

On the evolution of the laryngeal contrasts in Korean*

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Ahn, Sang-Cheol. 2009. On the evolution of the laryngeal contrasts in Korean. *Studies in Phonetics, Phonology and Morphology* 15.3. 465-484. This paper discusses how the laryngeal contrasts have evolved in the history of the Korean language, with respect to the motivations and the constraint interactions. I first treat the emergence of tense consonants as lengthening of duration as well as segmental loss. For this, I argue that the overall emergence has evolved from an alignment constraint to the effect that a fortified edge be aligned with a certain edge, signaling a loss of an extra consonant. Here I employ the “geminate hypothesis” (Ahn & Iverson 2004) in providing various pieces of evidence to support this claim, such as tonal characteristics, ideolectal/dialectal variations, and loanword adaptation, etc. As for the emergence of the aspirated series, I examine if there are certain phonetic or phonological constraints, suppressing velar aspiration, while favoring coronal aspiration, which seems to show the markedness hierarchy. I, however, demonstrate that the markedness hierarchy does not play any role in the restricted distribution of the velar aspirates as the emergence pattern can be better explained in terms of the functional overlap between the existing /h/ and a possible velar aspirate. I thus claim that the overall process of the emergence of aspiration can be effectively described within the framework of Dispersion Theory as the overall consequence is obtained by the pattern evaluation of the adjacent segments. Finally, I show that the overall change should be described by dividing it into (at least) three historical stages in which each stage requires a different constraint ranking accounting for its change more properly. (Kyung Hee University)

Keywords: Korean laryngeal contrasts, alignment, geminate hypothesis, aspiration, markedness hierarchy, Dispersion Theory, pattern evaluation, constraint ranking

1. Introduction

The well-known three-way laryngeal contrast in Korean (i.e., lax, aspirated, tense) is a somewhat unusual diachronic consequence as Proto-Korean did not have the aspirated series, which (presumably) existed in Proto-Altaic. Moreover, there has been much controversy over when and how the aspirated consonants emerged in (or before) the Old Korean period. Furthermore, it was not until the Late Middle Korean period when the tense (or the geminate) series began to emerge. The following table (1) shows the diachronic sound correspondences within the Altaic family (Starostin et al. 2003). (The hyphens indicate the occurring environments of the relevant segments.)

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(1) Diachronic sound correspondences within the Altaic family

Proto-Altaic	Proto-Turkic	Proto-Mongolic	Proto-Tungusic	Proto-Korean	Proto-Japonic
p ^h	∅-, j-, p	h-, j-, -b-, -h-, -b	p	p	p
t ^h	t-, d-, t	t, ʃ-d	t	t	t
k ^h	k	k-, -k-, -g-, -g	x-, k, x	k, h	k
p	b	b-, h-, b	p-, b	p	p
t	d-, t	t, ʃ	d-, ʃ-, t	t, -r-	t-, d-, t
k	k-, k, g	k-, g	k-, g-, g	k-, -h-, -∅-, -k	k
b	b	b-, -h-, -b-, -b	b	p-, -b-	p-, w, b, p
d	j-, d	d, ʃ	d	t, -r-	d-, t-, t, j
g	g	g-, -h-, -g-, -g	g	k, -h-, -∅-	k-, k, ∅

As well documented in historical literature, the emergence of the tense consonants in the Middle Korean period occurred after the evolution of the aspirated series. That is, while the usage of the aspirated consonants was already common in Early Middle Korean, the tense consonants were not used until the early part of the Late Middle Korean period, i.e., the *Hunminjeongum* period. Although there has been much controversy over the phonemic status of the aspirated series in the Old Korean period (C.-W. Park 2002), we can posit the following diachronic sequences regarding the emergence of the three-way laryngeal contrast. (Fricatives/affricates are not considered here for simpler discussion. See Ahn & Cho (2004) for the emergence of the palato-alveolar affricates.)

	Proto K. ¹	Ancient K.(?)	Old K.	Early Mid K.	(Early)Mod K.
plain	p, b, t, k	p, t, K	p, t, k	p, t, k	p, t, k
aspirated		t ^h	p ^h , t ^h	p ^h , t ^h , k ^h	p ^h , t ^h , k ^h
tense/gem.					pp, tt, kk
glottal fric.	h	H	h	h	h

The table (2) shows not only the precedence of the emergence of the aspirated series but the incomplete two-way laryngeal contrast in Old Korean, lacking the tense group. That is, the shaded area in the Old Korean period indicates the asymmetric emergence of the aspirated consonants, while the shaded area in the Early Modern Korean shows the completion of the three-way laryngeal contrasts.²

¹ The voiced labial stop /b/ was presumably changed to /v/ before the Middle Korean period. So, the fricative inventory included the now extinct voiced /β, z, ʝ/ (K.-M. Lee 1972, Ahn 2006) along with the still existing voiceless /s/.

² K.-M. Lee (1972) proposed the following categorization for the history of Korean.

