Phonetic Variation in Korean /n/: A Corpus Study*

Miyeon Ahn†
Hankyong National University

ABSTRACT

The purpose of this study is to examine the dynamic acoustic properties of the postconsonantal nasal /n/ in Korean, which may be associated with the phonetic variation arising from three different phonological inputs. The inputs of the three types of /n/ sounds are (i) a canonical as in /kamnamu/ → [kamnamu] "*a persimmon tree*," an epenthesized or inserted /kaŋnam_jʌk/ → [kaŋnamnjʌk] "*Gangnam Station*," and a nasalized /tiŋɹok/ → [tiŋnok] "*registration*". In this study, we examine the temporal and spectral properties of these three types of /n/ sounds – both the temporal duration and the first and second formant frequency values – in corpus data. Consonantal duration varies as a function of a particular age group and is characterized by an increase in duration from canonical to inserted /n/. Significant spectral variation is observed within the female group, with the inserted and nasalized types characterized by a low F1 and a high F2, respectively. The results partially support the idea that grammatical knowledge may contribute to phonetic variation, thus suggesting that language users may require more time to process phonologically complex linguistic representations.

Keywords: Korean /n/, canonical, inserted, nasalized, phonological complexity

1. Introduction

Human speech is full of variability. Variation in speech has been considered across multiple dimensions, encompassing regional and social aspects (Foulkes & Docherty, 2006; Farrington et al., 2021; Fridland et al., 2014), as well as differences among inter- or intra-speakers (Allen et al., 2003; Bayles et al., 2016) within both native and cross-language settings (Johnson & Babel, 2023; Yu et al., 2015). Many of these studies on variation aim to identify various linguistic representations, understand how variations function, investigate the sources that trigger variation, and explore its consequences (Beddor, 2023; Yu, 2021).

Among the multiple sources of variation, factors such as the role of lexicon,

* I sincerely appreciate the detailed comments and suggestions provided by the three reviewers.
† Corresponding author: mahn@hknu.ac.kr

lexical frequency and fluency can be considered as linguistic and non-random ones. Setting aside these input-related factors, the purpose of this study is to explore whether the role of grammar, with a particular focus on phonological processing, may be attributed to another source of variation. Specifically, we aim to understand the phonetic nature of the seemingly diverse phonemic representations of word-medial and postconsonantal /n/ in Korean and their interaction with morphophonological processes.

A range of studies investigating phonetic properties of variation focuses on examining temporal and spectral features (Carter & Local, 2007; Carter, 2009) and intends to explain how these acoustic features can be understood in linguistic and/or non-linguistic contexts. In a similar vein, we examine these acoustic features to identify variable patterns of Korean /n/.

Word-medially, postconsonantal Korean /n/ is phonetically realized from one of the following three different morphophonemic sources: the canonical, inserted or nasalized types. The following illustrates the three different types of /n/ with example words.

(1) Three sources of [n]

a. Canonical

/kamn̲amu/ → [kamn̲anu] → *'a persimmon tree'*

b. Inserted

/kaŋnam_jʌk/ → [kaŋnamn̲jʌk] → *'Gangnam Station'*

c. Nasalized

/tiŋ_ok/ → [tiŋn̲ok] → *'registration'*

By comparing the underlying representations and their respective surface forms, it can be found that the canonical /n/ refers to instances in which the surface /n/ can be found in its input. The surface /n/ is fully faithful as the output [n] corresponds directly to its input /n/. It should be noted that no phonological processes are involved in this input-to-output process.

On the other hand, /n/ can be epenthesized as a result of a phonological process of inserting /n/ between a nasal consonant and /i/ or /j/ known as n-insertion (Hong, 2003, 2006; Jun, 2015, 2018, 2021; Lee & Lee, 2006). The inserted /n/ differs from the canonical in that its input is absent from the underlying representation and it involves the phonological process of epenthesis, inserting a new segment. In other words, for the inserted /n/ type, /n/ appears in the output after

undergoing a phonological process between heteromorphemic boundaries.

Finally, the nasalized /n/ pertains to instances in which /n/ is phonetically realized as a result of a feature change in which a liquid is assimilated to the nasality of its preceding neighbor /ŋ/. It is important to note that both inserted and nasalized /n/ sounds involve distinct phonological processes. These two /n/ sounds differ in that the nasalized /n/ is partially faithful to its underlying representation, whereas the inserted /n/ is inserting a sound which is entirely absent from the input.

