Two sides of the same coin: an account of the dual phonetic realisation of obstruent clusters in Korean*

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Rhee, Sang Jik. 2010. Two sides of the same coin: an account of the dual phonetic realisation of obstruent clusters in Korean. *Studies in Phonetics, Phonology and Morphology* 16.3. 433-452. Normally, obstruent sequences generated by suffixation undergo tensification (e.g./kap^{h}ta/ [kapt'a]). In the phonological literature, an alternative form is noted optionally, in Seoul dialect and child speech, an [ɨ] appears between two obstruents in a cluster (e.g. /kap^{h}ta/ [kap^{h}ɨta]). The mainstream approach has treated these two processes independently in terms of two separate rules in the non-linear framework or re-ranking of constraints in OT. This paper, however, argues that the two phenomena are phonologically motivated by the failure of a governing relation being established between two obstruents in underlying representations. These two types of phonetic realisations can then be captured by separate modes of morpheme concatenation. Specifically, the failure of the governing relations requires a repair strategy to modify the ill-formed sequence into a phonotactically permitted one. In terms of morpheme concatenation, while tensification is invoked in an analytic structure, in which the morphological boundary is transparent on the one hand, the insertion of [ɨ] between the obstruents is treated as a non-analytic structure, in which the morpheme boundary is ignored on the other. In this way, the different surface manifestations of obstruents sequences constitute two sides of the same coin in the sense that they are induced by the requirements of one and the same principle. **(Chungnam National University)**

Keywords: phonetic realisation of obstruent clusters, consonantal governing relation, analytic structure, non-analytic structure, suffixation

1. Introduction

In Korean, an obstruent cluster generated by suffixation normally undergoes tensification. In the phonological literature, however, another variant is observed in that a vowel [ɨ] is inserted between the obstruent clusters in the Seoul dialect and child speech. Relevant data are shown in (1).

(1) (a) Tensification

/kap^{h}ta/	[kapt'a]	'to repay'
/məkta/	[məkt'a]	'to eat'
/k'ak'ta/	[k'akt'a]	'to trim'
/mat^{h}ta/	[matt'a]	'to smell'

* I would like to thank the anonymous reviewers for their helpful comments. The remaining errors, of course, are mine.

(b) /ɨ/-epenthesis

/kap^{h}ta/	[kap^{h}ɨta]	'to repay'
/məkta/	[məkɨta]	'to eat'
/k'ak'ta/	[k'ak'ɨta]	'to trim'
/mat^{h}ta/	[mat^{h}ɨta]	'to smell'

(Yoo 2000, Ahn 1991, among others)

The mainstream approaches have treated these two processes in (1a) and (1b) as tensification and [ɨ]-epenthesis, respectively. A rule-based approach would analyse these phenomena as follows (Ahn 1991).

(2) (a) Tensification

/kap^{h} + ta/	
[kapta]	neutralisation
[kapt'a]	tensification

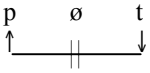
(b) ɨ-epenthesis

/kap^{h} + ta/	
[kap^{h}ɨta]	ɨ-epenthesis

These analyses suggest that these two processes are unrelated to each other. This paper, however, proposes an alternative view on these phenomena in that the different surface realisations are motivated by the failure of a governing relation being established between two obstruents in underlying representation. When the conditions on governing relations among obstruent sequences are not met, repair strategies must take place to make them into phonotactically permissible clusters. In the course of repair processing on the basis of identical inputs as in (2), these two processes depend on specific modes of morpheme concatenation. While tensification occurs in an analytic structure where a morpheme boundary is transparent, [ɨ]-epenthesis takes place in non-analytic structure in which the morpheme boundary is opaque, i.e. when this structure is considered as a single word.

Concretely, tensification occurs in the analytic structure of [[kap^{h}ø] ta] which contains two phonological domains: a stem and a suffix. In contrast, ɨ-epenthesis arises in the non-analytic structure of [kap^{h}øta], which contains a single domain (ø: empty nucleus).[1] To account for tensification, first neutralisation applies to the innermost domain, i.e. [kap^{h}ø], and so its result emerges as [kapø]. This result is concatenated with a suffix /ta/ to form a single domain, i.e. [kapøta], in which a governing relation is set up between the two lenis obstruents across an empty nucleus, as shown below.

(3) [k a p ø t a]



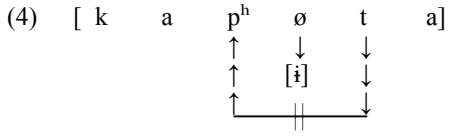
As we will see later in section 3, since mutual government among lenis obstruents is not allowed in (3), a lenis obstruent /t/ cannot govern a

[1] The phonetic realisation of empty nuclei will be dealt with in sections 2 and 3.

preceding /p/. Hence, a repair strategy is triggered so that its result produces tensification as in [kapt'a].

With respect to ɨ-epenthesis, a governing relation is set up in a single domain, i.e. [kap^{h}øta], as shown in (4).

