Separating brain processing of pain from that of stimulus intensity.

Abstract:

Regions of the brain network activated by painful stimuli are also activated by nonpainful and even nonsomatosensory stimuli. We therefore analyzed where the qualitative change from nonpainful to painful perception at the pain thresholds is coded. Noxious stimuli of gaseous carbon dioxide (n = 50) were applied to the nasal mucosa of 24 healthy volunteers at various concentrations from 10% below to 10% above the individual pain threshold. Functional magnetic resonance images showed that these trigeminal stimuli activated brain regions regarded as the "pain matrix." However, most of these activations, including the posterior insula, the primary and secondary somatosensory cortex, the amygdala, and the middle cingulate cortex, were associated with quantitative changes in stimulus intensity and did not exclusively reflect the qualitative change from nonpainful to pain. After subtracting brain activations associated with quantitative changes in the stimuli, the qualitative change, reflecting pain-exclusive activations, could be localized mainly in the posterior insular cortex. This shows that cerebral processing of noxious stimuli focuses predominately on the quantitative properties of stimulus intensity in both their sensory and affective dimensions, whereas the integration of this information into the perception of pain is restricted to a small part of the pain matrix. Hum Brain Mapp, 2012. © 2011 Wiley