NN Sequences, the Vowel [ɨ] and Domains in Korean*

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This paper deals with the asymmetrical distribution of [ɨ] in NN (N: nasal) clusters in Korean. Morpheme-internally, this vowel is absent between two nasals when they are flanked by two vowels. However, in connective and effective suffixation, this vowel does intervene in these clusters and yet it is absent in interrogative and assertive suffixation. This paper proposes that the presence/absence of [ɨ] in these clusters can be analysed in terms of the Empty Category Principle (ECP). Specifically, it is assumed that [ɨ] is lexically represented by an empty nucleus and surface consonant clusters are syllabified as two onsets intervened by an empty nucleus. The phonetic interpretation of empty nuclei is determined by the ECP in well-defined contexts that are provided by the morphology. The analysis proposes that the asymmetrical distribution of [ɨ] in NN clusters is appropriately accounted for by the ECP with the interaction of three types of domains, i.e. bare stem, non-analytic and analytic.

Key words: NN clusters, the vowel [ɨ], empty nuclei, the Empty Category Principle, bare stem, non-analytic and analytic domains

1. Introduction

The vowel [ɨ] in NN sequences is distributed in an interesting way in mono-morphemic words and in suffixation. As shown in (1) below, morpheme-internally, we observe that nasal geminates are possible except for velar ones. Also, heterorganic nasal sequences are possible with the proviso that velar nasals must be followed by either labial or coronal

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nasals but not vice versa.[1] In (1a), note that [ɨ] does not occur between NN sequences when a vowel follows, but it does appear when there are no following vowels, as shown in (1b). This indicates that the absence of [ɨ] between two nasals is sensitive to the presence of a following vowel.

(1) a. NN with a following vowel

[simmani]	'ginseng-digger'
[ənni]	'sister'
[paŋmaŋi]	'club'
[maŋnani]	'wretch'
[kumnil]	'to stretch up'
[kənman]	'even though'

b. NN without a following vowel

[kɨmɨm]	'the last day of the month'
[kanɨm]	'aim'
[nɨn]	'topicaliser'
[nɨŋ]	'enough'

Verbal suffixation, however, shows a different picture from (1). As shown in (2a) below, when the connective /mjə/ or the effective /ni/ suffix[2] follows a vowel-final or liquid-final stem, the vowel [ɨ] does not occur between a stem-final and a suffix-initial segment. When a nasal-final stem is followed by these suffixes, however, this vowel splits up a NN sequence. Furthermore, as shown in (2b), this vowel never occurs in the assertive /ne/ and the interrogative /ni/ forms. It is of interest to note that the homophonous suffixes /ni/ (effective and interrogative) produce different outputs.

1) Though this paper will not deal with the behaviour of the velar nasal, note that this is due to a distributional restriction on the velar nasal, i.e. this segment cannot occur in onsets.

2) See section 3.3 for a discussion of the lexical representations of the two suffixes.

(2) a.	Stem	Connective /mjə/	Effective /ni/	
	/ka/	[kamjə]	[kani]	'to go'
	/nal/	[nalmjə]	[nani][3]	'to fly'
	/kam/	[kamɨmjə]	[kamɨni]	'to wind'
	/an/	[anɨmjə]	[anɨni]	'to hug'
b.		Assertive /ne/	Interrogative /ni/	
	/ka/	[kane]	[kani]	'to go'
	/nal/	[nane]	[nani]	'to fly'
	/kam/	[kamne]	[kamni]	'to wind'
	/an/	[anne]	[anni]	'to hug'

A crucial difference of (1a) and (2a) is that morpheme-internal NN sequences can be realised without an intervening [ɨ], but this vowel separates two nasals in suffixation. In the assertive and the interrogative forms in (2b), however, NN sequences are left intact, just like morpheme-internal ones, as shown in (1a). The distribution of [ɨ] in NN sequences can be summarised as follows:

(3) a. Morpheme-internal
  (i) NøNV (ii) NɨN
b. In suffixation
  (i) Conjunctive and effective NɨNV
  (ii) Assertive and interrogative NøNV
  (ø: absence of [ɨ], V: Vowel)

This paper addresses three issues regarding the distribution of [ɨ] in NN sequences in various contexts. The first concerns the question of why the presence of a following vowel is a significant factor for the occurrence of morpheme-internal [ɨ] in NN sequences. The second deals with the distribution of [ɨ] in suffixation: how is morphological information implemented in phonological representations so that we can adequately account for the presence/absence of [ɨ] in a given context? The third issue is how to capture the distribution of this vowel in morpheme-internal position and in suffixation in a unified way.

In discussing these issues, the theoretical framework that this paper

3) The deletion of [l] is due to a phonotactic constraint imposed on -ln- sequences in Korean: *ln.

adopts is Government Phonology (GP) which is a principles-and-parameters based approach (Kaye, Lowenstamm and Vergnaud (KLV) 1985, 1990, Charette 1991, Harris 1994, among others). This paper is organised as follows. In section 2, the distribution of morpheme-internal [ɨ] and the notion of empty nuclei are introduced. It will be shown that the Empty Category Principle (ECP), head-final inter-onset government and government-licensing determine the phonetic interpretation of empty nuclei. The absence of [ɨ] in morpheme-internal NN sequences is due to the Nasal Condition. In section 3, the approach to the morphology-phonology interface in GP is presented (Kaye 1995). The postulation of the *bare stem* domain is required in Korean to appropriately account for opacity effect regarding the distribution of [ɨ] in morpheme-internal position. The asymmetrical distribution of the vowel [ɨ] in NN sequences in suffixation is due to a difference in domainhood: connective and effective, and interrogative and assertive suffixation constitute non-analytic and analytic domains, respectively. In the final section, previous approaches are compared with the analysis in this paper and the summary is presented.

2. The Vowel [ɨ] and Empty Nuclei in Korean

2.1. A Summary of the Distribution of the Vowel [ɨ]

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, because 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.[4] The presence

4) There are three exceptions to this statement, viz. [kɨ] 'he', [jənɨ] 'other (person)' and [ənɨ] 'which'. Also see Heo (1995) for the treatment of initial [ɨ] as in [nɨk'i] 'to feel'.

of this vowel is sensitive to the surrounding consonants. The Table (1) summarises the distribution of internal [ɨ] and relevant data are shown in (4) (Heo 1995, Rhee 2002).

Table 1. 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[5]

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

(4) a. Absence of [ɨ]

(i) between L+L

[kʰjəlɨle]	'a pair of shoes'	[tulɨle]	'girth'

(ii) between L+N or L+LO

[tasɨlɨki]	'gastropod'	[kətɨlɨmək]	'arrogant'
[kalɨpi]	'ribs'		

(iii) between L+TAO

[kalɨkʰwi]	'wooden rake'	[tɨlɨs'ək]	'moving slightly'
[salɨpʰi]	'to consider'	[malɨt'oŋ]	'blankly'

(iv) betwen N+N

[simɨmani]	'ginseng-digger'	[kumɨnil]	'to stretch up'
[ənɨni]	'sister'	[kənɨman]	'even though'

(v) between N+LO

[pənɨgɛ]	'lightening'	[simɨburɨm]	'errand'
[əŋɨdəŋi]	'hip'		

(vi) between N+TAO or LO+TAO

[sikɨmɨcʰi]	'spinach'	[pənɨc'ək]	'sparkling'
[nɨkɨt'ɛ]	'wolf'	[sɛkɨs'i]	'lady'

5) The vowel [ɨ] is found between aspirated stops in loanwords, such as *naphthalene* [napʰɨtʰallin].

b. Presence of [ɨ]

(i) between N +L or LO+L

[cinɨrəmi]	'fin'	[hətɨre]	'trash'
[pusɨrəm]	'ulcer'		

(ii) between LO+N

[nakɨne]	'stranger'	[kocɨnək]	'silent'
[sɨløkɨməni]	'secretly'		

(iii) between LO+LO

[pandɨsi]	'certainly'	[potɨki]	'dwarf tree'

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

[k'akɨraki]	'bits of rice'	[tələkʰɨtək]	'click'
[kjaløc'ɨmak]	'slender'	[kɛk'ɨsi]	'tidily'
[tələkʰɨtək]	'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. That is, liquid geminates (e.g. (4ai)), nasal (partial) geminates (e.g. (4aiv)), liquid + nasal or liquid + lenis obstruent (e.g. (4aii)), nasal + lenis obstruent (e.g. (4av) and both nasal + tensed or aspirated and lenis obstruent + tensed or aspirated obstruent sequences (e.g. (4avi)) can form a coda-onset cluster and the vowel [ɨ] is absent. Note that these coda-onset clusters require 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 reverse, [ɨ] is present between the two consonants in question (e.g. (4bi, 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.

