

### Coda Neutralization in Korean: OT Approach\*

Soonhyun Hong  
 University of Pennsylvania  
 shong@unagi.cis.upenn.edu

Korean coda neutralization phenomenon is analyzed by invoking positive feature/node licensing constraints in the spirit of Ito 1986. The opaque behaviors of the coda neutralization at a morpheme boundary are analyzed without invoking rule-ordering (syllabification, coda neutralization and then resyllabification) and without positing more than one level by invoking relative ranking of node/feature License constraints and output correspondence constraints in Optimality Theory (McCarthy 1995, Benua 1995 and Kenstowicz 1995).

#### 1. Coda Neutralization

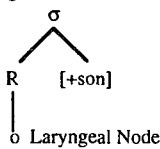
In Korean, all labial and velar stops neutralize to homorganic plain stops (/p, p', p<sup>h</sup>/->[p] and /k, k', k<sup>h</sup>/->[k]) and all Coronal obstruents to [t] (/t, t', t<sup>h</sup>, s, s', c, c', c<sup>h</sup>/->[t]), in a syllable coda. And these coda obstruents are realized phonetically unreleased, forcing the following plain obstruent tensified (Kim-Renaud 1974, Sohn 1987), which is independent of neutralization.

#### (1) Coda Neutralization

a. /sup <sup>h</sup> /	sup	orest'			
b. /sup <sup>h</sup> -kwa/	sup-k'wa.	'forest-and'	cf. /sup <sup>h</sup> -e/	sup <sup>h</sup> -e	'forest-at'
c. /puək <sup>h</sup> /	puək	'a kitchen'	cf. /puək <sup>h</sup> -i/	puək <sup>h</sup> -i	'a kitchen-Nom'
d. /puək <sup>h</sup> + pak'/	puək-p'ak	'outside of the kitchen'			
e. /nac/	nat	'day'	cf. /nac-e/	nac-e	'day-during'
f. /nas/	nat	'a scythe'	cf. /nas-il/	nas-il	'a scythe-Acc'
g. /k'ək'-ta/	k'ək'-t'a	'pick off'	cf. /k'ək'-ə/	k'ək'-ə	'pick off-Cont'

Given the data, we observe that an obstruent cannot retain these features in a coda: [+cont], [+sg], [+cg]<sup>1</sup> and [+high]<sup>2</sup>. Extending the idea of Prosodic Licensing in Itô 1986, Lombardi 1995 proposes a positive universal licensing configuration for a Laryngeal node: A Laryngeal node is only licensed in a consonant if it immediately precedes a sonorant segment including a glide and a vowel, in the same syllable:

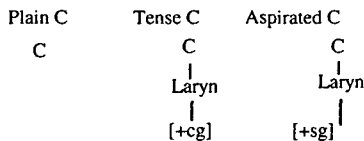
#### (2) Laryngeal Constraint (LC)



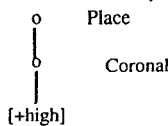
The Laryngeal Constraint positively constrains that laryngeal distinctions of a consonant should occur only in syllable-initial position. Also following from Lombardi 1995, we assume that Laryngeal node is specified only when it has a

\* I would like to thank Prof. Eugene Buckley and Ms. Hikyung Lee for helpful comments and suggestions.

<sup>1</sup>We assume the following hierarchical representations for phonemic plain, tense and aspirated C's partly adopted from Kim 1987:

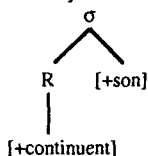


<sup>2</sup>We will assume that alveo-palatal consonants /c, c<sup>h</sup>, c'/ have the following place representation:

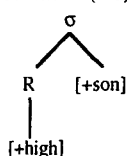


dependent like [+cg] or [+sg]<sup>3</sup>. In Korean, not only the laryngeal features like [+cg] and [+sg] but also [+cont] and [+high] are only licensed in the same configuration: namely those features [+cont] and [+high] are only licensed in the same syllable initial position, as the data in (1) suggest it. We propose for Korean that [+continuent] and [+high] is only licensed in a consonant if it immediately precedes a sonorant segment:

## (3) [+continuent] Constraint (CC)



## (4) [+high] Constraint (HC)



The two constraints CC and HC are the licensing conditions for [+continuent] and [+high], respectively, specific to Korean. We are going to reinterpret in OT the idea that violation of a constraint invokes a repair mechanism like delinking the unlicensed node or feature, as in Mester & Itô 1989, Rice 1987, Calabrese 1987 and Paradis 1988. In the proposed OT analysis, however, only output candidates, not the processes themselves, will be evaluated, based on the relative ranking of constraints.

