Unpacking pain: what causes it and why it's hard to measure

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Pain is difficult to measure. Unlike using a thermometer to measure body temperature, a blood test to measure blood glucose, or a magnetic resonance imaging (MRI) scan to detect a tumour, there are no

instruments or tests that objectively measure pain.

To understand why, one needs to understand what pain is.

Pain is a perception, and like other perceptions (such as happiness, sadness, anxiousness), it reflects the sum of a lot of external and internal information interpreted by our brains.

For example, we have a specialised part of our nervous system that responds to harmful or potentially harmful stimuli, such as heat from a hot stove and chemicals from a stinging nettle. This system relays information on the location (like the tip of your right index finger) and intensity (the paper cut vs cutting your fingertip off) of a harmful stimulus to the brain. This sensory input is called nociception (detection of noxious stimuli). But the brain doesn't only rely on incoming nociceptive information to generate our perception of pain.

Rather, the brain mixes the sensory information with lots of other sources of information. This other information includes the context in which you were exposed to a harmful stimulus, your emotional state, and your past experiences.

In the context of all these variables, assessing the magnitude of someone's pain is fraught.

Some of the variable factors

Context matters. For pain perception, context may reflect changes in a person's:

- attention – a person feels less pain if they are distracted,
- psychological state – a person experiences more pain when they are anxious compared to when they are calm,

- cultural norms – in many cultures it is frowned upon for men to overtly express pain,
- if a person is sleep deprived – lack of sleep increases pain sensitivity, and
- if a person is a woman – women are more likely to have chronic pain conditions than are men.

Past experience matters too. For example, if the last time a person felt a twinge in their lower back it developed into sciatica, with significant pain that took months of therapy to come right, the next time they experience a twinge in their back the person is likely to experience more anxiety and pain.

Pain, you see, isn't an input to the body, rather pain is an output of the brain's threat detection system.

Another major factor is a person's current state of mind. They may rate a noxious stimulus differently from day to day, or even within a day. Indeed, from your own experiences, you might appreciate that pain associated with an injury isn't constant throughout the day.

There's also significant variation in pain sensitivity and tolerance between people.

There may be large differences in contextual and experiential influences affecting how pain is perceived differently by people. Added to these influences, the pain experience is further complicated by inherent biological differences in the nociceptive and pain perception systems caused by natural genetic variation.

So, how to measure?

If pain perception is so complicated, how on earth is it reliably

measured? Well, it's actually quite simple: just ask the person. The clinical adage, "a person's pain is what they say it is", describes the approach perfectly.

Scientists and clinicians do, however, try to standardise how people rate their pain using some simple scales. These can include scales that show various facial expressions associated with increasing pain, or asking people to rank pain from zero to 10. In all cases, scales are anchored at the extremes by the descriptors, "no pain", and "the worst pain you can imagine/have ever experienced".

But by translating a complex perception into a simple scale, important information can be lost, especially qualitative information about the nature of the sensation. For example, is the pain sharp, dull, aching, squeezing, shooting; or how the pain makes a person feel (worried, sad, anxious); and how it modulates behaviour (unable to do housework).

A simple scale of a complex perception also contributes to the high variability in ratings when ratings are repeated in the same individual, and biased ratings across individuals.

As scientists and clinicians working in the field of pain, we understand the limitations of our measurement tools, much like individuals who study diseases without objective diagnostic measures, such as depression and schizophrenia. We understand that the variability in our measurements is high and objectivity is low.

We have to work within these limitations to effect better pain management and to study the mechanisms of pain.

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