Korean Accent: Internal Reconstruction and Historical Development

Chiyuki Ito
Tokyo University of Foreign Studies,
Research Institute for Languages and Cultures of Asia and Africa

Abstract

This paper examines the accent systems of Middle Korean (MK) and the contemporary Korean dialects (North/South Kyengsang, Hamkyeng/Yanbian) both synchronically and diachronically, focusing on native simplex nouns. In an analysis of the MK accent system, we clarify correlations between a syllable's segmental shape and the accent class of the stem, and propose that in Proto-Korean native nouns did not have a distinctive pitch accent. We also show that MK (as well as Proto-Korean) had a right-to-left iambic prominence system in which the unaccented stem class had an underlying floating H tone reflecting the apocopated syllable from the earlier stage of the language. We then examine the regular accentual correspondences between MK and the contemporary dialects and hypothesize that the accent retraction found in the Kyengsang dialects ("Kyengsang accent shift") took place after the introduction of Sino-Korean vocabulary. Finally, based on an Optimality Theoretic analysis, we show that all dialects including MK tend to avoid a lapse in accent at the right edge of the word, which is accomplished by different repair strategies.

1. Introduction

Since the invention of an alphabetic writing system (Hangul) in 1446, the Korean language has been documented systematically. The language which was recorded in the earliest period, Middle Korean (MK, 15-16th C), is known as a language that had distinctive pitch accent. Standard Korean spoken in Seoul has lost this distinctive accent, and only the length distinction which goes back to a certain tonal category in MK is retained. On the other hand, various other dialects such as Kyengsang (South Korea), Hamkyeng (North Korea), and Yanbian (North-eastern China), still preserve the distinctive accentual contrasts. So far, various studies have examined the details of accent systems in these dialects both phonetically and phonologically (Ceng 1968a, 1968b, Cha 2004, Fukui 1991, 2000, 2003, Hashimoto 1973, Hattori 1958, Hayata 1974, 1976, 1978, 1999, Ito 2008, Kang 2005, 2008, Kanno 1972, Kenstowicz et al. 2007, C-K. Kim 1970, 1973, 1993, 1994a, 1994b, 1995, 1997, 2002, N-J. Kim 1997, Y-J. Lee 2000, 2002, Lee and Davis 2009, Miyashita 2007, Ooe 1976, 1977, Park 2001, Rha 1974, Son 2007, 2008, Umeda 1961, 1972, 1993, Utsugi 2009, and others). The accent of MK has also been analyzed by Ceng (1960, 1971, 1972), Fukui (1985, 2000), He (1955), Kadowaki (1976), W-C. Kim (1973), S-O. Lee (1978), Ramsey (1978), among others, and the correspondences between MK and contemporary dialects have been documented. In particular, Ramsey (1978) successfully showed the historical development from the older stage of Korean to contemporary dialects, by comparing the MK data with both Hamkyeng and Kyengsang dialects. Although there is still some controversy about some parts of his analysis, the basic generalizations made by Ramsey (1978) are valid.

Unlike MK, the linguistic information of the pre-MK period is extremely limited, due to the lack of sufficient documentation and systematic transcription methods. Thus in order to know the form of

the original Korean language (Proto-Korean), internal reconstruction based on the materials from MK as well as the contemporary dialects is essentially the only viable option. Of course, though fragmentary, information from written materials can sometimes be used to supplement the findings of internal reconstruction.

Given this background, the goal of this paper is, on the one hand, to examine the MK accent system and its correlation with segmental shapes, and, on the other, to compare it with the accent of the contemporary dialects (North/South Kyengsang, Hamkyeng/Yanbian). We focus on the analysis of native nouns in this paper,[1] since they are studied relatively less compared to verbal stems (Ceng 1963, Ramsey 1978, 1986, 1991, 2001, S-O. Lee 1978, Martin 1996). Our major findings are summarized as follows:

a. Proto-Korean had /*ï/, a counterpart of /i/, in its vowel harmony system. In MK, /*ï/ appears as /jə/.

b. MK (and probably Proto-Korean) had a minimal word restriction, prohibiting CV nouns (McCarthy and Prince 1993). Apparent exceptions are either bound forms/pronouns or derived from original diphthongs/disyllabic words.

c. Consonant clusters resulted from weak vowel syncope (Ramsey 1986, 1991, Whitman 1994), which is confirmed by the segmental distribution of disyllabic nouns. The process of weak vowel syncope may have eliminated monosyllabic noun stems *OʌO/OɨO (O = simplex obstruent) from Proto-Korean.

d. The monosyllabic High class is divided into two subcategories (H-a and H-b). These two classes as well as the Low and Rise classes correlated with the segmental shapes.

e. Among native monosyllabic nouns, only the H-b class originally consisted of monosyllabic stems. The hypothesis that the MK Low class developed from disyllabic stems with CV.Cʌ/CV.Cɨ structure is supported by evidence from its locative construction.

f. It is assumed that native nouns in Proto-Korean did not have a distinctive pitch accent. A default final accent was assigned for each stem (Ramsey 1986, 1991, 2001).

g. MK (as well as Proto-Korean) had a right-to-left iambic accent system. The unaccented class had a floating H tone underlyingly.

h. The accents found in contemporary dialects regularly correspond to the accents in MK, except for those in several accent classes. Shared irregularities among these contemporary dialects are observed in the disyllabic H-initial class. They are probably due to the conservative tonal representation found in MK texts, which was faithful to the etymological accent once the tonal distinctions had been established.

i. It is assumed that the MK/Hamkyeng/Yanbian dialects show a more conservative accent system than the Kyengsang dialect. A leftward accent shift (the "Kyengsang accent shift", Ramsey 1978: 80) took place after Sino-Korean words were introduced into Korean.

j. All dialects including MK tend to avoid a lapse at the right edge of the word. MK avoids it by alternating tone insertion, while Hamkyeng/Yanbian and Kyengsang do so by shifting initial H to other positions.

k. All accent classes in Kyengsang, including the typologically unusual double-H class, result from the leftward H tone shift in an LH sequence in an MK-type accent system with the right-to-left iambic footing, which led to the complicated synchronic grammar of the Kyengsang accent.

This paper is organized as follows. Section 2 introduces the materials which were used for the

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[1] A few words that may be old (nativised) Sino-Korean words are also included. E.g.) *mək* "ink", *sjoh* "layman", *tjəh* "flute".

current study. Section 3 examines the MK accent system and its correlation with segmental shapes. Section 4 investigates the correspondences of each accent class between MK and the contemporary Korean dialects. Section 5 is a summary and conclusion.

2. Materials

The data used in this study are collected from various sources. (1) summarizes the data sources.

(1) Data sources
a. North Kyengsang (NK): Rha (1974), Cen (1966a, b, 1967), C-K. Kim (1993, 1994a, 1994b), H-J. Kim (2012), three consultants from Taykwu in their 20's-40's.
b. South Kyengsang (SK): He (1955), C-K. Kim (2002), Kim et al. (2008), Hankwuk cengsin munhwa yenkwuwen (1993), Son (2008), five consultants from Pusan in their 20's-40's.
c. Hamkyeng/Yanbian (HY): Ramsey (1978), Umeda (1993), 21 consultants from Yanbian in their 20's-80's.
d. Middle Korean (MK, 15-16th C): collected by the author from approximately 30 major texts.

The representative accent of each word in contemporary Korean dialects was determined by the author based on a detailed examination of these sources. As a rule, the accent patterns that seem to be the most conservative were chosen.

3. Middle Korean accent[2]
3.1 Basic patterns

(2) shows the accent patterns observed in MK nouns. L, H, and R indicate low, high, and rising, respectively. R is assumed to be composed of L + H (Kōno 1945: 232).

   In MK, the first high pitch is distinctive and the tonal contour after the first H is predictable depending on the number of following syllables in the same phonological phrase (Ceng 1971, W-C. Kim 1973, Kadowaki 1976, Ramsey 1978, Fukui 1985). These predicted tonal patterns after the first H are notated as "X" in this paper.

(2) MK accent

Monosyllabic	Disyllabic	Trisyllabic
H	HX	HXX
L	LH	LHX
R	LL	LLH
	RX	LLL
		RXX

(3) shows representative tonal contours after the first H in MK.[3] The underlying/distinctive H tone

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[2] This paper as well as Hayata (1974), Ramsey (1978), Kadowaki (1976), Fukui (1985), and others treat the MK prosodic system as pitch accent, based on the fact that the distinctive element is the locus of a pitch change. Other studies such as He (1955), Ceng (1971, 1972), W-C. Kim (1973) refer to this system as "tone". S-O. Lee (1978), applying McCawley (1970)'s approach, takes a position intermediate between these two approaches.
[3] Other patterns are observed as well, as discussed in W-C. Kim (1973: 77-105). W-C. Kim (1973) describes these

is indicated with an underline. In order to explain these alternating tonal contours, some pitch assignment rules are required (Hayata 1974, Y-J. Lee 2012). The phonological analysis of these tonal contours is proposed in 3.3.

(3) MK alternating tonal contours

H̲	H̲H	H̲LH	H̲HLH	H̲LHLH
LH̲	LH̲H	LH̲LH	LH̲HLH	LH̲LHLH
LLH̲	LLH̲H	LLH̲LH	LLH̲HLH	LLH̲LHLH

(4) Examples[4]
a. *hál.mi* "grandmother": *hál.mí* #   *hál.mì.rʌ́l* "grandmother-ACC"
b. *sɨ́.mɨlh* "twenty": *sɨ́.mɨ̀l.héj* "twenty-LOC"   *sɨ́.mɨ́l.hì.mjə́* "twenty-COP- conjunctive"
c. *tós.ka.pi* "spirit": *tós.kà.pí* #   *tós.ká.pì.ní* "spirit-COP-sequential"
d. *hà.nʌ́lh* "sky": *hà.nʌ́l.háj* "sky-LOC"   *hà.nʌ́l.hàj.sjə́* "sky-dynamic LOC"   *hà.nʌ́l.hí.ə̀.nɨ́l* "sky-COP-literary concessive"
e. *nú.n* "eye": *nú.nɨ́n* "eye-topic"   *nú.nì.rá* "eye-COP-indicative-assertive"
f. *íp* "mouth": *íp.kwá* "mouth-COM"   *í.pʌ́.rò.sjə́* "mouth-instrumental"
g. *nɨ̌m* "master": *nɨ̌.mì.ə́.sì.ní* "master-COP-honorific-sequential"
h. *ptɨ̌t* "will": *ptɨ̌.tɨ́l* "will-ACC"   *ptɨ̌.tì.ó* "will-COP-gerund"   *ptɨ̌.tì.rí.ŋìs.ká* "will-COP-prospective polite attentive"

The MK H class nouns have been further classified into two sub-categories: H-a and H-b classes (W-C. Kim 1973: 73-74, Whitman 1994: 436-437). H-a class words always appear with H, whereas H-b class words appear with L before a locative suffix (-*aj*/-*əj*, -*ʌj*/-*ɨj*) and with H elsewhere. The L

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tonal alternations ("rules of rhythm") with a constraint on the occurrence of three successive high tones. Fukui (1985: 69-70) classifies the alternation patterns into two types: the first pattern appears as H̲, H̲H, H̲LH, H̲HLH, and the second pattern appears as H̲, H̲L, H̲HL, H̲LHL. He points out that "noun + particle" and verbal inflectional forms tend to appear with the former pattern. See Fukui (2013: 119-124) for more details.

[4] The transcription system for the examples in this paper is as follows. Middle Korean (MK) diphthongs have been monophthongized in Contemporary Korean (CK). Some symbols such as ㄹ, ㅇ are transcribed differently depending on environment. Consonant clusters in MK are transcribed as in ㅳ pt, ㅲ psk, ㅼ st, etc. For the MK accent, low pitch (= no dot), high pitch (= one dot) and rising pitch (= two dots) are transcribed with grave accent (ˋ), acute accent (ˊ), and both accents (ˇ) over the vowel, respectively. The precise codas of some nouns are unknown since they appear only in the environment of neutralization. In this case, the neutralized coda is indicated as follows: P = /p/ or /pʰ/; T = /t/ or /tʰ/; K = /k/ or /kʰ/; S = /s/, /sk/, /c/ or /cʰ/; L = /l/ or /lh/; M = /m/ or /mh/; N = /n/ or /nh/;] = Ø or /h/; j] = /j/ or /jh/. Other Korean words in the body of the paper follow the Yale Romanization system, except for some authors' names which follow the customary spelling.

MK	ㄱ	ㄴ	ㄷ	ㄹ	ㅁ	ㅂ	ㅅ	ㅇ	ㆁ	ㅈ	ㅊ	ㅋ	ㅌ	ㅍ	ㅎ	ㅸ	ㅿ
	k	n	t	r/l	m	p	s	Ø/ɣ	ŋ	c	cʰ	kʰ	tʰ	pʰ	h	β	z
	ㅏ	ㅐ	ㅑ	ㅓ	ㅔ	ㅕ	ㅖ	ㅗ	ㅘ	ㅙ	ㅚ	ㅛ	ㅜ	ㅝ	ㅞ	ㅟ	ㅠ	ㅡ	ㅢ	ㅣ	ㆍ
	a	aj	ja	ə	əj	jə	jəj	o	wa	waj	oj	jo	u	wə	wəj	uj	ju	ɨ	ɨj	i	ʌ

CK	ㄱ	ㄲ	ㄴ	ㄷ	ㄸ	ㄹ	ㅁ	ㅂ	ㅃ	ㅅ	ㅆ	ㅇ	ㅈ	ㅉ	ㅊ	ㅋ	ㅌ	ㅍ	ㅎ
	k	k*	n	t	t*	r/l	m	p	p*	s	s*	Ø/ŋ	c	c*	cʰ	kʰ	tʰ	pʰ	h
	ㅏ	ㅐ	ㅑ	ㅓ	ㅔ	ㅕ	ㅖ	ㅗ	ㅘ	ㅙ	ㅚ	ㅛ	ㅜ	ㅝ	ㅞ	ㅟ	ㅠ	ㅡ	ㅢ	ㅣ
	a	ɛ	ja	ə	e	jə	je/e	o	wa	wɛ	we	jo	u	wə	we	wi	ju	ɨ	ɨj/i	i

and R classes do not show any alternations and remain L and R. This locative alternation is not observed in disyllabic or longer stems (W-C. Kim 1973: 74, Fukui 1985: 65, 2013: 101).

(5) Examples
a. H-a class: *mɨ́l* "water"   *mɨ́.rɨ́l* "water-ACC"   *mɨ́.rə́j* "water-LOC"
b. H-b class: *móm* "body"   *mó.mí* "body-NOM"   *mò.máj* "body-LOC"
c. L class: *cìp* "house"   *cì.pɨ́l* "house-ACC"   *cì.pɨ́j* "house-LOC"
d. R class: *nǔn* "snow"   *nǔn.kwá* "snow-COM"   *nǔ.nə́j* "snow-LOC"

H-b class words also tend to appear with L when they constitute the first member of compound words (W-C. Kim 1973: 73-74, Whitman 1994: 436-437).[5]

(6) Examples: the first member of the compounds belongs to the H-b class.
a. H-b + H: *nùns.kóP* "eye + mucus", *òs.kíc* "clothing + genitive *s* + collar"
b. H-b + L: *kùj.mìt^h* "ear + bottom", *pàs.tìŋ* "foot + back" [< *pal* + genitive *s* + *tiŋ*]
c. H-b + LH: *nùn.cλ.zʌ́* "eye + nucleus"
d. H-b + LL: *pàs.kà.ràk* "foot + stick"

3.2 Middle Korean accent and segmental shapes

In this section, we examine the MK accent classes based on their segmental shapes.

3.2.1 Previous studies

Ramsey (1978, 1986, 1991) classifies monosyllabic verbal stems into eight classes. Among them, Classes 1, 6, and 2 (strictly speaking, Class 2b) show the following tonal contrasts.

(7) Class 1, 6 and 2 verbal stems

	Class 1	Class 6	Class 2
C-initial suffix	kùp.tá "it's bent"	kŭp.tá "(I) bake it"	psɨ́.tá "(I) use it"
V-initial suffix	kù.pɨ́.mjə́n "if it's bent"	kù.βɨ.mjə́n "if (I) bake it"	psɨ́.mjə́n "if (I) use it"

Class 1 stems have a fixed L tone and are closed by voiceless obstruents. Class 6 stems alternate between R tone (before consonant [obstruent]-initial suffix) and L tone (before vowel-initial suffix), and are closed by voiced obstruents or sonorants. Class 2 stems have a fixed H tone along with a characteristic canonical shape: open syllable, initial consonant cluster or aspirate, minimal vowel /ʌ/,

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[5] Still, accentual behavior in these two conditions (locative, compounds) seems to not always be the same. For example, in compounds H-b class words do not necessarily become L, whereas some words from H-a appear with L. E.g.) *pʌ́j* (H-a, "boat"): *pʌ̀j.táj ~ pʌ́j.táj* "boat + pole", *pʌ̀j.tòsk ~ pʌ́j.tòsk* "boat + sail". R class words may alternate to L in compounds as well (Mun 1966: 60-61, Ramsey 1978: 132-133). E.g.) *mǒjh* (R, "mountain): *mòjs.kʌ̌z* "mountain + genitive *s* + edge", *mòjs.kì.sɨ́lk* "mountain + genitive *s* + bottom", *mòjs.ə̀n.tə̀K* "mountain + genitive *s* + hill". The alternations in these compound words may be due to a separate compound accent rule. In this paper, the classification between H-a and H-b is based on the accent patterns before a locative suffix.

