

Glides as Consonants in Korean*

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This paper is to examine the underlying representation and the structural status of glides in Korean, focusing on the syllable-structure status of on-glides in the onset position. Supporting the two hypotheses : Onset Hypothesis and Coda Hypothesis, in this paper, it has been argued that : (1) Korean glides are orthographically like vowels but phonologically and phonetically like consonants in the phonetic representation; (2) in Korean syllable structure, onset and nucleus form a constituent (X), and a single glide before a vowel is like a consonant in the onset, and on-glides preceded by a consonant are part of the onset based on articulatory and acoustic evidence as well as evidence from glide formation and insertion, language games, phonotactic constraints, partial reduplication, and vowel harmony; (3) a consonant + glide sequence is treated as a consonant cluster, deleted or being simplified in casual speech; (4) a vowel + glide sequence /ij/ acts like nucleus plus coda in Korean because consonant clusters are not allowed in the coda on the surface, thus the off-glide cannot be followed by any tautosyllabic consonants in the coda position. Therefore, Korean glides in the underlying representation may be vowels. In the course of derivation, however, the glides are like consonants in the phonetic representation in that glides cannot occur in the nucleus of the syllables, and they do not maintain steady states acoustically. In addition, in the articulation of glides, they are produced with a construction that is greater than the corresponding vowels.

Key words : on-glides, off-glides, syllable structure, Onset Hypothesis, Korean

1. Introduction

It has generally been accepted that the glides /j/ and /w/ are called semi-vowels or semi-consonants because sometimes they function like the

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vowels /i/ and /u/ and at other times they act more like consonants.¹⁾ In theories of phonology, glides and diphthongs have been problematic entities. This is the case in Korean. Traditionally, glides in Korean have been treated as vowels under the influence of the Korean orthographic system. It indicates that on-glides as well as the off-glide have been considered to be structurally a part of the nucleus based on traditional analysis (Y.-K. Kim-Renaud, 1974; H.-S. Sohn, 1987; C.-W. Kim & H.-Y. Kim, 1991). There are, however, current studies claiming that they should be analyzed as forming a cluster with a consonant in the onset position (B.-G. Lee, 1982; C.-K. Gim, 1987; S.-C. Ahn, 1989; C.-H. Kim, 1990; Y.-S. Lee, 1994). For more details, see the following sections 3.1 and 3.2.

The central questions addressed in this paper are : (1) Are all the glides in phonology either underlying vowels or underlying consonants? (2) Do on-glides belong to the onset or the nucleus of the syllable on the surface in Korean? In other words, what is the syllable-structure status of on-glides in CGV (i.e., in post-consonantal position) and in GV (i.e., in syllable-initial position) sequences? (3) How are glides treated from articulatory and acoustic points of view? (4) What is the syllable structure status of the off-glide in a VG sequence like /ij/? I distinguish three kinds of tautosyllabic vocalic sequences in this paper. These Korean vocalic sequences are divided as follows : (a) the on-glide in syllable-initial position as in /jak/ 'medicine,' (b) the on-glide in the post-consonantal position, as in /kwan/ 'crown,' (c) the off-glide /ij/ 'justice.'

In the following section, I first define the phonological distinction between on-glides and off-glides, underlying representation of glides, previous cross-linguistic studies of glides, and syllable structural representation of glides. Section 3 introduces different kinds of Korean syllable structures discussed by phonologists and deals with the syllable-structure status of glides in Korean, in particular, focused on on-glides, giving evidence for the Onset Hypothesis from glide formation and insertion, language games, phonotactics, partial reduplication, and vowel harmony, in addition to articulatory and acoustic evidence. Concluding remarks are given in Section 4.

1) The use of symbols (e.g., [i] [j], [y]) varies among phoneticians. In this paper, I use the symbol [j] and [w] for glides and [i] for high unrounded central vowel in Korean. According to analysis of all UPSID (UCLA Phonological Segment Inventory Database) languages, 86% of the languages have /j/, 75% have /w/, and 71% of the languages have both (Maddieson, 1980).

2. Glides

2.1. Defining On-Glides and Off-Glides

Donegan (1978, pp. 187-221) differentiates between on-glides (part of rising diphthongs) and off-glides (part of falling diphthongs). On-glides refer to the first of two vocalic elements, that is, rising diphthongs, and off-glides are the second vocalic elements in falling diphthongs, considering that both off-glides and on-glides are vocalic but non-syllabic elements.²⁾ To distinguish falling diphthongs from rising diphthongs, she also takes into account prosodic arguments such as the equivalence between falling diphthongs (vowel-vowel sequences) and long vowels. Falling diphthongs and long vowels do rhyme as follows:

Since the length or ‘weight’ of a syllable is reckoned from the start of the syllabic, falling diphthongs are counted together (as two moras) in speech timing, but in rising diphthongs, the non-syllabic counts as part of the syllable-onset—which means, in most languages, that for prosodic purpose it doesn’t count at all : VV is no longer than V, and VV : is no longer than V. Further, falling diphthongs function as units in rhyme : *paid* [peɪd] and *raid* [reɪd] rhyme, but *paid* [peɪd] and *red* [rɛd] do not. But rising diphthongs do not act as units in rhyme; the pre-syllabic glide does not ‘count’ : *feud* [fiud] rhymes with *mood* [mud] and *coed* [kud] as well as with *mewed* [miud] (p. 190).³⁾

In rising diphthongs, on the contrary, on-glides do not represent length and do not count prosodically. Donegan added that off-glides are more likely to assimilate to the syllabics, while on-glides (pre-syllabic glides) are more like consonants in syllable onset position, which means that a rising diphthong parallels the CV syllable (p. 193). For this reason, I claim that Korean on-glides should be considered to be consonants in syllable onset position.

2) There is still no agreed (or well-defined) definition of the notion ‘diphthong.’ Whether diphthongs should have been considered as single sounds or sequences of two sounds has been controversial. Catford (1977, p. 215) defines “a diphthong as a sequence of two perceptually different vowel sounds within one and the same syllable,” which refers to two vowels (duality), while Ladefoged (1993, p. 293) regards diphthongs as “single vowels with changing qualities,” which refers to one vowel (unity), and later as movement from one vowel to another in a single syllable as well (1993, p. 293).

3) According to Donegan [in personal communication], there are some variations. Depending on the speaker, some have [miud] and [fiud]. Thus, *mewed* [miud] and *feud* [fiud] do not rhyme with *mood* [mud] and *coed* [kud].

2.2. Underlying representation of glides

Hyman (1985) argues that glides behave like consonants in the surface representation, proposing that they may be treated as vowels at one point in the course of derivation only to act like consonants in the surface representation.⁴⁾ The examples in (1) show that glides from underlying vowels function like consonants on the surface.

