http://dx.doi.org/10.17959/sppm.2019.25.1.3

The Asymmetric tense consonant effects in compound and word-initial tensifications in Korean*

Hijo Kang** (Chosun University)
Mira Oh *** (Chonnam National University)

Kang, Hijo and Mira Oh. 2019. The asymmetric tense consonant effects in compound and word-initial tensifications in Korean. *Studies in Phonetics, Phonology and Morphology* 25.1. 3-30. A tense consonant blocks compound tensification (Ito 2014, S. Kim 2016) but facilitates word-initial tensification in Korean (Kang and Oh 2016, H. Kim 2016). Previous studies examined such a tense consonant effect as dissimilatory in compounds but as assimiliatory in simplex words separately. The aims of this paper are twofold. First, we will test if a tense consonant is affected differently depending on the morphosyntactic domains by studying both compound and word-initial tensification processes, unlike previous studies. Second, we will investigate what motivates the asymmetry of the tense consonant effect between compound and word-initial tensification processes. We conducted a survey where 40 Korean speakers selected their own pronunciations for 120 compounds and 100 simplex words. We found that a tense consonant in fact behaves differently in compound and in word-initial tensification processes. We present two possible reasons why such a difference is observed. The perception view assumes that each tensification has its own perceptual function. Compound tensification is intended to make a compound perceptually distinguishable from each of its components. Compound tensification is then avoided before another tense consonant since a tense-tense sequence of consonants could make them perceptibly similar to simplex words. The production view of the tense consonant effect emphasizes the avoidance of consecutive long vowel-to-vowel intervals. Laryngeal co-occurrence restrictions attested in tensification in Korean will be discussed in light of both production and perception. **(Chosun University, Assistant Professor and Chonnam National University, Professor)**

Keywords: compound tensification, word-initial tensification, laryngeal co-occurrence restriction

---

* This study was supported by research fund from Chosun University 2017. A part of this paper was presented at the 7th International Conference on Phonology and Morphology.
** First author
*** Corresponding author

1. Introduction

A segment can be realized differently according to a non-adjacent sound besides an adjacent one. Vowel harmony is the most well-known phonological process of that kind (van der Hulst and van der Weijer 1995, Krämer 2003, Gafos and Dye 2011, among others). Consonant harmony has also been reported in phonology. Previous studies on consonant harmony show that a consonant may assimilate to another consonant at a distance in terms of phonological features such as [voice], [nasal], [lateral], and [sibilant] (Rose and Walker 2004, 2014). The long distance effect of consonants is sometimes dissimilatory (Bye 2011). On the basis of MacEachern's (1999) typological study of laryngeal co-occurrence restrictions (LCR[1]), Gallagher (2010) categorized them into three types: dissimilation, assimilation, and mixed. That is, a laryngeal feature may require or prohibit the appearance of another one in a specific domain. Whether assimilatory or dissimilatory, the effect of a feature is expected to be taken in a unitary direction in a language. However, previous studies have shown that a tense consonant in Korean may facilitate the appearance of another tense consonant in simplex words (Kang and Oh 2016, H. Kim 2016) but block it in compounds (Ito 2014, S. Kim 2016). In this paper we will present the result of a survey on the long-distance effect of tense consonants in compound and word-initial tensification processes by Korean speakers to get a more complete picture of the tense consonant effect in Korean. Accordingly, the aims of this paper are to compare the tense consonant effect in compound tensification and word-intial tensification, and to investigate what motivates the asymmetry of the tense consonant effect between compound tensification and word-intial tensification.

1.1 Compound tensification in Korean

When a compound is formed by combining two nouns, the word-initial lax consonant of the second component may become tense as shown in (1), even though it is

---

[1] LCR is a type of OCP (Obligatory Contour Principle) in a broad sense, which was proposed by Leben (1973) and developed by Goldsmith (1976), McCarthy (1979, 1981, 1986, 1988), Odden (1988) among others. At the outset, it was proposed to account for tonal phenomena but later its application was extended to segmental ones. Besides laryngeal features, place and manner features could be involved in this principle depending on languages (Frisch et al. 2004).

[2] A lax consonant is always tensified after an obstruent but is usually not tensified after a

preceded by a sonorant[2].

(1) Compound tensification in Korean

a. san + twetɕi	'mountain' + 'pig'	[santwetɕi] ~ [san**t'**wetɕi]
b. mul + tɕaŋgu	'water' + 'drum'	[multɕaŋgu] ~ [mul**tɕ'**aŋgu]
c. p'alle + tɕipk'e	'laundry' + 'nipper'	[p'alletɕipk'e] ~[p'alle**tɕ'**ipk'e]

The previous literature on compound tensification in Korean reports two noticeable findings. First, the likelihood of tensification is lexically determined. For example, compound tensification is almost obligatory for some compounds (e.g., mul+koki 'water'+'meat' [mulk'ogi] but *[mulgogi]) but it never occurs for others (e.g., bul+koki 'fire'+'meat' [bulgogi] but *[bulk'ogi]) (Park 2004: 532). Compound tensification also differs between speakers. Second, the likelihood of tensification can be conditioned by phonological factors (Zuraw 2011, Ito 2014, S. Kim 2016), morphosyntactic factors (Ahn 1985, Woo 2017, Kim 2017), and semantic factors (Kim 1996, Yun 2006). This study is mainly concerned with the effect of the laryngeal features contained in a non-adjacent consonant out of phonological factors.

Zuraw (2011) reported by analyzing a Korean corpus that the presence of a tense consonant influences compound tensification. Since then, a series of studies have tested the LCR effect in Korean. Ito (2014) showed that tense and aspirated consonants tend to lower the rate of compound tensification regardless of whether they belong to the first or the second component of the compound (W_1 or W_2), by conducting a judgment experiment and wug tests with Yanbian speakers. For example, when W_2 contains a tense or an aspirated consonant, the tensification rate was 43% and 44%, respectively, which was significantly lower than when W_2 contains only lax or sonorant consonants (58%). S. Kim (2016) replicated a judgment test with 21 Seoul Korean speakers for 304 compound nouns. The tensification rate differed depending on the consonant type of W_2. As with Ito (2014), tense (31.3%) and aspirated (31.1%) consonants in W_2 triggered tensfication less than did lax consonants in W_2 (59.7%). However, the consonant type of W_1 did not affect the rate of tensification in contrast to Ito's (2014) study. Thus, in this study, we will focus on the LCR effect of a consonant in W_2. By doing so, we can compare the regressive LCR effect between compound tensification and word-initial tensification.

---

sonorant, e.g., /pak-to/ [pakt'o] 'gourd too' vs. /pal-to/ [paldo] *[palt'o] 'foot too'.

1.2 Word-initial tensification in Korean

A lax consonant is always tensified after an obstruent in word-medial position in Korean. Unlike productive post-obstruent tensification, word-initial tensification sporadically occurs to intensify the meaning of the word as exemplified in (2).