Old K.	Early Middle K.	Late Middle K.	Late K.	Modern K.
? - 9c	10c - 14c	14c - 16c	17c - 19c	20c -

Moreover, K.-M. Lee (1972) claims that Modern Korean is a descendant of the language spoken during the *Sylla* dynasty. This view, however, is still controversial. The language of

Observing this seemingly idiosyncratic emergence pattern, I will examine how the laryngeal contrasts have evolved in the history of the Korean language, following the basic premises of Evolutionary Phonology (Blevins 2004, Iverson & Salmons 2007). In particular, I first show that the evolutionary approach views the emergence of tense consonants not as a teleological consequence of a certain universal constraint, but as lengthening of duration as well as segmental loss, e.g., *psʌ* > *s'al* 'rice'. For this claim, I examine the known history of consonantal tensing in Middle Korean and argue that the overall emergence has evolved from an alignment constraint (McCarthy & Prince 1994) to the effect that a fortified edge be aligned with a certain edge, such as a morphological boundary or a higher prosodic edge, signaling a loss of an extra consonant (Blevins 2004). Considering the longer closure/frication duration of the tense obstruents than that of the lax/aspirated ones, I employ the "geminate hypothesis" (Ahn & Iverson 2004) in providing various pieces of evidence to support this claim, such as tonal characteristics, ideolectal/dialectal variations, and loanword adaptation, etc.

As for the emergence pattern of the aspirated series, we reexamine the data showing that the velar aspirates were not documented in the Old Korean literature, while the aspirated coronals were very common in frequency and the aspirated labials were less common in the beginning of the Old Korean period. We, therefore, discuss if the (teleological) universal hierarchy of markedness could have played any role in the gradual emergence of the aspirated consonants. During the discussion, however, I show that the markedness hierarchy probably had nothing to do with the gradual emergence of the aspiration. Rather, I argue that the emergence pattern should be interpreted in terms of the functional role of the aspiration and the constraint interaction based on articulatory naturalness, rather than the markedness of velarity. To this end, I will employ the framework of Optimality Theory (McCarthy & Prince 1995, 2007), more specifically the version of Dispersion Theory (Flemming 1995, 2001).

2. Emergence of tense consonants

2.1. Fortition by gemination as edge marking

There has been general agreement on the view that the tense consonants evolved from onset clusters during the Late Middle Korean period, as *Hunminjeongeum* (訓民正音)³, specifically the *Commentaries and Examples* part, called *Je.ja.hae* (制子解) does not include tense consonants. In fact, however, we can find orthographic gemination in the literature,

Baekje was somewhat similar to the one spoken in *Sylla*, while the language spoken in *Goguryeo* was quite different from these two languages. But after the unification of the three kingdoms by *Sylla* in the late 7th century, the language of *Sylla* became the root of the Korean language.

³ *Hunminjeongeum* (*The Correct Sounds for the Instruction of the People*, 訓民正音), the treatise on the Korean writing system promulgated by King Sejong the Great in 1446.

such as *pp*, *tt*, *kk*, etc. The orthographic geminates, however, were used to represent the [voice] property of the Chinese consonants in transliteration. That is, the geminate writing “*Gak.ja.byeong.seo*” (各自並書) represented a voiced consonant of a Chinese word, unlike the mixed writing “*Hap.yong byeong.seo*” (合用並書) such as /sp, st, sk, pt, ps, pc/, which became tensed consonants later in Middle Korean. Therefore, the orthographic geminates (in (3)) employed for the voiced consonants of Chinese loanwords became lax.

- (3) ppo > po ‘step (步)’, ttam > tam ‘deep (潭)’, cco > co ‘mercy (慈)’,
kkyu > kyu ‘baby dragon (虬)’, etc.

There are various, both diachronic and synchronic, pieces of evidence supporting the claim on the origin of the Korean tense consonants. In elaborating this argument, I employ the “geminate hypothesis” (Ahn & Iverson 2004), which defines the tense consonants as “geminates”, rather than a singleton having [constricted glottis], as the closure/friction duration of the tense obstruents is significantly longer than that of the lax/aspirated ones (by about 1/3 (207 ms vs. 145 ms and 146 ms, H. Ahn 1999). (They were even called “long consonants”(H.-B. Choi 1937).) Moreover, the Korean tense stops do not undergo intervocalic lenition unlike plain or aspirated stops, as stated in Hayes (1986) as the inalterability of geminates⁴.

