# Coda Cluster Simplification and the Emergence of Sonorants in Korean

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## 1. Introduction

In many languages, either epenthesis or deletion takes place to avoid consonant clusters due to a language-specific reason. Although epenthesis is the major occurrence, especially in loanword phonology (Yip 1993, 2002, Paradis & LaCharité 1997, Takano 2007), deletion tends to be preferred in Korean coda clusters. However, it is very difficult to decide which segment should be deleted in the Korean coda cluster simplification process. Hirano (1995, 1996) proposes that a segment with a simpler Feature Geometrical structure tends to be deleted. Although basically following Hirano (1995, 1996), I suggest the height of sonority is mainly related to deletion, and that this principle of sonority hierarchy is the main factor in examining this kind of phenomenon only if some Korean-specific coda conditions are added. In this case, the idiosyncratic behavior of sonorants, nasals and laterals, is found. Their idiosyncrasy can extend to sonorantization at syllable boundaries in Korean. In sonorantization, laterals behave more curiously than nasals. Lateralization only takes place when a targeted segment is a coronal. Otherwise, laterals themselves are nasalized by the counterparts.

In this paper, I analyze two kinds of phenomena and consider the idiosyncrasy of sonorant segments, especially those of laterals.

The remainder of this paper is constructed as follows: Section 2 discusses coda simplification and how it is analyzed in Optimality Theory (Prince & Smolensky 1993). Section 3 quotes Kuroda's (2003) sonorantization analysis at syllable boundaries, and suggests the idiosyncrasy of the sonorants, extending Kuroda's (2003) proposal to my analysis. The conclusion of this study is found in section 4.

## 2. Coda Simplification in Korean

### 2.1. Korean consonants and the coda condition

In Korean, there are 19 consonants as (NB $^{h}$, aspirated, ', emphatic):

(1) Korean consonants

| | | | | |
|---|---|---|---|---|
| p | t | tʃ | k | |
| $p^h$ | $t^h$ | $tʃ^h$ | $k^h$ | |
| p' | t' | tʃ' | k' | |
| | s | | | h |
| | s' | | | |
| m | n | | ŋ | |
| | l | | | |

In coda position, only seven consonants can be allowed as in (2). This is because neutralizations like those in (3) take place. Due to the neutralizations, obstruents are diminished to /-p/, /-t/ and /-k/. Fricatives and aspirated or emphatic segments are prohibited at a coda position.

(2) Korean coda inventory

| | | |
|---|---|---|
| -p | -t | -k |
| -m | -n | -ŋ |
| | -l | |

(3) Neutralization at coda position[1)]

| | | | | | | |
|---|---|---|---|---|---|---|
| -p | } -p | -t | } -t | -k | } -k | |
| $-p^h$ | | $-t^h$ | | $-k^h$ | | |
| | | -tʃ | | -k' | | |
| | | $-tʃ^h$ | | | | |
| | | -s | | | | |
| | | -s' | | | | |
| | | -h | | | | |

In Korean, coda clusters can be underlyingly allowed. This is confirmed by the Korean orthography and the phenomenon where an onsetless syllable gains the latter segment of the preceding coda cluster at the onset (see also Hirano 1995: 157) as in (4).

(4) hɯlk + i → hɯl.ki "soil (with nominative case marker)"
ɔps + ɔ → ɔp.sɔ "not to exist (adverbial form)"

Otherwise, at a word-ending or followed by a consonant, such coda clusters are simplified. (5) shows 11 possible underlying coda clusters. The cluster simplifications for each pattern are in (6).

(5)

| | | | |
|---|---|---|---|
| -lk | -lm | -lp | -lp$^h$ |
| -ks | -ps | -ls | |
| -nh | -lh | | |
| -ntʃ | -lt$^h$ | | |

(6)

| | | | |
|---|---|---|---|
| a. -(l)k; | hɯlk → h ɯk | | "soil" |
| b. -(l)m; | salm.ta → sam.t'a[2)] | | "to boil" |
| c. -(l)p; | palp.ta → pap.t'a[2)] | | "to step" |
| d. -(l)p$^h$; | ɯlp$^h$.ta → ɯp.t'a[2)] | | "to chant" |
| e. -k(s); | nɔks → n ɔk | | "soul" |
| f. -p(s); | ɔps.ta → ɔp.t'a[2)] | | "not to exist" |
| g. -l(s); | kols → kol | | "direction" |
| h. -n(h); | manh.ta → man.t$^h$a[3)] | "to be many" | |
| i. -l(h); | ilh.ta → il. t$^h$a[3)] | | "to lose" |
| j. -n(tʃ); | antʃ.ta → an. t'a[2)] | | "to sit down" |
| k. -l(t$^h$); | halt$^h$.ta → hal.t'a[2)] | | "to lick" |

