

Simulating Tonic Events in Speech Production

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Studies of speech production have often focused on transient events—those that happen over short temporal intervals. We know, however, that speech is made up of movements that can be distributed over longer durations as well (e.g., tongue bracing, oralization, articulatory setting, laryngeal state, harmony, etc.). Such events, which involve maintaining continuous activation of a particular muscle group tonically over a long duration, have often been treated as qualitatively different from transient speech events. The present study considers examples of these types of movements in speech and non-speech (e.g., emotion expression, posture, etc.) domains. Biomechanical simulations are used to show how tonic activations operate on the same principles as transient ones (except for the difference in duration), and to show how tonic activations can overlap with multiple other activations—whether transient or tonic—through superposition [Bizzi et al. *Science* 253, 5017 (1991)]. This work aims to show how these previously anomalous kinds of movements fit seamlessly into broader theories of movement and speech. [Funding from NIH Grant DC-002717 and NSERC RGPIN-2015-05099.]