(1) Glides from underlying vowels

a. French (Hyman, 1985, p. 79)

<u>UR</u>	→	<u>SR</u>	
/uɛst/	→	[wɛst]	'west'
/ruɛt /	→	[rwɛt]	'osier band'
/bruɛt /	→	[bruɛt]	'wheel-barrow'

b. Sanskrit (Whitney, 1960, pp. 44-55, cited in Donegan, 1978, p. 194)

<u>UR</u>		<u>SR</u>	
/vi/ + /usti/		[vjusti]	'day break'

In French (1a), a high vowel /u/ becomes a glide [w] when the high vowel is preceded by at most one consonant. In other words, the vowel /u/ glides to become an onset on the following vowel. Two consonants in the onset of /brut/, however, block glide formation process. In Sanskrit (1b), when two high vowels are adjacent, the first high vowel /i/ becomes a glide [j], losing syllabicity. Thus, the examples in (1) show that the glides derived from underlying vowels count as consonants in the phonetic representation.

Historically, consonants can become vocalic, creating a falling diphthong. Let's consider the case of the glides that are derived from earlier consonants.

(2) Glides from underlying consonants

a. French (Pope, 1934, p. 154, 239, cited in Donegan, 1978, p. 192)

/ellos/ (Latin)	>	/ews/ (Old French)	'them'
/parel/ (Old French)	>	/paRej/ (Mod French)	'similar'

4) Hyman (1985, pp. 77-78) prefers the feature [cons] to the feature [\pm syll] in order to avoid a redundancy problem in distinguishing vowels from glides. Thus, glides refer to [+cons] and vowels [-cons] on the surface regardless of the underlying representation of glides.

- b. English (Jones, 1940, pp. 108-113, cited in Donegan, 1978, p. 193)
 ear > [iə], pair > [pɛə], oar > [ɔə], cured > [kiuəd]
- c. Cibaeño Spanish (Harris, 1983, p. 47)⁵⁾
- | | | | |
|------------|---|------------|-------------|
| /revolver/ | → | [revoʝvej] | ‘to stir’ |
| /carta/ | → | [cajta] | ‘letter’ |
| /papel/ | → | [papej] | ‘paper’ |
| /algo/ | → | [ajgo] | ‘something’ |

As shown in example (2), in many languages, some or all glides arise from consonants. In (2a), syllable-final Latin /l/ has become an off-glide [w] in Old French and Old French palatal /l/ was vocalized to an off-glide [j] in Modern French, showing historical change. In (2b), Modern English /r/ in syllable coda position has vocalized to a schwa-like off-glide [ə], showing synchronic alternation r/ə, depending on dialect.⁶⁾ In Cibaeo Spanish, the liquids /r/ and /l/ are realized as [j] under certain conditions, which is called liquid gliding. Thus, the examples in (2) show that the glides can come from earlier consonants, which form falling diphthongs.

Consider the case of English indefinite articles. The indefinite article *a* occurs before a consonant and a glide, whereas the other indefinite article *an* occurs before a vowel.

- (3) a. a year, a use, a union, a European, a yellow man, a young child
 a window, a woman, a word, a wood
- b. an ear, an eagle, an ink

The examples given above are representative of the distinction of glide consonants (3a) and high front vowel (3b) in English. In (3), each of the glides /j/ and /w/ in the syllable-initial position functions as a consonant.

Returning to the first question of this study, what is the underlying

5) Cibaeño is the dialect of Spanish spoken in El Cibao, a north central region of the Dominican Republic.

6) In this paper, [ə] standing for ‘schwa’ is used to refer to the off-glide of centering “diphthongs during whose articulation the tongue moves toward the central vowel schwa” (Trask 1996, p. 68). British dialects, especially RP (Received Pronunciation), prefer a schwa-like off-glide as in *fear* [fiə] and *pair* [pɛə], while General American English (GenAm) prefers [r] as in *fear* [fir] and *pair* [per]. For more details, see Wells (1998, p. 124).

representation of glides in Korean? Are the glides in Korean underlying vowels or consonants? To address this question, some examples of glide formation in Korean are provided.

(4) Glide formation: data from Y-S. Lee (1994), Kim & Kim (1998), and S-C. Ahn (1998)

/mo.i + ə /	→	[mo.jə]	'gather'
/c ^h i.u + ə /	→	[c ^h i.wə]	'clean'
/o + a /	→	[wa]	'come'
/tu + ə /	→	[twə]	'put'
/s'o + a /	→	[s'wa]	'shoot'
/se.u + ə /	→	[sewə]	'set up'

A verbal suffix /ə/ (or /a/ after the stem-final vowel /a/ or /o/) is added at the end of a verb stem. High front vowel /i/ becomes [j] and back rounded vowels /u/ and /o/ become [w]. The data in (4) show that glides in Korean are underlying vowels, but to avoid onsetless syllables, glides in (4) function like consonants in the phonetic representation.

2.3. Previous cross-linguistic studies of glides

On-glides are treated in different ways from language to language (Davis & Hammond, 1995). In the analysis of Italian diphthongs, Marotta (1988, pp. 389-420) considers only [uɔ] in rising diphthongs as a "true" diphthong, in which the [u] is the prenuclear part of the syllable, and falling diphthongs including diphthongs with /j/ as a "false" diphthong. In the case of Frisian, Booij (1989) argues that on-glides can be treated as glide-vowel sequences of which the glide forms part of the syllable onset (see (8b) below). Thus, like Donegan, Booij regards falling diphthongs as "real" diphthongs. In other words, Frisian has falling diphthongs only and the combinations of a vowel and the tautosyllabic [-cons] segment are analyzed as Nucleus.

In the case of English, Davis & Hammond (1995) conclude that in the syllable-structure status of on-glides in CGV sequences, [w] is treated as an onset while [j] is treated as a prenuclear part of the syllable, providing some evidence from Pig Latin and phonotactics.

(5) Evidence from Pig Latin (Davis & Hammond, 1995)

a. <u>CwV</u> sequences		b. <u>CyV</u> sequences		
<u>English</u>	<u>Pig Latin</u>	<u>English</u>	<u>Pig Latin A</u>	<u>Pig Latin B</u>
queen	[inkwe]	cute	[yutke]	[utke]
twin	[Intwe]	puke	[yukpe]	[ukpe]
sway	[eswe]	mute	[yutme]	[utme]
dwel	[eldwe]	fuse	[yuzfe]	[uzfe]

The /w/ in CwV sequences in (5a) behaves like a sequence of consonant clusters, where the Cw moves to the end, with the vowel [e] being added after it. On the contrary, English words beginning with CyV sequences in (5b) yield two different Pig Latin forms, indicating that in Dialect A, the [y] in CyV sequences is not part of the onset and in Dialect B, the [y] in [utkye] is deleted to avoid violation of English phonotactics. There is no doubt that in English glide + vowel sequences like /wa/ in syllable-initial position are analyzed as consonant + vowel (CV).