/ɨ/ or /i/.[6]

Based on these tonal patterns and segmental shapes, Ramsey (1986: 183-184, 1991: 237) proposes the following reconstructions for Proto-Korean, which are different from the MK forms.

(8) Ramsey (1986: 183-184, 1991: 237)
a. Proto-Korean had no pitch, length, or stress distinctions. The last syllable of a stem was automatically given prominence. The pitch distinctions in MK and contemporary dialects resulted from segmental changes.
b. The most important segmental changes were vowel syncope and apocope.
c. The clusters produced by syncope were reduced to the aspirated and tense consonants in Contemporary Korean. Tense consonants are attested as clusters in MK texts. Aspirates developed from clusters containing a velar obstruent.
d. Proto-Korean had a consonant system with a [±voice] distinction.

Thus the three accent classes mentioned above are assumed to have developed as in (9). The voiced final in Class 6 results in compensatory lengthening after syncope.

(9) Reconstruction by Ramsey (1986: 191-194, 1991: 229)

	Proto-Korean		Syncope	Devoicing	Lenition	MK
Class 1	*kù.pɨ́- "be bent"	*kù.pɨ́.tá	kùp.tá			kùp.tá
		*kù.pɨ́.mjə́n				kù.pɨ́.mjə́n
Class 6	*kù.bɨ́- "bake"	*kù.bɨ́.tá	*kùúb.tá	kùúp.tá		kŭp.tá
		*kù.bɨ́.mjə́n			kù.βɨ́.mjə́n	kù.βɨ́.mjə́n
Class 2	*pɨ.sɨ́- "use"	pɨ.sɨ́.tá	psɨ́.tá			psɨ́.tá
		pɨ.sɨ́.mjə́n	psɨ́.mjə́n			psɨ́.mjə́n

This hypothesis was partially emended later by Ramsey (2001), following Martin (1996) which denies the existence of a voice distinction in Proto-Korean. Martin (1996: 48) states that "I am unhappy with the burden of an additional set of obstruent phonemes that occur only medially and (in verb forms, at least) only before the minimal vowels", and explains that voiced segments in MK resulted from lenition in a certain environment. Fukui (2013: 157-158) also assumes that a voice distinction did not exist at least back to the Kolye period, based on the phonetic realization of nasals as pre-voiced nasals in Korean which is documented in *Nichūreki* 二中歴 and *Sezokujiruisyō* 世俗字類抄 (both 12th C), since they are confusable with voiced obstruents. In the emended hypothesis, Class 1 stems have always been monosyllabic with a fixed low tone followed by a high pitch in the following suffix, while Class 6 stems were disyllabic whose intermediate consonant was voiceless. In this framework, Class 1 and 6 contrasted only by the presence or absence of a stem-final vowel.[7]

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[6] This correlation between syllable shapes and accent classes is pointed out by Ceng (1963) as well.

[7] Still, as pointed out by Ramsey (1991: 226, fn. 18, 2001: 13), this emended hypothesis has several problems. For example, it cannot explain why Class 1 stems never end in /m/ and /n/, while Class 6 stems frequently do so. Also, an arbitrary phonological condition is necessary to explain the difference in the application of the lenition rule between Classes 1 and 6, as seen in *kù.pɨ́.mjə́n* vs. *kù.βɨ́.mjə́n*. That is, we have to assume that Korean speakers could tell the difference between a stem-final vowel and a suffix-initial vowel in some way.

(10) Reconstruction by Ramsey (2001: 13-14)

	Proto-Korean		Syncope	Lenition	MK
Class 1	*kùp- "be bent"	*kùp.tá			kùp.tá
		*kù.pɨ.mjə́n			kù.pɨ.mjə́n
Class 6	*kù.pɨ- "bake"	*kù.pɨ.tá	*kùúp.tá		kŭp.tá
		*kù.pɨ.mjə́n		kù.βɨ.mjə́n	kù.βɨ.mjə́n

In spite of this emendation, Ramsey (1986, 1991)'s hypothesis about the syncope process is still important and valid. Such an approach was taken by Whitman (1994). He extended Ramsey (1986, 1991)'s reconstruction of verbal stems to native nouns and reconstructed the atonic monosyllabic nouns in MK as disyllabic stems in Proto-Korean. He proposed that weak vowel syncope was applied not only between voiceless consonants but also in absolute final position following a voiceless consonant. (11) summarizes this process that produced the atonic class.

(11) Weak Vowel Syncope (revised by Whitman 1994: 428)
        ʌ, ɨ → Ø / C$_1$ [−voice] ____ C$_2$ [−voice] or C$_1$ [−voice] ____#

Similarly, Whitman (1994: 428-429) proposed that MK rising monosyllabic nouns also resulted from disyllabic words, where a minimal vowel following a voiced consonant is syncopated. According to him, monosyllabic nouns in the H class are reconstructed as originally monosyllabic stems. Thus Whitman (1994: 428) summarized the consequent reconstructed stem types as in (12).

(12) Reconstruction by Whitman (1994: 428)

Class	MK example	Reconstruction	Proto-Korean type
L	kòc "flower"	*kò.cʌ́	*CV.C[−voice]V
H	kóh "nose"	*kóh	*CVC
R	kŏl "valley"	*kò.rʌ́	*CV.C[+voice]V

Whitman (1994: 428) pointed out that (1) the monosyllabic R class nouns appear with the full range of sonorant consonant finals; (2) the monosyllabic H class nouns appear with the full range of vowels and all consonants except for /ŋ/; and (3) the monosyllabic L class nouns are almost entirely absent of sonorant finals. These segmental shapes provide a strong support for the reconstruction in (12).

As to the distinction between the H-a and H-b classes, he analyzed the former as underlyingly accented, but the latter as underlyingly unaccented; the latter acquires an H tone in the surface by ordering the rule of H-Insertion after compounding (but before attachment of nominal particles).

Unlike verbal stems that always accompany some suffixes, nouns can appear in isolation, which explains the different default accent of the stems themselves between verbs and nouns: L (= Class 1) for verbs vs. H for nouns. Given this and the general correlations between segmental type and accent classes in nouns, the analysis by Whitman (1994) about monosyllabic nouns is likely to be correct: both the L and the R classes resulted from disyllabic stems, whereas the H class is originally monosyllabic. In 3.2.2 and 3.2.3, we examine the MK monosyllabic and disyllabic nouns in detail, taking his analysis into account.[8]

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[8] An important implication of Whitman (1994)'s conclusion is that lax consonants did not appear as voiced in word-medial position, at least in Proto-Korean.

3.2.2 Monosyllabic stems
3.2.2.1 Basic morpheme structure

(13) shows the distribution of morpheme structures in MK monosyllabic native nouns. In the table, C indicates a single consonant (p, t, k, p^h, t^h, k^h, m, n, ŋ, l, s, h), and CC/CCC indicates a cluster of consonants (pt, pk, ps, pc, pst, psk, st, sk, sp, etc.). Similarly, V indicates a monophthong (a, ə, o, u, ʌ, ɨ, i), whereas VV/VVV indicates a diphthong/triphthong (aj, əj oj, uj, ʌj, ja, jə, wa, jəj, waj, etc.). Words whose precise underlying coda is unknown are excluded here.

(13) Morpheme structure in MK monosyllabic nouns

Nucleus	V			VV			VVV	
Coda	Ø	C	CC	Ø	C	CC	Ø	Totals
Onset: C	21	196	40	44	39	2	5	347
Onset: CC	3	18	3	6	1			31
Onset: CCC	3	4		3				10
Onset: Ø	2	13	9	2	3	2	1	32
Totals	29	231	52	55	43	4	6	420

(14) Examples
pá (CV) "place", *pál* (CVC) "foot", *pàsk* (CVCC) "outside", *pjə́* (CVV) "rice plant", *pjə́s* (CVVC) "cockscomb", *sjə́ks* (CVVCC) "reins", *hwáj* (CVVV) "torch", *ptí* (CCV) "wheel", *psʌ́l* (CCVC) "rice", *ptɨ́lh* (CCVCC) "garden", *ptʌ́j* (CCVV) "dirt", *skwə̀ŋ* (CCVVC) "pheasant", *pskí* (CCCV) "time", *pskɨ́l* (CCCVC) "chisel", *pskáj* (CCCVV) "sesame", *í* (V) "this", *íp* (VC) "mouth", *álh* (VCC) "egg", *ŏj* (VV) "gourd", *jə́s* (VVC) "candy", *jə̀lh* (VVCC) "hemp seed", *jə̌j* (VVV) "Japanese".

As shown in (13), the most frequent morpheme structure in monosyllabic native nouns is CVC (196), followed by CVV (44) and CVCC (40). Compared with simplex onset C, complex onsets (CC, CCC) are rare (31 and 10, respectively, *COMPLEX). Onsetless words (Ø) are very few as well (32, ONSET). As for nuclei, monophthong (V) is much more attested than diphthongs/triphthongs. Also as for codas, the simplex coda (C) is most common, while complex codas (CC) are much fewer (*COMPLEX). Codas with three successive consonants (CCC) are unattested. As a whole, the maximum segmental slot size in a MK monosyllabic stem is five, such as CCCVV and CCVVC, and structures composed of six or more segments are impossible. On the other hand, open syllable words (V, CV, CCV, CCCV) are relatively rare (29) and most of these words are bound forms or pronouns (e.g. *tʌ* "place", *i* "person", *kɨ* "it", *na* "I", *nə* "you", *nu* "who"). Exceptions are: *p^{h}a* "scallion", *ni* "louse", *ni* "tooth", *psi* "seed", *ko* "mallet", *pi* "rain", *p^{h}i* "blood", etc. Most such words have aspirated/cluster onsets, suggesting the possibility that they were originally disyllables (discussed below). This also indicates the existence of a minimal word restriction in MK (McCarthy and Prince 1993).

(15) below shows the distribution of vocalism type in each syllable structure. Here "C" indicates either onset or coda, not distinguishing the complexity (simplex vs. complex). "VV" indicates both diphthongs and triphthongs. There are several noteworthy tendencies. First, the nucleus of CVV is mostly composed of falling diphthongs. Given this fact, the relatively higher frequency of /jə/ (and /jəj/) is peculiar. Second, the nucleus of CVVC is composed of both falling and rising diphthongs, but it is mainly /jə/ (35 stems). Third, in CV structure, /i/ is relatively more frequent than other vowels. Finally, in CVC structure, Yang 陽 vowels (= /a/, /o/, /ʌ/) are observed more frequently

than Yin 陰 vowels (/ə/, /u/, /ɨ/) in general: MK had a vowel harmony system in which Yang vowels only combined with Yang vowels, whereas Yin vowels only combined with Yin vowels; /i/ was a neutral vowel and combined with both Yang and Yin vowels freely.

(15) The distribution of vocalism type in each syllable structure. Words whose underlying coda is unknown among -Ø, /-j/, -/jh/ and /-h/ are excluded.

(C)VV	Number
aj	15
ʌj	8
oj	8
jə	7
uj	6
əj	5
jəj	4
ɨj	4
jo	2
waj	2
Totals	61

(C)VVC	Number
jə	35
ʌj	4
jo	4
ja	3
ju	3
əj	2
uj	2
aj	1
wa	1
oj	1
wə	1
Totals	57

(C)V	Number
i	14
a	5
o	3
ʌ	2
ə	2
ɨ	2
u	1
Totals	29

(C)VC	Number
o	79
a	72
u	47
i	42
ʌ	36
ɨ	32
ə	31
Totals	339

Based on the philological and dialectal data, K-M. Lee (1972: 138-139) infers that some examples of /jə/ in MK originate from /*jʌ/. This hypothesis may be true, but the problem is that /*jʌ/ is also a rising diphthong which rarely appears in CVV and CVVC structures. Given the distributions just mentioned, it is rather assumed here that /jə/ in MK (at least a part of the examples) is derived from /*ï/ (the counterpart of /i/ in the vowel harmony system) or /*ïj/.[9] /*ï/ can be phonetically [e] as well. In the same way, CV words with /i/ may originate from /*Cij/. If this is true, then we can conclude more convincingly that there was a minimal word restriction in MK (or in Proto-Korean). The supporting evidence for this analysis is discussed in 3.2.2.4.

3.2.2.2 Onset types and accent classes

(16) shows the distribution of each accent class in MK monosyllabic native nouns. "H (unknown)" indicates an H class noun whose subcategory (H-a or H-b) is unknown. As can be seen, H is the largest class as a whole, followed by the L and R classes. The H-a and H-b classes are more or less equally distributed.

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[9] The existence of /*ï/ itself in Proto-Korean is also inferred by Kōno (1968: 511).

(16) Distribution of each accent class (MK monosyllabic nouns)

Accent	Number	Ratio
H-a	75	15%
H-b	72	14%
H (unknown)	139	27%
L	132	26%
R	89	18%
Totals	508	

(17) shows the correlation between onset type and accent class. It is observed that essentially no word with an aspirate/cluster or /h/ onset appears in the R class. Also, with regard to subcategories H-a and H-b, simplex onsets appear with the H-b class more frequently, while aspirate/cluster onsets tend to prefer the H-a class. This fact is comparable to the accent of Class 2 verbal stems (Ramsey 1978, 1986, 1991, 2001), which uniformly appear in the H class regardless of the following suffix.

(17) Correlation between onset type and accent class. H = H (unknown).

onset / accent	H	H-a	H-b	L	R	Totals
p	10	10	11	16	11	58
t	5	9	4	18	7	43
k	23	6	15	16	17	77
c	9	5	3	8	9	34
s	21	4	6	13	16	60
Ø	8	3	7	10	11	39
m	13	4	5	15	6	43
n	6	3	9	14	11	43
z				3		3
Totals	95	44	60	113	88	95

onset / accent	H	H-a	H-b	L	R	Totals
p^h	4	3	1			8
t^h	5	5	3	3	1	17
c^h	9	3	1	4		17
k^h	2			1		3
h	3	6		6		15
pt	3	1	3			7
pc			2			2
ps	2	2				4
pst		1				1
psk	5	5				10
sp		2	1	1		4
st	5		3	1		9
sk	5	3		1		9
ss	1					1
Totals	44	31	12	19	1	107

(18) Examples

páj (H-a) "boat", *pál* (H-b) "foot", *pìt* "debt", *păm* "chestnut", *táj* (H-a) "bamboo", *tə́t* (H-b) "short time", *tʌ̀lk* "chicken", *tŭjh* "back", *kíl* (H-a) "sentence", *kálh* (H-b) "knife", *kìt* "pillar", *kŏm* "bear", *cʌ́j* (H-a) "ash", *cícʰ* (H-b) "feather", *cìp* "house", *cŭm* "a handful amount", *sám* (H-a) "hemp", *sín* (H-b) "shoes", *sòtʰ* "pot", *sĭl* "thread", *jə́s* (H-a) "candy", *íp* (H-b) "mouth", *òs* "lacquer", *ĭl* "work", *múl* (H-a) "crowd", *móh* (H-b) "corner", *mə̀c* "cherry", *mŏjh* "mountain", *ní* (H-a) "tooth", *náks* (H-b) "fishing", *nàp* "monkey", *nə̌l* "board", *zjùS* "Four-Stick Game", *pʰíl* (H-a) "grass", *pʰúm* (H-b) "breast", *tʰíl* (H-a) "frame", *tʰʌ́k* (H-b) "chin", *tʰàs* "fault", *tʰăl* "reason", *kʰíj* "height", *kʰòŋ* "soy bean", *cʰúm* (H-a) "saliva", *cʰʌ́lh* (H-b) "origin", *cʰjə̀ŋ* "membrane", *hím* (H-a) "strength", *hwàl* "bow", *ptʌ́j* (H-a) "dirt", *ptí* (H-b) "wheel", *pcàk* "one of a pair", *psʌ́l* (H-a) "rice", *pstáj* (H-a) "time", *pskúl* (H-a) "honey", *spɨ́l* (H-a) "horn", *spám* (H-b) "cheek", *spòŋ* "mulberry leaves", *stɨ́j* (H-b) "belt", *stòŋ* "feces", *skúm* (H-a) "dream", *skwə̀ŋ* "pheasant", *ssí* "weft".

10

As mentioned above, it is hypothesized that nouns with an aspirate/cluster onset resulted through weak vowel syncope in the initial syllable: *Cʌ/ɨ.CV́ → CCV́. Thus, for example, MK *psʌ́l* "rice" resulted from Proto-MK *pʌ̀.sʌ́l*, which had a default LH tone. Similarly, aspirate onsets probably resulted from *kʌ.C, as hypothesized by Ramsey (1977). Thus, for example, *tʰɨ́l* "frame" probably resulted from *kɨ̀.tɨ́l*. We return to the details of this hypothesis (the origin of aspirates from a velar cluster) below in 3.2.2.4.

