Title: Phonetic variation and sound change in word-initial nasals in Korean dialects

Abstract

This study investigates dialectal variation and sound change in Korean word-initial denasalization, by using large-scale production data from an underdocumented North Korean (NK) dialect, as well as Seoul Korean (SK). Based on the acoustic analysis, we found that the initial nasals /m/ and /n/ are often realized as one of three denasalized variants—weak nasal, short nasal and stop. Significant findings include: (i) SK speakers denasalize more frequently than NK speakers; (ii) younger speakers denasalize more than older speakers, suggesting sound change in progress in both dialects; and (iii) NK speakers living in Seoul do not acquire the denasalization of SK.

Keywords: nasal, denasalization, variation, sound change, Korean

1. Introduction

This paper investigates the denasalization of the word-initial nasals in Korean by using large-scale production data from two dialects of Korean, the Northern Hamkyeong dialect in North Korea and the Seoul dialect in South Korea. It has been reported that the nasal consonants /m/ and /n/ undergo denasalization (or weakening) in word-initial position in Seoul Korean (Martin 1951, Umeda 1957, Chen and Clumeck 1975, Yoshida 2008, Kim 2011). In particular, recent production studies confirmed the earlier impressionistic descriptions of the initial denasalization in Korean (Martin 1951, Umeda 1957), showing that the initial nasals may be denasalized in the dialect of Seoul (Yoshida 1998, Kim 2011). On the other hand, a much weaker pattern of denasalization is reported for the Southern dialects spoken in Kyungsang-do (Yoshida 2008) and in Busan, more specifically (Yoo 2015).

The main questions to be addressed in this study are as follows. First, we investigate whether the denasalization of the initial nasal is an ongoing sound change in Seoul Korean (SK), by examining the speech of older speakers as well as younger speakers. Based on the apparent time construct (Sankoff 2006), we predict that younger speakers of SK denasalize more frequently than older speakers if there is a sound change in progress. Second, we examine whether denasalization also occurs in North Korean (NK) dialects. Phonetic properties of NK dialects have been understudied, and this is also true of the pattern of initial nasal realizations. We aim to describe how the initial nasals are realized in the Northern Hamkyeong dialect of NK and see if the initial denasalization is a feature that the NK dialect also exhibits. Third, we investigate whether the initial denasalization can be learned by adult speakers under dialect contact as it has been found that adults who move to a new dialect region acquire speech characteristics of the new dialect (Shockey 1984, Munro, Derwing, and Flege 1999, Evans and Iverson 2007, Nycz 2011, 2015, Ziliak 2012, Walker 2014). This study investigates the speech of NK speakers who moved to and reside in Seoul, South Korea. We hypothesize that the longer NK speakers have lived in Seoul, the more frequently they will show the denasalization, a feature of SK, other things being equal.

Other factors investigated include the gender of the speaker and the nasal place of articulation. We hypothesize that young female speakers will denasalize more frequently than young male speakers; while no previous studies reported a gender effect on this variation, young female speakers are generally expected to lead sound change (Labov 1990). Moreover, Kang (2014) showed that in SK, young female speakers are at the most advanced stage of sound change in reweighting of VOT and F0 cues to phrase-initial stop contrasts. As for the place of articulation of the initial nasals, conflicting results have been reported; for example, Chen and Clumeck (1975) report that /m/ is more likely to be denasalized than /n/, while Kim (2011) reports the opposite. We do not have a specific hypothesis about the place of articulation effect nor did we find any noticeable effect in our preliminary analysis. So, we do not discuss this factor further.

2. Methods

2.1 Participants

35 NK refugees residing in Seoul who speak the Northern Hamkyeong dialect and 20 Seoul Korean speakers participated in the experiment. Table 1 shows the distribution of the participants

according to their demographic information. No participants reported a speech or hearing problem.