As shown in the evidence from phonotactics (i.e., *nwV, *lwV, *rwV, *ml, *mr, *nl, *nr, *rl, *rn, *rm, *ln, *lm, *mn, *nm; *thwart, twin, dwarf, schwa, quote*), the initial consonant in CwV sequences can not be a sonorant. The absence of initial sonorants in CwV sequences shows that there is a relationship in terms of sonority distance between /w/ and the preceding consonant, indicating that the /w/ in CwV sequences is like other sonorant consonants. Thus, the /w/ is part of the syllable onset. On the other hand, in CyV sequences /y/ can occur after sonorant consonants except for coronal consonants in syllable-initial position: *music, mute, muse; *tyV, *dyV, *nyV, *lyV* (Davis & Hammond, 1995, pp. 162-164).

In Mandarin Chinese, Wan (1997) points out that the glides can be either onset or nucleus, depending on the place of articulation of the consonant that precedes them. From a psycholinguistic point of view, he provides evidence from speech errors, proposing that the glide preceded by a posterior consonant is associated with the onset while the glide preceded by an anterior consonant is associated with the nucleus.⁷⁾

- (6) a. [kw-ɔ t-o-ŋ] → [kw-ɔ kw-o-ŋ] * [kw-ɔ k-o-ŋ]
 b. [p-u t-jɛ-n] → [p-u p-jɛ-n] * [p-u p-ɛ-n]

7) Posterior consonants include both palatal and velar consonants, while anterior consonants include labial, dental, and retroflex consonants.

In (6a), a velar initial consonant-glide sequence [kw] replaces a consonant [t], where [kw] functions as a unit, while in (6b), a bilabial consonant [p] is substituted for [t], which means that [je] belongs to a nucleus within a syllable structure.

On the other hand, Fu (1990) argues that on-glides belong to an onset in Mandarin but are part of the nucleus in Taiwanese.

- (7) a. Mandarin *p'an, man, fan, twan, kwan, zwan, p'u, mu, wo, mo*
 **pwan, *mwan, *fwan*
- b. Taiwanese *pwe, mwi, maw, bo*
 **tup, *kiom, *lum, *twap, *wam*

In Mandarin (7a), initial labials can co-occur with a round back vowel [u]. However, labial consonants cannot co-occur with a following rounded back glide [w], indicating that syllable-initial labial consonant plus labial glide (i.e., [-lab][+lab]) are not permissible because they belong to the same node within a syllable, that is, the onset. And syllable-initial labial consonant plus labial back vowels are permissible because they do not form the same constituent as onset of the syllable. On the contrary, in Taiwanese (7b), a round vowel or rounded glide cannot co-occur with a labial consonant in the coda but can co-occur with a labial consonant in the onset, because [w] is part of the rhyme and not part of the onset.

Unlike some languages mentioned above, however, both glides /j/ and /w/ in Korean behave like consonants, indicating that the glides belong to the onset. As for the status of Korean on-glides, it is dealt with in section 3 in more detail.

2.4. The Syllable Structural Representations of Glides⁸⁾

Whether a glide is a part of a diphthong or is a consonant in the onset depends on where it is located in the syllable structure. In a non-linear

8) It is important to know the syllable structure of a word because phonological phenomena are sensitive to syllable structure. The syllable structures play an important role in the organization of the phonological processes of a language. Although it is not easy to know exactly where syllables are present in the derivation, glides in syllable structure are derivable by phonological mechanisms. In Korean, glides in the underlying representation may be vowels. However, in the course of derivation, the glides are like consonants in the phonetic representation in that glides cannot occur in the nucleus of the syllables, and they do not maintain steady states acoustically. In addition, in the articulation of glides, they are produced with a construction that is greater than the corresponding vowels. See the section 3.3 for detailed evidence.

theory of syllable structure, Booij (1989, p. 320) distinguishes between two different structural representations of glides. The two types illustrated in (8) are : (a) glides within the same node, nucleus, are called diphthongs and are subject to co-occurrence restrictions with respect to each other; (b) glides in onset or coda may be subject to co-occurrence restrictions on consonant clusters.

<p>(8) a. diphthong</p> <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td style="text-align: center;">N</td> <td style="text-align: center;">N</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">/ \</td> <td style="text-align: center;">/ \</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">V V</td> <td style="text-align: center;">V V</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">j a</td> <td style="text-align: center;">a j</td> <td></td> <td></td> </tr> </table>	N	N			/ \	/ \			V V	V V							j a	a j			<p>b. glide-vowel/vowel-glide combination</p> <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td style="text-align: center;">O</td> <td style="text-align: center;">N</td> <td style="text-align: center;">N</td> <td style="text-align: center;">C</td> </tr> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">V</td> <td style="text-align: center;">V</td> <td style="text-align: center;">C</td> </tr> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> </tr> <tr> <td style="text-align: center;">j</td> <td style="text-align: center;">a</td> <td style="text-align: center;">a</td> <td style="text-align: center;">j</td> </tr> </table>	O	N	N	C					C	V	V	C					j	a	a	j
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Some languages prefer the first structural representation (8a), where glides occupy the nucleus position, and other languages the second structural representation (8b), in which glides are in the onset or coda. In the case of the vowel-glide sequences /oi/ and /ai/ in Dutch, these segments cannot be followed by any tautosyllabic consonant except /s/ and /t/ (e.g., *aip, *aim, *oip, *oim) because the second non-syllabic segments belong to the coda, and because the /s/ and /t/ belong to word-final appendix (Booij, 1989, pp. 320-321).

Glides in Tagalog can also be considered to have the structural representation found in (8b). The representations in (9) show that *my* [maj] in English includes a diphthong under the node Nucleus, while a word like *maj* which is an existential marker in Tagalog is regarded as containing an off-glide consonant.