Adopting from Itô, Mester & Pridgett 1993, we propose the following feature or node License constraints:

(5) License( $\phi$ ): The phonological node or feature  $\phi$  must be licensed.

License[Laryngeal]/[+continuent]/[+high]

The proposed License constraint family says that [Laryngeal], [+continuent] and [+high] must be licensed by satisfying LC, CC and HC, respectively.

## 2. Interaction of Syllabification, Coda Neutralization and Resyllabification

In Korean, the stem-final obstruent is neutralized when the stem appears as an independent word and it is also neutralized before a consonant-initial clitic or inflection. However, the stem-final obstruent is not neutralized before a vowel-initial clitic or inflection. Note that /t, t<sup>h</sup>/ palatalize to [c, c<sup>h</sup>], respectively before suffix/clitic-initial /i/ or /y/. Note also that Korean verbs cannot appear as independent words and should be always morphologically accompanied by inflections and hence do not have citation forms unlike nouns.

## (6) a. nouns

/os/	'clothes'	/kat <sup>h</sup> /	'surface'
ot	citation form	kæt	citation form
ot-t'o	'clothes-also'	kæt-t'o	'surface-also'
ok-k'wa	'clothes-and'	kæk-k'wa	'surface-and'
os-i	'clothes-Nom'	kæt <sup>h</sup> -il	'surface-Acc'

## b. verbs

/əp <sup>h</sup> /	'turn upside down'	/pəs/	'take off'
əp-k'o	'turn upside down-Cont'	pək-k'o	'take off-Cont'
əp <sup>h</sup> -əs'-əyo	past-informal VE	pəs--əs'-əyo	past-informal VE
/kat <sup>h</sup> /	'be same'	/is/	'exist'
kat-k'o	'be same-Cont'	ik-k'o	'exist-Cont'
kac <sup>h</sup> -i	'together (same-Adv. suffix)'	is'-əyo	'exist-Decl'
/ic/	'forget'		
ik-k'o	'forget-Cont'		
ic-əyo	'forget-Decl'		

Those noun stems *ot* and *kət* in (6a) show that stem-final /s/ and /t<sup>h</sup>/ coda-neutralize when those stems appear alone.

However, stem-final /s/ and /t<sup>h</sup>/ do not coda-neutralize before a vowel-initial clitic. The verbal root-final /p<sup>h</sup>/, /s/, /t<sup>h</sup>/, /s/ and /c/ and the inflection-final /s/ also do not neutralize when they appear before a vowel-initial suffix or inflection, as shown in (6b).

<sup>3</sup>In this paper, we ignore the non-categorical and allophonic obstruent voicing phenomenon in which an obstruent becomes voiced between vowels. If it should be incorporated in LC, LC may be replaced by License[+cg] and License[+sg].

Kang 1992 tried to explain the data under the assumption that phonological rules apply within strings delimited by the prosodic word but never apply directly to morphological strings in the lexical component (Inkelas 1989, 1993). Kang 1992 proposed that Prosodic Word structure is formed word-internally, which is predictable. She adopted Selkirk's 1986, 1990 End-Based Theory, and extended  $X^0$  setting into the word-internal structure in Korean. Kang argued that the Prosodic Word Formation in Korean is purely lexical and the left edge of a lexical category coincides with the left edge of the prosodic word, still keeping the internal morphological structure visible in the lexicon.

- (7) Korean Prosodic Word Rule (KPWR: Lexical)  
 $X^0[ \_ ] \rightarrow \omega( \_ )$  (X is a lexical category)

She further proposed that only lexical categories (N, V, A, ADV) map into the prosodic words in the lexicon under the assumption that prosodically dependent suffixal or clitic elements are adjoined to a preceding prosodic word lexically or postlexically, respectively:

- (8) Stray Adjunction/Incorporation:  $\omega$  is left-headed, with leftward adjunction of stray material  
 a. lexical adjunction: derivational suffixes  
 b. postlexical adjunction: functional categorial suffixes, clitics<sup>4</sup>

Kang further assumed that syllabification and Coda Neutralization have to wait until prosodic words are formed in the lexical component and that the prosodic word boundary delimits the domain of syllabification. The following shows how Kang derived [tətot] from the prefixed stem /təs-os/:

- |                     |  |                         |  |
|---------------------|--|-------------------------|--|
| (9)                 |  | Morphological Structure | Phonological Structure                     |
| a. Prefixation:     |  | [təs N[os]]             |  |
|                     |  | 'outer' 'clothes'       | /təs/ 'outer' + /os/ 'clothes'             |
| b. Percolation:     |  | N[təs N[os]]            | a. PWF (lexical): $\omega(təs) \omega(os)$ |
| c. Bracket Erasure: |  | [təsos]                 | b. Syll.: $\omega(təs.) \omega(os.)$       |
|                     |  |                         | c. CN: $\omega(tət.) \omega(ot.)$          |
|                     |  |                         | d. Resyllabification: $\phi(tət.ot.)$      |
|                     |  |                         | e. output [tətot]                          |

Since Prosodic Word Formation applies at the end of lexical component before Bracket Erasure Convention, Kang can derive two prosodic words from a prefixed word. Within each  $\omega$ , syllabification and CN apply to derive the correct output. She further argued that each stem of a compound also corresponds to a separate prosodic word.

Kang's analysis, however, fails to derive the correct output when a vowel-initial nominative clitic /i/ cliticizes (postlexically) to the noun stem /os/: /os=i/ 'clothes-Nom'. According to Kang's analysis, \*[o.ti.] will be derived. First, prosodically constrained syllabification and coda neutralization take place in the lexical component:  $\omega(os)$  after lexical Prosodic Word Formation would become  $\omega(ot.)$  by prosodically constrained syllabification and Coda Neutralization at a late stage of lexicon. When the clitic /i/ is adjoined postlexically to  $\omega(ot.)$ , the wrong output \*[ $\phi(o.ti.)$ ] would be derived after resyllabification. The correct output should be [osi].

- |                     |  |                         |   |
|---------------------|--|-------------------------|---|
| (10)                |  | Morphological Structure | Phonological Structure                      |
| a. Stem:            |  | N[os]                   | /os/ 'clothes'                              |
|                     |  | 'clothes'               | a. PWF (lexical) $\omega(os)$               |
| b. Bracket Erasure: |  | [os]                    | b. Syll.: $\omega(os.)$                     |
|                     |  |                         | c. CN: $\omega(ot.)$                        |
|                     |  | Phrasal Structure       |   |
| a. Cliticization:   |  | [[os] i]                | d. Adjunction (postlexical): $\omega(ot.i)$ |
|                     |  |                         | e. Resyllabification: $\omega(o.ti.)$       |
|                     |  |                         | f. output: *[oti]                           |

To remedy this problem, S. Lee 1994 suggested that clitics might be adjoined to the prosodic word at the lexical component. However, this suggestion directly go against the spirit of (prosodic) Lexical Phonology since cliticization is a phrasal-level process. In the next section, we will show that only one level is enough for syllabification and resyllabification in Korean.

<sup>4</sup>Clitics are well-attested to be of the phrasal-level. Case-marker clitics which include nominative /i/, accusative /il/ and dative /eyke/ are cliticized leftward to a noun phrase which may include the head noun, a relative clause and/or a determiner:

- |   |                               |
|---|-------------------------------|
| NP[ki N[ CP[k <sup>h</sup> i-n] N[salam]]]-i    | 'the person who is tall-Nom.' |
| NP[ki N[ CP[k <sup>h</sup> i-n] N[salam]]]-il   | 'the person who is tall-Acc.' |
| NP[ki N[ CP[k <sup>h</sup> i-n] N[salam]]]-eyke | 'the person who is tall-Dat.' |

## 3. OT Analysis

We will show that the interaction of the coda neutralization and syllabification can be captured in OT by adopting the concept of Correspondence Theory (McCarthy 1995, Benua 1995 and Kenstowicz 1995).

## (11) McCarthy 1995, Benua 1995 and Kenstowicz 1995

- a. IDENT([F]): Correspondent segments in S1 and S2 have identical values for feature [F].
- b. Max: Every segment in S1 has a correspondent in S2. That is, Domain (f) = S1.
- c. Base-ID: Given an input structure [X Y] output candidates are evaluated for how well they match [X] and [Y] if the latter occur as independent words.

We introduce following input-to-output correspondence constraints for the Korean data above to explain the survival of the features [+cont] and [+high] and the Laryngeal node of the stem-final obstruent before a vowel-initial morpheme.

## (12) IDENT-IO [+cont]/[+high]/[Laryngeal]

The proposed feature/node License constraint family which is inviolable is ranked above the IDENT-IO constraint family to explain the loss of underlying [Laryngeal]/[+cont]/[+high] in a coda in the outputs. It is more important for a coda consonant to avoid violation of the License constraint family than to avoid violation of Identity-IO constraint family. This explains the coda neutralization of the stem-final obstruent in word-final position.

