
About to speak...: Spatio-temporal brain dynamics of word production

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Abstract

The cortical regions involved in the different stages of speech production are relatively well-established, but their spatio-temporal dynamics remain poorly understood. We addressed this point by recording electroencephalography (EEG) during a picture naming task, one of the most popular tasks for studying single word production. High spatial resolution of EEG components was obtained by a Laplacian transformation and by using two types of source localization techniques (equivalent dipole and surface minimum norm modeling). Crucially, considering that the core aspect of speech production is not perception but action, we looked at EEG components time-locked to vocal-onset in addition to components time-locked to stimulus presentation. Various salient neural activities were found time-locked to both events. Visual and conceptual processes related to object recognition were reflected by a sequence of activities taking place between 100 and 220 ms after stimulus presentation, presumably stemming from the secondary visual cortices and the occipito-parietal junction, respectively. In parallel, lexical activation was observed around 100 ms, presumably in the left posterior temporal cortex. At the cross-road between stimulus presentation and vocal onset, an activity which can be linked to word selection was observed over the medial frontal region. Finally, peaking at vocal onset, a left frontal activity was associated with verbal response execution processes. The temporal overlap of some of these components is consistent with the hypothesis of cascaded processing levels. More generally, our detailed description establishes an innovative look at the spatio-temporal dynamics of language production, providing a valuable ground for future investigations of this behavior.

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