In the syncope process (*Cʌ/ɨ.CV́ → CCV́), the L tone in the initial syllable is lost after the syncope and is not retained as a part of an R tone in the resultant monosyllabic stem, thus leading to the H class. On the other hand, most of the words with an aspirate/cluster onset that appear with an L tone have obstruent codas, suggesting that they are from *C_1ʌ/ɨ.C_2V.C_3ʌ/ɨ where C_3 is a voiceless obstruent. E.g.) *pʌ̀.cà.kʌ́* → *pcàk* "one of a pair". Based on Whitman (1994)'s analysis, C_3 [+voice] should result in the R class (*pʌ̀.cà.rʌ́* → *pcǎl*). The general lack of such a form may be either because the nouns with *C_1ʌ/ɨ.C_2V̀.C_3[+voice]ʌ/ɨ structure were accidentally missing in Proto-Korean or due to a constraint against having multiple complex components in one stem (aspirate/cluster onset and complex tone). See Ito (2007b) for a similar line of analysis for Contemporary Standard Korean.

The fact that many words with an aspirate/cluster onset belong to the H-a class is also explained, given that they were originally disyllabic words. Recall that disyllabic or longer words seem not to have a comparable distinction (W-C. Kim 1973: 74, Fukui 1985, 2003: 101).

The syncope rule, at least for verbal stems, has a condition that the syncopated vowel is not the only vowel in the stem (Ramsey 1986: 193, 1991: 231, Whitman 1994: 427, fn. 2). Thus Class 2 verbal stems retain the nucleus: e.g.) *pɨ̀.sɨ́-* > *psɨ́-* (not > *ps-*). However, interestingly, there is no native noun with OʌO/OɨO structure in MK (O = simplex obstruent). When minimal vowels appear as a nucleus, at least either the onset or the coda is an aspirate/cluster or sonorant. E.g.) *nʌ̀cʰ* "face", *tʰʌ́k* "chin", *mʌ̀t* "oldest son", *kɨ́tʰ* "edge", *sɨ́cʰ* "interval", *nɨ̀c* "symptom", *tʌ́l* "moon", *pɨ́l* "fire", *kɨ̀m* "fold", *sʌ́n* "young man", *tʌ̀lk* "chicken", *pʌ̀lh* "arm". If the condition for the syncope rule was applicable in nouns, then we would expect more words with OʌO/OɨO structure to be attested. One possible explanation for this gap is that the words with this structure existed in Proto-Korean, but they changed the nucleus to some other vowel in order to avoid the syncope., It is difficult to prove this hypothesis, however.

3.2.2.3 Nucleus and accent classes

(19) shows the correlation between the syllabic nucleus and accent class. Based on the discussion above, /jə/, which is probably from /*ɨ/, is grouped with monophthongs.

(19) Correlation between nucleus and accent class

nucleus \ accent	H	H-a	H-b	L	R	Totals
a	29	13	16	20	21	99
ə	7	2	3	17	12	41
i	16	8	15	12	8	59
jə	14	7	5	15	9	50
o	25	6	13	26	23	93
u	15	10	8	13	12	58
ʌ	16	13	8	12	2	51
ɨ	15	13	4	6	1	39

nucleus \ accent	H	H-a	H-b	L	R	Totals
ja	1			2		3
jo	1	1		4	1	7
ju				3		3
wa		2		1		3
wə				1		1

(20) Examples

sám (H-a) "hemp", *kálh* (H-b) "knife", *kàs* "woman", *kăj* "dog", *cə́l* (H-a) "bow, obeisance", *tə́t* (H-b) "short time", *kə̀cʰ* "skin", *kə̌l* "river", *pʰí* (H-a) "blood", *kílh* (H-b) "road", *mìtʰ* "bottom", *kĭm* "breath", *spjə́* (H-a) "bone", *tjə́l* (H-b) "temple", *kjə̀tʰ* "side", *sjə̌m* "island", *tʰók* (H-a) "elbow", *kót* (H-b) "place", *kòl* "appearance", *kŏl* "valley", *skúm* (H-a) "dream", *nún* (H-b) "eye", *ùh* "upper part", *nŭn* "snow", *tʌ́l* (H-a) "moon", *nálh* (H-b) "blade", *nʌ̀cʰ* "face", *kʌ̌z* "edge", *mɨ́l* (H-a) "water", *kɨ̀tʰ* (H-b) "end", *kɨ̀* "it", *cɨ̌z* "appearance", *jáK* "spices", *jàk* "turtle", *cʰjó* (H-a) ~ *cʰjò* "candle", *cjŏŋ* "servant", *hjùŋ* "scar", *hwáj* (H-a) "torch", *hwàl* "bow (and arrow)", *skwə̀ŋ* "pheasant".

   At least two tendencies are observed. First, the minimal vowels /ʌ/ and /ɨ/ rarely appear in the R class. This suggests that they had shorter durations than the other vowels. This is plausible given that they were often syncopated as well.
   Second, rising diphthongs appear in the L class relatively frequently. This fact and their general low type-frequency indicate that the nouns with rising diphthongs probably resulted from disyllabic (or longer) words.

3.2.2.4 Coda types and accent classes

(21) shows the correlation between coda type and accent class. As can be seen, the correlation between coda types and accent classes is not completely regular. However, two general tendencies are observed: (a) the L and H-b classes are preferred by obstruent codas; (b) the R and H-a classes are preferred by sonorant codas. Based on the final segment, a Pearson's Chi-squared test with Yates' continuity correction showed a significant result ($\chi^2 = 82.124$, df = 1, p-value < 2.2e-16).

(21) Correlation between coda type and accent class

accent / coda	H	H-a	H-b	L	R	Totals
p	3	1	3	6	2	15
t	3		5	4	2	14
k	2	3	2	11	1	19
c	1	1	5	3		10
s	4	3	7	11	1	26
Ø	19	11	2	5		37
j	15	20	3	5	10	53
m	9	9	8		11	37
n	2		4	1	6	13
ŋ	2	1		11	3	17
l	13	19	4	7	18	61
z					2	2

accent / coda	H	H-a	H-b	L	R	Totals
pʰ	1			4	1	6
tʰ			1	9	1	11
kʰ				1		1
cʰ	7	3	3	4	1	18
h	5	1	6	9		21
ps			1			1
ks	2		1	4		7
sk	1			9		10
jcʰ				1		1
jh			1		5	6
jm				1		1
mh	2					2
nh	1		3			4
lp	1	1				2
lk	1			5		6
ls			1			1
lpʰ				1		1
lh	4	2	8	3	2	19

(22) Examples

tʰóp (H-a/b) "nail", *páp* (H-b) "rice", *cìp* "house", *kĭp* "silk gauze", *kút* (H-b) "hole", *kìt* "pillar", *pə̆t* "friend", *psúk* (H-a) "moxa", *tʰǎk* (H-b) "chin", *cə̀k* "time", *sŏk* "inside", *cjə́c* (H-a/b) "breast, milk", *nác* (H-b) "daytime", *kòc* "flower", *más* (H-a) "taste", *kís* (H-b) "nest", *tàs* "fault", *căs* "pine nuts", *ní* (H-a) "tooth", *ptí* (H-b) "wheel", *nə̀* "you", *nǽj* (H-a) "smoke", *stɨ́j* (H-b) "belt", *pʌ̀j* "pear", *sǎj* "bird", *hím* (H-a) "strength", *spám* (H-b) "cheek", *pə̆m* "tiger", *sín* (H-b) "shoes", *sòn* "guest, *tŏn* "money", *tʰóŋ* (H-a) axis", *stòŋ* "feces", *cjŏŋ* "servant", *sál* (H-a) "arrow", *nál* (H-b) "day", *mʌ̀l* "horse", *măl* "language", *kə̆z* "edge", *nípʰ* (H-b) "leaf", *àpʰ* "front", *kɨ́tʰ* (H-b) "end", *pàtʰ* "field", *nătʰ* "piece", *njə̀kʰ* "direction", *pícʰ* (H-a/b) "light", *cícʰ* (H-b) "feather", *kàcʰ* "skin", *năcʰ* "piece", *tʰəh* "base" (H-a/b), *kóh* (H-b) "nose", *nòh* "rope", *káps* (H-b) "value", *náks* (H-b) "fishing", *sàks* "wages", *pʰʌ́sk* "red bean", *pàsk* "outside", *pʌ̀jcʰ* "oar", *mǽjh* (H-b) "field", *năjh* "river", *sə̆jm* "fountain", *ámh* "female", *ánh* (H-b) "inside", *kʌ́lp* (H-a) "pile", *cʰɨ́lk* "arrowroot", *hʌ̀lk* "ground", *tóls* (H-b) "one cycle", *àlpʰ* "front", *tólh* (H-a) "ditch", *sʌ́lh* (H-b) "flesh", *pʌ̀lh* "arm", *tŏlh* "stone".

Given this, it is assumed that in MK monosyllabic words, there are two-mora words (μμ) and one-mora words (μ): this analysis in terms of mora is justified later (3.3). A sonorant coda (in particular /-j/ and /-l/) could constitute one mora, whereas an obstruent coda could not. Note that a liquid behaves like vowels in the choice of particles in MK, indicating that it is closer to vocalic. CV words such as *pi* "rain", *ni* "tooth" belong to the H-a class, suggesting that they used to be two moras with a falling diphthong at some stage of the Korean language: **pij* and **nij*. Also, Cjə words such as *hjə* "tongue" belong to the H-a class, again suggesting that the nucleus had two moras with a falling diphthong: **hïj*.[10] On the other hand, CV words (= coda Ø) do not appear in the R class, since at least some of these words are composed of just one mora.

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[10] *spjə* (H-a) "bone" appears as both *spjə́.əj* and *spjə́.jəj* in locative constructions, which may indicate that this word was originally **spïj* (< **sɨ.pïj*).

13

As for the H-a class words that do not have an aspirate/cluster onset, such as *tʌl* "moon", *mɨl* "water", *cul* "cord", there are two possible explanations. First, we may reconstruct forms with onsetless initial weak vowels ʌ/ɨ (**ʌ̀.tʌ́l*, **ɨ̀.mɨ́l*, **ɨ̀.cúl*) in Proto-Korean, which lost the initial syllable due to aphesis in an unaccented syllable. [11] In fact, essentially no words with onsetless initial weak vowels are attested in MK (exception: *ɨ̀.sɨ̀m~ɨ̀.sɨ̀m* "the head, basis", K-M. Lee 1972: 17). Second, based on the fact that quite a few words from the H-a class appear with a minimal vowel (other examples: *kɨl* "sentence", *pɨl* "fire"), they may in fact have resulted from the same process that gave the R class (**CV.C[+voice]V*) but they could not appear with R, due to the constraint against a minimal vowel with an R tone.

Some H-a class words ending with /-j/ may have resulted from nativising Sino-Korean CV stems by adding a diminutive suffix /i/ (Kōno 1968: 447), in order to satisfy the minimal word restriction observed in native lexicon: $CV́ + /i/ \rightarrow CV́.i \rightarrow CV́j$ (two moras). Note that the diminutive suffix /i/ does not shift the original accent position of the words to which it attaches: e.g.) *pʰʌ́l ~ pʰʌ́.ri* "fly", *ól.cʰaŋ ~ ól.cʰaŋ.i* "tadpole". Thus, for example, *máj* "millstone" is from Sino-Korean 磨 *ma*. Probably *tój* "measure" is also from Sino-Korean 斗 *tó. The attested Sino-Korean reading for 斗 is *tú*, but some Sino-Korean morphemes in rhyme 侯 appear as *Co* (Ito 2007a: 165).

It is also possible to reconstruct H-a class words with /-j/ as **CV.Ci*, which later lost the intervocalic C (Kōno 1945: 235-237): e.g.) *kaj* "inlet" < **ka.ri*. For this change, the intervocalic C is usually /r/ or /n/. In this case, we have to assume that these CV.Ci words had an initial accent (CV́.Ci), otherwise the resultant accent is expected to be R (a related phenomenon is discussed below). It is considered here that CV́.Ci words resulting in the H-a class were morphologically CV́C + diminutive suffix /i/.

There is supporting evidence that the L class words resulted from disyllabic words containing a minimal vowel in the second syllable. MK L class nouns take *-ʌj/-ɨj* for a locative particle as a rule, while other accent classes mainly take *-aj/-əj*.[12] E.g.) *àlpʰ-ʌ́j* "front-LOC" (L class), *skúm-ə́j* "dream-LOC" (H-a class), *ìp-ə́j* "mouth-LOC" (H-b class), *sjə̌m-ə́j* "island-LOC" (R class).[13] This suggests that L class nouns used to have /ʌ/, /ɨ/ in the second syllable. On the other hand, it is assumed that R class nouns originated from disyllabic words with any kind of vowel in the second syllable, which is shown in the locative particle they take as well.

Among sonorant codas, /-ŋ/ tends to appear in the L class frequently (11/17). As pointed out by Whitman (1994: 429-430), /-ŋ/ probably resulted from /*nkʌ(C)/ or /*nkɨ(C)/, thus showing bias to the L class. (Not from /*nʌk/ or /*nɨk/ since these result in the R class.)

As mentioned above, Ramsey (1977, 1991) infers that Korean aspirates developed from clusters

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[11] A potential problem for this analysis is that many disyllabic words that have minimal vowels in both the first and the second syllables (Cʌ.CʌC) tend to appear in the LL accent class in MK: *mʌ̀.zʌ̀m* "heart", *kʌ̀.zʌ̀l* "autumn", *pʌ̀.rʌ̀m* "wind", *nʌ̀.mʌ̀cʰ* "bag". If **ʌ.CʌC/*ɨ.CɨC* had the LL accent in Proto-Korean, the accent of the resultant word due to aphesis should be in the L class, not H-a. One possible explanation is that Proto-Korean had only the LH accent and the LL accent observed in MK Cʌ.CʌC words is due to a later development that occurred at least after the syncope/aphesis process was completed.

[12] The choice between *-ʌj* and *-ɨj*, *-aj* and *-əj* is based on vowel harmony.

[13] Original **CV̀.Cʌ́j/CV̀.Cɨ́j* words in Proto-Korean could change to CVC in the L or H-b class, due to confusion with a locative structure. Some exceptions from the H-b class that appear with *-ʌj*, *-ɨj* in a locative construction may be explained this way. E.g.) **pà.mʌ́j* → *pám* "night" (H-a/b), **nà.cʌ́j* → *nác* "daytime" (H-b). Also, related to the locative construction, there is one noteworthy tendency. In the MK L class, many words are nouns for locations which take a locative construction frequently. E.g.) *cìp* "house", *pàtʰ* "field", *mìtʰ* "bottom", *mùtʰ* "land", *kjə̀tʰ* "side", *àlpʰ* "front". This may suggest that at least some of these stems with an L accent were originally monosyllabic words with an H-b accent and their accent was restructured based on locative forms (= analogical change or leveling from a locative form). E.g.) **cíp ~ cì.pɨ́j* → *cìp* "house".

containing a velar obstruent (probably a simple velar stop *k*). One bit of evidence for this hypothesis is from the causative/passive morpheme, which alternates between *-ki-* ~ *-hi-* ~ *-ɣi-* ~ *-i-*. He assumes that this morpheme was originally **-ki-*, but had diverged into these shapes by the MK period. Which variant appears depends on the final segment of the verbal stem it was suffixed to, as shown in (23).

(23) Alternation of the causative/passive morpheme **-ki-* (from Ramsey 1977: 128, slightly modified)
a.   -ki-: m__, (n__), s__ [n__ is not attested but inferred from modern examples]
b.   -hi-: p__, t__, c__
c.   -ɣi-: l__, z__, j__
d.   -i-: V__, h__, k__

As in (23b), original /k/ lenited to /h/ after /p/, /t/, /c/ and made them aspirated /pʰ/, /tʰ/, /cʰ/, respectively, whereas when /k/ followed /h/ and /k/, it went to zero.

