

Gender-related variation of nasality and sound change of denasalization driven by prosodic boundaries in Seoul Korean

Jungah Lee¹, Sahyang Kim², Taehong Cho¹

¹Hanyang Institute for Phonetics & Cognitive Sciences of Language, Hanyang University (HIPCS);

²Hongik University

jlee14@uoregon.edu; sahyang@hongik.ac.kr; tcho@hanyang.ac.kr

ABSTRACT

This study investigates gender-related variation of nasal consonant duration and coarticulatory V-nasalization across two boundary conditions (IP-initial/IP-medial) in Seoul Korean. N-duration and V-nasalization (using A1-P0) of bisyllabic words (e.g., /mami/) were measured from 17 speakers in their 20s (F:8, M:9). IP-initially, N-duration was extremely reduced along with reduced V-nasalization as compared with IP-medial patterns, indicating that position-driven denasalization is underway. There were no gender-related effects on N-duration, but there was a significant Gender x Boundary interaction on V-nasalization. Females nasalized the vowel much more than males, and maintained a similar degree of V-nasalization across boundary conditions. In contrast, males substantially reduced V-nasalization IP-initially, suggesting that the on-going sound change of position-driven denasalization has been led by males, counter to the fact that sound changes are often female-led. The male-led denasalization process can be accounted for by different gender-related social meanings associated with nasality in interaction with boundary-related prosodic structure.

Keywords: nasalization, denasalization, Korean, prosodic boundary, sound change

1. INTRODUCTION

A linguistic message is encoded in a phonetic form that is inevitably variable, driven by various linguistic and non-linguistic factors. Speech variation is often deeply rooted in the phonetics-prosody interface, especially in how phonetic encoding of a linguistic message is fine-tuned by prosodic structure. A low-level phonetic process such as coarticulatory nasalization, phrase-final lengthening or non-contrastive creakiness, often considered to bring about non-contrastive phonetic variation, often turns out to be systematically modulated by prosodic structural factors such as stress hierarchy and the level of prosodic boundary [6, 14, 16]. For example, phonetic variation reflected in the degree of consonantal nasality and its influence on the vowel's coarticulatory nasalization can be controlled by the

speaker in a language-specific way in reference to prosodic structure as discussed in various studies (Chinese [25]; French, [13]; English, [9, 10]; and Korean, [7, 17]). The converging evidence from these studies indicates that despite its cross-linguistic variation, the non-contrastive coarticulatory nasalization varies as a function of the strength of prosodic boundary and prominence system. Seoul Korean provides an interesting case because the nasality of the nasal consonant is extremely reduced in a phrase-initial position [17], compared to a nasal consonant that occurs in other languages such as English, French and Chinese [17]. For such an extreme reduction of the nasality, it is generally considered that Seoul Korean undergoes a sound change of 'denasalization' [21, 30, 31], which is taken to have originated from a boundary-induced reduction of nasality in phrase-initial position [17].

In the present study, we continue to explore the nature of the position-driven sound change of denasalization in Seoul Korean in conjunction with effects of gender as a sociolinguistic factor. It is well known that speech production often differs systematically between the genders [11, 23, 26]. In particular, female speakers are more likely to lead a new sound change than male speakers as female speakers tend to prefer to produce more innovative linguistic production [22, 26]. In fact, in Seoul Korean, young female speakers have led a recent on-going sound change, showing a merger of VOT difference between lenis and aspirated stop categories which is localized to phrase-initial position similar to the denasalization process [2, 10, 19]. One might therefore expect that female speakers will also play a leading role in the sound change of denasalization process that are underway in Seoul Korean.

We, however, still leave an alternative possibility open. Female speakers are often thought to produce more articulate and clearer speech forms because they are more sensitive to produce standard and socially-upward prestigious linguistic forms [3, 24, 26]. The denasalization process results in a reduced form deviating from the canonical nasal sound. Moreover, a nasalized sound is often preferred in female speech especially in Asian speech communities especially in Japan and China [12, 32]. Thus, it is possible that

female speakers may turn out not to take a lead in the denasalization process.

In the present study, we will test these possibilities by examining how the nasality of the nasal consonant and the degree of vowel nasalization of bisyllabic words (/mami/ or /mima/) is modulated by prosodic boundary and how the position-sensitive denasalization process manifests itself differently between the female versus the male speech in Seoul Korean.