Consider which segment is deleted and why. In the first approach, I try to classify 11 patterns by the position of a preserving segment; whether it is at the syllable edge or not. Among 11 patterns in (6), four patterns (a-d) show preservation of a syllable edge element, whereas the remaining seven patterns (e-k) show syllable edge deletion. Since there is no remarkable contrast between the two classes, there may be no important evidence here.

Next consider the sonority hierarchy. In general, a segment with lower sonority is preferred at a coda position. This is shown as the constraint ranking in Optimality Theory.

(7) *Margin/x: X cannot be at a syllable margin.
Ranking: *M/vowel >> *M/glide >> *M/lateral >> *M/nasal >> *M/obstruent

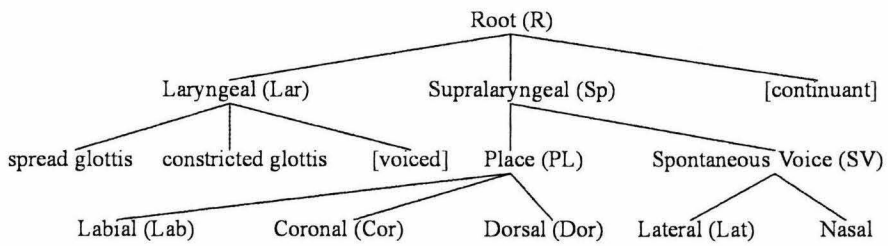
Among the examples in (6), only six patterns (a-f) satisfy the ranking in (7). Therefore, the sonority hierarchy principle may not function successfully.

Once again, try to focus only on laterals. Kuwamoto (2007) hints at the idiosyncrasy of laterals in French number and gender inflection. Kuwamoto (2007) shows some idiosyncratic behavior of French laterals as well as nasals, and in the same way, I consider a similar kind of idiosyncrasy of laterals in Korean. In (6) examples, there are four deleting laterals (-(l)k. -(l)m, -(l)p, -(l)p$^h$) whereas there are three preserving laterals (-l(s), -l(h), -l(t$^h$)). But any motivation for preserving or deleting laterals in these two groups cannot be considered. On the contrary, nasals are always, without exception, preserved regardless of their position or sonority hierarchy (-(l)m, -n(h), -n(tʃ)).

Hirano (1995, 1996) analyzes the same phenomenon of Korean coda cluster simplification in Feature

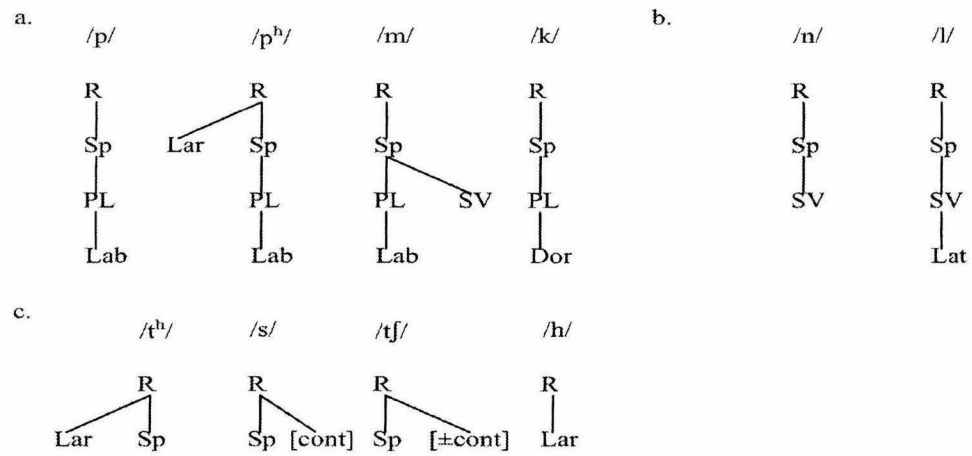
Geometry and Optimality Theory. Hirano (1995) adopts Archangeli's (1988) underspecification theory, where only unpredictable values for features or nodes are specified and where predictable values don't have to be underlyingly specified (cf. Archangeli 1988: 192). Hirano (1996) suggests Supralaryngeal Node and Spontaneous Voice Node by summing up a few previous studies.

