APERTURE THEORY IN KOREAN CODA NEUTRALIZATION

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1 Introduction
One of the most controversial problems in Korean consonantal phonology is Coda Neutralization (henceforth CN) The three-way contrast of obstruents—plain, tense, and aspirated—is neutralized to a homorganic plain stop in coda position, as seen in (1a) Also, the syllable final affricates and continuants are neutralized into plain stops, as seen in (1b) and (1c), respectively Relevant data are drawn from Lee (1992)

(1) a Neutralization of stops

| /p/ | → | /p/ | 'mouth' |
| /p/' | → | /p/' | 'to elect' |
| /pʰ/ | → | /pʰ/ | 'front' |
| /pʰ/' | → | /pʰ/' | 'to expand' |
| /kʰ/ | → | /kʰ/ | 'to be alike' |
| /kʰ' | → | /kʰ' | 'end' |
| /kʰ/ | → | /kʰ/ | 'soup' |
| /pʰ/ | → | /pʰ/ | 'to fry' |
| /pʰʰ/ | → | /pʰʰ/ | 'kitchen' |

b Neutralization of affricates

| /nas/ | → | /nar/ | 'day' |
| /nasʰ/ | → | /nar/ | 'face' |

c Neutralization of fricatives

| /kas/ | → | /kar/ | 'a kind of plant' |
| /kap•as•(-ta)/ | → | /kap•u•(-ta)/ | 'to catch (past)' |
| /noh/ | → | /nor/ | 'to let go of' |

The specific neutralizations are shown in (2)

(2) a /pl, lpl, lph/ → [p]

b /l/, l'l, l'lh/ → [l]
| /ls/ | → | [l] |
| /ls' | → | [l] |

| /bh/ | → | [k] |

| /b' | → | [k] |
| /b'h/ | → | [k] |
| /b'h/ | → | [k] |

Similar patterns are found in Thai (Lombardi 1991) In Thai, the obstruents that can appear in coda position are plain stops. However, unlike Korean, there exists the only two-way contrast in obstruent consonants—plain and aspirated. Besides Thai, in Klamath, voiced, voiceless, and glottalized obstruents are neutralized into voiceless stops when preceding another stop (Clements 1985) However, few languages probably show such a full range of neutralization as Korean. This is extremely complicated to analyze in a uniform way, none of the previous researchers have provided a single rule that could cover the full range of Korean CN data, shown in (1). However, following Aperture Theory developed by Sterneche (1992, 1993), I will provide a simple rule to account for CN in Korean—delinking an open aperture node, A₀ or A_max The more interesting argument proposed in this study is that CN does not apply only to obstruents, but also to
sonorants. It has been argued by many Korean phonologists that only coda obstruents are subject to CN, as seen in (1). However, I will give evidence that the Aperture Theory supports the assumption that CN applies to all the coda consonants. This paper is organized as follows: I will review some of the previous studies in 2. I will introduce Aperture Theory, based on Sternade's (1992, 1993) proposal in 3. Then, in 4, I will offer a new analysis of CN that incorporates Aperture Theory.

2 Previous Studies

2.1 A Proposal Within the Framework of Standard Generative Phonology

Within the framework of Linear Generative Phonology, Chung (1980, 1970) treats CN as the combination of two separate rules: coronal neutralization and laryngeal neutralization. This is illustrated in (3).

\begin{align*}
\text{a. coronal obstruents become } & [t] \text{ syllable-finally} \\
C & \rightarrow [+\text{coronal}] \\
& \rightarrow [-\text{anterior}] \\
& \rightarrow [+\text{continuant}] \\
& \rightarrow [+] \\
& \rightarrow \$
\end{align*}

\begin{align*}
\text{b. tense and aspirated obstruents become lax syllable-finally} \\
C & \rightarrow [+\text{tense}] \\
& \rightarrow [+] \\
& \rightarrow [+] \\
& \rightarrow \$
\end{align*}

There are a couple of problems with this proposal. First, this proposal fails to account for why all coronal obstruents are neutralized into [t], despite differences in anteriority or continuancy. Second, as mentioned by Kim (1987), this proposal does not explain why tense and aspirated consonants become homorganic plain obstruents instead of neutralizing to either tense or aspirated consonants. Since Chung's proposal is not convincing, many other Korean phonologists, such as Kim (1987), Kim (1990), Cho (1991), and Lee (1992), analyze NC within the theory of Underspecification. Several proposals within this framework are discussed in the next section.