(2) Word-initial tensification in Korean

a. tɕak-	'small'	[tɕak] ~ [**tɕ'**ak]
b. kam-	'to shampoo'	[kam] ~ [**k'**am]
c. sonaki	'squall'	[sonagi] ~ [**s'**onagi]

Word-initial tensification is similar to compound tensification in many ways. To begin with, it exhibits the strong lexical effect[3]. For some words, tensified forms are almost lexicalized although the word-initial consonants are still written as lax (e.g., <tɕalɯ-> 'to cut' [tɕ'arɯ-])[4]. Besides the lexical effect, word-initial tensification is also conditioned by phonological (Park 2000, Wee 2008, Kang and Oh 2016, H. Kim 2016), morphosyntactic (Kang 2001), and sociolinguistic factors (Lee 1989, Han 2011, 2013). Among these, we will focus on the effect of laryngeal features in word-initial tensification and compare it with that in compound tensification.

Kang and Oh (2016) showed that the rate of word-initial tensification was raised when the word-initial lax consonant is followed by a tense onset by conducting a judgment survey in which 39 Korean speakers rated the likelihood of word-initial tensification of 196 Korean words. The same tendency was found in loanwords (H. Kim 2016, Oh 2017). In H. Kim's (2016) study, 20 Korean speakers chose the word-initial tense stops more frequently when the following onset was also a tense (33.8%) than it was a lax (8.7%), an aspirated (13.8%), or a sonorant (7.0%) for 310 English loanwords[5].

---

[3] Although compound tensification is restricted to compound nouns, word-initial tensification can occur in other lexical categories. Actually, verbs and (predicative) adjectives are known to be more prone to word-initial tensification than are nouns (Kang 2001, Han 2011, Kang and Oh 2016). But this study deals only with word-initial tensification of nouns for the comparison with compound nouns.

[4] For this reason, we tried to minimize the lexical effect in selecting the stimuli and the statistical analysis model.

[5] English voiced stops are adapted as lax in Korean. However, the word-initial voiced stop can

1.3 Research questions

We will first schematize the laryngeal effect shown in compounds and simplex words in (3) before presenting research questions.

(3) Schematization of the laryngeal effect

a. Compound [W_1 + [C_1V_1 (C).C_2V_2 (C)…$]_{W2}]_{Compound}$

b. Simplex word [C_1V_1 (C).C_2V_2 (C)…$]_{Simplex\ Word}$

↑ ↑

target factor

In (3a) and (3b), C_1 (W_2-initial consonant in compound and simplex word-initial consonant) is the target of tensification. We have shown that the tensification rate is influenced by the type of C_2 (factor) differently between compound tensification and word-initial tensification, specifically when C_2 is laryngeally marked (tense or aspirated). Table 1 summarizes the finding discussed in previous subsections.

Table 1. Effects of the following tense and aspirated consonants on tensification rate
(▲ indicates raising the rate and ▼ lowering the rate.)

C_2	Compounds			Simplex words	
	Ito (2014)		S. Kim (2016)	Kang and Oh (2016)	H. Kim (2016)
	real	nonce	real	real	real (loan)
tense	▼	▼	▼	▲	▲
aspirated	▼	▼	▼	-	-

It is clear that a tense C_2 affects the rate of tensification in the opposite way between compound tensification and word-initial tensification. Such a finding raises some questions about LCR in Korean. First, is it true that the rates of compound and word-initial tensification are affected by the following tense consonant differently? In this study, we will conduct a survey to confirm the asymmetric patterns of LCR in compound tensification and word-initial tensification since no study has ever been done to investigate them together in light of LCR.

---

be loaned as either a lax or a tense stop in Korean, e.g., [poi]~[p'oi] 'boy'.

Second, what motivates the different patterns of the tense consonant effect in compound tensification and word-initial tensification? The asymmetric pattern of LCR between compound tensification and word-initial tensification should inform our understanding of how perception and production work together to produce a segment. It has been known that LCR may be not only absolute but also gradient in the lexicon (Frisch et al. 2004, Ito 2014, Kang and Oh 2016). Given the quantitative results from the survey, we will investigate how the asymmetric pattern of LCR can be explained in terms of perception and production. Furthermore, we will look into other factors, such as Korean-specific and typological lexical patterns, to understand the tense consonant effect in the two types of tensification.

2. Judgment survey

2.1 Method

A judgment survey was conducted to confirm the conflicting patterns of the tense consonant effect between compound tensification and word-initial tensification in Korean. Since the lexical effect is strong in both tensification processes, it is very important to set up a set of stimuli that is balanced with the tendencies of words as well as the potential phonological factors mentioned above. For compounds, we selected 120 compounds as shown in Table 2.

Table 2. Distribution of C_1 and C_2 of W_2 for compound stimuli[6]

C_1	C_2				
	lax	tense	aspirated	nasal	total
/p/	11	3	3	4	21
/t/	9	7	4	6	26
/tɕ/	13	5	7	3	28
/s/	1	5	0	2	8
/k/	10	6	8	13	37
total	44	26	22	28	120

[6] Compounds were excluded if the C_2 of W_2 is liquid or vocoid in order to focus on tense and aspirated. Also, compounds whose first component ends with an obstruent were also excluded because an obstruent automatically tensifies the following lax consonant.

A lax consonant was the most frequent C_2 (44 stimuli), because it was included as control. Given that LCR is also effective in nonce words (Ito 2014), 60 nonce compound words were created for the survey, with three monosyllabic real words combined with 20 bisyllabic nonce words[7]. They were expected to show the patterns more explicitly, if any, because they were perfectly balanced with the laryngeal features of C_2. Finally, 100 simplex words were selected from the data of the previous studies (Lee 1989, Park 2000, Han 2011, etc.) with the same criteria as those for compounds. In order to avoid the morphological effect and to make them consistent with compounds, simplex words were all nouns.[8] Because a pilot study showed that the rate of word-initial tensification is much lower than that of compound tensification, the data for the survey included only simplex words that show the tendency of word-initial tensification in the previous studies[9]. Nonce words were not included for simplex words in the survey[10].

Table 3. Distribution of C_1 and C_2 for simplex word stimuli

C_1	C_2						
	lax	tense	aspirated	nasal	liquid	vocoid	total
/p/	3	3	2	0	0	2	10
/t/	2	1	0	2	2	1	8
/tɕ/	7	8	2	1	1	1	20
/s/	11	6	7	8	2	3	37
/k/	8	6	4	6	0	1	25
total	31	24	15	17	5	8	100

Stimuli were given in Hangeul (the Korean writing system) in a random order in each set (real compounds, nonce compounds, and simplex words) differently for each

---

7 They were <san> 'mountain', <kaŋ> 'river', and <mul> 'water', which are frequently combined with the names of animals and plants in Korean.

8 Adverbs and verbs showed a higher rate of word-initial tensification than did adjectives and nouns without significance (Kang and Oh 2016).

