Korean Lexical Palatalization as Affrication: Acoustic Evidence from the Post-Alveolar Affricate Comparison

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ABSTRACT

Recently, lexical palatalization in Korean has analyzed as the interplay of phonological process called Affrication and phonetic palatalization (Kim, 2011). This study investigates the profile of this Affrication process by comparing underlyingly and derived post-alveolar affricates. Specifically, it analyzed temporal and spectral measurements of the production made by 15 native speakers of Korean. Stimuli were controlled regarding morphological structure, considering that lexical palatalization only occurs across a morpheme boundary. According to the results, Affrication process changes the contrition location of alveolar plosive backward, unlike the morpheme boundary effect which lengthens closure duration. However, the changed place of articulation is still anterior to its post-alveolar counterpart, compatible with Zsiga (1994)'s report on the difference between derived and underlyingly post-alveolar affricates.

Keywords: lexical palatalization, coarticulation, speech production, spectral analysis, Korean

1. INTRODUCTION

This study discusses lexical palatalization in Korean. Studies in articulatory phonetics have stated that two types of palatalization, i.e., lexical and post-lexical palatalization, are distinguished in this language (Cho, 2001; Yun, 2006; Sung, 2014; 2015). In lexical palatalization, alveolar plosives change into their post-alveolar affricate counterparts only when followed by /i/ across a morpheme boundary; post-lexical palatalization is a coarticulation process between consonants and subsequent /i/. However, Kim (2011) reported that these two are indistinguishable in terms of articulation, and are the same as an anticipatory coarticulation in front of /i/, regardless of a morpheme boundary. She analyzes lexical palatalization as the interplay of the phonological process of Affrication and phonetic post-lexical palatalization.
As Kim (2011)'s Affrication that underlies lexical palatalization is only triggered across a morpheme boundary in Korean, one can raise the possibility that it should actually be a morpheme boundary effect. In this regard, this study aims to cast light on Affrication process by first profiling the morpheme boundary effect and then controlling it to examine Affrication only.

2. METHODS

2.1. Stimuli

34 real words were selected as target words. First, ten /Vt^{h}#i/ words and seven /Vtɕ^{h}#i/ words constitute the core. For each of them, a monomorphemic word was chosen which has the same surface phonemic sequence. 17 core words and 17 matching monomorphemic words consist 34 target words.
All targets follow the sequence of VC(#)i, and always surface as [V.tɕ^{h}i]. However, they are grouped into three. The morphological structure and C are different by each group (see Table 1).

Table 1: Examples of stimulus

Type	Segments	Example	Gloss
Group 1	/Vt^{h}#i/	S**uth+i**	'hair density'
Group 2	/Vtɕ^{h}#i/	S**uch+i**	'charcoal'
Group 3	/Vtɕ^{h}i/	S**uchi**	'shame'

After profiling the acoustic realization of the morpheme boundary effect by comparing Group two and three, the acoustic measurements of Group one and two were compared, as they have the same morphological structure.
The target words and fifty-one filler items were embedded in a carrier sentence: 'Ca icey ___ta haseyyo (Now say this is **___**).'

2.2. Participants and procedure

15 native speakers of Seoul Korean (8 females and 7 males, age: 20 - 26, median: 22.97) participated.
Subjects were left alone in a sound-attenuated booth as they read stimuli three times. The participants were forbidden from pressing any key, as each target sentence in Korean orthography was flipped automatically. After participants completed the whole set, I told them to repeat for another session with emphasis on possible contrasts. Therefore, each person spoke in casual/natural speech and in clear speech.

2.3. Analysis

Temporal and spectral measurements were taken from 2,772 tagged speech tokens. I composed TextGrid markings in Praat (Boersma & Weenink, 2017), as exemplified in Fig. 1.