With respect to suffixation, it was noted in (2a) that the absence of [ɨ] after a liquid-final stems can be accounted for by the fact that [lm] sequences are well-formed coda-onset clusters. In other contexts, this vowel occurs after obstruent-final stems, e.g. /mək/ [məkɨmjə], [məkɨni] 'to eat'; /tat/ [tatɨmjə], [tatɨni] 'to close'; /əp/ [əpɨmjə], [əpɨni] 'to carry something or someone on the back'. The occurrence of the vowel [ɨ] after the obstruent-final stems is due to the fact that phonetic forms such as

[km], [tm], [pm], [kn], [tn] and [pn] are not well-formed coda-onset sequences, just like in the case of morpheme-internal [ɨ].

This explanation is problematic, however, for NN sequences in suffixation. Recall that morpheme-internal NN sequences can be realised if a following vowel is present. If the distribution of [ɨ] in suffixation followed the general pattern of morpheme-internal [ɨ], then this would predict that the vowel [ɨ] should not occur between NN sequences in suffixation, because morpheme-internal NN sequences are completely acceptable coda-onset clusters. However, this vowel occurs in the connective and the effective forms, although not in the assertive and the interrogative forms. These two types of suffixes show a different phonological behaviour, in that the former shows ɨ/zero alternation but the latter exhibits various consonant-related processes, such as nasalisation and tensification, depending on the quality of the stem-final consonant. The topic of how this difference in behaviour between these two types of suffixes is captured will be discussed in section 3.

2.2. Empty Nuclei in Korean and the Empty Category Principle (ECP)

In this section, the notion of empty nuclei is introduced to capture the relatively parallel distribution of the vowel [ɨ] in morpheme-internal position and in suffixation. Empty nuclei are not a novel notion, in that Underspecification Theory (UT) treats this vowel as an empty nucleus in phonological representation: it is the maximally underspecified vowel (Sohn 1987). This empty nucleus is deleted or inserted in appropriate contexts. The GP approach differs from UT in that the empty nucleus in GP is subject to phonetic interpretation in certain well-defined circumstances. It is neither deleted nor inserted. Rather, it is present in lexical representation and the context in which it occurs determines whether or not it is phonetically realised.

With respect to syllable structure, Heo (1995) and Rhee and Heo (1998) propose that Korean has neither branching onsets nor branching rhymes: Korean is a so-called CV-only language. Concretely, the occurrence of the vowel [ɨ] is represented by an empty nucleus and all surface consonant clusters are syllabified as two onsets intervened by an empty nucleus. Furthermore, domain-final single consonants are syllabified as an onset followed by a final empty nucleus, due to the effect of the 'Coda' Licensing Principle (Kaye 1990) and the Onset Licensing Principle (Harris 1994), which are given below.

(5) a. 'Coda' Licensing Principle
A post-nuclear rhymal position must be licensed by a following onset.
b. Onset Licensing Principle
An onset head position must be licensed by a nuclear position.

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 (Selkirk 1984, Nespor and Vogel 1986, McCarthy and Prince 1986). In addition to hierarchical licensing, GP proposes a set of syntagmatic relations that sanctions certain adjacent syllabic positions. (5) expresses such inter-constituent licensing relations in that every onset requires a following nucleus, and every coda requires a following onset. These two principles ensure that a final consonant is syllabified as an onset that is followed by an empty nucleus.[6] Thus, a word such as [kotɨrɨm] 'icicle' has the following lexical representation.

(6) /kotØLØmØ/ [kotɨrɨm] (Ø: empty nucleus)

```
O     N1[7]  O     N2    O     N3    O     N4
|     |      |     |     |     |     |     |
x     x      x     x     x     x     x     x
|     |      |           |           |
k     o      t           L[8]        m
```