I agree with his analysis that aspirates developed from clusters containing a velar obstruent. Besides the examples he mentioned, there are quite a few other instances providing evidence of this process: e.g.) *tut.kə.pi* ~ *tu.tʰə.pi* "frog", *tɨt.kɨl* ~ *tɨ.tʰɨl* "dust", *sik.pɨ-* "want" → *sipʰ-* (Contemporary Korean). Probably both "obstruent-(ʌ/ɨ)-velar" and "velar-(ʌ/ɨ)-obstruent" (except for /k/) changed historically to aspirates /pʰ/, /tʰ/, /cʰ/ through metathesis. No MK disyllabic nouns with the structures kʌ/ɨ.tV(C), kʌ/ɨ.pV(C), kʌ/ɨ.cV(C) seem to be attested, suggesting that the words with these structures changed to CʰV(C) by MK. Furthermore, as Ramsey (1991: 231, fn. 25) points out, no cluster with /k/ exists in MK except /sk/ and /psk/, while there is no aspirated /s/ (/sʰ/) in MK. These facts are strong evidence for his hypothesis.[14]

Based on this, it is natural that relatively many words with an aspirate coda as well as /-k/ and /-h/ appear in the L class: these words originated from **CV.tʌk, *CV.cʌk, *CV.kʌk, *CV.hʌk*, etc. in Proto-Korean. Rather, the problem is that there are some words with an aspirate coda that appear in the H class, such as *típʰ* "straw", *ípʰ* "gate", *nípʰ* "leaf", *púpʰ* "drum", *súpʰ* "forest", *pʰʌ́cʰ* "red bean", *sʌ́cʰ* "rope", *cicʰ* "feather". This fact may suggest that at least some coda clusters existed in Proto-Korean. For example, along with /-ps/ and /-ks/,[15] /*-ts/ may have existed in Proto-Korean, which probably changed to /-c/. Also, parallel to /-sk/, /*-pk/ and /*-tk/ (or /*-kp/ and /*-kt/) may have existed as well, which resulted in /-pʰ/ and /-tʰ/. Some doublets such as *púpʰ* ~ *púk* (Contemporary Korean) "drum", *pɨ̀.zə̀p* ~ *pɨ̀.zə̀k* ~ *pu.əkʰ* (Contemporary Korean) "kitchen"[16], *súpʰ* ~ *súh* "forest" suggest this possibility.

Ramsey (1977: 127) shows some correspondences between MK and contemporary dialects

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[14] Lee and Ramsey (2011: 89) report that in the *Jilin leishi* 鷄林類事, a Chinese compilation and vocabulary list compiled in the 12th C, the 15th C verb *tʰa* "rides" was transcribed as 轄打, indicating that the verb was **hʌta*. They assume that the 15th C aspiration was produced by syncope of the first-syllable vowel followed by the metathesis of the two consonants: ** hʌta > * hta > tʰa*. Similarly, the *Jilin leishi* transcription of "big" suggests the reconstruction **hɨkɨn > kʰɨn*. This finding by Lee and Ramsey (2011) does not contradict the hypothesis by Ramsey (1977, 1991) on the source of aspirates from clusters containing a velar obstruent, since it is possible that the velar consonant lenited to [h] after the syncope. That is, two possible sources for the aspirate are assumed: **hʌCV/hɨCV (C = plosive) > *hCV/hCV > CʰV* or **kʌCV/kɨCV (C = plosive) > *kCV/kCV > *hCV/hCV > CʰV*. No words with a structure **hʌCV/hɨCV (C = plosive)* are attested in MK as well.

[15] At least *naks* "fishing" probably used to have coda /*-ksk/, based on the verbal stem *naksk-* "fish". Recall that nouns do not have three consonant coda clusters. Thus *naks* dropped the final /k/ to satisfy this constraint (*CCC#).

[16] Still, Ramsey (1977: 129-130) assumes that *pu.əkʰ* "kitchen" was originally a compound *pɨl* "fire" + *sə̀pʰ* "side".

(Seoul and Hamkyeng), in which an MK cluster coda /sk/ mainly corresponds with /c^h/ in Seoul and /k*/ in Hamkyeng. E.g.) *susk* (MK) ~ *suc^h* (Seoul) ~ *suk** (Hamkyeng) "charcoal". For these cases, he reconstructs *CV.cʌ/ɨk, which syncopated the minimal vowel in the final syllable, resulting in the cluster. In MK, a doublet such as *p^{h}ʌc^h* ~ *p^{h}ʌsk* "red bean" is observed as well. Related to this, Fukui (2013: 159) points out that some words appear only with /-c^h/ while other words appear only with /-sk/, and that the relationship between these two codas is unclear. It is assumed that doublets such as *p^{h}ʌc^h* ~ *p^{h}ʌsk* are the result of confusion in isolation forms. That is, probably in Old Korean, the affricate /c/ was distinguished from the fricative /s/ and the stop /t/ in coda (and pre-consonantal) position, but at some point, the affricate /c/ in this position merged with the fricative /s/, as observed in MK. In fact, based on the documentary evidence, Lee and Ramsey (2011: 93) conclude that the contrast between *c and *c^h in terminal position was neutralized in the 13th C, but the contrast between *s and *c was not. Around the time the change from /ck/ to /c^h/ took place, the merger from /c/ to /s/ in coda position may have been taking place as well. Thus the original /sk/ (from /*sk/ or /*sʌk/ through syncope) had the same surface coda as /ck/, resulting in the confusion between these two codas. This is a case of analogical change due to Base-Identity (Kenstowicz 1996).

(24) Analogical change between /c^h/ and /sk/

Proto-Korean	syncope	change to aspirate, coda merger	MK with analogical change
*cʌk	ck	ck [ck] → c^h, ck [ck] → [sk]	c^h, (sk)
*sʌk, *sk	sk	sk [sk]	sk, (c^h)

Finally, the R class mainly appears with /-j/ or sonorant codas. As mentioned above, these words are believed to have originated from disyllabic words with *CV.C[+voice]V structure. Kōno (1945: 233-238) also proposes that several words with /-j/ used to be disyllabic words with CV.Ci structure. (25) shows the examples.

(25) R class nouns from disyllabic source words (Kōno 1945: 237, Fukui 2013: 161). Two words (*nu.rí]*[17] "world" and *ka.hí* "dog") are attested in MK.

*CV.CV > CVC	*CV.Ci(C) > CVj(C)	
*kŏm < *kò.má* "bear"	*nŭj < *nù.rí]* "world"	*kăj < *kà.hí* "dog"
*sjə̆m < *sjə̀.má* "island"	*năjh < *nà.ríh* "river"	*kŏj < *kò.ní* "cat"
*pjə̆l < *pjə̀.rí* "star"	*nĭm < *nì.rím* "master"	*mŏjh < *mò.ríh* "mountain"
	*jə̆j < *jə̀.rí* "Japanese"	

Most of the examples of *CV.Ci(C) > CVj(C) used to be *CV.ri or *CV.ni. The ban against /r/ and /n/ before a high front vowel is still observed in Contemporary Korean in general. If the final vowel was not /i/, then that vowel dropped as a rule. According to the reconstruction above, *pjə̆l < *pjə̀.rí* "star" is the only exception to this change, in that it had lost the final /i/, not /r/. Fukui (2013: 161) infers that either the /r/ or /i/ of this word was different from other CV.ri words. Based on the general tendency discussed so far, *pjə̆l* may be reconstructed as having a minimal vowel in the final syllable: *pjə̆l < *pjə̀.rɨ < *pì.rɨ*.

Related to this, we can point out interesting distributional phenomena in disyllabic native nouns: (a) there is essentially no stem with CV.rʌj/CV.nʌj/CV.rɨj/CV.nɨj in MK; (b) nouns with CV.Cjə structure are extremely underrepresented. Based on these facts, the following historical changes are

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[17] Recall that "]" indicates neutralization between Ø and /h/ codas.

assumed.

(26) Assumed historical changes
a. *mŏjh* < *mò.ríh* "mountain"
b. *nŭj* (< *nù.rí*) < *nù.rí̋* "world"[18]
c. *so.rí* < *sò.rʌ́j* "sound"
d. *hə.rí* (< *hə̀.rí̋*) < *hə̀.rʌ́j* "waist"

That is, original /-ri/, /-ni/, /-rï/, /nï/ had lost /r/ or /n/ and became /-j/, whereas /-rʌj/, /-nʌj/, /-rɨj/, /-nɨj/ monophthongized to /-ri/, /-ni/, /-rï/, /-nï/ and filled in the open slot.[19] The fact that some words have doublets such as *sò.rí ~ sò.rʌ́j* "sound" is supporting evidence for this analysis. Given that there are few words ending with /-jə/, original /*ï/ may have merged with /i/ in non-word-initial position. In the case of CV.rï/CV.nï, they may have changed to CV.ri/CV.ni first and then become CVj, not directly changing from CV.rï/CV.nï to CVj. As discussed below, in disyllabic native nouns, the most frequent nucleus in the final syllable is /i/. This supports the hypothesis that the merger /ï/ > /i/ in this position took place.

3.2.2.5 Monosyllabic words—reconstruction

Based on the discussion so far, the monosyllabic nouns are reconstructed as in (27). Only the H-b class was originally monosyllabic; the other three classes (L, H-a, R) resulted from disyllabic words.

(27) Reconstruction of Proto-Korean monosyllabic nouns

Class	MK example	Reconstruction	Proto-Korean type
L	kòc "flower"	*kò.cʌ́	*CV(C).C[−voice]ʌ(C)
	pàsk "outside"	*pà.sʌ́k or *pàs.kʌ́?	
H-a	psʌ́l "rice"	*pʌ̀sʌ́l	*Cʌ.CV(C)
	mɨl "water"	*ɨ.mɨ́l?	*ʌ.CVC
	tój "measure"	*tó.i	*CV(C)-i
H-b	kóh "nose"	*kóh	*CVC
R	kŏl "valley"	*kò.rʌ́	*CV$_1$.C[+voice]V$_2$ [V$_2$ ≠ i/ï]
	nŭj "world"	*nu.rí̋	*CV.ri/CV.ni/CV.rï/CV.nï

Based on this reconstruction, the dominant canonical shape of native nouns in Proto-Korean was disyllabic, and only a small number of monosyllabic nouns were available at that stage. This may suggest that not only a strong minimal word restriction (*CV) but also a weaker minimal word restriction (*CVC) may have existed in Proto-Korean, which affected the lexicon to different degrees.

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[18] Since *nù.rí]* is attested in MK, this word may have had another form *nù.rʌ́j* in Proto-Korean as well. Alternatively, this word may have irregularly retained /r/ before /i/ for some unknown reasons.

[19] Also CV.ti lenited to CV.ri, such as *mà.tí > mà.rí > mə̀.rí* "head" (Martin 1996: 49).

3.2.3 Disyllabic stems
3.2.3.1 Basic morpheme structure

Next, we examine disyllabic nouns. (28) shows the distribution of disyllabic native simplex nouns with each structure. Words whose precise underlying coda is unknown are excluded here.

(28) Morpheme structure of disyllabic native simplex nouns. C = simplex onset/coda, CC =cluster onset/coda, V = monophthong, VV/VVV = diphthong/triphthong.

penult \ final	CCVVV	CV	CVC	CVCC	CVV	CVVC	CVVV	V	VC	VCC	VV	VVC	VVV	Totals
CCCV		1			1									2
CCV		1			1									2
CCVC		2												2
CCVV		1												1
CV	1	59	136	13	45	2		1	21	7	11	1	1	298
CVC		16	25	1	30	5	3	3	2		2			87
CVV		8	21	1	10	2			4	1	1	3		51
CVVC		4	4		1	1								10
CVVV		1												1
V		10	21	1	9				2			1		44
VC		5	5		5		1							16
VV	1	1	8	2	1	1					1	1		16
VVC			2		4	1	1		1					9
Totals	2	109	222	18	107	12	5	4	30	8	15	6	1	539

(29) Examples

pskí.ni (CCCV.CV) "meal", *pskɨ.rǝ́j* (CCCV.CVV) "wrapped thing", *skò.rí* (CCV.CV) "tail", *pcà.kàj* (CCV.CVV) "one piece of beans", *ptál.ki* (CCVC.CV) "strawberry", *skwà.rí* (CCVV.CV) "ground cherry", *tà.sswáj* (CV.CCVVV) "five days", *kò.kí* (CV.CV) "meat", *kà.sʌ́m* (CV.CVC) "breast", *sù.nɨ́lk* (CV.CVCC) "peak", *pì.rǝ́j* (CV.CVV) "cliff", *kɨ̀.rjὲk* (CV.CVVC) "wild goose", *sà.í* (CV.V) "shrimp", *nà.ʌ́l* (CV.VC) "four days", *kɨ̀.òlh* (CV.VCC) "county", *kǝ̀.jú* (CV.VV) "goose", *pʌ́.jam* (CV.VVC) "snake", *nù.wǝj* (CV.VVV) "silkworm", *cùl.kí* (CVC.CV) "stem", *kòs.kál* (CVC.CVC) "Buddhist priest's hood", *mʌ̀s.tʌ̀lk* (CVC.CVCC) "satisfaction", *màl.mʌ́j* (CVC.CVV) "reason", *nàm.sjὰŋ* (CVC.CVVC) "turtle", *tàs.swáj* (CVC.CVVV) "five days", *sòŋ.í* (CVC.V) "cluster", *pàŋ.ól* (CVC.VC) "bell", *pìŋ.áj* (CVC.VV) "cliff", *cjǎ.pi* (CVV.CV) "swallow", *mjà.nʌ́l* (CVV.CVC) "daughter-in-law", *kjà.zɨ́lh* (CVV.CVCC) "winter", *cjò.hʌ́j* (CVV.CVV) "paper", *sjǒ.kjǝŋ* (CVV.CVVC) "blind person", *sjǎ.oŋ* (CVV.VC) "husband", *sjǒ.ulh* (CVV.VCC) "capital", *sàj.jó* (CVV.VV) "shrimp", *pʌ́j.jam* (CVV.VVC) "snake", *tjáŋ.sʌ* (CVVC.CV) "trade", *njὰm.tʰòŋ* (CVVC.CVC) "heart", *hwál.kaj* (CVVC.CVV) "open arms", *sjǒŋ.njǝŋ* (CVVC.CVVC) "manual industry", *cjǒj.pi* (CVVV.CV) "swallow", *á.ki* (V.CV) "baby", *à.cʰʌ́m* (V.CVC) "morning", *ù.sɨ̀lk* (V.CVCC) "marten", *à.ráj* (V.CVV) "bottom", *ì.úc* (V.VC) "neighbor", *ò.jác* (V.VVC) "plum", *íl.hi* (VC.CV) "wolf", *ìl.húm* (VC.CVC) "name", *àn.háj* (VC.CVV) "wife", *ǎs.tjaj* (VC.CVVV) "why", *jà.sswáj* (VV.CCVVV) "six days", *jǔ.mu* (VV.CV) "letter", *jà.rɨ́m* (VV.CVC) "fruit", *jà.tɨ́lp* (VV.CVCC) "eight", *jà.kʌ́j* (VV.CVV) "here", *jǒ.hjaŋ* (VV.CVVC) "galingale", *jà.ɨ́j* (VV.VV) "stamen", *òj.jác* (VV.VVC) "plum", *jàl.hɨ́l* (VVC.CVC) "ten days", *jǎk.taj* (VVC.CVV) "camel", *jὰŋ.sɨ̀jŋ* (VVC.CVVC) "peppermint", *jàs.swáj* (VVC.CVVV) "six days", *àjŋ.ʌ́c* (VVC.VC) "circumference".

For the penultimate syllable, the most frequent structure is CV, followed by CVC, CVV, V, etc.

There are few words with onset clusters. For the final syllable, the most frequent structure is CVC, followed by CV, CVV. Again, complex codas are rare. As a whole, CV.CVC is the most frequent structure. A maximum of eight segments can appear as in CVVC.CVVC (*sjǒŋ.njəŋ* "manual industry"), which may be from Sino-Korean.

(30) below shows the distribution of the syllabic nucleus in both penultimate and final syllables. In the penultimate syllable, most nuclei are monophthongs. Among diphthongs, /jə/ is again the most frequent, suggesting its origin as a monophthong /*ï/. In the final syllable, /i/ is by far the most frequent, followed by other monophthongs. As mentioned above, this high type-frequency of /i/ may be due to the merger /*-ï/ > /-i/ in non-word-initial position.

The four right columns in (30) show the ratio of open vs. closed syllable for each nucleus when in the final syllable. As can be seen, monophthongs tend to appear in a closed syllable except for /i/, while falling diphthongs tend to appear in an open syllable. A Pearson's Chi-squared test with Yates' continuity correction showed a significant result (χ^2 = 231.6584, df = 1, p < 2.2e-16). Given this, at least some examples of /i/ in the final syllable in MK are assumed to be /*ij/ or /*ïj/ in Proto-Korean.

(30) Distribution of nucleus in penultimate and final syllables (MK disyllabic nouns). For the calculation of the ratios of open/closed syllables, words whose precise underlying coda is unknown among -Ø, /-j/, /-h/ and /-jh/ are excluded.

nucleus	Penult	Final		Open	Closed	Open %	Closed %
a	155	70		8	51	14%	86%
ə	84	31			31	0%	100%
i	78	125		84	14	86%	14%
jə	67	14		2	12	14%	86%
o	116	84		9	62	13%	87%
u	85	49		3	43	7%	93%
ʌ	68	98		6	83	7%	93%
ɨ	56	93		3	86	3%	97%
ja	14	13		1	10	9%	91%
jo	10	8		2	3	40%	60%
ju	9	9		2	3	40%	60%
wa	4	8		1	4	20%	80%
wə		2		2		100%	0%
aj	8	45		27		100%	0%
əj	2	27		21		100%	0%
jəj	4	2		2		100%	0%
waj	1	5		4		100%	0%
oj	8	22		16		100%	0%
wəj		2		2		100%	0%
uj	2	27		18		100%	0%
ʌj	12	26		18	3	86%	14%
ɨj	5	28		14		100%	0%

3.2.3.2 Syllable weight and accent classes

(31) shows the distribution of each accent class of MK disyllabic nouns, excluding a noun *màk.tăj* "stick"(LR) which resulted from *màk.tà.hí* due to a contraction. As can be seen, LH is the largest

class, followed by LL. HX and RX are relatively small. The general tendency agrees with that reported by Ramsey (1991: 219).

