

Morphological basis of sonorant assimilation in Korean^{*}

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Sohn, Hyang-Sook. 2006. Morphological basis of sonorant assimilation in Korean. *Studies in Phonetics, Phonology and Morphology*. 12.2. 321-338. Focusing on aspects of assimilation between two alveolar sonorants /n/ and /l/, this study provides an optimality-theoretic account of sonorant assimilation, where lateralization takes place when the lateral is followed by the nasal, but nasalization is the predominant pattern of assimilation when the precedence is reversed. This generalization holds true for different strata of the lexicon and different domains of the prosodic hierarchy. This study claims that morphological information on the status of morphemes in the domain of sonorant assimilation is crucial on account of geminate structure in the output. When two alveolar sonorants are in contact across the prosodic word boundary, the nature of geminate in the output is not feature-dependent, but stem-driven, and more specifically, faithfulness to the stem-final sonorant is more imperative than to the stem-initial sonorant. (Kyungpook National University)

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1. Introduction

It is a general phonological process in Korean that oral stops are nasalized before a lateral and the lateral is assimilated to the preceding nasal (/p/ + /l/ → [mn], /k/ + /l/ → [ŋn]). Pre-liquid nasalization was accounted for in terms of serial rule application (Kim-Renaud 1974 among others) in early generative phonology. Much recent research, however, cast in the framework of Optimality Theory (Prince and Smolensky 2004), has dealt with this phenomenon in terms of constraint interaction and there is strong agreement that the motivation for this process is that preliquid nasalization contributes to improving poor condition of syllable contact (Shin 1997, Davis and Shin 1999, S. Hong 2000, H. Kang 2002).

Given pre-liquid nasalization and post-nasal delateralization, it is expected that the lateral is nasalized post-nasally (/m/ + /l/ → [mn], /ŋ/ + /l/ → [ŋn]). In the adjacency of alveolar nasal and liquid, however, it is not only nasalization but lateralization that takes place: /n/ + /l/ → [nn] or [ll]. Both types of geminate structure in the output improve syllable contact.

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The Syllable Contact constraint revised from Vennemann's (1988) original proposal of the Syllable Contact Law is given in (1).

- (1) Syllable Contact (SC: Davis and Shin 1999)
 Avoid rising sonority over a syllable boundary.

Given the Syllable Contact constraint in (1), a sequence of a lateral followed by a nasal stop, namely, /l/ + /n/, should be exempt from any assimilatory process since there is no syllable contact-based motivation for assimilation in the input: the lateral is more sonorous than its following nasal. However, lateralization never fails to take place in the sequence of these two sonorants: /l/ + /n/ → [ll] (*[ln], *[nn]).

Focusing on aspects of assimilation between two alveolar sonorants /n/ and /l/, this study provides an optimality-theoretic account of sonorant assimilation, where lateralization takes place when the lateral is followed by the nasal, but nasalization is the predominant pattern of assimilation when the precedence is reversed. This generalization holds true for different strata of the lexicon and different domains of the prosodic hierarchy. This study claims that the type of geminate structure in the output is determined by the morphological structure of the input. The predominant pattern of sonorant assimilation is the one in which the sonorant in the stem as an independent word determines the target value of assimilation. Furthermore, the sonorant in the stem-final position takes priority over the stem-initial one in the case where there are two stems competing within the domain of sonorant assimilation.

This paper is organized as follows: the following section presents dominance of the feature [lateral] over [nasal] within the domain of the Sino-Korean word. Section 3 presents an analysis of the assimilation pattern where the output of assimilation is dependent on the stem-final sonorant, regardless of the feature involved, i.e. [lateral] or [nasal], and claims that sonorant assimilation is not feature-dependent, but stem-driven, arguing for the morphological role of sonorant assimilation. Stem-driven assimilation is further attested in loanword phonology in section 4 and in higher prosodic domains in section 5, and a more specific claim is made, namely that the target value is determined by the stem-final sonorant.

2. Feature-driven assimilation in minimal phonological word

In (2) we see cases of lateralization in the Sino-Korean strata, regardless of the linear precedence between alveolar nasal and lateral.

- (2) Lateralization in Sino-Korean words
 a. /n+l/ → [pallon] 'counterargument'
 (cf. [non-cæŋ] 'debate', [tho-ron] 'discussion')

- /pun +lan/ → [pullan] ‘rampage’
 (cf. [nan-dong] ‘riot’; [so-ran] ‘turmoil’)
- /kin +lo/ → [killo] ‘work’
 (cf. [no-don] ‘labor’; [kwa-ro] ‘overwork’)
- b. /l+n/
- /sil +næ/ → [sillæ] ‘indoor’
 (cf. [kyo-næ] ‘within the school’)
- /il +nyəm/ → [illyəm] ‘one devoted thought’
 (cf. [kæ-nyəm] ‘concept’)
- /hil +nan/ → [hillan] ‘reproach’
 (cf. [pi-nan] ‘blame’)

