The nuclear status of onglides in Korean[*]

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Ahn, Mee-Jin. 2011. The nuclear status of onglides in Korean. *Studies in Phonetics, Phonology and Morphology* 17.3, 427-444. This paper argues that Korean onglides are part of a diphthong; and Korean glides remain in the nucleus position when there is no preceding onset consonant. I examine four different views on Korean onglides: the nucleus hypothesis, the onset hypothesis, the duality hypothesis, and the secondary articulation hypothesis, with data invoking such conflicting views, and provide a new analysis on co-occurrence restriction between a consonant and a glide, glide formation, the phonological grouping of a consonant and a CG sequence from a language game, glide coalescence blocking in Kyungsang Korean, and English loanword adaptation. Under the new approach, none of the previous counter examples prove against the nucleus status of Korean onglides. Korean ideophones and the writing system also support the Korean nuclear onglide. **(Pai Chai University)**

Keywords: Korean onglides, diphthong, nucleus, onset, secondary articulation

1. Introduction

The prevocalic glides may appear in two phonologically distinct syllable positions, onset and nucleus: Glides in French and Spanish have been identified as nucleus or onsets (Kaye and Lowenstamm 1984, and Harris and Kaisse 1999); Davis and Hammond (1995) analyze English prevocalic /w/ as onsets but /y/ as nucleus. The sub-syllabic constituency of Korean glides has been a highly controversial topic in phonology. Based on consonant cluster simplification, language games, and co-occurrence restriction between a glide and its following vowel in Korean, Sohn (1987), Kim (1990), and Kang (1991) characterize Korean onglides as being part of a diphthong, while Lee (1982), Ahn (1985), and Lee (1993) represent them as an onset to account for co-occurrence restriction between an onglide and its preceding tautosyllabic consonant and glide formation.

(1) Different views of Korean onglides
  a. Nucleus Hypothesis: Sohn (1987), Kim (1990), Kang (1991)
  b. Onset Hypothesis: Lee (1982), Ahn (1985), Lee (1993)
  c. Duality Hypothesis: Lee (1999), Yun (2006)
  d. Secondary Articulation Hypothesis: Kim (1998), Chung (2007),
    Kim et al. (2008)

Lee (1999) and Yun (2006) propose that Korean onglides are both onset

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and nucleus: glides occur in the nucleus with a preceding tautosyllabic consonant, or in the onset. Recent studies (Kim 1998, Chung 2007, and Kim et al. 2008) incorporate a glide as a secondary feature of its preceding consonant to resolve conflicting views of onset and nucleus positions of Korean glides: Kim (1998) and Chung (2007) describe glides as originally being in the nucleus position before moving to the onset position as a secondary feature of the preceding onset consonant, or as an onset consonant when the preceding onset position is empty, while glides in Kim et al. (2008) are characterized as a floating feature which may function in the onset or in the nucleus position.

In this paper I argue for the nucleus hypothesis and against the other hypotheses: i) Korean onglides are part of a diphthong; and ii) Korean glides remain in the nucleus position when there is no preceding onset consonant. To support the nuclear onglide, I analyze Korean glide formation not as an onset filling process, but rather as a transitional glide between vowels (Blevins 2008). As for the conflicting data from language games on the sub-syllabic structure of glides, I provide a new analysis which supports the nucleus status of onglides. The proposal also accounts for a new set of Korean ideophones where a vowel and a glide-vowel seqence pattern together (Chae 2003). Furthermore, the nucleus hypothesis coincides with Korean orthographic information where a glide is represented as a diacritic feature on the nuclear vowel and a GV syllable appears with an onsetless marker, Korean alphabet "ㅇ" in the syllable-initial position.

In section 2, I examine the issues concerning conflicting views on Korean onglides and present problems with their previous analyses. Section 3 reanalyzes the previous data from the conflicting theories from the perspective of Korean nuclear onglides and provides a new set of data supporting the nucleus status of Korean glides. A conclusion follows in section 4.

2. Previous studies

2.1 Four different Korean syllable structures

The conflicting views regarding Korean onglides have introduced four different types of the Korean syllable structure, as shown in (2).