(8) Hirano's (1996: 2) Feature Geometry




Hirano (1995) assumes that deleted consonants are structurally simpler than the other consonants in Korean consonant clusters. According to Hirano (1995), "structurally simpler" means having fewer underlying nodes or features. He presents the structures of 10 consonants related to coda cluster simplification.

(9)




The consonants in (9a) are the most preserving because they have the Place node. The consonants in (9b) follows those in (9a) because the SV node is specified. Consonants in (9c) are the most deleted segments without any specification of PL or SV nodes.

Here, some problems arise. First, why are coronals such as /tʰ/ or /tʃ/ deleted when it is true that obstruents are universally the most suitable elements as a syllable edge? Next, double articulated segments

such as aspirates or affricatives should be structurally "complicated," but /t$^{h}$/ or /tʃ/ are the simplest in this schema. While I agree with Hirano's (1995, 1996) suggestion about the structural simplicity of deleted segments, the fact remains that the complexity of aspirates and affricatives must be considered separately. Looking back on the examples in (6), all the aspirates and affricatives (except (6d)) are deleted. Fricatives are prohibited at a coda position, particularly in Korean. In (3) all fricatives are neutralized to the same place stops. This is formalized in Choi's (2002: 30) constraint.

(10) Coda Condition (CodaCon): Only /p, t, k, l, m, n, ŋ/ are allowed as coda in Korean.

Now let us analyze this phenomenon in Optimality Theory. In addition to some constraints mentioned above, the following are needed in order to be accounted for in this phenomenon:

(11) a. *Complex Coda (*CompCoda): Coda clusters are prohibited.
b. Identity[F] (Ident): Correspondent segments have identical values for feature [F].

*CompCoda and CodaCon are the most highly ranked because neither is prohibited in Korean phonology. Ident dominates sonority hierarchical constraints (*M/x) because any underlying fricatives, affricatives or aspirates are never preserved except in the case -(l)p$^{h}$ → -p, which will be discussed later. Thus a constraint ranking is assumed as in (12).

(12) *CompCoda, CodaCon >> Ident >> *M/lat >> *M/nas >> *M/obs

In the 11 patterns in (6), the first six examples (6a-f) delete the segment with the lower sonority. For example, (6b) salm.ta → sam.t'a is elaborated as in (13).

(13) salm.ta → sam.t'a "to boil"

| /salm/ | *CompCoda | CodaCond | Ident | *M/lat | *M/nas |
|---|---|---|---|---|---|
| a. salm | *! | | | | * |
| b. sal(m) | | | | *! | |
| ☞c. sa(l)m | | | | | * |

Fricatives, aspirates or affricatives are deleted regardless of their sonority hierarchy due to CodaCond.

(14) kols → kol "direction"

| /kols/ | *CompCoda | CodaCond | Ident | *M/lat | *M/obs |
|---|---|---|---|---|---|
| a. kols | *! | | | | * |
| ☞ b. kol(s) | | | | * | |
| c. ko(l)s | | *! | | | * |
| d. ko(l)t | | | *! | | * |

The example in (15) is rather problematic. In this type of evaluation, the candidate (15b) is optimal although it is not the correct output. The correct output is in fact (15d).

(15) ɯlp$^{h}$.ta → ɯp.t'a "to chant"

| /ɯlp$^{h}$/ | *CompCoda | CodaCond | Ident | *M/lat | *M/obs |
|---|---|---|---|---|---|
| a. ɯlp$^{h}$ | *! | | | | * |
| ☹ b. ɯl(p$^{h}$) | | | | * | |
| c. ɯ(l)p$^{h}$ | | *! | | | * |
| d. ɯ(l)p | | | *! | | * |

This exceptional example may contain two phonological processes; deletion and deaspiration. This reflects the Threshold Principle (Paradis & LaCharité 1997).