There are various pieces of evidence supporting the geminate hypothesis and the gemination as the trigger of the consonantal tensing. First, the textual data (4) and (5) show that the Middle Korean onset clusters were a consequence of vowel truncation, and the lengthening of the second consonant triggered the pitch rise (i.e., over 80% of all cases) (K.-M. Lee 1972, C.-W. Park 2002, etc). As a result, the tenseness of an onset consonant assigned the vowel a higher pitch, which still exists in Modern Korean.⁵

- (4) Gemination by syncope:
CVCV > CCV (e.g., pɔtɔl > ptɔl > stɔl > t’al ‘daughter’)

- (5) a. H tone after CC
spyám ‘cheek’, spól- ‘to wash’, spíl ‘horn’, sták ‘rice cake’, etc.
b. L tone after C
sɔ.laŋ ‘to love’, sɔ.mac^h- ‘to pierce’, sa.pal ‘bowl’, pɔy ‘pear’, etc.
(ref. Modern Korean: tál ‘daughter’, t^hál ‘mask’ vs. tal ‘moon’)

⁴ t^hal [t^hal] ‘mask’ ~ pa^htaŋ [pa^htaŋ] ‘bottom’, taso [taso] ‘more or less’ ~ pa^hta [pa^hta] ‘sea’, vs. k’at’ak [k’at’ak] ‘nodding’

⁵ This type of gemination by syncope is one of the most common pathways in language change as observed in Blevins (2004) for Austronesian languages.

e.g., *sakura* [sak'ura] 'cherry blossom', *sashimi* [sasimi], *Suzuki* [sijik'i].⁸⁾

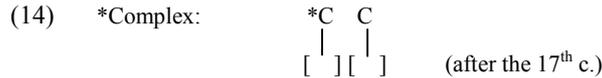
2.2. Phonotactic change for gemination

Unlike Modern Korean, early Middle Korean had only two types of obstruents, i.e., plain and aspirated. Then, the tense series appeared due to the simplification of the complex onsets, especially the *sC*-clusters. According to C.-W. Park (1996: 285-296), the *sC*-cluster, (presumably) derived from the earlier *cC*-cluster, became tense consonants before the 16th century. Then, the *pC*-cluster became tense consonants after the 17th century, as shown below. (Although the usage was very rare, the /s/ cluster was a combination of /s/ plus another /s/, rather than a geminate representation.)⁹⁾

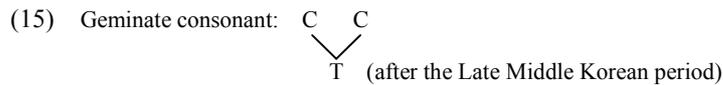
(13)

<i>c</i> -cluster	cp	ct		ck	disappeared first (before 15c) > <i>sC</i> -
<i>s</i> -cluster	sp	st (ss)		sk	disappeared next (before 16c), after tensing > C'
<i>p</i> -cluster		pt	ps	pc	disappeared last (after 17c), tensed > C'

This table shown in (13) implies several major facts that have been enforced in the history of Korean. First, unlike Modern Korean, Early Middle Korean did not obey the general phonotactic constraint banning complex onset clusters because this constraint became to be strictly enforced only after the 17th century.



As for the case of the already tensed *sC*-cluster, however, we also note that Late Middle Korean began to allow the geminate consonant of the following structure as the *sC* cluster became a tense [C'] represented as a geminate.



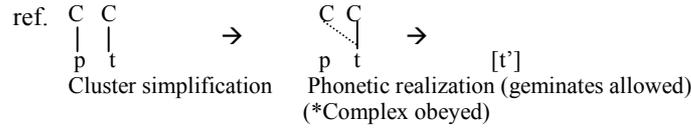
Early Middle Korean must have allowed genuine consonant clusters with two (or three) segments as well as geminates. After the 16-17th centuries, however, the general *Complex constraint began to take a crucial role, generating various tense consonants, in which the rightmost segment of a cluster survived as a tense consonant. Therefore, we need the following alignment constraint to make the rightmost onset segment be saved in the

⁸⁾ The tense [s'] in *sumo* [s'imo] 'Sumo wrestling' is probably a result of analogy to *s'ilim* [s'irim] 'Korean traditional wrestling'.

⁹⁾ We, however, note that the /ps/ cluster was often interchanged with the /ss/ cluster orthographically even in the 15~16th centuries, indicating that the *pC*-clusters were already undergoing tensification in that period.

output.

- (16) ALIGN-R
Align the rightmost segment with the rightmost C-slot in an onset.¹⁰



We can illustrate a sample evaluation tableau for the tensing by gemination processes as follows (Ahn 2007). Here we can observe how Align-R plays a crucial role selecting the optimal candidate.