(4)



In (4), the intervening empty nucleus is phonetically realised as [ɨ] due to the failure of inter-onset government in that a lenis obstruent cannot govern a preceding aspirated one: a lenis obstruent (/t/) cannot govern a preceding aspirated one (/p^{h}/).[2]

In this way, this paper claims that these separate surface realisations from the identical input are accounted for exclusively by the mechanism of consonant governing relations set up between obstruent clusters. In other words, these two phenomena constitute two sides of the same coin in the sense that they are caused by the fact that the conditions on governing relations among obstruents are not met.

In order to explain these two processes properly, this paper adopts the theory of Government Phonology (GP), which is based on a principles-and-parameters approach (Kaye, Lowenstamm, and Vergnaud (KLV) 1985, 1990; Harris 1990, 1994; Charette 1991, among others). This paper is organised as follows. In section 2, the basic notions of GP are introduced with respect to syllable structure and the Empty Category Principle (ECP), which determines the phonetic realisation of empty nuclei. In section 3, which discusses the syllable structure of Korean in detail, the distribution of morpheme-internal consonant clusters is considered in terms of the presence/absence of the vowel [ɨ]. To account for the distribution of this vowel, surface consonant clusters are syllabified underlyingly as two onsets separated by an empty nucleus. The vowel [ɨ] between two consonants is also represented by an empty nucleus. It is demonstrated that the ECP determines the well-formedness of consonant clusters in terms of the head-final inter-onset government, together with government licensing and domain-final licensing. To substantiate inter-onset governing relations among obstruent consonants, the theory of elements is briefly introduced to show how segmental government affects well-formedness of a given sequences. Section 4 discusses how suffixes in Korean are classified into analytic and non-analytic one. On the basis of this classification, the analysis suggests that different phonetic realisations are captured by the fact that tensification occurs in an analytic structure, while the occurrence

[2] In fact, the different phonetic realisations on empty nuclei in (3) and (4) can be ascribed to the different status of an empty nucleus. This difference will be dealt with in section 4.

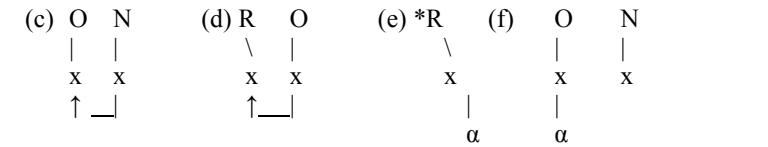
of [ɨ] is invoked in a non-analytic structure. The final section discusses some implications of the proposal regarding the different structures assigned to adult and child speech and summarises the main points of this paper.

2. Basic notions of GP

The core notion in GP is *government*. One of the key roles of government is to determine a non-ambiguous syllabification for a given phonological string consisting of a sequence of skeletal points with which segments are associated. With regard to syllabification, the GP approach is different from the mainstream phonological theories in that a final consonant is syllabified as an onset rather than a coda. This assumption is formally expressed by following two principles.

(5) (a) The 'Coda' Licensing Principle (Kaye 1990: 311)
Post-nuclear rhymal positions (i.e. coda: SJR) must be licensed by a following onset.

(b) The Onset Licensing Principle (Harris 1994: 160)
An onset head position must be licensed by a nuclear position.



(O: onset, R: rhyme, N: nucleus)

In the phonological literature, the notion of licensing is used as a relation that binds one unit to another. Each unit within a representation must belong to some higher-order unit in a hierarchical way (Selkirk 1984, Nespor and Vogel 1986, Itô 1986, among others). GP, however, proposes a different licensing approach in that a set of syntagmatic relations sanctions certain adjacent syllabic positions. The 'Coda' Licensing and the Onset Licensing Principle illustrate such licensing relations in that every onset requires a following nucleus (5c), and every rhymal complement (i.e. coda) requires a following onset (5d). The two principles ensure, as in (5f), that a final consonant is syllabified as an onset that followed by an empty nucleus rather than the configuration in (5e). In (5f), we note that the empty nucleus appears in the final position and its phonetic realisation is treated as inaudible.

However, a final empty nucleus is not present in all languages. Languages such as Hawaiian, Italian and Zulu, must end in a nucleus with phonetic content. This indicates that the presence of empty nuclei in final position is decided by language specific conditions. Thus, the presence

versus absence of final consonants is characterised in terms of a parameter which determines whether or not final empty nuclei are sanctioned in the language. In GP, the presence of final empty nuclei is determined by the ECP, which is understood as a part of Universal Grammar (UG).