Table 1. Participant demographic information (Mean, Range)

Dialect	Age group (years)	Length of residence in Seoul (months)	number of speakers
Northern	older	short (Mean=16.3, Range=3-32)	9 (1M 8F)
Hamkyeong	(Mean=52.2, Range=41-78)	long (Mean=95.3, Range=57-164)	9 (1M 8F)
(NK)	younger	short (Mean=14.1, Range=2-30)	7 (0M, 7F)
	(Mean=30.8, Range=21-40)	long (Mean=77.4, Range=36-146)	10 (3M 7F)
Seoul	older	-	10 (5M 5F)
(SK)	(Mean=55.8, Range=41-66)		
	younger	-	10 (5M 5F)
	(Mean=24.2, Range=19-28)		

Both NK and SK speaker groups are balanced for age (older >40 years vs. younger < 40 years). NK participants were also balanced for the length of residence; more than three years of residence in Seoul was considered long, and less than three years was considered short.[1] Unlike SK participants, NK participants were not balanced for gender, as most of NK settlers in Seoul are female according to the report of Ministry of Unification (71% female, as of September 2017).[2] Therefore, speaker gender is included as a predictor for SK only in our analysis below.

[1] Three years was set as a cut-off for long vs. short LOR, as it is argued that it takes two to three years for NK settlers not to experience substantial difficulties with SK dialects (Jeong and Seo 2001, Lee et al. 2003).
[2] http://www.unikorea.go.kr/unikorea/business/statistics/

2.2 Stimuli

The stimuli consisted of seven /m/-initial and fifteen /n/-initial words, listed in Table 2.

Table 2. Target words used in the experiment[3]

/m/-initial		*/n/-initial*	
/maknɛ/	‘the youngest child’	/nallɛ/	‘quickly’
/masikljʌŋ/	‘Masik Pass’	/namluhata/	‘shabby’
/mɛkukno/	‘traitor’	/naplyaŋtʰɨkcip/	‘horror special’
/misʌŋnjʌnca/	‘minor’	/namnam/	‘others’
/mokljʌn/	‘magnolia’	/namtɛmunlo/	‘Namtaemun Road’
/mujʌklo/	‘trade route’	/nanli/	‘fuss’
/mulnanli/	‘flood’	/nanlo/	‘heater’
		/nɛil/	‘tomorrow’
		/nɛŋlɛŋhata/	‘cold’
		/nikʰel/	‘nickel’
		/nɨmlɨmhata/	‘manly’
		/nɨŋljʌk/	‘capability’
		/nonlicʌk/	‘logical’
		/nolɛ/	‘song’
		/nun/	‘eye’

[3] /l/ is used for the Korean liquid here, which in fact has complex allophonic distribution by position.

2.3 Procedure

The experiment was conducted either in the sound-proof room in the Phonetics Lab at Seoul National University or a quiet room in downtown Seoul. The recording was made mono at 44,100 Hz on a Zoom H4n recorder, using a high-quality lapel condenser microphone (Audio-Technica AT831B) on a tabletop mic stand.

The stimuli were presented in Korean orthography with a picture depicting the target word. Each target word was produced twice, first embedded in a frame sentence and then in isolation. Only the isolation reading was analyzed because in sentence reading the word-initial nasal was often located in Accentual Phrase-medial position, where denasalization is not expected (Yoshida 2008, Kim 2011, Yoo 2015).[4] The stimuli were embedded in a larger word list so that the participants did not notice the purpose of the experiment.

2.4 Acoustic analysis

A total of 1,210 word-initial nasal tokens were obtained (22 words * 55 participants). For analysis, we excluded three NK speakers who often spoke in a whisper because it was not clear whether the tokens involving aspiration were due to the initial denasalization or the participants' speech habits. There were also cases in which the participants did not have a sufficient pause after the sentence reading and proceeded to produce the nasal-initial word in isolation, resulting in the target nasal included in the last Accentual Phrase of the sentence. In this case, no

[4] The prosodic domain of denasalization and its cumulativity is controversial. This is not the interest of the current study and we investigate only the speaker variation in denasalization.

denasalization took place, as expected, and this type of tokens was excluded for analysis. Excluding clear pronunciation errors as well, 1,110 tokens in total were analyzed.