(2) Four different views on the Korean syllable structure

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     a. Nucleus Hypothesis          b. Onset Hypothesis
            σ                              σ
          /  |                           /  \
         O   R                          O    R
         |   |\                        /|    |\
         |   N \                      / |    N \
         |  /\  \                    /  |    |  \
         C  G V  C                  C   G    V   C
```
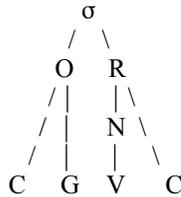
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     c. Duality Hypothesis          d. Secondary Articulation Hypothesis
       i)   σ        ii)   σ                    σ
          /  |           /  \                 /  |
         O   R          O   R                O   R
         |   |\         |   |\              /   / \
         |   N \        |   N \            /   N   \
         |  /\ \        |   |  \          /    |    \
         C  G V C       G   V   C        Cᴳ    V     C
```
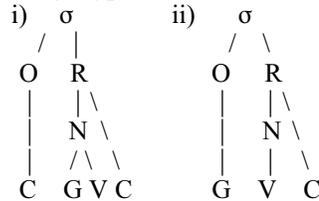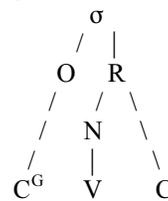
The syllable structure (2a) of the nucleus hypothesis represents a glide as part of a diphthong, while the syllable structure (2b) of the onset hypothesis posits a glide as part of a complex onset. The dual hypothesis assumes two different structures (2ci) and (2cii): a glide appears in the nucleus position (2ci) but in the onset position when there is no preceding tautosyllabic consonant (2cii). Glides in the structure (2d) of the secondary articulation hypothesis function as a secondary feature of the onset consonant or appear as an onset when there is no other onset consonant within a syllable. These four different views have arisen from the observation of various Korean-language phonological processes. This section reviews what has produced such conflicting views on the status of Korean onglides. In the next section, I will argue for the nucleus hypothesis even though most of the previous studies have argued, fully or partially, for the onset status of Korean onglides.

First, Korean allows only one consonant in the coda position, as in (3a). If a morpheme ends with two consecutive consonants, only one of the two is realized on the surface, as in /kaps/ → [kap]. In prepeak positions of a syllable, only one consonant surfaces, except a consonant-glide sequence, as in (3b).

(3) Consonant cluster simplification (Sohn 1987, Kim 1990)

a.	/kaps/	'price'	→	[kap]
	/nəks/	'spirit'	→	[nək]
	/paŋ/	'room'	→	[paŋ]
b.	/tal/	'moon'	→	[tal]
	/kwi/	'ear'	→	[kwi]
	/pyəŋ/	'bottle'	→	[pyəŋ]

The restriction of a single consonant in prepeak and postpeak positions within a syllable has argued for the nucleus hypothesis: if a glide is a part of a diphthong, it is clear that Korean does not allow consonant clusters in both onset and coda positions. Otherwise, a CG sequence would be the only marked consonant cluster permitted in Korean.

Second, the Korean glide /y/ does not precede a high front vowel /i/ nor follow coronal consonants /t, t^h, t', tʃ, tʃ^h, tʃ', s'/, as shown in (4a) and (4c). The glide /w/ does not precede round vowels /o, u/ nor follow labial consonants /p, p^h, p', m/, in (4b) and (4d).

(4) Co-occurrence restriction of Korean onglides (Sohn 1987, Lee 1993)
    a. *yi, ye, yə, yu, yo, ya
    b. *wu, *wo, wi, we, wə, wa
    c. */ t, t^h, t', tʃ, tʃ^h, tʃ', s'/+ /y/
    d. */p, p^h, p', m/ +/w/

The co-occurrence restriction between a glide and its following vowel is claimed to support the nucleus hypothesis of glides, while the co-occurrence restriction between a glide and its preceding consonant is argued for the onset hypothesis.

Apparently, the most solid evidence for the onset hypothesis is optional glide formation in casual speech, by which a glide /y/ or /w/ is produced in between two vowels to eliminate vowel hiatus, as in (5). According to Lee (1993), the glide formation occurs to remove onsetless syllables and to fill the empty onset position: if glides are nucleus segments, then it is not obvious why a sequence of two vowels is changed into a sequence of a glide and a vowel.

(5) Glide Formation (Lee 1993, Kim et al. 2008)
    stem+ infinitive /ə/

	Formal	Casual	
a. w glide			
/k'u+ə/	[k'uə]	[k'wə]	'to loan money'
/tu+ə/	[tuə]	[twə]	'to put'
/po+a/	[poa]	[pwa]	'to see'
b. y glide			
/ki+ə/	[kiə]	[kyə]	'to crawl'
/titi+ə/	[titiə]	[tityə]	'to step on'
/i+ə/	[iə]	[yə]	'to thatch'

Data from the "Popuri" language game in Korean also provides conflicting views on the status of Korean onglides. Output forms of the Popuri game are derived from a lexical word by adding CV at the end of each vowel segment, where an inserted consonant C is /p/ and an inserted vowel copies the preceding vowel, as in (6).