9 However, 31 simplex words showed a rate of tensification below 5% in the survey.

10 Nonce simplex words were tested in the pilot study. 100 nonce words were created and 10 Korean speakers gave real words associated with each nonce word. In this way, 60 nonce words that had fewer associations with real words were selected for the survey. Since the results of nonce words showed no patterns (low tensification rate and no significant factors), nonce simplex words are not presented in this paper.

participant. The two pronunciations (lax and tensified) were given for each stimulus, and 40 Korean speakers in their 20's (14 male and 26 female) were asked to choose one of the three choices (lax, tensified, or both). All the participants were students at Chosun University in Gwangju. The 11,200 responses ((120+60+100)*40) were coded to 0 (lax) or 1 (tensified). Since 951 'both' responses were coded twice (0 and 1), 12,151 responses were subject to the statistical analysis with the following phonological factors.

(4) Phonological factors in statistics
  a. C_1_place: labial, coronal, dorsal
  b. C_1_manner: stop, affricate, fricative
  c. V_1_height: high, mid, low
  d. C_2_laryngeal: lax, tense, aspirated, nasal (for both), liquid, vocoid (only for simplex words)

Frequency effect was tested for real (compound and simplex) words. For compounds, in addition to the frequency of the compound, the frequency of W_2 itself and the frequency of W_2 in compounds were also obtained from the Sejong corpus (Kang and Kim 2009)[11]. For simplex words, only the frequency of the simplex word was considered. All the frequency values were log-transformed.

2.2 Results

2.2.1 Compound tensification: compounds

'Tensified form' was less likely to occur before the tense or aspirated onset than before the lax or nasal as shown in Figure 1.

[11] For example, the frequencies for a compound <son-kabaŋ> 'hand-bag' were 54 for <sonkabaŋ>, 1258 for <kabaŋ> as a single word, and 193 for the compounds containing <kabaŋ> as W_2 (e.g., <tɕʰɛk-kabaŋ> 'book-bag', <tɕʰʌl-kabaŋ> 'steel-bag', <son-kabaŋ> 'hand-bag', and so on).

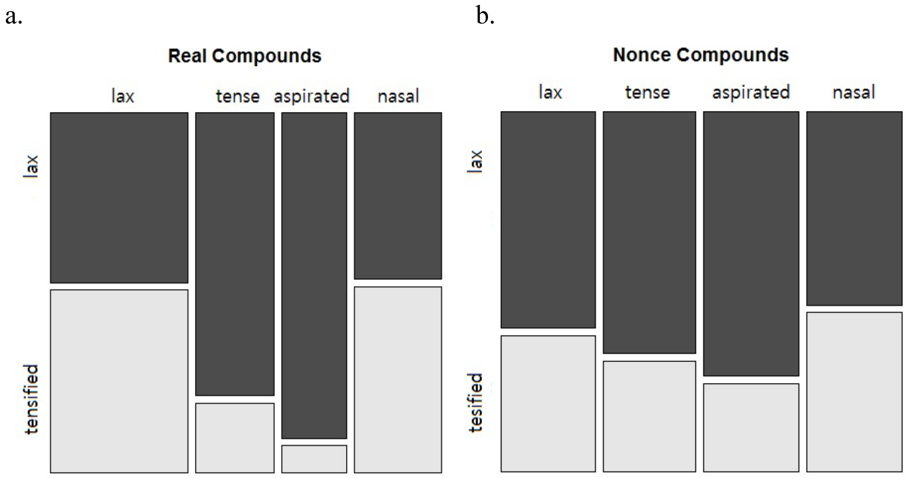

Figure 1. Mosaic plots of the responses as a function of the laryngeal features of the following onset: real and nonce compounds

For each group of words, phonological factors were tested with the random effects of speakers and words by the mixed effect model in R (lmerTest package). Tense and aspirated C_2 significantly lowered the tensification rate compared to lax C_2, but other effects were not significant as shown in Table 4.

Table 4. The results of mixed effect model: real compounds

Fixed effects:

	Estimate	Std.Error	z value	Pr(>|z|)	
(Intercept)	-0.08523	0.48384	-0.176	0.8602	
C2_laryngeal: aspirated	**-3.21472**	**0.42426**	**-7.577**	**3.53e-14**	***
C2_laryngeal: nasal	-0.07226	0.36019	-0.201	0.8410	
C2_laryngeal: tense	**-1.86021**	**0.38253**	**-4.863**	**1.16e-06**	***
C1_place: dor	0.67617	0.40892	1.654	0.0982	.
C1_place: lab	-0.68812	0.46679	-1.474	0.1404	
C1_manner: affricate	0.06583	0.41631	0.158	0.8744	
C1_manner: fricative	0.23540	0.59659	0.395	0.6932	
V1_height: low	0.29457	0.39651	0.743	0.4575	
V1_height: mid	-0.07835	0.37889	-0.207	0.8362	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1

The effects of tense and aspirated consonants were also confirmed in the nonce data, too. Tense and aspirated C_2 significantly affected the tensification in a negative way, but nasal in a positive way with a marginal significance as shown in Table 5[12].

Table 5. The results of mixed effect model: nonce compounds

Fixed effects:

	Estimate	Std.Error	z value	Pr(>|z|)	
(Intercept)	-0.8866	0.2648	-3.348	0.000813	***
C2_laryngeal: aspirated	**-0.8624**	**0.2057**	**-4.193**	**2.75e-05**	***
C2_laryngeal: nasal	0.3799	0.1977	1.921	0.054680	.
C2_laryngeal: tense	**-0.4201**	**0.2013**	**-2.087**	**0.036876**	*
C1_place: dor	0.1225	0.2287	0.535	0.592413	
C1_place: lab	-0.1959	0.2303	-0.850	0.395171	
C1_manner: affricate	0.2972	0.2263	1.313	0.189041	
C1_manner: fricative	**1.3234**	**0.2244**	**5.898**	**3.67e-09**	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The fact that tense and aspirated consonant effects were stronger in real compounds than in nonce ones reaffirms that the lexical effect is still strong. Thus we took a further step to minimize the lexical effect and ruled out real compounds showing robust biases for or against tensification. So we excluded 43 words out of 120 real compounds (35.8%), whose tensification rate was too low (below 10%) or too high (above 90%). Figure 2 shows that tense and aspirated consonant effects are real even after we excluded the compounds with solid lexical effects. Tense and aspirated C_2 significantly lowered the tensification rate more than lax C_2 did ($p<.001$ for each), but other effects were not significant except for 'C1_place: lab'[13].

[12] Fricative C_1 is more subject to compound tensification ($p<.001$). Such 'fricative' effect was not evidenced in real compounds. We leave the explanation for that for further study.

[13] Labial lax consonants underwent tensification less often than coronal ones in nonce compounds ($p<.05$).

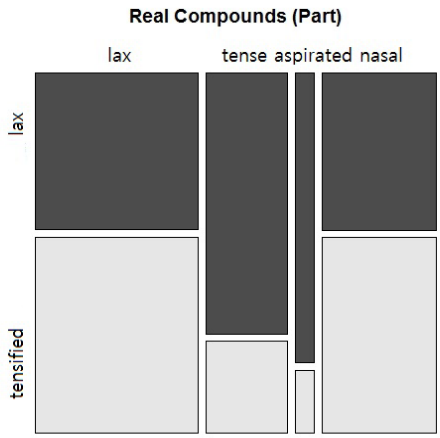

Figure 2. Mosaic plots of the responses as a function of the laryngeal features of the following onset: 77 real compounds with variable tensification

2.2.2 Word-initial tensification: simplex words

Simplex words showed a different pattern from compounds in terms of the laryngeal consonant effect. In comparison to lax C_2 (and nasal C_2), tense and aspirated C_2's affect word-initial tensification in the opposite direction. Aspirated C_2 tends to lower the rate of word-initial tensification but tense C_2 tends to raise it as shown in Figure 3a. In order to minimize the lexical effect, we excluded 31 words out of 100 words, whose tensification rate was below 5%. The result for the part of simplex words is shown in Figure 3b[14].

