



# **Cognitive electrophysiology and behavioral correlate of somatosensory disruption due to dental loss in humans**

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## Abstract

**Introduction:** Masticatory function has been increasingly associated with cognitive performance; however, the neurophysiological mechanisms underlying this relationship remain poorly understood. This thesis investigates how chewing modulates cortical oscillations and functional connectivity to support working memory and cognitive control.

**Methods:** Two experimental EEG studies were conducted with healthy young adults to eliminate the confounding effects of aging and neurodegeneration. The first study examined the real-time effects of chewing during a visuospatial working memory task. The second assessed whether these neuromodulatory effects persisted after chewing ceased. EEG data were analyzed using time–frequency decomposition, phase–amplitude coupling (PAC), and functional connectivity metrics.

**Results:** The first study demonstrated that rhythmic mastication entrains fronto-central theta oscillations through PAC between the chewing phase and theta amplitude, leading to enhanced working memory performance and faster reaction times. The second study revealed that the neuromodulatory effects of mastication persist beyond the chewing episode, reflected in sustained increases in theta power and stronger frontocentral functional connectivity, which correlated with improved behavioral performance. Both studies consistently showed a dose–response relationship between chewing frequency and theta-band modulation.

**Discussion:** These findings establish chewing as a bottom-up modulator of cortical dynamics, facilitating cognitive performance through transient oscillatory entrainment and longer-lasting plasticity mechanisms. The work integrates electrophysiological evidence with behavioral outcomes, providing a mechanistic framework that links oral sensorimotor inputs to executive function via  $\theta$ -band synchronization and thalamocortical resonance. This thesis addresses significant limitations in the epidemiological literature by demonstrating that the effects of mastication are present even in cognitively healthy adults. The results highlight the critical role of masticatory function in supporting not only cognition but also broader sensorimotor network integrity.

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