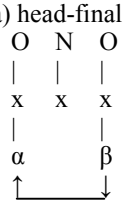
(6) The Empty Category Principle[3]
A licensed (empty) category receives no phonetic interpretation licensing under the following circumstances:
(a) Domain-final (empty) categories are licensed (parameterised)
(b) A (empty) nucleus within an inter-onset domain

(Rhee 2004)

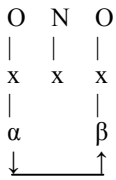
The ECP dictates that an empty nucleus is not phonetically realised (i.e. inaudible) if it is licensed. The condition in (6a) is a parameter, i.e. some, but not all, languages license domain-final empty nuclei.[4] Informally speaking, languages with consonant-final words (such as English, Dutch or Arabic) license a domain-final empty nucleus: it is inaudible. In contrast, languages without consonant-final words (such as Hawaiian or Italian) must end in a vowel. In this regard, Korean permits consonant-final words so that the parameter setting for (6a) is 'on'.

Inter-onset government in (6b) concerns the phonetic interpretation of domain-internal empty nuclei, as illustrated in (7).

(7) (a) head-final government



(b) head-initial government



In (7), an inter-onset governing relation is set up between two consonants intervened by an empty nucleus. The governing direction is parametrically proceed from right-to-left in (7a) and from left-to-right in (7b). For instance, Korean belongs to the former (Heo 1995 and Rhee 2002) and Polish to the latter (Gussmann and Kaye 1993). Regarding the

[3] The ECP in (3) differs in its formulation from that of Kaye (1995). Missing licensing conditions in the ECP are *magic licensing*, which is designed to account for sC clusters in Indo-European languages (Kaye 1992). Apart from this, the difference has no bearing on matters discussed in this paper.

[4] The notion of licensing in the ECP differs from that of syntagmatic licensing in (2). In the latter, syntagmatic licensing ensures that an onset requires a following nucleus and a coda must be followed by an onset. Licensing in the ECP relates to the phonetic manifestation in that an empty nucleus is silent when it is licensed; otherwise it is phonetically realised, i.e. it is treated as unlicensed.

phonetic realisation of the empty nucleus, it is treated as silent, i.e. it is licensed, when the condition of governing relation is satisfied; otherwise it is phonetically realised.[5] To fulfil the governing relations between two consonants in question, the head consonant must have appropriate governing properties to govern its complement. Next section presents a brief overview of the distribution of the vowel [ɨ] in mono-morphemic contexts and of how governing relations account for the distribution of consonant clusters account.

3. Syllable structure and the distribution of [ɨ] in Korean

Unlike other vowels in Korean, the vowel [ɨ] is unique in that it is subject to ɨ/zero alternations in suffixation, and to insertion in loanwords. These topics have been discussed in various theoretical frameworks (e.g. Hong 2001 for ɨ/zero alternations and Kang 1996 for loanword phonology in Optimality Theoretic (OT) framework, among others). What previous analyses have not dealt with is the distribution of [ɨ] in mono-morphemic words, since this vowel has traditionally been regarded as lexically specified. There is positive evidence, however, that this vowel must be treated differently from other vowels, since the distribution of [ɨ] is highly constrained and hence predictable both morpheme-internally and in suffixation.

In final position, the vowel [ɨ] generally does not occur. The presence of this vowel is sensitive to the surrounding consonants. (8) and (9) illustrate the distribution of morpheme-internal [ɨ] within consonant sequences.

(8) The occurrence of internal [ɨ] between two consonants (C1 and C2)

C1 \ C2	L	N	LO	TAO
L	ø	ø	ø	ø
N	ɨ	ø	ø	ø
LO	ɨ	ɨ	ɨ	ø
TAO	ɨ	ɨ	ɨ	ɨ[6]

(L: liquid; N: nasal; LO: lenis obstruent TAO: tensed or aspirated obstruent; ø: absence; ɨ: presence)

[5] The phonetic interpretation of empty nuclei varies from language to language: it is [ɨ] in Moroccan Arabic (Kaye 1987) and Korean (Heo 1995); [ə] in French (Charette 1988); [e] in Polish (Gussmann and Kaye 1993).

[6] The vowel [ɨ] is found between aspirated stops in loanwords, such as *naphthalene* [nap^{h}ɨt^{h}allin].

(9) (a) Absence of [ɨ]

(i) between L+L

[k^{h}əl<u>øl</u>e] ‘a pair of shoes’	[tu<u>løl</u>e] ‘girth’

(ii) between L+N or L+LO

[tasɨ<u>løk</u>i] ‘gastropod’	[kətɨ<u>løm</u>ək] ‘arrogant’
[ka<u>løp</u>i] ‘ribs’	

(iii) between L+TAO

[ka<u>løk^{h}</u>wi] ‘wooden rake’	[tɨ<u>løs’</u>ək] ‘moving slightly’
[sa<u>løp^{h}</u>i] ‘to consider’	[ma<u>løt’</u>oŋ] ‘blankly’

(iv) between N+LO

[pə<u>nøg</u>ɛ] ‘lightening’	[si<u>møbur</u>ɨm] ‘errand’
[ə<u>ŋød</u>əŋi] ‘hip’	

(v) between N+TAO or LO+TAO

[sikɨ<u>møc^{h}</u>i] ‘spinach’	[pə<u>nøc’</u>ək] ‘sparkling’
[nɨ<u>køt’</u>ɛ] ‘wolf’	[sɛ<u>køs’</u>i] ‘lady’