6) This entails that a final consonant cannot be syllabified as a coda. For instance, the syllabification of the English words *ten* and *tent* is as follows.

```
e.g./ten/                          /tent/
*O  R          O  R  O  R          O  R        O  R
 |  |\         |  |  |  |          |  |\        |  |
 |  N \        |  N  |  N          |  N \       |  N
 |  |  \       |  |  |  |          |  |  |       |  |
 x  x  x       x  x  x  x          x  x  x       x  x
 |  |  |       |  |  |             |  |  |       |
 t  e  n       t  e  n             t  e  n       t        (R: rhyme, see footnote 7)
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See Harris (1994) and Harris and Gussmann (1998) for a discussion of the status of final consonants from a GP perspective.

7) In KLV (1990), the left branch of every rhyme is the nuclear constituent. In other words, the rhyme is a projection of the nucleus. In (6), however, the rhymal node is omitted for notational convenience.

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] occur in an onset and a coda, respectively. The underlying liquid is represented by the 'archiphonemic' L.

In (6), there are three empty nuclei, N2, N3 and N4. With the assumption that the phonetic realisation of empty nuclei is [ɨ] in Korean, how do these empty nuclei receive phonetic interpretation? GP provides an account based on the Empty Category Principle (ECP), which is assumed to be a part of Universal Grammar:

(7) Empty Category Principle (cf. Kaye 1995)
A licensed (empty) category receives no phonetic interpretation licensing under the following circumstances:
a. when it is domain-final (parameterised).
b. when it is properly governed.
c. when it occurs within an inter-onset domain.

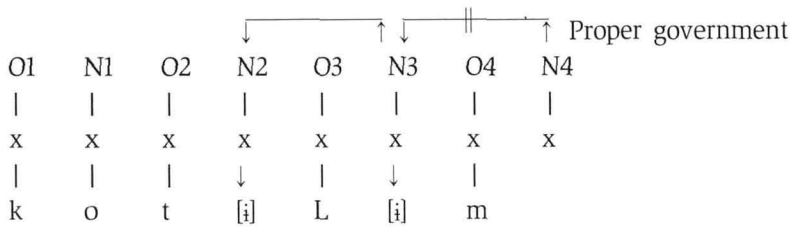
The ECP basically dictates that an empty nucleus is not phonetically realised (i.e. is inaudible) if it is licensed. The condition in (7a) is a parameter, i.e. some, but not all, languages license domain-final empty nuclei. Informally speaking, a language that has consonant-final words (such as English, Dutch or Arabic) licenses a domain-final empty nucleus: it is inaudible. However, languages without consonant-final words (such as Hawaiian or Italian) do not license a domain-final empty nucleus. Words in these languages must end in a vowel. Korean allows consonant-final words, so that the parameter setting for (7a) is 'on' in Korean. In addition, Heo (1995) proposes that both proper and inter-onset government as in (7b, c) are required to license internal empty nuclei. The definition of proper government is as follows:

(8) Proper government
α properly governs β iff:
a. α and β are adjacent on the relevant projection
b. α is not itself licensed, and
c. No governing domain separates α from β.

A domain-internal empty nucleus is licensed, and therefore has no phonetic interpretation (i.e. is inaudible), if it is properly governed by another nucleus. It must be phonetically interpreted if proper government does not hold. To establish a proper governing relation between two nuclei, these two nuclei are adjacent at the nuclear projection. Hence an unlicensed nucleus (with phonetic content) allows the preceding empty

nucleus not to be phonetically interpreted by proper government.[9] Consider, for instance, the word /kotØrØmØ/ 'icicle' in (9) to see how proper government works.

(9) /kotØLØmØ/ [kotɨrɨm][10]



The final empty nucleus N4 is licensed because of parameter-setting (7a). Hence, it cannot act as a proper governor for the preceding empty nucleus (see (8b)). In other words, a proper governor must have phonetic content (i.e. be unlicensed). Therefore, N3 is not licensed and is phonetically realised as [ɨ], as in other examples like /katØkØ/ [katɨk] 'full', /mɛtØpØ/ [mɛtɨp], /kjarØmØ/ [kjarɨm] 'oval' and /musØnØ/ [musɨn] 'what'.

What about the empty nucleus N2? The potential proper governor is N3 which is not licensed (i.e. is phonetically realised as [ɨ]) and so N2 is properly governable.[11] However, the phonetic form [kotɨrɨm] indicates that it is not licensed. As observed in Table 1, the distribution of [ɨ] in morpheme-internal position is sensitive to the quality of surrounding consonants, i.e. if a *surface* consonant sequence is a coda-onset cluster, then the intervening empty nucleus does not receive phonetic interpretation; otherwise this nucleus is realised as [ɨ].

Bearing this in mind, consider the consonants neighbouring N2 in (9), i.e. -tØr-. This obstruent + liquid sequence is obviously not a well-formed coda-onset cluster in any version of syllabification theory. When this sequence is reversed, viz. liquid + obstruent, an intervening empty nucleus

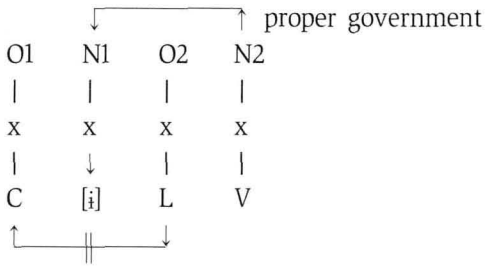
9) In the GP literature, the direction of proper government is assumed to be head-final universally (Kaye 1987, Charette 1991).

10) Notice that the nuclear projection level at which proper government applies is omitted for notational convenience.

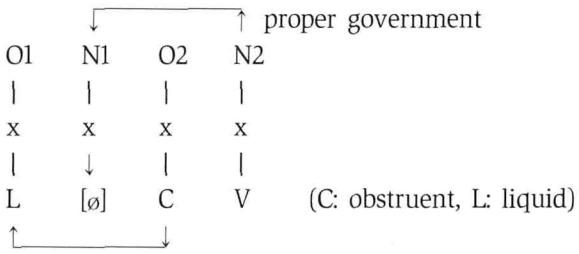
11) A reviewer enquires whether or not a proper governing relation between N1 and N2 can be established. This is not the case because N1 contains a lexical vowel (i.e. unlicensed), irrespective of whether or not N2 is licensed.

does not receive phonetic interpretation (i.e. licensed), e.g. /kaLØpi/ [kalpi] 'rib', /kaLØki/ [kalki] 'mane'. The following configurations summarise these points.

(10) a. Obstruent + Ø + liquid + V



b. Liquid + Ø + obstruent + V



(10) illustrates the fact that proper government is not sufficient to license empty nuclei and the distribution of the surrounding consonants affects licensing conditions (Heo 1995). In GP terms, the phonetic interpretation of empty nuclei depends on the governing relation between two adjacent consonants, with the assumption that the governing direction is head-final (i.e. from right to left). In (9), the empty nucleus N2 is realised due to the fact that a liquid is weaker than an obstruent on the consonant strength scale (Oh 1995, among others): liquids are lower in rank in the governing hierarchy and obstruents are higher in rank. In the next section, this onset-to-onset government is discussed in more detail.

2.3. Inter-onset Government and Government-licensing

The configurations in (10) indicate that proper government alone is not enough to license an internal empty nucleus. Rhee (2002) contends that proper government is not a necessary condition for internal empty nuclei

to be licensed. This is due to the fact that a properly governable empty nucleus always receives phonetic interpretation when the consonant cluster which surrounds such an empty nucleus fails to form a coda-onset cluster. Rhee (2002) proposes the following licensing conditions, in which inter-onset government and government-licensing are needed.

(11) Licensing conditions for internal empty nuclei