[14] If we exclude words with tensification rate below 10% or above 90%, only 51 words are left. There was no word whose tensification rate was above 95%.

a. b.

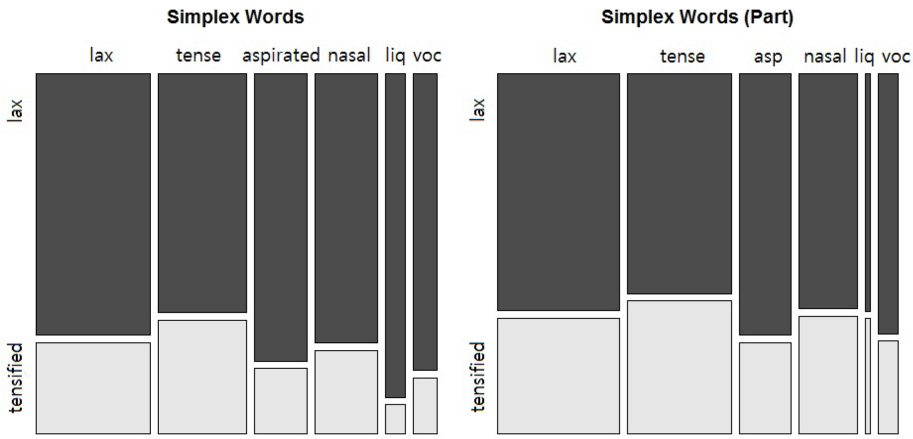

Figure 3. Mosaic plots of the responses as a function of the laryngeal features of the following onset: all simplex words and part of simplex words

Figure 3 shows that the effects of tense and aspirated consonants on word-initial tensification are not very different. Although it shows some tendency of laryngeal co-occurrence restriction, the tendency was not confirmed by a statistical analysis. The rate of tensification was significantly lower when C_2 was liquid and higher when C_1 was an affricate or a dorsal stop[15]. Considering that the tense consonant effect was marginally significant in a simple logistic regression model (p=.056), this mixed effect model seems to have removed the lexical effect by setting apart the random effects.

[15] The 'liquid' and 'dorsal' effects are attributed to the lexical effect since they were not significant in the partial data (69 words showing variation). Discussing these effects is beyond the topic of this paper.

Table 6. The results of mixed effect model: simplex words

Fixed effects:					
	Estimate	Std.Error	z value	Pr(>|z|)	
(Intercept)	-2.8317	0.7476	-3.788	0.000152	***
C2_laryngeal: aspirated	-0.6029	0.5425	-1.111	0.266408	
C2_laryngeal: liquid	-1.6344	0.8182	-1.998	0.045768	*
C2_laryngeal: nasal	-0.1045	0.5270	-0.198	0.842849	
C2_laryngeal: tense	0.3569	0.4575	0.780	0.435313	
C2_laryngeal: vocoid	-0.7087	0.7652	-0.926	0.354402	
C1_place: dor	1.6067	0.7364	2.182	0.029120	*
C1_place: lab	-0.3695	0.8932	-0.414	0.679104	
C1_manner: affricate	1.5157	0.7600	1.994	0.046110	*
C1_manner: fricative	0.9596	0.7089	1.354	0.175880	
V1_height: low	-0.3168	0.5053	-0.627	0.530735	
V1_height: mid	0.1427	0.4584	0.311	0.755551	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

2.2.3 An analysis of MaxEnt Grammar

The mixed effect model gave birth to contrasting results for the tense consonant effect between compound tensification and word-initial tensification although the tense consonant effect in simplex words was not significantly salient. To prove that tense consonants behave differently depending on word groups, we present an analysis using the MaxEnt Grammar Tool (Hayes and Wilson 2008. The MaxEnt model accounts for grammars with free variation based on constraint violations. To compare word groups, the responses were submitted to the MaxEnt Grammar Tool with a set of constraints proposed by Ito (2014) and S. Kim (2016). Assuming that every compound has the so-called 'sai-siot' inserted between the two components, compound tensification is interpreted as the realization of 'sai-siot', which is driven by the constraint RealizeMorpheme. This constraint competes with Ident[laryngeal], which is violated by tensification. Other constraints, except for *Tense/LowFrequency, are all about the effect of the following onset. For example, *Tense/_Tense is violated when tensification takes place before the tense onset. Table 7 shows the results of constraint weights calculated by the MaxEnt Grammar Tool.

Table 7. The constraint weights calculated by MaxEnt Grammar Tool

	Compounds			Simplex Words	
	Real		Nonce	Real	
	All	Part	All	All	Part
RealizeMorpheme	0.27	0.40	0	N.A.	N.A.
Ident[laryngeal]	0	0	0.16	0.83	0.48
*Tense/_Tense	1.36	1.13	0.45	0	0
*Tense/_Aspirated	2.51	1.69	0.77	0.53	0.33
*Tense/_Nasal	0	0	0	0.20	0
*Tense/_Liquid	N.A.	N.A.	N.A.	1.48	0.24
*Tense/_Vocoid	N.A.	N.A.	N.A.	0.70	0.31
*Tense/LowFrequency	0.60	0.52	N.A.	0	0

Two findings can be drawn from the results of constraint weights in Table 7. First, ‘*Tense/_Aspirated’ constraint is effective in every group, though the relative weights are different. That is, the aspirated C_2 lowers the rate of tensification of the preceding lax C_1 regardless of the morphological categories. However, ‘*Tense/_Tense’ constraint is valid only for compounds, and tensification is not impeded by the following tense C_2 in simplex words. Hence compound and simplex words in Korean have different grammars in terms of LCR. Second, ‘RealizeMorpheme’ is not effective for nonce compounds, which suggests that compound tensification basically depends on lexical items.

To summarize the results, the statistics confirmed that the tense consonant effect in compounds is dissimilatory. But in simplex words, the tense consonant effect is marginally assimilatory. Furthermore, the aspirated consonants consistently showed a dissimilatory effect in both compounds and simplex words, though it was not significant in simplex words. In other words, *Tense/_Tense constraint is effective only in compounds, whereas *Tense/_Aspirated constraint is valid throughout all groups of words. We will discuss what these results suggest in the next section, focusing on the asymmetry of tense consonant effects.

3. Discussion

We will first discuss the different tense consonant effects from the viewpoints of perception and production. Then we will move on to the aspirated consonant effect which is observed in both compound and word-initial tensification.