2. METHODOLOGY

2.2. Participants and recording

Seventeen native Seoul Korean speakers (F:8, M: 9) participated in the experiment as part of a large-scale acoustic-articulatory database building project in Korean at Hanyang Institute for Phonetics and Cognitive Science of Language [15]. All speakers were born and raised in Seoul and were students at Hanyang University in Seoul. They were all in their 20s (mean age: 23.4) and were paid for the participation. The acoustic data from the seventeen speakers were collected in a soundproof room with a Tascam HC-P2 digital recorder and SHURE KSN44 condenser microphone at a sampling rate of 44kHz, along with the articulatory data acquisition using Electromagnetic Articulograph (Carstens AG 501). We analyzed the acoustic data only for the purpose of the present study.

2.2. Speech materials and measurement

The HIPCS database corpus included several passages, and we used a passage that contains two bisyllabic words (names) with nasal consonants (/mami/, /mima/). The passage was originally constructed to induce these words to be produced in different prosodic boundary contexts. To elicit an IP boundary context, the target names were preceded by an adverbial phrase, which aided the speaker in inserting a phrase boundary as in (1a); and to elicit an IP-medial context, each target word was used as the second part of a two-word compound noun as in (1b). The whole passage will be available at <https://osf.io/ecm6s/>.

- (1)
- a ...우리 동네에 # 미마네라는 빵집이 생겼는데.. (# = IP)
 ...ulitonjæ # *mimane*ran p*ayŋjipi sɔŋkjɔnunt..
 ‘...the bakery called ‘mima’ opened in our neighborhood...’
- b ...계피#마미 빵에 집중하게 되었어 (# = phrase-medial)
 ...kɔpɪ#*mami*p*ay: tɔpɔŋhake twɔs*ɔ
 ‘(they) got to specialize in cinnamon ‘mami’ bread...’

The participants were asked to read the passages as naturally as possible twice at a normal speech rate

and twice at a fast speech rate, and we used the data produced at a normal speech rate. At the normal speech rate, speakers produced the target words most of the time in the intended prosodic boundary contexts, as checked by the authors. In total, 936 target word tokens were obtained to be used for analysis (/mami/, IP-initial, 345, IP-medial, 123;/mima/, IP-initial, 345, IP-medial, 123).

Following [9] and [17], to assess the nasality of the words, we measured the duration of nasal murmur for the consonant (N-duration) and the A1-P0 during the vowel to estimate the degree of vowel nasalization. A1-P0 is the difference in amplitude for the first formant and the amplitude of the spectral nasal peak that was detected around 250-450 Hz. As in [9], A1-P0 values were taken at relative time points (25%, 50%, and 75%) of the vowel duration, using a Praat script [29]. We also measured A1-P0 at absolute time points (20ms, 40ms, and 60ms) from the vowel onset, but the results are not included in the results section partly due to the space limit and partly due to the fact that absolute measures yielded more or less comparable results as relative measures. These measures were taken from both the first and the second syllable of each target word.

2.3. Statistical analyses

All the statistical analyses were performed by running linear mixed-effects models [1] in [27]. The first and the second syllables were analyzed separately. As in (2a), a model included N-duration as a dependent variable with Boundary and Gender as fixed factors (with their interactions). Another model as in (2b) included A1-P0 as a dependent variable with Gender, Boundary, and Timepoints as fixed factors (including their interactions). The factors were sum coded to interpret main effects and to compare conditions with the overall means. The models in (2) were obtained with the maximal random effects structure to the extent the model converged (i.e., random intercept by subject and slopes for fixed factors). Because the target words contained two vowel contexts (/i/ vs. /a/), and because A1-P0 values obtained from the high vowel context could be more error-prone due to the proximity of A1 and P0, we included Vowel Type as a fixed effect in the model, so that the results could be interpreted with a possible vowel height effect taken into account. When there was an interaction between Boundary and Gender, post-hoc t-tests with Tukey’s HSD correction were further carried out to examine what would have caused the interaction effect.

- (2) a. N-duration ~ Gender*Boundary*Vowel Type + (1 + Gender + Boundary + Vowel Type|Speaker)
 b. A1-P0 ~ Gender*Boundary*Vowel Type + Timepoint+ (1 + Gender + Boundary + Timepoint |Speaker)

3. RESULTS

3.1. Nasal duration

For the first syllable (NVNV), there was a significant effect of Boundary on N-duration ($\beta = -19.8$, $SE = 1.9$, $t = -10.2$, $p < 0.001$), showing that N-duration was *much shorter* IP-initially than IP-medially (Fig. 1a). There was, however, no significant interaction between Boundary and Gender ($\beta = 5.2$, $SE = 2.7$, $t = 1.9$, $p = 0.07$). As shown in Fig. 1a, while there was no gender difference in the IP-initial condition, N-duration was significantly longer for females than for males in the IP-medial condition (IP-initial, Gender difference, $\beta = -4.6$, $SE = 2.56$, $t = -1.8$, $p = 0.092$; IP-medial, Gender difference, $\beta = 10.6$, $SE = 3.66$, $t = 2.9$, $p = 0.0111$).

