

The subsyllabic hierarchy of Korean

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May 1, 2011

Abstract

Korean, a syllable-timed language, has been the subject of much study in theoretical phonology. In particular, the branching hierarchy of the syllable has been a topic of much debate, especially considering the relative simplicity of the syllable, which has a maximal CGVC structure.

This essay examines the issue of subsyllabic branching in Korean. In light of an asymmetrically substantial body of evidence, I conclude that the Korean syllable, in contrast to syllables in other languages, is left-branching. The salient subsyllabic unit is the body, composed of the body and nucleus, which challenges previously held assumptions that the rime, the nucleus and coda, formed a cross-linguistically universal constituent. Further, the prevocalic glide is investigated, and deemed to join an initial consonant in the onset, and not join the nuclear vowel.

The nature of Korean orthography and its implications for the above results are also discussed, as written Korean script could be seen to encode various details at hierarchical levels above the syllable. It is concluded that various phonological phenomena, while not completely independent of orthographic effects, nevertheless motivate the above conclusions.

The theoretical implications of this study include challenging traditional notions of phonological universals, as well as past and future changes to Korean speakers' mental representations of syllabic phonology.

Acknowledgements

Of the many, many people without whom this essay would not have been possible, I thank first of all my senior thesis advisor, Matthew Wolf, as well as my DUS and overseer, Laurence Horn. I cannot stress enough that I, and I alone, am responsible for the weaknesses and omissions of this essay; they are merely its victims.

My thanks also go to those who have guided me through the beautiful sciences of phonetics and phonology, Louis Goldstein, Darya Kavitskaya and Jelena Krivokapić. Your encouragement and patience, I value beyond words.

To the Yale Linguistics faculty, who have each, in some way, contributed to this, Dianne Jonas, Raffaella Zanuttini, Claire Bower, Ashwini Deo, and Gaja Jarosz, thank you.

To my fellow undergraduate linguists, thank you for your good humor and helpful attention.

To all the Korean students I've tutored in English, thank you for not understanding rhyme.

Finally, thank you to all my family and friends, who have had to put up with my complaints regarding the writing of this essay, and have worried about my sanity.

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1. Introduction

I am surely not the first bilingual¹ Korean/English speaker to notice that Korean does not appear, for want of a more precise description, to *rhyme*. That is, syllables with identical nuclei and codas – so-called perfect rhymes – do not appear to have any special correspondence, as they do in English. I also doubt very strongly that I am the first person to teach² Korean-educated students about English poetry, only to find intuitive notions of rhyme completely missing. A rudimentary knowledge of syllable structure, as it turns out, is a useful pedagogical aid.

Even disregarding the stress requirements for perfect rhymes, I have not come across such correspondence in poetry or song lyrics in Korean, whereas other typical poetic devices such as alliteration, syllable count and meter are common. The closest thing to rhyme is the use of verse-final identity, homophonous syllables in which onset, nucleus and coda are all identical. Kim (1987) makes a similar note, pointing out that Chinese, which has had a long and profound influence on Korean, has had poetic rhyme, in some form or another, for over 2,000 years.

Thus, this essay began as an investigation into why Korean might differ from other languages in this way. It has grown into an attempt to give a relatively comprehensive overview of the branching structure of the Korean syllable. Chapter 2, as its title might suggest, contains some background information. Chapter 3 covers the original issue alluded to above, namely branching immediately below the level of the syllable. Chapter 4 looks at glides, and Chapter 5 is a brief discussion of the role of orthography. Finally Chapter 6 is a summary and concluding discussion.

¹ I use this term very, very loosely.

² This term is also used very loosely indeed.

Please note that the phonetic transcription used is not entirely canonical; indeed, it seems no two articles in the Korean linguistic literature appear to completely agree on the representation of segments. As such, I have resorted to a mixture of traditional Yale Romanization, IPA notation (following Lee, 1999) and other transcription systems, motivated by a combination of faithfulness to existing literature, phonetic accuracy, and sheer convenience. Some notable representations are:

[ʌ] for the low-mid back unrounded vowel³ (also seen transcribed, in various texts, as [ə])

[i] for the high central unrounded vowel⁴ (also seen as [ɨ])

[ç] for the lax postalveolar affricate⁵ (also seen as [tʃ])

[ç̟] for the (palatalized) lax alveolar fricative⁶ (also seen as [ʃ̟])

As a further explanatory measure, transcription in Korean script (Han'gul) is provided in footnotes. This, admittedly, is only useful to Korean-literate readers; it is a self-indulgent move, partly motivated by my own frustrations, arising from inconsistent transcription, during research.

³ 어

⁴ 이

⁵ ㅈ

⁶ ㅉ

2. Background

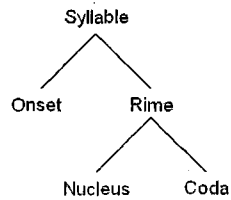
2.1 The Syllable

Although not originally recognized as a salient phonological unit – for example in Chomsky & Halle (1968) – the syllable has since gained a place in phonological theory, largely because of various phenomena that cannot be satisfactorily accounted for in terms of segmental strings – even if delimited by juncture elements – but require reference to a higher-level syllabic unit (Selkirk, 1982). Blevins (1995) notes decades of research data into phonological processes – whether described by transformative rules or constraints – for which the syllable is the domain of application. Also noted are aspiration rules which are best formulated in terms of syllable boundaries (thus solving the problem of consonants and word boundaries not forming a natural class), as well as morphological processes including language games, in which the syllable, and not a segment- or word-based unit, is prosodic the target of affixation, reduplication, or other morphological transformation.

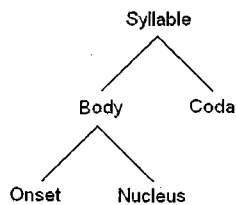
Experimental studies have also found evidence of the syllable's salience. Speech errors involving exchanged segments – Spoonerisms, for example (Mackay, 1970) – generally respect a *syllable-position constraint*. Only segments occupying the same position within the syllable are exchanged. While such patterns have been argued to reflect *word-position* and not syllable-position effects (Davis, 1989), syllabic nuclei and codas have also been found respect the constraint (Cholin, 2011). Moreover, Cholin found, from psycholinguistic reaction data, that speakers of Dutch and English store syllables as phonetic units, separately from segments or words.

With the establishment of the syllable as a unit, further research has investigated organization at a syllable-internal level. Various organizational structures have been proposed, three of which are shown in (1):

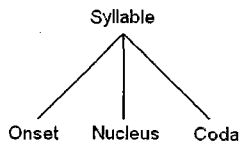
(1) a. Right-branching (onset-rhyme) structure



b. Left-branching (body-coda) structure



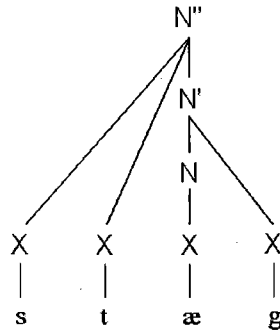
c. Flat structure



While (1)a. is cross-linguistically the most commonly proposed syllabic analysis, (1)b. has also been proposed, notably for Korean, but also for CVC syllables (and only CVC syllables) in Hebrew (McCarthy, 1979). The flat structure of (1)c. is proposed by Clements and Keyser (1983), who posit an underspecified X tier; such a model does not account for onset-coda asymmetry. The flat tree also appears in Davis (1985), but as the result of differential diagnoses, which reject various lines of argument for a tier between syllable and segment, notably analyses of speech errors and word games (further argument in Davis, 1989). Subsyllabic branching will be further discussed in Chapter 3, below, where alternate structural models, such as moraic theory, will also be discussed.

Another structural model is Levin's (1985) N-bar theory, according to which a syllable is the maximal projection of the nucleus. For example:

- (2) the English word 'stag' (including the X-tier that Levin argues for):



This structural account draws from X-bar syllabic theory (e.g. Jackendoff, 1977), and is motivated by, among other things, redundancy of the [+syllabic] feature. Such issues are beyond the theoretical scope of this essay, which chiefly concerns itself with inherent branching, and not issues of metrical theory. I believe, however, that the account given in this essay is not incompatible with an N-bar syllable, although the configuration of adjuncts may differ from Levin's assumptions.

One issue that arises in syllabic research is the unreliability of native speakers' syllabification judgments. As noted by Côté and Kharlamov (2011) from their experimental study on Russian, it is not clear whether "the phonological syllable can be seen as a purely abstract constituent" or whether it is a "metalinguistic procedure which results from a complex interplay of phonetic, phonological and morphological factors, including segmental regularities."

2.2 The Korean Syllable

As Korean is inherently syllable-timed – and has been so for several centuries (Kim, 1987) – the phonological saliency of the syllable is without question. Further, the orthography is rigidly syllabic, with writing in syllabic blocks. On one hand, this makes for clear syllable boundaries, and issues of syllabification judgments do not arise. On the other hand, the influence of orthography on production is unclear – is the syllable a phonological primitive, or is it the result of prescriptive orthographical and morphological rules? Furthermore, the orthography almost exclusively reflects underlying phonemes, and not surface representations, further muddying the interaction between syllabification and other phonological transformations. See Chapter 5 for further details.

The Korean syllable has, in general, a (C)(G)V(C) structure, affricates generally deemed single segments. There are two, fairly rare, exceptions to this relatively simple structure, the first being underlying lateral-stop coda clusters /lk/ and /lp/ that sometimes surface as clusters when followed by an obstruent, as in (3)b. This surface cluster primarily appears in careful, read speech. In spontaneous, naturalistic speech, it is most commonly reduced, with the lateral deleted, as in (3)c:

- | | | | | |
|------|----|------------------------|--------------------|----------------------|
| (3). | a. | /palp/ ⁷ | <i>to step on</i> | verb root |
| | b. | [palp.ko] ⁸ | <i>step on-and</i> | (read speech) |
| | c. | [pap.ko] | <i>step-on-and</i> | (spontaneous speech) |

⁷ 밟(다)

⁸ 밟고

When the cluster is followed by a vowel (that is, an onsetless syllable), however, resyllabification occurs:

- (4) a. /palp . in/⁹ *to step on* - PERFECTIVE
 b. [pal . pin]

Of all the underlying coda clusters in Korean, only /lk/ and /lp/ surface as clusters, and then only in restricted environments, and not universally among speakers. The two repairs above, lateral deletion and resyllabification, are also employed for all other underlying coda clusters.

The second exception is the off-glided vowel /ɨ/¹⁰. It occurs only as one of many homophonous Sino-Korean morphemes¹¹ (Kim-Renaud, 1986a), and as the genitive suffix. Notably, it only occurs in modern Korean as a complete morpheme; that is, it does not occur in a syllable with an onset or coda. There did exist several such now-archaic syllables, such as /kɨ/¹², which in any case was (and is) realized as [ki]. Similarly, /ɨ/ as a Sino-Korean morpheme and as a genitive suffix usually reduce to [i] and [e:], respectively. I believe, however, that the coda clusters and the off-glided vowel can also be addressed within the framework of the (C)(G)V(C) syllable. See Section 4.1 for details.

⁹ 밝은

¹⁰ 의

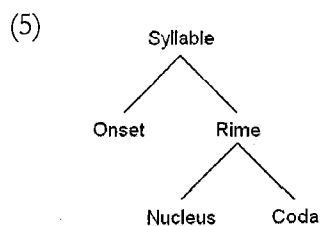
¹¹ These include 意 *idea*, 醫 *medicine*, 議 *discussion*, 依 *dependence*.

¹² 기

3. Branching

3.1 Right branching

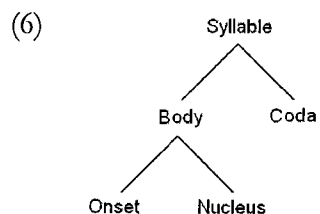
The structure of the Korean syllable has been relatively controversial. A right-branching syllable structure - an onset-rime structure as in (5) - has been put forth by several authors (Sohn, 1987; Kim, 1985; Chung, 2008).



This structure has, in the past, been assumed to be cross-linguistically universal. (Fudge, 1987; Kaye, 1989; and many others). Indeed, this assumption of universality persists even in recent accounts. (See, for example, Goldstein et al., 2006). In the case of English, at least, there is a large body of evidence that supports such a structure. Fudge (1987) cites distributional constraints, speech errors and word games as evidence for a rhyme constituent; Treiman (1983, 1985, 1986) found word-blending tasks lead to a similar conclusion.

3.2 Left branching

In the case of Korean, however, the evidence points to a left-branching body-coda structure (6).



3.2.1 Word Games

Kim (1987) recalls, from his childhood in the 1950s, the ‘nosa’ word game (7), where /*.no.sa/* is inserted after the nuclear vowel in a syllable, before the coda consonant (if one exists).

$$(7) \quad \emptyset \rightarrow .no.sa / .CV _ (C) .$$

This is obligatory in the first syllable of a word, and optional thereafter. For example, the sentence in (8) could be *nosafied* to become (9). The inserted strings are underlined.

$$(8) \quad a) \# c^h\Lambda l.su.nin \# o.nil \# hak.kjo.e \# an.kan.ta \#^{13}$$

Cheolsu-topic # today # to school # not go.

Cheolsu is not going to school today.

$$(9) \quad \# c^h\Lambda \underline{.no.s}\underline{a}l.su.\underline{.no.s}\underline{a}.nin \# o.\underline{.no.s}\underline{a}.ni.\underline{.no.s}\underline{a}.l \# \underline{h}\underline{a}.\underline{.no.s}\underline{a}k.kjo.e \# \underline{a}.\underline{.no.s}\underline{a}n.kan.ta \#^{14}$$

Of note is that the syllable is broken, and the /*nosa/* inserted, between the nucleus and coda, leaving the body intact, which argues against the rime as a Korean unit and adds weight to the argument that the body is a salient constituent.

Kim also cites, from decades past, another language game that points to such a structure. This game, which survives to this day as ‘Dokkaebi Mal’¹⁵ (lit. *bobgoblin speech*), involves the insertion of a consonant, (either /s/ or /p/, depending on the variant), and vowel reduplication, as follows:

¹³ 철수는 오늘 학교에 안간다.

¹⁴ 처노살수노사는 오노사느노살 하노삭교에 아노산간다.

¹⁵ 도깨비말

- (10) a) $\emptyset \rightarrow .s V_i / . CV_i _ (C) .$
 b) $\emptyset \rightarrow .p V_i / . CV_i _ (C) .$

That is, after each nucleus there is inserted a syllable of the form CV, where the consonant is fixed and the vowel a reduplication, as in from (11), to (12):

- (11) a) # in.su.ja # kwaŋ.ho.ha.ko # i.ri # o.nΛ.ra #¹⁶
 # Insu-EXCLAMATORY # with Kwangho # to here # come-IMPERATIVE #
Hey Insu, come here with Kwangho.
- (12) a) # i.pin.su.pu.ja.pa # kwa.paŋ.ho.po.ha.pa.ko.po # i.pi.ri.pi # o.po.nΛ.pa.ra.pa #¹⁷
 b) # i.çin.su.su.ja.sa # kwa.saŋ.ho.so.ha.sa.ko.so # i.çi.ri.çi # o.so.nΛ.sa.ra.sa #¹⁸

As with the ‘nosa’ game above, Dokkaebi Mal detaches the syllable’s coda from its body, and the insertion results in the coda being attached to a subsequent syllable. This is especially striking in comparison to English games such as Pig Latin or Ubbi Dubbi, which also involve separating constituents of a single syllable. In the English games, however, it is invariably the onset which is detached, leaving the rime intact.

Lee (1993) argues, however, that such language games do not necessarily indicate a left-branching syllable. According to Lee, the /nosa/ can only be inserted between nucleus and coda because of its CVCV form, and to insert it between onset and nucleus would result in an unsyllabifiable CC onset, as Korean does not permit onset consonant clusters. This mirrors Davis’s (1985) cross-linguistic

¹⁶ 인수야 광호하고 이리 오너라

¹⁷ 이빈수부야바 과망호보하바고보 이비리비 오보너버라바

¹⁸ 이친수수야사 과상호소하사고소 이시리시 오소너서라사

summary of insertion language games, which concludes that it is the nature of the inserted segments that determines their placement, and not a language's branching syllable structure.

Thus, it may be that language games do not necessarily serve as conclusive evidence of a left-branching syllable in Korean. Nevertheless, they are compatible with such a structure. Furthermore, it is worth noting the conspicuous absence of language games in Korean which involve insertion at the onset-rime boundary, a phenomenon which is seen in games in other languages. It may be that the constituency of the body has a preventative effect; perhaps Korean only permits CV insertion because inserting alternate strings (say, VC strings) would violate the constituency of the body as a subsyllabic unit.