## (13) /os/          ot          'clothes'          citation form

/os/	License [+cont]	IDENT-IO [+cont]
os	*!	
\$ot		*

On the other hand, IDENT-IO [+cont] is ranked above Base-ID. This forces a consonant in a non-coda position to retain underlying [+cont] in the output despite earning a violation mark for Base-ID. This explains avoidance of the coda neutralization by the stem-final obstruent before a vowel-initial clitic. Following from Kenstowicz 1995, we indicate the output base form against which the derived form is evaluated at the end of the tableau with an ampersand.

## (14) /os-i/          os-i          'clothes-Nom'

/os-i/	License [+cont]	IDENT-IO [+cont]	Base-ID
\$os-i			*
ot-i		*!	

& ot

The following two tableaux show the coda neutralization of the stem-final obstruent before a consonant-initial morpheme and avoidance of the coda neutralization by the (verb)stem-final obstruent before a vowel-initial inflection, respectively. We will assume that a plain obstruent tensifies after another obstruent.

## (15) /os-to/          ot-t'o          'clothes-also'

/os-to/	License [+cont]	IDENT-IO [+cont]	Base-ID
os-t'o	*!		*
\$ot-t'o		*	

& ot

## (16) /is'-əyo/          is'-əyo          'exist-Decl'

/is'-əyo/	License [+cont]	License [Laryngeal]	IDENT-IO [Laryngeal]	IDENT-IO [+cont]
\$is'-əyo				
is'-əyo			*!	
il'-əyo			*!	*

We have seen that when a vowel-initial clitic or inflectional suffix is attached to a stem, [+cont]/[+high]/[Laryn] of the stem-final obstruent are retained. This is explained by ranking IDENT-IO family above Base-ID. On the other hand, when prefixed stems and compounds are concerned, an overapplication of the coda neutralization is observed in the final obstruent of a prefix or the left member of a compound. The final obstruent of a prefix or the left member of a compound always neutralizes, regardless of whether it is followed by a consonant or a vowel or whether it appears in an onset or a coda position.

- (17) a. prefixed words
- |                             |         |                    |   |           |                     |
|-----------------------------|---------|--------------------|---|-----------|---------------------|
| /təs <sup>5</sup> -os/      | tət-ot  | 'outer garment'    | /təs-os-il/                               | tət-os-il | 'outer garment-Acc' |
| 'additional(pref) 'clothes' |         |                    | 'additional(pref) 'clothes' 'Nom(clitic)' |           |                     |
| /təs-tæ-/                   | tət-t'æ | 'add additionally' |   |           |                     |
| 'additional' 'add'          |         |                    |   |           |                     |
- b. compounds
- |                             |             |                     |                            |                      |               |
|-----------------------------|-------------|---------------------|----------------------------|----------------------|---------------|
| /kət <sup>h</sup> +os/      | kət+ot      | 'outer garment'     |                            |                      |               |
| 'surface' 'clothes'         |             |                     |                            |                      |               |
| /kət <sup>h</sup> +os-ilan/ | kət+os-iraŋ | 'outer garment and' | cf. /kət <sup>h</sup> -il/ | kət <sup>h</sup> -il | 'outside-Acc' |
| /os+an/                     | ot+an       | 'clothes' inside"   | cf. /os-i/                 | os-i                 | 'clothes-Nom' |
| /k'oc <sup>h</sup> +ilim/   | k'ot+ilim   | 'flower's name'     | cf. /k'oc <sup>h</sup> -i/ | k'oc <sup>h</sup> -i | 'flower-Nom'  |

We cannot take advantage of Base-ID for such an overapplication of the coda neutralization since a prefix is not an independent word, though the two stems in compounds can occur as independent words. The ranking of License family >> IDENT-IO family >> Base-ID cannot predict the overapplication of the coda neutralization in the final /t<sup>h</sup>/ of the left member of the compound (/kət<sup>h</sup>+os/ -> kət-ot) since it appears in onset.

