

## Syllable Structure in Korean Revisited\*

Inkie Chung

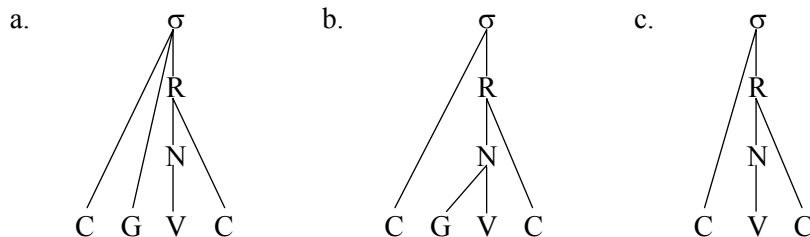
Central Connecticut State University

### 1. Introduction

The basic surface syllable structure in Korean is (C)V(C), and a consonant cannot appear in a syllabic peak position. In some instances, a glide such as [w] and [y] (or rather their core properties [+round] and [+high, –back], respectively) is present somewhere in the syllable. Many authors hypothesize that there is an independent position for a separate glide segment and that the maximal syllable structure contains the CGV sequence. Regarding where the glide is located in the hierarchical syllable structure, some contend that a consonant and a glide form a complex onset as in (1)a (K.-O. Kim and Shibatani 1976, B.-G. Lee 1982, among others), while others argue that the glide constitutes a complex nucleus along with the peak vowel as in (1)b (C.-K. Gim 1987, cf. Y.-S. Kim 1984: 9ff).

However, this paper argues that, phonetically, there can be only one consonant segment position in a syllable onset and that there are no diphthongs, i.e., no complex nuclei. That is, the maximum surface syllable structure is simply CVC as in (1)c. A similar view to (1)c is presented in S.-C. Ahn (1985: 48).

#### (1) Three different views on the syllable structure in Korean




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The claim for the structure (1)c is that at the level of the systematic phonetic representation there is no glide as an independent segment between the onset consonant and the nucleus vowel in a syllable. The alleged glide, which has once existed at a deeper phonological level, is incorporated into the preceding consonant as a property of secondary articulation.

This paper provides arguments for this claim. First, some phonological aspects are discussed, including loanword adaptations of consonant-glide and consonant-liquid clusters, the distribution of the glide [ɥ], palatal variants of non-plosives before a vowel other than [i], and hiatus tolerance. An acoustic study follows to show the status of the alleged glide in a C\_V environment (and the associated properties of such a glide realized on the consonant). Finally, a few factors are considered for (wrongly) identifying a glide in such syllables with a non-vocalic onset consonant. The phonological reality of the glide at issue is considered as well.

## **2. Consonant Cluster Adaptations in Loanwords**

Korean loan phonology strongly supports the view on the syllable structure (1)c. This section considers loanword adaptations focusing on two types of consonant clusters: consonant-glide and consonant-liquid. There are two distinct cluster adaptations but the results of them share a common property: the lack of a glide as an independent segment between a non-vocalic onset consonant and a peak vowel in a single syllable. The lack of consonant-liquid sequences is employed to argue that Korean does not have consonant-glide sequences.

### ***2.1. No CG sequences in loanwords***

Consider the following loanwords, where the first consonant of a complex onset sequence is a stop and the second segment is a glide in the original loanword forms in the “lending” languages. Proper

names are provided in some instances.<sup>1</sup>

(2) Loanwords with a complex onset of a consonant-plus-glide sequence

original form	borrowed form	
[tyuwnə]	[t <sup>hy</sup> una]	‘tuna’
[dyuws]	[t <sup>y</sup> usɯ]	‘deuce’ (sports)
[twɪst]	[t <sup>h</sup> ɯwisɯt <sup>h</sup> ɯ]	‘twist’ (dance)
[dwaɪt]	[tɯwait <sup>h</sup> ɯ]	‘Dwight’
[swetər]	[sɯwetɻ]	‘sweat shirt’
[kyuwt]	[k <sup>hy</sup> ut <sup>h</sup> ɯ]	‘cute’
[kwiyn]	[k <sup>hwy</sup> in]	‘queen’
[gwarneri]	[k <sup>w</sup> arɯneri]	‘Guarneri’
[pyuwmə]	[p <sup>hy</sup> uma]	‘puma’
[byuwtɪ ʃɑp]	[p <sup>y</sup> ut <sup>h</sup> iʃɑp <sup>ɿ</sup> ]	‘beauty shop’
[pwazɔ̃] Fr. <i>poison</i>	[p <sup>ɿ</sup> ɯwɑʃoŋ]	‘perfume’
[fyuwz]	[p <sup>hy</sup> uʃɯ] ~ [çuʃɯ]	‘fuse’
[rɪvyuw]	[rɪb <sup>y</sup> u]	‘review’

The input stop-plus-glide (CG) sequences in loanwords are transformed in two different ways. One way of adaptation is deletion of the glide. This glide deletion operates after labialization or palatalization of the preceding consonant (resulting from Cy/Cw mostly in C<sup>y</sup>/C<sup>w</sup>). The other adaptation process is *u*-epenthesis, which separates the disallowed sequence into two syllables (resulting in CɯGV). This insertion operation is observed in examples such as [t<sup>h</sup>ɯwisɯt<sup>h</sup>ɯ], [tɯwait<sup>h</sup>ɯ], [sɯwetɻ] and [p<sup>ɿ</sup>ɯwɑʃoŋ] from the French form [pwazɔ̃].<sup>2</sup>

Even though it is interesting that there are two different ways to fix disallowed CG sequences, I will

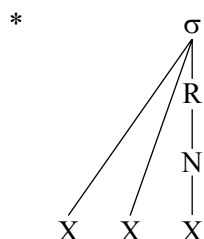
<sup>1</sup>Some of the (non-IPA) phonetic symbols and diacritic marks used in this paper are as follows:

[š]	voiceless alveopalatal fricative	[ü]	high front round vowel
[č]	voiceless alveopalatal affricate	[ö]	mid front round vowel
[j]	voiced alveopalatal affricate	[ɯ]	high back unround vowel
[ <sup>y</sup> ]	palatalized (as in [p <sup>y</sup> ])	[y]	high front (palatal) unround glide
[ <sup>ɿ</sup> ]	glottalized (as in [p <sup>ɿ</sup> ])	[ɯ]	high back (velar) unround glide
[ <sup>ɿ</sup> ]	unreleased (as in [p <sup>ɿ</sup> ])		

<sup>2</sup>An alternative form [p<sup>ɿ</sup>uwaʃoŋ] is possible for this French word. The epenthetic vowel can be the round [u] instead of [ɯ]. The environment for the round vowel is not the following glide, because the round vowel is possible even when there is no glide [w] following it. This [ɯ~u] variation is found in loanwords with the initial consonant clusters whose first consonant is labial: [ptɯraʃa] ~ [puraʃa] ‘brassiere’, [pɯlɛɪndɯ] ~ [pulɛɪndɯ] ‘blind, shade’, [p<sup>h</sup>ɯrogɯræm] ~ [p<sup>h</sup>urogɯræm] ‘program’. Hence, the vowel [ɯ] is to be inserted first in these cases of consonant clusters. Then, if the first consonant is labial, there is a process of rounding the inserted vowel to [u] (perhaps optionally).

not discuss here what plays a role of choosing the proper operation between the two adaptations or how these operations are formulated formally. I highlight, for the present purpose, that there is a conspiracy effect in the two distinct adaptation strategies for consonant clusters disallowed in Korean. The configuration that the two strategies target to change is syllable-initial CG sequences in the original lent words. The result in the borrowed forms is the lack of such configurations. The conspiracy effect is due to the following constraint:

(3) Complex Onset Constraint: Complex onsets are not allowed.



The constraint (3) bans a syllable that has more than one onset segment. It also bans more marked structure with three or more onset consonants. By convention, a more marked configuration in a scale is automatically banned if a less marked configuration is excluded in the same scale. Being a surface constraint in Korean, this constraint marks the initial consonant sequence of the original loanwords in (2) with an asterisk. One of the two repair strategies (labialization/palatalization of the consonant followed by glide deletion; *u*-epenthesis) enters to fix the marked configuration. The result is absence of disallowed CG clusters, the structure found in (3). Lacking such onset consonant clusters, the surface syllable structure conforms to (1)c.