(16) Threshold Principle (Paradis & LaCharité 1997: 385)

All languages have a tolerance threshold to the amount of repair needed to enforce segment preservation.

Takano (2007) points out that processing by two or more steps required in a repair is too costly (cf. Paradis& LaCharité 1997: 385). In the case of (15), deletion and deaspiration simultaneously take place, so the correct output "ɯp.t'a" has to be regarded as quite exceptional.

Again, in fact, there are other ambiguous patterns. -lk and -lp have two types of coda simplification.

(17) -lk → -(l)k / -l(k) (but rare)

a. ilk.ta → ik.t'a / ilk.ko → il.k'o "to read (sentence final form / adverbial form)"

(18) -lp → -(l)p / -l(p)

a. palp.ta → pap.t'a "to step" (6c)

b. yɔ.tɔlp → yɔ.tɔl "eight"

c. nɔlp.ta → n ɔl.t'a / nɔlp. tʃɔk → n ɔp. tʃ'ɔk "to be wide / widely opened"

These exceptional examples in (15), (17) and (18) all contain /l/, which is very characteristic.

To summarize this section, Hirano's (1995, 1996) formalization about coda cluster simplification in Korean can be simplified by adopting CodaCond in Choi (2002) and the principle of sonority hierarchy even if not using rather complicated Feature Geometry. It is also remarkable that laterals behave idiosyncratically as well as the French number and gender alternations analyzed in Kuwamto (2007).

### 3. Sonorantization at Syllable Boundaries in Korean

The idiosyncratic behavior of laterals in Korean is shown in another type of phenomenon: sonorantization at syllable boundaries. There are two types of sonorantization at syllable boundaries in Korean; nasalization and lateralization.

Nasalization takes place in the following three ways:

(19) -p/-t/-k + m-/n- → -m/-n/-ŋ + m-/n- (regressive assimilation)

| | | |
|---|---|---|
| kap.ni.ta | → kam.ni.ta | "to come (formal)" |
| k'otʃʰ.no.ri | → k'on.no.ri | "seeing cherry blossoms" |
| pak.mul.kwan | → paŋ.mul.kwan | "museum" |

(20) -m/-ŋ + l- → -m/-ŋ + n- (progressive assimilation)

| | | |
|---|---|---|
| sim.ri | → sim.ni | "mentality" |
| koŋ.ryoŋ | → koŋ.nyoŋ | "dinosaur" |

(21) -p/-k + l- → -m/-ŋ + n- (reciprocal assimilation[4])

| | | |
|---|---|---|
| ip.ryɔk | → im.nyɔk | "input" |
| sik.ryo | → siŋ.nyo | "foodstuff" |

Targeted obstruents are all nasalized. Triggered consonants that nasalize a lateral are labial and dorsals. In the case of coronals /t/ and /n/ they are in turn targeted segments and lateralized by the following or precedent /l/.

(22) -t/-n + l- → -l.l- (regressive assimilation)

| | | |
|---|---|---|
| ti.kɯt.ri.ɯl | → ti.kɯl.li.ɯl | "'ㄷ (t-sound character)' & 'ㄹ (l-sound character)' " |
| sin.ra | → sil.la | "Silla (dynasty)" |

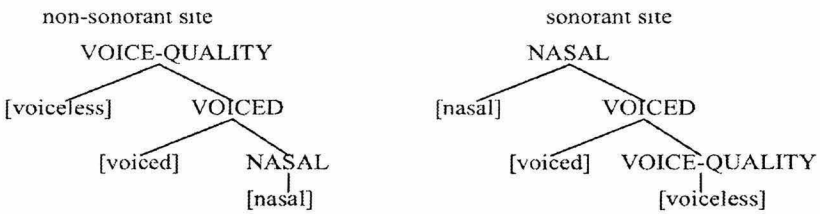
(23) -l + n- → -l + l- (progressive assimilation)

| | | |
|---|---|---|
| sɔl.nal | → sɔl.lal | "New Year's Day" |

Kuroda (2003) analyzes the above phenomena in Feature Geometry. Kuroda (2003: 93ff.) introduces "VOICE-QUALITY node" and "projection reversal." Kuroda (2003: 94) proposes that "sonorant sites" are designated where a sonorant is adjacent to another sonorant; then the branch VOICE-QUALITY is projected

