

Korean Fortis Consonants and Post Obstruent Tensification: A Cognitive Approach¹

Eon-Suk Ko
Brown University/University of Pennsylvania
esko@unagi.cis.upenn.edu

Korean fortis consonant is not included in the consonantal inventory, but a result of phonetic implementation at the phonetic level, P. With the framework of Cognitive Phonology, a construction of Post Obstruent Tensification is proposed in such a way that rule-ordering is eliminated. This enables us to overcome methodological problems raised in former analyses of fortis under geminate hypothesis, and give a uniform account for three categories of fortis consonants. By assuming extrasyllabicity of verb-stem-final, consonant neutralization of fortis in the coda position is explained by the invisibility at the P-level, and, therefore, modification of Coda Neutralization rule is called for.

0. Introduction

It is well known that Korean obstruents show three-way phonation contrasts which bring about phonemic distinctions. However, whether these phonation contrasts come from the UR or not has been a matter of debate. This paper argues that the fortis which has been generally considered as an independent phonemic inventory from the lenis is an instantiation of geminated lenis linked to two timing units at the UR, which is realized as fortis via phonetic implementation at the surface level.

In analyzing the underlying representation of the fortis and the process of fortification, which is a phenomena occurring when an obstruent is preceded by another obstruent, I adopt the framework of Cognitive Phonology (CP), as has been initiated by Lakoff (1993) and also by Goldsmith (1993), in a similar line. Both works commonly argue that it is not possible to achieve a satisfactory phonological system with only two levels of representation; three levels are minimum.

The rest of this paper is composed as following: In section 1, a brief background about the CP will be given. In section 2, data related with Korean fortis will be provided. In section 3 and 4, representative works from the geminate hypothesis and singleton hypothesis will be analyzed. In section 5, an analysis of the phenomena will be made with the framework of CP. Section 6 concludes.

1. Theoretical Background

Cognitive Phonology (CP) characterizes correspondences between morphemes (as stored in the mind) and phonetic sequences (Lakoff 1993). CP refers to these as M-level and P-level, respectively. In addition, it posits one intermediate level, called W, at which constraints on word-level phonology are stated.

Rather than paying attention to the matter of phonological representation, CP mainly focuses on how many levels there are and what the relationship is between the notion of 'levels' as it relates to derivations in phonology, and what role it would play in the representation of phonotactics and other sorts of phonological generalizations. What is running through the background of such an approach is the development of connectionism² in neuroscience and also the relevance of computational complexity (Goldsmith 1993: 1-20).

The main achievement of CP can be summarized as the elimination of step-by-step derivations, ordered rules and cycles. In CP, 'rules' are seen as relations between different levels of representation, which are required to be satisfied simultaneously. The notion of generative 'rules' which take inputs and give outputs is substituted by 'constructions' - which are structural relations between levels. For examples, a lowering rule which would traditionally be written $u \rightarrow o$: is reformulated as a relation between [u:] one level and [o:] on the next level.

W:	u:
P:	o:

By eliminating rule ordering, some of the crucial problems in the previous analysis of Korean fortis under the Geminate Hypothesis (GH) can be overcome, which will be shown in detail in section 5.

¹I am grateful to Soonhyun Hong for helpful discussions. All errors are my own.

²Optimality Theory (Prince and Smolensky 1993) is also one such framework that has been affected by the connectionist model. However, the main difference between OT and CP is that CP posits one intermediate level between the UR and SR, while OT pays attention just to the SR.

2. Data

The following data are to show the distributional fact about Korean fortis consonants. As is seen in the following data, their distribution can be classified into three occasions.

- (1) a. t'al 'daughter' ap'a 'dad'
 pok'-ta > pokt'a 'stir fry' is'-e > is'e 'be present'
- b. /maktæ/ > makt'æ 'stick'
 /top-ta/ > topt'a 'to help'
 /kak+to/ > kakt'o 'angle'
- c. /ak+ki/ > akk'i ~ ak'i 'musical instrument'
 /kEt-ta/ > kEtt'a ~ kEt'a 'to walk'

Most current works on Korean phonology analyze the fortis consonants in (1a) to be singleton underlyingly specified with [+cg] feature in the the laryngeal node. Examples in (1b) show that fortis consonants can also be derived via a process generally described as Post Obstruent Tensification (POT)³, whereby a lenis obstruent preceded by another lenis obstruent is tensified. Finally, examples in (1c) are cases that involve fake geminates at the UR. The phonetic realization of these cases are generally described to show variance depending on the speed of speech (Kim-Renaud 1974).