(b) Presence of [ɨ]

(i) between N +L or LO+L

[ci<u>nɨr</u>əmi] ‘fin’	[hə<u>tɨr</u>e] ‘trash’
[pusɨ<u>r</u>əm] ‘ulcer’	

(ii) between LO+N

[na<u>kɨn</u>e] ‘stranger’	[koc<u>ɨn</u>ək] ‘silent’
[sɨløkɨməni] ‘secretly’	

(iii) between LO+LO

[pan<u>dɨs</u>i] ‘certainly’	[po<u>tɨk</u>i] ‘dwarf tree’

(iv) between TAO+L or TAO+N or TAO+LO

[k’a<u>k’ɨr</u>aki] ‘bits of rice’	[tələk<u>ɨt</u>ək] ‘click’
[kjaløc’ɨmak] ‘slender	[kɛ<u>k’ɨs</u>i] ‘tidily’
[tələk^{h}<u>ɨt</u>ək] ‘click’	

(ø: absence of [ɨ])

The generalisation that we can make is that the occurrence of the vowel [ɨ] depends on whether or not a surrounding consonant sequence can form a coda-onset cluster.[7] That is, liquid geminates (e.g. (9ai)), liquid + nasal or liquid + lenis obstruent (e.g. (aii)), nasal + lenis obstruent (e.g. (9av) and both nasal + tensed or aspirated and lenis obstruent + tensed or aspirated obstruent sequences (e.g. (9avi)) can form a coda-onset cluster. In these cases, the vowel [ɨ] is absent. Note that these coda-onset clusters require

[7] An anonymous reviewer points out that the occurrence of [ɨ] between an intervocalic consonant cluster can be accounted for in terms of the Sonority Contact Law (Vennemann 1988, Davis and Shin 1999). According this theory, a falling sonority capture an absence of the vowel [ɨ] but a rising sonority invokes a presence of this vowel. In comparison to this theory, a GP approach is a rather different mechanism in that the absence/presence of [ɨ] is determined by a governing relation set up between two consonants intervened by an empty nucleus. Specifically, if a governing consonant governs a preceding one, the phonetic content of empty nuclei is silent; otherwise it emerges as [ɨ]. Thus, it is very difficult to evaluate pros and cons for these two theories. See Ohala (1992) for a review of the sonority contact law.

the presence of a following vowel. Without a following vowel, [ɨ] must occur between the two consonants, e.g. for liquid + nasal sequences [kərɨm] 'fertiliser'; liquid + lenis obstruent sequences [turɨp] 'aralia shoot'.

However, when the order of consonants is reversed, [ɨ] is present between the two consonants in question (e.g. (9bi, ii, iii, iv)), irrespective of the presence of a following vowel. This indicates that the distribution of [ɨ] is not arbitrary. Rather, it is controlled by the presence or absence of following vowels and the quality of surrounding consonants. In order to capture the distribution of [ɨ] in a unified way, surface consonant clusters are syllabified as two onsets separated by an empty nucleus and the occurrence of the vowel [ɨ] flanked by a consonant cluster is also represented by an empty nucleus underlyingly (Heo 1995, Rhee 2002). For instance, the lexical representations of [kolmok] 'alley' and [omɨri(ta)] 'to close up' are shown in (10).

(10)(a) /koLØmokØ/ [kolmok]

O	N1	O	N2	O	N3	O	N4
|	|	|	|	|	|	|	|
x	x	x	x	x	x	x	x
|	|	|		|	|	|	
k	o	L[8]		m	o	k	

(b) /omØLi/ [omɨri]

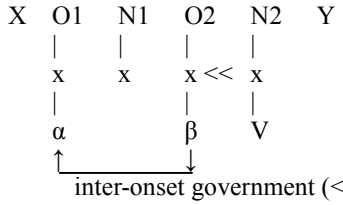
O	N1	O	N2	O	N3
	|	|	|	|	|
	x	x	x	x	x
	|	|		|	|
	o	m		L	i

(Ø: empty nucleus)

As we have seen in (5), the final consonants are syllabified as an onset followed by an empty nucleus due to the effect of the Coda Licensing and the Onset Licensing Principle. In order to account for the distribution of [ɨ], (6b) in the ECP, i.e. head-final inter-onset government together with government-licensing and domain-final licensing as in (6a), determines the well-formed of consonant clusters. Rhee (2004) proposes the following conditions on phonetic realisation of internal empty nuclei.

[8] This paper will not treat the topic of what is the underlying segment of liquids in Korean. It suffices to say that [r] and [l] occurs in internal onset and in final onset position, respectively. The underlying liquid is represented by the 'archiphoneme' L.

(11) Conditions on phonetic realisation of internal empty nuclei in Korean



(a) An internal empty nucleus N1 is licensed (i.e. inaudible) iff:
(i) The governing onset O2 must have the relevant governing properties to govern O1.
(ii) An unlicensed (i.e. with phonetic content) government-licenser is present.