It is generally accepted in Korean phonology that the word-initial [n] is underlyingly lateral /l/. Word-initial /l/ surfaces as [n], as shown in [non-cæn] from the input /lon+cæn/ in (2a), while it alternates with flap intervocally as in [tho-ron]. This leads to the claim that there is no word-medial, yet morpheme-initial alveolar nasal /n/ in the input. Although this statement is true to a great extent, it directly contradicts the input representation in (2b). A handful of Sino-Korean morphemes, as listed in (2b), are no longer lateral in the input: they are underlyingly alveolar nasal /n/ since they surface as nasal intervocally. In other words, there is an underlying /l/ that alternates with [n] in initial position, in contrast to an underlying /n/ that does not alternate. Note that morpheme-initial sonorant in (2b) does not become a flap in the intervocalic environment, as in (2a). This suggests that Sino-Korean morphemes such as in (2b) are under the process of restructuring the input from /l/ into /n/ in morpheme-initial position.

Having set the input representation of the /n/-initial and /l/-initial morphemes, we need the following constraints to account for lateralization.

- (3) I-O constraints and their ranking¹ (Davis and Shin 1999)
- a. Max-IO(lat): The feature [+lateral] from an input segment is realized in the output.
 - b. Max-IO(nas): The feature [+nasal] from an input segment is realized in the output.
 - c. Max-IO(lat) ≫ Max-IO(nas)

Two faithfulness constraints evaluate I-O correspondence with respect to the features [lateral] and [nasal]. As lateralization takes precedence over nasalization in determining the output of two adjacent alveolar sonorants, Max-IO(lat) is ranked higher than Max-IO(nas). SC (Syllable Contact) in (1) is ranked undominated since assimilation is motivated by the syllable contact.

¹ Apart from designation of the marked value for the features [lateral] and [nasal], Max constraints in (5) are the same as postulated in Davis and Shin (1999).

Unlike the sonorant sequence /n+l/, the reversed order /l+n/ does not violate the syllable contact constraint, and yet undergoes lateralization. Thus, a constraint regulating the contact between two sonorants is proposed as follows:

(4) *HeteroSonority (*Hetero)²

A sequence of alveolar sonorants of different sonority rank is disallowed.

As *Hetero carries out a more specific function of syllable contact between two sonorants, this is also ranked above the faithfulness constraints in (5), hence yielding the following constraint ranking:

(5) SC, *Hetero \gg Max-IO(lat) \gg Max-IO(nas)

Given the constraints and their ranking, the cases in (2a) and (2b) are accounted for essentially in the same way as in Davis and Shin (1999):

(6) Word-internal lateralization

i.	/n-l/	SC	*Hetero	Max-IO(lat)	Max-IO(nas)
	a. nl	*!	*		
	^{1.5} b. ll			*!	*
	c. nn				
ii.	/l-n/	SC	*Hetero	Max-IO(lat)	Max-IO(nas)
	a. ln		*!		
	^{1.5} b. ll				*
	c. nn			*!	

As I-O faithfulness with respect to the feature [lateral] ranks higher than the one with respect to [nasal], assimilation of the input sequence involving nasal and lateral in any precedence relation is bound to be symmetric, selecting the lateral geminate as the optimal output. Thus, within the domain of phonological word a sequence of nasal followed by lateral systematically surfaces not as a nasal geminate but as a lateral geminate, as predicted by the constraint ranking.

The insight of the autosegmental account, where lateralization was dealt with by spreading the feature [lateral] (Iverson and Sohn 1994), is captured in OT by the constraint ranking in which faithfulness to the feature [lateral] is more dominant than faithfulness to [nasal]. However, this reformulation is not readily available when the lateral geminate is not necessarily optimal as an output, a situation to which we now turn.

² This constraint is essentially the same as Similarity constraint in Davis and Shin (1999).

3. Stem-driven assimilation

In (7) we see cases in which a sequence of /n+l/ does not conform to the pattern of lateral assimilation discussed above. Nasalization takes place across the free morpheme boundary of Sino-Korean stems. The output with a nasal geminate is the dominant speech pattern preferred by most contemporary speakers, although the one with a lateral geminate is marginally accepted by a limited group of speakers in the older generation.

(7)	Dominant	Marginal
/nokin-li/	[nokinni] [nokilli]	‘small town (Li) of Nokeun’ (cf. [cinbu-ri] ‘Cinbu town’)
/dæhan-lo/	[dæhanno] [dæhallo]	‘Daehan Street’ (cf. [kuma-ro] ‘Kuma Road’)
/imun-lon/	[imunnon] [imullon]	‘phonology (theory)’ (cf. [kyəŋce-ron] ‘economics theory’)

Difference between the data in (2) and (7) lies in the nature of the morphemes involved. In the former, two bound morphemes are combined to form a Sino-Korean word, while in the latter a bound morpheme is preceded by a stem, which may appear as an independent word.