(6) Data from the Popuri Language Game (Kim 1991, Lee 1993)

    a. satali   → sa-<u>pa</u>-ta-pa-li-pi   'ladder'
    b. tʃamsil → tʃa-<u>pam</u>-si-pil   'place name'
    c. yaku   → ya-<u>pya</u>-ku-pu   *ya-pa-ku-pu   'baseball'
    d. kwənse → kwə-<u>pwən</u>-se-pe   *kwə-pən-se-pe   'power'
    e. hakkyo → ha-pak-kyo-<u>po</u>   *ha-pak-kyo-pyo 'school'
    f. yəŋkam → yə-<u>pəŋ</u>-ka-pam   *yə-pyəŋ-ka-pam 'husband'

Supporting the nucleus status of glides, Kim and Kim (1991) provide data (6c) and (6d) where the inserted vowel copies a glide and vowel sequence of /ya-/ and /-wə-/ of the preceding syllable. In contrast, data (6e) and (6f) claim the opposite (Lee 1993). In the transformation of /hakkyo/ and /yəŋkam/ to /ha-pak-kyo-<u>po</u>/ and /yə-<u>pəŋ</u>-ka-pam/, glide-vowel sequences /-yo/ and /yə-/ do not group together, with a vowel portion copied in the output forms, supporting the onset status of onglides.

   Another set of data on glide coalescence in Kyungsang Korean provides conflicting views of Korean onglides. Glide coalescence in Kyungsang Korean seems to support the nucleus hypothesis of Korean onglides since a glide and vowel sequence undergoes coalescence as in (7a) and (7b), where /-yə-/ is realized as /-e-/. This coalescence supports the grouping of a glide and its following vowel.

(7) Coalescence and its blocking of a glide and vowel sequence in Kyungsang Korean (Lee 1999)
    a.   kyəlhon → keron   'marriage'
    b.   kyəul → keul   'winter'
    c.   yətʃa → *etʃa   'woman'
    d.   yəu → *eu   'fox'

However, data in (7c) and (7d) show the coalescence does not occur when a glide is positioned word-initially.

   The conflicting data in (7) induce the duality hypothesis of Korean onglides (Lee 1999, Yun 2006). Lee (1999) and Yun (2006) argue that Korean onglides are in the nucleus position when there is a preceding tautosyllabic consonant, as in (6a) and (6b), while they are in the onset position when there is no tautosyllabic preceding consonant as in (6c) and (6d). Accordingly, 'kyəul' (winter) and 'kyəlhon/ (marriage) undergo glide coalescence because the glide /y/ is in the nucleus, but 'yətʃa' (woman) and 'yəu' (fox) does not because the glide /y/ is in the onset position under the duality hypothesis.

   Next, another proposal to incorporate a glide as a secondary feature of the preceding consonant has been made based on the apparent dual functions of a glide, phonetic observation, and data from loanword adaptation in Korean (Kim 1998, Chung 2007, and Kim et al. 2008). This secondary articulation approach postulates only a CVC structure for Korean syllables: it allows neither a branching onset nor a branching

nucleus. Chung (2007) presents English loanwords for supporting evidence, where an English consonant-glide sequence does not appear in the Korean loanword. According to Chung (2007), the consonant-glide sequence is transformed by means of 'i-epenthesis' between a stop and a glide and labialization or palatalization of the first consonant of the sequence in Korean. For example, the English words /twist/ 'twist' and /kyu:t/ 'cute' are adapted as /tɨwistɨ/ and /kʰʸutɨ/ in Korean loanwords, as in (8b).

(8)   English Loanwords with a complex onset (Chung 2007)
    a.   [printer]   'printer'   [pʰɨrintʰə]
         [plækard]   'placard'   [pʰɨlækʰadɨ]
         [blaynd]   'blind'   [pɨlaindɨ]
         [klinik]   'clinic'   [kʰɨlinik]
         [trʌk]   'truck'   [tʰɨruk]
         [θril]   'thril'   [sɨril]
    b.   [twist]   'twist'   [tɨwisɨtɨ]
         [sweter]   'sweater'   [sɨwetə]
         [kwin]   'queen'   [kʰʷʸin]
         [tyu:nə]   'tuna'   [tʰʸuna]
         [kyu:t]   'cute'   [kʰʸutʰɨ]

Data (8a) show that English word-initial consonant clusters, /pr-, pl-, bl-, kl-, tr-, θr-/ are pronounced with /ɨ/-epenthesis in between two consonants in Korean. It is because Korean does not allow such a consonant cluster, so the foreign sound sequence is transformed to fit Korean phonology. On the other hand, the data in (8b) presents a consonant-glide sequence of /tw-, sw-, kw, ty-, ky-/, which is legitimate in Korean, but the sequence surfaces with an epenthetic vowel /ɨ/ or with a secondary articulation of glides. According to Chung (2007), epenthesis or glide deletion in (8b) should not occur if Korean allows a consonant-glide sequence. Based on the data (8b), Chung (2007) claims that Korean does not allow a consonant-glide sequence and instead a glide is manifested as a secondary feature of its preceding consonant in Korean.