The two adaptations of the original CG clusters show that there is no room for a glide when there is a non-vocalic onset consonant in the syllable onset. Neither of the two structures, (1)a and (1)b, with an independent glide segment is the correct syllable structure regardless of where the glide is linked. If the input glide could be syllabified into either the syllable node (as an onset as in (1)a) or the nucleus node

(as part of complex nucleus as in (1)b), the epenthetic vowel would not be inserted or the input glide should remain as such. Rather, the structure (1)c without a glide is the correct syllable structure reflecting the loanword adaptations.

## 2.2. Lack of CL clusters

Another piece of supporting evidence for the CVC syllable structure comes from the fact that a syllable onset does not allow a sequence of obstruent-plus-liquid (CL) in Korean. In fact, Korean does not allow any consonant clusters in onset positions, except for the alleged CG case.

No native Korean words or Sino-Korean words exhibit a syllable-initial sequence with an obstruent (or any other consonant) followed by either of [r,l]. When Korean borrows words with such a consonant sequence in an onset, the constraint (3) actively draws the repair operation to fix the illicit structure. This point is illustrated in the following loanwords and their adaptation:

### (4) Loanwords with a complex onset of a consonant-plus-liquid sequence

original form	borrowed form	
[pɹɪntər]	[p <sup>h</sup> ʷɪrɪnt <sup>h</sup> ʌ]	‘printer’
[plækɑrd]	[p <sup>h</sup> ʷlæk <sup>h</sup> ɑdʷ]	‘placard’
[bræziər]	[pɹʷɑɹʌ]	‘brassiere’
[blaynd]	[pɹʷlɑɪndʷ]	‘blind, shade’
[kɹiym]	[k <sup>h</sup> ʷɪrɪm]	‘cream’
[klɪnɪk]	[k <sup>h</sup> ʷlɪnɪk <sup>ʷ</sup> ]	‘clinic’
[gɹiys]	[kɹʷɪrɪsʷ]	‘Greece’
[gɹliy]	[kɹʷli]	‘glee’
[trʌk]	[t <sup>h</sup> ʷɹʌk <sup>ʷ</sup> ]	‘truck’
[dɹɪl]	[tɹʷɪl]	‘drill’
[slɪpər]	[stʷlɪp <sup>h</sup> ʌ]	‘slipper’
[fɹiɹ lænsər]	[p <sup>h</sup> ʷɪrɪrænsʌ]	‘free-lancer’
[θɹɪl]	[stʷɪl]	‘thrill’

In the cases of CL clusters, there is only one repair operation, *uu*-insertion, unlike CG clusters.

The absence of CL clusters is a serious problem if a CG sequence as in (1)a is the possible syllable structure. There is an implicational relationship between a CL cluster and a CG cluster in the syllable

onset position. A language with a CG onset also has a CL onset; but not vice versa. This property has been observed by Calabrese (2002), Clements (1990) and van der Hulst (2005), among others. In Korean, there are no syllable-initial CL consonant clusters, as loanwords with such a sequence are subject to vowel epenthesis separating the sequence into two syllables. This means that Korean lacks syllable-initial CG clusters, as well. The structure (1)a, with a bisegmental onset whose second consonant segment can only be a glide but not a liquid, is reverse to the universal implication, and hence cannot be the correct maximal syllable structure in Korean.

It might be argued that the universal implication between CG and CL clusters does not exclude the structure (1)b, where the alleged glide constitutes a part of a branching nucleus as an on-glide. The loanword adaptations for CG sequences show that the GV complex nucleus is not possible in Korean, either. Otherwise, the epenthetic vowel between the consonant and the glide would remain unexplained.

### 3. The High Back Unround Glide [ɰ]

There is a totally unrelated piece of evidence, especially against (1)b with a glide segment in the nucleus in Korean. In addition to [y] and [w], Korean has a third glide, which is often ignored in the literature. This third glide is [ɰ], corresponding to the high back unround vowel [ɯ]. Its distribution provides a strong argument for the structure (1)c.

Peculiarly, this glide appears only before the vowel [i], and not with any other vowel within a syllable. Hence, we find words with the glide [ɰ] and the following [i] in (5).

- (5) Distribution of the glide [ɰ]
- |           |             |
|-----------|-------------|
| [ɰi]      | ‘justice’   |
| [ɰimu]    | ‘duty’      |
| [ɰisa]    | ‘physician’ |
| [ɰigušim] | ‘doubt’     |

Relevant to the present discussion is the fact that a syllable containing the sequence [ɰi] cannot have a

consonant preceding this sequence within the given syllable. Conversely, if a syllable contains a non-vocalic onset consonant and the vowel [i], the glide does not appear between the two segments. In fact, Korean systematically lacks syllables with an initial consonant followed by this peculiar glide and then the vowel [i].

This restriction on the *C<sub>1</sub>yi* sequence in a syllable is well-demonstrated in Sino-Korean words, whose non-initial part has the syllable /tɕi/ and the immediately preceding part ends in a consonant. The majority of the Sino-Korean words are compound words that have more than one word (or morpheme), where each word has one syllable. Those individual monosyllabic words have their own independent meaning and can be combined to form compound words. The restriction on *C<sub>1</sub>yi* is observed in a series of homophonous words with the syllable /tɕi/, when it appears as the second (or the following) part of a compound. When /tɕi/ appears in the first syllable of a compound word, the full form is realized at surface as in (5). However, if this sequence appears in a syllable other than the first one and if the preceding syllable has a coda consonant, the glide is not pronounced as in (6).

(6) Deletion of [tɕ] in the resyllabified C<sub>1</sub>i environment

/ak/ ‘evil’	+ /tɕi/ ‘intention’	[aŋ <sup>y</sup> i] ‘malicious intention’
/hap/ ‘sum’	+ /tɕi/ ‘intention’	[hab <sup>y</sup> i] ‘mutual agreement’
/sim/ ‘deliberation’	+ /tɕi/ ‘justice’	[šim <sup>y</sup> i] ‘deliberation’
/non/ ‘argument’	+ /tɕi/ ‘justice’	[noŋi] ‘conference’
/čil/ ‘quality’	+ /tɕi/ ‘doubt’	[čir <sup>y</sup> i] ‘interrogation’

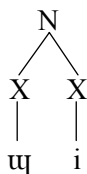
The final consonant of the first syllable is resyllabified as the onset of the following syllable [tɕi] in each case. The resulting structure *C<sub>1</sub>yi* is reduced to *Ci* as shown above. The last form [čir<sup>y</sup>i] clearly shows that the original coda consonant has been resyllabified into the following syllable, as the liquid consonant is realized as rhotic. The rhotic allophone of the single liquid phoneme is found only in the onset position in Korean, while the lateral variant is found in the coda position. Further the resyllabified consonants are palatalized as [noŋi] illustrates clearly. The coronal nasal’s place of articulation is distinguishably palatal at surface, and other resyllabified consonants are palatalized as well. Palatalization of these consonants is

due to the following vowel [i], and shows that the consonant and the vowel are adjacent to each other in the same syllable at the point of application of this palatalization process.

The lack of the *Cui* sequence is a crucial piece of evidence for the syllable structure (1)c. The other structures (1)a and (1)b have a room for the glide between the initial consonant and the peak vowel [i] regardless of the internal hierarchical relationship of the glide segment with respect to the nucleus, rhyme or syllable nodes. If either of (1)a and (1)b is correct, the glide should be able to appear in surface forms.

As pointed out already, the glide [ɥ] occurs only with the vowel [i], as long as there is no other initial consonant in the syllable. This fact leads to the co-occurrence restriction between [ɥ] and [i]. This co-occurrence restriction may well be represented structurally by forming a constituent within a syllable. That is, the on-glide [ɥ] and the peak vowel [i] may form a complex nucleus constituent as in (7), which is part of the structure (1)b.