The marginal speech pattern with its lateral geminate in the output is accounted for straightforwardly as they are parallel to the cases in (2a): given the I-O faithfulness constraint on [lateral] ranked above the one on [nasal] as in (5), the word-medial and morpheme-initial lateral /l/ is expected to surface in the output, triggering lateralization of the preceding nasal, as illustrated in tableau (6i).

The dominant speech pattern, by contrast, involves a nasal geminate. In this pattern, the priority is to preserve the stem-final nasal rather than the feature [lateral], contrary to what is implied by the ranking in (5). When the morphological structure is taken into consideration, the inputs in (7) are prosodically represented as follows:

- (8) [[nokin]_{PWD} li]_{PWD}
 [[dæhan]_{PWD} lo]_{PWD}
 [[imun]_{PWD} lon]_{PWD}

Each stem in (7) forms an independent word and, as a consequence, is subject to Base Identity (Kenstowicz 1996), whereby the stem undergoes evaluation by an O-O faithfulness constraint (Benua 1997, McCarthy and Prince 1995), in addition to I-O correspondence³.

³ H. Kang (2002) made essentially the same proposal on the prosodic structure of the words as in (8), which led her to proposing O-O faithfulness constraints. Unlike H. Kang’s, however, O-O correspondence in the present paper is differentiated with respect to positions in the syllable as well as to features, as introduced in (9).

As a parallel to the constraints in (3), an O-O faithfulness constraint is postulated below. Since it is the nasal segment in the coda that crucially corresponds between output and output, the constraint must specify syllable position.

(9) Max-OO(nas/cod)

The feature [+nasal] in coda position from an output segment is realized in the corresponding output.

For the O-O faithfulness effect to be seen, it needs to be ranked above Max-IO constraints, hence yielding the following constraint ranking:

(10) Constraint ranking (revised from (5))

SC, *Hetero \gg Max-OO(nas/cod) \gg Max-IO(lat) \gg Max-IO(nas)

Given the constraint ranking as in (10), selection of the optimal form for the dominant speech pattern is illustrated below:

(11) /dæhan-lo/ \rightarrow [dæhanno] (output: [dæhan])

/n-l/	SC	*Hetero	Max-OO(nas/cod)	Max-IO(lat)	Max-IO(nas)
a. nl	*!	*			
b. ll			*!		*
c. nn				*	

The output with the lateral geminate loses out by fatally violating the O-O faithfulness constraint. Thus, the dominant speech pattern is distinguished from the word-internal assimilation across two bound morphemes as in (2), on the one hand, and on the other, from the marginal speech, which apparently ignores the nested prosodic word structure represented in (8).

The analysis offered in terms of O-O correspondence can be extended to nasalization of the suffixes in (12), where unlike the cases in (7), the marginal speech pattern yielding a lateral geminate is not acceptable⁴.

⁴ Nasalization takes place regardless of whether the stem is a Sino-Korean or loanword (cf. /ilbon-lyəŋ/ \rightarrow [ilbonnyəŋ] (*[ilbollyəŋ]) ‘Japanese Territory’ vs. /sip^hein-lyəŋ/ \rightarrow [sip^heinnyəŋ] (*[sip^heillyəŋ]) ‘Spanish Territory’ (H. Kang (2003)); /k^hæn-lyu/ \rightarrow [k^hænnnyu] (*[k^hæillyu]) ‘category of can’).

Nonetheless, discrepancy with respect to acceptability of lateral geminate in the output between the data (7) and (12) remains to be further investigated. *A priori*, lateral germination is induced by the morphological boundary across two bound morphemes. On an empirical note, however, fluctuation between recognition of the stem boundary and its (mis)interpretation as a bound morpheme boundary seems to narrow down to a matter of frequency and familiarity of the suffixal morphemes. Frequently used words whose tokens involve instances of lateral geminate tend to allow lateral gemination as in (7), while stems preceding the infrequent suffixes are robust in their stem demarcation as in (12), hence blocking lateral geminate. See also discussion in footnote 6.

- (12) Stem-final /n/ followed by suffix-initial /l/
- a. /sæŋsən-lyu/ → [sæŋsə~~nn~~yu], *[sæŋsə~~ll~~yu] ‘category of fish’
 cf. /pun+lyu/ → [pu~~ll~~yu], *[pu~~nn~~yu] ‘categorization’
 - b. /caŋkwan-lyəŋ/ → [caŋgwə~~nn~~yəŋ], *[caŋgwə~~ll~~yəŋ] ‘Minister’s Order’
 cf. /hun+lyəŋ/ → [hu~~ll~~yəŋ], *[hu~~nn~~yəŋ] ‘disciplinary order’

The sonorant sequence of nasal followed by lateral systematically surfaces as a nasal geminate when the nasal and lateral are stem-final and suffix-initial respectively.⁵ Note that this contrasts with the output of lateral geminate, which arises across the bound morpheme boundary, as observed in (2a).