<p>(9) a. <u>English</u></p> <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td style="text-align: center;">O</td> <td style="text-align: center;">N</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;">^</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">m</td> <td style="text-align: center;">a j</td> <td></td> <td style="text-align: center;">‘my’</td> </tr> </table>	O	N				^			m	a j		‘my’	<p>b. <u>Tagalog</u></p> <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td style="text-align: center;">O</td> <td style="text-align: center;">N</td> <td style="text-align: center;">C</td> <td></td> </tr> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> <td></td> </tr> <tr> <td style="text-align: center;">m</td> <td style="text-align: center;">a</td> <td style="text-align: center;">j</td> <td style="text-align: center;">‘existential marker’</td> </tr> </table>	O	N	C						m	a	j	‘existential marker’
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m	a j		‘my’																						
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m	a	j	‘existential marker’																						

In Philippine languages like Tagalog, vowel + glide sequences like /aw/, /aj/, /iw/, and /uj/ are analyzed as /V/ + /C/ sequences, not diphthongs (Clynes, 1997, p. 352). One piece of evidence for this claim comes from morphophonemic alternations found in (10).

(10) Tagalog

a. buk <u>as</u>	-an	→	buksan	'be opened'
b. gaw <u>a</u>	-in	→	gawin	'be made'
c. lag <u>aj</u>	-an	→	lagjan	'be put upon'
d. big <u>aj</u>	-an	→	bigjan	'be given to'

In Tagalog, a vowel in the final syllable is deleted when suffixation takes place. /a/ is deleted because glides in the final syllable of the root function as separate consonants, as in (10).

Similar observations to those in Frisian can be made regarding Korean glide-vowel combinations.⁹⁾ As mentioned earlier, glides in Korean have been treated as vowels in the traditional analysis. Thus, some phonologists regard a glide + vowel sequence like /wa/ as a diphthong, that is, a part of the nucleus. However, the glide plus vowel sequences should be considered to be consonant plus vowel sequences. I will present evidence in favor of the structure (8b) in section 3.3.

3. On the status of on-glides in Korean

3.1. Glides as consonants in Korean

English has many off-glides, which are treated as the second element of falling diphthongs, while on-glides are considered to be consonants. Unlike English, in Korean most glides are on-glides. In the syllable structure of Korean, a single glide before a vowel behaves like a consonant, as in *wang* 'king.' When a glide is preceded by a consonant, as in *kwan* 'crown,' however, whether the glide belongs to onset or nucleus is still controversial. In Middle Korean, a syllable could have had consonant clusters in the onset position as well as in the coda position, as shown in /ps-/ , /pc-/ , /pt-/ , /pt^h-/ , and /pt'-/. All the clusters started with /p/ and the second consonant of the clusters were all non-bilabial obstruents (Lee 1972 : 56-63). However, in Contemporary Korean, the initial consonant clusters and final consonant clusters have undergone simplification.

9) Also another similar observation to those in Dutch can be made regarding Korean vowel-glide combination. Thus, the off-glide in both Dutch and Korean belongs to the coda.

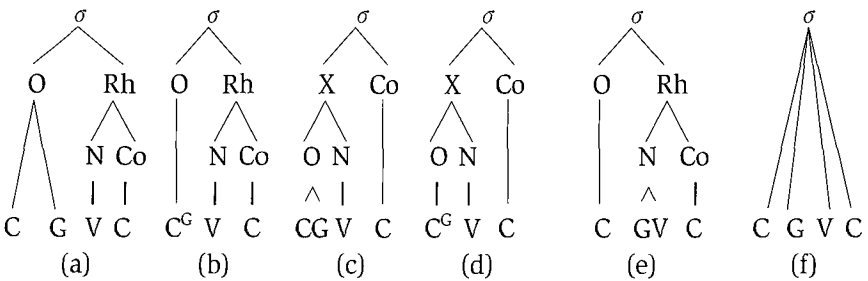
I argue that Korean has some consonant clusters in the syllable-initial position, and propose that there is asymmetry between phonemic and phonetic levels. Korean consonant clusters¹⁰⁾ in syllable-initial position are all composed of a consonant plus a glide in the phonetic level. In Korean orthography, however, *ya*, *we*, *wa*, and the like are single symbols. They may have been one unit or one phoneme, perhaps diphthongs in earlier Korean; but historically the diphthongs became two independent sounds (glide consonant plus vowel), and subsequently the glide has been analyzed as a part of the onset in Contemporary Korean, since writing systems do not necessarily determine or reflect phonemic representation. The initial consonant clusters are still in the process of being simplified. For instance, post-consonantal glides tend to be deleted in casual speech, as in /pwara/ [para] ‘See!’ in Contemporary Korean, even though phonetic realizations of consonant clusters vary from speaker to speaker or from dialect to dialect.¹¹⁾

3.2. The Structural Representations of On-Glides in Korean

Different types of syllable structure discussed by Korean phonologists can be summarized as follows:

(11) Onset Hypothesis

Nucleus Hypothesis



10) As for tense-lax distinction in Korean, whether the tensed consonants are geminated or not is controversial. It is true that tense consonants are always longer than their corresponding lax consonants in terms of duration. However, it does not necessarily mean that tensed consonants are geminated. Tensed consonants are considered as one of three stop consonant contrasts.

11) A few people are able to pronounce some of the clusters including consonant + glide sequences in careful speech without deletion. Most Kyungsang speakers and some Seoul speakers tend to delete glides when preceded by a consonant in the onset.

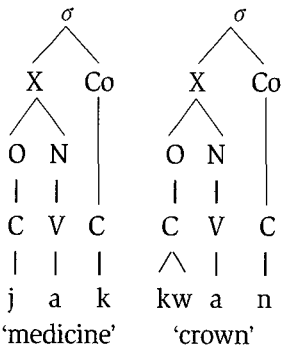
Syllable structures like (11a), (11b), and (11e) are represented as an onset followed by a rhyme, and the rhyme itself consists of a nucleus followed by a coda (see B-G. Kim (1982), S-C. Kim (1985), and H-Y. Kim (1998) for glides as onset in (11a) through (11d); see Kim & Kim (1991) and H-S. Sohn (1987) for glides as nucleus in (11e)). Structures like (11c) and (11d) imply, in particular, that the relationship between nucleus and onset is closer than that between nucleus and coda¹²⁾ (see B-G. Lee (1982), C-K. Gim (1987), S-C. Ahn (1989), C-H. Kim (1990), Y-S. Lee (1994), H-Y. Kim (1998) for glides as onset). A structure like (11f) has no internal structure, indicating that there is no relationship between nucleus and onset or between nucleus and coda (See Kim-Renaud (1974) and Kim & Shibatani (1976) for flat syllable structure with glides in the nucleus).