(7) Conceivable structure for the [ɥi] sequence reflecting the co-occurrence restriction



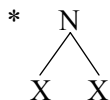
This structural treatment seems to be the most efficient and intuitive way to capture the co-occurrence restriction on the sequence [ɥi].

However, this does not necessarily mean that this structure should be preserved in the surface representation. If the above structure, and hence (1)b, is a legitimate surface structure, it is not clear why the skeletal position is not available for [ɥ] between the onset consonant and the peak vowel. The onset position is separate and independent of the nucleus, complex or simplex, and hence should not interfere with a complex nucleus containing a glide. On the other hand, the structure (1)c has no such problem, because it does not have a position for the alleged glide occupying an independent skeletal position.

Bisegmental complex onsets are disallowed by the Complex Onset Constraint (3).

To ensure that the surface syllables lack a branching nucleus, the following constraint needs to be recognized in Korean.

(8) Branching Nucleus Constraint: Branching nuclei are not allowed.



Due to this constraint, the glide [ɥ] cannot be housed under the nucleus node, even when there is no preceding consonant in the syllable. Rather, it fills the onset position, which would normally be occupied by a single consonant.

When a *Cɥi* sequence arises due to morphological concatenations, the glide [ɥ] deletes as seen in (6). The glide [ɥ], like the other two glides [y] and [w], competes with non-vocalic consonants for the single onset position. When there is a non-vocalic consonant in addition to one of these glides in a single syllable, the consonant takes precedence over the glide when syllabified as the onset of the syllable. The structure (1)c is the appropriate syllable structure reflecting these aspects.

#### 4. Palatal Allophones: Coronal Non-stops and Laryngeal

A few other arguments in favor of the CVC syllable structure come from the distribution of palatal variants of certain non-plosives. This section observes the distribution of those palatal variants of coronal consonants other than (oral) stops (i.e., /s, n, l, r/) and of the laryngeal /h/. It argues that the nucleus vowels following those variants are not complex, i.e., not branching, and that there is no complex onset.

In considering this matter, one needs to look into morphologically complex or derived words (such as conjugated predicate forms of bound stems) and loanwords, because mono-morphemic native words do not contain such relevant sequences as [šʌ, ša, šo, šu, ...]. Note that the palatal variant [š] of /s/ is also

found before the high front [i] and that [ši] can appear in morpheme-internally as in [šigo] (< /si-ko/ ‘be sour-and’) and [taši] (< /tasi/ ‘again’) and across morpheme boundaries as in [oši] (< /os-i/ ‘clothing-NOM.’) and [mašis’ʌ] ‘be delicious-and’ (< /mas-is’-ʌ/ ‘taste-exist-INF.’). The palatalization of /s/ is obligatory before the vowel [i] and the sequence [si] is not a licit surface form.

Consider the following loanwords and loanword adaptations focusing on the coronal consonant and the glide [y] in the original form.

(9) Palatal variants of coronal non-stop consonants in loanwords		
original form	borrowed form	
[syuwpər]	[šup <sup>h</sup> ʌ]	‘supermarket’
[menyuw]	[meɲu]	‘menu’
[vɔlyuwm]	[pɔʌum]	‘volume, loudness’
[ryuwmətɹzm]	[r <sup>y</sup> umat <sup>h</sup> ijum]	‘rheumatism’

The relevant syllable in the original forms of the lent language contains a sequence of one of [s, n, l, r] plus the glide [y] followed by a vowel. The resulting forms in Korean show the palatal variants of these consonants, i.e., [š, ɲ, ʌ, r<sup>y</sup>] conforming to the general palatalization process.

The crucial point is that the resulting forms with the palatal variant of /s, n, l, r/ do not contain the original glide segment [y]. The glide [y] does not constitute an independent segment as part of a branching nucleus as represented in (1)b. The sequence of a palatal variant and the glide [y] followed by a vowel would perfectly fit in the syllable template (1)b, and the absence of this glide is unexpected. Another syllable template (1)a is confronted with the same problem of glide deletion, because this template also has a room for the glide as an independent segment. However, the structure (1)c reflects the fact that there is no glide [y] in resulting borrowed forms, where the relevant property is realized as part of the preceding coronal consonant.

Consider the following conjugated predicates, which exhibit exactly the same points as the cases of loanwords with a coronal consonant plus [y].

(10) Palatal variants of coronal non-stop consonants in conjugations			
stem		gerund /-ko/ ‘and’	infinitive /-Λ/
/tasi-/	‘smack’	[taʃigo]	[taʃΛ]
/tani-/	‘travel’	[taɲigo]	[taɲΛ]
/talli-/	‘run’	[taɭigo]	[taɭΛ]
/tali-/	‘iron’	[tar <sup>y</sup> igo]	[tar <sup>y</sup> Λ]

In the gerund forms, various coronal onset consonants of the second syllable, /s, n, l, r/, become palatal before the stem-final vowel [i]. The infinitive forms also have palatal variants of the coronal consonants, but the stem vowel [i] found in the gerund forms is not present any more. This high front vowel causing palatalization first becomes the corresponding glide [y] in the environment of the suffixal vowel /Λ/ due to hiatus. If (1)b were the correct maximal syllable structure in Korean, the resulting glide would form a complex nucleus along with the following vowel, making an on-glide of the complex nucleus. Likewise, if (1)a were the correct structure, the glide would remain as an independent segment forming a complex onset.

However, this is not what happens in the actual outcome. Instead, we obtain forms with a single (palatal) consonant segment and a single nucleus vowel segment as the infinitive forms shown in (10). The preceding coronal consonant acquires the [+high, –round] property of the glide, which is not present as an independent segment in the actual surface forms. These forms show that the maximal syllable structure is CVC in Korean, which can have up to one onset segment and up to one coda segment along with a simple nucleus.

A very similar situation also supports the inadequacy of the syllable structures (1)a and (1)b for Korean. The relevant examples are shown in the following, where the consonant before the vowel /i/ is a palatal affricate underlyingly.

(11) Palatal consonants not occurring with the glide [y] in conjugations			
stem		gerund /-ko/	infinitive /-Λ/
/či-/	‘lose’	[čigo]	[čΛ]
/č <sup>h</sup> i-/	‘hit’	[č <sup>h</sup> igo]	[č <sup>h</sup> Λ]
/č’i-/	‘steam’	[č’igo]	[č’Λ]

The expected glide [y] resulting from the stem-final /i/ due to hiatus resolution lacks in the infinitive forms, i.e., before the suffix vowel (cf. gerund forms). Again, the fact that the glide [y] is absent between a palatal affricate and a vowel shows that the maximal syllable structure in Korean is neither (1)a nor (1)b, and that a glide cannot constitute a branching nucleus together with a peak vowel.

The allophone [ç] of the laryngeal /h/ shows the same point. The place of articulation of this laryngeal fricative is determined by the following vowel. The palatal allophone is found before the high front vowel [i] as in [çim] < /him/ ‘power’. The palatalization of it is phonetically grounded and the high front vowel is responsible for the palatalization process. Unexpectedly, however, the allophone is also found before some other vowels such as [ʌ, a, u, o], which are not associated with the features responsible for the palatalization process.

(12) The palatal allophone [ç] of /h/ before vowels other than [i]

[çʌ]	‘tongue’
[çʌŋgi]	‘scent’
[ç <sup>w</sup> uʃik <sup>1</sup> ]	‘rest’
[ç <sup>w</sup> omo]	‘yeast’

The same reasoning for the palatal variants of /s, n, l, r/ applies for the laryngeal fricative’s palatal variant before a vowel other than [i]. That is, the segment sequence in the lexical representation would be CGV (in this case /hy/ plus one of /ʌ, a, u, o/).<sup>3</sup> The glide turns the laryngeal into palatal and is subsequently deleted. Again, the result is lacking the glide in the context of C\_V in a syllable.

The alleged glide [y] does not occur between a palatal or palatalized consonant ([š, ɲ, ʎ, r<sup>y</sup>, č, č<sup>h</sup>, č’, ç]) and a vowel in phonetic representations of the above-mentioned forms. From a phonetic point of view, having the glide [y] after these palatalized consonants is much more natural and transparent. The reason

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<sup>3</sup>Because of a restriction on sequencing phonemes in the lexical representation, other vowels (i.e., /i, e, æ, ü, ö/) cannot be put together with the preceding glide [y] if there is a further consonant before the glide. This can be understood as an OCP effect on the co-occurrence of a glide and a vowel (in the presence of a preceding consonant), because all of these vowels are front. The vowel /tu/ cannot be preceded by any glide at all (in Standard Korean), when it occupies a nucleus position. This co-occurrence pattern explains why the palatal variant [ç] does not appear before vowels other than [ʌ, a, u, o] and [i], the last of which by itself causes palatalization of /h/.

why the glide is not present in the phonetic representation despite the opaque environment for the palatalized consonants is the simple syllable structure (1)c which lacks a position for a glide. The core property of the vocoid, i.e., [+high, –back], survives in the glideless syllable, not in an independent glide segment but as part of the palatalized consonant which linearly precedes the glide at some point of phonological derivation. The consonant is palatalized by virtue of this high front vocoid, before the vocoid deletes due to the restrictions on the syllable structure.

All the data discussed in this section provides arguments against two views on the Korean syllable structure, (1)a,b, which recognize the position for a glide as an independent segment in a maximal syllable. Instead, the CVC structure is consistent with the data in this section.

### 5. Optionality of Hiatus Resolution to Avoid a CGV Sequence

There is an interesting variation in conjugated forms which supports the syllable structure (1)c. The variation is found in stems that end in one of [i, u, o] and have an onset consonant before this vowel. These stems are contrasted to stems that end in the same vowel but do not have an onset consonant.

Let us first consider stems ending [i, u, o] without a preceding onset consonant. In the following set of verbal forms, the stem-final vowel becomes the corresponding glide (/i/ → [y]; /u,o/ → [w]) before a suffix-initial vowel (/ʌ/).

(13) Stem		infinitive /-ʌ/	imperative /-ʌla/	causal /-ʌsʌ/
/i-/	‘thatch’	[yʌ]	[yʌra]	[yʌsʌ]
/moi-/	‘gather’	[moyʌ]	[moyʌra]	[moyʌsʌ]
/u-/	‘float’ (arch.)	[wʌ]	[wʌra]	[wʌsʌ]
/meu-/	‘fill up’	[mewʌ]	[mewʌra]	[mewʌsʌ]
/t’æu-/	‘patch’	[t’æwʌ]	[t’æwʌra]	[t’æwʌsʌ]
/s’au-/	‘fight’	[s’awʌ]	[s’awʌra]	[s’awʌsʌ]
/o-/	‘come’	[wa]	[wara]	[wasʌ]
/t’ao-/	‘quote’	[t’awa]	[t’awara]	[t’awasʌ]

No matter how this phenomenon of glide formation is expressed formally, it is important to recognize that

this operation is obligatory. This obligatoriness is due to the hiatus constraint, which disfavors two consecutive nucleus positions. Without a non-nucleus segment between the two nuclei, the hiatus configuration is subject to some repair operation. In these cases, the preceding vowels become the corresponding glide in the obligatory glide formation repair process. The resulting glide is resyllabified into the onset of the syllable where the infinitive suffix vowel [ʌ] becomes the nucleus of the syllable.

Contrary to the glide formation of [i, u, o], the stem vowel /ü/ does not show any hiatus-driven glide formation before the suffix vowel /ʌ/ at all. Consider the following stems and conjugations containing the vowel /ü/. The underlying vowel /ü/ or the derived vowel [i] does not become a glide:

(14)	Stems with no glide formation before the suffix vowel /ʌ/			
	stem	infinitive /-ʌ/	imperative /-ʌla/	causal /-ʌsʌ/
	/yʌü-/ ‘get lean’	[yʌwiʌ]	[yʌwiʌra]	[yʌwiʌsʌ]
	/saü-/ ‘burn up’	[sawiʌ]	[sawiʌra]	[sawiʌsʌ]

The sequence [wi] derived from /ü/ by splitting this marked vowel<sup>4</sup> already constitutes a desirable CV sequence. (See Chung 2007 for more details of why the hiatus-driven glide formation of the final [i] of [wi] resulting from /ü/ is blocked before the suffix vowel /ʌ/.)

The common property in (13) with /i, u, o/ and in (14) with /ü/ is that the relevant syllable does not contain a non-vocalic onset consonant underlyingly and that the surface syllable invariably contains a glide onset. The stem vowels in (13) do not have a consonant, and the vowels devocalize to the corresponding glides due to the hiatus constraint to form a stable CV syllable along with the suffix vowel. In (14), the stem vowel /ü/ yields the [wi] syllable by itself due to the split operation. The vowel [i] of the resulting [wi.ʌ] does not undergo the hiatus-driven glide formation. Consequently, [wi.ʌ] unambiguously surfaces as such in the phonetic representation. The surface forms are constant in both cases, (13) and (14), and they are in contrast with the stems that have an onset consonant in the relevant syllable

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<sup>4</sup>See Calabrese (1995, 2002) regarding the split operations (called ‘fissions’) of marked segments such as [ü]. Depending on one’s phonological analysis, the underlying form of this vowel form might be considered as /wi/. See Chung (2007) for treating /ü/ as the underlying form.

underlyingly.

As shown in the conjugated forms below, there is a certain amount of variation if the stem's (final) syllable has a non-vocalic onset consonant.

(15) Stems showing “optional” glide formation: Variations with an onset consonant

stem	infinitive /-Λ/	imperative /-Λla/	causal /-ΛsΛ/
/ki-/ ‘crawl’	[kiΛ] ~ [kʲΛ]	[kiΛra] ~ [kʲΛra]	[kiΛsΛ] ~ [kʲΛsΛ]
/titi-/ ‘step on’	[tidiΛ] ~ [tidʲΛ]	[tidiΛra] ~ [tidʲΛra]	[tidiΛsΛ] ~ [tidʲΛsΛ]
/yΛmi-/ ‘adjust’	[yΛmiΛ] ~ [yΛmʲΛ]	[yΛmiΛra] ~ [yΛmʲΛra]	[yΛmiΛsΛ] ~ [yΛmʲΛsΛ]
/si-/ ‘sour’	[šiΛ] ~ [šΛ]	[šiΛra] ~ [šΛra]	[šiΛsΛ] ~ [šΛsΛ]
/tu-/ ‘put’	[tuΛ] ~ [tʷΛ]	[tuΛra] ~ [tʷΛra]	[tuΛsΛ] ~ [tʷΛsΛ]
/kʷu-/ ‘lend’	[kʷuΛ] ~ [kʷʷΛ]	[kʷuΛra] ~ [kʷʷΛra]	[kʷuΛsΛ] ~ [kʷʷΛsΛ]
/sʷu-/ ‘boil (gruel)’	[sʷuΛ] ~ [sʷʷΛ]	[sʷuΛra] ~ [sʷʷΛra]	[sʷuΛsΛ] ~ [sʷʷΛsΛ]
/po-/ ‘see’	[poa] ~ [pʷa]	[poara] ~ [pʷara]	[poasΛ] ~ [pʷasΛ]
/ko-/ ‘boil down’	[koa] ~ [kʷa]	[koara] ~ [kʷara]	[koasΛ] ~ [kʷasΛ]
/sʷo-/ ‘shoot’	[sʷoa] ~ [sʷʷa]	[sʷoara] ~ [sʷʷara]	[sʷoasΛ] ~ [sʷʷasΛ]

The alternating forms in (15) have sometimes been said to be in free variation in the literature (Y.-S. Kim 1984, Y.-S. Lee 1996, among others). This is not correct. The variation depends on register, or style of speech (Y.-S. Kim 2000). The forms with the stem vowel retained are the preferred and desired forms in formal and careful style, while the “contracted” forms with fewer syllables are used in colloquial and fast style. The formal style retains the stem vowel in the surface forms not exhibiting the glide formation operation observed in (13), while the colloquial forms do not have the stem vowel or the corresponding glide. Instead, the corresponding secondary articulation properties are realized on the preceding onset consonant.

