phrases are attempts to relay one’s pain experience to another via a shared experience. These examples themselves can be culturally or geographically relative depending on the type of pain experienced. For instance, someone living in a rural area might use the example of “my finger feels like it was bitten by a snake”; someone living in a city is less likely to use that example as snakes are less common in urban areas, thus making it unlikely that someone living in a city has been bitten by one. How someone verbally communicates their pain experience affects how the listener understands it, which affects their attitude toward treatment (if they are a healthcare provider).\(^9\) Because of the difficulty in accurately communicating pain, healthcare providers often use a numeric rating scale to assess patient pain levels. Patients are asked to rate the intensity of their pain on a scale of 0-10 with a rating of 0 indicating no pain and a rating of 10 indicating excruciating pain. Studies suggest modest accuracy for these studies, highlighting a potential gap in understanding between healthcare providers and patients.\(^9\) Miscommunication can potentially be exacerbated by other obstacles to communication, such as language barriers and cultural differences.

One’s expectation of how painful an experience will be affects their actual experience of it, as explained in the tattoo example above.\(^11,12\) Treating pain as a purely objective, physiological phenomenon (which is actually just the perception component) downplays a patient’s experience of pain. Pain can still exist, even without evidence from test results indicating a problem, and should be treated. When dispensing treatment, providers can help patients by being conscious of their language (verbal and body) that they are using in order to validate their patients’ experiences and make patients more confident in the treatment options.

The Mystery of Phantom Limb Pain

Phantom limb pain results after the loss of a limb of the body, with patients reporting experiencing pain in the limb that is no longer there.\(^13\) How can sensory information from the hallux (“big toe”) of an amputated leg be transmitting sensory information to one’s brain? The phenomenon of phantom limb pain complicates our understanding of pain. Although the biopsychosocial model is widely accepted, phantom limb pain may offer insight into which part—biological or psychosocial—is more of a factor in the experience of pain in certain situations. In this case, the psychological aspect of pain seems to be more of a mediator than the biological, although some evidence points to a possible physical source of pain at severed nerve endings; therefore, a psychologically-based treatment (e.g. mirror treatment) would be beneficial. Although phantom limb pain often radially decreases, such that pain becomes limited to the site of amputation, it is still an affliction that deserves treatment.\(^15\)

Mirror treatment involves putting a mirror in between the patient’s remaining limb and the missing one. For example, someone with an amputated arm would have a mirror against the shoulder of that arm, so that they can only see their remaining arm and its reflection. By performing various behavioral tasks (such as waving the arm or grasping an object), patients are able to “gain control” of their missing limb (self-efficacy), decreasing pain experienced.\(^16\) Although an effective treatment has been identified, the phenomenon may be an indicator that the popular understanding of pain is too rigid and does not accommodate physical pain arising from mental anguish.

Conclusion and Future Directions of Research

There are many areas that warrant further study, but a few are presented here. There have been several studies whose results have indicated ethnic disparities in the experience of pain.\(^17,18,19\) Despite this, there has been a lack of research into possible explanations; there are mainly notes at the ends of research articles which state that future studies should look into this issue further.

There also exists ethnic disparities in quality of medical care for pain (and overall medical care), controlled for many possible confounding variables.\(^20,21\) Compensatory solutions to remedy this issue warrant further research. Unequal medical treatment for pain on the basis of race and class negatively
impacts not only physical health, but mental health as well. Studies have shown that black patients receive inadequate treatment when compared to white counterparts, white people show an absence of empathy toward black people, and that there is a widely held stereotypical view that black people do not experience (or experience very little) physical or mental pain.\(^{2,3}\) Surprisingly, even when healthcare professionals were sampled, researchers obtained similar findings. It has also been shown that racism (interpersonal and systemic) has extremely detrimental effects on mental health—in some studies of African Americans, racial discrimination (in multiple forms) was cited as the number one psychological stressor in their daily lives for almost every participant.\(^{24,25,26}\) As healthcare providers and researchers are in positions of power relative to the general population, their biases have a direct negative impact on patients’ experiences in the healthcare system.

Possible solution

What might a successful solution look like? The most important element is feasibility—of course, eliminating systemic racism would be the most effective solution, but it is not practical. One major challenge is that solutions cannot effectively eliminate bias. Biases and stereotypes form at an early age, and it has been found that implicit biases are nearly impossible to change.\(^{28}\) With this in mind, individual healthcare providers who do not hold explicit discriminatory thoughts, but the implicit biases they hold can affect their assessment of patients.

One solution would be a system that allows for a double blind evaluation of the patient. Upon arrival for appointments, patients could fill out a short computer survey, rating their pain across numerous measures. A different healthcare provider that does not know the ethnicity of the patient could then evaluate this survey, possibly as part of an oversight committee. The assessment of the patient by their assigned provider and the oversight provider could then be compared, with discrepancies being noted and analyzed. It is important for the survey to be evaluated by someone other than the patient’s physician so that the physician does not recognize the patient’s verbal answers from their written ones.

Limitations

Adding an extra evaluative step would take up time that many healthcare organizations do not have, making this implementation unfeasible. However, many healthcare organizations already have some sort of assessment of competency for physicians, so this would not be much of a burden to many. Of these existing systems, doctors are evaluated on an individual and team-based level; often patients are assigned a healthcare team that works together.\(^{29}\) It is widely agreed upon that physicians’ performance should be periodically assessed throughout their careers. However, a major conflict concerning evaluations is about the specific measures; how will providers be assessed, and who will do the assessment?\(^{30}\) If a computer does the oversight, it would be harder for the software to pick up on nuances of qualitative assessments. In addition, the cost of these extra steps in the process is surely a huge barrier in implementation. How would it be decided which patients to screen? If history of severe pain issues is the requirement, then a large segment of the population would be left out. Because these biases are seen in the evaluation of physical and emotional pain, a more thorough assessment with a wider range of types of healthcare organizations participating would be necessary.

There are different ways to address provider-side biases, and differential modifications would be necessary in order to account for multiple variables; the type of healthcare organization and patient population demographics relative to the demographics of the physicians are just some examples of factors that could affect the structure of this intervention. Although generating and implementing solutions is difficult, it is still important to view pain within context of world—the biopsychosocial model would be incomplete without recognizing the impact of societal racism on health, which includes experience of pain. In order for the biopsychosocial model to be adequate in conceptualizing pain, it must take into account the various social structures that harm marginalized people; focusing on just the biological and psychological aspects ignores how a social environment affects health. Although it has been found nearly impossible to completely eliminate implicit biases, putting measures in place and enforcing them is a step in the right direction.

Pain is surprisingly very multifaceted. It is far more complex than the average person would believe—a commonly held view is that there is a direct relationship between the infliction of pain and the experience of pain. It was previously thought that pain shouldn't be affected by any factors that were not biological. As pain research progresses, a more comprehensive, biopsychosocial approach is changing the way pain is understood and treated.

References:


