

PHRASAL SIGNATURES IN NON-SPEECH DOMAINS

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Although the human vocal tract is most well-known for its speech movements, it also produces skilled movements in domains other than language (e.g. singing, beatboxing). In particular, the relationship between speech and vocal music is under-studied with respect to strategies of articulation.

For example, the timing of articulator movements in speech compared to vocal music is unknown. In the speech domain, it has been shown that articulators slow down at phrase boundaries (e.g. Byrd and Saltzman 1998, 2003). This type of slowing is thought to be a manifestation of prosody, a non-lexical component of speech. However, it is unknown if vocal tract movement in other domains features similar slowing at comparable musical phrase boundaries.

This study tests the extent to which musical domains of vocal tract movement exhibit slowing at phrase boundaries, similar to the slowing observed in speech. The domain under investigation is beatboxing, a form of vocal music that mimics percussion instruments, and other (usually non-melodic) sounds. Beatboxing was chosen for this study because beatboxers commonly use articulations that require complex articulator configurations; if phrasal lengthening is a property of this non-speech domain, these articulations would be expected to exhibit lengthening at musical phrase boundaries. A separate goal of this study is simply to present more data about beatboxing, for which scientific investigation has, until recently, been quite sparse (Lederer 2006, Proctor et al 2013).

The investigation tool used here is real-time magnetic resonance imaging (rtMRI). In a larger study, five beatboxers (2 advanced beatboxers, 1 intermediate beatboxer, and 2 novice beatboxers) produced beatboxing patterns while supine in the MRI scanner. Video reconstruction offers a real-time look at the movements of the tongue, lips, velum, and other articulators, as well as the rest of the respiratory tract above the upper trachea (Narayanan 2004, Lingala et al 2017). The movement of the vocal tract articulators is measured using a region of interest analysis (Lammert et al 2013) and an automatic gesture-finding algorithm (Tiede, 2010). The relative timing of articulator movements within a sound unit is then calculated, and compared to the relative timing of articulator movements reported for speech.

Preliminary observations of this beatboxing data suggest that beatboxing, like language, has certain grammatical components. In particular, there is anecdotal evidence of allophony and phonotactic co-occurrence restrictions in beatboxing, both of which can

also be found in the grammatical phonology of language. The timing investigation reported here contributes to our understanding of the increasingly blurry distinction between speech and other vocal tract movement domains.

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