The environment for the variation is the underlying non-vocalic onset consonant. In the cases where there is no such consonant as in (13) and (14), the glide (derived from either /i, u, o/ or the [w] part of /ü/ in the stem) occupies the onset position. In this case, the syllabification of the glide into the onset position is stable and there is no variation in glide formation regardless of registers. On the contrary, an additional consonant prevents the glide at issue from occupying the onset as in (15). Due to the hiatus constraint, the stem vowel is first devocalized just like predicates in (13). However, the resulting glide cannot be housed

in an appropriate skeletal position in a syllable, neither as a part of complex onset nor as a part of a branching nucleus. Consequently, the casual style deletes the unsyllabified glide resulting from devocalization of the stem vowel, while the formal style invalidates the glide formation operation motivated by hiatus.<sup>5</sup>

The formal style supports the CVC syllable structure. If CGV is the correct maximal segment sequence in a syllable (either (1)a or (1)b), it is not clear why the input sequence of CV+V does not become a CGV sequence. As examples in (15) show, the otherwise expected glide formation of the stem-final vowel /i, u, o/ due to hiatus (as found in (13)) does not operate in the formal register when there is an additional consonant. The blocking of glide formation with an additional onset consonant is not explained with the segment sequence CGV within a single syllable.

The stem vowels /i, u, o/ do not surface as an independent segment (as a peak vowel or a glide) in the casual forms in (15), either. These vowels are rather realized as the corresponding secondary articulation properties on the preceding consonants. Chung (2007) analyzes the entire phenomena as a series of phonological operations: glide formation due to hiatus; secondary articulation process (palatalization/labialization); glide deletion. The glide deletion process is due to the Complex Onset Constraint (3) and the Branching Nucleus Constraint (8), and would not be driven if a glide position were available as in (1)a or (1)b.

More interestingly, both styles share the property of not having a complex onset or a branching nucleus in surface forms. That is, there is no glide in a syllable with an additional non-vocalic onset consonant. In both registers, the Complex Onset Constraint and the Branching Nucleus Constraint are always satisfied in Korean. This common property is compatible only with the structure (1)c. The “optional” operation of hiatus resolution (glide formation) shows that the correct maximal syllable

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<sup>5</sup>This invalidation of glide formation in the formal style suggests that hiatus resolution be a non-surface constraint in a derivational phonological model (see Calabrese 2002, Chung 2007), or be ranked lower than a faithfulness constraint in the sense of optimality theory.

structure in Korean is (1)c. There can be only one consonant position per onset and per coda in a syllable and there is no complex nucleus.

## 6. An Acoustic Study of the Claimed CGV Sequences

This section examines spectrograms of some syllables in Korean with a palatalized or labialized onset consonant (or a consonant with both secondary articulation properties in the two different orders), that is, syllables which are often claimed to contain a CGV sequence. Such syllables in Korean are compared with syllables with a genuine CGV sequence in English on the one hand and with other types of syllables in Korean on the other hand. The study of spectrograms within the language and across languages illustrates that surface syllables in Korean do not contain a glide along with a non-vocalic onset consonant.

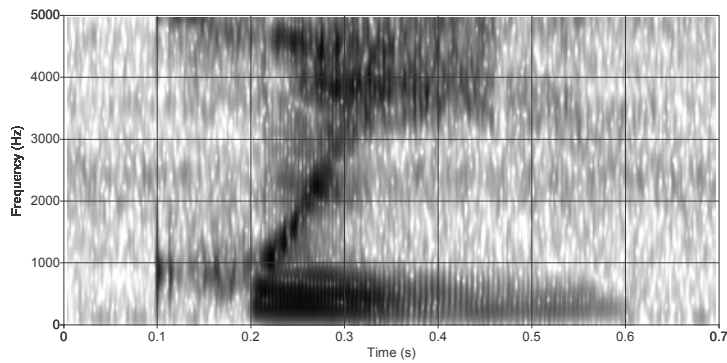
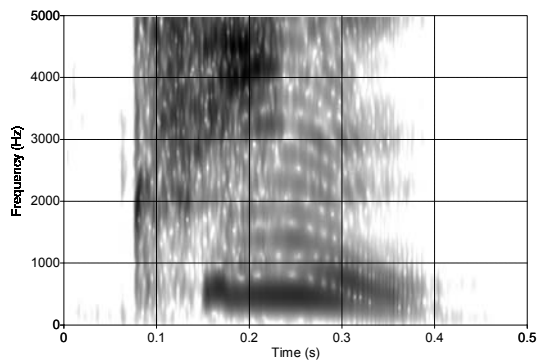
All of the speech samples are uttered by a seven-year-old female.<sup>6</sup> She is a native speaker of both (Northeastern) American English and (Standard) Korean. A single bilingual speaker of both languages has been chosen in order to ensure that the differences regarding the glide at issue in the two languages are indeed language differences rather than speaker differences.

First, the two monosyllabic Korean words *khwin* [k<sup>hw</sup>in] and *khywu* [k<sup>hy</sup>u] are compared with the two comparable English words *queen* [k<sup>h</sup>wiyn] and *cue* [k<sup>h</sup>yuw], respectively, from which the Korean words are derived through loanword adaptation. *Khwin* and *khywu* are the standard Romanization, i.e., Yale Romanization, of [k<sup>hw</sup>in] and [k<sup>hy</sup>u],<sup>7</sup> respectively. The first two spectrograms are the pair of the English word *queen* and its adapted form *khwin* [k<sup>hw</sup>in] ‘queen (playing cards)’ in Korean.

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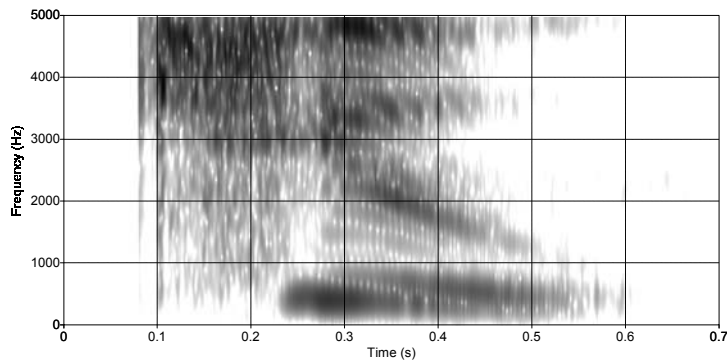
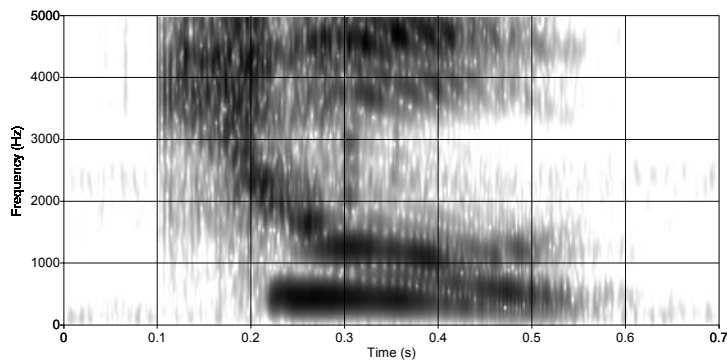
<sup>6</sup>All the speech samples have been recorded digitally to .wav files (monaural, 22050 Hz of sampling frequency, 16 bits per sample) on a PC with a Microsoft Windows operating system, and converted to spectrograms using *Praat* version 4.4.05 (by Paul Boersma and David Weenink; available on the web at <http://www.praat.org>).

<sup>7</sup>In Yale Romanization, certain single Korean characters are transliterated as a sequence of two Roman characters. The vowel [u] is one such case, which is transliterated as *wu*, while the transliteration *u* is used for the unround vowel [ʉ]. In the paper, Roman transliterations and phonetic symbols are used interchangeably for Korean forms.