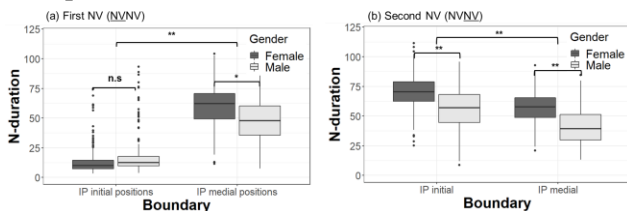


Figure 1. N-duration of first (a) and second (b) syllables across Boundary Positions

As for /n/ in the second syllable (NVNV) of the target word, there were significant effects of Boundary and Gender on N-duration (Boundary, $\beta = 5.77$, $SE = 0.91$, $t = 6.3$, $p < 0.0001$; Gender, $\beta = 7.85$, $SE = 1.61$, $t = 4.86$, $p = 0.0001$) with no Boundary x Gender interaction ($\beta = 0.81$, $SE = 0.91$, $t = 0.89$, $p = 0.38$). N-duration of the second syllable was significantly longer when the target word occurred in the IP-initial condition than when in the IP-medial condition; and it was also significantly longer for female speakers than for male speakers (see Fig. 1b). These results indicate that even the non-edge (the second) syllable was influenced by the preceding boundary strength.

3.2. Vowel nasalization (A1-P0)

For the first syllable (NVNV), there was a significant effect of Boundary and Timepoint 75% on A1-P0 ($\beta = 1.08$, $SE = 0.22$, $t = 4.8$, $p < 0.0001$; $\beta = -0.7$, $SE = 0.22$, $t = -3.17$, $p = 0.001$, respectively) with no Boundary x Timepoint interaction, indicating that the degree of V-nasalization was generally greater in the IP-initial than in the IP-medial condition, and it got smaller later in the vowel. Crucially, however, there was a significant interaction between Gender and Boundary ($\beta = -0.71$, $SE = 0.22$, $t = -3.15$, $p = 0.004$) with no further interaction with Timepoint.

As can be seen in Fig. 2a, the interaction stemmed from the fact that there was a significant gender difference only in the IP-initial context. Notably,

female speakers nasalized the vowel much more than male speakers in the IP-initial context. Put differently, despite the fact that the N-duration itself was extremely reduced in the IP-initial context, female speakers still nasalized the vowel to a larger extent, as much as they did in the IP-medial context ($\beta = -0.005$, $SE = 0.6$, $t = -0.009$, $p = 0.99$); whereas the male speakers substantially reduced V-nasalization in the IP-initial position matched with the reduction of N-duration compared to when in the IP-medial position ($\beta = 2.52$, $SE = 0.56$, $t = 4.46$, $p = 0.0005$).

As for the V-nasalization of the second syllable, there was no effect of either Boundary or Gender on V-nasalization ($\beta = 0.39$, $SE = 0.33$, $t = 1.2$, $p = 0.2$; $\beta = -0.05$, $SE = 0.6$, $t = -0.09$, $p = 0.9$, respectively) nor was there an interaction between them ($\beta = 0.39$, $SE = 0.33$, $t = 0.11$, $p = 0.9$). But it is noteworthy that the overall nasalization was greater for the second syllable than for the first syllable, despite the fact that the first vowel was flanked by the nasal consonant. It appears that the vowel is nasalized progressively larger into the second syllable in the NVNV context.

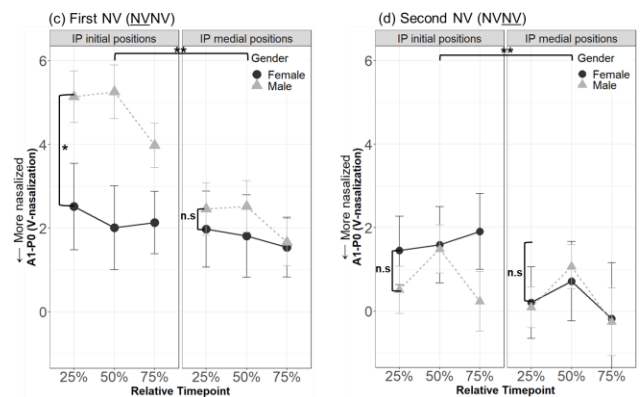


Figure 2. V-nasalization of first (c) and second (d) syllables across Boundary Positions

4. SUMMARY AND DISCUSSION

The present study examined how nasality of NVNV words (/mami/, /mima/) as reflected in N-duration and coarticulatory V-nasalization (A1-P0) would vary as a function of prosodic boundary in Seoul Korean and how the boundary-induced variation would be further conditioned by the gender difference. The results can be recapitulated as follows. First, N-duration of the first syllable (NVNV) was extremely shortened when in the IP-initial position compared to when in the IP-medial position with no further difference due to Gender. It is noteworthy that in a similar study on boundary effects on nasality in Seoul Korean, [17] showed that IP-initial N-duration was around 30 ms (estimated based on Figure 1c of [17]).