2.2 Proposals Within the Framework of Underspecification

In order to eliminate problems raised within the analysis in Standard Generative Phonology, Kim (1987) argues that CN can be treated as a single process of delinking the terminal features of a syllable-final obstruent [+spread glottis], [+constricted glottis], [+continuant], and [-anterior] (Kim 1987). This is depicted in (4).

\[ C \uparrow \]
\[ \text{Root} \]
\[ \text{Laryngeal} \]
\[ \text{Supralaryngeal} \]
\[ \text{Manner} \]
\[ \text{Place} \]
Even though this proposal accounts for the problems raised by Chung (1980), it fails to explain why only obstruents, not sonorant consonants, undergo CN. Moreover, Kim (1987) excludes the case in which the syllable final /h/ is realized as [t] noh — not 'to let go of'.

Later, Lee (1992) proposes that CN should be treated as the rule that delinks the laryngeal features [+spread glottis] and [+constricted glottis], and the manner feature [+continuant]. In her proposal, she discusses the neutralization of the syllable final /h/ in such a way that since the delinking of [+spread glottis] results in no features under the Root Node, the most unspecified consonant /h/ is realized as the surface form. However, Lee (1992) does not mention why palatals become coronals, because changing palatals to coronals results from delinking [-anterior], as discussed in Kim (1987).

Cho (1990), following Sohn (1987), has proposed that CN is a single rule that delinks three separate features the laryngeal feature nodes, [+continuant] and [-anterior] 4. However, both proposals of Sohn (1987) and Cho (1990), cannot explain why these three separate features, but not other features, are delinked. In other words, they fail to account for whether there is any common property that these three features share.

Most of studies on Korean CN deal with the issue of delinking with at least two separate operations on the feature geometric tree, one of which deletes the laryngeal features and the other of which deletes the feature [continuant]. In favor of a single rule for Korean CN, Kim (1990) groups together the laryngeal features [spread glottis] and [constricted glottis] along with [continuant] under the Laryngeal-continuant Node. This is shown in (5)

Given (5), he claims that Korean CN is the rule of delinking the Laryngeal-continuant Node. Even though this approach seems to account for Korean CN with a single rule, it has a shortcoming in dealing with the feature [continuant]. The issue of the location [continuant] in the feature geometric tree has been controversial in the phonological literature. In Korean, there does not appear to be other motivation to assume that [continuant] should be grouped with other laryngeal features.

Due to the fact that none of the previous studies can provide any uniform solution of Korean CN, in the next section I will discuss in more detail this issue in the framework of Aperture Theory and Underspecification. I contend that Korean CN can be best interpreted as delinking any open aperture node of a coda consonant no matter whether they are obstruents or sonorants.

3 Aperture Theory

Since the previous studies fail to take Korean CN into account in a uniform way and also fail to include all data with respect to CN, I will propose a new version of this phenomenon, following Sterneche (1992, 1993), with the assumption that Korean syllable coda consonants are never released. This assumption is also discussed by Kim-Renaud (1986), Cho (1990), and Iverson & Sohn (1994).

With the development of segment structure, revealed by Anderson (1976), it has been widely accepted that there are some segments which internally have two values for a feature, such
segments are called contour segments. The following figure shows the internal representation of the prenasal /mb/ that must be phonologically analyzed as being a monosegment, as in Sagey (1986):

\[ (6) \quad /mb/ \]

\[ \begin{array}{c}
\text{[+nasal]} \\
\text{Root} \\
\text{[-nasal]} \\
\text{Labial}
\end{array} \]

Thus illustrates that /mb/ is a monosegment which is linked to a single root node, however, it is a contour since it contains two sequenced values for the feature [nasal]. Further, Stenaire (1992), following Anderson (1976), uses the term "aperture nodes"--\( A_0 \) (full closure), \( A_f \) (intermediate aperture), and \( A_{\text{max}} \) (maximal aperture)--to explain the integrity of contour segments. Based on Stenaire (1992), I assume that segments may comprise more than one of the intrasegmental values which she calls aperture positions. These aperture positions are demonstrated with various primitive degrees of constriction within the vocal tract. The definitions are based on Stenaire (1992, 1993):

\[ (7) \quad \text{Aperture position Types} \]

\[ \begin{align*}
A_0 &= \text{closure (i.e., zero aperture)} \\
A_{\text{max}} &= \text{maximal aperture} \\
A_f &= \text{intermediate aperture generating turbulent airflow}
\end{align*} \]

Given these definitions, the representations of released stops, affricates, approximants, and fricatives are obtained in (8a-d), respectively:

\[ (8) \quad \begin{align*}
a & \quad \text{Released stops } A_0A_{\text{max}} \\
b & \quad \text{Affricates } A_0A_f \\
c & \quad \text{Approximants } A_{\text{max}} \\
d & \quad \text{Fricatives } A_f
\end{align*} \]