We have examined the data which has given rise to four different phonological views on Korean onglides. In the next section, I will argue against the onset hypothesis, the duality hypothesis and the secondary articulation hypothesis, based on their assumption and analyses on the data. Given that simpler is better, I will argue for the nucleus hypothesis: without a dual structure of glides and a non-phonological concept of secondary articulation, Korean glides should instead be represented in the nucleus position.

2.2 Problems with previous studies

First, table 1 presents which data each of the four hypotheses accounts for. The nucleus hypothesis has been argued to have problems with accounting for glide formation between two vowels, co-occurrence restriction between a consonant and a glide, patterning of a consonant and a consonant-glide sequence in a language game, glide coalescence blocking, and loanword adaptation. On the other hand, the onset hypothesis has difficulties in explaining consonant cluster simplification, co-occurrence restriction between a glide and a vowel, patterning of a glide-vowel sequence and a vowel in a language game, glide coalescence, and loanword adaptation.

Table 1. Comparison of four hypotheses on Korean onglides

DATA	Nucleus	Onset	Duality	Sec. A
1. Consonant Cluster Simplification	O		O	O
2. Co-occurrence Restriction (G and V)	O			
3. Co-occurrence Restriction (C and G)		O		O
4. Glide Formation		O	O	O
5. Language Game I	O			
6. Language Game II		O	O	O
7. Glide Coalescence	O		O	
8. Glide Coalescence Blocking			O	
9. Loanword Adaptation				O

The duality hypothesis and the secondary articulation hypothesis account for more data than either the nucleus hypothesis or the onset hypothesis does since they assume two different functions of a glide within a syllable: nucleus and onset, and onset and a secondary feature. However, neither of them account for all the data.

The duality hypothesis (Lee 1999, Yun 2006) predicts a glide functions as a part of diphthong when there is a preceding tautosyllabic consonant, and as an onset when there is no preceding consonant. However, data reported in the Korean language game in (6) do not show such a distinction: the two different structures of a glide cannot account for the conflicting patterns in (6). As in (6c) and (6d), /ya-/ in /yaku/ and /-wə-/ in /kwənse/ are copied respectively in the second syllable of the output word even though /y/ and /w/ are predicted to be placed in a different position within a syllable: /y/ in the onset, and /w/ in the nucleus due to the preceding /k-/. Thus, the prediction of the duality hypothesis turns out to be false in the language game.

With respect to co-occurrence restriction, the duality hypothesis makes incorrect predictions: i) there would be no co-occurrence restriction between a consonant and a glide when it is preceded by a tautosyllabic consonant and positioned in the nucleus; and ii) there would be no co-

occurrence restriction between a glide and a vowel if a glide is placed syllable initially and in the onset position. Of course, the predictions are false.

The secondary articulation hypothesis (Chung 2007, Kim et al. 2008) is partly based on phonetic observation. Kim et al. (2008) argue that Suh (2007) provides phonetic evidence of a secondary articulation of Korean glides. However, Suh (2007) is not a study to prove that Korean glides are realized as a secondary feature of its preceding consonant. Suh (2007)'s phonetic study is designed to compare a CWV sequence with a CV sequence in Spanish and Korean, and finds stronger F2 lowering effect of /w/ at the vocoid onset in Spanish than in Korean and different stop release burst spectral mean frequencies in both languages. Her study does not provide any evidence for the secondary articulation of /w/ in Korean CW clusters. The fact that the F2 lowering effect of /w/ is weaker in Korean than in Spanish does not prove that /w/ is realized as a secondary feature of its preceding consonant in Korean. Further solid phonetic study is required, including the comparison of F2 values of an isolated /w/ sound in both languages.

Chung (2007) reports his phonetic observation of a seven year old Korean-English bilingual child's pronunciation of English and Korean words: Korean shows a very short transition of glides in a consonant-glide sequence, compared to English. However, this approach is not adequate to argue for the different syllable structures of the two languages, Korean and English. Besides phonological structures of each language, a language has a distinct phonetic representation. Even if two languages have the same phonological structure, they may have different phonetic manifestations.

Even if a consonant is produced with secondary articulation, it does not mean that the secondary articulation is phonological. In Korean, a palatalized or labialized consonant is not phonemic. The secondary articulation, if it is, might be the by-product of phonetic co-articulation of a consonant-glide sequence. We should be more cautious to distinguish co-articulation of a consonant-glide sequence from the secondary articulation: there should be phonetic criteria to differentiate a $C^{G}V$ sequence from a CGV sequence. Therefore, it is desirable to define Korean syllable structure based on phonological patterns in Korean.