Selkirk (1980) argues that a hierarchically organized structure of the syllable is required to account for phonotactics as well as dynamic phonological phenomena. She observes that individual languages typically exhibit “co-occurrence constraints within onsets and within rhymes, but not typically between onsets and the rest of the syllable.” By introducing different types of syllable structures, however, Fudge (1987) argues that the division of the syllable into onset and rhyme is not the only universal syllable structure. Although the division of the syllable into onset and rhyme is generally accepted syllable structure in many languages, however, it seems that languages can have a variety of syllable structures. In this regard, it is argued that Korean syllable structure is different from that found in other languages. Korean is one of the languages with the surface structure of (C)(G)V(C), as shown in *mul* ‘water,’ *so* ‘cow,’ *um.ak* ‘music,’ or *a.i* ‘child’ Notice that the syllable structure in Korean is simple and predictable, since Korean allows maximally one consonant or the combination of one consonant and a glide in the onset position (although the glides become reduced or deleted in casual speech, see H-S. Kang [1996]), permits only one consonant in the coda position, and allows one obligatory vowel in the nucleus position in the phonetic level. Even though diphthongs and consonant clusters occur in the Korean orthography, glides become part of the onset or are deleted, and the first or second element of consonant clusters in the coda is also deleted on the surface. This paper is based on the syllable

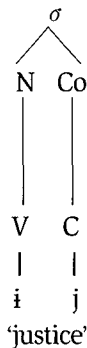
12) σ (syllable), O (onset), Rh (rhyme), Co (coda), N (nucleus), C (consonant), G (glide), V (vowel), X (core as a constituent).

structure in (11c), where Korean syllable structure can be represented as a core (X as a constituent) followed by a coda, and the core itself is made up of an onset followed by a nucleus. I support the claim that onset and nucleus form a constituent in Korean syllable structure. When *Hangul* was first invented in 1946 by King Sejong and his court, they explained, in Korean Script, *Hunminchongum*, the view that the Korean syllable was originally composed of three parts: initial, medial, and final. This interpretation deviated from the long Chinese phonological tradition with which they were entirely familiar, a theory that saw basically two parts in a syllable: the initial consonant and the remaining part of the syllable (Gim, 1993, p. 293). We might assume that the Korean syllable has a non-hierarchical structure. However, evidence for the hierarchical syllable structure is plentiful. Evidence from language games, phonotactic constraints, and children's language shows that the relationship in Korean between onset and nucleus is closer than that between nucleus and coda. In the following section, I argue that in Korean glide + vowel sequences should be treated as consonant + vowel (CV) sequences, and a vowel /i/ + off-glide /j/ acts like a vowel + consonant (VC), which supports the structural representation of glide-vowel or vowel/glide combination in (8b) and (11c), and thus onset and nucleus form a constituent named core. See sections 3.3.3 and 3.3.4 for detailed evidence. The following structural representations for the analysis of Korean glides as consonant are based on (11c).

(12) a. Onset Hypothesis¹³⁾
(Glide-vowel Sequence)



b. Coda Hypothesis
(Vowel-Glide Sequence)



13) In Onset Hypothesis, on-glides are part of an onset of a syllable and in Nucleus Hypothesis, on-glides are part of a nucleus of a syllable.

Before dealing with the structural status of on-glides in Korean, it is important first to discuss the Coda Hypothesis in (12b), which supports Ahn's claim (1998) cited below. There are no off-glides in Contemporary Korean, except for /ij/ in the morphophonemic level, which is often simplified as [i], [e] or [i] in casual speech. A few speakers pronounce it as [ij], but most speakers tend to pronounce it as [e] or [i]. We expect that /k ic^hki j munce/ 'problem of the book' would be [ki c^hεke munce] or [ki c^hεki munce] depending on the speaker. Ahn (1998) treats the off-glide as well as the on-glides as consonants, arguing that the off-glide in Korean does not belong to the nucleus.

Korean has only one off-glide /ij/, which cannot be followed by any consonant within a syllable since Korean syllable structure does not allow coda clusters on the surface. Thus, if /ij/ is regarded as a part of the nucleus, we need to explain why * j+C is not allowed within a syllable (Ahn 1998:79).

The above citation shows that a vowel + glide sequence /ij/ acts like the nucleus and coda in Korean since consonant clusters are not allowed in the coda position in the phonetic representation. As mentioned earlier, this argument is similar to the one used for Dutch, where a sequence of vowel-glide like /oi/ or /ai/ form a rhyme, which is composed of a nucleus and a coda. The off-glide cannot be followed by any tautosyllabic consonants because it is in the coda position (Booij, 1989). In Korean the only off-glide /ij/ is considered to be a consonant, as shown in the following spectrogram (15).

In Onset Hypothesis, on-glides are part of the onset within a syllable. The Onset Hypothesis is divided into two : Single Onset Hypothesis (SOH) and Cluster Onset Hypothesis (COH). The difference between the two is whether the onset is just one complex segment (C^C) as in (11b) or a consonant cluster (CG), as in (11c). H-Y. Kim (1998, p. 122) argues that a glide in Korean is not an independent segment but a secondary articulation if preceded by another consonant, and that a single glide before a vowel is treated as a single consonant on the surface. My argument, however, is that in Korean, a consonant + glide sequence followed by a vowel is treated as a consonant cluster that includes a glide in the phonetic representation.

3.3. Evidence for Onset Hypothesis

I would like to give some evidence to support the Onset Hypothesis in

(12a), which claims that on-glides should be regarded as part of the onset, rather than part of the nucleus. Articulatory and acoustic evidence as well as evidence from glide formation and insertion, language games, phonotactics, partial reduplication, and vowel harmony are considered in the following sections.

3.3.1. Articulatory and Acoustic Evidence

Generally the articulation of the glides involves movement of the tongue and lips. In articulation of the palatal glide /j/, the tongue blade approximates the palate with a slight constriction and without lip rounding; in articulation of the labio-velar glide /w/, both lips protrude with lip rounding and at the same time the back of the tongue is elevated toward the velum. In English, on-glides /j/ and /w/ are said to be like non-syllabic versions of the English high vowels /i/ and /u/. Thus, glides have many similarities to vowels because both of them are formed with very narrow or little constriction of the articulators but they are different from vowels because they do not maintain steady states acoustically.

As for the differences between glide consonants and diphthongs¹⁴⁾ in phonetics, for the first time, Pike (1943) regards the initial segments /j/ and /w/ of the (RP) pronunciations of the English words “yes” and “went” as non-syllabic approximants, distinguishable from diphthongs, which are single segments changing vowel quality in the postvocalic position. On the other hand, Borden, Harris, and Raphael (1994, pp. 114-115) state that glides are considered to be consonants regardless of whether they are in prevocalic or postvocalic positions.

Although the vocal tract is relatively open for the semivowels [glide consonants], as it is for vowels and diphthongs, and although the semivowels are characterized acoustically by formants, yet they are considered to be consonants, not vowels. The reason for this is that the semivowels occur on the periphery of syllables, as do other consonants and not in the nuclei of syllables, as do the vowels and diphthongs. ...The semi-vowels, are always positioned next to the vocalic nuclei, both individually and in contexts containing consonant clusters.