In the present study, we examine whether the three phonetically realized types of /n/ sounds reveal any variation of the acoustic properties. Specifically, we explore both the temporal and spectral properties of the three types of the nasal consonant /n/, examining the consonantal duration and the first two formant frequencies (i.e., F1 and F2) that are key features commonly discussed in identifying sonorant properties. Understanding the possibly variable phonetic nature of the three types of /n/, we also examine whether speakers of the same gender or age exhibit similar or distinct phonetic features across those three types. Given the systematic variation observed among these three types of /n/, we can partially attribute this variation to morphophonemic grammar as a potential source.

2. Methods

2.1. The corpus

The acoustic data analyzed in this study is based on the corpus known as *The Korean Corpus of Spontaneous Speech* (aka, *Seoul Corpus*, Yun et al., 2015). The corpus includes a total of 40 speakers in which the age groups are ranged from 10s to 40s and the gender is equally distributed. It includes an hour-long, interview-style speech for each speaker. The corpus consists of a total of 1,135,263 segmented phonemes.

2.2. Data collection

The final dataset for analysis was obtained through a series of procedures. First of all, we collected all instances of /n/ within the corpus based on its prelabeled phoneme segmentation, using Python software. Data with any missing values were excluded (e.g., failure of automatic measurement of F1 or F2 values). The three

types of /n/ particularly appear as word-medial onsets, which led us to eliminate all word-initial /n/ instances. Additionally, given that both inserted and nasalized /n/ exclusively occur after a consonant, some of the prevocalic canonical instances, such as /halmʌni/ '*a grandmother*', were excluded.

The data set was then categorized into the three types of /n/ sounds. The number of /n/ in the canonical type outnumbered the other two types. Among the canonical type, two kinds of words were further removed: (i) if the nasal appears in bound affixes as in /pat-nɨntɛ/ '*receive-but*' or (ii) if the /n/-embedded words are pronounced with geminate /n/ as in /kjosunim/ → [kjosunnim] '*professor*-Honorific' or /k*ɨt^{h}nas*ta/ → [k*ɨnnat*a] '*to end*-Past', as the boundaries of the onset /n/ may not be clearly defined. These procedures resulted in a total of 1,255 words, compromising 29 inserted, 229 nasalized and 997 canonical words, which were subsequently analyzed[1)].

For those words categorized into the three types of /n/ sounds, the two phonetic properties of both temporal duration and the first two formant frequencies were measured. Temporal duration was measured from the onset to the offset of each/n/ sound, and the F1 and F2 values were measured at the midpoint of the /n/ sounds.

3. Analysis

3.1. Temporal variation of /n/

Figure 1 illustrates the temporal properties of the three types of /n/, that is, the canonical, inserted and nasalized /n/ (marked as 'class' in the figures) by two speaker groups − by gender (Figure 1 left) and by age (Figure 1 right).

1) The inserted /n/ may appear immediately following a preceding nasal as in /kaŋnam_jʌk/ → [kaŋnamnjʌk]. It can also appear after /k/, which undergoes a change to /ŋ/, subsequently inducing a nasalized /n/ as in /tɛhak-ɹo/ → [tɛhaŋno].

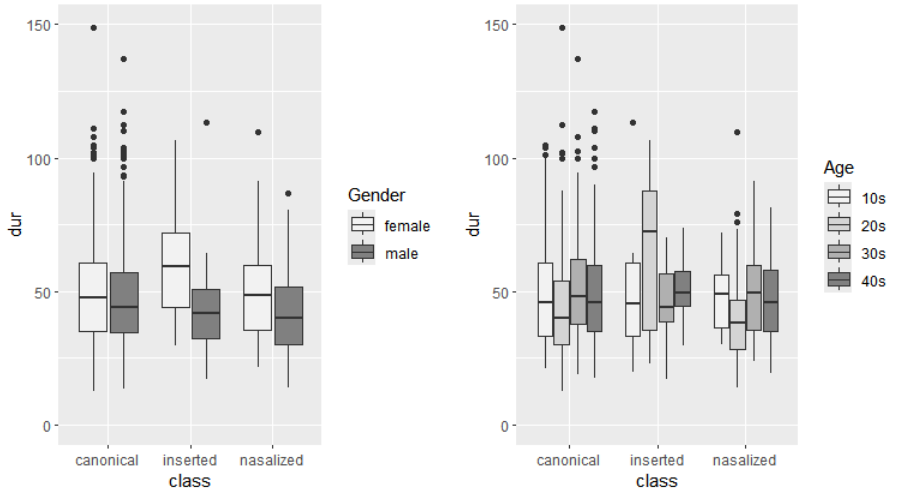

Figure 1. Temporal variation of the canonical, inserted and nasalized types by speaker groups