3.2.2 Spontaneous speech

Naturalistic speech processes also support left branching. Berg & Koops (2010) note several speech error studies that show an overwhelming preference, when more than one segment is involved, for CV units. In the case of partial retrieval of word targets, the retrieved string takes the form of a CV sequence (from a CVC target). In the case of speech errors, CV errors predominate over VC errors, which are almost negligibly rare. This agrees with Cheon's (1980) findings, in which multisegmental transposition errors involve CV units:

- (13) a. /cil.sʌ.ka mun.lan.ha.ta/¹⁹
 order-NOM not-in-order.be
Something is not in order.
- b. [cil.sʌ.ka mul.la.na.ta]²⁰ (correct surface form)
- c. [mul.sʌ.ka cil.la.na.ta] (transposed form)

As can be seen, the transposed sequences /ci/ and /mu/ are word-initial bodies. While Cheon also discusses other speech errors which do not preserve the body as a unit, these other errors all involve the substitution, transposition, omission or addition of single segments (or, in one case, the omission of an entire syllable). Notably, the rime never participates as a unit in speech errors, as it does in other languages; examples include German (MacKay, 1972) and English (Shattuck-Hufnagel, 1983).

Further evidence for the body as a salient phonological constituent comes in the form of CV deletion in fast speech, as follows:

- (14) a. ca.sip.sʌ²¹ → cap.sʌ *self-study book*
- b. tɛ.heŋ. cin²² → tɛŋ. cin *parade*

As above, the deletion of the body unit (preceding resyllabification) suggests its constituency. (See, Section 3.3.3 for an alternate moraic account.) Moreover, there appears that no corresponding rime deletion effect exists. While a rigorous study of this kind is, to my knowledge, yet to be done, (See,

¹⁹ 질서가 문란하다.

²⁰ While not relevant to the issue at hand, [n] assimilates to a following [l], and [h] is known to be elided following [n].

²¹ 자습서

²² 대행진

however, Section 3.2.3 for similar experiments with word blending.) cursory questioning of native speakers suggests that unlike the abbreviated forms in (14), which are judged possible (and relatively common), the example in (15) below – in which a tautosyllabic nucleus and coda have been deleted, does not correspond phonologically to its source word.

(15) cʌ.kim.tɔŋ²³ → cʌk.tɔŋ *moneybox*

In contrast, when the deleted string was an onset-coda pair, as in (14), the output was deemed acceptable:

(16) cʌ.kim.tɔŋ → cʌm.tɔŋ *moneybox*

Again, while this result is by no means definitive, it is expected if the onset and nucleus form a body constituent, instead of the nucleus and coda forming a rime. I expect that any further experimental study will lead to similar outcomes; related experiments below further support the existence of a body constituent.

3.2.3 Experimental Evidence

Derwing et al. (1993) argue for a body-coda syllable, from forced-choice word blending tasks, as in Treiman (1986) where such a task was used to test for English syllabic constituency. Derwing et al.'s two-choice word blending task tested native Korean speakers' preference for either onset + rime blends – choice (9)a. below – or onset+rime blends – (9)b.

²³ 저금통

- (17) a. sem + tɔŋ → sɔŋ
 b. sem + tɔŋ → seŋ

A clear preference was found for body+coda blends over onset+rime blends, suggesting a stronger link between onset consonant and nuclear vowel than between vowel and coda consonant. It was noted that this result held for both blends resulting in real words and nonsense words, and is thus consistent with a left-branching syllable.

Yoon & Derwing (2001) provide a variety of experimental evidence in support of this structure. Sound similarity tests involving CVC syllables found that syllable structure is salient to phonological similarity judgments of native Korean speakers. Syllable pairs of the type CVX, with a matching body but mismatched coda, were consistently judged more similar than XVC pairs, with matched rime but mismatched onset. The authors contrast this body-prominent result with the results of English sound similarity judgment experiments (Vitz & Winkler, 1973, among many others), which find the opposite effect: matched rimes are judged as more similar than matched onsets.

Further, Yoon & Derwing's subsequent concept-formation experiments also confirmed the earlier finding. Each subject heard a list of words, having been informed that some of them shared a common phonetic property. After each word was played, the subject was asked to decide whether or not it had the common property, after which they were informed of the correct answer. At the end of the test, the subject was then asked to identify the defining common property. The property in

question was that the relevant words contained a common syllable, /kaC/ or /Cak/, either a common body (with variable coda) or a common rime (with variable onset).

The rather complicated experiment yielded several results. First, the proportion of subjects who were able to form the concept – that is, master correctly categorizing stimuli as having or lacking the common property in question – was higher for the common-onset condition than the common-coda condition. Second, the common-onset group reached mastery in fewer trials than the common-rime group. Third, more common-onset subjects than common-rime subjects were able to explicitly identify the relevant common segments. All three results were statistically significant ($p < .005$), providing an insight into the psycholinguistic processes that affect perception for the participants. As Yoon & Derwing conclude, “a CV unit is more salient for Korean speakers than a VC string,” and it “coheres as a significant linguistic unit (the body), while a VC sequence represents nothing more than an arbitrary sequence of two segments.”

3.2.4 Phonotactics

Support for a contrast between English and Korean syllable structure comes from phonotactic evidence. Kessler & Treiman's (1997) statistical analysis of monomorphemic English monosyllabic words found an association between consonant type and syllable position. Glides occur only in onset position, while /ŋ/ occurs only in the coda. Moreover, /z/, /θ/, /n/, /t/, /l/ and /k/ were found to prefer the coda, while /b/, /f/ and /r/ showed a preference for the onset. Further, association tests found a statistically significant connection between vowel and coda, but none between onset and vowel. This result held even when consonants and vowels involved in absolute co-occurrence

restrictions (/ŋ/, for example) were omitted, confirming the existing onset-rime model for English syllables.