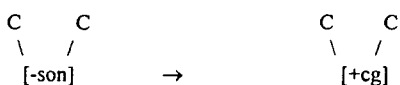
Previous works on Korean fortis consonants hardly succeeded in treating the above three cases in a uniform way. As will be examined in the following sections, some have explained (1a) and (1c) in a category, and others have analyzed (1b) and (1c) with a rule. However, I will propose that all of the three cases can be explained with a rule of POT, by assuming that the fortis as in (1a) is a geminated lenis in the UR.

3. Geminate Hypothesis

There have been arguments that we should see underlying fortis consonants as geminate lenis (Martin 1951, 1954, 1982; J-I Han 1992, Schmidt 1992). Geminate Hypothesis (GH) on the Korean fortis consonants generally assumes that surface plain consonants and fortis consonants are distinguished underlyingly by the timing units they are associated with, rather than by the laryngeal feature specification: Plain consonants occupy just one timing slot, while fortis consonants occupy two.

In this section, Han (1992)'s analysis will be examined, which is the most concrete of several such claims. Her explanation is a rule-based one which involves several derivational steps to derive an output from the underlying representation. She argues that geminate plain consonants, underlying or derived, get the feature of tension at the surface level via a rule of Geminate Reinforcement (GR).

- (2) Geminate Reinforcement (Han 1992)



³Fortis and tense are used interchangeably in the literature. Though I prefer to use 'fortis' to 'tense', I will use this more commonly known name for the phenomenon for ease of discussion thread related to previous works.

The following summarizes her view on such processes.

(3)	/tok+ki/ 'spite'	/tokki/ 'axe'	/tam/ 'sweat'
Syllabification	$\begin{array}{c} \sigma \quad \sigma \\ / \ \ \ \wedge \\ CVC + CV \end{array}$	$\begin{array}{c} \sigma \quad \sigma \\ / \ \ \ \wedge \\ CVC CV \end{array}$	$\begin{array}{c} \sigma \\ / \ \ \ \wedge \\ CCVC \end{array}$
Word Formation	$\begin{array}{c} \ \ \ \ \\ t \ o \ k \ \ k \ i \end{array}$	$\begin{array}{c} \ \ \ \ / \ \\ t \ o \ k \ \ i \end{array}$	$\begin{array}{c} \ \ \ / \ \ \\ \ \ \ t \ a \ m \end{array}$
Geminate Formation (by OCP)	$\begin{array}{c} \sigma \quad \sigma \\ / \ \ \ \wedge \\ CVC CV \\ \ \ \ / \ \\ t \ o \ k \ \ i \end{array}$	-----	-----
GR	$\begin{array}{c} \sigma \quad \sigma \\ / \ \ \ \wedge \\ CVC CV \\ \ \ \ / \ \\ t \ o \ k \ \ i \\ \\ [+cg] \end{array}$	$\begin{array}{c} \sigma \quad \sigma \\ / \ \ \ \wedge \\ CVC CV \\ \ \ \ / \ \\ t \ o \ k \ \ i \\ \\ [+cg] \end{array}$	$\begin{array}{c} \sigma \\ / \ \ \ \wedge \\ CCVC \\ \ \ \ \ \ / \ \ \\ \ \ \ \ \ t \ a \ m \\ \\ [+cg] \end{array}$
Stray Erasure	-----	-----	$\begin{array}{c} \sigma \\ / \ \ \ \wedge \\ CVC \\ \ \ \\ t' \ a \ m \end{array}$

Her analysis involves two crucial rule ordering relations. One is between Geminate Formation and GR and the other is between GR and Stray Erasure. The former is in a feeding relationship, and the latter in a counterbleeding one.

Apart from the matter whether we should accept the multi-level step-by-step derivational process, the ordering between the GR and the Stray Erasure contains a serious problem. Since Han states GR to be a phonetic implementation rule, such an explicit rule ordering amounts to treat Stray Erasure as a late phonetic rule, too. However, as Cho and Inkelas (1994) has pointed out, this is at odds with other phonological phenomena in Korean because it is closely related with boundary phenomena and has to occur cyclically at the lexical level.

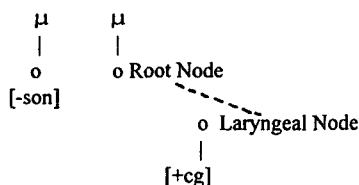
Also, Han's GR rule begs the phenomena by dealing only with geminates, true or fake, without referring to the cases of singleton obstruents as in (1b) which involve POT phenomenon. My proposal in section 5 will show that her GR rule can be merged to a more general rule of POT.

4. Singleton Hypothesis

In making an analysis of the cases as in (1b), where the singleton obstruent is tensified, and (1c), where geminates are tensified, Cho and Inkelas (1994) proposes a POT rule which covers both cases. To strengthen their argument that POT rule should be applied both to singletons and geminates, they make an argument against the GH, referring to the analysis in Han (1992), as a case example. But I argue that by bringing the phenomena to a three-level based model of Cognitive Phonology, we can fix theoretical problems raised in the course of Han's multi-level step-by-step analysis, and maintain the GH.