We examined the produced words acoustically using Praat (Boersma and Weenink 2017). The first author categorized each token into one of four major patterns: (i) sonorant nasal, (ii) weak nasal, (iii) short nasal, and (iv) stop. First, the sonorant nasal refers to the standard nasal consonant [m] or [n]. As shown in Figure 1, the initial sonorant nasal involves a steady state with energy weaker than the following vowel and anti-formants. The weak nasals, illustrated in Figure 2, show a diminished amplitude in the nasal period, which may decrease further towards the release. Also, the weak nasal tends to involve a clear release burst at the end, indicating a pressure build-up similar to a voiced obstruent stop. The short nasal, shown in Figure 3, is very short in duration, as the name implies, and involves no steady state unlike the sonorant nasal and the weak nasal. The short nasal tends to have no clear release burst. The stop variant of the initial nasal acoustically looks like the unaspirated stop [p] or [t] in Korean, as shown in Figure 4; it is realized with a clear release burst, which might be followed by a short aspiration. We also found several instances where the nasal was realized as the glide [w] (for /m/, n=3), the tap [ɾ] (for /n/, n=19), or deleted (n=7). Instances of tap were mostly observed in NK speakers' speech, and most of these were for Sino-Korean words, which are pronounced with initial liquid in standard North Korean (e.g., /nɛil/ 'tomorrow' cf. NK /lɛil/). These minor variants are excluded in the statistical analyses below.

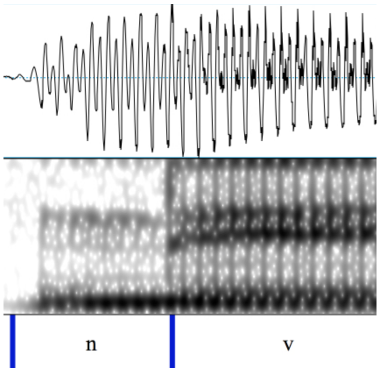

Figure 1. Sonorant nasal from /nɛil/

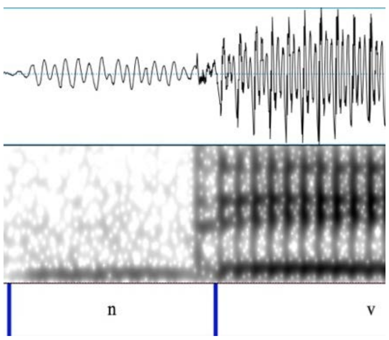

Figure 2. Weak nasal from /nɛil/

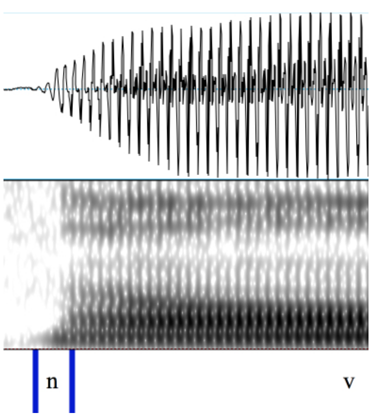

Figure 3. Short nasal from /nolɛ/

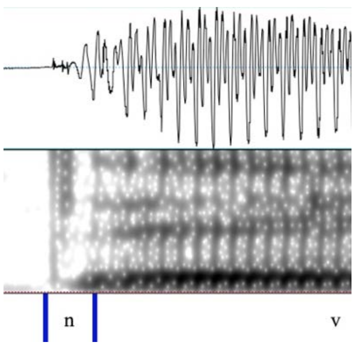

Figure 4. Stop from /nɛil/

In sum, we observed the four main patterns of initial nasal realization, including the three types of the denasalized variants.[5] It should be noted that we cannot be sure whether the nasality is completely removed in the weak and short nasals since we did not measure the nasal flow. Our classification of the nasal variants is solely based on the visual inspection of spectrograms. We named them the weak and short "nasals," nevertheless, because auditorily they still sounded like the nasal consonants to the authors who are native speakers of Korean. This percept may be due to the remaining nasality in the consonant proper or the following vowel, or as native listeners of Korean, the authors are primed to categorize these denasalized phonetic variants as nasal phonemes. We leave this question for future research.