In Stenaire's proposal, contour segments include released stops, aspirated stops, glottalized stops, and affricates. Plain released stops are defined as a stop phase--\( A_0 \)--followed by abrupt maximal release--\( A_{\text{max}} \). In the case of affricates, they are analyzed as a noncontuuant node \( A_0 \) followed by fricative release \( A_f \). Aspirated and glottalized consonants are represented as the sequence of \( A_0 \) followed by \( A_{\text{max}} \) associated to [spread glottis] and [constricted glottis], respectively. Given this assumption, the representations for plain released stops, affricates, aspirated stops, and glottalized stops are illustrated in (9a), (9b), (9c), and (9d), respectively.
By contrast, approximants and fricatives are regarded as having a single aperture node, $A_{\text{max}}$ or $A_f$. This is illustrated in (10).

\begin{equation}
\begin{aligned}
(10) \quad \text{(a) Approximants} & \quad A_{\text{max}} \\
& \quad \text{Place}
\end{aligned}
\end{equation}

\begin{equation}
\begin{aligned}
(10) \quad \text{(b) Fricatives} & \quad A_f \\
& \quad \text{Place}
\end{aligned}
\end{equation}

I have shown how segments are represented in the framework of Aperture Theory. Given these representations, in the next section I will reanalyze CN in Korean.

4 Proposed Analysis of Coda Neutralization

As indicated in section 1, in Korean all the syllable-coda labial obstruents are neutralized into the unreleased [p'], all the coronals into the unreleased [t'], regardless of anteriority and continuancy, and all the dorsals into the unreleased [k']. However, most Korean phonologists have ignored the fact that the sonorant consonants may not be released in syllable-coda position. Kim-Renaund (1986), Baek (1991), and Iverson & Sohn (1994) introduce the unreleased condition of sonorant consonants in coda position. In their view, the nasal /n/ is produced without release of the oral closure [n']. For example, as discussed in Iverson & Sohn (1994), the /n/ in the English word can is produced by a Korean speaker with oral contact maintained throughout with no release of the oral closure as [kæn']. As a consequence, Korean speakers learning English as a second language have difficulty differentiating it from can't [kæt'], since these two words emerge as homophones. Moreover, oral contact may be maintained throughout the articulation of the lateral /l/ in Korean in coda position. This is shown in (11).

\begin{equation}
\begin{aligned}
(11) \quad \text{Unreleased lateral in coda position} & \quad /\text{mal}/ \\
& \quad /\text{pul}/
\end{aligned}
\end{equation}

Therefore, CN should be extended to obstruents as well as to sonorants.

As a consequence, in this study, I propose CN as a simple rule—dehnking an open aperture node, $A_f$ or $A_{\text{max}}$. At first glance, though, dehnking the second feature under the Aperture Node of a contour segment seems to be the right rule for CN. This is shown in (12).
Coda-neutralization in Korean
Unreleased stops may be simply represented as closures without any open aperture nodes

This is shown in (13)

Unreleased stop
\[ \begin{array}{c}
A_0 \\
\text{Place}
\end{array} \]

The CN process of stops, delinking \( A_{\text{max}} \), is illustrated in (14)

Coda Neutralization of Stops
\[ \begin{array}{c}
\text{Root}_1 \sigma \\
A_0 \quad A_{\text{max}} \\
\text{Place}
\end{array} \quad \rightarrow \quad \begin{array}{c}
\text{Root}_1 \sigma \\
A_0 \\
\text{Place}
\end{array} \]

Here, a further explanation for the affricates is required. In Korean, there is no palatal stop comparable to a palatal affricate /l/. Therefore, delinking \( A_f \) triggers delinking the [palatal] feature attached under the Coronal Node. I assume this is a language-specific realization by means of Structure Preservation (Kiparsky 1985). This is shown in (15)

Coda Neutralization of Affricates
\[ \begin{array}{c}
\text{Root}_1 \sigma \\
A_0 \quad A_f \\
\text{Place}
\end{array} \quad \rightarrow \quad \begin{array}{c}
\text{Root}_1 \sigma \\
A_0 \\
\text{Place}
\end{array} \]

However, in Korean, /s/ and /h/ which just have a single Aperture Node are also subject to CN. They are then realized as [t]. The representations of /s/ and /h/ are introduced within Steriade's framework, as in (16)
(16) Coda Neutralization of Fricatives

\[
\begin{array}{ccc}
\text{a} /h/ & \text{b} /s/ & \text{c} [\text{i}'] \\
\text{Root}_a & \text{Root}_b & \text{Root}_c \\
\lfloor \text{spread glottis} \rfloor & \text{Place} & \text{Place} \\
\text{A}_{\text{max}} & \text{A}_{f} & \text{A}_o \\
\end{array}
\]

Since these two are not contour segments, delinking their second feature under the Aperture Node is not possible as the expression of a single rule for CN. Therefore, I suggest a new version of CN in which any open aperture node—A_f or A_{\text{max}}—is delinked. In cases of fricatives, after delinking the open aperture node A_f, they are realized as unreleased stops, represented as A_o by default. They are then realized as [i'], given that this is the unmarked consonant.\(^4\)

With respect to the lateral /l/, I assume that in Korean, a single feature [lateral] is linked to A_o followed by A_{\text{max}} which represents release. Then, delinking of A_{\text{max}} automatically results in an unreleased lateral as in (17b) This is pictured in (17).