The following is a POT rule suggested by Cho and Inkelas to cover the cases like (1b) and (1c):

(4) Post Obstruent Tensification



Since [+cg] feature is not present in lexical representation in Korean, tensification is correctly predicted to apply to any obstruents meeting the structural description of the rule. This is an unwanted result both by the Linking Constraint (LC; Hayes 1986)⁴ and Uniform Applicability Condition (Schein and Steriade; 1986: 727)⁵. The only way to keep these two constraints would be maintaining two separate rules that would apply to singletons and to geminates. By pointing out problems in Han's GR rule, they discard this option and choose to abandon the LC and UAC.⁶

However, I argue that Han's GH is not mistaken in itself. A theoretical assumption and methodological problems raised in the course of analysis are separate issues. So, in the following section, I propose an analysis which covers all the three cases of the data given in (1). Such an analysis will be shown to accommodate Han (1992)'s GH, but still reconfirming the argument of Cho and Inkelas (1994) to falsify the LC and UAC.

5. Cognitive Approach to Fortis and POT

Based on the result of experimental measurements which show the closure duration of fortis to be about twice as long as that of the lenis (Han 1992, Park 1994), I assume that fortis consonants occupy two timing units in UR, and will call them true geminates in contrast with the fake geminates which become geminate in the course of derivation (1c). So the examples of underlying fortis in (1a) can be restated like the following:

(5=1a) /tʰal/ > t'al /appa/ > app'a
 /pɒkk-ta/ > pɒkt'a /iss-E/ > is'E

As was mentioned in the introduction, I adopt the three-level model of CP and restate Cho and Inkelas' POT rule (4) like the following constructions. Each cross-level construction has two levels of representations and a set of correspondence lines.

(6) Post Obstruent Tensification in CP: Obstruents preceded by another obstruent at level W are inserted [+cg] feature at level P

```

W: [-son]    C
              |
P:           [+cg]
  
```

⁴Linking Constraint: Association lines in structural descriptions are interpreted as exhaustive.

⁵Uniform Applicability Condition

Given a node *n*, a set *S* consisting of all nodes linked to *n* on some tier *T*, and a rule *R* that alters the contents of *n*: a condition in the SD of *R* on any member of *S* is a condition on every member of *S*.

⁶Since Han's GR is based on cases like (1a; true geminate) and (1c; fake geminate) and Cho and Inkelas's POT rule covers cases like (1b; singleton POT) and (1c; fake geminate), they could have discarded her GH, and still buy her rule as applying to fake geminates (1c). In that case, their argument against the LC and the UAC would become weakened to the extent such principles are given priority to the principle of economy.

To satisfy the above construction, examples in (1b) are analyzed like the following:

(7)	M:	m a k t æ		n o p ^h t a
	W:	[m a k] ⁸ [t æ]		[n o p ⁹] [t a]
	P:	m a k t' æ		n o p t' a

Likewise, tensification of fake geminates in (1c) are analyzed like the following:

(8)	M	a k - k i		k E t t a
	W	[a k] [k i]		[k E t] [t a]
	P	a k k' i		k E t t' a

Now let us look at the tricky case of (underlying) fortis consonant (i.e. true geminate in my analysis). Along the lines of Kang (1991) and Cho (1992), I assume that Stray Erasure takes place before the phonetic level in Korean. So the following construction of Stray Erasure is proposed.

(9) Stray Erasure: Unsyllabified segments at level W are erased at level P.

W:	C
	‡
P:	

A crossed line indicates the absence of a corresponding element at a level.

So the geminates in examples (1a) are realized as fortis at level P like the following:

(10)	M:	t t a l		a p p a
	W:	t [t a l]		[a p] [p a]
	P:	t' a l		a p p' a

As is seen above, when geminate appears in the word initial position (/tla/), the first half is not syllabified. Notice that multiple constructions (POT, Stray Erasure and Syllabification) are satisfied simultaneously in the above representation. Such autonomous and simultaneous satisfaction of plural constructions makes it possible to eliminate rule-ordering from CP.

Finally, let us look at another instance of underlying geminates which appear in the coda position. Most recent works on Korean phonology assume a Coda Neutralization rule, which is described in such a way that fortis is also subject to it (Kang 1992, for example). However, a careful examination of Korean words reveals an interesting fact that geminates can come to the word-final position only when it is verb-stem-final.