Even under the secondary articulation hypothesis, co-occurrence restriction between a glide and a vowel, the patterning of GV and V in the language game are not fully explained since the grouping of a GV does not occur on the surface: a glide occurs as a secondary feature of the onset consonant or as an onset itself. In order to account for the dual function of glides, Kim et al. (2008) argues that Korean onglides are floating features [labial] and [coronal]. However, their analysis does not account for the patterning of a GV and a V shown in (4) and (6), either: on the surface form, their floating features are always realized in the onset position of

standard Korean.[1]

So far, I have argued that each of the four different views on Korean onglides has its limitations in accounting for the data in section 2. In the next section, I propose that Korean onglides are a part of diphthongs in the nucleus position, which is the same as the previous nucleus hypothesis. In order to argue for the nuclear onglides, I reanalyze some of the phonological patterns discussed in the previous studies: co-occurrence restriction between a consonant and a glide, glide formation, a patterning of C and CG in a language game, glide coalescence blocking, and loanword adaptation.

3. Korean nuclear onglides

I claim that Korean onglides /y/ and /w/ are a part of the diphthongs /ye, yə, yu, yo, ya, wi, we, wə, wa/ and they are not positioned in the onset position. This hypothesis predicts the grouping of a glide-vowel sequence and a vowel, but not the grouping of a consonant-glide sequence and a consonant in Korean phonology. Accordingly, the prediction contradicts many phonological patterns in Korean if the previous analyses are correct. I now present a new approach to the contradicting data.

First, the co-occurrence restriction between a consonant and a glide in (4c) and (4d) is supposed to argue for the onset status of onglides. However, it is not the case. According to Davis and Hammond (1995), a sonority distance restriction between the consonant and the glide in CGV sequences provides evidence for the glide being part of the onset. For example, the English glide /w/ is preceded by obstruents but not by nasals, as in (9a) and (9b). It is because two consonants in the same constituent onset have to follow the language-specific restriction on sonority distance. On the other hand, the English glide /y/, which is in the nucleus position, does not follow the sonority restriction, thus it may follow both obstruents and nasals, as in (9c).

(9)   a. *nw-:
        b. kw-, sw-, tw-: queen, sweet, twin
        c. my-, ny-, ky-, fy-, ty- : muse, news, cue, few, tune

In Korean, there is no sonority distance restriction between a consonant and a glide in CGV sequences. Glides /y/ and /w/ can follow both obstruents and nasals, as in (10).

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[1] Kim et al. (2008) argue that floating features [labial] and [coronal] are attached to a vowel in the nucleus in Kyungsang Korean, where glide coalescence is observed.

(10) a.   nw-   : nwe (brain)
     b.   kw-, tw-, sw-   : kwi (ear), twi (back), swin (fifty)
     c.   my-,   : myən (noodle)
     d.   ky-, py-   : kyəul (winter), pyəŋ (bottle)

In Korean, the co-occurrence restriction between a consonant and a glide in CGV sequences in (4c) and (4d) is on the homorganic sequence: coronal consonants do not precede coronal glide /y/ in a CYV sequence, and labial consonants do not precede labial glide /w/ in a CWV sequence. However, as mentioned in Steriade (1988), constraints against homorganic tautosyllabic sequences can hold regardless of subsyllabic constituency: constraints on homorganic sequences are irrelevant to the internal structure of a syllable. Accordingly, the co-occurrence restriction between a consonant and a glide in a CGV sequence in Korean does not support the onset hypothesis of Korean onglides.

Second, it has been taken for granted that glide formation in Korean is solid evidence for the onset status of Korean glides. Its proponents argue that glide formation is a process to fill the empty onset position. However, glide formation is irrelevant to syllable structures, as argued in Blevins (2008). According to Blevins, glides evolve spontaneously between adjacent vowels: in hiatus contexts formant transitions between adjacent vowels can give rise to the percept of a medial glide.[2] She claims the requirement that syllables have onsets is unnecessary but also inaccurate since glide formation occurs only in vowel hiatus context but not in onsetless syllables. Across languages, there are no known cases where glide formation occurs before a vowel-initial word. Accordingly, glide formation in Korean cannot be used as supporting evidence for the onset status of Korean onglides.

Third, the 'Popuri' language game data in (11) shows two different patterns of glides, grouping with either the preceding onset consonant or the following vowel. In (11b), a glide and a vowel appear together in the second syllable, but in (11c), a glide does not appear in the second syllable. I argue that the grouping of a glide and a vowel are phonologically natural since they are nuclear constituents while the grouping of a glide and its preceding consonant results from "the emergence of the unmarkedness".[3] In other words, glide deletion of the output form results from the constraint which prohibits a diphthong (*GV). The constraint is generally inert in Korean phonology but becomes *optionally* active in this partial reduplication form (Lee 1999).