(17) Coda Neutralization of a Lateral

\[
\begin{array}{cc}
\text{a} \text{ Released Lateral} & \text{b} \text{ Unreleased Lateral} \\
\text{Root}_a & \text{Root}_b \\
\text{A}_o & \text{A}_{\text{max}} \\
\text{Spontaneous Voice [lateral]} & \text{Spontaneous Voice [lateral]} \\
\end{array}
\]

As seen in (12)-(17), the CN process may be formalized as the elimination of the open Aperture release phase. This can best account for CN in the uniform way to cover all cases, obstruents as well as sonorants.

5 Conclusion

In this paper, I have accounted for CN in Korean in a uniform way by reference to Underspecification and Aperture Theory. I have maintained that Korean consonants, both obstruents and sonorants, are not released in coda position. In light of this, I propose that CN in Korean is best accounted for in a very simple way—delinking the open aperture release phase in coda position.

NOTE

\(^1\)Kim (1987) adopts the Feature Geometry based on Clements (1985) and Sagey (1986)

\(^2\)Sohn (1987) investigates CN focusing on its complicated interaction with the other aspects of Korean consonantal phonology, such as resyllabification and Nasal Assimilation. However, here I will not consider other phonological phenomena which are not crucially relevant to the topic of this paper.
3In Steriade's (1992, 1993) framework, nasals are also treated as contour segments, docking [nasal] to both $A_o$ and $A_{max}$.

4One piece of evidence that the unmarked consonant is the coronal in Korean is based on co-compounding of nouns. It is normally accepted that an empty C-slot is inserted between compounded words, and the empty C-slot is realized in various ways depending on the context. For example, the initial obstruent of the right element of a compound is tensed as in (i), and the segment /l/ or the nasal /n/ or /ln/ is inserted between two elements of a compound as in (ii) and (iii), respectively (data come from Han 1992).

(1) cam 'sleep' + cah 'place' [camc'ah] 'sleeping place'
    cho 'candle' + pul 'light' [chop'ul] 'candlelight'

(2) u 'upper' + os 'clothes' [utot] 'upper clothes'

(3) i 'teeth' + mom 'body' [ummom] 'gum'
    k'ho 'nose' + nul 'lme' [k'nonnal] 'nose lme'

After inserting an empty C-slot between two elements of a compound, the place feature of the following consonant spreads to the empty C-slot. (In Korean, the tense consonants are regarded as a geminate.) The data (ii) show that when there is no following consonant, the empty C-slot is realized as [l], suggesting that it is the least marked consonant in Korean.

REFERENCES

Anderson, Stephen 1976 Nasal consonants and the internal structure of segments Lg 52 326-44
Cho, Young-Mee 1990 Parameters of consonantal assimilation Doctoral dissertation, Stanford University
Chung, Kook 1980 Neutralization in Korean A functional view Doctoral dissertation, University of Texas
Clements, George 1985 The geometry of phonological features Phonology Yearbook 2 225-52.
Han, Jung-Im 1992 On the Korean tensed consonants and tensification CLS 28 206-23
Iverson, Gregory, and Hyang-Sook Sohn 1994 Liquid representation in Korean Theoretical issues in Korean linguistics ed by Kim-Renaud, Young-Key, 77-100
Kim, Hee-Soeb 1990 The manner features in phonological representation Doctoral dissertation, Indiana University
Kim, Kee-Ho 1987 The phonological representation of distinctive features Korean consonantal phonology Doctoral dissertation, University of Iowa.
Kim-Renaud, Young-Key 1986 Studies in Korean linguistics Seoul, Korea Hanshim Publishing Company
Kiparsky, Paul 1985 Some consequences of lexical phonology Phonology Yearbook 2 85-138
Lombardi, Linda 1991 Laryngeal features and laryngeal neutralization Doctoral dissertation, University of Massachusetts
Sagey, Elizabeth 1986 The representation of feature and relations in autosegmental phonology Doctoral dissertation, MIT
Sohn, Hyang-Sook 1987 Underspecification in Korean phonology Doctoral dissertation, University of Illinois
Steriade, Donca 1992 Segments, contour, and cluster Reduced version in Proceedings of the 15th International Congress of Linguistics
__________ 1993 Closure, release, and nasal contours Phonetics and phonology nasal, nasalization, and the velum 5 401-70