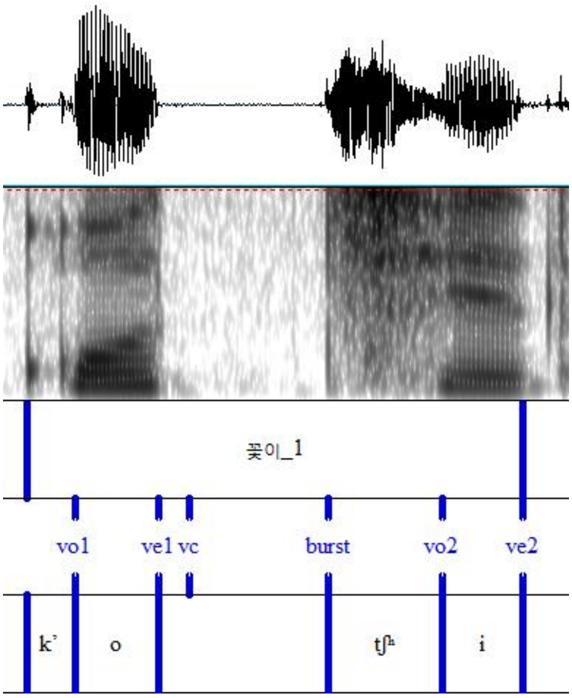

Figure 1: An example of Praat TextGrid marking.

2.3.1. (Relative) Stop duration

For the temporal measurement, the length of time from 've1' (first vowel ending) to 'burst' was analyzed. The stop duration value was divided by the total word duration (Smith, 2012) to calculate relative stop duration.

2.3.2. Spectral analysis

The center of gravity (COG) of frication noises (between 'burst' and 'vo2' in Fig. 1) was calculated. Pre-emphasis of 6 dB/oct from 80Hz was done to clarify the properties of the frication spectrum (Smith, 2012). Then, the COG was calculated in four 20ms windows to capture initial and subsequent gradual movement in the articulation. The centers of these windows were: (1) 10ms forward from 'burst;' (2) the 25% point of the frication noise; (3) the half point of the frication noise; (4) 10ms backward from 'vo2.'

2.3.3. Statistical analysis

Data were statistically analyzed using linear mixed-effect models.

3. RESULTS

3.1. Morpheme boundary effect

Fig. 2 presents average value of relative stop duration with 95% CI. The median is represented by dots, and the vertical bar covers 95% of respective data.

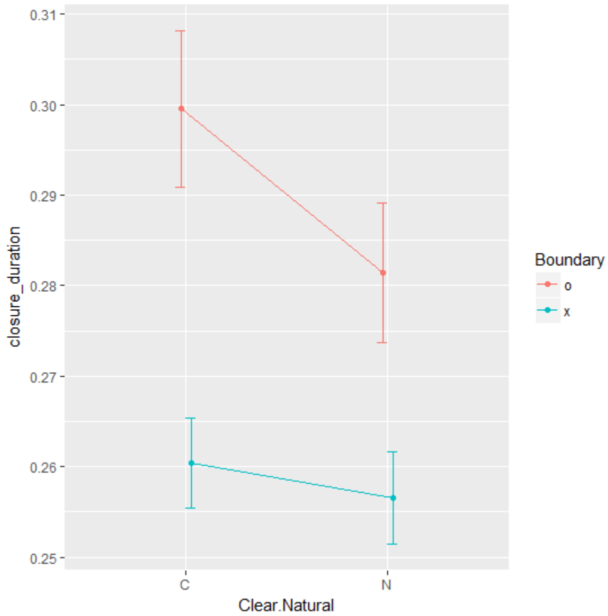

Figure 2: Relative stop duration (stop duration divided by total duration) by a morpheme boundary.

The linear mixed-effect model with subjects and preceding vowels as random effects showed that the existence of a morpheme boundary affected relative stop duration ($\chi2(1)=14.438$, $p=0.0001449$), increasing the value by about 0.034205 ± 0.005786 (s.d.). Specifically, the coefficient of the model by the subject and vowel showed that this morpheme boundary effect exists regardless of those random effects.

However, a morpheme boundary did not significantly change constriction locations as inferred by the COG value.

3.2. Affrication effect

Fig. 3 and 4 indicate median (point) and 95% CI (vertical bar) of the COG in four windows in clear and casual speech respectively. According to the linear mixed-effect model, the total COG in frication noise was 103.79Hz higher when the underlying coda was /t/ ($\chi2(1)=3.1146$, $p=0.0776$).