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[2] Chitoran and Hualde (2007) also argue that the developments from vowel hiatus to diphthongs are articulatorily and perceptually motivated: diphthongs are more stable than vowel hiatus in articulation and the percept of a glide in VV sequences arises from substantial overlap between the two vowels, resulting in a shorter overlapped glide.
[3] See McCarthy and Prince (1994).

(11) Outputs of the Popuri language game
    a. CV̲C → CV. [p]V̲C
    b. CG̲VC → CGV. [p]G̲VC
    c. *CGV̲C → CGV. [p]V̲C*

Kang (2003)'s findings concerning speech errors are notable: the glide interacts either with the following vowel or with the preceding consonant in errors, but the glide is more often associated with the following nucleus vowel than the onset in errors. Based on the data, Kang (2003) argues that the glide is considered as part of the nucleus rather than as an onset. Now I present the error data relevant to glides from Kang's study, where there is asymmetry between glide onset errors and glide nucleus errors.

(12) Speech errors of glides (Kang 2003)[4]
              Target   Erros
    a. V→GV/GV→V
        i) pʰ**u**ŋ.ky̲ə̲ŋ.hwa.ka   pʰ**y̲ə̲**ŋ.kyəŋ.hwa.ka
          (landscape-picture-Subj)
        ii) ta.paŋ.m**y̲ə̲**n.e   ta-paŋ.m**a̲**n.e
          (all areas-Loc)
    b. CG→C/ *C→CG
        i) p̲o-ko   **m̲y̲**o.sa.li̵l   p̲o.ko   **p̲**o.sa.li̵l
          (see-and) (description-Obj)
        ii) tæ.**h̲w̲**a   sikan.i̵l   tæ.**k̲**a   sikan.i̵l
          (talk)   (time-Obj)

In errors, a vowel alternates with a GV sequence and vice versa, as in (12 a) where /-u-/ and /-yə-/ surfaces as /-yə-/ and /-a-/ respectively. However, it should be noted that in her study a single consonant may replace a CG sequence, but a CG sequence does not replace a single consonant, as in (12b) where /my-/ and /-hw-/ surface /p-/ and /-k-/ respectively. If both a CG sequence and a C are an onset constituent, then they could alternate with each other, just as a GV sequence and a single vowel do so. But it is not the case. I claim this one way alternation (CG to C) is evidence for "the emergence of the unmarkedness" but not evidence for the onset status of Korean glides.

Turning to glide coalescence and its blocking in Kyungsang Korean, it is clear that glide coalescence is a process to change marked diphthongs into

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[4] Kang (2003) also reports the alternation between a single glide /y/ or /w/ and a single C as in (a) and (b). The change in (a) is also one example of the emergence of unmarkedness since a possible output /myə-/, a marked form with a diphthong /-yə/, is not selected for its output form. The change of /p/ to /w/ in (b) may be analyzed as one of consonantal weakening, but not as one of consonant substitution.

    (a) sa.pæk(4-100) y̲ə̲.manmyəŋ (around-10.000) → sa.pæk m̲ə̲.man.myəŋ
    (b) ko.p̲i.ka (crisis-Subj) twe.l → ko.w̲i.ka   twel

unmarked monophthongs under the nuclear hypothesis. However, it is not clear why glide coalescence does not occur when a glide is placed word-initially, as in (7c) and (7d). I claim that glide coalescence occurs only if a diphthong is preceded by a tautosyllabic consonant: a glide-vowel sequence is a marked structure, but a consonant-glide-vowel sequence is a more marked structure, as in (13a). Accordingly, the glide coalescence in Kyungsang Korean occurs due to the higher ranked constraint *CGV in (13b): a glide-vowel sequence remains intact even it is marked.

(13)   a. *CGV >> *GV
        b. *CGV: A consonant-glide-vowel sequence is prohibited.
        c. *GV: A glide-vowel sequence is prohibited.

These sequential constraints are irrelevant to sub-syllabic structures and are based on Clements (1990)'s Sonority Sequencing Principle. According to Clements (1990), the initial demisyllable maximizes the contrast in sonority among its members, while the final demisyllable minimizes it. And he proposes complexity rankings for demisyllables of two and three members based on the sonority scale: Obstruent < Nasal <Liquid < Glide <Vowel, as in Table 2.

Table 2. Complexity rankings for demisyllables[5]

Demisyllables		D[6]
a. Initial two-members	OV	0.06
	NV	0.11
	LV	0.25
	GV	1.00
b. Initial three-members		
	OLV	0.56
	ONV, OGV	1.17
	NLV, NGV	1.36
	LGV	2.25

In table 2, D is a measure of dispersion of the distance in sonority rank between the various pairs of segments within a demisyllable: the value for D is lower to the extent that sonority distances are maximal and evenly distributed (Clements 1990: 303). Table 2 shows that a glide and vowel

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[5] Here, a syllable is divided into two overlapping parts in which the syllable peak belongs to both; each of these parts is termed a demisyllable (Clements 1990: 303). The definition of a demisyllable is irrelevant to sub-syllabic structures.