To summarize, a sequence of two alveolar sonorants does not yield lateralization across the board. The lateral geminate arises as an artifact of the constraint interaction between input and output, where faithfulness to laterality has priority over faithfulness to nasality. When the stem which is nested in a phonological word functions as an identifiable base, however, the effect of Base Identity (Kenstowicz 1996) derives stem-driven assimilation: O-O correspondence is established and the nature of the geminate is determined by the stem-final sonorant. What follows from this generalization is the corollary that the stem-final lateral results in a lateral geminate, to which we now turn.

4. Stem-final sonorant as target value of assimilation

4.1 Lateralization in compound

In (13) we see compounds where lateral is followed by nasal and both of the constituents function as an independent word.

⁵ There is an exception to this generalization:

/dækwan-lyəŋ/ → [dægwa~~ll~~yəŋ], *[dægwa~~nn~~yəŋ] ‘Daegwan Ridge’
 cf. /cun+lyəŋ/ → [cu~~ll~~yəŋ], *[cu~~nn~~yəŋ] ‘steep ridge’

Unlike the generalization, lateral geminate is the dominant speech pattern in the suffixed form, disallowing a nasal geminate in the output. I speculate that this word is of particularly common use as a proper place name in Korea and that its frequent usage contributes to blurring its internal morphological boundary and to making the entire structure unanalyzable. Although /-lyəŋ/ is identifiable as a morpheme, high frequency of the entire word as a unit seems to impose a certain limitation on the morphological identifiability of the stem as an independent word. That is, the morphological structure of /dækwan-lyəŋ/ is equivalent to the one in (2a), which is simply a concatenation of two bound morphemes. If this is the case, then the stem in /dækwan-lyəŋ/ is no longer subject to O-O correspondence and lateralization comes into play under the effect of Max-IO(lat), as shown in tableau (6).

As pointed out by an anonymous reviewer, however, issues remain unresolved on how frequent a word should be when its stem boundary no longer counts as such in the morphological computation and how this effect can be correctly modeled in phonological account.

(13) Lateralization in Native compounds

/mul/ +/noli/	→ [mul l ori]	‘water activity’
‘water’ ‘play’		
/kyəul/ +/namul/	→ [kyəul l amul]	‘winter vegetable’
‘winter’ ‘vegetable’		
/hani/ +/nala/	→ [hani l ara]	‘heaven’
‘sky’ ‘kingdom’		
/səl/ +/nal/	→ [səl l al]	‘New Year’s day’
‘New Year’s day’ ‘day’		
/cul/ +/nəmki/	→ [cul l əmki]	‘jump rope’
‘rope’ ‘jumping’		

The second compounding element beginning with nasal might raise the issue of how abstract phonology is, provided the phonotactic constraint banning word-initial /l/ in Korean. On the basis of the absence of alternation between [n] and [l] in the intervocalic environment (/əpəi/+nal/ → [əpəi-nal], *[əpəi-ral] ‘parents’ day’), however, there is no justification for positing an underlying /l/ in the morpheme-initial position. Instead, the underlying representation is posited to be /n/, thus avoiding unnecessary and unjustified abstraction.⁶

When compared with the cases in (7), positions of the lateral and nasal in the syllable are switched around in (13), and hence Max-OO(nas/cod) in (9) becomes irrelevant here. The following constraints are additionally required:

(14) O-O constraints

- a. Max-OO(lat/cod): The feature [+lateral] in coda position from an output segment is realized in the corresponding output.
- b. Max-OO(nas/ons): The feature [+nasal] in onset position from an output segment is realized in the corresponding output.
- c. Max-OO(lat/cod) ≫ Max-OO(nas/ons)

Max-OO(lat/cod) is ranked higher than Max-OO(nas/ons) since it is the lateral geminate that surfaces in (13).

For the effect of O-O correspondence to be seen, O-O faithfulness constraints need to be ranked above I-O constraints. Putting the constraints in (14) together with those discussed above, we arrive at the following constraint ranking:

(15) Constraint ranking (revised from (10))

- SC, *Hetero ≫ Max-OO(nas/cod), Max-OO(lat/cod) ≫ Max-OO(nas/ons) ≫ Max-IO(lat) ≫ Max-IO(nas)

⁶ Unlike Sino-Korean morphemes where there is an underlying /l/ that alternates with [n] in initial position in contrast to an underlying /n/ that does not alternate (cf. (2)), parallel alternation between underlying /l/ and [n] is not observed in Native Korean words. Therefore, no Native Korean word begins with /l/ underlyingly.

Max-OO(nas/cod) and Max-OO(lat/cod) are invoked in the grammar on a complementary basis and hence are unranked with respect to each other. This also suggests a parallel postulation of Max-OO(lat/ons) in the grammar unranked with respect to Max-OO(nas/ons), although it is not motivated yet due to lack of liquid-initial independent words.