3.1 The tense consonant effect

3.1.1 The perception-based account

We have shown that a tense consonant affects the emergence of another tense consonant in *different* ways in *different* domains. We contend that the tense consonant effect, which is a part of LCR in Korean, is domain-specific. In other words, compound tensification and word-initial tensification may have different motivations. To begin with, compounds differ from other morphosyntactic units cross-linguistically. A compound is different from a simplex word in that it consists of two or more lexeme bases and from a syntactic phrase in that it is also a lexeme (Bauer 2006)[16]. For this reason, languages apply different phonological processes to make compounds distinguishable from other morphological categories (Vogel 2010: 151). For example, stress is assigned in compounds differently from how it is assigned in single words or phrases in English. Compounds are marked phonologically through various ways across languages as given in (5).

(5) Phonological strategies for compounds[17]
  a. Manipulation of prosody: English and Dutch (compound stress rule: Chomsky and Halle 1968, Hayes 1984, Selkirk 1984, Vogel 2010), Japanese (compound accent rule: Kubozono 2008), Hausa (tone lowering: McIntyre 2006)
  b. Insertion of a linking element: German and Dutch (schwa insertion: Wiese 1986, Neijt and Schreuder 2007).
  c. Change of an edge sound: Marathi (nasalization: Pandharipande 1997), Hausa (final vowel lengthening: McIntyre 2006), Japanese (voicing of consonant: Ito and Mester 1986, 1998, 2003)

If compound tensification results from 'sai-siot' insertion[18], Korean would belong

---

[16] For the definitions and general characteristics of compounds, see Scalise and Vogel (2010).
[17] Of course, the phonological processes in (5c) do not occur word-internally in the language in question.

to the type in (5b) but the type in (5c), otherwise. In either case, compound tensification is construed as a means to make a compound phonetically distinguishable from other morphosyntactic units, in particular from simplex words. In other words, compound tensification takes place to make sure that the compound is perceptually distinct from the simplex words that compose it. This view is in line with Woo (2017), who argues that non-phonological tensification, including compound tensification, occurs in order to mark syntactic boundaries and is blocked when the tensification cannot resolve the problem of a homonym. That is to say, tensification is to intensify the differentiation of words in Korean.

The frequency effect supports this perception-based account. According to this account, it is expected that the more frequently a compound is used, the more likely compound tensification is to occur in order to make it independent of its components. According to Kim (2017), even in compounds with the structure of [[N_3-N_1]-N_2], the initial consonant of N_2 tends to remain tensified when the frequency of the compound [N_1-N_2] is high (e.g., *urum-sori* 'crying sound' in *agi-urum-sori* 'baby crying sound'). We also examined the effect of frequency in our data.

Table 8. The results of mixed effect model: frequency effect (other factors omitted)

Fixed effects:					
	Estimate	Std.Error	z value	Pr(>|z|)	
Compounds					
logC	0.25640	0.25970	0.987	0.3235	
logW_2	-0.50415	0.37550	-1.343	0.1794	
logW_2inC	0.91866	0.43916	2.092	0.0365	*
Simplex Words					
logW	-0.80354	0.05955	-13.493	< 2e-16	***

The effect of frequency of compounds turned out to be insignificant. However, the

[18] In Middle Korean, *sai-siot* functioned as an adjectivizer, which attaches to phrases and sentences, as well as to nouns (Huh 1983). So *sai-siot* in Modern Korean could be regarded as an adjectivizer to attach to a noun (the first component of a compound) to make it an adjective. In compounds consisting of an adjective and a noun, *sai-siot* never appears (e.g., tɕʰam-ke [tɕʰamge] 'horse-shoe crab', tɕʰam-sɛ [tɕʰamse] 'sparrow', tɕʰam-kirɯm [tɕʰamgirɯm] 'sesame oil').

frequency of W_2 in compounds affects the rate of tensification in a positive way[19]. The more frequently used a word is as W_2 of a compound, the more likely the initial lax consonant is to be tensified, presumably to make the compound more distinguishable. In other words, the independence of a compound from its head noun is fortified in such a case and 'RealizeMorpheme' constraint is more required. This is consistent with the result of the frequency of W_2, which affects the tensification rate in the opposite direction. If W_2 is frequently used by itself, the independence of a compound would be weakened and the rate of tensification will be lowered.

Given that compound tensification is to make compounds independent of simplex words, compound tensifiction before another tense consonant may not serve the purpose for the following reason. A sequence of tense consonants is overrepresented in the first two syllables in the Korean lexicon, which motivates word-initial tensification to occur more when the following onset is also a tense consonant (Kang and Oh 2016)[20]. Consequently, if compound tensification takes place before a tense consonant, then the second component of a compound could be parsed as a simplex word as opposed to the second component of a compound word. In other words, compound tensification is avoided when tensification could make it possible to treat the second component of a compound word as the simplex word. Likewise, the asymmetry between compound and word-initial tensification in the tense consonant effect can result from the need to perceptually distinguish the second component of a compound word from a simplex word.

The asymmetric pattern of the tense consonant effect between compound tensification and word-initial tensification can also be attributed to a general perceptual bias. A repeated appearance of a feature in a domain may cause confusion in perception and eventually in processing (Frisch et al. 2004), specifically when the acoustic cue of the feature is elongated as in Figure 4b. If the acoustic cue of C_2 overlaps with that of C_3, the acoustic signals of C_2 might be attributed to C_3 and vice versa (Ohala 1981, 1993, 2003, Blevins 2004). Then, the acoustic signals would be mapped to one consonant.

---

[19] Baayen et al. (2010) also show that head compound family size (the frequency of compounds containing a specific head), rather than head (W_2) frequency, turned out to be effective in lexical decision.

[20] In the Standard Korean Pronunciation Dictionary (Lee 2002), the O/E ratio of tense-tense pairs in the first two syllables of words is 2.35, whereas it is 1.22 in general (Kang and Oh 2016).

$C_1\ V_1$ (C) $C_2\ V_2$ (C) $C_3\ V_3$ (C) …
a. short acoustic cue

$C_1\ V_1$ (C) $C_2\ V_2$ (C) $C_3\ V_3$ (C) …
b. long acoustic cue

Figure 4. Repeated appearance of a feature in a word

In general, the acoustic features of laryngealization is known to be extended (Ladefoged et al. 1988). Specifically, Korean tense consonants are characterized by short VOT and high F0 (Han 1996, Cho et al. 2002, Kim 2004, etc.) and high F0 is extended to the adjacent syllable (Kang 2014). Then it follows that the perceptual effect of tensification can be minimized by the following tense onset.

In contrast to compound tensification, word-initial tensification is rather likely to occur before a tense consonant. Word-initial tensification does not create a new word but just emphasizes the meaning of a word. Thus, it does not aim to make a great perceptual difference between the input and the output. As a result, the following tense consonant does not impede word-initial tensification. Likewise, the different motivations between compound tensification and word-initial tensification are evidenced by the frequency effect in Table 8 given above. The frequency of simplex words was *negatively* related to the rate of word-initial tensification (p<.001), whereas frequent compounds are *more likely* to go through tensification, as claimed by Kim (2017)[21].