[6] D is defined by the following equation in (a) (Liljencrants and Lindblom 1972, Clements 1990).

   (a)
$$D = \sum_{i=1}^{m} 1/d_i^2$$

sequence (GV) is less marked than a consonant–glide-vowel sequence (CGV: OGV, NGV and LGV).

Tableaux in (14) and (15) show how the output form is selected in Kyungsang Korean under the interaction of constraints, *CGV and *GV.

(14)   / kyə.ul / → [ke.ul] 'winter'

kyə.ul	*CGV	Max[COR][7]	MAX[8]	*GV
a. kyə.ul	*!			*
☞ b. ke.ul			*	
c. kə.ul		*!	*	

(15) /yə.ʧa/ → /yə.ʧa/ 'woman'

yə.ʧa	*CGV	Max[COR]	MAX	*GV
☞a. yə.ʧa				*
b. e.ʧa			*!	
c. ə.ʧa		*!	*	

In tableau (14), candidate (b) [kyeul] surfaces out satisfying higher ranked constraints *CGV and Max[COR], but candidates (a) and (c) are out due to violation of *CGV and Max[COR] respectively. Tableau (15) reveals how candidate (a) without glide coalescence becomes the output form. The faithful candidate to the input /yəʧa/ in (15a) vacuously satisfies *CGV since a glide-vowels sequence does not have a tautosyllabic preceding consonant. The output form (a) surfaces satisfying higher ranked constraints Max[COR] and MAX. Therefore, glide coalescence blocking in Kyungsang Korean can be neither a counter example to the nuclear hypothesis nor a supporting example for the onset hypothesis or the duality hypothesis.[9]

Next, let's examine Chung (2007)'s data of loanwords in (8b) presented to argue against a consonant-glide sequence, either a [CG]V cluster or a C[GV] cluster in Korean. A consonant-glide English sequence is transformed with an epenthetic vowel /ɨ/ before a consonant (e.g. /sɨwitɨ/ 'sweet') or with a very short transition of glides (e.g. /kyu:tɨ/ 'cute') in Korean. Contrary to Chung's claim, the given data do not prove that Korean does not allow a CGV sequence. As claimed in various studies (Silverman 1992, Kenstowicz 2001, Broselow 2003, Yip 2006, and etc.), loanword adaptation involves both phonology and phonetic similarity between loan and native segments. The pattern of loanword adaptation in (8b) may arise from the different phonetic manifestation of glides rather

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[7] Max[Coronal]: An input [coronal] feature must have an output correspondent.
[8] MAX: An input segment should have its output correspondent.
[9] In standard Korean, MAX is higher ranked than *CGV and *GV and, therefore, the input forms /kyə.ul/ and /yə.ʧa/ surface out as they are. The ranking of *CGV >> *GV is ineffective in standard Korean.

than the different phonological structure between two languages, English and Korean. Therefore, the loanword adaptation cannot be evidence to argue against the Korean CGV sequences.

So far, I have argued that five different phonological patterns: co-occurrence restriction between an onset consonant and its following glide, glide formation, the grouping of an onset consonant and a consonant-glide sequence in a language game, glide coalescence blocking in Kyungsang Korean, and loanword adaptation of an English consonant-glide sequence do not disprove the nuclear status of Korean onglides. On the other hand, consonant cluster simplification, the grouping of a vowel and a glide-vowel sequence in a language game, and glide coalescence are evidence for the nucleus status of Korean onglides, as shown in previous studies (Sohn 1987, Kim 1990, Kang 1991, Kim 1998, Lee 1999, and Kim et al 2008).

To support the nuclear onglide in Korean, I present a set of data from Korean ideophones of partial reduplication from Chae (2003). The data in (16) reveal that a vowel and a glide-vowel sequence pattern together. Chae (2003) divides partial reduplicated ideophones into three different groups: i) vowel alternation, ii) consonant alternation, and iii) syllable (CV) alternation.