We observe in the data in (17) that the final obstruent of a prefix and the final obstruent of the left member of a compound are always neutralized regardless of whether the following stem is vowel-initial or consonant-initial. The Base-ID constraint cannot be invoked since a prefix does not appear as an independent word. And also the stem in the (noun)stem=(Nom)clitic sequence /os-i/ which surfaces as os-i, does not resemble the output base form [ot]. The behavior of the uniform neutralization of the final obstruent of a prefix and the left member of a compound resembles that of the prefix /des-/ in Spanish which is always realized as deh- before a vowel-initial and consonant-initial stem. Following from the analysis of /des-/ in Kenstowicz 1995, we adopt the concept of Uniform Exponence for the analysis of the obligatory neutralization of the final obstruent of a prefix and the final obstruent of the left member of a compound in Korean.

- (18) Uniform Exponence (Kenstowicz 1995)

Minimize the differences in the realization of a lexical item (morpheme, stem, affix, word).

For the Korean case, we argue that the candidates for the prefix and the left member of a compound are evaluated so as to minimize allomorphic differences in the realization of those morphemes. Those types of morphemes which appear before a stem are uniformly realized as neutralized forms: namely output base forms. Unlike /des-/ in Spanish, we suggest that UE is morpheme-specific as well as position-specific in Korean: specific morphemes (prefixes and left stem of a compound) and specific position (the morpheme position followed by a stem). Since the Uniform Exponence constraint should be specific to the prefix and the left member of a compound which appear before a stem in Korean, we propose the following Uniform Exponence family for the Korean neutralization in question:

- (19) UE(prefix): Minimize the differences in the realization of the prefix  
 UE(left member of a compound) (hereafter UE(left stem)): Minimize the differences in the realization of the left member of a compound.

The overapplication of the coda neutralization can be explained by ranking the UE constraint family above IDENT-IO family and Base-ID. The following tableau explains the obligatory neutralization of the prefix-final obstruent before a vowel-initial environment.

- (20) /təs-os/                      tət-ot                      'outer garment'

/təs-os/	License [+cont]	UE [Prefix]	IDENT-IO [+cont]	Base-ID
təs-os	*!	*		*
təs-ot		*!	*	
tət-os	*!		*	*
tət-ot			**	

& ot

<sup>5</sup>The prefix /təs/ never surfaces in a prefixed word in Korean. However, the choice of /təs/ as the underlying form over /tət/ is weakly motivated by the fact that native speakers recognize /təs/ as UR. When they are asked "Which is the prefix in təs-os?", their answer is təs-i cəp'usa-ipnita 'təs is the prefix.' in which təs surfaces in the noun-(nom.)clitic sequence. Though this is only external evidence, we will assume in this paper that /təs/ is the underlying representation. However, this assumption does not affect our analysis.

The following tableau explains the neutralization of the stem-final obstruent of the left member of a compound before a vowel-initial stem (an overapplication of the coda neutralization) and also the avoidance of neutralization by a stem-final obstruent before a vowel-initial clitic environment.

- (21) /kət<sup>h</sup>+os-iləŋ/      kət-os-iraŋ      'outer garment and'

/kət <sup>h</sup> +os-iləŋ/	License [Laryn]	UE [left stem]	IDENT-IO [+cont]	IDENT-IO [Laryn]	Base-ID
kət <sup>h</sup> -os-iləŋ		*!			**
ʃkət-os-iləŋ				*	*
kət <sup>h</sup> -ot-iləŋ		*!	*		*
kət-ot-iləŋ			*	*!	

& kət, ot

Violation of a UE constraint which is ranked above IDENT-IO[+cont]/[Laryn] eliminates the first and third candidates. The two violation marks of the fourth candidate for IDENT-IO[+cont]/[Laryn] are fatal in comparison with one violation mark of the optimal second candidate for IDENT-IO[Laryn].

#### 4. Summary

So far we have proposed the following constraint ranking for the (over-)application of the coda neutralization:

- (22) License family >> UE family >> IDENT-IO family >> Base-ID

This analysis shows that only the surface level is enough to analyze the opaque behaviors of coda neutralization. *Uniform Exponence constraint* is worth further study since it can handle Consonant Cluster Simplification and underapplication of /t/-palatalization in Korean compounds in which morphemes before a stem are uniformly realized as one surface form: i.e., the output base form (S. Hong in preparation).

- (23) a. /pat<sup>h</sup>+iləŋ/      pat+iraŋ 'field ridge'      (lack of /t/-palatalization)  
       cf. /pat<sup>h</sup>/      pat 'field (citation form)'      /pat<sup>h</sup>-i/      pac<sup>h</sup>-i      'field-Nom'  
       b. /talk+ima/      tak+ima 'chicken's forehead'  
       cf. /talk/      tak 'chicken (citation form)'      /talk-i/      talk-i or tak-i      'chicken-Nom'

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