(11)	pokk-ta > pokt'a	pokk-a > pokt'a	'stir fry'
	iss-ta > itt'a	iss-e > is'e	'be present'
	kkEkk-ta > k'Ekt'a	kkEkk-E > k'Ekk'E	'pick'
	hæss-ta > hætt'a	hæss-E > hæss'E	'do(past)'

Therefore, I want to treat the commonly assumed neutralization phenomenon from a different point of view. From an independent motivation, M. Oh (1995) argues that every verb-stem-final consonant is extrasyllabic in Korean while it is optional for a noun-stem-final consonant. Based on her analysis, I also assume extrasyllabicity for a verb-stem-final consonant and propose the following analysis for the neutralization of fortis consonants.

⁷The line indicates sanctioned correspondence.

⁸Syllabification: W: [(C)V(C)]σ

⁹Obstruents undergo neutralization at level W.

(12)	M:	p o k k - t a	i s s - t a	k k E k k - E
	W:	[p o k] <k> [t a]	[i t] <s> [t a]	k [k E k] [k E]
	P:	p o k t' a	i t t' a	k' E k k' E

The above analysis shows that extrasyllabic segment is syllabified only when it is followed by a vowel. Otherwise, it is invisible and not realized at the P-level. As such, the neutralization of fortis (i.e. geminate) in the coda position is explained with an intermediate level extrasyllabicity of verb-stem-final consonant, and this suggests that the generally assumed Coda Neutralization should be modified to capture the phenomena correctly.

6. Conclusion and Theoretical Implications

By attesting the GH with the framework of CP, which eliminates rule ordering with the three-level model, I have shown that fortis is not included in the Korean consonantal inventory, which is faithfully reflected in the Korean orthographical system.

Though CP does not put its main focus on the phonological representation, CP is set within a general autosegmental phonological framework (Lakoff 1993: 118). Therefore, when enriched with skeletal representations, my analysis will further strengthen Cho and Inkelas (1993, 1994)'s argument to falsify the LC and the UAC, since my analysis covers not only the alterability of derived (fake) geminates, but also of the underlying geminates.

I have also suggested that Korean Coda Neutralization rule, as has been generally assumed in previous works (Kang 1992, etc.), should be revised in such a way that the fortis is ruled out of the SD. Rather, the neutralization of fortis (i.e. geminate) is reduced to a more general phenomena extrasyllabicity in my analysis.

This paper also throws some light on the markedness of consonantal inventory: There should not be any dialects which include only the fortis without the lenis in Korean. This prediction correctly applies to Kyeng-Sang dialect, which substitutes *s* for *s'*.

Whether we could attest the GH with a framework which reduces the number of levels one step further is remained to be seen.

References

- Cho, Y-M Y (1992) Sublexical Prosodic Constituents and the Phonological Word, Paper presented at the Berkeley Linguistics Society meeting.
- Cho, Y-M Y and S. Inkelas (1993) Inalterability as Prespecification, *Lg* 69.3: 529-574
- Cho, Y-M Yu and S. Inkelas (1994) Post-Obstruent Tensification in Korean and Geminate Inalterability, in *Theoretical Issues in Korean Linguistics*, Young-Key Kim-Renaud (ed), CSLI, 45-60
- Goldsmith, J. (ed) (1993) *The Last Phonological Rule*, The University of Chicago Press
- Han, J-I (1992) Korean Tense Consonants and Tensification, *CLS* 28.1, 206-223
- Hayes, B. (1986) Inalterability in CV Phonology, *Lg* 62, 321-351
- Kang, O. (1991) Prosodic Word in Korean, Paper presented at the Northeastern Linguistics Society meeting
- Kang, O. (1992) *Korean Prosodic Phonology*, Doctoral Dissertation, University of Washington
- Kim-Renaud, Y-K (1974) *Korean Consonantal Phonology*, Doctoral Dissertation, University of Hawaii
- Lakoff, G. (1993) Cognitive Phonology, in *The Last Phonological Rule*, Goldsmith, J. (ed), The University of Chicago Press, 117-145
- Martin, S.E. (1951) Korean Phonemics, *Word* 20, 519-533
- Martin, S.E. (1954) *Korean Morphophonemics*, LSA, Baltimore
- Martin, S.E. (1982) Features, Markedness and Order in Korean Phonology, *Linguistics in the Morning Calm*, Linguistic Society of Korea (ed), Hanshin, Seoul
- Park, Wonchul (1994) A Phonetic Study on Korean Obstruents, *The Penn Review of Linguistics: Proceedings of the Eighteenth Annual Penn Linguistics Colloquium*, 133-144
- Prince, A. and P. Smolensky (1993) *Optimality Theory: Constraint Interaction in Generative Grammar*, ms., Rutgers University and University of Colorado at Boulder
- Schein, B. and D. Steriade (1986) On Geminates, *LJ* 17, 691-744
- Schmidt, Deborah (1992) Syllable Contact in Korean, ms., University of Georgia