(16) Korean Ideophones of partial reduplication
    a. Vowel alternation (V-V)

/i/-/e/:	mi̱k'ɨn-me̱k'ɨn	'slippery',
	siluk-seluk	'in a twitch'
	tʰikyək-tʰekyək	'in bickering'
/i/-/ya/:	<u>ilkɨt-yalkɨt</u>	'in a twisted shape'
	<u>ilkitʃuk-yalkitʃuk</u>	'in a twisted shape'
/ɨ/-/a/:	t'ɨ̱k'ɨm-t'a̱k'ɨm	'smarting, burning'
	nɨnsil-nansil	'behaving licentiously'
/we/-/e/:	<u>kwepal-kepal</u>	'scribbling'
/wi/-/e/:	<u>twisuŋ-tesuŋ</u>	'jabbering'

    b. Consonant alternation (∅V-CV)

∅-/tʃ/:	aki-tʃaki	'charmingly'
∅-/tʃ'/:	okɨl-tʃ'okɨl	'wrinkled and withered'
∅-/tʃʰ/:	ulɨŋ-tʃʰulɨŋ	'tossing'
∅-/p/:	atɨŋ-patɨŋ	'doing one's upmost'
	asak-pasak	'with a crunch',
	ulak-pulak	'looking roughly'
∅-/t/:	osun-tosun	'getting along'
∅-/tʰ/:	otol-tʰotol	'with grainy texture'
∅-/m/:	əntʰɨl-mətʰɨl	'with a rough surface'

    c. CV alternation (CV-CV)

∅VC-/pVC/:	antal-poktal	'fussy'
	əsɨt-pisɨt	'alike'

∅V-/tV/:	uksil-tɨksil	'swarming'
∅V-/kV/:	oksin-kaksin	'arguing'
∅V-/mV/:	əli-mali	'drowsily'
∅V-/tV/:	waksikɨl-təksikɨl	'swarming'
	walkɨlak-talkɨlak	'with rattling sound'[10]
/hV/-/mV/:	hɨŋtʃʰəŋ-maŋtʃʰəŋ	'squandering'

In data (16a) there is only vowel alternation between a base and a reduplicant[11] The underlined words, 'ilkɨt-yalkɨt′ (in a twisted shape, 'kwepal-kepal'(scribbling), and 'twisuŋ-tesuŋ' (jaberring) in (16a) are notable since they show alternation of a vowel and a glide-vowel sequence, /i~ya, we~e, wi~e/. This alternation cannot be accounted for under the onset hypothesis. Chae (2003) also notes that a vowel and a glide pattern together in Korean ideophones of partial reduplication.

The Korean writing convention also supports the view of Korean nuclear onglides. The Korean writing system was created with understanding of phonology as well as of the problem of how to symbolize the articulated sound stream with graphic means (Coulmas 2003). It is well-known that the Korean writing system is purely phonetic: each Korean character represents a sound. In this system, a glide is represented as a part of a vowel by adding one stroke to the vowel. That is, the designers of Korean letters interpreted a glide as a part of a vowel. In addition Korean orthography does not allow vowel graphs to stand alone: in the absence of an initial consonant they combine with a zero graph 'ㅇ'. Here, it should be noted that the zero graph 'ㅇ' is added when a syllable begins with a glide-vowel sequence: a glide-vowel sequence is treated as the same as a vowel in writing. Thus, it is obvious that the representation of a glide in Korean writing also supports the view of the nucleus status of Korean onglides.

4. Conclusion

In this paper I have argued for the nucleus status of Korean onglides: Korean onglides are a part of diphthongs, in the nucleus position. The nucleus hypothesis has been counter argued by three different approaches since a glide seems to pattern with the preceding consonant, but not with the following vowel in some phonological patterns: co-occurrence restriction, glide formation, language games, glide coalescence blocking, and loanword adaptation. As for these apparent counter examples, I

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[10] In Chae (2003), 'walkɨlak-talkɨlak' (with rattling sound) and ʹweŋkaŋ-teŋkaŋʹ(brassy) are included in the group of consonant alternation. I place them in the group of syllable alternation because all the members of consonant alternation except the two show '∅ ~ C' alternation.

[11] Here, I do not provide a formal analysis for the partial reduplication: I do not specify which part is a base of the partial reduplication. Whichever the base is, it does not affect the grouping of a vowel and a glide-vowel sequence in data (16).

provided a new analysis or perspective to account for: i) co-occurrence restriction on homorganic sequences is irrelevant to sub-syllabic structures; i) glide formation is not motivated to fill the empty onset position but motivated articulatorily and perceptually in vowel hiatus context; iii) the grouping of a C and a CG in a language game arises in order to avoid a marked CG sequence in reduplicant forms ("the emergence of the unmarkedness"); iv) glide coalescence in Kyungsang Korean occurs to avoid a CGV sequence, not a GV sequence; and v) loanword adaptation involves both phonology and phonetics of both loan and native languages. Under the new analysis, none of the previous counter examples can argue against the nucleus hypothesis. On the other hand, consonant cluster simplification, the grouping of a vowel and a glide-vowel sequence in the Popuri language game and speech errors, and glide coalescence still provide evidence for the nucleus status of Korean onglides. Furthermore, the nucleus hypothesis accounts for another set of Korean ideophone data and coincides with the Korean writing convention in interpretation of a glide status.

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