Selection of an optimal form in (13) is illustrated below:

(16) /mul/ +/noli/ → [mullori] (outputs: [mul]; [nori])

/l-n/	*Hetero	Max-OO(lat/cod)	Max-OO(nas/ons)	Max-IO(lat)
a. ln	*!			
b. ll			*	
c. nn		*!		*

In (16) it is Max-OO(lat/cod) that crucially opts for lateral geminate, as it was Max-OO(nas/cod) that selected a nasal geminate in tableau (11). Note here that there are two O-O faithfulness constraints lined up above the I-O faithfulness constraints since the cases in (13) are compounds, while tableau (11) deployed a single O-O constraint as the data in (7) are cases of suffixation.

To summarize, as in the case of suffixation in previous discussion, assimilation within a compound corroborates the claim that a free morpheme functions as an identifiable independent word, and serves as the base for drawing a correspondence relationship. The claim that the lateral geminate in (13) is an output of stem-driven assimilation whose target value is set to the stem-final sonorant, although it coincides with the output of feature-dependent assimilation, is further supported by nasalization in loanword compounds, to which we now turn.

4.2 Nasalization in Loanword

Unlike Sino-Korean or Native Korean words where a phonotactic constraint disallowing words beginning with lateral restricts the possible sonorant to nasals in the word-initial position, loanwords are exempt from this binding constraint and the liquid freely appears in the word-initial position (O. Kang 1993, E. Han 1993, Cho 1997, Davis and Shin 1999, J. Jun 2000, H. Kang 2003, M. Seo 2004). That is, the constraint prohibiting singleton /l/ in the word-initial position is no longer valid in the loanword strata in the lexicon.

In (17) we see loanwords beginning with liquid adapted from the L2 liquid, regardless of whether it is lateral or central in the source language⁷. The liquid surfaces as a flap [ɾ] in the onset, but as a lateral [l] in the coda, showing complementary distribution. Thus, liquid is unspecified with

⁷ Distinction is made in intervocalic position depending on whether the liquid is lateral or not: [alloe] 'aloe' vs. [aroma] 'aroma'. The issue of distinguishing lateral vs. central liquid, however, does not directly bear on the present discussion.

respect to the feature [lateral] in the input of L1; it is specified with the feature [approximant].⁸

(17) Loanwords with liquid

- a. /Lopi/ → [robi] ‘lobby’
 /Lain/ → [rain] ‘line’
 /Læp^h/ → [ræp] ‘lap’
 b. /Latio/ → [radio] ‘radio’
 /Litim/ → [ridim] ‘rhythm’
 /Læp^h/ → [ræp] ‘wrap’
 c. /maiL/ → [mail] ‘mile’
 /t^haiL/ → [t^hail] ‘tile’
 /p^haiL/ → [p^hail] ‘file’

As word-initial liquid is allowed in loanwords, we need constraints to adapt the liquid into lateral and flap according to their position in the syllable and postulate two constraints, *_o[l] and *_r[_o], to the effect of no singleton lateral [l] in the onset and no flap [r] in the coda respectively. These two markedness constraints are ranked above the faithfulness constraints with respect to the features [approximant] and [lateral]. As the input contains liquid from loanword adaptation, which is unspecified with respect to laterality, I-O correspondence with respect to the features [+sonorant] and [+approximant] needs to be added in the tableau.

(18) [robi] ‘lobby’, [radio] ‘radio’, [mail] ‘mile’

i.	/Lopi/	* _o [l]	* _r [_o]	Max-IO(son)	Max-IO(appr)
	a. lobi	*!			
	^{1,28} b. robi				
	c. nobi				*!
ii.	/Latio/	* _o [l]	* _r [_o]	Max-IO(son)	Max-IO(appr)
	a. ladio	*!			
	^{1,28} b. radio				
	c. nadio				*!
iii.	/maiL/	* _o [l]	* _r [_o]	Max-IO(son)	Max-IO(appr)
	^{1,28} a. mail				
	b. mair		*!		
	c. main				*!

⁸ Under the present account where O-O correspondence as well as markedness constraints such as *_o[l] and *_r[_o] are ranked above I-O correspondence, the underspecified representation is not crucially more explanatory than the fully specified representation in which the loanword liquid is specified with either [+lateral] or [-lateral]. Based on the complementary nature of the allophones of the loanword liquid, however, the underspecified representation is assumed in this paper.

As the liquid /L/ is unspecified in the input with respect to the feature [lateral], the constraint Max-IO(lat) is vacuously satisfied across the board, and hence is left out from the tableau above.

Compounding in loanwords provides a ground to investigate the nature of assimilation between nasal and lateral since loanwords are exempt from the native constraint banning a word-initial lateral. In (19) we see cases of O-O correspondence in loanword compounds, where each compounding element stands as an output. The data are broadly termed compounds since they are regarded as analyzable and identified as independent words. The cases in (19) are instances of O-O correspondence where the stem-final nasal in an output triggers a nasal geminate.