(17)

	$\begin{array}{cc} C & C \\ & \\ p & t \end{array}$	*COMPLEX	ALIGN-R	MAX[C]	MAX[seg]
a.	$\begin{array}{cc} C & C \\ & \\ p & t \end{array} [pt]$	*!			
b.	$\begin{array}{cc} C & C \\ \diagdown & \\ p & t \end{array} [p']$		*!		*
c. ☞	$\begin{array}{cc} C & C \\ \diagdown & \\ p & t \end{array} [t']$				*
d.	$\begin{array}{cc} C & C \\ & \\ p & t \end{array} [t]$			*	*

¹⁰ The alignment constraint also functions for the coda cluster simplification in that, despite some dialectal variations, the first consonant (underlined) of a coda C₁C₂ cluster was preserved in Middle Korean, e.g., *ps*, *ks*, *lm*, *lh*, *l^h*, *nc*, *nh*, *lp*, *lp^h*, *lk*, etc. Thus, we might invoke an Align-L constraint, indicating that the alignment constraints, Align-L (for coda) and Align-R (for onset), therefore, work in the manner by which the consonant closer to the nucleus vowel is retained. In Modern Korean, however, the preference for the first coda consonant does not hold in certain cases (Ahn 1998), e.g., *ps*, *ks*, *lm*, *lh*, *l^h*, *nc*, *nh*, *lp*, *lp^h*, *lk*, etc. Unlike the onset cluster simplification, moreover, the coda C₂ is subject to be linked to the next syllable if followed by a vowel, e.g., *kaps-to* [kap.t'o] 'price also'.

	$\begin{array}{ccc} \underline{C} & C & C \\ & & \\ p & s & t \end{array} /kaps+to/$	*COMPLEX	CODA-COND	ALIGN-L	MAX[C]	MAX[seg]
a.	$\begin{array}{ccc} \underline{C} & C & C \\ & & \\ p & s & t \end{array} [kaps+to]$	*!				
b.	$\begin{array}{ccc} \underline{C} & C & C \\ \diagdown & & \\ p & s & t \end{array} [kas.to]$			*!	*	*
c. ☞	$\begin{array}{ccc} \underline{C} & C & C \\ \diagdown & & \\ p & s & t \end{array} [kap.t'o]$					*
d.	$\begin{array}{ccc} \underline{C} & C & C \\ & & \\ p & s & t \end{array} [kap'.to]$		*!			*

(Coda-Cond: no geminate or aspirate in coda)

And the same evaluation procedure applies to the three consonant onset clusters.

(18)

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p	s	t															
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C	C	C															
p	s	t															
		[sʰ]															

As we can see in these tableaux, Align-R takes a crucial role along with the top constraint *COMPLEX. (Refer to Ahn (2007) for further discussion on this issue.)

3. Emergence of the aspirated series

3.1. Controversy over the emergence

As mentioned in C.-W. Park (2002: 153), we observe three major approaches to the investigation of the Old Korean phonemic system. First, numerous comparative studies have been attempted, based on the comparison with the Proto-Altaic or other Altaic languages such as Manchurian and Mongolian (Poppe 1965, Starostin et al. 2003). The second approach is to analyze the sounds of the Chinese letters, transliterating the names of people, places, and governmental titles, which were used in the literature on the history of the three kingdom period, i.e., <Samguksagi> or <Samgukyusa> (K.-M. Lee 1972, B.-C. Park 1971, Chang 1990). The third method is to rely on the reconstruction of the Middle Korean textual data or dialectal variations as have been done in numerous studies (K.-M. Lee 1972, B.-C. Park 1971, C.-W. Park 2002, etc.).

First of all, K.-M. Lee (1972: 90) claims that there already existed the distinctive aspiration even in Old Korean (i.e., the period of Sylla) as documented in *Samgukyusa* (The unofficial history of the three kingdom period, 三國遺事). (The underlines and translations are mine.)

- (19) 或作異次, 或云伊處, 形音之別也, 譯云厭也
 (They called it [c^ha] or [c^hə] (in transliteration), showing variations, and we translate this word as ‘hate’.) (Samgukyusa(三國遺事) Vol.3)

The (underlined) words “異次” and “伊處” (i.e., [ic^ha] and [ic^hə] in

transliteration) are related to the Middle Korean word <ic^h-> ‘tiring’, where the aspirated [c^h] was used for both “[c^ha] (次)” and “[c^hə] (處)”.

K.-M. Lee (1972: 90) cites more examples for [c^h] documented also in *Samguksagi* (The official history of the three kingdom period, 三國史記).

(20) 東萊郡本居柒山郡 (*Samguksagi* Vol. 34)

(The county of 東萊郡 (pronounced as [ton]lekun] in Modern Korean) was originally the county of 居柒山 ‘harsh/wild mountain’.)

居柒夫 或云 荒宗 (*Samguksagi* Vol. 44)

(They call 居柒夫 (‘tough/harsh man’) or a man with a ‘harsh’ root.)

As the pronunciation of 居柒 corresponds to [kæc^hil] in Middle Korean (rendering translation 訓讀) (C.-W. Park 2002:120), we may thus take these examples as the supporting evidence for the existence of the aspirated consonants in Old Korean. Furthermore, we can consider the word 佛體 which appears in the tenth century literature *Pohyeonsipwonga* (普賢十願歌)¹¹, an ancient Korean traditional poetry *Hyangga* (鄉歌) written in the archaic writing system *Hyangchal* (鄉札, literally vernacular letters).¹² As shown in (21), the second letter in 佛體 ‘Budda’ in (21) could have been pronounced with aspiration, i.e., [t^hyə], in the later Middle Korean period.