To summarize, compound tensification intends to create an independent word, whereas word-initial tensification is intended only to intensify the word. So compound tensification is prohibited when it cannot give birth to a perceivable difference from its components but word-initial tensification is allowed. Also, the more frequently used a compound is, the more it needs to be perceptually distinct from its components. But frequently used simplex words do not need this perceptual enhancement[22]. Rather, they tend to resist changes that ~~are *not* phonologically driven and~~ to experience reduction (Bybee 2001, 2002).

[21] Though it was not significant, the frequency of compounds and the tensification rate were correlated in a positive way in our study, too.

[22] Lee (2007) argues that word-initial tensification is "motivated to carry out perceptual enhancement at the left-edge of words".

3.1.2 The production-based account

We have discussed how the tense effect paradox can be accounted for from the viewpoint of perception in the previous subsection. From now on, we will take the production-based account into consideration to account for the asymmetry of tense effects. Two consecutive marked features would require more articulatory energy, which is not generally preferred by speakers. For example, Gallagher (2011) proposed the Generalized Obligatory Contour Principle [long VOT], which prohibits two [long VOT] segments in a root. However, Korean tense stops show the shortest VOT, and only aspirated ones the longest VOT. Given that tense consonants are equally avoided before another tense consonant or an aspirated consonant, we can ask the following question. What do tense and aspirated stops have in common in Korean? Both stops surface with long closure duration and high F0 (Oh and Johnson 1997, Choi and Jun 1998). In addition, they shorten the adjacent vowels as shown in Table 9. As a result, vowel-to-vowel duration (V_1 + closure + VOT) is longer (247.79 ms for /p'/ and 282.64 ms for / p^h/) than that of lax (206.6 ms). According to Steriade's (2012) Interval Theory, the V-to-V interval explains "how metrical quantity is computed: why heavy positions are defined by what follows the vowel and not what precedes it".

Table 9. Durations of V_1, closure, VOT (in ms, Choi and Jun 1998: 533)[23]

	V_1	closure	VOT	V-to-V interval
/p/	123.69	66.37	16.54	206.60
/p'/	87.62	148.02	12.15	247.79
/p^h/	89.14	118.48	75.02	282.64

If we accept the V-to-V interval as a phonological unit, OCP [long V-to-V interval] can account for the asymmetry of tense consonant effects[24]. If compound tensification occurs when followed by a tense consonant, two consecutive long V-to-V intervals are inevitable.

---

[23] Though V_2 is the longest after lax consonants in Choi and Jun 1998, vowels are longer after tense consonants than after lax consonants in other studies (Choi 2011, Lee 2018, etc.).

[24] Oh and Kim (2017) showed that VOTs of lax and aspirated C_1s are shorter before tense and aspirated C_2s, which phonetically evidences this constraint.

(6) Compound tensification: Violation of OCP [long V-to-V interval]

$[\ [C_1V_1\ (C).C_2V_2\ (C)]_{W1}+[C_1V_1\ .\underline{\mathbf{C_2'}}V_2\ \ldots]_{W2}]_{Compound}$

Long Interval

↓ compound tensification

$[\ [C_1V_1\ (C).C_2V_2\ (C)]_{W1}+[\underline{\mathbf{C_1'}}V_1\ .\underline{\mathbf{C_2'}}V_2\ \ldots]_{W2}]_{Compound}$

Double Long Intervals

However, word-initial tensification is not governed by this constraint since there is no vowel preceding the tensified word-initial consonant. Then, this constraint does not exert any influence on word-initial tensification. This is consistent with the fact that tense-tense pairs are more frequently found in the first two syllables in the Korean lexicon[25].

(7) Word-initial tensification: Invalidity of OCP [long V-to-V interval]

$[C_1V_1.\underline{\mathbf{C2'}}V2\ (C)\ldots]_{Simplex\ Word}$

Long Interval

↓ word-initial tensification

$[\underline{\mathbf{C1'}}V1.\underline{\mathbf{C2'}}V2\ (C)\ldots]_{Simplex\ Word}$

Single Long Interval

Now we can say that the asymmetry of tense consonant effects is attributed to the morphosyntactic status and the phonological traits of compounds. On the one hand, compounds should be perceptually distinguishable from simplex words, which results in less frequent tensification when tensification does not give birth to the independence of its component or a noticeable prominence (i.e., before another tense). On the other hand, the two components should be phonetically linked as a one word and thus, the tensification is restricted by OCP [long V-to-V interval] because it occurs in the middle of a compound.

These accounts apply not only to the tense consonant effect, but also to the aspirated consonant effect. Since the aspirated consonants have long V-to-V intervals as seen in Table 9, compound tensification is prevented before aspirated consonants by the OCP [long V-to-V interval] constraint. From the perspective of perception,

---

[25] The O/E ratio is 2.35 in the first two syllables, but 1.08 in the second and third syllables (Kang and Oh 2016).

tense consonants might not be as prominent before aspirated consonants as before lax, for example, because aspirated consonants are also laryngeally marked in Korean. This will be discussed in the next section, in order to answer the remaining question about why aspirated consonants prevent word-initial tensification though word-initial tensification is free from the OCP[long V-to-V interval] constraint.

3.2 The aspirated consonant effect

Unlike tense consonants, aspirated consonants uniformly block tensification of the lax consonants regardless of whether the lax consonants belong to compounds or simplex words. This is not surprising considering the typological patterns of LCR. Typological restrictions on the cooccurrence of laryngeal features (MacEachern 1999) were categorized by Gallagher (2010) as follows:

(8) Long-distance laryngeal restrictions

(T and K stand for obstruents with different places of articulation and ’ laryngeally marked feature.)[26]

a. Dissimilation type (Shuswap, Souletin Basque)

*T’-K’	T’-K	T-K
*T’-T’	T’-T	T-T

b. Assimilation type (Zulu, Kalabari Ijo)

T’-K’	*T’-K	T-K
T’-T’	*T’-T	T-T

In a dissimilation type language, a marked feature can appear only once in a domain, whereas in an assimilation type a marked feature must appear whenever it is available. Aspirated consonants, which are marked, would prohibit the emergence of a tense consonant, whether Korean has a dissimilatory or an assimilatory constraint. An existing aspirated consonant would block tensification which gives rise to another laryngeally marked consonant under a dissimilatory constraint. Assuming that Korean has an effective assimilatory constraint, an aspirated consonant in a word would cause a lax consonant to be an aspirated one, rather than a tense one. This way, the typology of LCR predicts that aspirated consonants would block tensification.

[26] Mixed type is omitted because it is not relevant here.

The Korean lexicon partially supports this argument. Aspirated-tense pairs are underrepresented (O/E ratio = 0.81) though tense-aspirated ones are not (O/E ratio = 1.02). So we argue that the avoidance of tensification before an aspirated consonant is attributed to the cross-linguistic tendencies of LCR.