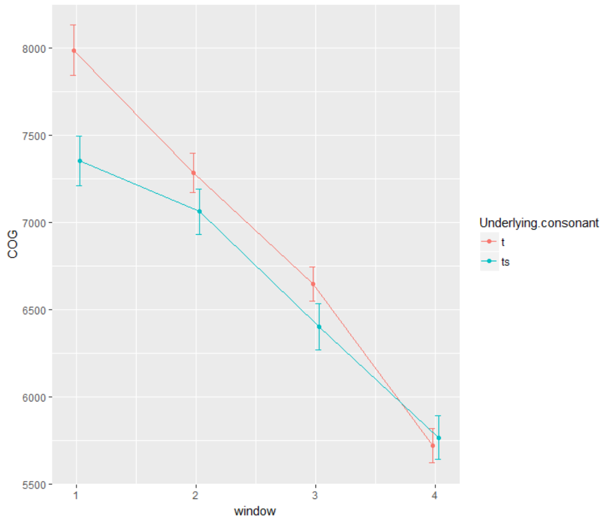

Figure 3: The center of gravity of frication noise by application of Affrication (clear speech).

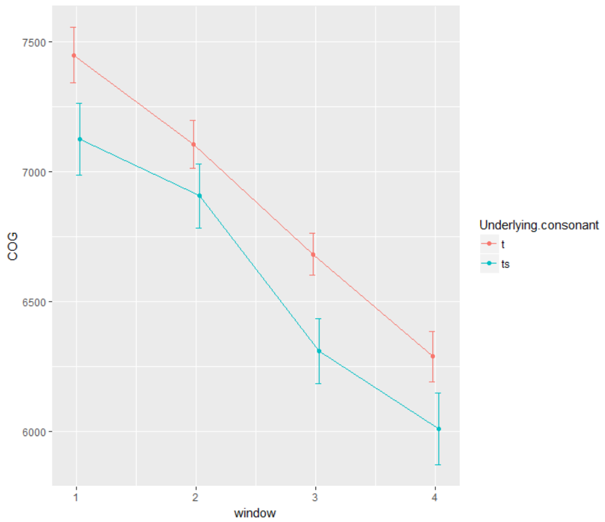

Figure 4: The center of gravity of frication noise by application of Affrication (casual speech).

95% of relative stop duration values did not overlap as in Fig. 5, but the difference was statistically insignificant.

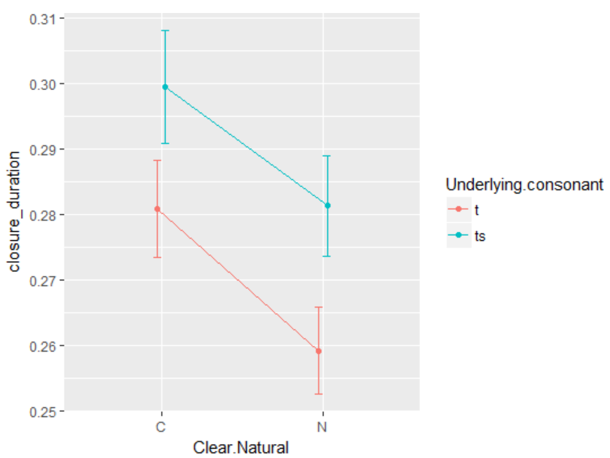

Figure 5: Relative stop duration (stop duration divided by total duration) by application of Affrication.

4. DISCUSSION AND CONCLUSION

Morpheme boundaries lengthened the closure duration by 3% - 4% point in the production experiment but did not change articulation as inferred from the COG. By contrast, the closure duration did not show a significant difference when compared lexical and post-lexical palatalization with the morpheme boundary effect controlled; the COG value was different by the underlying coda consonant. Underlying coda /tʰ/ that undergoes Affrication process surfaced with a systematically higher COG value than /tɕʰ/. The difference is more prominent between the initial constriction locations of underlying /tʰ/ and /tɕʰ/ (Window 1 of Fig. 3 and 4) Affrication moves the articulation point of /tʰ/ backward, but less than the surface form of underlying /tɕʰ/. It is in line with Zsiga (1994), which disclosed that English post-alveolar affricates that derived from lexical and post-lexical are different.

In sum, the implication of this study is in two-fold. Firstly, it shows that a morpheme boundary is acoustically realized as a lengthening of closure duration in affricates. Secondly, and more importantly, it provides evidence that Affrication process that underlies Korean lexical palatalization (Kim, 2011) changes the contrition location of alveolar plosive backward but less so than its post-alveolar counterpart (cf. Zsiga, 1994).

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