(16) Spectrogram of the English word *queen* [k<sup>h</sup>wiyn](17) Spectrogram of the Korean word *khwin* [k<sup>hw</sup>in]

The presence of F1 far below the 1000 Hz range indicates sonorant segments including (the prenuclear glide in *queen*,) the vowel parts and the postnuclear nasal. In both *queen* in English and *khwin* in Korean, the initial consonant shows a very short falling transition after the burst. The falling transition is a general characteristic that the location of a velar stop's burst is always higher than the following vocoid, in this case [w] whose F2 is quite low. Afterwards, the rising transition targets the high F2 (over 3000 Hz) which is the property of the high front vocoid, the vowel [i] or the glide [y].

The following two spectrograms are from the English word *cue* and the corresponding loanword *khywu* [k<sup>hy</sup>u] 'billiard cue' in Korean.

(18) Spectrogram of the English word *cue* [k<sup>h</sup>yuw](19) Spectrogram of the Korean word *khywu* [k<sup>hy</sup>u]

In this case, the F1 of the vocoid parts are low as these vocoids are high vowels and glides. The F2 transitions in the range between 1000 Hz and 4000 Hz show the same falling pattern in both the English and the Korean cases: falling from somewhere between 3000 Hz and 4000 Hz to somewhere between 1000 Hz and 1500 Hz.

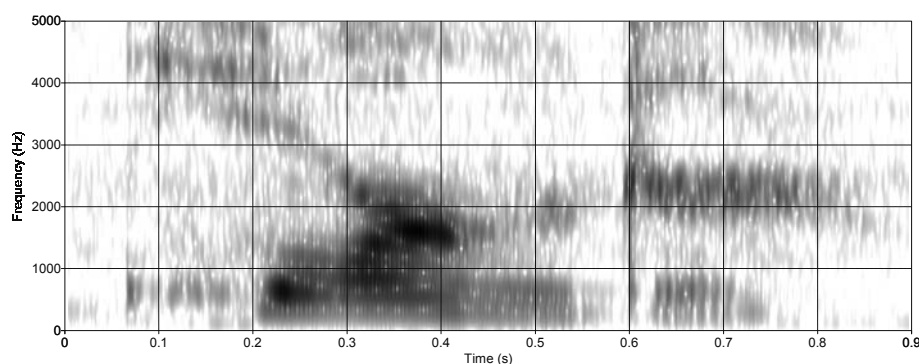
The first difference between English and Korean in each pair is that the rising ([w] to [i] in the first pair) and the falling ([y] to [u] in the second) transitions are quite longer in English than in Korean. This difference of transition times supports the absence of the claimed glides in Korean.

More importantly, however, the (a)synchronism of the F1 initiations and the F2 transitions reveals that Korean does not have a glide in the C\_V context in a syllable. In *queen* and *cue*, the F2 transition starts only after the F1 initiates, i.e., after the (sonorant) vocoid part starts to be pronounced. Hence, the glide starts at the starting point of the F1 along with the subsequent vowel. In the case of *queen*, the rising

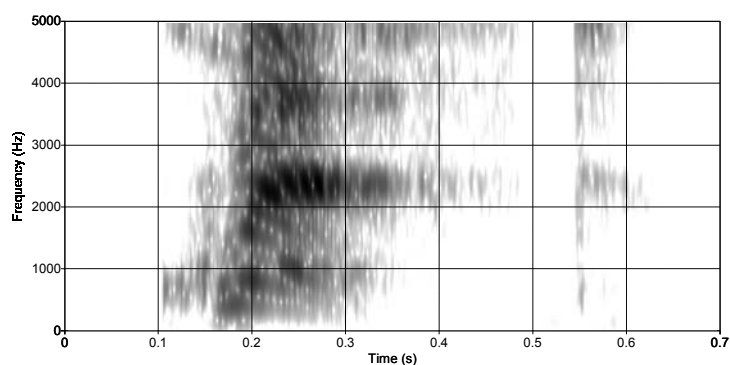
transition to [iy] starts right after the beginning of the vowel and continues for a little longer than 100 ms. The glide in *cue* has much longer time duration with additional stable F2 for a little less than 100 ms before the falling transition.

The following spectrograms of the English words *quarter* and *quest* show the same point.

(20) Spectrogram of the English word *quarter* [k<sup>h</sup>wɔ̃tə̃]



(21) Spectrogram of the English word *quest* [k<sup>h</sup>wɛst]



Even though the two words are uttered in quite different rates, the F2 transition in both cases starts only after the beginning of the entire vocoid part, i.e., after the consonant part. Hence, the above English syllables show that they have an isolable glide as an independent segment between an onset consonant and a nucleus vowel. When the secondary articulation effect on the consonant due to the glide is taken into consideration, narrower phonetic transcriptions for *queen* and *cue* would be [k<sup>hw</sup>wiyn] and [k<sup>hy</sup>yuw].

However, Korean shows a different pattern. In both [k<sup>hw</sup>iŋ] and [k<sup>hy</sup>u], the F2 transition already

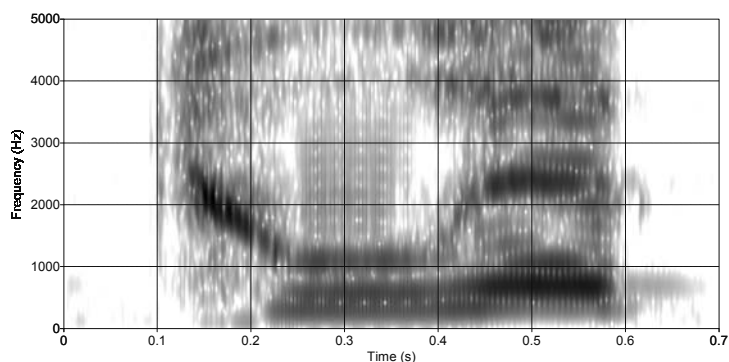
starts before the following vowel's F1 appears. The transition starts from around 2000 Hz immediately after the consonant burst in [k<sup>hw</sup>in], and reaches higher than 3000 Hz when the following vowel's F1 starts. The transition is almost completed, when the vowel [i] starts along with its F1. In [k<sup>hy</sup>u], the transition begins approximately 50 ms. after the stop burst and reaches the 2000 Hz range when the vowel's F1 starts. In other words, the F2 transition is within the consonant segment, rather than it follows the consonant. The F2 transitions are totally different from those in English. In English, the F2 transition occurs in the vocoid part from [y] to [u] in *cue* or from [w] to [i] in *queen*, i.e., after the consonant. The consonant does not have any transition other than the short initial burst, and the consonant's formant is constant after the initial burst.

At the end of the stop [k<sup>h</sup>] in [k<sup>hy</sup>u] in Korean, the consonant is already labialized when the consonant is still in its frication phase. The labialization would be unexplained, if the glide [y] as an independent segment intervened between the consonant and the round vowel [u]. If [y] were present between [k<sup>h</sup>] and [u], it would separate the segments linearly, and the separated round vowel should not be able to influence the consonant in terms of labializing it. Rather, the labialization effect at the end of the (already palatalized) consonant shows that the round vowel immediately follows the consonant and that there is no independent glide segment [y] between the consonant and the vowel. Likewise, the consonant in [k<sup>hw</sup>in] (labialized at the beginning) is palatalized at the end of it, when the articulation of the stop has not been completed. The (second) formant of the consonant [k<sup>hw</sup>] reaches almost the 3000 Hz range at the end effectively making the already labialized consonant palatalized just before the vowel starts. The following vowel is [i] with the F2 ranging between 3000 Hz and 3500 Hz. Again, the additional palatalization, i.e., the rising transition of the formant within the consonant, shows that there is no glide [w] that would intervene between the consonant and the vowel.

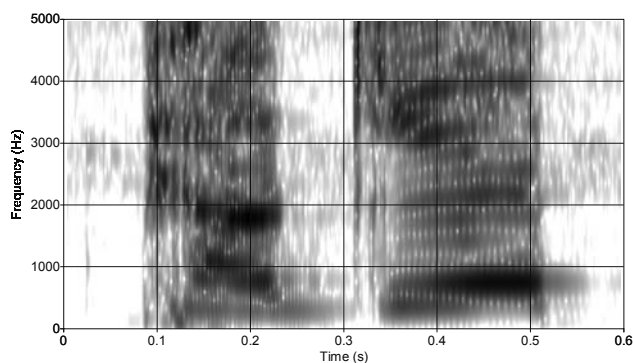
The labialized consonant further becomes palatalized toward the end of it in [k<sup>hw</sup>in] due to the following front high vowel [i]. Likewise, the palatalized consonant becomes labialized in [k<sup>hy</sup>u] due to the

following round vowel [u]. Thus, more detailed phonetic transcriptions for [k<sup>hw</sup>in] and [k<sup>hy</sup>u] would be [k<sup>hwy</sup>in] and [k<sup>hyw</sup>u], respectively. Such radical F2 transitions within the consonant are observed in other syllables that contain a nucleus vowel other than [u] or [i], as shown below. Observe the following spectrograms focusing on the initial consonant with a formant transition within it before the vowel's F1.