```
X    O1   N1   O2   N2   Y
     |    |    |    |
     x    x    x << x
     |         |    |
     α         β    V
     ↑_________↓
     inter-onset government  (<<: government-licensing, V: vowel)
```

a. An internal empty nucleus N1 is licensed iff:
   (i) The governing onset O2 must have the relevant governing properties to govern O1.
   (ii) An unlicensed 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: 101)

(11) states 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 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 O1 (see 2.4). 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 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.

For the sake of concreteness, consider there are three cases in which an empty nucleus within an inter-onset domain can be phonetically realised as [ɨ], viz. (i) as a result of the failure of inter-onset government, (ii) as a

result of the absence of an unlicensed government-licenser and (iii) as a result of the failure of both requirements.

(12) a. /kotØrØmØ/ 'icicle' [kotɨrɨm]

O1	N1	O2	N2	O3	N3	O4	N4
|	|	|	|	|	|	|	|
x	x	x	x	x	x	x	x
|	|	|	↓	|	↓	|	
k	o	t	[ɨ]	L	[ɨ]	m	

↑——‖——↓ inter-onset government

b. /kəLØmØ/ 'fertiliser' [kərɨm]

O1	N1	O2	N2	O3		N3
|	|	|	|	|		|
x	x	x	x	x	<<	x
|	|	|	↓	|		
k	ə	L	[ɨ]	m		

↑——————↓

inter-onset government (<<: non government-licensing)

c. /k'umØt^{h}ØLØ/ 'wiggling' [k'umt^{h}ɨl]

O1	N1	O2	N2	O3		N3	O4		N4
|	|	|	|	|		|	|		|
x	x	x	x	x	<<	x	x	<<	x
|	|	|	↓	|		↓	|		
k'	u	m	[ø]	t^{h}		[ɨ]	L		

↑——————↓ ↑——‖——↓

inter-onset government

In the first case (12a), the unlicensed government licenser N3, which has phonetic content ([ɨ]), is present but the liquid in the governing onset O3 cannot govern the lenis stop in the preceding onset O2. Hence, the intervening empty nucleus N2 receives phonetic interpretation. The phonetic form is therefore [kotɨrɨm]. In (12b), the nasal in O3 can govern a preceding liquid in O2, but the absence of an unlicensed government-licenser induces, again, phonetic interpretation of the intervening empty nucleus, since the potential government-licenser N3 is licensed due to parameter-setting (cf. 7). In the last case, (12 c), the liquid in O4 cannot govern the aspirated stop in O3, and neither is an unlicensed government-

licenser present. Note that in this form the empty nucleus N2 is licensed due to the fact that both of these two conditions are satisfied. The next section discusses the governing properties of segments and proposes a consonant governing hierarchy in Korean to account for the presence/absence of [ɨ] in morpheme-internal position.

2.4. Governing Hierarchy in Korean

This paper will not attempt to present a full-fledged overview on the Theory of Elements (KLV 1985, Harris 1990, 1994) or Revised Element Theory (RET) (Ploch 1999) nor a detailed discussion on consonantal representations in Korean (Heo 1995, Rhee 2002). Rather, some important notions relevant to this topic are briefly introduced. In GP, the ultimate unit of segments is the monovalent (privative) element. Thus, contrasts among segments are represented by the presence/absence of relevant elements. This paper adopts the view that proposes that *headed* segments possess governing properties and so can occur in a governing position to govern *headless* segments (RET). Headed segments contain one head element but headless ones do not. Informally speaking, obstruents are regarded as headed segments in that sonorant + obstruent sequences are widely accepted as well-formed coda-onset clusters, viz. a headed segment in an onset governs a headless one in a coda. Thus, sonorants are treated as headless. Among headless segments, 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). In terms of segmental complexity, nasals are treated as more complex than liquids.[12] Thus, liquid + nasal clusters are treated as well-formed coda-onset clusters.

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

---

12) In the GP literature, liquids are treated as less complex than nasals. The former contains at most two elements. Nasals, on the other hand, are composed of three elements, viz. nasality, place and non-contiguity. See also footnote 14.

(13) 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.

(14) The governing hierarchy in Korean

a. liquids < nasals and lenis obstruents <tensed and aspirated obstruents

headless 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 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] (14) provides an appropriate account of the presence of [ɨ] between two lenis obstruents, as was illustrated in (4biii). 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 (15a).

13) There are exceptions to this statement in Korean, i.e. liquid-coronal nasal clusters generated by suffixation (cf. footnote 3).

(15) a. /potØki/ [potɨki] 'dwarf tree'

O1	N1	O2	N2	O3		N3
|	|	|	|	|		|
x	x	x	x	x	<<	x
|	|	|	↓	|		|
p	o	t	[ɨ]	k		i

↑ ‖ ↓ inter-onset government

b. /komØp^{h}aŋØ/ [komp^{h}aŋ] 'must'

O1	N1	O2	N2	O3		N3	O4	N4
|	|	|	|	|		|	|	|
x	x	x	x	x	<<	x	x	x
|	|	|	↓	|		|	|	
k	o	m	[ø]	p^{h}		a	ŋ	

↑ ↓

inter-onset government (<<: government-licensing, V: vowel)

In (15b), on the other hand, the fact that there is no [ɨ] between /m/ and /p^{h}/ can be explained by the fact that the aspirated stop can govern the nasal.

It is important to note that nasals and lenis stops are ranked equally in this strength hierarchy. Formally, this is correlated with segmental complexity, i.e. both classes of segments consist of three elements.[14] The hierarchy in (14) makes different predictions than the sonority-based consonant strength scale (Oh 1995, among others) or the Syllable Contact Law (SCL, Vennemann 1988, among others), which predicts that nasal + obstruent clusters should be well-formed coda-onset sequences. It is beyond the scope of this paper to discuss all aspect of this hierarchy extensively, but there is positive evidence that nasals behave in a natural class with lenis obstruents in verbal suffixation.[15] Consider indicative suffixation, in

14) Rhee (2002) proposes that nasals consist of elements for place (labiality (U), coronality (R) or velarity (@)), nasality (L) and occlusion (?), and the lenis stops contain place, noise (H) and occlusion elements.

15) Potential exceptions to (14) are morpheme-internal nasal + lenis stop clusters in which there is no intervening [ɨ]. This possibly indicates that these are also well-formed coda-onset sequences, as was shown in (4av). Rhee (2002) argues that the absence of [ɨ] in these clusters is due to post-nasal voicing. This is achieved by the element L, which is shared between a nasal and a following obstruent. On the basis of Ploch (1999), it is contended that the element L is interpreted as nasality in nasals but that in lenis

which both stem-final lenis obstruents and nasals trigger tensification of a suffix-initial /t/, e.g. /cap/ [capt'a], /tat/ [tatt'a], /mak/ [makt'a], /an/ [ant'a] and /kam/ [kamt'a]. Post-nasal tensification in this context clearly undermines an account based on sonority or on the SCL, both of which would predict that this process should not occur, since nasal + stop sequences satisfy the sonority requirements for well-formed coda-onset clusters. The hierarchy in (14) is able to account for tensification as a strengthening process in a unified way: in this interpretation a headless segment becomes headed to govern its preceding headless segment (cf. Rhee 2002 for further discussion).

2.5. The Nasal Condition in Korean

The hierarchy in (14) predicts that the vowel [ɨ] should occur between two nasals. Contrary to this prediction, however, this vowel does not occur morpheme-internally between two nasals, as was shown in (2a). These examples seem to constitute exceptions to the governing hierarchy. To account for the absence of [ɨ] in this context, Rhee (2001) proposes the following condition on morpheme-internal nasals in Korean.

(16) The Nasal Condition in Korean

a.
```
O1     N1     O2     N2
|      |      |      |
x      x      x  <<  x
|             |      |
([place])    [place]  V
 \_____________|
              [nasality]
```

b. An unlicensed government-licenser must be present.

(16) states that morpheme-internal NN sequences form a (partial) geminate in which the first member O1 may contain its own place element but lacks the nasal element which is provided by the second member O2 which is

obstruent it is interpreted as voicing. Since Korean does not have lexical laryngeal voicing, voicing in this context would be sonorant voicing (Rice 1992). Note that the sharing of L increases the complexity of a following obstruent, i.e. a voiced obstruent has four elements. Hence, the requirements of inter-onset government are fulfilled in terms of segmental complexity.

followed by the unlicensed government-licenser. This doubly-linked structure satisfies the requirements of inter-onset government. Recall that more complex segments can govern less complex ones when two headless segments are subject to inter-onset government (cf. footnote 12, 14). In (16a), the segment in the governed position has fewer elements than the one in the governing position: the segmental complexity in the former is null (for full geminates) or one (for partial ones) and the rest of the elements are provided by the latter. Furthermore, this condition requires an unlicensed government-licenser following the NN sequence, as expressed in (16b). In other words, (16) is a special condition of (11), imposed on NN sequences. The presence or absence of the government-licenser provides an account of the phonetic interpretation of [ɨ] in NN sequences, as shown in (17).

(17) a. /simØmani/ [simmani] 'ginseng digger'

```
O1   N1   O2   N2   O3   N3   O4   N4
|    |    |    |    |    |    |    |
x    x    x    x    x << x    x    x
|    |                |    |    |    |
s    i              [labiality] a    n    i
                      |
                    [nasality]
```

b. /kənØmanØ/ [kənman] 'even though'

```
O1   N1   O2   N2   O3   N3   O4   N4
|    |    |    |    |    |    |    |
x    x    x    x    x << x    x    x
|    |    |         |    |    |
k    ə  [coronal]  [labiality] a    n
                      |
                    [nasality]
```

c. [kØmØmØ] [kɨmɨm] 'the last day of the month'