14) Olive et al. (1993) also make a similar distinction between on-glides and off-glides: When a glide precedes a vowel, the glide usually functions as an independent phoneme. When a glide follows a vowel, a diphthong is formed.

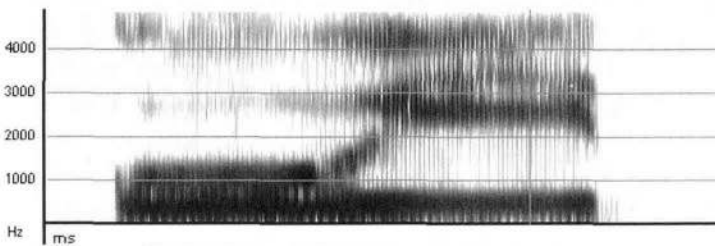
Pickett (1999, p. 102) also states that glide consonants and glides in diphthongs show differences in articulatory movements.

...[G]lide consonants are produced with a constriction that is greater than the closest vowels and the articulatory movements to and from the glide constriction are faster than the movements between the two vowels of a diphthong.

The differences between on-glides and off-glides from an acoustic point of view are 1) the formant transition portion is faster in on-glides than in off-glides; 2) off-glides that function as part of the diphthongs have a shorter duration than on-glides because vowel and its following off-glide are considered to be a single phoneme, while an on-glide and its following vowel are considered to be two different phonemes (Olive, et al, 1993).

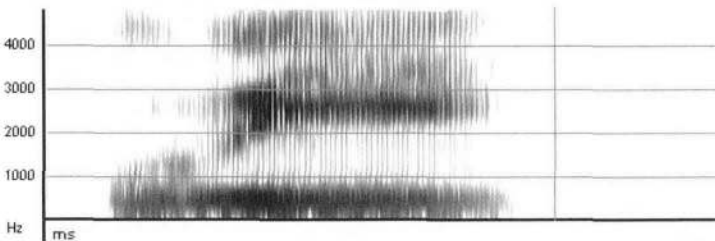
The following figures are the acoustic and temporal patterns of combinations of glides and vowels produced by this author in careful speech. Each of the three different spectrograms shown in (13) through (15) displays formant transitions from the one sound toward another changing quality.

(13) Spectrogram showing formant transition of vowel /u/ to vowel /i/



/ui/

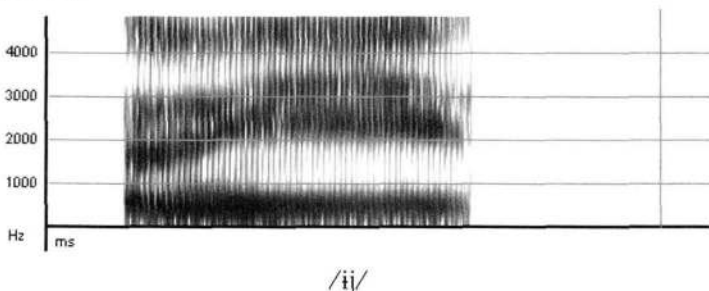
(14) Spectrogram showing formant transition of consonant glide /w/ to vowel /i/



/wi/

The spectrogram (13) shows a vowel-to-vowel transition, that is, a combination of a relatively steady state followed by a continuous F2 transition followed by a relatively steady state offset vowel.¹⁵⁾ Both /u/ and /i/ are independent vowels in a sequence so that its entire duration is relatively longer. The word used in the spectrogram is *Udong* 'name of district in Seoul.' The word used in the spectrogram (14) is *wi* 'stomach' The formant transition pattern between glide /w/ and vowel /u/ in (14) is similar to that between /u/ and /i/. The similarity is not surprising since these two sounds /u/ and /w/ have a similar formant structure. However, one of the differences between the glide /w/ and the vowel /i/ is seen in the temporal patterns, that is, the duration of their steady states. The glide /w/ in (14) has a very short steady state compared to the vowel /u/ in (13) because, generally, a vowel tends to be longer than a glide (the glide is also considered to be a consonant). Therefore, the entire duration of glide plus vowel sequence in (14) is shorter compared to two continuous vowels in (13). The steady state of the vowel /i/ has approximately the same duration in both (13) and (14). Another difference between /u/ in (13) and /w/ in (14) is in the lower intensity of the glides. As shown in (13) and (14), the glide /w/ in (14) has a lower intensity than the vowel /u/.

(15) Spectrogram showing formant transition of vowel /i/ to consonant glide /j/



In (15), /ij/ is the only off-glide in Korean. The pronunciation of the off-glide varies depending on the context. The word used in the spectrogram is *ij* 'justice.' Unlike English off-glides, the off-glide in (15) has

15) There is a big difference in F2 between the vowels /i/ and /u/.

a relatively longer duration and shows faster formant transition, the way an independent phoneme does. There are two reasons for the longer duration of the off-glide than the preceding vowel. First, the word used in the spectrogram was pronounced in isolation at a very slow speed, so the target sound tends to be longer in final position. Second, there are no off-glides in contemporary Korean, except for the off-glide /ij/ in the morphophonological level. The speaker's way of producing the off-glide may be different from what we expected. In actuality, the speaker pronounced it as two separate vowels, [ii], as expected. Most Korean speakers tend to pronounce /ij/ as a single vowel (/i/, /e/, or /i/).

I argued previously that Korean does not have diphthongs and glides are part of the onset, not nucleus. Let us consider the difference between glides as parts of diphthongs and glides as independent phonemes. On-glides in diphthongs and those in the onset show some acoustic differences. The differences can be found by observing the movement and direction of the formants during the transitions and by examining the formant values of the vowels and glides. First, the on-glide portion of the diphthong is not as stable as the on-glide in the onset. For this reason, the transition portion of the diphthong is slower and more gradual than in the vowel-to-glide transitions. Second, the formant value of the glide in diphthongs does not reach the target value and is affected by the vowel, while the glide as an independent phoneme is not affected by the following vowel since the glide and the following vowel are separate phonemes. Third, the glides have a longer duration than glides that function as part of diphthongs since the on-glide is considered to be a separate phoneme. Accordingly, based on articulatory and acoustic characteristics of on-glides and of the off-glide in Korean described above, Korean glides are considered to be consonants.