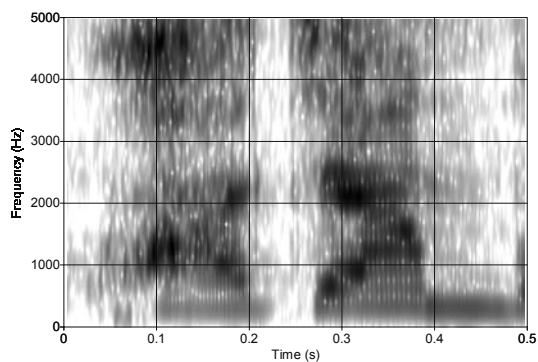
(22) Spectrogram of the Korean word *kyohoy* [k<sup>y</sup>oh<sup>w</sup>e] ‘church’



(23) Spectrogram of the Korean word *pyekey* [p<sup>y</sup>ʌge] ‘wall-LOCATIVE’ (< /pyʌk + e/)



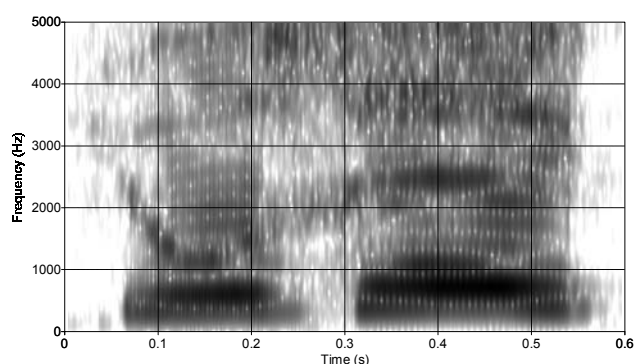
(24) Spectrogram of the Korean word *kwaja* [k<sup>w</sup>aʝa] ‘cookie’



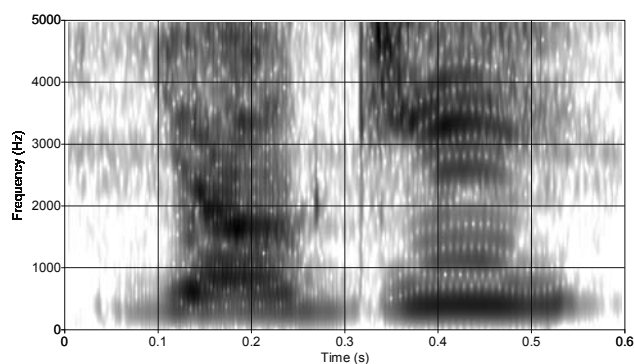
The falling or rising formant transitions in the above syllables range relatively smaller vertical spans than the cases of [k<sup>hyw</sup>u] and [k<sup>hwy</sup>in]. However, the initial consonant has the transition before the nucleus vowel starts in all cases and the transition is almost completed when the vowel starts. Hence, the difference of transition locations relative to the beginning point of the vocoid in the two languages reveals the status of the glide in Korean.

In addition to the cross-linguistic differences of the formant transition locations, a comparison between syllables containing a consonant with a relevant secondary articulation property and syllables containing a genuine glide but not such a consonant in Korean also shows that there is no surface glide in the C\_V context. Compare the initial consonants in (22)-(24) to the initial glide segments [y] or [w] without a consonant in the following spectrograms.

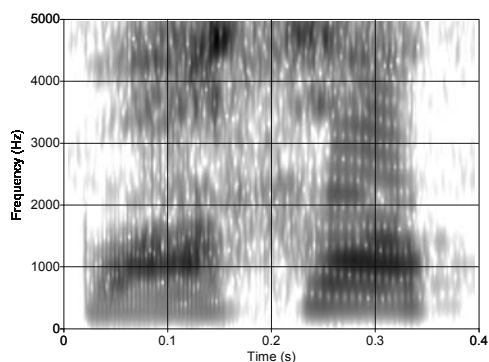
(25) Spectrogram of the Korean word *yosay* [yosɛ] ‘recently’



(26) Spectrogram of the Korean word *yeki* [yɛgi] ‘here’



(27) Spectrogram of the Korean word *wase* [wasΛ] ‘come-CAUSAL’ (</o + ΛsΛ/)



In each case, the glide part has both F1 and F2, distinct from those of the following peak vowel. Both formants show a visible transition to the following vowel after the onset of the glide in each case. However, no such (vertically) separable glide segments observed in spectrograms in (25)-(27) are found in the spectrograms in (22)-(24). As discussed above, the only properties related to the glides, i.e., palatality, labiality or both, are superimposed on the consonant as part of it.

At the level of phonetic representation, there is no glide in the C\_V context. The glide which has once existed at a deeper phonological level survives as a secondary articulation effect superimposed on the consonant. The abstract glide deletes, after labialising or palatalizing the preceding consonant, due to the Complex Onset Constraint (3) and the Branching Nucleus Constraint (8). Formant transitions within the consonant segments show the consonant's acquisition of such a secondary articulation property. Spectrograms show that there is no identifiable glide segment in the C\_V context. If, in this resulting syllable (after glide deletion), the subsequent peak vowel carries the other secondary articulation, i.e., if the resulting sequence is one of C<sup>w</sup>i, C<sup>y</sup>u, and C<sup>y</sup>o, then the consonant further acquires this other secondary articulation effect from the following vowel. The additional secondary articulation of the consonant is reflected in the formant transitions within the consonant as illustrated in the spectrograms in (17), (19) and (22)-(24). The study with spectrograms in this section provides evidence that Korean has no glide in a C\_V environment.

## 7. The Phonological Reality of the Glide and its Vestige in the Phonetic Forms

As argued repeatedly, my claim is that there is no glide as an independent segment in a surface syllable that has an additional onset consonant. Instead, the relevant properties of such alleged glides are incorporated into the preceding non-vocalic onset consonant as the secondary articulation features. This section briefly considers possible factors that confuse language users and linguists regarding the status of the alleged glide. It also considers the phonological reality of such glides and the phonetic correlates.

One major reason for (wrongly) identifying a glide in the C\_V context may be orthography. First of all, non-vocalic onset consonants are written consistently regardless of whether they are palatalized or labialized by the following vocoid or not. For example, the palatalized allophone [š] before the vowel [i] and the non-palatalized [s] before other vowels are put with the same letter. Likewise, the same consonant letter is used for the labialized [k<sup>hw</sup>] before [u] or [o] and the non-labialized [k<sup>h</sup>] before other vowels. The main reason for the use of the same symbol is that the allophonic differences on the consonant part are not distinctive but predictable. The following vowel is responsible for palatalization and labialization of the consonant.

For the alleged CGV sequences, an additional symbol is used on the vowel part. In the cases of the “CyV” sequences, the glide part is represented as an additional stroke (or line) on the vowel symbol. The additional stroke is used also for the genuine glide in a syllable without a non-vocalic consonant. For the “CwV” cases, an additional vowel character is added between the non-vocalic consonant and the peak vowel. The glide characters used for the alleged CwV sequences are the same as the characters for the vowels [u, o] which are used as sole vocalic segments in CVC syllables and as the characters for the corresponding glide [w] in a syllable without a non-vocalic consonant. The additional stroke (for palatality or [y]) and the vowel/glide symbol (for labiality or [w]) are for palatalization and labialization, respectively, of the preceding consonant. Crucially, those glide symbols are not realized as a real glide in the phonetic forms. They are better understood as diacritics for the preceding onset consonant as far as

surface forms are concerned.