- (19) Loanword compounds (/n+L/)
- | | |
|-------------------------------------|---|
| /wən/ + /Lum/ | [wə nn um](*[wə ll um]) |
| ‘studio apt (one room)’ | |
| /taun/ + /Loti/ | [taun nn odi] (*[taun ll odi]) |
| ‘download’ | |
| /in/ + /Lain/ | [in nn ain](*[in ll ain]) |
| ‘inline skate’ | |
| /kiLin/ + /Lain/ | [kirin nn ain](*[kirin ll ain]) |
| ‘Green Line (subway)’ | |
| /Lopinsən/ + /Lisit ^h i/ | [robin sənn isit ^h i](*[robin səll isit ^h i]) |
| ‘Robinson list’ | |
| /sucan/ + /Læmci/ | [sucan nn æmci](*[sucan ll æmci]) |
| ‘Susan Ramsey’ | |

The dominant speech pattern is a nasal geminate, and speakers avoid an output with a lateral geminate, which would be optimal if sonorant assimilation were feature-driven⁹.

Selection of the optimal form in (19) is essentially the same as shown in tableau (16). Note, however, that the constraint Max-OO(lat/ons), as a symmetric counterpart to Max-OO(nas/cod), is left out from tableau (20): it is vacuously satisfied across all the candidates since the word-initial liquid is no longer lateral in the output [roti]. On the other hand, the markedness constraint *RR is added to tableau (20) since geminate sonorants are universally more marked than the geminate obstruents and geminate flap [rr] is less preferred in the geminate liquids (Kawahara 2005). Geminate flap [rr] is articulatorily dispreferred as well since flap has a very short duration in

⁹ There is an exceptional case in which unlike the cases in (19), a lateral geminate is not entirely ruled out: /on/+Lain/ → [on**nn**ain] ([ollain]) ‘online’. The output with nasal geminate [on**nn**ain] is the dominant speech pattern and it falls out from dominance of the stem-final sonorant in O-O correspondence, in the same way as illustrated in tableau (20). The marginally accepted output form [ollain] is a consequence of the dominance of the feature [lateral], as observed in Sino-Korean words consisting of two bound morphemes. This suggests that to those speakers who accept lateral geminate, the morphological structure as compounding is invisible and the word as a whole is regarded as an unanalyzable unit.

Korean (Ahn and Gordon 2005), and hence prolonging the constriction duration would result in a different quality of sonorant, namely a trill. The markedness constraint *RR is ranked higher than correspondence constraints, and is unranked with respect to other undominated markedness constraints regulating syllable contact:

(20) /taun/ + /Loti/ → [taunnodi] (outputs: [taun]; [roti])

/n-L/	*Hetero	* _o [l]	*RR	Max-OO (nas/cod)	Max-IO (son)	Max-IO (appr)
a. nl	*!	*				
b. nr	*!					
c. nt					*!	*
d. rr			*!	*		
e. ll				*!		
f. nn						*

Non-assimilated candidates in (20a, b) are fatal since they violate *Hetero as well as SC. The candidate [nt] in (20c) violates correspondence with respect to [+sonorant] as well as [+approximant]. Assimilation to the flap yielding [rr] in (20d) is blocked due to the markedness constraint banning geminate rhotics, and the competitive candidate [ll] in (20e) loses out by crucially failing to preserve the stem-final nasal in an output. Thus, the constraint ranking in tableau (20) shows that given the input sequence of nasal followed by liquid, nasal geminate is selected as the optimal output in the domain above the minimal phonological word.

Selection of nasal geminate as an optimal candidate provides supporting evidence to the claim that the nature of sonorant assimilation is stem-driven, and that when there are two stems competing, the target value of sonorant assimilation is determined by the stem-final, but not stem-initial, sonorant.

Cases in (21) further corroborate the claim that the nature of the geminate structure is dependent on the stem-final sonorant. Just as a sequence of nasal followed by lateral systematically surfaces as a nasal geminate in (19), a sequence in reverse order as in (21) systematically results in a lateral geminate, disallowing a nasal geminate.

(21) Loanword compounds (/L+n/)

/pæ ^h iL/ +/nes/	[pæ ^h il ^h et] (*[pæ ^h in ^h net])
‘battle net (game)’	
/piL/ + /nait ^h i/	[pillait ^h i] (*[pinnait ^h i])
‘Bill Knight’	
/mont ^h iLioL/ + /naLit ^h a/ (/kukan/)	[mont ^h iriollait ^h a]
‘flight between Montreal and Narita’	(*[mont ^h irionnarit ^h a])

Selection of the optimal form in (21) is symmetric to the cases in (19), and is essentially the same as shown in tableau (20), except for the fact that the target features of the relevant O-O correspondence constraints are switched around, namely Max-OO(lat/cod) and Max-OO(nas/ons).