(21) 佛體 ‘Budda’ (10c) > put^hyə (15c)

There are, however, the opposite claims denying the possible existence of the aspirated consonants in Old Korean. First of all, B.-C. Park (1971) claims that the earlier documents do not verify the existence of aspiration in Old Korean. Illustrating the following data, for example, B.-C. Park argues that the Ancient Chinese (中古音) plain consonants were not systematically realized in the Old Sino-Korean words.

(22) a. 清川縣本薩買縣

b. 柒提縣本柒吐縣

c. 高丘縣本仇火縣 或云高近

d. 大城縣本仇刀縣

(*Samguksagi* (三國史記) 34)

B.-C. Park argues that the transliteration of the Korean letters and their corresponding Middle Korean translation do not show any uniformity in correspondence. For example, he observes that the letter 薩 in (22a)

¹¹ The eleven 10-line (十句體) *Hyangga* poems written by Gyunyeo (均如) in the beginning period of *Goryeo dynasty*, i.e., 10c. (963~967?).

¹² In the *Hyangchal* system, Chinese characters were given a Korean reading based on the syllable associated with the character. The *Hyangchal* writing system is often classified as a subgroup of *Idu* (吏讀) as each syllable was “transcribed with a single graph”. The following example form *Cheoyongga* shows how *Hyangchal* was used to transliterate the Korean words.

東京明期月良夜人伊遊行如可
東京 불기드라밤드리놀니다가
(We had fun till the middle of the bright night of the capital city....)

corresponds to *c^ha->c^hal-* ‘cold’ in Middle Korean translation, but it begins with the fricative /s/ (i.e., [sal] in Modern Korean) in this text. Moreover, the aspirated sound [ts^h] in 菜 ([c^hil] in Modern Korean) in (22b) corresponds to *cil-* ‘muddy’ in Middle Korean translation. Finally, 仇 (pronounced [ku] in Modern Korean) in (22c,d) was used to represent the meaning of 大 ‘big’ ([k^hi] in pure Korean) but there is no aspiration in 仇 ([ku]).¹³ Based on this textual data, B.-C. Park (1971) denies the existence of the aspirated consonant in Old Korean.

In order to further support this claim denying the existence of the aspirates in Old Korean, he presents the following data which shows the asymmetric distribution of the aspirated consonants in the transliteration of Ancient Chinese literature. Table (23) illustrates the unbalanced adaptation pattern of the Ancient Chinese (i.e., 6-10c AD)¹⁴ sounds (中古音) into Old Korean, in which the aspirated velar consonants were not properly transmitted to Old Korean (B.-C. Park 1971).

	Labial				Apical				Laminal				Dorsal			
Ancient Chinese	幫, 非		滂, 敷		端, 知		透, 徹		精, 照, 莊		清, 穿, 初		見		溪	
	p		ph/fh		t/ʈ		th/ʈh		ts/tsʰ		tsh/tʃh/tʃh		k		kh	
Old Korean	p	p ^h	p	p ^h	t	t ^h	t	t ^h	c	c ^h	c	c ^h	k	k ^h	k	k ^h
Occurrence	82	30	30	17	89	14	41	61	151	34	13	86	270	-	88	-
Percentage(%)		27		36		14		60		18		87		0		0

The table (23) shows that the Ancient Chinese aspirated consonants were realized either as aspirated or plain obstruents in Old Korean literature. Moreover, as shown in the shaded areas, there was no realization of /k^h/ corresponding to the Ancient Chinese aspirated velar stop /kh/. Based on this statistical results, therefore, B.-C. Park (1971) claims that the aspirated consonants did not have the phonemic status until the Old Korean period. In addition to B.-C. Park (1971), there have been numerous accounts denying the phonemic status of the aspirates in Old Korean, which can be listed as follows.

(24) Views on the Old Korean obstruent system lacking the aspirated series

	Obstruents				Sonorants
	Labial	Alveolar	Velar	Glottal	
C.-G. Yoo (1960)	p, v	t, s, ts, dz	k		m, n, ŋ, r

¹³ K.-M. Lee (1972), however, claims that this inconsistency was inevitable since there was no corresponding letter which could express this meaning.

¹⁴ Ancient Chinese (as used by Bernhard Karlgren) refers to the language used during the period of Sui (隋), Tang (唐), and Song (宋) dynasties (6th through 10th centuries AD, D.-J. Lee 1995: 30-35). It is also categorized as Middle Chinese, in contrast to Old Chinese and Modern Chinese in the context of historical Chinese phonology (Wikipedia online 2009). The following categorization is taken from D.-J. Lee (1995: 30-35) following an earlier research by Akiyasu Tōdō (藤堂明保).

Proto-Chinese (太古) BC 15-10c, Archaic Chinese (上古) BC 7- AD 4c,
Ancient Chinese (中古) 6-10c, Middle Chinese 11-16c, Modern Chinese 17-20c.