[5] Our classification of the nasal and the denasalized variants integrates the classifications of the previous studies that used an acoustic analysis (Yoshida 2008, Yoo 2015). The sonorant nasal corresponds to 'flat nasality' in Yoshida (2008) and 'sonorant nasals' in Yoo (2015). The weak nasal includes Yoo's (2015) 'voiced non-nasals' and Yoshida's (2008) 'falling nasality'. The short nasal corresponds to the 'rising nasality' in Yoshida (2008), and the stop incorporates 'voiceless non-nasals' with or without aspiration Yoo (2015).

2.5. Statistical analysis

The data were analyzed in R (R Core Team 2017), using the mixed effects logistic regression models implemented in the *glmer* function from the *lme4* package (Bates et al. 2015). The models posited "denasal" as a dependent variable, which collapsed "weak nasal," "short nasal" and "stop" patterns as '1' and "sonorant nasal" as '0'. We first built a model that included a single predictor of DIALECT (SK = -0.5 vs. NK = 0.5) to test the dialect difference in denasalization. Then, separate models were built for each dialect to probe the dialect-internal patterns; for SK, AGE (Old = -0.5 vs. Young = 0.5) and speaker GENDER (M = -0.5 vs. F = 0.5) were included as predictors, and for NK, AGE and Length of Residence (LOR; Short = -0.5 vs. Long = 0.5) were included. For the dialect models, interaction terms were also included initially but no interaction was found significant according to the likelihood ratio test. All models also included random intercepts for speaker and word.

3. Results

We found a statistically significant dialectal difference in the frequency of denasalized variants ($\beta = -1.6864$, $z = -4.296$, $p<.001$); SK speakers denasalized significantly more frequently (49.9%) than NK speakers (22.4%), as shown in Table 3.

Table 3. Distribution of the initial nasal variants in each dialect

<table>
<tr><th>dialect</th><th>sonorant</th><th>weak</th><th>short</th><th>stop</th><th>total</th></tr>
<tr><td rowspan="2">NK</td><td rowspan="2">514
(77.6%)</td><td>45
(6.8%)</td><td>94
(14.2%)</td><td>9
(1.4%)</td><td rowspan="2">662
(100%)</td></tr>
<tr><td colspan="3">denasalized: 148 (22.4%)</td></tr>
<tr><td rowspan="2">SK</td><td rowspan="2">210
(50.1%)</td><td>80
(19.1%)</td><td>75
(17.9%)</td><td>54
(12.9%)</td><td rowspan="2">419
(100%)</td></tr>
<tr><td colspan="3">denasalized: 209 (49.9%)</td></tr>
</table>

Within SK, we found a significant effect of speaker AGE ($\beta = 1.7800$, $z = 4.565$, $p<.001$); as demonstrated in Table 4, the initial denasalization occurred more frequently in younger speakers' speech (68.3%) than in older speakers' speech (32.2%). On the other hand, the difference in denasalization rate between male (47.8%) and female speakers (51.8%) was not statistically significant ($\beta = .1179$, $z = .307$, $p = .759$).

Table 4. Distribution of the initial nasal variants by speaker age in SK

<table>
<tr><th>age</th><th>sonorant</th><th>weak</th><th>short</th><th>stop</th><th>total</th></tr>
<tr><td rowspan="2">old</td><td rowspan="2">145
(67.8%)</td><td>24
(11.2%)</td><td>29
(13.6%)</td><td>16
(7.5%)</td><td rowspan="2">214
(100.0%)</td></tr>
<tr><td colspan="3">denasalized: 69 (32.2%)</td></tr>
<tr><td rowspan="2">young</td><td rowspan="2">65
(31.7%)</td><td>56
(27.3%)</td><td>46
(22.4%)</td><td>38
(18.5%)</td><td rowspan="2">205
(100.0%)</td></tr>
<tr><td colspan="3">denasalized: 140 (68.3%)</td></tr>
</table>

The age difference in denasalization was also significant in NK. As shown in Table 5, younger NK speakers denasalized more frequently (36.9%) than older speakers (10.8%), and this difference was statistically significant ($\beta = 1.7800$, $z = 4.565$, $p<.001$). This difference was carried by the high frequency of the younger NK speakers' short nasal production. On the other hand, there was no significant difference in the denasalization frequency between NK speakers with long LOR (20.6%) and those with short LOR (24.7%), as shown in Table 6.

