ARTICULATION AND ACOUSTICS OF KOREAN LIQUIDS: A CASE STUDY IN LOANWORD ADAPTATION

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1   Introduction

This paper presents a case study in phonetic variation in the realization of liquid consonants (laterals and rhotics) in Korean loanwords from English. English has two liquid phonemes, lateral /l/ and approximant /ɹ/. Korean, on the other hand, has a single liquid phoneme, /L/, which is restricted in the native vocabulary to word-medial and word-final positions. Word-medially, it is realized as a tap if single and as a lateral if geminate; in word-final position, it is realized as a lateral [1]. The restriction against word-initial liquids, however, is relaxed in English loanwords, with recent studies observing a range of realizations: with most common variants being taps and laterals, and other variants including approximants, stops, nasals, obstruents, and trills [5,7]. To better understand the details of this variation, we collected electropalatography (EPG) and acoustic data from two native Korean speakers fluent in English. Specifically, we wanted to investigate details of realization of the word-initial liquid in loanwords, as compared to the same phoneme occurring in Korean word-medially and to the English liquids, as produced by the same speakers.

2   Method

2.1   Speakers

The participants were a female and a male native speaker of Korean (KF and KM). Both were in their early forties, originally from Seoul, South Korea, and had been living in Toronto for less than three years. They studied English from the age of 12 and have been speaking it regularly since moving to Canada. Both can be considered intermediate to advanced learners of English.

2.2   Materials

Control items included word-medial singleton /L/ and geminate /LL/ in Korean-native words (n=9; e.g., paLam 바람, 'wind'; taLLi 달리, 'differently') and word-initial and medial /l/ and /ɹ/ in English words (n=38; e.g., lilac; radio). Target items included Korean loanwords corresponding to the English control words (n=38; e.g., LaiLLak 라일락, 'lilac'; Latio 라디오, 'radio'). In loanwords, English /ɹ/ and /l/ are generally adapted as singleton /L/ and geminate /LL/ word-medially, while only a singleton realization is possible word-

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initially. The loanwords were selected from the *National Academy of the Korean Language* survey ([3]). The stimuli were randomized and produced 6 times each in a language-specific carrier (이게 또 _ 이다. /ike t*o _ ita/, 'This another_'; *I saw _ over there*), in separate sessions.

2.3   Articulatory Analysis

We used the WinEPG system [6], which tracks the contact between the tongue and the palate over time (at 100 Hz) using a custom-made acrylic palate with 62 electrodes. This palate, organizing into a grid of 8 rows and 8 columns allows to distinguish among different kinds of liquids: a lateral (a closure at the alveolar ridge and reduced posterior side contact), a tap (a weak postalveolar constriction with some posterior side contact), and an approximant (mainly posterior side contact). A measure of Centre of Gravity (CoG) of linguopalatal contact (higher is more anterior) taken at the consonant midpoint was employed to quantify the anteriority of these categories (lateral > tap > approximant). Additionally, we measured constriction duration, which was expected to be longer for laterals (and Korean /LL/ > English /l/) than the approximant and especially the tap.

2.4   Acoustic Analysis

Word-initial liquids in Korean loanwords and the corresponding English words were extracted from the EPG data, segmented using the Montreal Forced Aligner [4], and classified in Praat [2] following the criteria reported in Yun & Kang [7]. Specifically, taps were defined as sounds with a brief stop-like release burst, and a small abrupt amplitude decrease and increase. Laterals were defined as sounds with a long steady state, with a shorter transition into the next vowel compared to approximants. Approximants were defined to have a longer transition into the next vowel than laterals (although still short) with a gradual increase in amplitude.