The mean duration for all the three types of /n/ was 48.5ms (SD 19.7ms). Among the three types, inserted was found to have the longest mean duration at 52.7ms, while canonical and nasalized were found to be similar, with mean durations of 48.4 ms and 48.0 ms, respectively. A linear mixed-effects model was applied to the pooled temporal variation across the three types of /n/ sounds with the three independent variables (i.e., class, age and gender) as fixed effects and one dependent variable (i.e., subject) as a random effect as in Table 1. Among the subject-related variables, age and gender were constant effects across the dataset, whereas 'subject' was considered as a variable that can introduce variability across speakers (e.g., a certain individual produces a longer nasal sound than others). The canonical type was considered the baseline to track the shift from canonical types (i.e., those with no changes) to non-canonical types (i.e., those with changes).

Table 1. Mixed effect model result for duration

	Estimate	Std. error	*df*	*t* value	Pr(>|*t*|)
(Intercept)	45.75	12.19	1,006.41	3.75	0.000185***
Class	1.21	4.14	1,238.97	0.29	0.77
Age 20s	21.47	15.72	955.12	1.37	0.17

Table 1. continued

	Estimate	Std. error	*df*	*t* value	Pr(>|*t*|)
Age 30s	4.80	14.78	885.24	0.33	0.75
Age 40s	7.44	15.01	881.17	0.50	0.62
Gendermale	12.53	16.10	949.63	0.78	0.44
Class:Age 20s	-7.16	5.42	1,236.40	-1.32	0.19
Class:Age 30s	-0.24	5.06	1,237.55	-0.05	0.96
Class:Age 40s	-3.04	5.08	1,238.57	-0.60	0.55
Class:Gendermale	-4.70	5.40	1,238.48	-0.87	0.38
Age 20s:Gendermale	-56.69	21.04	870.58	-2.69	0.007197**
Age 30s:Gendermale	-5.99	20.73	874.50	-0.29	0.77
Age 40s:Gendermale	-18.19	20.98	890.09	-0.87	0.39
Class:Age 20s:Gendermale	16.58	7.23	1,238.59	2.29	0.021937*
Class:Age 30s:Gendermale	1.70	7.03	1,236.06	0.24	0.81
Class:Age 40s:Gendermale	6.56	7.01	1,237.39	0.94	0.35

The linear mixed effects model did not show class, gender or age groups as significant main effects. (p > .05). This model, however, reported a significant two-way interaction between age and gender and a three-way interaction among class, age and gender (p < .05), which suggest that if the speakers were males in their 20s, their production would be around 22.7 ms shorter than the baseline group (i.e., canonical, Age10s, Genderfemale) and that the durational difference slightly increases in non-canonical types.

Examining the speaker groups further according to gender and age, divergent patterns emerged. As for the gender groups, the longest duration was observed for the canonical for male speakers while for it was the inserted type for female. Statistically, significant gender effect was not found regarding the temporal durations. Although not significant, the two non-canonical types of /n/ sounds, the inserted and nasalized, that involve phonological processes were found to be slightly longer than the canonical. This was observed in female but not in male speakers. Regarding the age groups, the one-way analysis of variance showed significant temporal variation was observed within the speaker group in their 20s (F (2,232) = 3.9499, p < .05) with temporal duration increasing from the canonical to the inserted type.

This result, based on limited tokens, suggests that the durational properties of /n/ may be related to the types, but further studies with a larger number of tokens should follow.

3.2. Spectral variation of /n/

Formant frequency values are measurements in the midpoint of each nasal segment. Table 2 presents the pooled mean and standard deviation (SD) in parentheses of F1 and F2 for the three types of /n/ sounds analyzed by male and female speakers. Separate analyses were conducted for male and female speakers due to the inherently lower formant frequencies in male speakers compared to female speakers. In male speakers' speech, F1 was the highest in the inserted type and the lowest in the nasalized, while F2 was the highest in the inserted and the lowest in the canonical type. In female speakers' speech, on the other hand, F1 was the highest in canonical and the lowest the inserted, whereas F2 was the highest in the nasalized and the lowest in the inserted. Across all speech groups, it is presumably true that the inserted and the nasalized types tend group together, while the canonical type constitutes a separate group.