4. Conclusion

We showed that a tense consonant influences the emergence of another tense consonant positively in word-initial tensification but negatively in compound tensification by conducting a survey. We suggested two possible reasons why a tense consonant behaves differently depending on the morphosyntactic categories where tensification occurs. One possible reason can be found from the perception perspective. On the one hand, since compound tensification functions to perceptually differentiate a compound from simplex words (and phrases), it is *less* likely to occur when the output of compound tensification ends up with a shape that is preferred in simplex words (tense-tense pairs). It is also *less* likely to occur when the perceptual effect is minimal (before another tense). On the other hand, word-initial tensification does not create a new word but intensifies the meaning of a simplex word. Then it is *more* likely to occur when the perceptual effect is minimal. Likewise, word-initial tensification and compound tensification are motivated to meet different purposes. Then, the tense consonant effect functions differently according to perceptual outcomes.

The tense consonant paradox can also be accounted for by a production mechanism. Since compound tensification takes place in the middle of compounds, it inevitably produces a sequence of long vowel-to-vowel intervals, which does not comply with 'ease of articulation.' However, word-initial tensification is exempt from this problem because the newly created tense consonant does not have a preceding vowel and is not subject to the articulatory constraint. Whereas LCR or OCP has been studied either from the viewpoint of perception (Frisch et al. 2004) or from the viewpoint of production (Gallagher 2011), we shed a new light on LCR by taking the tense consonant effect into consideration from both views. It still remains to test whether the accounts provided in this paper can be proved through production and perception experiments. We leave that work for further study.

REFERENCES

AHN, SANG-CHEOL. 1985. *The Interplay of Phonology and Morphology in Korean.* PhD Dissertation. University of Illinois.

BAAYEN, R. HARALD, VICTOR KUPERMAN and RAYMOND BERTRAM. 2010. Frequency effects in compound processing. In Sergio Scalise and Irene Vogel (eds.). *Cross-Disciplinary Issues in Compounding*, 257-270. Amsterdam: John Benjamins.

BAUER, LAURIE. 2006. Compounds and Minor Word-formation Types. In Bas Aarts and April McMahon (eds.). *The Handbook of English Linguistics*, 483-506. Malden: Wiley-Blackwell.

BLEVINS, JULIETTE. 2004. *Evolutionary Phonology*: *The Emergence of Sound Patterns*. Cambridge: Cambridge University Press.

BYBEE, JOAN. 2001. *Phonology and Language Use*. Cambridge: Cambridge University Press.

BYBEE, JOAN. 2002. Word frequency and context of use in the lexical diffusion of phonetically conditioned sound change. *Language Variation and Change* 14, 261-290.

BYE, PATRIK. 2011. Dissimilation. In Marc van Oostendorf, Colin J. Ewen, Elizabeth Hume and Keren Rice (eds.). *The Blackwell Companion to Phonology Volume III*, 1408-1433.

CHO, TAEHONG, SUN-AH JUN and PETER LADEFOGED. 2002. Acoustic and aerodynamic correlates of Korean stops and fricatives. *Journal of Phonetics* 30, 193-228.

CHOI, HANSOOK. 2011. Vowel duration as a perceptual cue for preceding stop laryngeal contrast in Korean. *ICPhS* 17, 484-487.

CHOI, SEONGWON and JONGHO JUN. 1998. Are Korean fortis and aspirated consonants geminates? *Language Research* 34, 521-546. Language Education Institute. [Written in Korean]

CHOMSKY, NOAM and MORRIS HALLE. 1968. *The Sound Pattern of English*. New York: Harper and Row.

FRISCH, STEFAN A., JANET B. PIERREHUMBERT and MICHAEL B. BROE. 2004. Similarity avoidance and the OCP. *Natural Language and Linguistic Theory* 22, 179-228.

GAFOS, ADAMANTIOS I. and AMANDA DYE. 2011. Vowel Harmony: Opaque and

Transparent Vowels. In Marc van Oostendorf, Colin J. Ewen, Elizabeth Hume and Keren Rice (eds.). *The Blackwell Companion to Phonology Volume IV*, 2164-2189.

GALLAGHER, GILLIAN. 2010. Perceptual distinctness and long-distance laryngeal restrictions. *Phonology* 27, 435-480.

GALLAGHER, GILLIAN. 2011. Acoustic and articulatory features in Phonology: the case for [long VOT]. *The Linguistic Review* 28, 281-313.

GOLDSMITH, JOHN A. 1976. *Autosegmental Phonology*. PhD Dissertation. MIT.

HAN, JEONG-IM. 1996. *The Phonetics and Phonology of "Tense" and "Plain" Consonants in Korean*. PhD Dissertation. Cornell University.

HAN, MYEONG-SUK. 2011. *A Study on the Word-initial Glottalization in Korean*. PhD Dissertation. Konkuk University. [Written in Korean]

HAN, MYEONG-SUK. 2013. A study on the word-initial glottalization reflected in Korean predicate. *Gyeoreeomunhak* 51, 639-672. [Written in Korean] Gyeoreeomunkakhoe.

HAYES, BRUCE. 1984. The Phonology of Rhythm in English. *Linguistic Inquiry* 15, 33-74.

HAYES, BRUCE and COLIN WILSON. 2008. A maximum entropy model of phonotactics and phonotactic learning. *Linguistic Inquiry* 39, 379-440.

HUH, WOONG. 1983. *Gugeohak (Korean Linguistics)*. Seoul: Saemmunhwasa.

ITO, CHIYUKI. 2014. Compound tensification and laryngeal co-occurrence restrictions in Yanbian Korean. *Phonology* 31, 349-398.

ITO, JUNKO and ARMIN MESTER. 1986. The Phonology of Voicing in Japanese: Theoretical Consequences for Morphological Accessibility. *Linguistic Inquiry* 17, 49-73.

ITO, JUNKO and ARMIN MESTER. 1998. *Markedness and Word Structure: OCP Effects in Japanese*. Ms. University of California, Santa Cruz.

ITO, JUNKO and ARMIN MESTER. 2003. *Japanese Morphophonemics: Markedness and Word Structure*. Cambridge, Mass.: MIT Press.

KANG, BEOMMO and HONGGYU KIM. 2009. *Hangukeo Sayongbindo (Frequency of use in Korean)*. Seoul: Hankookmunhwasa. [Written in Korean]

KANG, HIJO and MIRA OH. 2016. Dynamic and static aspects of laryngeal co-occurrence restrictions in Korean. *Studies in Phonetics, Phonology and Morphology* 22.1, 3-34. The Phonology-Morphology Circle of Korea.

KANG, HUISUK. 2001. A sociolinguistic study of language change and preservation.

Hangukeoneomunhak 46, 537-564. Korean Language & Literature. [Written in Korean]

KANG, YOONJUNG. 2014. Voice Onset Time merger and development of tonal contrast in Seoul Korean stops: A corpus study. *Journal of Phonetics* 45, 76-90.

KIM, CHANGSEOP. 1996. *Word formation and structure*. *Kugŏhak Chongsŏ 21*. Seoul: Taehaksa. [Written in Korean]

KIM, HYOJU. 2016. Contextual distribution of English loanword word-initial tensification in Korean. *Studies in Phonetics, Phonology and Morphology* 22.2, 245-288. The Phonology-Morphology Circle of Korea.