The identical symbols for the glide properties of the onset consonants are used in the cases without a non-vocalic onset consonant. When there is no additional consonant, those symbols represent genuine glides. The confusion seems to arise here. Because the symbols for the genuine glides are used for the secondary articulation properties of the additional, non-vocalic onset consonant, this double use seems to induce the confusion and to get the secondary articulation “diacritics” treated as independent segments in the C\_V contexts. As advanced in previous sections, however, the conceived glides denote secondary articulation properties in surface phonetic representations and do not have a status of an independent segment.

Treating the glide symbols as independent segments is not totally exorbitant. In fact, this treatment and the orthography reflect native speakers’ intuition on the phonetic palatality and labiality properties of the onset consonants. They are actual glides at a deeper level of phonological representation. For example, the loanwords in (2) contain a glide in the input forms, which are repaired to conform to the surface constraints and requirements. This glide incurs palatalization or labialization of the preceding consonant. If there is no glide the preceding consonant is not palatalized before a vowel other than [i] or labialized before an unround vowel. As shown below, the initial stops in the borrowed forms are not palatalized when there is no [y] in the original forms of the lending language.

(28) No palatalization of a consonant before a vowel other than [i] in loanwords

original form	borrowed form		
[pɛst]	[p <sup>h</sup> ɛsʊt <sup>h</sup> ʊ]	*[p <sup>hy</sup> ɛsʊt <sup>h</sup> ʊ]	‘pest’
[tɛst]	[t <sup>h</sup> ɛsʊt <sup>h</sup> ʊ]	*[t <sup>hy</sup> ɛsʊt <sup>h</sup> ʊ]	‘test’
[sɛksɪ]	[sɛk <sup>ʰ</sup> s’i]	*[s <sup>y</sup> ɛk <sup>ʰ</sup> s’i], *[ʃɛk <sup>ʰ</sup> s’i]	‘sexy’
[kæstɪŋ]	[k <sup>h</sup> æstʊt <sup>h</sup> iŋ]	*[k <sup>hy</sup> æstʊt <sup>h</sup> iŋ]	‘casting (of characters)’
[hæpɪŋɪŋ]	[hæptʊniŋ]	*[h <sup>y</sup> æptʊniŋ], *[çæptʊniŋ]	‘happening’

The surface secondary articulation properties are a reflection of the reality of glides at a deeper level, i.e., phonologically.

Likewise, the infinitive forms of those predicates in (10), (11) and (15) have a stem-final vowel, i.e., one of /i, u, o/, before the suffix vowel /Λ/. Even though the stem vowel is not retained in the casual style, it survives in the formal style. In addition, the same vowel always surfaces in other forms with a consonant-initial suffix such as gerund forms in (10) and (11). In the casual forms of infinitives, the vowel is represented with a glide symbol. This suggests that the stem-final vowel is actually considered as a derived glide resulting from the hiatus configuration. The devocalized vowel in the casual infinitive forms is phonologically real at a deeper level of representation.

The writing system reflects the glidehood (and the devocalization process) of the underlying stem vowels in the (casual) infinitive forms in (10), (11) and (15). The Korean writing system is basically alphabetic, but consonant and vowel symbols are combined to form syllable blocks. Each syllable block has an onset consonant symbol, a vowel symbol and an optional coda consonant symbol. As mentioned earlier, when a syllable has a glide, a line on the vowel symbol (for palatality) or a vowel symbol (for labiality) is added. The casual infinitives form of /ki-Λ/, for example, is written in a single syllable with the additional line for the glide part on the vowel symbol. The use of the “glide symbol” and the single syllable block (with two underlying vowels) indicate that the stem vowel is not a nucleus vowel any more in the casual infinitive form, but a devocalized glide. In other words, the double use of the glide symbol in orthography mentioned earlier in this section reflects native speakers’ knowledge on the phonological reality of the glide.

Spectrograms, too, support the presence of an abstract glide. As illustrated in the previous section regarding the spectrograms, the initial stops in *khwin* [k<sup>hwy</sup>in] (17) and *khywu* [k<sup>hyw</sup>u] (19) contain two secondary articulation properties: the stop in [k<sup>hwy</sup>in] contains labiality and then palatality, and the stop in [k<sup>hyw</sup>u] contains palatality and then labiality. In each case, the second of the two secondary articulation effects is due to the peak vowel that immediately follows the consonant in the phonetic forms. The first secondary articulation effect reflects the reality of the corresponding glide (i.e., [w] for the labiality and

[y] for the palatality) at a deeper level, even though the responsible glide is not present in the phonetic forms as an independent segment.

I argue that the glide at issue has been present between an initial consonant and a vowel at an earlier stage of derivation either lexically or as a result of a glide formation process, and that it later deletes in the derivation due to constraints such as the Complex Onset Constraint (3) and the Branching Nucleus Constraint (8). The surface forms do have a vestige of the glide, i.e., a secondary articulation property on the preceding consonant. This phonetic cue reflects the psychological and phonological status of the glides and may lead native speakers to the recognition of independent segments for the glides on the surface.

There are cases where such a phonologically independent glide is realized as its core property, in the surface forms, added to another segment instead of being realized as a separate segment. Native speakers would still recognize the property of the glide added to the non-vocalic consonant. The nasality of vowels in English is a parallel case. Nasal vowels in English are predictable. If there is a nasal consonant following a vowel, the vowel becomes nasal phonetically, and if not the vowel remains oral. Some dialects of English drop the nasal consonant before a voiceless consonant. The nasal drops after vowel nasalization. Consequently, the phonetic difference between words such as *set* and *sent* is the nasality of the vowel as in [set] and [sẽt], while the phonological contrast is absence vs. presence of the nasal consonant as in /set/ and /sent/. The nasality of the vowel is not contrastive or distinctive phonologically, and the phonetic difference between the oral and nasal vowels is not recognized as such, but as absence vs. presence of the responsible nasal consonant. That is, native speakers regard the nasal property of the vowel in [sẽt] as a phonologically independent segment /n/, not as a property discerning the nasal and oral vowels.

The abstract glides and the palatal and labial properties on the consonants in Korean have the same status. The glide segments at a deeper level are materialized as corresponding secondary articulations on

the preceding consonant. The acoustic phonetic properties on the consonant (for palatality and labiality) as shown in the spectrograms (17), (19) and (22)-(24) are reconstructed as the respective phonological segments. This aspect represented in orthography reflects native speakers' phonological knowledge. This knowledge and orthography, however, do not show that surface forms necessarily have a glide as an independent segment. The surface phonetic forms do not contain individual glides in the C\_V context, but the non-vocalic onset consonant carries the relevant core properties of these glides. When a CGV string arises either from loanwords or from morphological concatenations, the glide palatalizes or labializes the preceding consonant. Subsequently, the glide deletes due to the Complex Onset Constraint (3).

## 8. Conclusion

This paper has examined the syllable structure in Korean. A wide range of phenomena indicates that a surface syllable contains a maximum of the CVC sequence as in (1)c. It has three syllabic components: optional onset, obligatory nucleus and optional coda. Each of these components can have only one segment. There is no complex onset, and no branching nucleus. The glides, whose presence is supported underlyingly by certain conjugated forms of predicates, loanwords and a co-occurrence restriction, do not appear in the phonetic representations, when there is an onset consonant in the syllable. This non-occurrence of the intervening glide is due to the two constraints: the Complex Onset Constraint (3) and the Branching Nucleus Constraint (8).

The study of spectrograms for such syllables which are often claimed to have a CGV sequence show that these syllables do not contain a glide as a separate segment, but that the relevant property of the glide is incorporated into the consonant. The spectrograms also reflect the phonological constraints (such as Complex Onset Constraint and Branching Nucleus Constraint) and the related phonological process (such as glide deletion). Orthography, which could be an obstacle to identifying the accurate phonetic forms, reflects native speakers' knowledge of the glides at a deeper phonological level. The conclusion

drawn in this study for Korean conforms to the universal implication between CL and CG sequences: a language with CG onsets allows CL onsets, but not vice versa.

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