Table 2. The mean and SD of F1 and F2 frequencies in Hz for the three types of /n/

		F1 mean (SD)	F2 mean (SD)
Male	Canonical	344 (154)	1,601 (561)
	Nasalized	334 (127)	1,647 (522)
	Inserted	371 (179)	1,738 (557)
Female	Canonical	330 (78)	1,342 (595)
	Nasalized	318 (113)	1,534 (645)
	Inserted	269 (56)	1,268 (515)

Spectral variation in the canonical, inserted and nasalized types is illustrated in Figure 2. In terms of the spectral properties of F1 and F2, the canonical type exhibited the widest distribution relative to the inserted and nasalized types and female speakers displayed a wider distribution than male. This tendency was noted both across different gender and age groups of speakers and it appears to be partly

attributable to the uneven number of tokens.

The linear mixed effects model was applied to F1 and F2 with class, gender and age groups as fixed factor and subject as a random factor. None of them was reported as a significant main effect ($p > .05$) and no interactions were found. We then separated speech groups age and gender across the three types of /n/ sounds. Spectral differences by age group were not observed, but the differences by gender are worth discussing further.

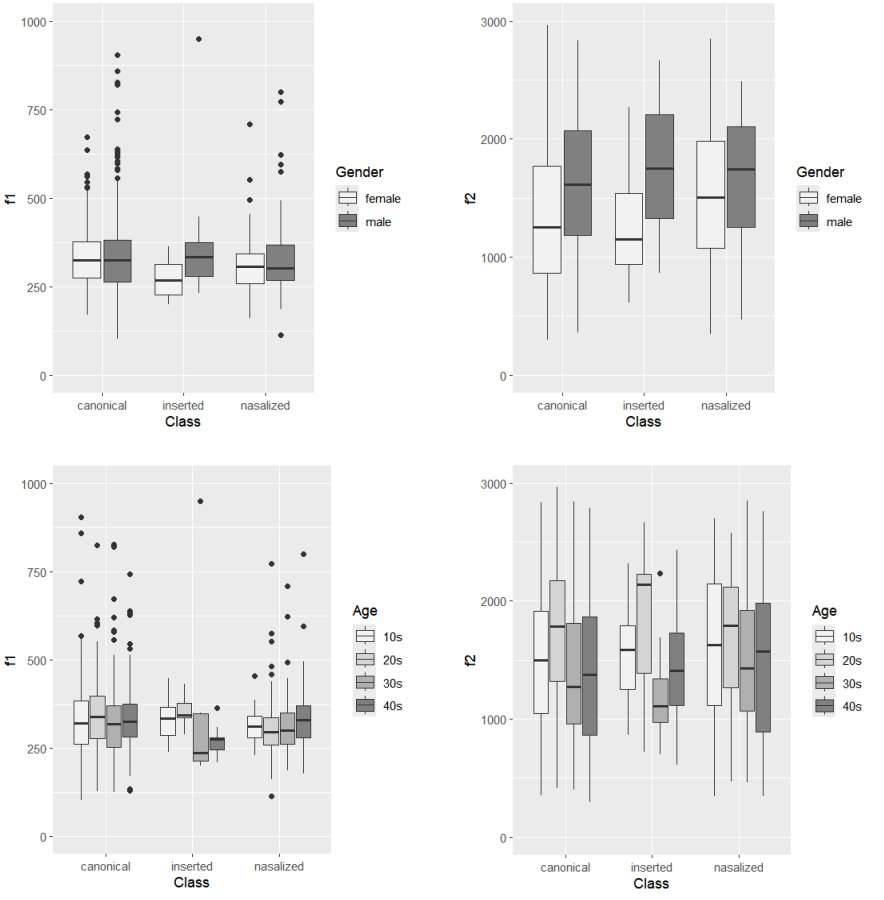

Figure 2. Spectral variation of canonical, inserted and nasalized /n/ by gender (top) and age groups (bottom)

