The brain’s duck test in phantom percepts: multisensory congruence in chronic pain and tinnitus

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Abstract

Chronic neuropathic pain and chronic tinnitus have been likened to phantom percepts, in which a complete or partial sensory deafferentation results in a filling in of the missing information derived from memory. 150 participants, 50 with tinnitus, 50 with chronic pain and 50 healthy controls underwent a resting state EEG. Source localized current density was recorded from all the sensory cortices (olfactory, gustatory, somatosensory, auditory, vestibular, visual) as well as the parahippocampal area. Functional connectivity by means of lagged phase synchronization was also computed between these regions of interest. Pain and tinnitus were associated with gamma band activity, reflecting prediction errors, in all sensory cortices except the olfactory and gustatory cortex. Functional connectivity identified theta frequency connectivity between each of the sensory cortices except the chemical senses to the parahippocampus, but not between the individual sensory cortices. When one sensory domain is deprived, the other senses may provide the parahippocampal ‘contextual’ area with the most likely sound or somatosensory sensation to fill in the gap, applying an abductive ‘duck test’ approach, i.e., based on stored multisensory congruence. This novel concept paves the way to develop novel treatments for pain and tinnitus, using multisensory modulation or via parahippocampal targeting.

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