In contrast, Berg & Koops's (2010) phonotactic corpus study of Korean speech syllables found no such statistical right-branching effect. In fact, it found no statistical branching effect at all; their results did not find the expected left-branching effect for Korean. They argue, however, against interpreting this as a "null result", arguing that the temporal left-to-right nature of speech introduces an inherent universal bias. That is, phonotactic constraints are more useful toward the end of a syllable than the beginning: "at earlier stages of word recognition the number of candidate words is still rather high." Thus, phonotactic constraints are more likely *a priori* to occur later in a syllable. In other languages – and in particular, in English – this processing bias is reinforced by a right-branching phonological hierarchy. In contrast, a left-branching syllable would result in a constraint that opposes the temporally-motivated rightward bias, and the authors suggest that the lack of branching effects in the data results from competition between these forces in the case of Korean.

Further complicating a phonotactics-based argument for branching direction is Lee & Goldrick's (2008) study, which did find the expected contrast between Korean and English, but argue that subsyllabic associations are statistical and probabilistic in nature – rather than strictly branching – citing short-term memory experiments. They go on to posit an emergent model of subsyllabic constituency, in which the left-branching Korean syllable is not an inherent property of the language, but a result of the statistical properties of segment combinations.

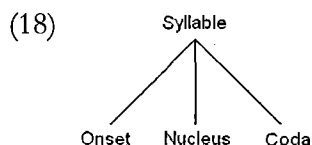
As noted, such an argument from statistical patterns does not invalidate branching as a concept, nor does it invalidate previous conclusions, drawn from other data, regarding branching direction. It does, however, call into question the absolute nature of phonological structures. While it does appear that the body is a salient unit within Korean syllables – far more salient than the rime – it may not be a primitive unit. That is, constituency in this case is not a binary, all-or-nothing, property. In fact, saliency appears to be a more appropriate concept; it is already a widely used descriptor in the phonological literature.

Although the left-branching structure of the Korean syllable may not be absolute constraint, it is a constraint nevertheless. In contrast to other languages, notably English, the onset and nucleus form a body unit, and the boundary between this body and the coda is a locus for transformative phenomena. Lee (2006) concludes, from a series of wordlikeness judgment and short-term memory experiments that the difference between Korean and English syllabic structure is significantly contrastive, and it corresponds to phonotactic patterns. This result confirms various effects cited earlier, in both language games and naturalistic speech, and suggests the branching syllable's structure's relevance for both production and perception.

3.3 Alternate analyses

3.3.1 Flat tree

Apart from the left- and right-branching debate, various other accounts have also been proposed. One of these is the non-hierarchical flat tree:

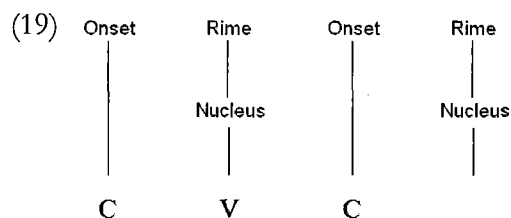


To my knowledge, this structure has not been proposed for Korean. A flat tree does not capture the strength of the onset-nucleus link (and resulting saliency of the body as a phonological unit), much as it fails to capture the similar onset-rime structure found in other languages. In light of the flat structure tree's inability to reflect such asymmetry, it would appear that it is a less accurate model than the left-branching tree. This does not preclude its applicability in other cases; there may be languages that do show symmetry between onset-nucleus and nucleus-coda relations. Lee & Goldrick (2011) suggest that this may be the case for Hungarian. In the case of the Korean syllable, however, it is less than adequate.

3.3.2 Government Phonology

Another syllabic model is that suggested by Rhee (2002), which has non-branching constituents.

According to this model, a CVC syllable would have the following structure:



Rhee argues for such a structure on the grounds of Government Phonology, according to which neither *syllable* nor *coda* are recognized as constituents. (Kaye, et al., 1990) Thus, what would otherwise be described as a CVC syllable is analyzed as two onset-nucleus sequences, with the second nucleus an empty one.

While it is beyond the theoretical scope of this paper (not to mention the author) to give a satisfyingly thorough appraisal of Government Phonology, it must be said that the conspicuous lack of the syllable and body as constituents does not correspond to the reality of spoken Korean. As such, it remains a goal of future research to reconcile a phonological framework based on government and licensing, with the existing body of data.

3.3.3 Moraic accounts

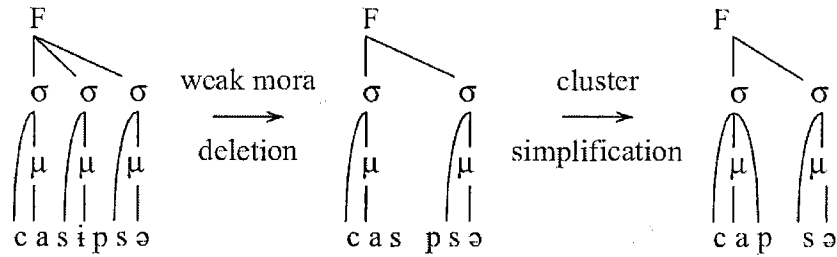
Another line of research has applied moraic structures to Korean syllables, in order to account for various effects. For instance, Lee (1993), which draws on McCarthy & Prince's (1986) moraic structure:

(20) English *cat*:



According to Lee, the fast speech CV deletion seen in Section 3.2.2 can be explained by moraic processes. First, it is noted that the deletion always occurs in the weak position of a foot – that is, the second of three syllables. This is characterized as the deletion of a mora (and its nucleic vowel), leaving the onset and coda consonants unsyllabified. This is followed by cluster simplification, which deletes the onset consonant, leaving the coda consonant to be incorporated into the coda of the first:

(21) From Lee (1993):



While this account does indeed account for the transformation, it is unclear why the cluster simplification process necessarily deletes the onset consonant /s/, and not the coda consonant /p/. One possible way to explain this asymmetry is the saliency of the body as a phonological unit, which requires the adoption of Hyman's (1985) moraic structure, in which onsets also fall under morae:

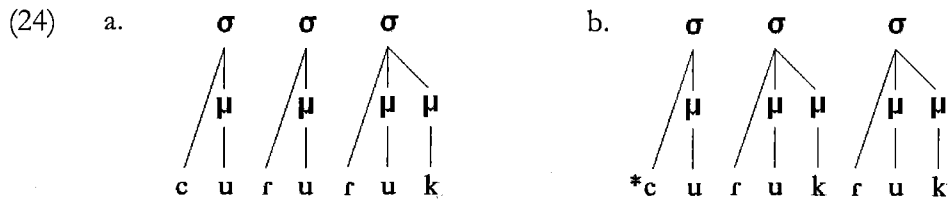
(22) English *cat*, following Hayes (1985)



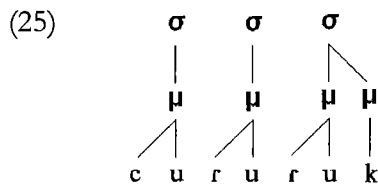
Jun (1994) also uses a moraic model to analyze onomatopoeic partial reduplication for example:

(23) cu.ruk → cu.ru.ruk *sound of dribbling*

Jun argues that a metrical weight consistency constraint is necessary to prevent codas from being reduplicated – that is, to achieve the correct output (24)a. instead of (24)b. The number of heavy syllables in the reduplicated form must match the number in the root:



This analysis does not preclude a moraic body:



This analysis also seems to suggest reduplication of the body (to be more precise, of the body mora), which mirrors transformations from earlier this chapter, which preserve the body as a unit. While I cannot make a definitive pronouncement regarding the precise mechanisms of partial reduplication, or about the widespread applicability of moraic analyses to Korean syllables, it can be seen that a left-branching syllable is not inherently incompatible with moraic processes.

3.4 Summary

Within the syllable, the nucleus and coda were previously assumed to form a universal rime constituent. This right branching model is applicable to many languages, notably English, and is supported by a variety of perception- and production-based data. It has, however, proven to be an assumption that does not hold in the case of Korean syllables, for which the evidence suggests the body is the salient subsyllabic constituent. While Korean does so far appear to be unique in this regard, this, too, is probably an unreasonable assumption. Left-branching tendencies have been

noted, at least for certain syllable types in other languages (McCarthy, 1979), and further investigations may unearth more.

The branching structure, however, may not be an absolute, discrete, structural constraint. As noted in phonotactic studies, the body-coda structure of Korean could be an emergent property, a tendency resulting from statistical patterns, and not an inherent phonological unit like the syllable. Nevertheless, it appears fairly clear that in this case, the direction of such effects is clearly in the direction of a body unit.

4. Glides

4.1 The postvocalic glide

As noted in Section 1.2, Korean has exactly one postvocalic glide, which attaches itself to exactly one vowel, in exactly one syllable, [ɨ̯]. It is the last surviving member of a class of six; some already consider it abandoned (eg. Ahn & Iverson, 2006). It does, however, occasionally surface in careful speech. As such, it does require addressing. However, its rarity and limited environment prevent a rigorous account. One option would involve redefining the Korean syllable form as (C)(G) V (G)(C), with the use of intrasyllabic co-occurrence restrictions, but this seems gratuitous. Another would be to define two maximal syllable forms: CGVC and VG. This, too, is unsatisfying, for obvious reasons. A third option would be to allow one segment to occupy a consonant slot, either onset or coda. Chung (2008), citing spectrogram data, proposes a CV representation, replacing [ɨ̯] with a [ɯ] – [i] sequence.

What is clear is that a synchronic analysis is inadequate; the Korean segment inventory has undergone quite remarkable changes over the past two centuries, changes which are still very evidently in progress. (Kim-Renaud, 1986b). Given the current trend toward monophthongization of the off-glide syllable, it is not unreasonable to predict that the process will shortly be complete, as it already is in some dialects (Kim, 1997). As this paper does not concern itself with issues of historical syllabic structure, it has assumed that the off-glide is indeed abandoned, and thus does impact the analysis herein.

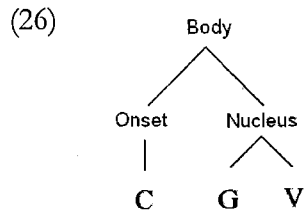
The labial-obstruent consonant clusters /lk/ and /lp/ are treated similarly, on similar grounds. They are the last of the clusters to disappear from the surface phonetics of Korean – at one point, Middle Korean also had /psk/ and /pst/ as onset clusters – and so I consider them for the purposes of this paper to have disappeared. Both the off-glide /j/ and the clusters /lk/ and /lp/ are historical artefacts, and thus have no bearing on the syllable structure presented here.

4.2 The Prevocalic glide

Unlike the near-archaic off-glide, the on-glides are alive and well. Both labial glides /wi, we, wɘ, wa/ and velar glides /ju, jo, jɛ, je, ja/, and the question of whether they fall under the onset or the nucleus is an open one.

4.2.1 Nucleus

A branching (G)V syllabic nucleus has been proposed, notably by Sohn (1987) and Kim (1997). Combined with the left-branching structure established in Chapter 3, it results in a syllable of the form:



This is also supported by orthographic structure, which treats diphthongs as complex vowels (See, however, Section 5.2). The main phonetic evidence for glides residing in the nucleus is so-called “liquid alternation”. Kim characterizes this as the lateral /l/ becoming flapped before a vowel:

- (27) a. /tal/²⁴ *moon*
 b. [tal.pit]²⁵ *moonlight*
 c. [ta.ri]²⁶ *moon - NOM*

It is noted that this flapping also occurs before a glide:

- (28) a. /il.jo.il/²⁷ *Sunday*
 [i.rjo.il]

Kim argues that when the lateral is moved to the onset slot as a result of resyllabification, the adjacent nucleus slot (containing glide and vowel) triggers flapping. Moreover, the movement itself is presented as evidence of a nucleic glide; the alveolar consonant would not be able to occupy an onset slot already filled with a glide.