Figure 2 presents the F1 and F2 values by gender and age groups across the three

types of /n/ sounds. With respect to the male speaker group, no significant differences were observed in F1 and F2 across the three types of /n/ sounds. Regarding the female speaker group, on the other hand, ANOVA displayed significant differences on F1 ($F(2,617) = 4.62$, $p < .05$) and F2 ($F(2,617) = 4.47$, $p < .05$) across the three types of nasals. TukeyHSD post hoc test revealed the following comparisons: canonical, nasalized > inserted for F1 and nasalized > canonical, inserted for F2. Considering that F1 is related to tongue height, the lower F1 for the inserted type can be interpreted as indicating tongue body gesture for the type less raised toward velum compared to the canonical and nasalized types. F2 is associated with tongue backness; therefore, the higher F2 for the nasal type can be understood as suggesting that the tongue gesture for this type is further back toward the tongue root compared to the canonical and inserted types.

4. Discussion

4.1. Phonologically complex and long inserted /n/

Let us now consider the factors responsible for these variable acoustic properties of the three types of nasals. It could be argued that the diverse phonological processes underlying these nasals may partially account for their varying phonetic properties. As briefly mentioned in (1), the inserted type involves a new segment in its phonetic output form that is absent in its phonological input one. This phonological process, which introduces a completely novel segment in the phonetic form, may be cognitively demanding, as it should undergo multiple procedural steps.

In general, it is well-known that the inserted /n/ is typically epenthesized between two separate morphemes (Jun, 2018), which means language users must identify morpheme boundaries. Moreover, most instances of inserted /n/ occur after another nasal consonant (e.g., /m/ or /ŋ/) followed by /i/ or /j/, as in [kaŋnamn̪jʌk] or /sintaŋ_jʌk/ → [ʃintaŋn̪jʌk] *'Shindang Station'*, meaning that language users must be aware of the preceding consonants. The phonetic environment for /n/-insertion, however, is not universal; it sometimes occurs even when the preceding consonant is not a nasal but a stop as in such as /nɛpok_jak/ *'oral medicine'*. This change engages even more complex processes, as in /nɛpok_jak/ → /nɛpoknjak/ → [nɛpoŋn̪jak], where a manner assimilation process occurs following insertion, as Korean does not allow the combination of *[...kn-]. Language users, therefore, need

to not only evaluate the morphophonological conditions of each word but also navigate these fairly complicated phonological procedures, in contrast to the other two types in which these complicated grammatical considerations are largely nonexistent.

A comparable example of segmental epenthesis can be found in English as in the word *'something'* /sʌmθɪŋ/ → [sʌmpθɪŋ]. Korean /n/-insertion differs from the English example in that it is an inevitable phonological process, which must be realized whenever the phonetic conditions are met while the epenthesis in English is optional. When expected, failure to apply the phonological process in Korean /n/ results in an unnatural speech production. Besides, this rule is highly productive, applying not only to loanword + native word combinations such as in [bɨlɛŋnjʌu] *'a black fox'* but also to foreign phrases as in [...biŋnjɛlou...] '*a big yellow balloon*'.

Nasalized /n/, on the other hand, may undergo less radical changes from its underlying phonological form to its phonetic realization, though it is still more complicated than the canonical /n/. Similar to the inserted example [nɛpoŋnjak], the nasalized /n/ sound often involves the intermediate stage as in /tokɹip/ → /toknip / → [toŋnip] *'independence'* in which /k/ turns into /ŋ/ due to *[...kn-] and /ɹ/ becomes nasalized. Still, the nasalized /n/ incorporates a featural change from a non-nasal into a nasal segment instead of segmental epenthesis. It could be arguably said that nasalized /n/ engages less complex phonological processes compared to the inserted type. In terms of rule productivity, this assimilating process appears to be limited in application and less productive than the /n/-insertion rule. Nasalization appears to be permitted in loanword-native word combinations as in [bɨlɛŋnjaɡu...] *'a black baseball team'* but is prohibited in foreign phrases as in [bɨlɛŋɹum] rather than *[bɨlɛŋnum] *'a black room'*.

How is phonological complexity linked to the temporal variation? One possible interpretation is that the complexity is likely reflected in the lengthened duration, which contributes to temporal variation. Complex linguistic representations possibly impose a cognitive 'load', requiring greater effort from language users in perceptually processing acoustic stimuli or in constructing appropriate speech material during production. This additional effort, in turn, necessitates more time for processing the representation, presumably leading to a slowdown in the coordination of relevant articulatory movements.