B.-C. Park (1971)	p, v	t, s	k	h, ʔ	m, n, ŋ, r, j
G.-T. Cho (1986)	p	t, s	k		m, n, ŋ, r, j
S.-G. Chang (1990)	p	t, s	k		m, n, ŋ, r/l
D.-S. Kim (1998)	p	t, s	k		m, n, ŋ, y

As we examine the table (23) more closely, however, we find that the coronals, i.e., apicals and laminals, were the most common aspirates, while the usage of the labial aspirates was less productive. This asymmetry in occurrences was also observed in Song (1995), M.-R. Kim (1998), and C.-W. Park (2002) suggesting that the aspiration of alveolar consonants could have occurred first, since about 60% of the Ancient Chinese aspirates were realized at the apical region and 87 % at the laminal region, while only 36% at the labial region. This observation reflects the universal markedness hierarchy.

- (25) Occurrences and the markedness hierarchy
 Coronal (laminal > apical) > labial > ∅ (dorsal)

At a glance, this markedness hierarchy looks quite convincing as the most marked /k^h/ was rarely used until the early Middle Korean period. And if this universal hierarchy works, it could be used as a case of a teleological sound change.

In fact, the rarity of the velar aspirate in Modern Korean is also mentioned in K.-M. Lee (1972: 89). K.-M. Lee cites the preface of the Middle Korean literature *Donggukjeongunseo*, <東國正韻序> stating that the aspirated velar [k^h] was used only for a few words such as “夫, 快, 噲” ([k^hway]) in Middle Korean. (Translation is mine.)

- (26) 國語多用溪母 而漢字音則獨夫一音而已 此尤可笑者也
 “The Korean language employs *Gyemo* (i.e., a velar onset) very often.
 As *k^hway* is the only Chinese word (having aspiration), however, it is rather silly (to expect more aspirated ones).”

We can also note that, unlike the common coronal aspirates, the labial aspirated consonants could vary with the plain counterparts, depending on the syllable structure (Kono 1968, cited in K.-M. Lee 1972: 89-90).

- (27) No restriction: pan~p^han, pal~p^hal, pyəyn~p^hyəyn, po~p^ho, pi~p^hi
 Plain only: pak (*p^hak), pən, pəl, pəm, pyək, pən, pəŋ, pun, pul, puk, piŋ
 Aspirate only: p^hay (*pay), p^hyəm, p^hyəy, p^hyo, p^huŋ, p^him, p^hil, p^hip

These data clearly indicate that the coronals were the most productive in the realization of aspiration, while the labials were somewhat restricted in the same environments. On the other hand, the aspirated velar stop may have appeared at the last developmental stage in the history of the Korean language.

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While the velar region acquired aspiration in a later stage of Old Korean (or even in early Middle Korean), the distribution of the velar stop /k^h/ is still restricted in Modern Korean. Based on *Phyojun Gukeo Daesajeon* (Grand Standard Korean Dictionary, 1999, Doosan Dong-A), for example, Ito (2007: 380) shows the following statistical result indicating that the aspirated velar stop is highly restricted in distribution even in Modern Korean (mono-syllabic stems).

(28) Totals of lax/aspirated consonants in onset and coda (Ito 2007)

Onsets & Codas	Lax	Aspirated	Totals	Aspirated (%)
p, p ^h	158	51	209	24.40
t, t ^h	119	76	195	38.97
c, c ^h	146	83	229	36.24
k, k ^h	252	23	275	8.36
Totals	675	233	908	25.66

Moreover, a similar restricted pattern can be found in the onset-coda co-occurrences as shown below. (Here we omit the so-called *p*-irregular stem consonant which shows *p*~*w* alternation.)

(29) Onset-coda co-occurrences (Ito 2007: 382)

Onset \ Coda	Coda											
	p	p ^h	t	t ^h	s	s'	c	c ^h	k	k ^h	k'	h
p	3		4	8	15		3	1	12	1	2	
p ^h				1								
p'	1		1		1				15		1	1
t		1	4		6		1	3	7		3	1
t ^h	2	2			2				3			
t'			1		1				4			1
s	3	6		3	3				9		2	
s'	2		1		1				4			1
c	7	2		2	6		9	1	11			1
c ^h							1		2			
c'							2	1	11			1
k	9	2		3	13		5				1	
k ^h												
k'	1			2			1	2			2	
h				2					2			

3.2. A new look within OT: pattern evaluation

The markedness hierarchy, however, does not have any phonetic ground for the emergence of aspirates, as it is hard to find any theoretical basis that prefers the coronals to be aspirated first (C.-W. Park 2002: 167). Rather, we need to consider the general tendency that aspiration is easier in the

region closer to the glottis (Yavaş 2006: 105-106).¹⁵ According to this tendency, then, aspiration could occur most easily near the back of the mouth where the velars are articulated. As the velars were not aspirated until the last stage of the change, however, it is questionable why the aspiration of the coronal consonants preceded the aspiration of the velar and labial consonants. Moreover, it is another mystery why the velar aspiration did not occur until the last stage of the emergence of aspiration.