(b) Government-licensing
For a governing relation to hold between a non-nuclear head α and its complement β, α must be government-licensed by its nucleus. (Charette 1991)

(11) asserts that both head-final inter-onset government and the presence of an unlicensed government-licenser (i.e. a segment with phonetic content) are necessary and sufficient conditions to license an internal empty nucleus. For the intervening empty nucleus N1 to remain inaudible (i.e. licensed), the governing onset O2 must have appropriate governing properties to govern. In addition, government-licensing is required, in the sense that the governing onset O2 should be licensed by a following unlicensed nucleus in order to govern its preceding onset O1. This nucleus, i.e. N2, is called a *government-licenser*. Informally speaking, a surface coda-onset cluster requires a following vowel. If either of these two conditions is not met, the intervening empty nucleus O1 must receive phonetic interpretation.

To substantiate a governing relation between two onsets in question, GP proposes an element-based approach to determine a segmental government hierarchy. In this paper, however, will not attempt to present a full-fledged overview on the theory of elements (KLV 1985, Harris 1990, 1994)) or revised element theory (Ploch 1999) nor a detailed analysis on consonantal representations in Korean (Heo 1995, Rhee 2002, 2006). Rather, basic notions relevant to this topic are briefly introduced. The ultimate unit of segments is the monovalent (privative) element in GP. Accordingly, contrasts among segments are denoted by the presence/absence of pertinent elements. This paper assumes that *headed* segments possess governing properties and so can occur in a governing position to govern *headless* segments. Informally speaking, obstruents are considered as headed

segments in that sonorant + obstruents sequences are widely allowed as well-formed coda-onset clusters, viz. a headed consonant in an onset position governs a headless one in a coda. Accordingly, sonorants are regarded as headless. Among headless consonants, more complex segments can govern less complex ones. Segmental complexity is calculated in terms of the number of elements that a segment is composed of (KLV 1990, Harris 1994). Regarding segmental complexity, nasals are treated as more complex than liquids. Thus, liquids + nasal sequences are regarded as well-formed coda-onset clusters.

With respect to obstruents in Korean, there are three types, i.e. lenis, tensed, and aspirated ones; not all of these can be headed. When we examine the distribution of morpheme internal obstruent clusters, note that lenis + tensed or lenis + aspirated sequences do not contain an intervening vowel [ɨ] but this vowel is present when the order of the sequences is reversed, as shown below.

(12) (a) Lenis stop + Ø + tensed or aspirated obstruent + V

/sɛkØs'i/	[sɛks'i]	'lady'
/akØc^{h}akØ/	[akc^{h}ak]	'toughness'
/kapØc'aki/	[kapc'aki]	'suddenly'
/nØkt'ɛ/	[nikt'ɛ]	'wolf'
/kakØt'uki/	[kakt'uki]	'pickled radish'

(b) Tensed or aspirated obstruent + Ø + lenis stop + V

/swet'Øki/	[swet'ɨki]	'horsetail'
/təLØk^{h}Øtək/	[təlk^{h}ɨtək]	'click'

These distributional facts strongly suggest that lenis obstruents are headless but tensed and aspirated ones are headed. Thus, the latter occur in a governing position and can govern a preceding lenis stop. Regarding the governing properties of consonants in Korean, Rhee (2002) proposes the following governing hierarchy.[9]

(13) The governing hierarchy in Korean

(a) $\underbrace{\text{liquids} < \text{nasals and lenis obstruents}}_{\text{headless}}$ $\underbrace{< \text{tensed and aspirated obstruents}}_{\text{headed}}$

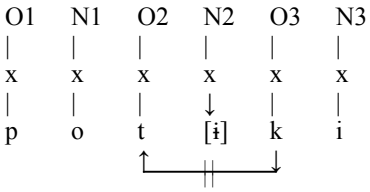
(b) Mutual government is not allowed among equally-ranked segments.

In this hierarchy, liquids are the weakest and the tensed and aspirated obstruents are the strongest governors. Among headless segments, nasals

[9] An anonymous reviewer points out that a word /nak'si/ 'fishing' can constitute a counterexample to the governing hierarchy in (13). Diachronically, /nak'si/ has been derived by an old form /naks+i/ (Yi, Seon-ung, personal communication). In this regard, the insertion of /s/ is treated as a historical residue.

and lenis obstruents are stronger than liquids. This is formally correlated with segmental complexity. Hence, the hierarchy predicts that liquids can occur in a coda while other types of segments occur in an onset. (13) provides an appropriate account of the presence of [ɨ] between two lenis obstruents, as was illustrated in (9biii). The presence of an intervening [ɨ] is due to the fact that inter-onset government cannot be established, since a lenis obstruent is prohibited from governing another lenis obstruent, as shown in (14).

(14) /potØki/ [potɨki] 'dwarf tree'



4. The analysis

In this section, the theory of morphology-phonology interface in GP is introduced to show how suffixes in Korea are classified as analytic and non analytic (section 4.1). On the basis of the classification of suffixes in Korean, it will show that the different phonetic realisations are treated by the fact that tensification occurs in an analytic structure and the occurrence of [ɨ] is invoked in a non-analytic structure (section 4.2).

