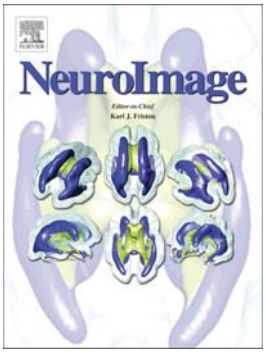

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Christopher J. Markiewicz, Jason W. Bohland

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Mapping the cortical representation of speech sounds in a syllable repetition task

Christopher J. Markiewicz[a], Jason W. Bohland[b,*]

[a] *Program in Cognitive and Neural Systems, Boston University, MA 02215, USA*
[b] *Department of Health Sciences, Boston University, MA 02215, USA*

Abstract

Speech repetition relies on a series of distributed cortical representations and functional pathways. A speaker must map auditory representations of incoming sounds onto learned speech items, maintain an accurate representation of those items in short-term memory, interface that representation with the motor output system, and fluently articulate the target sequence. A "dorsal stream" consisting of posterior temporal, inferior parietal and premotor regions is thought to mediate auditory-motor representations and transformations, but the nature and activation of these representations for different portions of speech repetition tasks remains unclear. Here we mapped the correlates of phonetic and/or phonological information related to the specific phonemes and syllables that were heard, remembered, and produced using a series of cortical searchlight multi-voxel pattern analyses trained on estimates of BOLD responses from individual trials. Based on responses linked to input events (auditory syllable presentation), predictive vowel-level information was found in the left inferior frontal sulcus, while syllable prediction revealed significant clusters in the left ventral premotor cortex and central sulcus and the left mid superior temporal sulcus. Responses linked to output events (the GO signal cueing overt production) revealed strong clusters of vowel-related information bilaterally in the mid to posterior superior temporal sulcus. For the prediction of onset and coda consonants, input-linked responses yielded distributed clusters in the superior temporal cortices, which were further informative for classifiers trained on output-linked responses. Output-linked responses in the Rolandic cortex made strong predictions for the syllables and consonants produced, but their predictive power was reduced for vowels. The results of this study provide a systematic survey of how cortical response patterns covary with the identity of speech sounds, which will help to constrain and guide theoretical models of speech perception, speech production, and phonological working memory.

Keywords: speech, phonological processing, working memory, fMRI, MVPA

*Corresponding author: 635 Commonwealth Ave, Room 403, Boston MA 02215. E-mail address: jbohland@bu.edu.