In order to find a clue for these questions, we need to examine the Proto-Korean consonant system, comparing with that of Proto-Altaic (Starostin et al. 2003), as already shown earlier in (1).

(30) Obstruent systems of Proto-Altaic and Proto-Korean

Proto-Altaic	Proto-Korean	Proto-Japonic
p ^h	p	p
t ^h	t	t
k ^h	k, h	k
p	p	p
t	t, -r-	t-, d-, t
k	k-, -h-, -∅-, -k	k
b	p, -b-	p-, w, b, p
d	t, -r-	d-, t-, t, j
g	k, -h-, -∅-	k-, k, ∅

We observe that the Proto-Korean glottal fricative /h/ alternates with the velar stop /k/, in reflecting the Proto-Altaic velar stops /k, k^h, g/. This aspect shows the general tendency favoring a back consonant for aspiration. We can therefore conjecture that the consonantal aspiration was initiated by the glottal fricative /h/, as aspiration is easier in the region close to the glottis (Yavaş 2006). Due to the articulatory proximity, however, /h/ would have prevented the emergence of the aspirated velar stop, avoiding possible functional overlap.¹⁶ As a consequence of suppressing the velar aspiration, the coronals became aspirated first during the process of expanding the consonantal inventory by aspiration, as they are closer to the glottis than labials.¹⁷

In order to describe the overall emergence of aspiration, we employ the framework of Dispersion Theory (Flemming 1995, 2001) for pattern

¹⁵ As we move the place of articulation from the front to the back of the mouth, stops tend to have greater VOT (Yavaş 2006: 105-106).

¹⁶ As shown in the following passive suffixation, /k/ often alternates with /h/ in Modern Korean causative/passive suffixation as well.

e.g., mak-*hi*-ta 'be blocked' ~ cam-*ki*-ta 'be locked'

¹⁷ A similar aspect can be found in the High German (Second) Consonant Shift in which the affrication (and later spirantization) of /t/ took place first, then /p/, last /k/ (Iverson & Salmons 1999, Davis 2008).

evaluation, as the changes of the single consonants cannot be considered separately; they are evidently parts of one great historical linguistic movement. Specifically, I claim that the final output of the consonant system is a consequence of interactions among several natural constraints.¹⁸

In analyzing the emergence pattern, we can take the already existing glottal /h/ as the trigger of the overall emergence of the aspirated consonants. Moreover, it is stated that aspirates began to emerge as a consequence of the continuous procedure to expand the consonantal inventory as the Old Korean obstruent system had the plain stops only, while the Proto-Altaiic **k/*g* and **k^h* were realized as **k* or **h*.

(31)

plain	p	t	k
aspirate	-	-	- h

Considering this effort to expand the consonantal inventory by aspiration, we can posit the following constraint requiring that all the stops be aspirated.

(32) ASP (stop) Expand the consonantal inventory by stop aspiration.

This constraint, however, conflicts with the tendency in which the aspiration is easier in the region closer to the glottis (i.e., velar). Therefore, we need the following constraint discouraging the possible aspiration of the labial or coronal stops/affricates.

(33) *Front (asp) Front aspirates are discouraged.

And this constraint does not reflect the fact that the existence of /h/ blocked the emergence of /k^h/ to avoid the possible functional overlap. Thus the following constraint requires a certain distance in place of articulation between a new aspirated stop and the already existing glottal /h/.

(34) KEEP DISTANCE (asp)
Keep enough distance between the new aspirated consonant and the glottal /h/.

Finally, the following precedence constraint is invoked in that coronal aspiration preceded labial aspiration.

(35) Preference in aspiration (PREFASP)
A front aspirate may not occur before the appearance of a more back aspirate.

¹⁸ In Dispersion Theory, there are constraints on the well-formedness of phonological contrasts and the selection of phonological contrasts is subject to the following three functional goals (Flemming 1995): (a) Maximize the number of contrasts, (b) Maximize the distinctiveness of contrasts, (c) Minimize articulatory effort. The basics of Dispersion Theory can be incorporated in OT in that the requirements on contrast conflict and the selection of an inventory of contrast involves achieving a balance between them.

Due to this constraint, labial aspiration may not be allowed until the occurrence of coronal aspiration.

As these constraints apply in a gradient manner, just a single violation would not discard the competing candidates from further evaluation. Employing the constraints invoked so far, we can show the pattern evaluation procedure in which the overall change can be better described by dividing it into three historical stages, in which each stage requires a different constraint ranking accounting for its change more precisely.

First of all, the initial stage of the change can be described as shown in (36), in which KEEPDIS(asp) took the crucial role blocking the emergence of /k^h/ as its articulation point is too close to the glottis where /h/ is articulated. So, we can first discard the two candidates (36a, e). Then, the candidates (36b) and (36c) are tied for *Front [asp] but PREFASP enables us to select (36b) as the optimal candidate. Here we observe that ASP(stop) took the minimum role so that only the coronal stop could undergo aspiration in the initial stage.