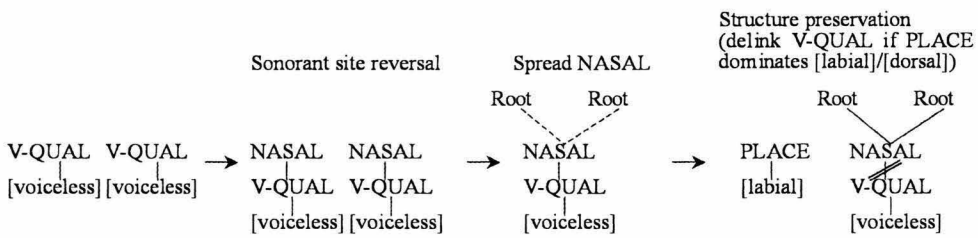
upside down due to the markedness characteristics at the sonorant site.

(24) Projection reversal

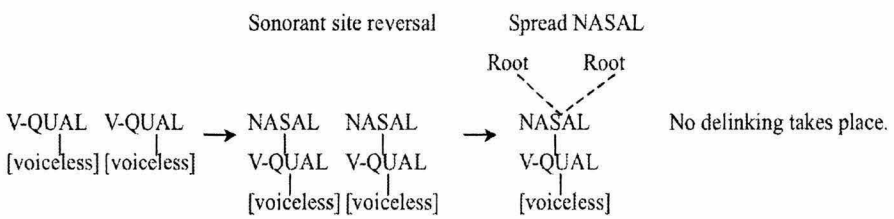



According to Kuroda (2003: 99ff.), nasalization and lateralization, like the examples in (19) through (23), are derived as follows:

(25) Nasalization; -p.l- → -m.n-




(26) Lateralization; -t.l- → -l.l-




The difference between nasalization and lateralization in the above diagrams is determined by whether V-QUAL node is delinked or not. This delinking only takes place when the triggered segment is a labial or a dorsal. If it is a coronal, lateralization takes place. But Kuroda's (2003) model cannot explain why labial or dorsal may cause delinking of V-QUAL.

As for nasalization, this takes place regardless of its relative sonority. For example, the nasalization -p.l- → -m.n-, /p/ is nasalized in spite of its originally low sonority (in general, lower sonority is preferred at a syllable edge), whereas /l/'s nasalization falls its sonority; /l/ → /n/. On the other hand, lateralization takes place only if the counterpart is coronal; /t/ and /n/, and in this case nasalization cannot take place at all. Why and how this occurs cannot be explained thus far. There is something curious about sonorant site in Kuroda's

(2003) proposal, and laterals, in particular, may behave idiosyncratically.

## 4. Conclusion

This paper examines coda cluster simplification and sonorantization at the syllable boundary in Korean. In simplification of coda clusters, nasals /m/ and /n/ are always preserved, whereas the lateral's emergence is not very clear. It is very curious that more sonorant segments are preferred as a coda against the universal tendency of the preference for lower sonority as a coda. This is because their counterparts tend to not be preferred for the language-specific reason (for fricatives) and due to the complexity of double articulated segments (for aspirates and affricatives). Otherwise, such deletions follow the sonority hierarchical principle. The idiosyncratic behavior of sonorants may be reflected in the syllable boundary sonorantization. Compared with nasalization, lateralization seems to be idiosyncratic because it takes place while only targeting on coronals /n/ and /t/.

## Notes

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1) In this chart, three possible codas are missing; -p', -t', -tʃ'. These do not exist in any coda position in Korean even if underlyingly.

2) In these circumstances, the following –p, -t, -k, -s are emphasized.

3) /h/ at a syllable-ending deletes but aspirates the following onset stop.

4) Kuroda (2003) classified it as "regressive assimilation."

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## 朝鮮語における複合音節末の子音削除と共鳴音の出没について

朝鮮語では、音節末で基底の子音複合が単子音化する現象がある。この問題について筆者は朝鮮語固有のコーダ位置での制約を回避するならばよりきこえ度の高い子音が削除されるということを示した。これは、コーダにはきこえ度の高い分節音はふさわしくないという一般的な原理を支えるものである。また、朝鮮語の音節境界での共鳴音化現象の結果とも関連して、鼻音が側面音にまさって得意なふるまいをすることを明示した。

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