3   Results

Articulatory results are summarized in Figure 1, with individual tokens plotted by set/position and speaker. Considering the Korean native control set first (leftmost column), the two word-medial liquids /L/ and /LL/ were clearly distinguished in CoG and duration, reflecting the contrast between a geminate lateral and a tap. In the English control set (last 2 columns), /l/ and /ɹ/ were also clearly distinguished by the speakers, but only by CoG (as would be expected). Turning to the target set (loanwords), we can see two types of liquids being produced word-medially (/L/ vs. /LL/, similarly to the native controls, and corresponding to the English source), yet no
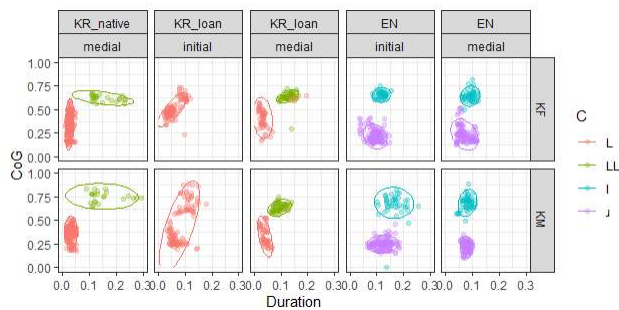
Figure 1: Scatterplots of individual articulatory tokens of liquid phonemes by Centre of Gravity and Duration, separately by set/position and speaker.

clear distinction word-initially. Here, realizations of /L/ show considerable variation, albeit with some separation for KM. Linear Mixed Effects Regression models confirmed significant differences ($p<.05$) among the control items and for the word-medial target items.

Acoustic results showed that for the highly variable word-initial liquid (/L/) in Korean loanwords, the male speaker favoured approximant and lateral realizations (47% and 39%), while the female speaker favoured taps and, to a lesser extent, laterals (68% and 31%). For the English set, productions mostly aligned with the underlying phoneme (Figure 2), as expected, with a lateral-like production for words starting with the underlying phoneme /l/ and an approximant-like production for words starting with /ɹ/, with some exceptions where the female speaker produced a couple of taps.

The logistic regression analyses, performed separately for the proportion of each variant compared to all other variants, tested for effects of language condition, source consonant (English /l/ or /ɹ/), and speaker (cf. [7]). Tests revealed that there were significantly more taps produced in the Korean condition ($p<.001$) and significantly more approximants produced in the English condition ($p<.01$). A significant effect of source consonant was present for approximants when the source consonant was /ɹ/ ($p<.001$), and the effect of speaker was present for taps and approximants, where the female speaker produced more taps, and the male speaker produced more approximants ($p<.001$).

4 Discussion

This study was first to examine variability in the Korean liquid production using both articulatory and acoustic methods. Consistent with observations made in the literature, we saw clear distinctions in the EPG data among liquids in the control sets (Korean native words and English words), as well as for word-medial liquids of Korean loanwords. In word-initial position, which was our main focus, we observed a great amount of variability, also as anticipated. Significant effects of language showed us that speakers were adapting their speech production to the language produced, indicative of some level of mastery of their L2 English. A great amount of individual difference between the two speakers was also observed, which could reflect gender or accentedness levels, although it is difficult to pinpoint exactly which effect given the data from only two speakers. To further explore the cause of var-
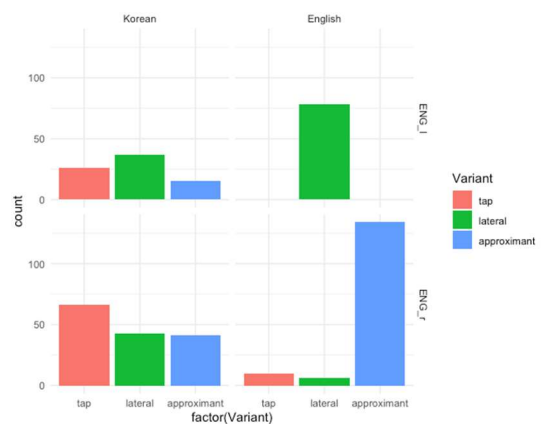

Figure 2: Distribution of counts of word-initial /L/ variants by language condition and source consonant (English /l/ or /ɹ/)

iation, we have collected and are currently analyzing acoustic data for 16 new Korean speakers (balanced for gender). Preliminary observations show similar amounts of variability in pronunciations of word-initial /L/ in loanwords, including tap, lateral and approximant realizations.

Acknowledgments

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