An alternate analysis, however, could account for liquid alternation. The conditioning environment for flapping is not prevocalic, but syllable-initial (ie, onset). While the two positions may appear equivalent, the latter refers to syllable position, and not the nature of adjacent segments. Moreover, the existence of a glide in an onset slot may not necessarily prevent resyllabification. If we assume

²⁴ 달

²⁵ 달빛

²⁶ 달이

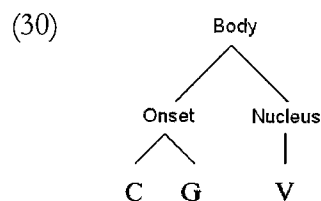
²⁷ 일요일

that the Maximal Onset Principle (eg. Selkirk, 1982) operates to some extent in Korean, the complex onset is a less surprising outcome. Finally, the existence of non-flapped laterals, for example in (29), causes problems for both the nucleic vowel hypothesis and the Maximal Onset Principle. Nevertheless, the contrasting data in (28) suggest that it is not a filled onset slot blocking resyllabification; another (possibly lexical) constraint appears to be involved.

- | | | |
|------|--------------------|--------------------------|
| (29) | [al] ²⁸ | [al.jak] ²⁹ |
| | <i>bead, grain</i> | <i>(bead + medicine)</i> |
| | <i>bead, grain</i> | <i>tablet, pill</i> |

4.2.2 Onset

Directly contrary to the nucleic glide proposal is the complex onset (eg. Lee, 1994):



Lee cites the *Dokkaebi Mal* game seen earlier in Section 3.2.1, noting that the V of the inserted CV is effectively a reduplication of the preceding vowel, but any glide present is not copied. Below is the fourth syllable of (11), repeated for clarity:

- (31) .kwaŋ. → .kwa.paŋ. or .kwa.saŋ.

²⁸ 알

²⁹ 알약

If the vowel were nucleic, occupying the V slot with the vowel, we would expect the output below:

(32) .kwaŋ. → *.kwa.pwaŋ. or *.kwa.swaŋ.

Finally, glide-vowel sequences lead to a less plausible structure under the nuclear glide model, unless we are to completely reject the Maximal Onset Principle. In a glide-vowel sequence such as /ja/, it appears much that the onset position would be occupied by the glide than be empty, followed by a complex nucleus.

Thus, I conclude that the onset glide model is superior to that with the glide in the nucleus. It is to be noted, however, that the evidence cited here is less than definitive. Future studies, particularly phonotactics-based studies, may yet provide further clarification – or, for that matter, suggest that glides do not exclusively fall under either onset or nucleus. There is no reason to believe that the emergent model for higher-level branching could not work at this level.

5. Orthography

One complicating factor in the analysis of Korean phonological phenomena is the role of Korean orthography, *Han'gul*, in the language process. Any experimental protocol involving written text, for example, is likely to affect processing; the phonological structures encoded in the script may interfere with subconscious mental representations being investigated. This is particularly true of the branching structures examined in this essay.

5.1 Body-coda structure

The Korean script consists of syllabic character blocks, each built up of phonemes. For each syllable, the onset and nucleus are obligatory; in fact, there exists a null onset grapheme \bigcirc which acts as a placeholder for syllables without consonantal onsets.³⁰ For example:

(33) 나 다 아
 /na/ /da/ /a/

Also of note is the non-linear structure of each character; onset, body and coda occupy consistent positions:

(34) a. 남 담 암
 /nam/ /dam/ /am/

 b. ном 돎 옴
 /nom/ /dom/ /om/

³⁰ Somewhat confusingly, the same grapheme, in coda position, represents [ŋ]. This does not appear in this chapter.

As seen in 34, the coda is always written below the body. While the body-internal organization varies – the onset grapheme is either situated above the nucleus, or to the left of it – the body-coda division is immediately apparent on sight. Moreover, the body is obligatory, while the coda is not – compare (33) with (34)a. – it is clear that the written syllable reflects a body-coda structure.

The syllabic nature of Han'gul is by no means unique, and nor is its visual preference for CV structure – Linear B and Cherokee are notable example of CV-prominent syllabaries (Gnanadesikan, 2011). These facts may reflect a general cross-linguistic preference for unmarked CV syllables, or they may reflect the higher positional faithfulness constraints that apply to onsets (Beckman, 1999). What cannot be concluded is that orthography simply serves as definitive evidence of left-branching in Korean. If anything, it confuses such arguments, as it is unclear whether what prescriptive effect the orthography has on mental representations and language production and perception processes.

Experimentally, this issue of orthographic interference has been avoided by studies on pre-literate children, generally around kindergarten or beginning elementary school age. Yoon & Derwing (2001) found that Korean nonreaders, when required to remember a list of words, performed better on words with a common body, than with a common rhyme. Kim's (2007) study on beginning readers confirmed these results, through word-blending and segmentation tasks that the body unit and the body-coda boundary are the most salient to phonological awareness. These results suggest that syllable-internal structure (in particular the left-branching Korean syllable), whether absolute or statistical, is encoded, to some degree, before speakers have reached reading proficiency, and thus presumably before orthographic reinforcement.