(31) Distribution of each accent class (MK disyllabic nouns)

Class	Number	Ratio
LH	417	54%
LL	206	27%
HX	97	13%
RX	55	7%
Totals	775	

Assuming that (C)VC, (C)VV, (C)VVC (C = any consonants, V = monophthong, VV = diphthong/triphthong) are heavy, the correlation between syllable weight structure and accent class is summarized below. The number on the left is the observed number, the number on the right is the expected number, and the numbers in parentheses are observed/expected values. The biased distributions which are statistically significant (α-level at .05) are shaded.

(32) Correlation between syllable weight and accent class. Words whose precise coda is unknown between -Ø and /-h/ are excluded.

weight \ accent	HX	LH	LL	RX	Totals
Heavy-Heavy	18/27 (0.68)	107/114 (0.94)	61/57 (1.06)	27/15 (1.77)	213
Heavy-Light	15/5 (3.01)	14/21 (0.65)	3/11 (0.28)	8/3 (2.79)	40
Light-Heavy	37/46 (0.80)	208/199 (1.05)	117/100 (1.17)	10/27 (0.38)	372
Light-Light	17/9 (1.87)	44/39 (1.13)	7/20 (0.36)	5/5 (0.96)	73

When the first syllable is Heavy, the RX class is overrepresented, which is probably because the R tone requires two moras. In Heavy-Light, HX is overrepresented, suggesting that the HX class was not ǒ ǒ but ǒ ʌ in MK. Interestingly, LL is underrepresented when the final syllable is light, which is explained by the phonological analysis discussed in 3.3.

3.2.3.3 Onset types and accent classes

As in monosyllabic words, there are some correlations between onset types of the penultimate syllable and accent classes. (33) shows the distribution. Not only consonant clusters, but also aspirate onsets including /h/ are relatively underattested, which supports the proposal that aspirates originate from clusters. Words with an aspirate/cluster onset rarely appear in the RX class, which parallels the tendency in monosyllabic nouns with an aspirate/cluster onset.

(33) Correlation between onset type and accent class in MK disyllabic nouns

onset＼accent	HX	LH	LL	RX	Totals
p	14	54	20	4	92
t	8	46	20	3	77
k	21	83	45	7	156
c	7	33	24	6	70
s	8	38	18	11	75
Ø	9	74	16	13	112
m	11	41	23	1	76
n	2	28	24	8	62
r[20]		2	2		4

onset＼accent	HX	LH	LL	RX	Totals
pʰ	5	1	1	1	8
tʰ	2	1			3
cʰ	3		3		6
h	4	10	9	1	24
pt	2				2
pc			1		1
pst		1			1
psk	1	1			2
sk		3			3
sn		1			1

(34) Examples

pán.toj "firefly", *pà.tók* "Korean checkers", *pʌ̀.rʌ̀m* "wind", *pǔ.ri* "beak", *tán.ti* "jar", *tà.póc* "mugwort", *tʌ̀j.kòl* "head", *tŏ.cʰʌj* "ax", *ká.ci* "branch", *kə̀.púp* "turtle", *kì.tòŋ* "pillar", *kăl.ki* "mane", *cán.cʰʌj* "party", *cà.cʰój* "trace", *cò.kàk* "piece", *cjǔ.pi* "swallow", *sʌ́.maj* "sleeve", *sàs.kí* "the young", *sò.kòm* "salt", *să.rʌm* "person", *á.ki* "baby", *à.pí* "father", *ə̀l.kùl* "face", *ăn.kaj* "fog", *mó.kʌj* "mosquito", *mòl.ɣáj* "sand", *mʌ̀.tʌ̀j* "joint", *mǐ.su* "a kind of unit", *nú.ri]* "a stack of grain stalks", *nì.pɨ́l* "bedding", *nʌ̀.mʌ̀lh* "wild vegetables", *nǐm.kɨm* "king", *rà.kúj* "donkey", *ròŋ.sʌ̀]* "bamboo colander", *pʰə́.ki* "root", *pʰɨ̀jŋ.í]* "(toy) top", *pʰjò.kò]* "shiitake mushroom", *pʰǐ.ki]* "hiccup", *tʰɨ́.rim* "belching", *tʰə̀.rí* "fur", *cʰə́.zəm* "first", *cʰì.mà* "skirt", *hwál.kaj* "open arms", *hà.nʌ́lh* "sky", *hʌ̀.nàh* "one", *hăj.ca* "expense", *ptál.ki* "strawberry", *pcà.kàj* "one piece of beans", *pstɨ̀.rí]* "blister", *pskí.ni* "meal", *pskɨ̀.rə́j* "wrapped thing", *skò.rí* "tail", *snà.hʌ́j]* "man".

3.2.3.4 Nucleus, coda types and accent classes

(35) shows the correlation between penultimate syllable nucleus in disyllabic native nouns and accent class.

(35) Correlation between penultimate syllable nucleus and accent class in MK disyllabic nouns

nucleus＼accent	HX	LH	LL	RX	Totals
a	17	111	22	11	161
ə	9	59	9	7	84
i	5	49	12	9	75
jə	6	45	11	9	71
o	14	57	44	7	122
u	13	45	26	3	87
ʌ	18	18	43		79
ɨ	9	24	25	1	59

nucleus＼accent	HX	LH	LL	RX	Totals
ja	2	5	4	2	13
jo	2	1	5	2	10
ju		1	5	3	9
wa	2	2		1	5

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[20] The words with an onset /r/ are probably from Sino-Korean words.

(36) Examples

tál.ko "a tool to strengthen the ground", *à.tʌ́l* "son", *cà.kòk* "trace", *kă.cʰi* "magpie", *pə́n.kəj* "lightning", *ə̀.pí* "father", *kə̀.pʰɨ́l* "outer layer", *nŏ.zi]* "wild goose", *íl.hi* "wolf", *ìl.húm* "name", *ì.sàk* "ear of grain", *nĭm.ca* "owner", *pjə́.rak* "thunder", *jə̀.rɨ́m* "fruit", *mjə̀.kàj* "neck", *cjə̆.pi* "swallow", *ól.hi* "duck", *ò.cóm* "urine", *kò.ràj* "whale", *sŏl.ɣoc* "gimlet", *kú.rum* "cloud", *kù.sɨ́l* "gem", *tù.tʰə̀p* "toad", *pŭ.cʰʌj* "Korean leek", *kʌ́.nʌlh* "shade", *kʌ̀.rʌ́m* "river", *kʌ̀.zʌ̀lh* "autumn", *kɨ́.mɨl* "net", *kɨ̀.rɨ́s* "vessel", *pɨ̀.zə̀p* "kitchen", *kɨ̆j.kəl* "order", *tjáŋ.sʌ* "trade", *cjà.ráŋ* "self-praise", *cjà.ràj* "soft shell turtle", *jăk.taj* "camel", *kjó.tʰo]* "a kind of spice", *cjò.hʌ́j* "paper", *cjò.kàj* "shellfish", *sjŏ.kjəŋ* "blind person", *sjù.rúP* "umbrella", *jùl.mɨ̆j* "tear grass", *cjŭ.poK* "pimple", *hwál.kaj* "open arms", *skwà.rí* "ground cherry", *kwăŋ.taj]* "performer".

As in monosyllabic nouns, the minimal vowels /ʌ/ and /ɨ/ do not appear in the RX class as a rule. They frequently appear in the LL class, while other monophthongs tend to appear in a default LH class.

    (37) shows the correlation between final syllable nucleus and accent class. Yang vowels (/a/, /o/, /ʌ/) tend to appear in the LL class more frequently than Yin vowels (/ə/, /u/, /ɨ/), but the cause of this tendency is unclear.

(37) Correlation between final syllable nucleus and accent class in MK disyllabic nouns

nucleus \ accent	HX	LH	LL	RX	Totals
a	19	45	41	13	118
ə	8	34	13	3	58
i	31	70	10	13	124
jə	2	4	6	4	16
o	9	48	37	8	102
u	6	48	14	6	74
ʌ	8	66	41	3	118
ɨ	5	80	31	3	119

nucleus \ accent	HX	LH	LL	RX	Totals
ja	2	8	2	1	13
jo	1	3	3		7
ju	3	4	2		9
wa	3	5	5		13
wə		2	1	1	4

(38) Examples

ól.cʰaŋ "tadpole", *nà.ráh* "country", *kì.càŋ* "millet", *nĭm.cah* "owner", *pú.həŋ* "owl", *kùl.hə́ŋ* "deep hollow", *cù.mə̀k* "fist", *kŭm.pəŋ* "maggot", *sú.ri* "eagle", *nù.pí* "quilting", *pò.rì* "wheat", *pŭ.ri* "beak", *cú.jəP* "Gleditsia sinensis", *kù.kjə́ŋ* "sightseeing", *pìn.hjə̀* "hairpin", *sjŏ.kjəŋ* "blind person", *kál.mo* "axle", *tòŋ.mó* "friend", *kì.tòŋ* "pillar", *sjă.oŋ* "husband", *kú.rum* "cloud", *cù.rúm* "wrinkles", *sù.ùl* "wine", *sjə̆.ulh* "capital", *kʌ́.nʌlh* "shade", *cʌ̀.zʌ́* "nucleus", *mʌ̀.tʌ̀j* "joint", *pŭ.cʰʌj* "Korean leek", *kɨ́.mɨl* "net", *kì.rɨ́m* "oil", *sɨ̀.sɨ̀ŋ* "teacher", *nĭm.kɨm* "king", *pʌ́.jam* "snake", *ò.jác* "plum", *nàm.sjàŋ* "turtle", *jŏ.hjaŋ* "galingale", *jə́m.kjo* "Korean leek", *sài.jó* "shrimp", *kàj.jòM* "hazelnut", *pí.juK* "chick", *kə̀.jú* "goose", *sàp.tjù]* "Atractylodes", *pú.hwa]* "lung", *jə̀s.swáj* "six days", *tòŋ.hwà* "wax gourd", *nìl.ɣwə́j* "seven days", *tɨ̀l.kwə̀L* "stump", *ə̆.wəL* "core".

    Ramsey (1991: 220) reports that in almost 30% of the disyllabic atonic nouns, the vowel of both syllables is the minimal vowel /ʌ/, /ɨ/, such as *kʌ̀.zʌ̀l* "autumn", *kɨ̀.tɨ̆j* "thou", *mʌ̀.zʌ̀m* "heart", *pʌ̀.rʌ̀m* "wind". The table below (39) shows the correlation between the combination of nucleus type (F = full vowel, M = minimal vowel) and accent class. Statistically significant biases are shaded. Although the ratio of "M-M" in the LL class is lower than the ratio reported by Ramsey (1991) (40/206 = 19%), "M-M" in the LL class is significantly overrepresented. Also, several other tendencies are observed: an initial minimal vowel prefers the LL class and disprefers LH and RX;

"F-M" is overrepresented for the LH class and underrepresented for the HX class, while "M-F" is overrepresented for the HX class.

(39) Correlation between the combination of nucleus type and accent class. Left number = observed number, right number = expected number, ( ) = observed/expected value.

nucleus \ accent	HX	LH	LL	RX	Totals
F-F	65/59 (1.11)	249/252 (0.99)	106/124 (0.85)	48/33 (1.45)	468
F-M	5/21 (0.24)	126/91 (1.39)	32/45 (0.71)	6/12 (0.50)	169
M-F	19/9 (2.17)	22/38 (0.58)	28/19 (1.50)	1/5 (0.20)	70
M-M	8/9 (0.94)	20/37 (0.55)	40/18 (2.21)	0/5 (0.00)	68
Totals	97	417	206	55	775

If we represent "F-F", "F-M", "M-F", "M-M" as Ca.CaC, Ca.CʌC, Cʌ.CaC, Cʌ.CʌC, respectively, Ca.CaC and Ca.CʌC appear more frequently than Cʌ.CaC and Cʌ.CʌC in MK (468, 169 vs. 70, 68), and the latter two structures do not appear with a default LH frequently. This is probably because many words from *Cλ.CáC and *Cλ.Cʌ́C in Proto-Korean monophthongized to CCáC/CCʌ́C due to weak vowel syncope and aphesis.

Ramsey (1991: 220) also points out the important fact that almost half of the atonic disyllables have the shape CVC₁VC₂, where C_1 and C_2 are voiced consonants. E.g.) *kù.mɨ̀ɣ "hole", *nà.mɨ̀ɣ "wood", *nò.rʌ̀ɣ "deer", *à.zʌ̀ɣ "younger brother", *hʌ̀.rʌl "one day". These forms are reconstructed ones (K-M. Lee 1962), since in MK these words appear without a coda in isolation and show the underlying coda in inflectional forms with the minimal vowel in the final syllable of the stem dropped. (40) shows these alternations.

(40)
a. *à.zʌ̀ɣ "younger brother": à.zʌ̀# ~ àz.ɣ-í (NOM)
b. *nà.mʌ̀ɣ "wood": nà.mò# ~ nàm.k-í (NOM)
c. *hʌ̀.rʌl "one day": hʌ̀.rʌ̀# ~ hʌ̀l.l-ʌ́l (ACC)

Whitman (1994: 432) accounts for these alternations as a result of the loss of an unaccented weak vowel.

(41)
a. *à.zʌ̀ɣ# > à.zʌ̀#   *à.zʌ̀k/g+í > àz.ɣ-í (NOM)
b. *hʌ̀.rʌl# > hʌ̀.rʌ̀#   *hʌ̀.rʌl+ʌ́l > hʌ̀l.l-ʌ́l (ACC)

He formulates this synchronic alternation in MK as in (42): an unaccented weak vowel only immediately before an accented final syllable is deleted.

(42) Unaccented Weak Vowel Deletion (MK)
      ʌ, ɨ > Ø / ___   C V (C)#
              [−accent] [+accent]

Whitman (1994: 432) mentions that (a) the medial consonant must be voiced, since otherwise the final vowel would have undergone deletion by the diachronic rule of weak vowel syncope; (b) these words (MK LL class) must have been atonic to satisfy this rule. Thus he concludes that the MK LL

class reconstructs as the originally atonic class. This is a different conclusion from Ramsey (1978, 1986, 1991, 2001), in whose reconstructions not only verbal stems but also nouns did not have distinctive accent.

Still, it is possible to reconstruct originally trisyllabic stems for the MK LL class, but as Whitman (1994: 432, fn. 7) points out, the problem is that there are many LL class words with voiced (sonorant) finals in MK, as seen in (43) below. The application of weak vowel syncope in this case would predict a result with final rising tone: *CV̀.CV̀.C[+voice]V́ → CV̀.CV̌C[+voice].

(43) Correlation between coda type and accent class in MK disyllabic nouns. Words whose precise underlying coda is unknown are excluded.

coda \ accent	HX	LH	LL	RX	Totals
p	1	3	2	1	7
k	1	6	15		22
c		8	1	2	11
s	1	10			11
Ø	34	62	13	13	122
j	14	71	27	10	122
m	9	33	11	3	56
n	2	5		1	8
ŋ	3	14	20	5	42
l	2	50	22	2	76
ɣ			17		17

coda \ accent	HX	LH	LL	RX	Totals
pʰ			2		2
cʰ			1		1
h		5	4	1	10
lp		2			2
lk		5	2		7
lh	2	3	11	1	17

(44) Examples

mú.cəp "pile", *à.hóp* "nine", *tù.tʰə̀p* "toad", *kjə̌.cip* "woman, wife", *pjə̌.rak* "thunder", *nù.rúk* "yeast", *kù.rə̀k* "straw basket", *ì.úc* "neighbor", *hʌ̀. òc* "the only thing", *sŏl.ɣoc* "gimlet", *háŋ.kəs* "master", *pə̀.sɨ́s* "mushroom", *kú.ki* "ladle", *kò.kí* "meat, *tʌ̀.rì* "bridge", *pŭ.ri* "beak", *sʌ́.mʌj* "sleeve", *nù.ə̌j* "silkworm", *nù.ǰj* "sister", *ă.raj* "old days", *pó.ram* "mark", *tə̀.pʰúm* "bubble", *pʌ̀.rʌ̀m* "wind", *sǎ.rʌm* "person", *cɨ́.mɨn* "thousand", *nìl.hɨ́n* "seventy", *tăm.san* "palanquin", *pú.həŋ* "owl", *kùl.hə́ŋ* "hollow", *kì.tòŋ* "pillar", *kŭm.pəŋ* "maggot", *kʌ́.mʌl* "drought", *hə̀.míl* "fault", *nʌ̀.mʌ̀l* "wild vegetables", *sjə̌.ul* "capital", *cʌ̀.rʌ̀ɣ* "handle", *mù.rùpʰ* "knee", *nʌ̀.mʌ̀cʰ* "bag", *nì.máh* "forehead", *hʌ̀.nàh* "one", *nĭm.cah* "owner", *jə̀.tɨ́lp* "eight", *tù.túlk* "ridge", *ù.sɨ̀lk* "marten", *sɨ́.mɨlh* "twenty", *hà.nʌ́lh* "sky", *nʌ̀.mʌ̀lh* "wild vegetables", *sjə̌.ulh* "capital".

