
Tactile intensity perception is shaped by temporal integration: evidence from single afferent recording and stimulation in humans

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Abstract

In glabrous hand skin, four types of fast-conducting mechanoreceptive afferent encode different aspects of touch. Temporal firing patterns in these afferents reflect stimulus quality, whereas the overall firing rate relates to perceived intensity. We used broadband vibration reflecting real world tactile interactions and found intensity ratings dropped markedly with stimulus duration < 400ms. We used microneurography to relate these perceptual equivalence judgements of intensity at different durations to coding in single mechanoreceptive afferents. Afferent firing rate gave a poor prediction of perceived intensity, which was instead best predicted by binned firing rate across 100ms windows. We also stimulated single afferents with intraneural microstimulation to evoke precise spike trains and associated tactile percepts. For type I afferents, intensity was perceived as lower at durations below 100 ms, but delivering the same number of impulses produced equivalence. In type II afferents, intensity judgements were reduced at longer stimulus durations (> 200ms). These data suggest that tactile intensity perception is integrated over short time windows for type I afferents, but this might be different in type II afferents. This has implications for the design of tactile feedback, where temporal aspects may be utilized to provide efficient modulation of vibrotactile and prosthetic neurostimulation intensity feedback.

Keywords: microneurography, microstimulation, perception

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