5.2 Glide placement

Unlike the body-coda structure, the onset-location for the prevocalic glide is not reflected in Han'gul. Quite the opposite, in fact: according to written Korean, glides are unquestionably part of the vowel. For example, the grapheme for a vowel preceded by a palatal glide is a variant of the glide-less vowel. The abstract vowel graphemes are given in (35)a. and example syllables are given in b.:

(35)	a.		
		o	jo
	b.		
		/ko/	/kjo/

Furthermore, labiovelar glides are reflected in the orthography as diphthongs, using compound vowel graphemes:

(36)			
	o	a	wa

These “compound vowels” often reflect historical coalescence, for example:

(37)	/po.a/ ³¹	→	/pwa/ ³²	<i>look</i> -IMPERATIVE
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It must be noted, however, that syllabification processes occur *after* lexical access. (Refer to Section 4.2 for an example.) Thus, assignment of the glide to the onset presumably takes place much later in the production process than orthographic processing. Moreover, when Han'gul was first developed, in the mid-fifteenth century, the syllable was conceived in simple CVC terms; that is, a flat structure,

³¹ 보아

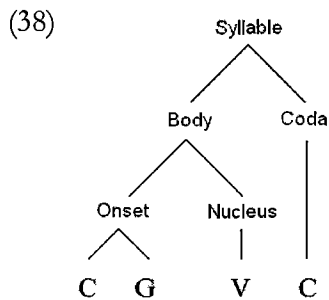
³² 봐

without subsyllabic branching (Kim-Renaud, 1997). While it appears impossible to reconstruct the subsyllabic structure of fifteenth century Korean, it can be said that the orthographical encoding did not necessarily reflect phonological structures in such atomic detail. Just as visual the apparent body-coda division cannot be assumed to reflect constituency, on-glided vowels represented as vowels do not necessarily imply that they occupy the nuclear position.

Han'gul, then, is again at best a distractor, confusing experimental participants' judgments. The evidence for an onset glide, in particular the language game mentioned above, is primarily spoken. This does not prevent subconscious manipulation of mental phonological structures; even if it does, the fact that the glide does not reduplicate together with the nucleic vowel indicates the primacy of the glide's onset position over prescriptive orthography. Thus, the evidence cannot be easily dismissed.

6. Summary and Discussion

This examination of Korean syllable structure has led to the conclusion that it is left-branching, contrary to previously held assumptions of universal right-branching. The onset and nucleus compose the body, which is the salient unit. Within the body, the onset can be empty, or occupied by a consonant, a glide, or both, while the nucleus contains only the vowel. Upon investigating Korean orthography and its interaction with phonological structures and processes, I conclude that while the potentially prescriptive influence of orthography on phonology cannot be completely ignored, experimental evidence on pre-literate speakers appears to support the left-branching model, and language game data agrees with an onset glide. In summary, the subsyllabic hierarchy of the Korean syllables resembles the following:



Notwithstanding the data presented in support of this structure, recent phonotactic analyses have cast doubt on the theoretically discrete nature of such phonological structures. It remains to be seen whether the structure proposed above is inherent, discrete and absolute, or whether it is the outcome of an emergent statistical tendency, a bias (admittedly, according to the data, a strong one) toward this branching hierarchy. Perhaps statistical modeling will provide an elegant way to model certain phenomena, including the possibility of exceptions; I speculate that emergence will come to serve as a useful theoretical framework, but do not conclude that the syllable is emergent. Nor do I,

however, conclude that it is not; I merely conclude that the data and arguments examined herein suggest a structure that generally resembles the one above.

Similarly, this paper did not attempt to answer the question of whence the syllable. While its existence and phonological relevance is, I believe, beyond doubt, whether it exists independently of other primitives is a question beyond the scope of this paper, as is the question of at what stage of the phonological/phonetic process at which the syllable comes into existence.

What this paper does claim is that the syllable structure of Korean can be shown to differ from that of other languages, many of which are deemed to have the rime as a constituent. Thus, the universality of phonological structures in general, and syllable-internal representations in particular, is challenged. The syllables of other languages could – and I believe will – be studied in future, and I speculate that further left-branching syllables will be found. This may also prove to be significant in historical linguistics and taxonomy; the branching direction of other East Asian languages will surely be relevant to the debate concerning the Altaic Language Hypothesis and the linguistic genealogy of modern Korean and Japanese.

While this paper's weaknesses no doubt render it theoretically conclusive, the investigation has, to my satisfaction, answered the question of why Korean does not exhibit poetic rhyme, as English does. In time, this answer may cease to be satisfactory. With the long-increasing influence on South Korea as a whole of English-language education and culture originating in English-speaking countries, I expect that Korean speakers' familiarity with the English language – including

unconscious familiarity with phonological structures will increase, and the results will be worthy of study, both from a sociolinguistic perspective and from a theoretical one. For example, might a longitudinal corpus study of Korean popular songs find a correlation between an increasing proportion of English lyrics and an increasing prevalence of hitherto rare nucleus-coda-based poetic rhymes? Do L1 Korean speakers exhibit body-coda effects in their L2 English? Or, might L2 English cause changes in L1 phonological representations? From these hypothetical studies, what conclusions might we draw about the nature and fundamentality of phonological representations?

Another promising area of future research involves the Articulatory Phonology framework. This analysis of speech production, based on temporally overlapping and co-ordinated articulatory gestures, combines phonological analysis with phonetic production, and has been shown to account for phenomena that a linear, segmental view cannot. (Browman & Goldstein, 1986, 1992; Goldstein & Fowler, 2003). Production (and its relationship to perception) is investigated in terms of gestures, goal-directed movements of vocal tract articulators, as well as the coupling relations between these gestures, which account for intergestural timing and temporal properties of speech (Nam et al., 2009). This approach is much more fine-grained than the segment-atomic one taken in this paper, and it is arguably more directly relevant to phonetic reality, given that traditional segments can encompass multiple gestures.

While relevant studies on Korean conducted under this framework are not yet numerous, research has been done on syllable structure in general (eg. Browman and Goldstein, 1988; Marin & Pouplier, 2010), and I predict that Korean syllable-based articulatory phonology research will yield insights far more substantial than the ones examined in this paper.

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