The observed temporal variation of Korean /n/ across the three types revealed that, although limited to speakers in their 20s, the consonantal duration of /n/ in the inserted type was significantly longer compared to the canonical and nasalized

types. The other speaker groups did not exhibit this lengthened durational property inthe inserted type; however, it should be noted that no reverse pattern was observed in the rest of speaker groups. In other words, a significant durational decrease from the canonical or nasalized types to the inserted type was not observed. This corpus result of the 'long' inserted /n/ coincides with the idea of phonologically complex linguistic representations, suggesting that phonological complexity have to do with planning speech production. Presumably, it can be inferred that if multiple phonological processes are involved within a single word − such as /tokɹip_jʌŋhwakatʰi/ → [toŋn̪ipnjʌŋhwakat̪ʃ͡ʰi] *'like an independent film'*, in which both nasalized and inserted /n/ as well as palatalized /t/ are present − phonological complexity is likely to increase, and lengthening is even more likely to occur. Obviously, other interpretation is possible and more detailed study regarding acoustic details is required for further validation.

4.2. Context-dependent spectral properties

Nasal consonants are characterized by relatively little energy compared to neighboring vowels. In terms of formant frequencies, F1 is related to the height of tongue body while F2 correlates to tongue retraction. As the tongue body is lowered, F1 increases, and as the tongue body is retracted, F2 decreases. It is known that nasal consonants generally involve a lower tongue body position, which results in a retracted tongue tip (Tabain, 2023) and articulation involving tongue tip gestures such as coronals lead an increase in F2 (Stevens, 1996). Obviously, these articulatory gestures influence both F1 and F2.

The corpus results, although limited to female speakers, report that F1 of the inserted type was significantly lower than that of both the canonical and nasalized types, while F2 of inserted and canonical types was significantly higher than that of the nasalized type. As for F1, which is related to the height of tongue body position, the results suggest that the tongue body for the inserted type was lowered than for the other two types. As for F2, which is associated with tongue retraction, the tongue body was more retracted for the canonical and inserted types than for the nasalized type. These corpus results partly imply that language users may exhibit different tongue configurations depending on the three types of nasals.

One possible interpretation as for the various properties of formant values is related to the extent of rule application. Due to the unnaturalness of omitting /n/ when it is expected, speakers may adjust their nasality to meet listeners' expectations

by hyperarticulating the relevant gestures. Another possibility is that the overall timing of tongue configuration, as reflected in the phonological processes, may influence spectral dynamics. The timing of articulatory gestures for each type could be related to these spectral variations.

It is not always the case that speakers overtly exert effort in producing an epenthetic segment. The English epenthetic schwa in non-native sequences, for instance, is known to be undershot (Davidson, 2003). Perceptually, the epenthesized schwa is selected to minimalize the perceptual gap between the non-native target and the percept, suggesting that the epenthetic segment should be least perceptible and, thus, articulatory undershot. Korean inserted /n/, on the other hand, should be explicitly realized due to inevitability of the rule application. /n/-insertion is not contrastive in Korean. Unlike other phonological processes, such as palatalization or obstruent tensification, where phonemic changes occur and failure to apply the rule results in critical meaning changes, the application of /n/-insertion marks a more correct and natural speech production. The failure to apply the rule does not lead to unintended meaning.

Spectral properties are clearly context-dependent; the described characteristics may arise from coarticulatory effects with neighboring sounds rather than from grammatical complexity. Corpus study highlights general patterns of acoustic properties. A more controlled acoustic study is needed to further explore the role of phonological complexity and other potential factors in the three types of Korean /n/.

5. Conclusion

In this study, we explored the temporal and spectral properties of the three types of /n/. Limited data from a few speaker groups revealed various phonetic properties, depending on the complexity of phonological rules. The data suggest that grammatical complexity may be one of the contributing factors in phonetic variation, which should be further confirmed with a more expanded data set. /n/-insertion is rather limitedly found in Seoul dialect but is more commonly found in Gyeongsang dialect, where inserting /n/ is considered a characteristic feature (Hong, 2003; Jun, 2021). This makes it a valuable topic for a comparative study between Gyeongsang and Seoul dialects. Additionally, by exploring the link between perception and production, it should be beneficial to investigate whether these acoustic details

provided by speakers offer useful information to listeners. Further studies on inter- and intra-speaker variation should also be conducted as the next step in this line of research.

