Spectral coherence to determine cross-linguistic influence on rhythm within and across modes in multilingual speech

The diverse typology of speech rhythm metrics within the fields of phonetics and phonology have led to broad, language-specific variation. Multiple metrics for examining rhythm render it difficult to quantify and interpret rhythm in a given language, across utterances produced by a single speaker, as well as across speakers of the same language, or even across tasks (Arvaniti, 2012). Interpreting rhythmic differences across languages is even more complex, not considering the impacts of multilingualism, cross-linguistic influence (CLI) and speaking mode (such as spontaneous or read speech).

This investigation will attempt to address this gap by employing an acoustic coherence approach (see Alexandrou et al., 2016) in order to examine the interface of acoustic rhythm with multilingual language proficiency scores, to quantify CLI within and across speaking modes. Participants consist of four groups: (1) 39 speakers of L1 Polish, L2 English, L3 Norwegian in Poland, (2) 10 speakers of L1 Norwegian, L2 English in Norway) (3) 10 speakers of L1 Polish, L2 English in Poland and the UK, and (4) 10 speakers of L1 English from the UK. Production data was collected across spontaneous and read tasks. Spontaneous tasks include a video retelling task and a picture description task. Read tasks consist of sentence reading, and a text reading task.

Analysis of speech rhythm via spectral coherence will be computed based on the cross spectrum of the amplitude envelopes, divided by the power spectra of the amplitude envelopes for each possible combination of two participants (Alexandrou et al., 2016). The analysis will be conducted separately for read and spontaneous speech modes. Language proficiency in each coherence pair is treated as a distance vector in a 3-dimensional Euclidian space (of Polish, English and Norwegian proficiency scores, scaled between 0.0-1.0). Statistical analysis of the data will be conducted using several linear mixed effects models, e.g., with coherence coefficient and proficiency distance, as well as coherence coefficient and language group as factors.

Our investigation aims to further linguistic understanding of rhythm and cross-linguistic influence in the area of multilingual speech production via the novel application of acoustic coherence analysis. In doing so, it attempts to quantify the relationship between spectral rhythm similarities in the time-frequency domain, paired with multilingual language proficiency data to better illustrate the link between language background and speech rhythm across spontaneous and read speech.

(Word count: 384)

Key words: Spectral coherence, speech rhythm, spontaneous speech, read speech, CLI

References

Alexandrou, A. M., Saarinen, T., Kujala, J., & Salmelin, R. (2016). A multimodal spectral approach to characterize rhythm in natural speech. *The Journal of the Acoustical Society of America*, *139*(1), 215-226.

Arvaniti, A. (2012). The usefulness of metrics in the quantification of speech rhythm. *Journal of Phonetics*, *40*(3), 351-373.