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Control of vowel tenseness with F0 variation and the development of a pronunciation method: Pronunciation of tense/lax vowels /iː/ and /ɪ/ for Japanese learners of English.

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A comprehensive and quantitative definition of vowel tenseness has not been established so far. Ishizaki (2019a) stated that the formant angles, θ_I and θ_{F1}, and the derived function $dZ1_{(t)}/dt = lim \tan\theta_{1(t)}$ could be used as indicators of vowel tenseness as time-dependent physical parameters are required for a quantitative study. Ishizaki (2020) argued that using the variation of fundamental frequency *F0* could be effective for Japanese learners of English in pronouncing the English tense vowel /iː/ and lax vowel /ɪ/. Further, he concluded that the Japanese vowel /iR/, with pitch accent HL, could be used as /iː/, while /iR/, with pitch accent LH, could be used as /ɪ/.

This paper aimed to ascertain how this method of pronouncing the two English tense/lax vowels can be made more effective while considering the time-dependent correlation between *F0* and *F1* in the Japanese vowel /iR/.

We observed a positive correlation between θ_I and the variation of *F0* in the Japanese vowel /iR/ ($r = .453$, $p < .001$). Hence, utilizing a large degree of variation of *F0* could be more effective for Japanese learners of English to pronounce the two English tense/lax vowels. Developing a mobile application that displays the formant angle θ_I along with the formant frequencies could further assist learners in recognizing the tenseness of the tense/lax vowels that they pronounce.

In the field of phonetics, the Japanese language is often said to have fewer segmental phonemes than the English language. However, there is a possibility that Japanese has more complicated phonetic characteristics in the vowel system than English, especially while considering both segmental and suprasegmental phonemes such as pitch accents, short/long vowels, and geminate consonants. Our research revealed a positive correlation between θ_I and the variation of *F0* in a Japanese long vowel. Such a result implies that a comprehensive analysis of the phonetic characteristics of Japanese vowels could be beneficial in exploring proper methods of pronouncing English tense/lax vowels for Japanese learners of English.

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