4.1 The morphology-phonology interface in GP

This section introduces the way in which GP deals with the morphology-phonology interface, on the basis of the proposal by Kaye (1995) which makes a distinction between analytic and non-analytic structure. GP recognises two types of phonological domains in the interface of morphology: analytic and non-analytic ones.

(15) (a) Analytic morphology (i) [[A] B]
(ii) [[A] [B]]
(b) Non-analytic morphology [A B]

There are two types of analytic structure: one in which only one of the concatenating structures forms a phonological domain, as in (15ai) (mostly involving stem-suffix relations) and one in which both concatenating structures form a phonological domain (mostly relevant to compounding), as in (15aii). A non-analytic structure does not contain any internal

domains so that it forms a single phonological domain. A phonological domain defines an area that is subject to the application of relevant phonological processes. In the structure [[A] B] in (15ai), phonological processes apply to A and concatenate the result with B, and then apply to the concatenation (i.e. [AB]). In the structure [[A] [B]], phonological processes apply to A and B separately. The results are concatenated to form a single domain (i.e. [AB]), and then phonological processes apply to that domain. Regarding the non-analytic structure [AB], phonological processes simply apply to the result of concatenation. This implies that non-analytic structures are treated in the same way as morphologically simplex words.

At first glance, the analytic domain assumes cyclic derivation like Lexical Phonology (LP, Kiparsky 1982, among others). This creates a new morphological domain that may coincide with the phonological domain structure, when a new analytic suffix is added (cf. Gussmann and Kaye 1993). The implication is that the analytic structure requires the notion of bracket erasure (Kiparsky 1982). In fact, the analytic and the non-analytic structure approximately correspond to the cyclic and non-cyclic levels in LP, respectively. In past tense inflection of English, for instance, the irregular past tense is treated as non-cyclic, e.g. *keep*/*kept*, while regular inflection is treated as cyclic, e.g. *peep*/*peeped*. The difference from LP, however, is that words that form non-analytic domains are not derived from a base by phonological rule application, but are regarded as lexically stored in the same way as morphologically simplex forms in the lexicon. Hence the so-called 'closed syllable shortening' process (Myers 1987) does not play a role at all in GP (Harris 1994, Kaye 1995).

Given this brief view of the morphology-phonology interface in GP, let us consider the question of how the Korean suffixes are classified into these two types. Whether or not a stem-final consonant undergoes neutralisation provides a criterion for this distinction (Rhee 2002). If it does, a following suffix is analytic; otherwise it is non-analytic. Korean permits certain types of segments to occur in stem-final position, i.e. sonorants [l, m, n, ŋ] and lenis stops [p, t, k]. Recall that the domain-final licensing parameter is 'on' in Korean. In GP, neutralisation is viewed as the effect of a licensing constraint imposed on a licensed domain-final empty nucleus (henceforth final empty nucleus), so that this empty nucleus can license only a limited set of segments. If segments other than these seven segments occur before a final empty nucleus, they undergo neutralisation and become one that the final empty nucleus can license. Thus, neutralisation signifies the presence of a final empty nucleus. The segmental changes are summarised as follows:

(16) (a) /p, p', p^h/ → [p]
(b) /t, t', t^h, s, s', c, c^h/ → [t]
(c) /k, k', k^h/ → [k]

In order to see how neutralisation works in suffixation, consider the following nominal stems which end in a tensed or aspirated obstruent and their nominative and emphatic forms.

(17)	Stem	In isolation	Nominative	Emphatic	
	/cip^{h}Ø/	[cip]	[cip^{h}i]	[cipt'o]	'straw'
	/mit^{h}Ø/	[mit]	[mic^{h}i]	[mitt'o]	'bottom'
	/puək^{h}Ø/	[puək]	[puək^{h}i]	[puəkt'o]	'kitchen'
	/pic^{h}Ø/	[pit]	[pic^{h}i]	[pitt'o]	'light'
	/pak'Ø/	[pak]	[pak'i]	[pakt'o]	'outside'

In (17), an underlying stem-final tensed or aspirated obstruent becomes a lenis stop in isolation and in emphatic suffixation. In emphatic suffixation, in particular, the fact that a stem-final segment consonant undergoes neutralisation indicates that it is followed by a final empty nucleus, which in turn suggests that the emphatic suffix should be treated as analytic, as shown below.

(18) (a) /[cip^{h}Ø]/ [cip]

	O1	N1	O2	N2
	|	|	|	|
[	x	x	x	x]
	|	|	|	
	c	i	p^{hh}	
			↓	
			[p]	

(b) /[[cip^{h}Ø] to]/ [cipt'o][10]

	O1	N2	O2	N2	O3	N3
	|	|	|	|	|	|
[[	x	x	x	x]	x	x]
	|	|	|		|	|
	c	i	p^{h}		t	o
			↓			
			[p]			

([ ]: phonological domain)

When the nominative suffix [i] is added to a stem, however, the stem-final consonant preserves its segmental content. To account for this, we assume that this suffix is added to the stem directly, i.e. without an intervening domain. That is, the nominative suffix is non-analytic, as illustrated in (19).[11]

[10] Note that tensification occurs in (18b). This process will be dealt with in section 4.