However, we can assume that Proto-Korean as well as MK had a constraint against a rising tone/complex tone in non-word-initial position (*R-NON-INITIAL), at least in simplex words.[21] A ban against a marked structure in non-initial position is common (positional markedness, Zoll 1996, 1998). Thus even if a diachronic change resulted in LR, it immediately changed to LL(H) to satisfy this constraint: H tone exists underlyingly but it is realized in the following suffix. As a result, LR merged to LL, which is from *CV̀.CV̀.C[–voice]ʌ́/ɨ́ (LLH) in Proto-Korean. This analysis is supported when taking into account the tonal alternation. See 3.3 below.

Some LL class words with coda /-j/ have doublets with obstruent codas /-k/ or /-h/. E.g.) *nà.còj ~ nà.còh* "evening", *sàj.pàj ~ sàj.pàk* "dawn". Also in actuality, many words in the LL class tend to

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[21] Specifically, the R class could appear in non-word-initial position in MK, if it followed the L class, through compounding or contraction. E.g.) *pʰjò.wə̌m* "leopard" < *pʰjò.βə̌m* < *pʰjó* "leopard" + *pə̌m* "tiger", *màk.tăj* < *màk.tà.hí* "stick".

end in /-aj/, /-ak/, /-ək/. E.g.) *cò.kàj* "shell", *pìŋ.γàj* "cliff", *ì.sàk* "ear (of grain)", *kà.ràk* "stick", *cò.kàk* "opportunity", *cù.mə̀k* "fist", *kə̀.cə̀k* "straw mat". These may be some derivative suffixes.[22]

As a whole, the LL class is overrepresented when the coda is an obstruent, which is the same tendency found in monosyllabic stems.[23]

(45) Left number = observed number, right number = expected number, ( ) = observed/expected value. /-ŋ/ (< * /-nk/) is treated as an obstruent coda here.

coda \ accent	HX	LH	LL	RX	Totals
Sonorant	61/50 (1.23)	221/200 (1.11)	73/107 (0.68)	29/28 (1.03)	384
Obstruent	8/19 (0.41)	56/77 (0.72)	75/41 (1.81)	10/11 (0.92)	149

Thus parallel to monosyllabic stems, it is assumed that disyllabic nouns of the LL class resulted from original trisyllabic words with final accent.

As for the smaller HX and RX classes, at least some of them are morphemically complex (Ramsey 1991: 220): compounds or derived from a monosyllabic word + diminutive suffix /i/. Also some words are probably Sino-Korean words.[24] E.g.) *ól.hi* "duck" (GEN: *ól.hʌj*), *ká.ci* "branch" (LOC: *ká.caj ~ ká.ci.jəj*), *pʰ ʌ́.ri* "fly" (~*pʰ ʌ́l*), *mú.ri* "crowd" (~ *múl*), *pó.siP* "edge of plow" (< *pó* "plow"), *cjə́k.saM ~ cjə̀k.sàM* "a kind of jacket" (< 衫 *sàm*), *pjə́.rak* "thunder" (< 霹靂 *pjə́k.rjək*), *nĭm.kɨm* "king" (< *nĭm* "master"), *sŏl.γoc* "a kind of plant" (< *kòc* "flower"?), *kjə̆.cip* "woman, wife" (< *cìp* "house"), *să.rʌm* "human" (< *săl-* "live"), *sjə̆.βɨL* "capital" (< **sjə.ra* "Silla" + **pəl* "town", see Fukui 2013: 160). Given this fact and the relatively low type-frequency of the HX and RX classes, as well as some phonological peculiarity observed in the LL class, it is probably safe to follow Ramsey (1991)'s hypothesis that Proto-Korean lacked phonemic pitch accent, although we still need more evidence for this analysis.[25]

Trisyllabic nouns in MK have five accent classes (HXX, RXX, LHX, LLH, LLL), but they are mostly compound words, and hence we do not deal with them in this paper.

3.3 The Middle Korean accent system

Based on the discussion in 3.1 and 3.2, we assume that Proto-Korean did not have a distinctive pitch accent and a default final accent was assigned for all the stems. In this section, we examine the MK accent system phonologically.

As mentioned above, in MK, an alternating tonal pattern appears after the first high pitch.

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[22] See the doublets *mù.cə̀k ~ mú.cəp* "pile", where accent classes are different depending on the codas (/-k/ vs. /-p/). The locative of *cʰì.mà* "skirt" appears as *cʰì.mà.jəj*, indicating that the original form of this word was **cʰì.màj*.

[23] The words that alternate between Ø and l, such as *hʌ̀.rʌ̀#* "one day"~ *hʌ̀l.l-ʌ́l* (ACC) may be reconstructed as **hʌ̀.rʌ̀t*: **hʌ̀.rʌ̀t+ʌ́l > *hʌ̀.rʌ̀d+ʌ́l > *hʌ̀r.d+ʌ́l > hʌ̀l.l-ʌ́l*.

[24] Mongolian loanwords regularly appear with the final accent, thus not explaining these exceptions. E.g.) *àk.táj < aγta* "gelding", *pà.rə́ < begelei* "bracelet", *sjòŋ.kól < šingqor, šonqor* "falcon", *kò.tʌ̀l.káj] < qudurγa* "crupper", *kàl.cì.kə́j] < qarciγai* "brown hunting falcon". The only exception not appearing with the final accent is *ìk.tə́.kuj] < itelgü* "a hawk for catching a rabbit". See K-M. Lee (1972: 100-101) and Lee and Ramsey (2011: 96-97) for more details of Mongolian loanwords.

[25] See S-O. Lee (1978: Chapter 7.3) for discussion of the connection between MK and coda consonants observed by Ceng (1963) and its possible implication for the emerging typology of tonogenesis.

25

(46) Tonal alternations in MK

a.   HX → HH, HL-H, HH-LH
b.   LH → LH, LH-H, LH-LH
c.   LL → LL, LL-H, LL-HH

It is assumed that MK had a right-to-left iambic tonal system as in Weri, Surawahá, and Modern Hebrew (Alber 2005). Rhythmic high tone is observed in the Bantu language Lamba as well (Bickmore 1995). The fact that the most frequent syllable structure is CV.CVC (Light-Heavy) in disyllabic nouns may indicate that iambic is the default accent in stems.

   The application of this rule stops when the underlying accent appears, as shown below. [ ] indicates stem boundaries.

(47) Right-to-left iambic tonal system observed in MK: LH and HX words

   ma.nʌ́l "garlic"   [ɓ ɓ́]   [ɓ ɓ́] (ɓ́)   [ɓ ɓ́] (ɓ ɓ́)   [ɓ ɓ́] (ɓ́) (ɓ ɓ́)
   kú.rum "cloud"   [ɓ́ (ɓ́)]   [ɓ́ (ɓ] ɓ́)   [ɓ́ (ɓ́)] (ɓ ɓ́)   [ɓ́ (ɓ] ɓ́) (ɓ ɓ́)

Given this, the unaccented class (L, LL, LLL) should theoretically appear with H, LH, HLH in isolation forms, but this is not the case. Also an unaccented class (LL) is expected to appear as [ɓ ɓ́] (ɓ ɓ́) rather than [ɓ ɓ́] (ɓ́ ɓ́), but the former is ungrammatical.

(48) Right-to-left iambic tonal system observed in MK: LL words

   pʌ.rʌm "wind"   [ɓ ɓ́]   [ɓ ɓ́] (ɓ́)   [ɓ ɓ́] (ɓ́ ɓ́)   [ɓ ɓ́] (ɓ́) (ɓ ɓ́)
                      *[(ɓ ɓ́)]   *[(ɓ́) (ɓ] ɓ́)   *[(ɓ ɓ́)] (ɓ ɓ́)   *[(ɓ́) (ɓ] ɓ́) (ɓ ɓ́)

Based on this, we will assume that the LL class has a floating H tone in the last syllable. Given this, the fact that LL accent is relatively underrepresented in structures with a final light syllable is understandable. On the other hand, RX words have two moras in the first syllable that are associated with L and H, respectively. We propose a phonological analysis of the MK accentual system (disyllabic words) by autosegmental theory here. (In Section 4.3, an additional analysis with OT constraints is discussed.)

(49) Autosegmental analysis of accent classes in MK disyllabic nouns

HX		LH		LL		RX	
ɓ	ɓ	ɓ	ɓ	ɓ	ɓ	ɓ	ɓ
CV.CV(C)		CV.CV(C)		CV.CVC		CV(C).CV(C)	
μ	μ	μ	μ	μ	μ	μ μ	μ
|			|		|	| |	
H			H		L H	L H	

A contour tone (LH) cannot be realized by one mora, thus LL does not become *LR. As mentioned above, this may be because of a constraint against a rising tone/complex tone in non-word-initial position (*R-NON-INITIAL). A floating tone is realized when combined with an inflectional suffix, such as the nominative /-i/.

   (50) shows the phonological analysis of MK monosyllabic words. The L class has a floating H tone. The R class has two moras that are associated with L and H. The H-b class is composed of one

mora with an H tone, whereas the H-a class is composed of two moras that are associated with H.

(50) Autosegmental analysis of accent classes of MK monosyllabic nouns

H-a	H-b	L	R
CVl, CVj	CVC	CVC[−voice]	CVC[+voice]
μμ or μμ | ∨ H H	μ | H	μ | LH	μ μ | | L H

In three-syllable words, there are few words with an LLL accent (only 7%) and there is no word with an LLLL accent in quadrisyllabic simplex words, suggesting that the unaccented class (L, LL, LLL) is resulted from contraction or apocope of longer words: L < LH, LL < LLH, LLL < LLLH. The rarity of LLL is explained by the fact that there are few quadrisyllabic simplex words in MK.

Finally, the tonal alternations in MK are explained as follows. By assuming that the unaccented class has an underlyingly H tone, it is possible to predict the tonal alternations correctly.

(51) Examples of derivations
a. HH-LH from HX words

1. Underlying tone	2. Binary right-to-left footing	3. Assigning H in the head of a foot
μ μ μ μ | H	μ (μ) (μ μ) | H	μ (μ) (μ μ) | | | H H H

b. LL-HLH from LL words

1. Underlying tone	2. Linking a floating tone to the next μ	3. Binary right-to-left footing	4. Assigning H in the head of a foot

μ μ μ μ μ
 	
LH
	μ μ μ μ μ
	   | |
	   L H
		μ μ μ (μ μ)
		   | |
		   L H
			μ μ μ (μ μ)
			   | | |
			   L H H

4. MK and the contemporary dialects

So far, we have examined the MK accent system and its correlation with segmental shapes. In this section, we investigate how regular the correspondences between MK and contemporary dialects are. By doing so, we try to find out the relationship among each dialect including MK with regard to the development from Proto-Korean. We also propose an OT model to explain the accent systems of each dialect by using the same set of constraints.

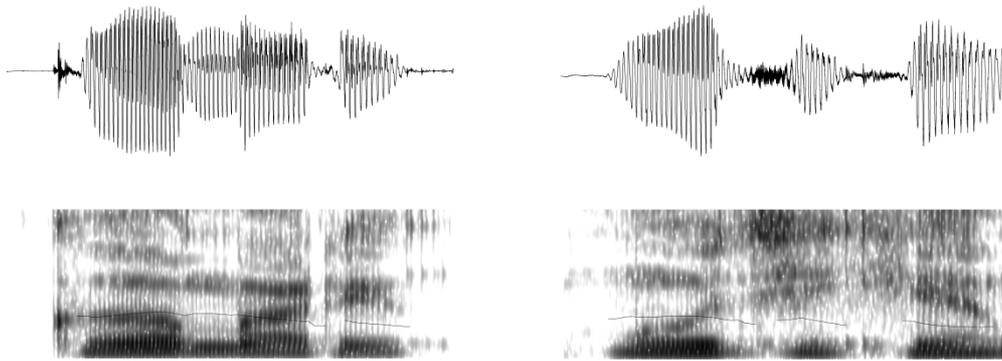## 4.1 Correspondences between MK and the contemporary dialects

The representative accent system of each dialect is shown in (52). ( ) indicates the accent of the following particle, and ":" marks vowel length. For HY, we show the accentuation of Yanbian, which differs from the South Hamkyeng dialect in that it lacks the initial boundary LH tone.

27

(52) Accent system of contemporary dialects

SK (Kimhay)			NK (Taykwu)			HY (Yanbian)		
H(H)	HH	HHL	H(H)	HH	HHL	H(L)	HL	HLL
H(L)	HL	HLL	H(L)	HL	HLL	L(H)	LH	LHL
L(H)	LH(L)	LHL	H:(H)	LH	LHL	H:(L)	LL	LLH
	LH(H)	LLH[26]		H:H	LLH		H:L	LLL
		LHH		H:HL				H:LL

In Pusan (South Kyengsang), trisyllabic LLH and LHH are merged to LHH, at least for the younger generation (Fukui 2003: 279). The length distinction in Taykwu such as H(H) vs. H:(H) is being lost among some younger speakers. Ramsey (1978: 122-123) reports that the South Hamkyeng dialect does not have a length distinction. Umeda (1993: 134) shows the same result for Yanbian. However, some older Yanbian speakers (from Helong) seem to retain the length distinction (MK H vs. R) partially as seen in (53). Younger speakers do not have this distinction and both HL and H:L appear with HL.

(53) Sample waveforms and spectrograms [Yanbian older speaker]

kə́:.ma.ri "leech" (154 ms)   *mú.ci.kɛ* "rainbow" (118 ms)

4.1.1 Monosyllabic nouns

(54) shows the regular correspondences between MK and contemporary dialects in monosyllabic nouns.

(54) Regular correspondences between MK and contemporary dialects (monosyllabic)

MK	SK	NK	HY
H	H(H)	H(H)	H(L)
L	H(L)	H(L)	L(H)
R	L(H)	H:(H)	H(L) ~ H:(L)

---

[26] This accent class is documented as MHH (M = mid tone) in He (1955), while LHH is described as LMM. Based on the correspondences with North Kyengsang and MK, it is assumed here that MHH resulted from *LLH by leftward spreading of final H, due to a *Lapse-left constraint. In fact, Co (2000) analyzes that the South Kyengsang Changnyeng dialect has the LLH class, which corresponds with the MHH class of He (1955).

(55) Examples of regular correspondences

a. MK H: *i* "louse", *c^{h}im* "saliva", *kas* "leaf mustard", *k*ɛ* "sesame", *k*ɨl* "chisel", *nun* "eye", *pal* "foot", *pam* "night", *pe* "hemp", *pi* "rain", *pom* "spring", *pus* "writing brush", *p^{h}ul* "grass", *p*jam* "cheek", *s*al* "rice", *t^{h}ə* "site", *t*al* "daughter".

b. MK L: *ap^h* "front", *jəp^h* "side", *hɨlk* "ground", *kuk* "soup", *k*oc^h* "flower", *k*wəŋ* "pheasant", *mit^h* "bottom", *mok* "neck", *nac^h* "face", *pak** "outside", *pɛ* "pear", *pjət^h* "sunshine", *suc^h* "charcoal", *tac^h* "anchor", *t*oŋ* "feces".

c. MK R: *ɛ* "worry", *om* "itch", *coŋ* "servant", *ke* "crab", *kim* "steam", *kol* "valley", *kom* "bear", *mal* "language", *nɛ* "stream", *pam* "chestnut", *pəl* "bee", *pəm* "tiger", *sɛm* "spring", *səm* "island", *sum* "breath", *tol* "stone", *twi* "back".

We examine the correspondences of each MK accent class separately below. First, (56) shows the accentual distribution of the words corresponding to the MK H class. In the "Accent class" columns, the left column indicates the tonal patterns of SK/NK, whereas the right column indicates the tonal patterns of HY. The shaded row shows the regular correspondences. As can be seen, the MK H class regularly corresponds with contemporary dialects (92-99%).

(56) MK H class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
H(H)	H(L)	147 (96%)	126 (92%)	159 (99%)
H(L)	L(H)	4 (3%)	8 (6%)	2 (1%)
L(H)/H:H	H(L) ~ H:(L)	2 (1%)	3 (2%)	0 (0%)
Totals		153	137	161

The same is true for the MK L class. In all dialects, regular correspondences are predominant (96-98%).