```
O1   N1   O2   N2   O3   N3
|    |    |    |    |    |
x    x    x    x    x <<̲ x
|    ↓    |    ↓    |
k   [ɨ]   m   [ɨ]   m
↑────‖────↓ ↑────‖────↓
```

inter-onset government

(<<: government-licensing, <<̲: non-licensing)

In (17a, b), partial or full geminates can be realised without an intervening [ɨ], due to the presence of the government-licenser N3, which sanctions the onset O3 to govern its compliment O2. (17c) shows that an NN sequence occurs finally. The final empty nucleus N3 cannot license its preceding onset O3 to govern O2, because this empty nucleus is licensed due to domain-final licensing. Accordingly, the preceding NN sequence cannot maintain a doubly-linked structure, so that each nasal has its own association line. The phonetic form is therefore [kɨmɨm].

To summarise, this section treats the distribution of [ɨ] in monomorphemic words in terms of the ECP. Final empty nuclei are licensed due to parameter-setting. The phonetic interpretation of internal empty nuclei is determined by inter-onset government and government-licensing. To establish an inter-onset governing relation, an unlicensed government-licenser must be present and a governing onset must contain the appropriate governing properties which are provided by the governing hierarchy in (14). The non-phonetic interpretation of an empty nucleus between two nasals, which is seemingly an exception to (14), is ascribed to the Nasal Condition, which states that two nasals form a doubly-linked structure if a following government-licenser is present. Cross-linguistically, doubly-linked structures resist epenthesis, i.e. they show effect of *integrity* (Hayes 1986, among others). Without an appropriate government-licenser, however, NN sequences are split up by [ɨ].

3. 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 in section 3.1. Suffixes relevant to this paper are classified as analytic and non-analytic. It is argued that phonetic interpretation of certain types of internal empty nuclei and neutralisation in nominative suffixation cannot be properly accounted for by Kaye's proposal. To resolve this problem, the notion of the *bare stem* domain is introduced in section 3.2. In the final sub-section, the analysis of NN sequences in suffixation is presented.

3.1. Analytic and Non-analytic Structures

GP recognises two types of phonological domains in the interface of

morphology: analytic and non-analytic ones.

(18) 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 (18ai) (mostly involving stem-suffix relations) and one in which both concatenating structures form a phonological domain (mostly relevant to compounding), as in (18aii). A non-analytic structure does not contain any internal domains and so 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 (18ai), 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. In 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), because, when a new analytic suffix is added, this creates a new morphological domain that may coincide with the phonological domain structure (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 'closed syllable shortening' rule (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. 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 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:

(19) 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.

(20) Stem	In isolation	Nominative (NOM)	Emphatic (EMP)	
/cip^hØ/	[cip]	[cip^hi]	[cipt'o]	'straw'
/mit^hØ/	[mit]	[mic^hi]	[mitt'o]	'bottom'
/puək^hØ/	[puək]	[puək^hi]	[puəkt'o]	'kitchen'
/pic^hØ/	[pit]	[pic^hi]	[pitt'o]	'light'
/pak'Ø/	[pak]	[pak'i]	[pakt'o]	'outside'

In (20), 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.

(21) a. /[cip^{h}Ø]/ [cip]

```
O1 N1 O2 N2
 |  |  |  |
[ x  x  x  x ]
 |  |  |
 c  i  p^h
          ↓
         [p]
```

b. /[[cip^{h}Ø] to]/ [cipt'o]

```
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 (22).[16]

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

```
   O    N    O    N
   |    |    |    |
[  x    x    x    x  ]
   |    |    |    |
   c    i    p^h  i
```

Regarding the phonetic interpretation of empty nuclei within a stem in nominative suffixation, however, a problem arises when the stem contains an empty nucleus flanked by two consonants which could hold inter-onset government, i.e. a liquid followed by a nasal or an obstruent. The relevant examples are shown in (23).

16) One can argue that all nominative forms are stored in the lexicon, since non-analytic structure is treated in the same way as morphologically simplex words. As we will see below, however, the non-analytic construction is not sufficient to account for certain processes and so an additional domain, i.e. the bare stem domain, is introduced.

(23) Stem	In isolation	Nominative	
/muLØp^{h}Ø/	[murɨp]	[murɨp^{h}i]	'knee'
/kØLØsØ/	[kɨrɨt]	[kɨrɨsi]	'dish'
/siLØmØ/	[sirɨm]	[sirɨmi]	'concern'

In isolation, the penultimate empty nucleus receives phonetic interpretation, because the domain-final empty nucleus cannot act as a government-licenser for the preceding onset to govern its compliment. Since the nominative suffix is non-analytic, /i/ directly follows the stem-final consonant in the nominative form. Consider /murØp^{h}Ø/ 'knee-NOM'.

(24) /[murØp^{h}i]/ [murɨp^{h}i]

```
   O1   N1   O2   N2   O3   N3
   |    |    |    |    |    |
[  x    x    x    x    x << x  ]
   |    |    |    ↓    |    |
   m    u    L   *[ø]   p^h  i
                ↑_________↓   (<<: government-licensing)
```

In (24), the requirements of inter-onset government are satisfied, because the government-licenser, i.e. the nominative suffix /i/, is unlicensed and the obstruent /p^h/ can govern the liquid [r]. Thus, we would expect the intervening empty nucleus to be licensed, but the phonetic form [murɨp^{h}i] shows that this is not the case, i.e. the empty nucleus resists being licensed and must appear phonetically. Heo (1995: 220) also notes the same problem and sums up as follows:

> We see that nominal suffixation in Korean cannot be fully accounted for by the morphological structure proposed by Kaye (1993) [(1995) SJR], thus, the theory requires extending to a certain degree.

This paper attempts to revise Kaye's proposal by refining the notion of morphological analyticity to provide an adequate account of the licensing of empty nuclei in suffixation.

3.2. The Bare Stem Domain

Let us consider that the nominative suffix is analytic. In this case, the

stem-final consonant would undergo neutralisation to become [p], because it occurs before a final empty nucleus. i.e. /[[murØp^{h}Ø] i]/ *[mur̥pi]. Note that the phonetic interpretation of the empty nucleus that is part of the stem is retained, despite the presence of a potential government-licenser that is not part of the stem. This shows that the empty nucleus which is part of the stem resists being licensed by a government-licenser outside the stem. In other words, the empty nucleus within the stem exhibits an opacity effect in that government-licensing fails to apply though the context satisfies its requirements, i.e. *underapplies*. Given this situation, one plausible way of resolving the problem is by allowing stems to constitute a domain of their own, i.e. *bare stem*, represented by angled brackets, as shown below.

(25) [<bare stem> i]

The postulation of bare stem domains is designed to account not only for the opacity effect regarding the phonetic interpretation of empty nuclei within stems but also the preservation of segmental content of stem-final consonants in nominative suffixation. This opacity effect is derivable from the Strict Cyclicity Condition (SCC, Kiparsky 1982, Cole 1995, among others). According to Cole, the empirical effects of the SCC can be summarised by way of the Reaching Back Constraint (RBC) and the Derived Environment Constraint (DEC). The former prevents a cyclic rule *R* applying on cycle *j* from reaching back inside an earlier cycle *i* to apply to a string contained wholly within cycle *i*. The effect of the latter, originally responsible for limiting the abstractness of phonological representations, prevents *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 by prohibiting them from applying within the morpheme on an earlier cycle. The empirical consequence is that phonological rules fail to apply within a stem (or root) or other mono-morphemic environments.

Implementing the insights of the SCC into the present analysis, the preservation of the phonetic interpretation of empty nuclei within a bare stem domain may be derived by either constraint. That is, the empty nucleus in question is not in final position and is part of the bare stem. Independent evidence that the bare stem domain is opaque comes from palatalisation. When the suffix /i/, whether it is a nominative suffix or

adverbialiser, follows a stem ending in a coronal stop, this stop undergoes palatalisation to become [c] or [c^h].

(26) a. Nominative suffix /i/

/pat^h-i/	[pac^hi]	'field'
/k'Øt^h-i/	[kɨ'c^hi]	'end'

b. Adverbialiser /i/

/kat^h-i/	[kac^hi]	'together'
/kut-i/	[kuci]	'positively'
/nat^h-nat^h-i/	[nannac^hi]	'one by one'
		(-: morpheme boundary)

However, palatalisation does not occur within the bare stem, even though the context in which this process applies is exactly the same as that in (26). In other words, the application of palatalisation signals a morpheme boundary.