[11] A list of analytic and non-analytic suffixes is shown below (Rhee 2002).

(a) Analytic suffixes

(i) nominal suffixes: /to/ 'also'; /macə/ 'even'; /pota/ 'than'; /put^{h}ə/ 'from'

(ii) verbal suffixes: /ta/ 'declarative'; /ni/ 'interrogarive'; /ca/ 'propositive'; /tə/ 'retrospective'; /ci/ 'supportive'

(b) Non-analytic suffixes

(i) nominal suffixes: /i/: nominative; /L/: accusative; /e/ dative; /esə/ 'locative, source'; /ro/ 'instrument'

(ii) verbal suffixes: /a or ə/: 'stative'; /ni/: 'effective'; /mjə/: 'connective'; /si/ 'honorific'; /mjən/ 'conditional';

(19) /[cip^{h}i]/ [cip^{h}i]

	O	N	O	N
	|	|	|	|
[	x	x	x	x]
	|	|	|	|
	c	i	p^{hh}	i

On the basis of the classifications on analytic and non-analytic suffixes, I show how obstruent clusters from identical inputs are phonetically realised as two variants in next section.

4.2 The dual phonetic realisations on obstruent clusters in suffixation

As indicated earlier, tensification occurs in analytic structure and ɨ-epenthesis arises in non-analytic structure. First, consider tensification. Relevant examples are repeated from (1a).

(20) Tensification

/kap^{h}ta/	[kapt'a]	'to repay'
/məkta/	[məkt'a]	'to eat'
/k'ak'ta/	[k'akt'a]	'to trim'
/mat^{h}ta/	[matt'a]	'to smell'

First, consider /kap^{h}ta/ and its underlying representation, as shown in (21).

(21) /[[kap^{h}Ø] ta]/ [kapt'a]

	O1	N1	O2	N2	O3	N3
	|	|	|	|	|	|
[[	x	x	x	x]	x	x
	|	|	|		|	|
	k	a	p^{h}		t	a

Given the analytic structure in (21), relevant phonological processes apply to the innermost domain, as shown in (22).

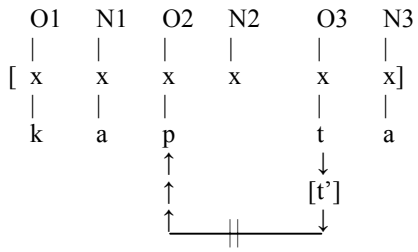
(22) [kap^{h}Ø]

	O1	N1	O2	N2
	|	|	|	|
[	x	x	x	x]
	|	|	|	
	k	a	p^{h}	
			↓	
			[p]	

As noted above, neutralisation occurs before the final empty nucleus N2 in this domain. Recall from section 2 that the licensing relations proceed syntagmatically among syllabic constituents. In GP terms, neutralisation is triggered by a constraint imposed on a final empty nucleus which cannot license a certain type of preceding onset segments (Rhee 2002). In particular, headed segments such as tensed and aspirated obstruents undergo neutralisation. That is, while any segment may occur before an unlicensed nucleus (i.e. the nucleus with phonetic content), only a limited set of segments may before a licensed empty nucleus. As Harris (1992) and Brockhaus (1995) put it, unlicensed nuclei have a much greater licensing ability. The weaker licensing ability of licensed empty nuclei affects the degree of segmental complexity of preceding onsets and may trigger segmental changes of the segments in question. That is, neutralisation is a reflection of their weakened or depleted licensing power. Concretely, this process is generally characterised as the loss of headship for headed segments, i.e. they become headless.

After the bracket erasure of the innermost domain in which neutralisation applied, the following configuration emerges.

(23) [kapØta]



Inter-onset government

An inter-onset government relation is set up between O2 and O3 across a licensed empty nucleus N2. I assume that the licensed status of N2 is protected by the effect of the Strict Cyclicity Condition (SCC) (Kean 1974, Kiparsky 1982, 1985, Cole 1995, among others).[12] This implies that the

[12] According to Cole (1995: 72), the empirical effects of the SCC can be summarised as the *Reaching Back Constraint* and the *Derived Environment Constraint*. The former prevents a cyclic rule *R* applying on *j* from reaching back inside an earlier cycle *i* to apply to a string contained wholly within cycle *i*. This indicates that the domain of an earlier cycle is opaque to phonological processes in a current cycle. The effect of the latter, originally responsible for limiting the abstractness of phonological analysis, inhibits a rule *R* from applying to a string contained within a single morpheme. Thus, the SCC regulates the way in which cyclic rules typically apply across a morpheme boundary and are prohibited from applying within a morpheme. The empirical consequence is that phonological rules fail to apply within a stem (or root) or other monomorphemic environment.

status of N2 is preserved after bracket erasure, i.e. N2 remains phonetically silent. Consequently, either O2 or O3 undergoes a segmental change to meet the inter-onset governing requirements. Since O3 in the governing position cannot govern O2 due to the fact that mutual government is prohibited as in (13) and (14), a best possible output is that O3 undergoes tensification, i.e. to become a headed segment to govern O2. In other words, tensification process consists of a headship change in order to satisfy a governing relation requirement among equally ranked segments.