(57) MK L class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
H(H)	H(L)	1 (2%)	2 (4%)	2 (3%)
H(L)	L(H)	56 (98%)	49 (96%)	57 (97%)
L(H)/H:H	H(L) ~ H:(L)	0 (0%)	0 (0%)	0 (0%)
Totals		57	51	59

As for the correspondence between the MK R class and Yanbian accent classes, we assume that both H(L) and H:(L) are the regular reflexes of the MK R class, since the length distinction is only partially retained by a small number of speakers. Probably the length distinction in the North Kyengsang dialect should be treated the same way (= H(H) as well as H:(H) counted as the regular reflex), given that the length distinction is being lost. If so, all three dialects show highly regular correspondences with the MK R class as well.

(58) MK R class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
H(H)	H(L)	3 (6%)	6 (13%)	0 (0%)
H(L)	L(H)	1 (2%)	0 (0%)	1 (1%)
L(H)/H:H	H(L) ~ H:(L)	48 (92%)	39 (87%)	68 (99%)
Totals		52	45	69

4.1.2 Disyllabic nouns

Regular correspondences between MK and the contemporary dialects in disyllabic nouns are as follows. The correspondences between MK and HY are straightforward: the position of the accented syllable is the same. On the other hand, in SK and NK, the position of the accented syllable is one syllable left from MK LH (= KS HL) and MK LL(H) (= KS LH(L)), whereas MK HX corresponds with the so-called double H (= HH). MK RX corresponds with an initial long vowel (H:H) in NK, while it corresponds with LH(H) in SK. MK RX and LL are distinguished by the accent of the following suffix in SK: LH(H) vs. LH(L).

(59) Regular correspondences between MK and contemporary dialects (disyllabic)

MK	SK	NK	HY
HX	HH	HH	HL
LH	HL	HL	LH
LL	LH(L)	LH	LL
RX	LH(H)	H:H	HL ~ H:L

(60) Examples of regular correspondences
a. MK HX: *jəm.so* "goat", *can.c^{h}i* "party", *caŋ.sa* "trade", *hal.mi* "grandmother", *hwal.kɛ* "open arms", *ka.mul* "drought", *kol.c^{h}i* "head", *ku.rɨm* "cloud", *pən.kɛ* "lightning", *p^{h}a.ri* "fly", *si.kol* "countryside", *t^{h}ɨ.rim* "belching".
b. MK LH: *a.pi* "father", *i.ma* "forehead", *i.sɨl* "dew", *ca.ri* "seat", *ha.nɨl* "sky", *hə.ri* "waist", *ka.wi* "scissors", *kə.ri* "street", *ko.ki* "meat", *ko.ri* "ring", *k*o.ri* "tail", *mo.rɛ* "sand", *na.pi* "butterfly", *no.rɛ* "song", *nu.e* "silkworm", *paŋ.ul* "bell", *p*u.ri* "root", *sə.ri* "frost", *so.ri* "sound".
c. MK LL: *ca.ru* "sack", *co.kak* "piece", *co.kɛ* "shellfish", *cu.mək* "fist", *ka.ɨl* "autumn", *kə.cək* "straw mat", *ki.tuŋ* "pillar", *ku.sək* "corner", *ma.ɨl* "village", *me.mil* "buckwheat", *mən.ci* "dust", *mu.rɨp^h* "knee", *na.mul* "wild vegetables", *pu.ək^h* "kitchen", *ta.rak* "loft".
d. MK RX: *an.kɛ* "fog", *ə.rɨn* "adult", *im.ca* "master", *cin.ci* "meal", *ke.cip* "woman", *kə.cis* "lie", *mu.taŋ* "shaman", *pak.cwi* "bat", *paŋ.ku* "gas", *sa.ram* "person", *so.kjəŋ* "blind person".

First, we examine the correspondences of the MK HX class. (61) shows the accentual distribution of the words corresponding to the MK HX class in each dialect. In all dialects, c. 60% of the words correspond regularly. Ramsey (1978: 94) reports a similar tendency as well.

(61) MK HX class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HH	HL	35 (61%)	38 (63%)	41 (63%)
HL	LH	10 (18%)	8 (13%)	11 (17%)
LH(L)	LL	9 (16%)	7 (12%)	13 (20%)
LH(H)/H:H	HL~H:L	3 (5%)	7 (12%)	0 (0%)
Totals		57	60	65

In some exceptions, V_1 and V_2 are minimal vowels in MK: $c^h\acute{\Lambda}.ps\Lambda l$ "glutinous rice", $st\acute{i}.m\dot{i}l$ "water in which rice was washed", $k\acute{\Lambda}.n\Lambda lh \sim k\dot{i}.n\dot{i}lh$ "shade". These words appear with LH(L) in SK/NK and LL in HY. There are two hypotheses about these exceptions: (a) MK HX → Contemporary Korean LL; (b) the earlier stage of Korean LL → MK HX. In the former case, the motivation for the change is leveling (analogy) based on the syllable structure, since many disyllabic words whose V_1 and V_2 are both minimal vowels appear with LL in MK. In the latter case, the more regular LL accentuation with regard to segmental shapes is assumed for the earlier stage of Korean. Etymologically, the former is the appropriate assumption (for example, $c^h\acute{\Lambda}.ps\Lambda l$ is $c^h\acute{\Lambda}l$- "sticky" + $ps\acute{\Lambda}l$ "rice"). Also given that all disyllabic words with V_1/V_2 minimal vowels that appear with HX have "$k\Lambda$" in the first syllable ($k\acute{\Lambda}.n\Lambda lh$ "shade", $k\acute{\Lambda}.m\Lambda S$ "trace", $k\acute{\Lambda}.m\Lambda l$ "drought"), there may have been a morpheme *$k\acute{\Lambda}$ that composed these words. We can assume that MK texts were faithful to the accent of the etymological source. Thus, the change from $c^h\acute{\Lambda}.ps\Lambda l$ to $c^h\grave{\Lambda}.ps\grave{\Lambda}l$ may have already occurred in MK, but MK people tried to preserve in writing the more faithful accentuation.

Another representative exception is *u.ri* "we", which appears with LH(L) in SK/NK and LL in HY. This can be interpreted as an innovation in either MK or the contemporary dialects due to analogy with other pronouns, in particular *na* "I". See the complicated alternations in tonal patterns of *na*: *náj* "I-NOM", *ná.nán* "I-topic", *nă.rál* "I-ACC", *nàj* "I-GEN", *nà.wá* "I-COM", *nà.tó* "I-also". Parallel to this, the accent of *u.ri* may have changed as either Pre-MK *$\grave{u}.r\grave{i}$ → MK *ú.ri* or MK *$\acute{u}.ri$ → Kyengsang/HY $\grave{u}.r\grave{i}$.

Next, in the MK LH class, more regular correspondences are observed than in the HX class. As a whole, c. 85% words regularly correspond. Among the exceptions, relatively many words correspond with MK LL class. E.g.) *a.c^him* (< *a.c^ʌm*) "morning", *o.cum* (< *o.com*) "urine", *tu.tuk* (< *tu.tɨlk*) "ridge", *tu.təŋ* (< *tu.təN*) "ridge", *i.raŋ* (< *i.rəm*) "ridge" (Kyengsang LH, HY LH), *ku.rəŋ* (< *kul.həŋ*) "hollow", *sal.ku* (< *sʌl.ko*) "apricot", *tal.lɛ* (< *tʌl.loj]*) "wild rocambole". Exceptions like these seem to have some tendencies: many words are Light-Heavy in contemporary Korean; semantic meanings are overlapping (many "ridge" words, plant names); codas changed irregularly (e.g. /n/ → /ŋ/, /m/ → /ŋ/). Given these facts, the irregularity of these words may not have to be treated so seriously.

(62) MK LH class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HH	HL	1 (1%)	2 (1%)	6 (3%)
HL	LH	167 (85%)	173 (83%)	201 (87%)
LH(L)	LL	22 (11%)	28 (13%)	23 (10%)
LH(H)/H:H	HL~H:L	6 (3%)	6 (3%)	2 (1%)
Totals		196	209	232

The MK LL class quite regularly corresponds with Kyengsang dialects (93-94%), whereas in HY, the regularity rate is lower (85%) and 12% of the MK LL words appear with HY LH. For HY, both LH and LL classes appear as LH in isolation, which could result in the merger of these two accent classes (at least in the younger generation). With more detailed investigation, the regularity rate of the MK LL class in HY may become higher.

(63) MK LL class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HH	HL	2 (2%)	2 (2%)	3 (3%)
HL	LH	4 (4%)	4 (4%)	12 (12%)
LH(L)	LL	85 (93%)	87 (94%)	84 (85%)
LH(H)/H:H	HL~H:L	0 (0%)	0 (0%)	0 (0%)
Totals		91	93	99

Finally, in the MK RX class, the regularity rate of NK is lower than that of SK. But this is probably because more conservative accent patterns have not yet been found for this dialect through my investigation. (This factor seems to be true for other cases, given that the regularity rate of NK is the lowest overall among these dialects.)

For the correspondence with the MK RX class, Yanbian HL is treated as the regular reflex as well as H:L, but still HY has relatively more exceptions than Kyengsang. Some of them are etymologically compound words and their irregular correspondences are explained by the different compound accentuation rules between Kyengsang and HY: in Kyengsang, the first element decides the accent of compound words, whereas in HY, the second (final) element decides the accent of compound words. E.g.) MK *sǐ.nǎj* > *si.nǎj* > *si.náj* > HY *si.nɛ̂* "brook". *nǎ.zam* "sophora" (*zam* = *sàm* "ginseng") > HY *nə.sam* can be explained in the same way.

(64) MK RX class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HH	HL	0 (0%)	3 (8%)	0 (0%)
HL	LH	1 (3%)	2 (5%)	4 (10%)
LH(L)	LL	1 (3%)	1 (3%)	5 (12%)
LH(H)/H:H	HL~H:L	30 (94%)	31 (84%)	33 (79%)
Totals		32	37	42

4.1.3 Trisyllabic nouns

Regular correspondences between MK and the contemporary dialects for trisyllabic words are as follows. As in disyllabic words, the correspondences between MK and HY are straightforward. On the other hand, in Kyengsang, a high pitch of MK LHX, LLH and LLL (= LLL(H)) appears one syllable to the left: HLL, LHL, LLH, respectively.

(65) Regular correspondences (trisyllabic words)

MK	SK	NK	HY
HXX	HHL	HHL	HLL
LHX	HLL	HLL	LHL
LLH	LHL	LHL	LLH
LLL	LLH	LLH	LLL
RXX	LHH	H:HL	HLL ~ H:LL

(66) Examples of regular correspondences

a. MK HXX: *ə.mə.ni* "mother", *ha.ra.pi* "grandfather", *mu.ci.kɛ* "rainbow", *to.k*e.pi* "spirit".

b. MK LHX: *a.hɨ.re* "nine days", *ə.cə.k*e* "yesterday", *uŋ.təŋ.i* "puddle", *ka.mul.cʰi* "snakeheaded fish", *mjə.nɨ.ri* "daughter-in-law", *na.kɨ.ne* "traveler".

c. MK LLH: *i.pa.ci* "contribution", *haŋ.a.ri* "jar", *k*a.ma.kwi* "raven", *mi.na.ri* "parsley", *nu.tə.ki* "rags", *pi.tul.ki* "dove", *so.na.ki* "shower", *tɛ.ka.ri* "head", *tu.k*ə.pi* "toad".

d. MK LLL: *k*u.ci.ram* "scolding", *pok.suŋ.a* "peach", *pu.sɨ.rəm* "ulcer", *pu.ci.rən* "diligence".

e. MK RXX: *ə.ri.sin* "esteemed elder", *kə.mə.ri* "leech", *kum.peŋ.i* "maggot", *sa.ma.kwi* "mole".

First, in the MK HXX class, the regular correspondence rate is relatively low. In SK and NK, c. 30-40% of the words appear with LHL, whereas in HY, the exceptions are either LHL or LLH.[27] Compared to Kyengsang, the regularity rate of HY is much lower. Some words that are etymologically compounds and show irregular correspondences seem to follow the compound accent rules. E.g.) *sə́.k*a.re* "rafter" (SK/NK HHL, HY LLH) < MK *sjə́* "rafter" + *ka.ráj* "spade"?; *kʰo.k*i.ri* "elephant" (SK/NK HHL, HY LHL) < MK *kóh* "nose" + *kĭ.ri/ki.rí* "being long".

(67) MK HXX class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HHL	HLL	10 (67%)	10 (59%)	6 (40%)
HLL	LHL	0 (0%)	0 (0%)	4 (27%)
LHL	LLH	4 (27%)	7 (41%)	5 (33%)
LLH	LLL	0 (0%)	0 (0%)	0 (0%)
LHH/H:HL	HLL~H:HL	1 (7%)	0 (0%)	0 (0%)
Totals		15	17	15

Second, in the MK LHX class, HY shows highly regular correspondence, while in Kyengsang the regularity rate is c. 40% and many words appear with LHL.

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[27] In actuality, most Yanbian speakers pronounce these exceptions as the LLH class, and the LHL accent is only observed in Ramsey (1978: 113)'s data from old South Hamkyeng speakers, as well as sporadically from the oldest speakers of Yanbian dialect.

(68) MK LHX class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HHL	HLL	0 (0%)	1 (3%)	0 (0%)
HLL	LHL	13 (43%)	11 (34%)	25 (81%)
LHL	LLH	15 (50%)	15 (47%)	6 (19%)
LLH	LLL	1 (3%)	2 (6%)	0 (0%)
LHH/H:HL	HLL~H:HL	1 (3%)	3 (9%)	0 (0%)
Totals		30	32	31

On the other hand, in the MK LLH and LLL classes, all three dialects show regular correspondences. Exceptions are as follows: MK LLH > HY LHL: *k*we.k*o.ri* "nightingale", *pəl.kə.ci* "insect", *k*ok.tɛ.ki* "top", *sa.na.i* "man"; MK LLH > HY LLL *ka.rak.ci* "ring"; MK LLL > KS LHL, HY LHL: *to.ri.k*ɛ* "pole".[28]

(69) MK LLH class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HHL	HLL	0 (0%)	1 (2%)	0 (0%)
HLL	LHL	0 (0%)	0 (0%)	4 (9%)
LHL	LLH	36 (100%)	41 (98%)	38 (88%)
LLH	LLL	0 (0%)	0 (0%)	1 (2%)
LHH/H:HL	HLL~H:HL	0 (0%)	0 (0%)	0 (0%)
Totals		36	42	43

(70) ML LLL class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HHL	HLL	0 (0%)	0 (0%)	0 (0%)
HLL	LHL	1 (20%)	1 (20%)	1 (20%)
LHL	LLH	0 (0%)	0 (0%)	0 (0%)
LLH	LLL	4 (80%)	4 (80%)	4 (80%)
LHH/H:HL	HLL~H:HL	0 (0%)	0 (0%)	0 (0%)
Totals		5	5	5

Finally, in the MK RXX class, some exceptions may be explained as follows. MK *mǒj.za.ri* "echo" (→ NK/SK *me.á.ri*, HY *me.a.rí*) may be due to compound accentuation in MK: *mǒjh* "mountain" + *săl-* "live" + *-i* (suffix) → *mǒj.zà.rí* → **mòj.zà.rí*. See parallel examples: *mǒjh* "mountain" + *kǒl* "valley" → *mòjs.kǒl* "mountain and valley", *mǒjh* "mountain" + *ən.təK* "hill" → *mòjs.ən.təK* "small mountain". Another exception is MK *kǎj.na.ri]* "forsythia" (→ NK/SK *kɛ.ná.ri*, HY *kɛ.na.rí*). One possible explanation for this is that it is due to analogy with MK *mì.nà.rí* "parsley" (→ NK/SK *mi.ná.ri*, HY *mi.na.rî*).

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[28] *pəl.kə.ci* (LHL) and *ka.rak.ci* (LLL) are observed in Ramsey (1978: 107, 110)'s data. All of my Yanbian consultants pronounce them with LLH, but this LLH pattern may be due to analogical change to the higher-type frequency class.

(71) MK RXX class correspondences

Accent class		SK	NK	HY
SK/NK	HY			
HHL	HLL	0 (0%)	0 (0%)	0 (0%)
HLL	LHL	0 (0%)	0 (0%)	0 (0%)
LHL	LLH	2 (25%)	2 (25%)	3 (38%)
LLH	LLL	0 (0%)	0 (0%)	0 (0%)
LHH/H:HL	HLL~H:HL	6 (75%)	6 (75%)	5 (63%)
Totals		8	8	8

As a whole, in trisyllabic words, the regularity rate trends are similar among the three dialects, and some differences can be attributed to different compound accentuation rules. Still, the MK LHX shows a quite different regularity rate between Kyengsang and HY, whereas the MK HXX class shows a higher regularity rate for Kyengsang than for HY. Why are the regularity rates different only in these accent classes? We discuss the cause for this difference in section 4.3.

4.2 The Kyengsang accent shift

As to the accentuation of contemporary dialects (Hamkyeng and Kyengsang), Ramsey (1978: 70, 77) proposes the following two pitch assignment rules.