(27)

/mati/	[mati]	*[maci]	'knot'
/pət^hi/	[pət^hi]	*[pəc^hi]	'to endure'
/t^hi/	[t^hi]	*[c^hi]	'dust'
/cipØ/	[cip]		'house'
/cicØ/	[cit]		'to bark'

Note that coronal stops within stems occur before the vowel /i/ without invoking palatalisation. Furthermore, affricates also occur before the same vowel. Thus, (26) and (27) show that the applicability of palatalisation is sensitive to the boundary between stem and suffix. Given the palatalisation facts in Korean, it is evident that the mode of application of phonological processes must be constrained. In fact, the context in which palatalisation occurs requires the presence of a boundary marker, as in (25), i.e. /[<pat^h> i]/. The absence of palatalisation can be characterised by assuming that the final vowel /i/ resides within the bare stem domain, i.e. /[<mati>]/.

Before discussing how empty nuclei are licensed in the bare stem domain as well as in suffixation, let us clarify some terminological matters. As shown below in (28), the consonant-final bare stem domain is contained within angled brackets and a final empty nucleus is outside the bare stem domain. In section 2.1, the internal square bracket notation has implicitly referred to the lexical representation of a given stem including a final

empty nucleus in analytic suffixation. In what follows, the term *stem domain* is reserved for phonological material ending in a final empty nucleus within square brackets. Very often, when a stem ends in a vowel, the bare stem domain coincides with the stem domain. This is due to palatalisation in which a (bare)-stem-final vowel /i/ does not trigger.

(28) a. Vowel-final stem domain
[<bare stem>]

b. Consonant-final stem domain
[<bare stem>Ø]

e.g. /[<kasi>]/ 'thorn'

```
   O    N    O    N
   |    |    |    |
[ < x    x    x    x > ]
   |    |    |    |
   k    a    s    i
```

/[<kam>Ø]/ 'persimmon'

```
   O    N    O    N
   |    |    |    |
[ <x    x    x>   x ]
   |    |    |
   k    a    m
```

In this proposal, the notions of analytic and non-analytic constructions are retained to account for phonological processes involved in suffixation. Given the introduction of the bare stem domain, non-analytic and analytic suffixations have the following structures.

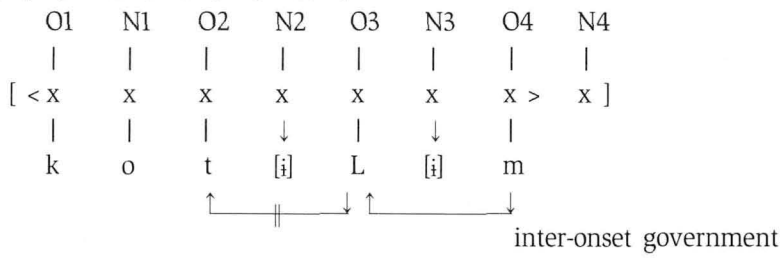
(29) a. Non-analytic suffixation
[<bare stem> suffix]
b. Analytic suffixation
[[<bare stem> (Ø)] suffix]

(29a) shows that a non-analytic suffix is directly attached to the bare stem domain without intervening square brackets. This construction differs from that of the stem domain in (28), since the stem domain may end in a final empty nucleus, e.g. /[<cip^h>Ø]/ 'straw', but the non-analytic domain contains a following suffix, e.g. /[<cip^h>i]/ 'straw-NOM. The structure resulting from analytic suffixation contains three domains: the bare stem domain, the stem domain, and the concatenation of the stem domain with a following suffix, e.g. /[[<cip^h>Ø] to]/ 'straw-EMP'.

Theory-internally, however, the notion of the bare stem raises the question as to whether or not the postulation of the bare stem domain violates the 'Coda' Licensing and the Onset Licensing Principle, both of which require that each phonological domain should end in a nuclear

position.[17] We assume that the bare stem domain is *parasitic* in the sense that this domain does not constitute an independent phonological domain.[18] For instance, the proper domain of (core) syllabification is based on the stem domain. In other words, the effect of these principles is temporarily suspended in the bare stem domain. Thus, the domain-final licensing parameter applies to the stem domain and neutralisation takes place. Furthermore, the parasitic nature of the bare stem domain is confirmed by the fact that the result of the ECP to the bare stem domain is the same as that of the ECP to the stem domain. That is, the presence of a final empty nucleus in the stem domain does not override the licensing of empty nuclei within the bare stem domain. Bearing this in mind, consider, for instance, the word /[<kotØrØm>Ø]/ [kotɨrɨm] 'icicle' again. The lexical representation is shown below.

(30) /[<kotØLØmØ>]/ [kotɨrɨm]



Given this lexical representation, relevant phonological processes apply first to the innermost domain, i.e. the bare stem domain. Thus, the ECP inspects this domain first. This domain is onset-final and so the empty nucleus N3 of the bare stem domain does not have a following government-licenser to license it. In other words, the stem domain-final empty nucleus

17) Nancy Kula (p.c.) also assumes all morphological and phonological domains to be consonant-final in her analysis of Bemba phonology, despite the strict CV syllable structure of the language (Lowenstamm 1996). This assumption follows from the fact that the obligatory final vowel of every verbal form is phonologically inactive but merely plays the role of specifying the parameter setting on final empty nuclei (i.e. the domain-final licensing parameter is 'off' in Bemba.). Support for this proposal comes from the processes of consonant mutation and imbrications (a form of infixation) within complex verbal structure. For details, see Kula (2002).

18) This is also the reason why the introduction of the distinction between bare stem and stem domain does not replicate the lexical strata of LP: each stratum forms an independent phonological domain.

N4 is invisible to the application of the ECP. With respect to the penultimate empty nucleus N2, the unlicensed status of this empty nucleus is due to the failure of inter-onset government between O2 and O3. In comparison to the analysis in the previous section, the difference lies in the fact that the stem domain-final empty nucleus N4 is not visible when the ECP applies to the bare stem domain. The bare stem domain is only visible to the stem-domain-final empty nucleus N4 after doing phonology to the bare stem domain. The phonetic form is therefore [kot̪ir̪im].

Finally, consider the nominative form /[<muLØp^h>Ø]/ 'knee'. Its lexical representation is /[<muLØp^h>i].

(31) /[<muLØp^h>i]/ [mur̪ip^{h}i]

```
   O1    N1    O2    N2    O3    N3
   |     |     |     |     |     |
[ < x     x     x     x     x > <<  x ]
   |     |     |     ↓     |     |
   m     u     L    [i]    p^h    i
                 ↑___________↓  inter-onset government
                                (<<: non-government-licensing)
```

Within the bare stem domain, the empty nucleus N2 is not licensed, as witnessed by its phonetic interpretation, due to the absence of a following government-licenser in this domain, even though an inter-onset governing relation between O2 and O3 can be established. After bracket erasure of the bare stem domain, the stem-final /p^h/ is licensed by the unlicensed nucleus N3 and so it is realised without any segmental changes. However, the empty nucleus N2 can preserve its phonetic interpretation, since the bare stem domain constitutes an opaque domain which can prevent N3 from being a government-licenser for O3 to govern O2. This is regulated by the SCC.

Regarding the licensing of empty nuclei, one merit of postulating the bare stem domain is that it provides a consistent account of the behaviour of the nominative suffix /i/, which was problematic within the analysis based on analytic and non-analytic constructions, as discussed earlier. The absence of neutralisation before the nominative suffix /i/ is directly explained by the adjacency of the bare stem-final consonant and the suffix /i/, as in the case of palatalisation in which a bare stem-final coronal stop is visible to the following /i/. An empirical consequence is

that unlicensed nuclei outside a bare stem domain function as licensers of the preceding bare stem-final consonant or triggers of palatalisation, but not as government-licensers of an empty nucleus within the bare stem domain.