(22) /pæt^hiL/ +/nes/ → [pæt^hi~~l~~et] (outputs: [pæt^hi], [net])

/L-n/	*Hetero	*r] _o	*RR	Max-OO (lat/cod)	Max-OO (nas/ons)	Max-IO (son)
a. ln	*!					
b. rn	*!	*		*		
c. tn				*!		*
d. rr			*!	*	*	
e. nn				*!		
f. ll					*	

It is the stem-final lateral, not the stem-initial nasal that is preserved in the sonorant assimilation. This result is consistent with O-O correspondence required in the analysis of Sino-Korean suffixation in (7) and (12) and Native Korean compounding in (13). Although the geminate structure in (21) coincides with the result of feature-driven assimilation within a minimal phonological word, it is the stem-final sonorant that determines the target value of sonorant assimilation within a compound, so that it results in nasal geminate and lateral geminate in (19) and (21) respectively.

To represent sonorant assimilation in terms of constraint ranking, stem-driven sonorant assimilation is accounted for by the following constraint ranking¹⁰:

- (23) Stem-driven assimilation (final)
 SC, *Hetero, *_ol, *RR ≫ Max-OO(nas/cod), Max-OO(lat/cod) ≫
 Max-OO(lat/ons), Max-OO(nas/ons) ≫ Max-IO(son) ≫ Max-
 IO(appr) ≫ Max-IO(lat) ≫ Max-IO(nas)

Sonorant assimilation whose target value is determined by the stem-final sonorant is represented by the ranking in which O-O correspondence for the stem-final sonorant is ranked above the one for the stem-initial sonorant.

¹⁰ Postulation of Max-OO(lat/ons) in the constraint ranking in (23), in spite of its non-distinctive role in tableau (20), potentially reflects non-assimilating speech where an underlying liquid is realized as a liquid in loanword sequences of nasal followed by liquid (also refer to production-based observation of non-assimilatory tendency in sonorant sequence reported in M. Seo (2004)). Non-assimilating form [onrain] 'online' (cf. footnote (10)), for example, is the speech which demotes the markedness constraints SC and *Hetero lower than I-O correspondence, so that a sequence of alveolar sonorants is not motivated to assimilate to each other. Once assimilation is unmotivated, it is O-O correspondence that is responsible for the nature of the output [nr] in a sequence of sonorants.

By contrast, feature-driven assimilation is distinguished from stem-driven assimilation by unavailability of O-O correspondence. To show that I-O correspondence is directly governed by the markedness in feature-driven assimilation, O-O correspondence is abstracted away from the constraint ranking in (24).

- (24) Feature-driven assimilation (O-O correspondence is unavailable)
 SC, *Hetero, *_o[l, *RR ≫ Max-IO(son) ≫ Max-IO(appr) ≫
 Max-IO(lat) ≫ Max-IO(nas)

Unavailability of O-O correspondence is conditioned by the morphological structure, where there are bound morphemes but no stems from which an O-O correspondence can be drawn.

To summarize, morphological structure of compounds corroborates stem-driven sonorant assimilation, namely that the nature of the output geminate is determined by the stem-final sonorant. From the prosodic perspective, sonorant assimilation makes reference to whether it takes place within a minimal phonological word across two bound morphemes or within a maximal phonological word in which at least a minimal phonological word is nested. This leads to a claim that when two alveolar sonorants are in contact across the prosodic word boundary, the nature of geminate in the output is not feature-dependent, but stem-driven, and more specifically, that faithfulness to the stem-final sonorant is more imperative than to the stem-initial sonorant.

5. Sonorant assimilation in higher prosodic domain

It has been shown that geminate output arising from assimilation between two alveolar sonorants is dependent on the stem-final sonorant insofar as it is related to an output form. The same effect can be tested in higher prosodic domains such as the phonological phrase (PP) and intonational phrase (IP). Noun phrase in Korean requires a modifier when it is modified by verbal phrase, as shown in (25) and (26): in (25) the present tense modifier /-n/ is followed by liquid-initial head noun, whereas in (26) the future tense modifier /-l/ is followed by nasal-initial head noun.

- (25) /n+L/ → [nn] (*[ll]) within PP
 /pap'i-n/ + /Ləsiawə/ → [nn] 'busy rushhour'
 'busy'-Mod. rushhour
 /əLyəu-n/ + /Lat^hin-ə/ → [nn] 'difficult Latin'
 'difficult'-Mod. Latin-language
 /simcəki-n/ + /Loti/ → [nn] 'mental burden'
 'mental'-Mod. load
 /cal/ + /c'ai-n/ + /Lotimæp/ → [nn] 'well-wrought roadmap'
 'well' 'wrought'-Mod. roadmap

- (26) /l+n/ → [ll] (*[nn]) within PP
 /til-il/ + /noræ/ → [ll] ‘song to hear’
 ‘hear’-Fut. Mod. ‘song’
 /mæk-il/ + /namul/ → [ll] ‘vegetable to eat’
 ‘eat’-Fut. Mod. ‘vegetable’
 /yəhæŋha-l/ + /noLiwei/ → [ll] ‘Norway to travel around’
 ‘travel’-Fut. Mod. Norway