(36)

	Early stage	KEEPDIS(asp)	*Front[asp]	PREFASP	ASP(stop)
a.	p, t, k, k ^h , h	*! (k ^h , h)			** (p ^h , t ^h)
b.	p, t, k, t ^h , h		* (t ^h)	* (t ^h > k ^h)	** (p ^h , k ^h)
c.	p, t, k, p ^h , h		* (p ^h)	** (p ^h > t ^h > k ^h)	** (t ^h , k ^h)
d.	p, t, k, p ^h , t ^h , h		**! (p ^h , t ^h)	* (t ^h > k ^h)	* (k ^h)
e.	p, t, k, p ^h , t ^h , k ^h , h	*! (k ^h , h)	**! (p ^h , t ^h)		

The next stage is described in terms of the constraint re-ranking in that ASP(stop) is promoted above the *Front [asp], so that both labial and coronal stops could get aspirated, generating the /p^h, t^h/ series lacking only */k^h/.

(37)

	Intermediate stage	KEEPDIS(asp)	ASP(stop)	*Front[asp]	PREFASP
a.	p, t, k, k ^h , h	*!	**		
b.	p, t, k, t ^h , h		**!	*	*
c.	p, t, k, p ^h , h		**!	*	**
d.	p, t, k, p ^h , t ^h , h		*	**	*
e.	p, t, k, p ^h , t ^h , k ^h , h	*!		**	

The final stage in the emergence of aspiration is completed by the promotion of ASP(STOP) to the top rank. As a consequence, all the stops are aspirated even though the aspirated velar stop /k^h/ is close enough to the glottal /h/ in distance.

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(38)

Final stage	ASP(stop)	KEEPDIS(asp)	*Front[asp]	PREFASP
a. p, t, k, k ^h , h	**!	*		
b. p, t, k, t ^h , h	*!		*	*
c. p, t, k, p ^h , h	**!		*	**
d. p, t, k, p ^h , t ^h , h	*!		*	*
e. p, t, k, p ^h , t ^h , k ^h , h		*	**!	

As we have described so far, the overall process of the emergence of aspiration can be effectively described within the framework of Dispersion Theory employing a pattern evaluation procedure, as the aspirated consonantal system cannot be evaluated in isolation. Moreover, the overall change should be described by dividing it into (at least) three historical stages in which each stage requires a different constraint ranking accounting for its change more precisely. Especially, ASP (STOP) takes the triggering role for the development of the aspiration system, and the gradual promotion of this constraint accounts for the developmental stages of aspiration. We can sum up the changes of the constraint ranking as follows.¹⁹

(39) Constraint ranking changes

Early stage: KEEPDIS(asp) >> *Front[asp] >> PREFASP >> ASP(stop)

Intermediate stage: KEEPDIS(asp) >> ASP(stop) >> *Front[asp] >> PREFASP

Final stage: ASP(stop) >> KEEPDIS(asp) >> *Front[asp] >> PREFASP

4. Concluding remarks

So far we have discussed how the three-way laryngeal contrasts could have emerged from the simple plain consonant system. I first treated the emergence of tense consonants as lengthening of duration as well as segmental loss. For this, I argued that the overall emergence has evolved from an alignment constraint to the effect that a fortified edge be aligned with a certain edge, signaling a loss of an extra consonant. Here I employed the “geminate hypothesis” in providing various pieces of evidence to support this claim, such as tonal characteristics, ideolectal/dialectal variations, and loanword adaptation.

As for the emergence of the aspirated stops, I demonstrated that the markedness hierarchy does not play any role in the restricted distribution of the velar aspirates, as the emergence pattern can be better explained in

¹⁹ As pointed out by a reviewer, the current analysis shows a constraint promotion account, which is different from those in Tesar & Smolensky (2000) and McCarthy (2002) endorsing a demotion mechanism. In this paper, however, the promotion of the Asp(stop) constraint reflects the argument that the emergence of aspiration was motivated by the continuous effort to expand the consonantal inventory.

terms of the functional overlap between the existing /h/ and the possible velar aspirate /k^h/. Instead, I argued that the initial motivation was to expand the phonemic inventory by aspirating the plain stops, but there might have been inherent conflicts between the motivation for aspiration and other constraints, such as those discouraging front stop aspiration or requiring a certain articulatory distance between the glottal /h/ and a new aspirated segment. In order to account for this, I showed that the overall process of the emergence of aspiration can be effectively described within the framework of Dispersion Theory employing a pattern evaluation procedure. Moreover, the overall change should be described with respect to (at least) three historical stages, as each stage requires a different constraint ranking accounting for its change more precisely. Especially, ASP (stop) takes the triggering role for the development of the aspiration system and the gradual promotion of this constraint account for the developmental stages of aspiration.

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