3.3. NN Sequences in Suffixation

Neutralisation provides a criterion for analytic vs. non-analytic status for suffixes involved in verbal suffixation. The connective suffix /mjə/ and the effective suffix /ni/ are non-analytic, while the assertive suffix /ne/ and the interrogative suffix /ni/ are analytic: the former group of suffixes shows ɨ/zero alternations and preserve the segmental content of a stem-final consonant, e.g. /<nop^{h}> Ø/ 'high' [nop^{h}ɨmjə], [nop^{h}ɨni]; /<kat^{h}> Ø/ 'same' [kat^{h}ɨmjə], [kat^{h}ɨni]; /<is'> Ø/ 'to exist' [is'ɨmjə], [is'ɨni], while the latter group of suffixes shows consonant-related processes such as nasalisation and tensification when the licensing conditions on empty nuclei, as stated in (11), are not met.

Based on the governing hierarchy in (14) and the notion of the bare stem domain, the occurrence of [ɨ] in connective and effective suffixation can be accounted for in the following way. The relevant data are repeated from (2) and their lexical representations are shown below.

(32) a.	/kam/	[kamɨmjə]	[kamɨni]	'to wind'
	/an/	[anɨmjə]	[anɨni]	'to hug'
b.	Connective form	/[<kam> Ømjə]/	/[<an> Ømjə]/	
	Effective form	/[<kam> Øni]/	/[<an> Øni]/	

In (32b), notice that an empty nucleus is present between the stem-final and the suffix-initial nasal. This follows from our proposal regarding the syllable structure of Korean as discussed in section 1.2. Recall also that the bare stem domain is not a proper domain for syllabification so that the bare stem-final consonant requires a following empty nucleus outside the domain. The lexical representation of /[<kam> Øni] is shown in (33).

(33) /[<kam> Øni]/ [kamni]

```
      O1    N1    O2    N2    O3    N3
       |     |     |     |     |     |
[ < x    x     x >   x     x     x  ]
       |     |     |     ↓     |     |
       k     a     m    [ɨ]    n     i
                 ↑____||____↓
                 inter-onset government
```

Note that each nasal, i.e. the stem-final one in O2 and the suffix-initial one in O3, has its own association line. This syllabification is due to the fact that these two nasals are in different domains. After bracket erasure involving the bare stem domain has taken place, inter-onset government applies to O2 and O3. Since mutual government is prohibited among equally ranked segments, the intervening empty nucleus N2 receives phonetic interpretation. In comparison to morpheme-internal NN sequences, in which an intervening empty nucleus does not receive phonetic interpretation, the difference in domainhood is responsible for the phonetic interpretation of N2 in (33).[19] The occurrence of [ɨ] in other forms in (32) can be explained in the same way as in (33).

Let us now turn to the interrogative and the assertive forms, where the vowel [ɨ] does not occur between the bare stem-final nasal and the suffix-initial nasal. The lexical representations of the assertive and the interrogative forms of /[<kam>Ø]/ are as follows:

(34) a. /[[<kam> Ø] ne]/ [kamne] 'to wind' (b) /[[<kam> Ø] ni]/ [kamni]

These two suffixes are analytic in that they are attached to the stem domain which ends in a final empty nucleus. Let us consider the interrogative form in (34b). After bracket erasure involving the stem-domain, the following configuration emerges.

19) The mode of application of the ECP to the two nasals in (33) can be derived from the Linking Constraint (Hayes 1986) which requires that all association lines be exhaustively interpreted.

(35) /[[<kam> Ø] ni]/ [kamni]

O1	N1	O2	N2	O3	N3
|	|	|	|	|	|
[x	x	x	x	x	x]
|	|	|		|	|
k	a	m		n	i

↑ ‖ ↓

inter-onset government

Unlike the effective form [kamɨni] in (33), the phonetic form [kamni] indicates that the empty nucleus N2 is licensed so that the nasal sequence [mn] is realised without an intervening [ɨ]. This phonetic form raises the following two questions: i) How is the empty nucleus N2 licensed after bracket erasure? and ii) Since O3 cannot govern O2, how does the NN sequence satisfy the requirements of inter-onset government?

Regarding the licensed status of N2, this empty nucleus is licensed in the stem-domain due to parameter-setting (cf. (7)). To produce the correct form [kamni], the licensed status of this empty nucleus must be remain licensed after the stem domain bracket erasure: otherwise, this empty nucleus would receive phonetic interpretation due to the failure of inter-onset government. One possible account of the preservation of licensed status is in terms of the SCC, i.e. the result of the application of the ECP to N2 is not altered after bracket erasure. There is positive evidence for this approach from English loanword adaptation in Korean. For instance, *bus* and *pen* are adapted as [pəsɨ] and [p^{h}en], respectively, i.e. the stem-final empty nucleus is unlicensed in the former and licensed in the latter case. When the emphatic suffix /to/ 'also', which is analytic, follows these forms, the phonetic outputs are [pəsɨto] and [p^{h}endo], respectively. Note that the unlicensed or licensed status of the final empty nucleus in each word is not changed after erasure of the stem domain. Thus, the result of phonetic interpretation of the final empty nucleus in a stem domain will be carried over after bracket erasure, without any change in licensing status. The licensed status of a final empty nucleus like N2 in (35) enables the surrounding consonants to contract an inter-onset government relation.

The second question, viz. how NN sequences can satisfy the requirements of inter-onset government, is dealt with in the following way. Since the coronal nasal in O3 cannot govern the labial one in O2, a repair strategy is required for the ill-formed inter-onset cluster. In this context, instead of

the occurrence of [i], *nasal-fusion* occurs, in order for the more complex segment in O3 to govern the less complex one in O2.[20] Nasal fusion is illustrated in (36).

(36) /[[<kam> Ø] ni]/ [kamni]

O1	N1	O2	N2	O3	N3
|	|	|	|	|	|
[x	x	x	x	x	x]
|	|	|	↓	|	|
k	a	[labiality]	[ø]	[coronal]	i
				[nasality]	

The result of nasal fusion in (36) is parallel to the effect of the Nasal Condition (16), which is a static phonotactic constraint where morpheme-internal NN sequences constitute a doubly-linked structure to satisfy the conditions in (11).[21] Nasal fusion can be regarded a dynamic process which also seeks to satisfy the Nasal Condition. This process seems closely related to nasalisation, e.g. /[[<cap> Ø] ni]/ 'to hold' [camni], /[[<tat> Ø] ni]/ 'to close' [tanni], /[[<mək> Ø] ni]/ 'to eat' [məŋni]. Both nasal fusion and nasalisation serve to remedy ill-formed inter-onset clusters generated by suffixation. In government terms, O3 (the suffix-initial nasal segment) cannot govern O2 (the bare stem-final lenis stop or nasal segment), and the outcome is a (partial) geminate NN sequence.[22] Hence, nasal fusion

20) On the assumption that repairs involve as few strategies as possible (Paradis 1996), nasal fusion in this context must be regarded as the most economical operation, since this process occurs without loss or addition of any element(s), in comparison to other possible repair strategies. Alternative ways of repairing NN clusters in this context would involve: (i) the lenition of the labial nasal in O2 to become [w] or being deleted; (ii) the fortition of the coronal nasal in O3 to become [d]. The lenition of /m/ to [w] creates an ill-formed cluster (i.e. -wn-) and the deletion of /m/ results in two adjacent empty constituents, which are prohibited in GP (Gussmann and Kaye 1993). The fortition of /n/ to [d] would require addition of an ambient element H (see footnote 14, 15).

21) Note that N3 in (36) acts as a government-licenser which is outside the bare stem domain. In comparison to (31), the context in which government-licensing occurs in (36) is different. In (31), government-licensing fails to apply to an unlicensed empty nucleus in the bare stem domain. In (36), the licensed status of N2 forces O2 and O3 to form an inter-onset governing relation. This triggers nasal fusion and the presence of N3 satisfies the requirements of inter-onset government.

