# Gemination of Final Consonants in English Nonsense Words: The Effects of Orthography, Vowel Duration, and Borrowers' L2 Proficiency on Loanword Adaptation

The gemination of English loanwords in Japanese has been extensively investigated. The purpose of this paper is to elucidate the impacts of orthography, vowel duration, and borrowers' proficiency in the source language on gemination.

A total of 60 subjects participated in this study, and all were university students majoring in computer science and engineering. 288 nonsense-word stimuli of the structure $C_1VC_2$ were prepared, where $C_1$ was a voiceless stop, V was one of four mid vowels ([ɛ], [eɪ], [ɔ], or [oʊ]) varying in duration from 90 to 140 ms, and $C_2$ was a stop. Plausible spelling was invented by the authors (e.g., *kep, pate, pawb, pode*). Audio files of stimuli were presented either with orthography (mixed condition) or without it (oral condition), and subjects were audio recorded saying each one as a newly introduced Japanese word in a given Japanese carrier sentence. The 60 subjects produced a total of 1,341 sentences that were useable for analysis, and Praat (acoustic analysis software) was used to compute the relative duration of the vowel (RDV). From past studies, it was decided that if RDV was at least 1.65, the new loanwords contained a geminate. The dependent variable was gemination occurrence rate. The independent variables were vowel quality (tense or lax), vowel duration (from 90 to 140 ms in 10 ms steps), final consonant voicing, subjects' English proficiency (TOEIC scores), and the presentation of the orthography of stimuli.

There were several findings. First, as expected, consonants following a lax vowel were adopted as a Japanese geminate significantly more frequently than those following a tense vowel, but the voicing of the final consonant did not cause a significant difference in the gemination rate. Because of this first result, all following discussion focuses on stimuli with a lax vowel, without distinguishing the voicing of the final consonant.

Next, the stimuli were classified into three groups; a long vowel, medium vowel and a short vowel group according to the vowel duration. The one-way ANOVA indicates that the medium vowel group showed significantly higher gemination rate than the short and long vowel groups. This is conceivably due to the constant length of the final consonant in the stimuli, implying that the perception of geminates is determined by both the duration of vowel and the following consonant. When subjects were provided with a spelling of stimuli, however, all the stimuli were adopted as geminates less frequently, resulting in no difference in the percentage of gemination among the three vowel-length groups. The provision of the orthography possibly made subjects less sensitive to the subtle difference in vowel duration.

In order to examine the effects of language proficiency on gemination rate, subjects were classified into high-, mid-, and low-proficiency groups according to their TOEIC scores. The results of the two-way factorial ANOVA showed that, contrary to previous research, those in the mid-proficiency group adopted the consonant as a geminate most frequently. There was also a significant interaction between proficiency and the provision of orthography, i.e., orthography strongly influenced the mid- and low-proficiency groups, while the high-proficiency group was not influenced. It appears that the presentation of orthography has a hindering effect on gemination, and the subjects with lower proficiency, not confident in their perception, were more strongly affected by the orthography, resulting in the adaptation of a final consonant as a singleton.

This research revealed that the vowel duration of a source word affects the perception of the final consonant, but the relationship is not straightforward. There seems to be an optimal vowel duration relative to the length of the following consonant. The fact that borrowers' proficiency in the source language affects gemination is intriguing and needs further investigation.