3.3.2. Glide Formation and Insertion

Korean has a rule which either forms a glide or inserts a glide between two adjacent vowels.¹⁶⁾ The glide formation and glide insertion shown in

16) Malayalam also has the glide insertion rule similar to Korean (Mohanam 1986:74-75), where the glide agrees in roundness and backness with the preceding vowels to avoid hiatus.

kari	'black'	+ ila	'leaf'	→	karijila	'dry leaf'
pasu	'cow'	- inte	'possessive marker'	→	Pasuwinte	'cow's'
taara	'Tara'	+ alari	'roared'	→	taarajalari	'Tara roared'

(16) are examples for arguing that glides belong to the onset in the phonetic representation:

(16) a. Glide formation (data from Y-S. Lee [1994], Kim & Kim [1998], and Ahn [1998])

/mo.i + ə/	→	[mo.jə]	‘gather’
/c ^h i.u + ə/	→	[c ^h i.wə]	‘clean’
/o + a/	→	[wa]	‘come’
/tu + ə/	→	[twə]	‘put’
/s'o + a/	→	[s'wa]	‘shoot’
/se.u + ə/	→	[se.wə]	‘set up’

b. Glide insertion (data from Y-S. Lee [1994] and Kim & Kim [1998])

/minsu-a/	→	[min.su.ja]	‘Minsu! (vocative)’
/minsun-a/	→	[min.su.na]	‘Minsun! (vocative)’

In example (16a), in order to avoid hiatus or onsetless syllables, vowels counted as an underlying nucleus become a glide (i.e., onset) in the surface representation. In (16b), a glide [j] is inserted to break hiatus, e.g., V + V → VCV. The glides in (16) function as a consonant in the onset. In other words, glides in Korean behave like vowels in the underlying representation, but in the phonetic representation behave like consonants, just as in the case of French.

Also, (17b) supports the claim that a glide counts as a consonant in the onset. The syllable structure in (17a) has a vowel sequence, where each vowel belongs to two different syllables, while the example in (17b) has a glide that is distinct from the first vowel in (17a).¹⁷⁾

(17) a.	σ	σ			
	V	V			
	o	a			
			b.	σ	
				/ \	
				C V	
				w a	‘to come’

17) In the SPE, Chomsky and Halle (1968:68) use the features [-consonantal, -syllabic] in order to classify glides [y, w, h, ʔ]. However, glides should be treated differently from language to language. [y] and [w] are consonantal variants of the vowels [i] and [u]. I claim that Korean glides should be considered to be [+cons].

When a nucleus does not have an onset to its left, then an adjacent vowel to the left within the same stem, if any, tends to become an onset in casual speech.

3.3.3. Language Games

Gim (1987) has observed that evidence from language games supports the grouping of a consonant and the following glide into a constituent, that is, onset. In a Korean language game such as CV ($p + V$) insertion, the sequence of p plus the same vowel of the preceding syllable is inserted after each CV. Below is a list of language games discussed earlier.

(18) a. CV insertion language game (data from Gim (1987, p.52))

#in.su.ja! kwa.ho.ha.ko i. ri o.na. ra.# 'Insu!, come here with Kwangho'

i.[pi]n.su.[pu]. ja.[pa]. kwa.[pa]. ho.[po]. ha.[pa]. ko [po]....#

b. CV insertion language game (data from Ahn [1998])

ka-ja-ci → ka[pa] ja[pa] ci[pi] (*ka[pa] ja[pa] ci[pi]) 'have to go'

kwan-sip → kwa[pa]n- si [pi]p (*kwa[pwa]n si [pi]p) 'custom'

A glide /j/ counts as a consonant in the onset, as in (18a) /ja/→/ja-pa/, and a consonant followed by a glide is also treated as onset as in (18a) /kwaŋ/→/kwa-paŋ/, in (18b) /kwan/→/kwa-paŋ/.

(19) a.	O	N	C		O	N	O	N	C
				→					
	C	V	V		C	V	C	V	C
	^				^				
	k w	a	n		k w	a	p	a	n
b.	O	N	C		O	N	O	N	C
				→					
	C	V	V		C	V	C	V	C
		^				^		^	
	k	w a	n		k	w a	p	w a	n

Based on the language game, if the glide is part of the nucleus, (19b) should be the output, inserting *pwa* before coda. But (19a) is the optimal output. Thus, the claims that not only glides are the onset or part of the onset in the syllable but the relationship between onset and nucleus is

closer than that between nucleus and coda in Korean are supported.

3.3.4. Phonotactic Constraints

The following tables summarize the co-occurrence restrictions existing between initial glides and the following vowels in (20a), where a glide /j/ does not precede a vowel /i/ or /i/ and /w/ does not precede a vowel (/i/, /u/ or /o/), and between a syllable-initial consonant and the following glide in (20b), where alveolar obstruents /t, t^h, t', s'/ do not precede a glide /j/ and labial stops /p^h, p'/ do not precede a glide /w/.

(20) a. Glide + Vowel sequences¹⁸⁾

	<i>i</i>	<i>e</i>	<i>ɛ</i>	<i>i</i>	<i>ə</i>	<i>a</i>	<i>u</i>	<i>o</i>
<i>j</i>	-	+	+	-	+	+	+	+
<i>w</i>	+	+	+	-	+	+	-	-

b. Syllable-initial consonant + glide sequences¹⁹⁾

	<i>p</i> -	<i>p^h</i> -	<i>p'</i> -	<i>t</i> -	<i>t^h</i> -	<i>t'</i> -	<i>c</i> -	<i>c^h</i> -	<i>c'</i> -	<i>k</i> -	<i>k^h</i> -	<i>k'</i> -	<i>s</i> -	<i>s'</i> -	<i>h</i> -	<i>m</i> -	<i>n</i> -	<i>l</i> -
<i>j</i>	+	+	+	(+)	-	(+)	(+)	(+)	(+)	+	+	+	+	-	+	+	+	+
<i>w</i>	(+)	-	-	+	+	+	+	+	+	+	+	+	+	+	+	(+)	(+)	(+)

In many languages including Korean, two consecutive sounds having similar articulatory position do not co-occur. But some languages allow this to occur, as in English, *yeast* [jist], *woo* [wu]. I argue earlier that on-glides behave as part of the onset. This implies that there are co-occurrence restrictions between syllable-initial consonants and the following glide within an onset, but that the glide occurs freely with following vowels. The exception to this argument is the existence of co-occurrence restrictions between the glides and the following vowel : vowels /i/ and /i/ do not follow the glide /j/, and vowels /u/ and /o/ do not follow glide /w/. The exception can be accounted for in terms of the Obligatory Contour Principle (McCarthy, 1986).²⁰⁾ They share the same features ([+back], [+high]). This implies that the constraints between glide

18) /e/ and /ɛ/ are being merged into /e/ in Contemporary Korean. See Lee (1995).