22) Two reviewers point out that the account of the distribution of [i] in suffixation in terms of different domainhood involves unnecessary stipulations which might complicate the

seems to receive wider motivation in Korean phonology in general.

4. Discussion and Summary

In this section, we briefly compare the analysis in this paper with previous approaches to the distribution of [ɨ] in suffixation. In order to account for [ɨ]/zero alternation in suffixation, rule-based analyses (Kim-Renaud 1982, Ahn 1985) assume that the connective and effective suffixes are underlyingly /ɨmjə/ and /ɨni/. To account for the absence of [ɨ] in the assertive and the interrogative forms, the underlying representations of these two suffixes are proposed to be /ne/ and /ni/, respectively. Though these authors do not discuss the distribution of [ɨ] with specific reference to nasal-final stems, they propose rules in which [ɨ] is deleted after a vowel, e.g. /ka/ 'to go' + /ɨmjə/ [kamjə], and between a liquid and a labial nasal, e.g. /nal/ 'to fly' + /ɨmjə/ [nalmjə]. Regarding vowel-final stems, this ɨ-deletion rule can be motivated by an appeal to avoidance of vowel hiatus. The implicit motivation for the deletion of [ɨ] after liquid-final stems would be the formation of a well-formed coda-onset cluster [lm]. Note that this vowel is retained after obstruent-final and nasal-final stems, e.g. /mək/ 'to eat' [məkɨmjə]; /tat/ 'to close' [tatɨmjə]; /cap/ 'to hold' [capɨmjə] and the examples in (2a) for nasal-final stems. The preservation of [ɨ] after obstruent-final stems can be also accounted for on the basis of the fact that phonetic forms such as [km], [tm] and [pm] are not well-formed coda-onset clusters.[23)]

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grammar. In GP, one of the purposes of phonology is to help a hearer parse a continuous input string into distinct cognitive units (Kaye 1993). I assume that these cognitive units include not only segmental and prosodic ones but also morphological ones. In other words, parsing provides an analytic tool for how morphological information is implemented in a phonological representation. In this sense, the explanation for the occurrence of [ɨ] is a result of proper parsing of the phonological representation. Furthermore, to the extent that these different domains receive independent motivation in Korean (Rhee 2002) and are also postulated in the analyses of other languages (e.g. Gussmann and Kaye 1993 for Polish, Harris 1994 for English and Kula 2002 for Bemba), they do not form unmotivated machinery for the grammar as a whole.

23) This can be accounted for on the basis of the Syllable Contact Law (SCL) which prohibits rising sonority over a syllable boundary. In this formulation a sonority plateau may be tolerated between a coda and an onset. This notion has been employed to analyse nasalisation and lateralisation in suffixation in Korean (Iverson and Sohn 1994, Davis and Shin 1999, among others). Though detailed discussion of how the SCL applies to Korean phonology is beyond the scope of the paper, sonority does not play any significant role regarding the occurrence of [ɨ] in suffixation. For instance, with respect to the connective forms, the SCL not only allows forms like [kamɨmjə] and [anɨmjə] but also ill-formed

In this respect, the retention of [ɨ] after nasal-final stems, e.g. /kam/ 'to wind' [kamɨmjə]; /an/ 'to hug' [anɨmjə], is problematic for analyses of this type, in that NN sequences without an intervening [ɨ] can also constitute a well-formed coda-onset cluster, just like those in morpheme- internal position.[24)]

A second disadvantage of rule-based approaches involves the postulation of different underlying representations for these four suffixes. This does not explain the phonological processes they are involved in a non-arbitrary way. Nasalisation is invoked when the assertive and interrogative suffixes follow stop-final stems, e.g. /cup/ 'to pick up' [cumne] and [cumni]; /tat/ 'to close' [tanni] and [tanne]; /mək/ 'to eat' [məŋne] and [məŋni]. In this case, nasalisation is regarded as a repair process for ill-formed coda-onset clusters (cf. footnote 20). A rule-based analysis sets up a nasalisation rule to account for this phenomenon. However, there is an alternative way to resolve these ill-formed clusters, viz. by [ɨ]-insertion, as in [cupɨne] and [cupɨni] etc. Within the rule-based framework, it is difficult to provide an account of why only in this context nasalisation is triggered but [ɨ]-insertion is not. In this respect, the analysis in this paper offers a more straightforward explanation. By establishing different domains for these two types of suffixes, we can provide a consistent account of what processes take place in a given domain.

To summarise, this paper has dealt with three issues regarding the distribution of [ɨ] in NN sequences, both morpheme-internally and in suffixation. The first issue involved the phonological role of vowels preceded by morpheme-internal NN sequences. As formulated in (16), the Nasal Condition specifically states that morpheme-internal NN sequences form a

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*[kammjə] and *[anmjə], since both NɨN and NN sequences satisfy the requirements of the SCL. Thus, the occurrence of [ɨ] in this context is not induced by sonority.

24) A reviewer points out that the asymmetrical distribution of [ɨ] between NN sequences in morpheme-internal position and suffixation can be accounted for by reference to the 'Derived Environment Constraint (DEC)', referring to Ahn (1985). Ahn claims that [ɨ]-deletion between a liquid and a nasal should be treated as a lexical rule. This rule applies to derived words after suffixation, but does not apply to monomorphemic words. This would predict that there are other instances as well in which the application of this rule is blocked, in particular, in non-derived environments. In other words, there should be cases in which there would be a difference in distribution of [ɨ] between non-derived and derived words. However, with exception of NN contexts, the morpheme-internal distribution of [ɨ] between two consonants is always the same as that in suffixation, as was illustrated in (4). This undermines an analysis in terms of an effect of the DEC and, for this reason, the Nasal Condition in (16) is needed to account for the absence of [ɨ] in morpheme-internal NN sequences.

partial or full geminate when they are followed by an unlicensed government-licenser. To account for the absence of [ɨ] in morpheme- internal NN sequences (e.g. [əmma] 'mom' and [maŋnani] 'wretch'), we postulated that these are represented with a doubly-linked structure and an unlicensed government-licenser. The presence of [ɨ] in NN sequences in final position, however (e.g. [kanɨm] 'aim' and [nɨn] 'topicaliser'), is due to the fact that a licensed final empty nucleus cannot act as a government- licenser.

The second issue involved the distribution of [ɨ] of NN sequences in suffixation. This was treated by the postulation of various domains, i.e. the bare stem domain, the stem domain, the non-analytic and the analytic domain. The occurrence of [ɨ] in the connective and the effective forms with these suffixes, e.g. [kamɨmjə] and [kamɨni] 'to wind', was accounted for by the failure of inter-onset government, whereby each nasal has its own association line (because both are in different domains) so that the nasal in governing position cannot govern the preceding nasal. The absence of [ɨ] in the assertive and the interrogative forms (e.g. [kamne] and [kamni]) was ascribed to the licensed status of the final empty nucleus, which enabled a bare stem final and a suffix-initial nasal to form an inter-onset governing relation. Since one nasal cannot govern another nasal, the result is a consonant-related process, i.e. nasal fusion, where the [nasal] element is fused to form a doubly-linked structure and thus meets the requirements of inter-onset government.

The third issue of the paper was how the occurrence of [ɨ] in NN sequences in various contexts could be accounted for in a unified way. The distribution of this vowel is controlled solely by the ECP, which requires that inter-onset government and government-licensing should be satisfied. In suffixation, the occurrence of [ɨ] in the connective and the effective forms, and nasal fusion in the assertive and the interrogative forms, are invoked as repair strategies to conform to the requirements of inter-onset government. Furthermore, as a result of the Nasal Condition, the distribution of [ɨ] in morpheme-internal NN sequences is captured in the same way as that in suffixation.

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