Table 5. Distribution of the initial nasal variants by speaker age in NK

<table>
<tr><td>age</td><td>sonorant</td><td>weak</td><td>short</td><td>stop</td><td>total</td></tr>
<tr><td rowspan="2">old</td><td rowspan="2">329
(89.2%)</td><td>17
(4.6%)</td><td>19
(5.1%)</td><td>4
(1.1%)</td><td rowspan="2">369
(100.0%)</td></tr>
<tr><td colspan="3">denasalized: 40 (10.8%)</td></tr>
<tr><td rowspan="2">young</td><td rowspan="2">185
(63.1%)</td><td>28
(9.6%)</td><td>75
(25.6%)</td><td>5
(1.7%)</td><td rowspan="2">293
(100.0%)</td></tr>
<tr><td colspan="3">denasalized: 108 (36.9%)</td></tr>
</table>

Table 6. Distribution of the initial nasal variants by LOR in NK

<table>
<tr><td>age</td><td>sonorant</td><td>weak</td><td>short</td><td>stop</td><td>total</td></tr>
<tr><td rowspan="2">short</td><td rowspan="2">217
(75.3%)</td><td>17
(5.9%)</td><td>48
(16.7%)</td><td>6
(2.1%)</td><td rowspan="2">288
(100.0%)</td></tr>
<tr><td colspan="3">denasalized: 71 (24.7%)</td></tr>
<tr><td rowspan="2">long</td><td rowspan="2">297
(79.4%)</td><td>28
(7.5%)</td><td>46
(12.3%)</td><td>3
(0.8%)</td><td rowspan="2">374
(100.0%)</td></tr>
<tr><td colspan="3">denasalized: 77 (20.6%)</td></tr>
</table>

4. Discussion

To summarize the results, we confirmed previous observations regarding the word-initial denasalization in SK, showing that almost a half of the tokens were realized as a denasalized variant. A novel finding is that the initial denasalization also occurs in NK, although far less frequent than in SK. Also, we found that younger speakers denasalize more frequently than older speakers, suggesting that denasalization may be an ongoing sound change in both SK and NK. There is no significant effect of speaker gender and this sound change is not specifically led by young female speakers. The hypothesis about dialect acquisition is not confirmed in the current results; there is no significant difference in the denasalization between NK speakers with long LOR and those with short LOR, indicating that NK settlers in Seoul have not acquired the initial denasalization, a feature of SK. This may imply that the denasalization of the initial nasal is too subtle a change to learn, compared to the other features known to be learned under dialect contact, such as /t/-flapping (Shockey 1984, Walker 2014) and monophthongization of a vowel (Bowie 2000). The change to the stop variant is rather salient, but the stop is the least common denasalized variant and might be so infrequent that NK speakers cannot acquire it.

The process of denasalization in Korean can be discussed in the context of other processes that affect phrase-initial consonants in Korean, which generally obey the Sonority Sequencing Principle (Sievers 1881); onsets with lower sonority are preferred to those with greater sonority. The so-called initial avoidance law, whereby word-initial liquids become nasalized, is consistent with this principle of preferring a lower sonority onset (liquid → nasal). Lenis stops, which are allophonically voiced in phrase-medial position, are fully devoiced phrase-initially (voiced stop → voiceless stop). The younger SK and NK speakers in our study produced their initial liquids less sonorously than their older counterparts; younger SK speakers pronounced less rhotic tap variants and more lateral variants compared to older SK speakers, and younger NK speakers produced less tap and trill but more stop-like variant of the underlying liquid (Yun and Kang, submitted). These younger speakers also produced their lenis stops with a longer VOT value than older speakers (Kang and Yun, 2018). These phrase-initial processes together form a chain-shift of segments down the sonority hierarchy (rhotic > lateral > nasal > voiced obstruent > voiceless obstruent).

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