19) Parentheses () indicate that some speakers prefer contracted forms as in *pwass-ta* 'saw' or *kasjəss-t'a* 'went.'

20) Obligatory Contour Principle (OCP) : At the melodic level, adjacent identical elements are prohibited (McCarthy, 1986, p. 208).

and following vowel are explained by “the universal tendency of avoidance of non-optimal sounds,” because “the combination of these two similar sounds fails acoustically to create minimal difference” (Ohala & Kawasaki 1984, cited in Lee 1994). In addition, sequences such as *pw*, *c^hj* in the onset are optionally permissible, and sequences such as *pu* and *c^hi* are permissible in Korean, indicating that the relationship between syllable-initial consonant and the following glide is closer than that between the glide and the following vowel, supporting Onset Hypothesis. Using Sohn’s evidence (1987) for the Nucleus Hypothesis of Korean on-glides, Lee (1994) supports the Onset Hypothesis. Sohn claims that there is no phonotactic constraint between syllable-initial consonant and following glide. As in (20b), however, phonotactic constraints between the two in Korean are found : some alveolar obstruents do not precede the glide /j/ and labial stops do not precede the glide /w/. Thus, I would like to take these examples as evidence for the Onset Hypothesis.

3.3.5. Reduplication

Reduplication in Korean is a morphological process, repeating all or part of the given morpheme. There are several types of reduplication, but consonant/consonant alternation forms are considered in this paper. Examples in (21) are consonant alternation forms found in the process of reduplication : *w/t*, *w/p*, and *j/c* alternations. /w/ alternates with /t/ and with /p/ and /j/ alternates /c/, so /w/ and /j/ are consonants. In other words, glides are the target of consonantal alternations, indicating that glides are considered to be consonants in the onset of the syllable.

(21) Reduplication of consonantal alternation (data from S-C. Ahn, 1998)

<i>w</i> alkak- <i>t</i> alkak	‘rattling’
<i>w</i> aktak- <i>t</i> aktak	‘noisy’
<i>w</i> aktal- <i>p</i> aktal	‘shaking’
<i>ʃ</i> eki- <i>c</i> eki	‘here and there’
<i>ʃ</i> omo- <i>c</i> omo	‘this and that’
<i>ʃ</i> oli- <i>c</i> oli	‘this way and that way’

3.3.6. Vowel Harmony

Vowel harmony in Korean also provides evidence supporting the Onset Hypothesis. Vowel harmony that was widespread in the Middle Korean was an assimilatory process in which each vowel group co-occurred with

members of the same group. Ch'oe (1961, pp. 108-111) states that Korean vowels belong to one of the two sound symbolic groups: (1) Yang or bright vowels (*a*, *o*) and (2) Yin or dark vowels (*u*, *ə*). Bright vowels are associated with brightness, lightness, smallness, thinness and quickness, while dark vowels involve relative darkness, heaviness, dullness, slowness, and thickness. The data below is focused on vowels after glides:

(22) Vowel Harmony (data from H-Y. Kim, 1998)

<u>Dark vowels</u>			<u>Bright vowels</u>					
wiŋ	wiŋ	'buzz of big bees'	→	wɛŋ wɛŋ	*oɛŋ oɛŋ	'buzz of small bees'		
sjuŋ	sjuŋ	'whiz of heavy things'	→	sjoŋ sjoŋ	*soɛŋ soɛŋ	'whiz of light things'		
k ^h wi	k ^h wi	(a little) foul smelling'	→	k ^h wɛ	k ^h wɛ	*k ^h oɛ	k ^h oɛ	'(more) foul smelling'

Glides are not the target of vowel harmony in (22) because they do not belong to the nucleus of the syllable (Kim, 1998, p. 117). If the glide is part of diphthongs, the vowel harmony should affect the glide.

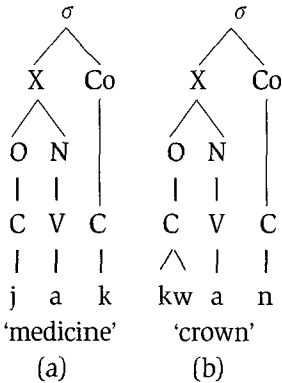
4. Concluding Remarks

The aim of this paper is to examine the underlying representation and the structural status of glides in Korean, with particular focus on the syllable-structure status of on-glides in the onset position. Traditionally, Korean glides have been considered to be vowels under the influence of the Korean orthographic system. In other words, glide+vowel sequences in the orthographic level form a constituent like a rising-diphthong. For example, in Korean, *jak* 'medicine' consists of nucleus /ja/ + coda /k/ and /ij/ is like a falling-diphthong in morphophonemic (or orthographic) level. However, there are a number of studies claiming that glides should be analyzed as forming a cluster with a consonant or a single consonant in the onset position. Thus, this study addresses the following questions:

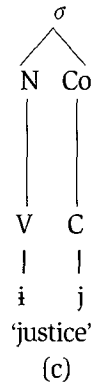
- 1) Are all the glides underlying vowels or underlying consonants in Korean?
- 2) On the surface, do on-glides belong to the onset or the nucleus of the syllable?
- 3) How are glides treated from articulatory and acoustic points of view?
- 4) What is the syllable structure status of the off-glide in a VG sequence like /ij/?

My proposition is compatible with the Onset Hypothesis and the Coda Hypothesis as follows:

(23) a. Onset Hypothesis
(Glide-vowel Sequence)



b. Coda Hypothesis
(Vowel-Glide Sequence)



In this paper, it has been argued that: (1) Korean glides are orthographically like vowels but phonologically and phonetically like consonants on the surface; (2) in Korean syllable structure, onset and nucleus form a constituent (X), and a single glide before a vowel is like a consonant in the onset, and on-glides preceded by a consonant are part of the onset based on articulatory and acoustic evidence as well as evidence from glide formation and insertion, language games, phonotactic constraints, partial reduplication, and vowel harmony; (3) a consonant + glide sequence is treated as a consonant cluster, deleted, or being simplified in casual speech; (4) based on articulatory and acoustic characteristics, Korean on-glides are glide consonants, and Korean off-glides are also like consonants (unlike English off-glides, which are a part of diphthongs). In English, when a glide is followed by a vowel, the glide functions as a glide consonant. On the contrary, when a glide is preceded by a vowel, the glide combines with the vowel, and a diphthong is formed; (5) a vowel + glide sequence /ij/ acts like a nucleus plus coda in Korean because consonant clusters are not allowed in the coda in the phonetic representation, thus the off-glide cannot be followed by any tautosyllabic consonants in the coda position. If the off-glide is a part of the falling-diphthong in Korean, there is no way to explain why no consonants follow the glide.

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