

Some consequences of micro-prosody for phonetic variation

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Prosodic structure, including syllables, metrical feet and phonological phrases, has been found to condition phonetic variation, particularly in the temporal dimension of speech (e.g., De Jong, 1995; Keating et al., 2004; Shaw, 2007, 2013; Shaw et al., 2009). One approach to modelling prosodically-conditioned variation characterizes prosodic structure in terms of timing between articulatory gestures (Goldstein et al., 2007; Byrd and Saltzman, 2003). Here, we use the term **micro-prosody** to describe configurations of articulatory gestures that characterize a higher level of prosodic structure and focus on the micro-prosody of syllables.

Through computational simulations, we illustrate predictions of syllable micro-prosody for phonetic variation and test these predictions on experimental phonetic data from English (Browman and Goldstein, 1988; Westbury, 1994), Arabic (Shaw et al., 2011), and English L2 producers of Russian consonant clusters (Shaw and Davidson, 2011). We formalize micro-prosody as coordination topologies, i.e., ensembles of local coordination relations between articulatory gestures (Gafos, 2002), and implement stochastic models of syllable micro-prosody (e.g., Gafos et al., 2014; Shaw and Gafos, 2015). The models consist of two key components: (1) a coordination topology characterizing syllable structure and (2) phonetic parameters that are either sampled from distributions representative of the data or varied systematically.

Simulations reveal that distinct syllable structures condition distinct patterns of co-variation between phonetic parameters. Phonetic covariance is an unavoidable consequence of micro-prosody, as it follows directly from coordination relations between gestures. For the case of [CCV] vs. [C.CV] parses of /CCV/ sequences, as in American English (complex onset syllables) vs. Moroccan Arabic (simplex onset syllables), stochastic sampling can cause any single phonetic parameter, including those sometimes used as heuristics for syllable structure, to overlap, but patterns of covariance between phonetic parameters reveal consistent distinctions between [CCV] vs. [C.CV] forms. The same is true for [CCV] vs. [Cə.CV] parses of /CCV/, as in productions of Russian consonant clusters by English speakers. To the extent that the predicted covariance reliably describes the phonetics, as is the case for the data considered here, micro-prosody provides an insightful link between abstract prosodic structure and the continuous phonetic signal.

Selected references

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