

The Effect of Syllable Frequency and Cognitive Load on L2 Phonetic Convergence and its Generalization

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This study aimed to examine the impact of syllable frequency and cognitive load on L2 phonetic convergence and its generalization. Phonetic convergence, the adaptation of speech production between interlocutors [4], is known to be affected by lexical factors such as word frequency [1]. But the role of sublexical factors, i.e., syllable frequency, in convergence is less understood. The mental syllabary hypothesis [5] proposes that high-frequency syllables are precompiled and directly retrieved for production, while low-frequency syllables are constructed online. Such online construction may be affected by cognitive resources, especially in challenging L2 contexts. We hypothesized that 1) perceived features are more readily applied to subsequent production for low-frequency syllables, leading to greater convergence on low-frequency syllables than high-frequency ones; 2) cognitive load may impact convergence on low-frequency syllables in the L2. We also tested whether these effects extended to convergence generalization, an area yet to be thoroughly explored.

The stimuli were sixteen pairs of high- and low-frequency English non-word syllables, matched on phoneme frequency, CV structure, and neighborhood density. The stimuli were divided into two lists: an exposure list (10 pairs) and a new list (6 pairs). Using a pretest-shadowing-posttest paradigm, sixty Chinese-English bilinguals read aloud both lists in the pretest and the posttest, and read after a model native speaker on only the exposure list in the shadowing task without the presence of orthography. To explore the impact of cognitive load, thirty participants were randomly assigned to a with-load condition (i.e., performing a concurrent dot memory task), and thirty to a no-load condition (i.e., no secondary task) in the shadowing task. Afterward, participants rated the frequency of the stimuli subjectively.

We adopted the holistic measure of mel-frequency cepstral coefficients (MFCC) [3] to index the holistic features of participants' syllable productions, and dynamic time warping [2] to estimate the production similarity between participants and the model talker. Participants' and the model talker's production of target syllables were extracted and then analyzed using MFCC. Each frame (a 25ms segment) of a syllable production was converted into 12 coefficients and a set of 12 coefficients was combined to form the overall parameter representing the syllable production.

The linear mixed-effect modeling results indicated that compared with the pretest production, participants' shadowing production of the exposed list became more similar to the native speaker's production, signifying phonetic convergence. This pattern extended to the posttest production of the new list, suggesting generalized convergence to unexposed syllables. Lower subjective syllable frequency (rather than corpus frequency) was associated with greater convergence. Higher load led to reduced convergence, but load did not modulate the syllable frequency effect. Neither load nor syllable frequency influenced generalization.

The finding of stronger convergence on low-frequency (vs. high-frequency) syllables suggested that the online construction of low-frequency syllables for production better manifests the reactivation of the "traces" left by the previously perceived features. Reduced L2 convergence under high cognitive load suggested that L2 convergence is not automatic. The null interaction effect of cognitive load and syllable frequency on L2 convergence might indicate a floor effect: Syllable encoding in L2 production was challenging to our participants, even for retrieving precompiled high-frequency syllables. This study sheds light on the underlying mechanisms of L2 phonetic convergence by testing linguistic (sublexical) and cognitive factors. The findings also draw attention to the possibility of using low-frequency syllables and low-load tasks to facilitate L2 phonetic training.

References

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