The dynamics of pain: Evidence for simultaneous peripheral habituation and central sensitization in thermal pain

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SUMMARY:
A decomposition of same-site and across-site repetition effects reveals novel evidence for simultaneous peripheral habituation and central sensitization in thermal pain.

Keywords: thermal pain, habituation, sensitization, dynamic model

31 pages (including figures); 4 Figures; 2 Tables
Abstract

Repeated exposure to noxious stimuli can change their painfulness. At the neural level, such sequential effects may arise from pain adaptation in the periphery as well as in the central nervous system. The literature on dynamic effects has been mixed, with evidence for both habituation and sensitization effects, and the respective contributions of peripheral and central mechanisms to these effects are largely unknown. We examined changes in reported pain during carefully counterbalanced sequences of repeated thermal stimulation on the same vs. different skin sites (N = 100). This allowed us to dissociate same-site repetition effects, which are likely driven by peripheral adaptation, from across-site repetition effects, which are more likely central in origin. In addition, we analyzed the interactions of these adaptations with stimulus intensity. Our results reveal that the dynamics of pain across repeated noxious events involve competing habituation and sensitization effects. Repeated stimulations on the same skin site produced temperature-dependent habituation, whereas repeated stimulation across different sites resulted in sensitization that plateaued after several stimuli. A dynamic model with four free parameters (direction/magnitude and decay parameters for central and site-specific adaptation) captured both habituation and sensitization effects, and explained 93% of the variance in the group mean temperature-corrected pain ratings across trials. The ability to obtain separate measures of central and peripheral adaptation processes may provide new measures for the study of pain-regulatory mechanisms and their assessment in patient groups.