The two sonorants nasal and liquid abut each other across the words within PP and the output of sonorant assimilation is dependent on the word-final sonorant. The present tense modifier /-n/ triggers nasal assimilation while the future tense modifier /-l/ triggers lateral assimilation. This adds to the instances of the active role of the O-O correspondence implemented by Max-OO(nas/cod) and Max-OO(lat/cod). The dichotomy of nasal and lateral geminates conditioned respectively by the present and future tense modifiers can also be construed as a reflection of Paradigm Contrast (Kenstowicz 2005), whereby phonological distinctness of the paradigm remains phonetically contrastive to mark the morphological contrast.

The effect of sonorant assimilation driven by the word-final sonorant¹¹, as represented by O-O correspondence is consistent in the prosodic domain of IP as well. In (27) IP-initial PP is the subject ending with the nominative case marker /-(i)n/ and its predicate begins with a liquid. A sequence of nasal followed by lateral surfaces as a nasal geminate. Following Paradigm Contrast, the nominative case marker preserves its word-final nasal to remain morphologically distinct from the accusative case marker /-(i)l/.

- (27) /n+L/ → [nn] (*[ll]) within IP
 {(yæki-n)_{PP} (Loma-ta)_{PP}}_{IP} → [nn]
 here-Nom. Rome-Ind.
 ‘It’s Rome here.’
 {(ikə-n)_{PP} (Ladio-ta)_{PP}}_{IP} → [nn]
 this-Nom. radio-Ind.
 ‘This is a radio.’
 {(cikim-in)_{PP} (Lodiŋ-cuŋ-i-ta)_{PP}}_{IP} → [nn]
 now-Nom. loading-under way-Comp.-Ind.
 ‘It’s loading now.’

As the word-final sonorant is a part of a grammatical element in the cases above, the effect of sonorant assimilation driven by word-final sonorant coincides with the effect of Paradigm Contrast in prioritizing preservation of the sonorant in the coda.

¹¹ The term “word” in verbal morphology corresponds to inflectable “stem” in noun morphology. Therefore, the “word-final sonorant” in larger prosodic domain is equivalent to the “stem-final sonorant” in noun compounds.

In (28) IP-initial PP ends with a lateral and its following PP begins with a nasal. Lateral geminate arising from sonorant assimilation is obtained by the crucial role of O-O correspondence, namely Max-OO(lat/cod), and this supports sonorant assimilation driven by the word-final sonorant in the prosodic domain of IP.

- (28) /l+n/ → [ll] (*[nn]) within IP
 {(næil)_{PP} (noLiwei-lo kan-ta)_{PP}}_{IP} → [ll]
 tomorrow Norway-to go-Ind.
 ‘(We) go to Norway tomorrow.’
 {(mæil)_{PP} (nəmu təp-ta)_{PP}}_{IP} → [ll]
 everyday too warm-Ind.
 ‘It’s too warm everyday.’
 {(nil)_{PP} (namul-man mək-nin-ta)_{PP}}_{IP} → [ll]
 always vegetable-only eat-prs.-Ind.
 ‘(We) always eat vegetable only.’

To summarize, the effect of sonorant assimilation driven by the word-final sonorant is consistently observed in higher prosodic domains as well as within a maximal phonological word. As far as O-O correspondence is drawn with respect to the word-final sonorant, the nature of sonorant assimilation is in favor of preservation of the word-final, but not word-initial, sonorant.

6. Conclusion

It has been shown that morphological information on the status of morphemes in the domain of sonorant assimilation is crucial on account of geminate structure in the output, since unlike the prediction made in the serial rule-based approach or feature-spreading mechanism, a lateral geminate is not always the output structure arising from sonorant assimilation in the adjacency of a lateral and an alveolar nasal. Lateralization takes place when lateral is followed by nasal, but nasalization is the predominant pattern of assimilation when the precedence is reversed. This generalization holds true, however, under the condition that O-O correspondence is available, and it is attested against different strata of the lexicon and against different domains of the prosodic hierarchy. Argued from this general pattern of sonorant assimilation is that the nature of the geminate output is determined by the stem-final sonorant.

The pattern of sonorant assimilation driven by the stem-final sonorant is intriguing since it goes against the generally accepted claim of positional faithfulness to the onset. Given the effect of positional faithfulness reported in the literature (Beckman 1998, Zoll 1998, Lombardi 1999), where the onset is considered a prosodically prominent position, the generalization that we are led to, namely positional faithfulness to the coda sonorant,

orders further investigation on the phonological nature of nasalization and lateralization of the onset sonorant (J. Jun 2000, M. Seo 2005). The question that truly needs to be addressed is then why the sonorant in the onset does not play a prominent role in sonorant assimilation in Korean.

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