In the present study, N-duration was found to be even shorter (ca. 16ms). Although such a comparison would not provide an accurate difference between the two studies because of the different speech materials and experimental conditions, the even more extreme reduction of N-duration implies that denasalization may have progressed over the past several years. It is also important to note that the same word-initial N-duration did not undergo denasalization when the word occurred IP-medially, confirming that the on-going denasalization process must be taken as a position-driven sound change.

Let us now consider a possible origin of the sound change. A relevant question here concerns why to begin with N-duration is generally shorter in the IP-initial than in the IP-medial position, as has been observed across languages (Chinese, [25]; French, [13]; English, [8, 9]; and Korean, [7, 17]). The initial nasal reduction has been considered as a kind of domain-initial articulatory strengthening. It arises with an increased articulatory force at the beginning of a phrase that applies to an oral articulation which may in turn has an effect of elevating the velum [9, 13]. The denasalization process in Seoul Korean then establishes an interesting case of sound change whose origin has stemmed from prosodic-structurally conditioned articulatory strengthening. Given that domain-initial strengthening is more robust in Korean as an edge-prominence language, as discussed in [5, 20], than in other languages such as English as a head-prominence language (see [18] for the typological difference), the left-edge effect of boundary-related strengthening (also known as domain-initial strengthening) appears to have been exaggerated over time to the extent that the nasal murmur of the consonant may not be easily heard by the listener [21, 31]. (The reader is also referred to [10] for a similar prosody account for another on-going sound change of Seoul Korean.)

Most notably, however, our results indicate that such a prosodic-structurally driven sound change is being led by male speakers rather than female speakers. Recall that despite the fact that IP-initial N-duration was extremely reduced in both female and male speech alike, female speakers still nasalized the vowel substantially just like they did in the IP-medial position. In other words, the female speakers still maintain the nasality in the form of V-nasalization. This phenomenon can be understood in phonological terms. For female speakers, the [nasal] feature originally associated with the consonant has spread to the following vowel, but the [nasal] feature itself is being delinked from the consonantal node, leaving a substantial nasalization over the vowel. On the other hand, for male speakers, the denasalization process has progressed much further in such a way that the

[nasal] feature is delinked from both the consonant and the vowel.

Another important question is why it is the male speakers that appear to have led the sound change of denasalization in Seoul Korean, especially given that a sound change is often led by female speakers [22]. We suggest that the male-led denasalization process is attributed to possible social meanings associated with phonetic nasality towards which the speech community is more positively inclined when produced by females than by males. In East Asian societies, linguistic forms that can characterize “immature, weak, feminine, friendly, polite, cute and passive” are often preferred in females’ speech. It is often assumed that Japanese and Chinese female speakers tend to employ high-pitched voice and more nasality to produce phonetic forms preferred for the female speech in the speech community they belong to [12, 32]. Since social meanings of linguistic varieties and variants are often formed differently between genders [4, 28], the resulting non-sonorancy of denasalization appears to carry a negative (possibly stigmatized) social meaning attached to female speech, thus being disfavored by female speakers. Another evidence of the female speakers’ preference of nasalization was also found in the present study. Recall that in the IP-medial position, female speakers produced a longer N-duration of the first syllable than male speakers did; and for the second syllable, female speakers produced a longer N-duration than male speakers did in both IP-initial and IP-medial positions.

5. CONCLUSION

The results of the present study elaborate on how prosodic-structurally conditioned phonetic variation of consonantal nasality and coarticulatory vowel nasalization may have developed into a sound change in Seoul Korean. The results also indicate that the on-going sound change is being led by males rather than females. We suggest that the target phonetic form (‘denasalization’) carries differential social meanings as a function of whether it is produced by males versus females, possibly leading to a stigmatized form in the latter case. More broadly, it is underscored that phonetic variation that is essentially modulated by prosodic structure can be further fine-tuned by social factors, an area of research that needs expanding to further our understanding of linguistic-phonetic underpinnings of speech variation in various social contexts.

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