

Attention vs. Emotion

How are they activated naturally? This is where psychology comes into effect. That psychological factors we are now showing modulate pain via these descending modulatory pathways that are targeted with these centrally activated, centrally acting analgesic drugs. And two kind of main components of psychological modulation of pain are those involved in emotions, how emotions modulate pain, and also attentional focus, how attention and distraction alter pain.

So first of all if we look at psychophysically, at perceptually, how does emotional state and how does attentional state alter the way we feel pain? And to do that, first of all with people who are studying pain psychophysically, we tend to divide pain into two main components. One is the intensity of the sensation. So if I put a hot thermode on your arm, you feel a burning sensation. There's also how much it bothers you, which is really the emotional aspect of pain and it's really what drives us to either get away from the pain or to seek medications, and so it's the affect of motivational dimension. So we can ask people to rate on various scales how intense is the actual physical sensation and how unpleasant, how much does it bother you. And when you distract the person, you present the painful stimulus and then you distract them from the pain, we find that it primarily modifies how intense the person experiences the sensation with less of an effect and usually not significant on how much it bothers them. On the other hand, with emotional modulation, let's say you give a person pain when he's in a good mood or a bad mood, we find that changing the mood state doesn't alter the perception of how intense the sensation is, but it dramatically affects how much the pain bothers you. So while attention alters the sensory dimension of pain, the emotions modify mainly the emotional—the unpleasantness dimension of pain.

And correlating with that is what we see in the brain, that attention modulates mainly sensory pathways. So here's an example: This is primary somatosensory cortex, this right block shows activation with a heat pain stimulus on the arm when a person is focusing on that pain. Then when we distract them from the pain, and we see here by the blue not-as-bright signal that there is less activation in the primary somatosensory cortex when the person is distracted from the pain than when he's focusing on the pain. So something very, very simple like just moving your attention away from the painful stimulus has a profound effect at the level of the primary somatosensory cortex, an area that we don't think of as being highly modifiable. So I mean this is important clinically in the sense that patients, if they're constantly—you know, when the doctor sends them home with their pain diary and says please, three times a day, rate how much pain you're feeling, they're constantly thinking about their pain. So although it may be very important—pain diaries are very useful in helping us understand a person's chronic pain—we also should be aware that, in fact, by constantly asking a person to focus on their pain, you're probably enhancing the ultimate signal going to the cortex.

Now, emotions, as I said, they alter the unpleasantness dimension of pain and consistent with that, the main modulation we see, the most profound modulation we see is in the anterior cingulate cortex, an area that we know from other studies to be involved in the emotional aspects of pain processing. So here you get a nice activation when you give the person pain when he's in a bad mood and it no longer even reaches statistical thresholds when you put the person in a good mood and you give them the same pain. So the physical stimulus is the same, the emotional state is different, and you get a very different activation pattern in the brain. And I don't have time to go into all the details but this is something that Chantal Villemure, who just joined our lab from Montreal this month—last month—has shown the fact that the attention and emotion activate different modulatory circuits in the brain. While there's this one that's been most described and that I showed you, with the analgesic targets from the prefrontal cortex down to the PAG down the rostral ventral medulla down to the spinal cord, is activating the emotional—it's involved in emotional modulation of pain. Another circuitry involving the superior parietal cortex interacting with the primary and secondary somatosensory cortex and the insula, then descending modulation is involved in attentional modulation of pain, and this is the same region that's involved, and attention in general, like attentional modulation of visual stimuli also involves the superior parietal cortex. So all that to say, there's multiple and differential modulatory systems in the brain that can be activated depending upon your psychological state.