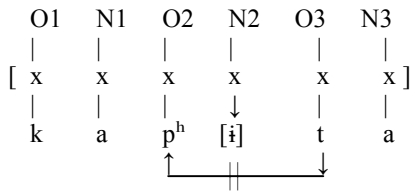
Next, ɨ-epenthesis occurs when a non-analytic structure is present. Relevant data are repeated from (1).

(24) /ɨ/-epenthesis

/kap^{h}ta/	[kap^{h}ɨta]	'to repay'
/məkta/	[məkɨta]	'to eat'
/k'ak'ta/	[k'ak'ɨta]	'to trim'
/mat^{h}ta/	[mat^{h}ɨta]	'to smell'

Consider /kap^{h}ta/ and its underlying representation as shown in (25).

(25) /[kap^{h}Øta]/ [kap^{h}ɨta]



Since a non-analytic structure as in (25) do not involve multiple domains, it can establish a governing relation between O2 and O3 straightforwardly. In this configuration, O3 in the governing position cannot govern a preceding O2 so that the intervening empty nucleus N2 receives a phonetic realisation as [ɨ]. The phonetic form [kap^{h}ɨta] emerges. This result suggests that the non-analytic structure in (25) is treated in the same way as mono-morphemic words as in (9).

To analyse the occurrence of [ɨ] in non-analytic suffixation and tensification in analytic suffixation on the basis of identical inputs, all outcomes conform to phonotactic constraints in Korean to satisfy the requirements of the ECP, in particular inter-onset government. The analysis in this paper shows that the failure of inter-onset government among obstruent sequences produces tensification and [ɨ]-epenthesis in a unified way. In this way, this paper demonstrates that these two processes are not independent phenomena.

5. Discussion and conclusion

Let us briefly discusses some implications with respect to the reason why [ɨ]-epenthesis rather than tensification is utilised in child speech. In a discussion of language development, Pae (1998) states that [ɨ]-epenthesis in child speech is treated as a speech error, e.g. [capɨca] rather than [capc'a] 'to hold'. This paper, however, puts forward a different view in that the occurrence of [ɨ]-epenthesis is attributed to the fact that simpler domains are preferred in child speech. As we have seen above, note that this process arises in a single domain in comparison with tensification which involves two domains. Thus, one speculation would be that a child chooses a simpler domain than a more complicated one. Specifically, it can be assumed that the ability of parsing domainhood in early stages for language acquisition is limited. This would suggest that children in early stages have not yet learned the interface of morphology and phonology.

Furthermore, notice that there is a crucial difference regarding the syllable structure. The non-analytic structure for [ɨ]-epenthesis consists of CV sequences on the one hand, the analytic structure for tensification contains a CVC cluster on the other.[13] In terms of syllable typology, the fact that syllable structure available to children (CV only) is rather rudimentary compared with the syllable structure that is available to adults. In this regard, it will be an interesting subject to survey as to when children apply tensification rather than [ɨ]-epenthesis to obstruent clusters in a language development perspective.

To recapitulate, this paper deals with the dual phonetic realisations of obstruent clusters generated by suffixation. The mainstream approach has treated these phenomena independently as tensification and [ɨ]-epenthesis. However, this paper claims that these two processes are motivated by the failure of a governing relation between the two obstruents set up in underlying representations. The different manifestation is captured by the separate mode of morpheme concatenation. Regarding morpheme concatenation, while tensification is invoked in an analytic structure, in which the morphological boundary is transparent, [ɨ]-epenthesis between the obstruents, on the other hand, is treated as occurring within a non-analytic structure, in which the morpheme boundary is ignored. In this way, the different surface phonetic realisations of obstruents sequences represent

[13] Two anonymous reviewers point out that children probably may not recognise the distinction between analytic and non-analytic structure in a given language acquisition process. Rather, the reviewer argues that children frequently use CV rather than CVC accounted for by phonetic effects, i.e. they prefer less complex syllable structure. In fact, this issue is related to a child's underlying representation for consonants. As Stoel-Gammon and Dunn (1985: 58) suggest, the child's linguistic system is exceedingly difficult to investigate because it cannot be tested directly. Thus, the issue of lexical representations of children may not discuss properly in this paper. Instead, as the child choose less complex syllable structure, I assume that the child also less complex phonological domain rather than more complex one.

two sides of the same coin in the sense that they are caused by one and the same underlying principle.

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received: September 27, 2010
accepted: December 15, 2010