KIM, JIN-HYUNG. 2017. Morphologically-conditioned variations in tensification in triconstituent Korean noun compounds. *Studies in Phonetics, Phonology and Morphology* 23.3, 349-364. The Phonology-Morphology Circle of Korea.

KIM, MIDAM. 2004. Correlation between VOT and F0 in the perception of Korean stops and affricates. *Interspeech 2004*, 49-52.

KIM, SEOYOUNG. 2016. *Phonological Trends in Seoul Korean Compound Tensification*. MA Thesis. Seoul National University.

KRÄMER, MARTIN. 2003. *Vowel Harmony and Correspondence Theory*. Berlin: Mouton de Gruyter.

KUBOZONO, HARUO. 2008. Japanese Accent. In Shigeru Miyagawa and Mamoru Saito (eds.), *The Oxford Handbook of Japanese Linguistics*, 165-191. Oxford: Oxford University Press.

LADEFOGED, PETER, IAN MADDIESON and MICHEL T. T. JACKSON. 1988. Investigating phonation types in different languages. In Osamu Fujimura (ed.). *Vocal Physiology: Voice Production, Mechanisms and Functions*, 292-317. New York: Raven.

LEBEN, WILLIAM R. 1973. *Suprasegmental Phonology*. PhD Dissertation. MIT.

LEE, HYUN-BOK. 2002. *Standard Korean Pronouncing Dictionary*. Seoul: Seoul National University Press.

LEE, MI-JAE. 1989. *A Sociolinguistic Study of Language Change*. PhD Dissertation. Seoul National University. [Written in Korean]

LEE, PONGHYUNG. 2007. Three types of laryngeal feature adaptation in Korean secondhand loanwords. *Studies in Phonetics, Phonology and Morphology* 13.3, 521-537. The Phonology-Morphology Circle of Korea.

LEE, SEON HA. 2018. *Production of Korean Stops by Korean Learners: In Neutral Words and Focused Words*. PhD Dissertation. Chonnam National University.

MacEachern, Magaret R. 1999. *Laryngeal Co-occurrence Restrictions*. New York: Garland.

McCarthy, John J. 1979. *Formal Problems in Semitic Phonology and Morphology*. PhD Dissertation. MIT.

McCarthy, John J. 1981. A prosodic theory of nonconcatenative morphology. *Linguistic Inquiry* 12, 373-418.

McCarthy, John J. 1986. OCP effects: Gemination and antigemination. *Liguistic Inquiry* 17, 207-263.

McCarthy, John J. 1988. Feature geometry and dependency: A review. *Phonetica* 45, 84-108.

McIntyre, Joseph. 2006. *Hausa Verbal Compounds*. PhD Dissertation. University of Leiden.

Neijt, Anneke and Robert Schreuder. 2007. Rhythm versus Analogy – Prosodic Form Variation in Dutch Compounds. *Language and Speech* 50, 533-566.

Odden, David. 1988. Anti antigemination and the OCP. *Linguistic Inquiry* 19, 451-475.

Oh, Mira. 2017. The effect of Korean phonological constraints on tensification of English voiced stops. *The Linguistic Association of Korea Journal,* 25.2, 121-141. The Linguistic Association of Korea.

Oh, Mira and Keith Johnson. 1997. A phonetic study of Korean intervocalic laryngeal consonants. *Journal of Speech Sciences* 1, 83-101.

Oh, Mira and Dahee Kim. 2017. An asymmetric effect of the following laryngeal category on VOT in Korean. A paper presented at *ICKL* 20.

Ohala, John J. 1981. The listener as a source of sound change. *Chicago Linguistic Society* 17, 178-203.

Ohala, John J. 1993. The phonetics of sound change. In Charles Jones (ed.). *Historical Linguistics: Problems and Perspectives*, 237-278. London: Longman.

Ohala, John J. 2003. Phonetics and historical phonology. In Joseph Brian and Richard Janda (eds.). *The Handbook of Historical Linguistics*, 669-686. West Sussex: Wiley-Blackwell.

Pandharipande, Rajeshwari V. 1997. *Marathi*. London: Routledge.

Park, Chang-won. 2004. Diachrony and synchrony of Korean interval sound. *Study of Korean Language Education* 2, 531-565. The Korean Language Education Society in China. [Written in Korean]

PARK, DONG-GEUN. 2000. Word-initial tensification in Seoul Korean. *Eoneohak* 27, 179-200. [Written in Korean]. The Linguistic Society of Korea.

ROSE, SHARON and RACHEL WALKER. 2004. A typology of consonant agreement as correspondence. *Language* 80, 475-531.

ROSE, SHARON and RACHEL WALKER. 2014. Harmony Systems. In John A. Goldsmith, Jason Riggle, and Alan C. L. Yu (eds.). *The Handbook of Phonological Theory*, 240-290. West Sussex: Wiley Blackwell.

SCALISE, SERGIO and IRENE VOGEL. 2010. Why compounding? In Sergio Scalise and Irene Vogel (eds.). *Cross-Disciplinary Issues in Compounding*, 1-18. Amsterdam: John Benjamins.

SELKIRK, ELIZABETH O. 1984. *Phonology and Syntax: The Relation between Sound and Structure*. Cambridge, Mass and London: MIT Press.

STERIADE, DONCA. 2012. Intervals vs. syllables as units of linguistic rhythm. A paper presented at *EALING*, Paris.

VAN DER HULST, HARRY and JEROEN VAN DER WEIJER. 1995. Vowel harmony. In John A. Goldsmith (ed.). *The Handbook of Phonological Theory*, 495–534. Oxford: Blackwell Publishers.

VOGEL, IRENE. 2010. The phonology of compounds. In Sergio Scalise and Irene Vogel (eds.). *Cross-Disciplinary Issues in Compounding*, 145-163. Amsterdam: John Benjamins.

WEE, JIN. 2008. The Word-initial tensification of Jeollanamdo dialect. *Hangukeoneomunhak* 65, 111-135. [Written in Korean]. The Society of Korean Language and Literature.

WIESE, RICHARD. 1986. Schwa and the Structure of Words in German. *German Linguistics* 24, 697-724.

WOO, SOONJO. 2017. The Environments and Constraints of Phonologically Unconditioned Tensification in Modern Korean. *Eoneohak* 79, 159-191. The Linguistic Society of Korea.

YUN, SUNG KYU. 2006. Epenthetic *s* in compound nouns. *English Linguistic Science* 16, 1-13. The English Linguistic Science Association of Korea.

ZURAW, KIE. 2011. Predicting Korean sai-siot: phonological and non-phonological factors. A paper presented at the *21st Japanese/Korean Linguistics Conference*.

Hijo Kang (Assistant Professor)
Department of English Language Education
Chosun University
309 Pilmundae-ro, Dong-gu, Gwangju
Korea 61452
e-mail: hijokang@chosun.ac.kr

Mira Oh (Professor)
Department of English Language and Literature
Chonnam National University
77 Yongbong-ro, Buk-gu, Gwangju
Korea 61186
e-mail: mroh@chonnam.ac.kr

received: March 21, 2019
revised: April 25, 2019
accepted: April 29, 2019