References

Allen, J. S., Miller, J. L., & DeSteno, D. (2003). Individual talker differences in voice-onset-time. *The Journal of the Acoustical Society of America*, *113*(1), 544-552.

Bayles, A., Kaplan, A., & Kaplan, A. (2016). Inter- and intra-speaker variation in French schwa. *Glossa: A Journal of General Linguistics, 1*(1), 1-30.

Beddor, P. S. (2023). Advancements of phonetics in the 21st century: Theoretical and empirical issues in the phonetics of sound change. *Journal of Phonetics*, *97*, 101228.

Carter, P. (2009). Extrinsic phonetic interpretation: Spectral variation in English liquids. In J. Local, R. Ogden, R. Temple (Eds.), *Phonetic interpretation: Papers in laboratory phonology VI,* (pp. 237-252). Cambridge University Press.

Carter, P., & Local, J. (2007). F2 variation in Newcastle and Leeds English liquid systems. *Journal of the International Phonetic Association*, *37*(2), 183-199.

Davidson, L. (2003). Phonology, phonetics, or frequency: Influences on the production of non-native sequences. *Journal of Phonetics*, *34*, 104-137.

Farrington, C., King, S., & Kohn, M. (2021). Sources of variation in the speech of African Americans: Perspectives from sociophonetics. *Wiley Interdisciplinary Reviews: Cognitive Science*, *12*(3), e1550.

Foulkes, P., & Docherty, G. (2006). The social life of phonetics and phonology. *Journal of Phonetics*, *34*(4), 409-438.

Fridland V., Kendall, T., & Farrington, C. (2014). Durational and spectral differences in American English vowels: dialect variation within and across regions. *Journal of Acoustical Society of America*, *136*(1), 341-349.

Hong, S. (2003). Parameterized OT analysis of [n]-insertion in Sino-Korean and native Korean. *The New Korean Journal of English Language and Literature*, *45*(2), 395-418.

Hong, S. (2006). /n/-insertion in native Korean and Sino-Korean revisited. *Studies in Phonetics, Phonology and Morphology*, *12*(2), 391-413.

Johnson, K. A., & Babel, M. (2023). Language contact within the speaker: Phonetic variation and crosslinguistic influence. *Language and Speech*, *67*(2), 401-437.

Jun, J. (2015). Korean n-insertion: a mismatch between data and learning. *Phonology*, *32*, 417-458.

Jun, J. (2018). Morpho-phonological processes in Korean. *Oxford Research Encyclopedia of Linguistics.*

Jun, J. (2021). Morphophonological gradience in Korean n-insertion. *Glossa: A Journal of*

General Linguistics, *6*(1), 1-40.
Lee, Y., & Lee, M. (2006). n-insertion as y-devocalization in Korean. *Korean Journal of Linguistics, 31*(3), 413-440.
Stevens, K. (1996). Articulatory-acoustic-auditory relationship. In W. Hardcastle, J. Laver, F. E. Bibbon (Eds.), *The handbook of phonetic sciences,* (pp. 462-506). Oxford: Blackwell.
Tabain, M. (2023). Articulatory and acoustic phonetics. In C. Browern (Ed.), *The Oxford guide to Australian languages*, (pp. 81-95). Oxford University Press.
Yu, A. (2021). Toward an individual-difference perspective on phonologization. *Glossa: A Journal of General Linguistics, 6*(1), 14.
Yu, A., Abrego-Collier, C., Phillips, C., Pillion, B., & Chen, D. L. (2015). Investigating variation in English vowel-to-vowel coarticulation in a longitudinal phonetic corpus. *Proceedings of the 18th International Congress of Phonetic Sciences.*
Yun, W., Yoon, K., Park, S., Lee, J., Cho, S., Kang, D., Byun, K., Han, H., & Kim, J. (2015). The Korean corpus of spontaneous speech. *Phonetics and Speech Sciences*, *7*(2), 103-109.

Miyeon Ahn
Associate professor
Department of English Language and Culture
Hankyong National University
327 Jungang-ro, Anseong, Gyeonggi-do 17579, Korea
E-mail: mahn@hknu.ac.kr

Received: February 5, 2025
Revised version received: April 10, 2025
Accepted: April 17, 2025