(72) Pitch assignment rules
a. Pitch assignment rule (PAR) 1: Within a phonological phrase, the initial mora is low pitched, unless it is accented, and all the moras following an accented mora are also low pitched. All the remaining moras are high pitched.
b. Pitch assignment rule 2 (**in Kyengsang**): Within a phonological phrase, if there is an accent in front of the first mora, the first two moras are high pitched, and all succeeding moras are low pitched.

With these pitch assignment rules, the differences between the two dialects are analyzed as in (73). Most cases are explained with PAR 1, but ´σσσ in Kyengsang requires PAR 2, as shown in *tʰó.k*é.pi-ka* "spirit + NOM". When a word from this accent class constitutes the second member of a compound word, the accent in front of the first mora ("pre-accent") of this class assigns a high pitch to the last syllable of the first member of the compound: *cíp.tʰo.ke.pi* (**cip.tʰó.k*é.pi*) "house devil".

(73) Comparison of the accent systems between South Hamkyeng and Kyengsang (Ramsey 1978: 79-80)

MK		South Hamkyeng			Kyengsang		gloss
σ σ σ	σ σ σ	sɛ.tá.rí-ká PAR1		σ σ σ	sɛ.tá.rí-ka PAR1		"ladder"
σ σ σ	σ σ σ	ka.má.kwí-ka PAR1		σ σ σ	k*a.má.ku-ka PAR1		"raven"
σ σ σ	σ σ σ	ka.múl.cʰi-ka PAR1		σ σ σ	ká.mul.cʰi-ka PAR1		"mullet"
σ σ σ	σ σ σ	tʰó.k*e.pi-ka PAR1		´σ σ σ	tʰó.k*é.pi-ka **PAR2**		"spirit"
		cip.tʰó.ke.pi-ka PAR1			cíp.tʰo.ke.pi-ka PAR1		"house devil"

Ramsey (1978: 80) interprets this difference between the two dialects as the "Kyengsang accent shift

rule": shift the accent one syllable to the left. We cite his explanation below:

"The Kyengsang accent shift rule does not mean that we are deriving the Kyengsang lexical accent directly from the South Hamkyeng accent, of course, but rather that the South Hamkyeng dialect has preserved lexical accent identical to the lexical accent of an earlier stage of the Kyengsang dialect. … In applying the comparative method, the "third witness", that is, MK, attests the same location of lexical accent as South Hamkyeng. … Furthermore, the existence of the aberrant pre-accented forms in Kyengsang provides internal evidence that that dialect has historically undergone a shift in lexical accent. Remember that a completely ad hoc rule (PAR2) had to be formulated to account for them; it is difficult to imagine that such a rule could have been original."

Thus, Ramsey (1978) infers that the difference between the accent system of Hamkyeng and Kyengsang is due to a later development in Kyengsang by virtue of the leftward accent shift while Hamkyeng still preserves the conservative accent. Similarly, Kenstowicz et al. (2007) propose that the Kyengsang accent system evolved from MK by a push chain shift: LL > LH > HL > HH.

However, Uwano (2012: 1436-1437) raises a question about the hypothesis that MK represents the older accent system compared to Kyengsang. Based on a report that people migrated from southern regions including Kyengsang to Hamkyeng in the 15th C, he states that "It is a strange fact, however, that dot marking, which is assumed to be used to indicate the accent in the fifteenth century Seoul dialect, disappeared entirely from the literature in the seventeenth century, and the modern Seoul dialect has no accentual distinctions. It means that ''original'' MK accentual distinctions were lost in less than two hundred years, while ''derived'' modern Kyengsang dialects still have a rich accent system with various accentual oppositions". He instead proposes that the "kernel" (= pitch accent) in Kyengsang shifted one syllable to the right, which resulted in the Hamkyeng/MK accent. His analysis of the tonal development of Korean as well as Japanese dialects is also supported by the typological tendency that in tonal languages a high pitch tends to be advanced rather than retracted (Hyman 2002).

Still, although leftward accent shift is rare, there are several languages where retraction is observed: Kinande (Hyman and Valinande 1985, Kenstowicz 2009), Neo-Shtokavian Serbo-Croatian (Becker 1977). In actuality, the MK accent system itself (right-to-left iambic system) is relatively rare typologically as well, but there exists several languages with the same system.[29]

Given the compound accent in Kyengsang ´σσσ structures, assuming the general retraction in Kyengsang seems to be simpler than postulating pitch advancement in MK and Hamkyeng.[30]

There is another piece of supportive evidence for the Kyengsang accent shift. Sino-Korean words in MK reflect the pitch values of Middle Chinese tone more faithfully than Kyengsang (Ito 1999: 134-136, Fukui 2013: 203-205). (74) shows the basic correspondences between Middle Chinese tones and the MK/HY/Kyengsang accent classes in disyllabic Sino-Korean words. In general, the accent patterns are determined based on the combination of the tonal classes of the penultimate and final syllables. Through various kinds of evidence, the phonetic values of each Middle Chinese tone (at least those on which Sino-Korean readings were based) are assumed to be as follows (Rai 1950: 16, Kindaichi 1951: 699): Level = low, Rising = high rise, Departing = rise,

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[29] In actuality, the MK accent system is comparable to English and Polish: In English mono-morphemic words, the main stress is at the right edge and the stress pattern is governed by a left-to-right trochaic system. E.g.) (wìnni)pe(sáukee), (àbra)ca(dábra), (àpa)(làchì)(cóla). In Polish, the main stress appears in the penultimate syllable and the secondary stress pattern is governed by a left-to-right trochaic system (Rubach and Booij 1985).

[30] Based on a comparative study of the accent systems of various Korean dialects, Hayata (1976) also concludes that Kyengsang accent resulted from an MK-type accent system.

Entering = high. When the penultimate syllable corresponds with Rising/Departing tones, MK accent either appears with RX or HX, whose diverging conditions are unclear. See Ito (2007a: 246-254) for details.

(74) The basic correspondences between Middle Chinese tones and the MK/HY/Kyengsang accent classes in disyllabic Sino-Korean words

a. MK

penult \ final	Level	Rising, Departing	Entering
Level	LL	LH	
Rising, Departing	RX/HX		
Entering	HX		

b. HY

penult \ final	Level	Rising, Departing	Entering
Level	LL	LH	
Rising, Departing	H:L/HL		
Entering	HL		

c. Kyengsang

penult \ final	Level	Rising, Departing	Entering
Level	LH(L)	HL	
Rising, Departing	NK = H:H/HH, SK = LH(H)/HH		
Entering	HH		

As can be seen in (74), Level + Level and Level + Rising/Departing/Entering clearly show more faithful adaptation in MK and HY than in Kyengsang: in MK and HY, Level + Level appears with LL and Level + Rising/Departing/Entering appears with LH, while in Kyengsang, Level + Level appears with LH(L) and Level + Rising/Departing/Entering appears with HL. That is, in Kyengsang, the same Level tone appears as L in one case and H in the other, which is an unnatural adaptation. On the other hand, the adaptations observed in MK and HY are more straightforward. Thus the accentual patterns in Sino-Korean words support the hypothesis that MK/HY shows an older stage of the adaptation process than Kyengsang does, which in turn provides evidence for the conservativeness of the MK/HY accent system vis-à-vis Kyengsang. This fact also indicates that the divergence of Kyengsang from a MK/HY-like system took place after Sino-Korean words were introduced into Korean.

4.3 OT analysis

Then how can we interpret the difference in accent systems between MK and the contemporary dialects? In this section, we propose a preliminary analysis of the accent systems of MK and the contemporary dialects, based on Optimality Theory (Prince and Smolensky 1993). The goal of this analysis is to give an account of the different regularity rates between Kyengsang and HY in the words corresponding to MK HXX and LHX classes: in the former, Kyengsang shows a higher regularity rate than HY, whereas in the latter, HY shows a higher regularity rate than Kyengsang. R-initial classes and their reflexes in the contemporary dialects are not examined in this paper, except for the MK monosyllabic R class.

The relevant constraints are shown below.

(75) Constraints
a.   IDENT-H: if a syllable has H in the input, then it is H in the output.
b.   IDENT-L: if a syllable has L in the input, then it is L in the output.
c.   ALIGN-R: a high pitch is assigned at the right edge of the word.
d.   *LAPSE: penalize a candidate with two successive syllables without H.
e.   *LAPSE-R: penalize a candidate with two successive syllables without H at the right edge of the word.
f.   *LAPSE-L: penalize a candidate with two successive syllables without H at the left edge of the word.
g.   DEP-H: do not insert H.
h.   *CLASH: penalize a candidate with two successive Hs.
i.   *CLASH-R: penalize a candidate with two successive Hs at the right edge of the word.
j.   *R-NON-INITIAL (*R-NI): penalize a candidate with R in non-word-initial position.
k.   *FLOAT-H: the floating H tone must be realized phonetically.
l.   *H-CODA [−voice] (*H-NR): penalize an H tone to be associated with a voiceless (non-sonorant) coda.

4.3.1 MK

Earlier discussion showed that the final syllable of the word was in general associated with an H tone in MK/Proto-Korean. Also, there was an alternating pattern of Hs, indicating a ban on a lapse of two successive non-high (= L) syllables. The one exception to these generalizations involves the toneless/atonic stems where the stem remains without a final H, apparently violating ALIGN-R as well as LAPSE. We hypothesized that these stems derived from words with an additional final syllable that was apocopated in the development from Proto-Korean. Based on this discussion, we hypothesize that the MK atonic class has an LH tone at the right edge, where the final H is associated to a floating Tone-Bearing Unit (TBU). Due to this floating H tone, MK atonic class does not violate ALIGN-R and *LAPSE-R. The crucial rankings for MK are as follows.

(76) Crucial rankings for MK
a.   *LAPSE-R >> *LAPSE-L to permit σ σ σ́ but not σ́ σ σ.
b.   *LAPSE-R >> DEP-H to permit σ σ σ́ but not σ σ σ.
c.   DEP-H >> *LAPSE-L: /σ σ σ́/ appears with σ σ σ́ and not with σ́ σ σ́.
d.   ALIGN-R >> DEP-H to exclude σ σ but not σ́ σ́.
e.   IDENT-H >> DEP-H: /σ́ σ́/ appears with σ́ σ́ but not with σ σ.
f.   IDENT-L >> *FLOAT-H to allow σ but not σ́ for the L class.
g.   *R-NI >> *FLOAT-H to allow σ σ but not σ σ̌ for the LL class.
h.   *H-NR >> *FLOAT-H to allow σ but not σ̌ for the L class.

Thus we obtain the following constraint ranking: IDENT-L, *R-NI, *H-NR, IDENT-H, *LAPSE-R, ALIGN-R >> *FLOAT-H, DEP-H >> *LAPSE-L.

   To illustrate our analysis, we start from disyllabic words. In the LL class, σ σ̌ and σ σ́ do not appear, since *FLOAT-H is ranked lower than *R-NI and IDENT-L. Also, σ́ σ is not an optimal output due to the violation of ALIGN-R.

(77) MK disyllabic word accentuation

a. HX class

σ σ | H	IDENT-H	*LAPSE-R	ALIGN-R	DEP-H	*LAPSE-L
→ σ́ σ				*	
σ́ σ			*!		
σ σ́	*!				

b. LH class

σ σ | H	IDENT-H	*LAPSE-R	ALIGN-R	DEP-H	*LAPSE-L
→ σ́ σ					
σ́ σ				*!	
σ σ́	*		*		
σ σ	*	*	*		*

c. LL class

σ σ <σ> | | L H	IDENT-L	*R-NI	IDENT-H	*LAPSE-R	ALIGN-R	*FLOAT-H	DEP-H	*LAPSE-L
→ σ σ						*		
σ σ̌		*			*			
σ σ́	*				*			
σ́ σ					*!		*	
σ́ σ	*				*		*	

Next, (78) demonstrates the accentuation of MK trisyllabic words.

(78) MK trisyllabic word accentuation

a. HXX class

σ σ σ | H	IDENT-H	*LAPSE-R	ALIGN-R	DEP-H	*LAPSE-L
→ σ́ σ σ				*	
σ σ σ		*	*		
σ σ σ			*!	*	
σ σ σ				**!	
σ́ σ σ	*!			*	
σ σ σ	*		*		
σ σ σ	*!				*

b. LHX class

σ σ σ | H	IDENT-H	*LAPSE-R	ALIGN-R	DEP-H	*LAPSE-L
→ σ́ σ σ				*	
σ σ σ			*!		
σ σ σ	*!			*	
σ σ σ	*!				*

c. LLH class

σ σ σ | H	IDENT-H	*LAPSE-R	ALIGN-R	DEP-H	*LAPSE-L
→ σ σ σ́					*
σ́ σ σ				*!	
σ σ́ σ				*!	
σ σ σ	*	*	*		*

d. LLL class

σ σ σ <σ>
  | |
  L H
	IDENT-L	*R-NI	IDENT-H	*LAPSE-R	ALIGN-R	*FLOAT-H	DEP-H	*LAPSE-L

→ σ σ σ						*		*
σ σ σ́	*				*			*
σ σ σ̌		*			*			*
σ́ σ σ	*				*		*	
σ σ́ σ	*				*		*	
σ σ́ σ					*!		*	

Also, if we assume *CLASH-R >> *CLASH and *LAPSE >> *CLASH, *DEP-H, σ σ σ σ → σ́ σ́ σ σ́ can be explained satisfactorily, excluding σ́ σ σ́ σ́ and σ́ σ σ σ́.

(79) HXXX class

σ σ σ σ | H	IDENT-H	*LAPSE-R	ALIGN-R	*LAPSE	DEP-H	*CLASH-R	*CLASH
→ σ́ σ́ σ σ́					**		*
σ́ σ σ́ σ́					**	*	*
σ́ σ σ́ σ				*!	*		
σ́ σ σ σ́			*!		*		
σ̋ σ σ σ		*	*	*			
σ σ σ σ	*!				*		

Finally in the monosyllabic L class, σ does not appear with σ̌ due to the violation of *H-NR: recall that the MK L class words end with a voiceless coda as a rule. Also, σ does not violate ALIGN-R since it has a floating TBU associated with an H tone.

(80) MK monosyllabic word accentuation
a. H class

σ | H	IDENT-H	ALIGN-R	DEP-H
→ σ́			
σ	*	*	

b. L class (= with non-sonorant coda)

σ <σ> | | L H	*H-NR	IDENT-L	IDENT-H	ALIGN-R	*FLOAT-H	DEP-H
→ σ					*	
σ̌	*			*		
σ́		*		*		

c. R class (= with sonorant coda)

σ μμ | | L H	*H-NR	IDENT-L	IDENT-H	ALIGN-R	*FLOAT-H	DEP-H
→ σ̌						
σ			*	*		
σ́		*!				

4.3.2 Contemporary dialects

Unlike MK, contemporary dialects do not show tonal alternations after the first high pitch. This fact as well as the irregular correspondences for MK HXX and LHX can be understood if we assume different rankings of basically the same constraints used in the analysis of MK.

First, we examine the HY accent system, based on the Yanbian dialect. Given that this dialect does not have the R tone, we assume a *R constraint as well. For the unaccented class, we assume the floating H tone associated to the floating TBU as in MK, based on the fact that the suffix following an unaccented class stem gets an H tone in HY: *cíp* "house", *ci.p-í* "house + NOM", *pa.rám* "wind", *pa.ram-í* "wind + NOM", *ma.ci.mák* "the last", *ma.ci.ma.kí* "the last + NOM". The crucial rankings for the Yanbian accent system are as follows:

(81) Crucial rankings for Yanbian
a. DEP-H is an undominated constraint since a high tone does not appear twice in one phonological phrase.
b. IDENT-H >> ALIGN-R: /σ́ σ/ does not appear with σ σ́.
c. *LAPSE-R and Ident-H are ranked the same to permit /σ́ σ σ/ to appear as σ σ́ σ or as σ σ σ́.
d. ALIGN-R and *LAPSE-L are ranked the same to permit /σ́ σ σ/ to appear as σ σ́ σ or as σ σ σ́.
e. *FLOAT-H >> IDENT-L: /σ̌/ does not appear with σ.
f. *R-NI >> IDENT-L: /σ́ σ/ does not appear with σ σ̌.
g. *FLOAT-H >> ALIGN-R: /σ̌ σ σ/ does not appear with σ σ σ́ but with σ σ σ́.

Thus we obtain the following constraint ranking: DEP-H >> *LAPSE-R, IDENT-H, *FLOAT-H, *R-NI >> ALIGN-R, *LAPSE-L, IDENT-L. It differs from MK by promoting *FLOAT-H above ALIGN-R and IDENT-L, and by promoting DEP-H to the top of the hierarchy. Based on this ranking, the accentuation of disyllabic words is explained as in (82). As an output for the LL class, σ σ does not violate *LAPSE-R, *LAPSE-L, and ALIGN-R due to the floating H tone, but it violates *FLOAT-H.

(82) Yanbian disyllabic word accentuation
a. HL class

σ σ | H	DEP-H	*LAPSE-R	IDENT-H	ALIGN-R	*LAPSE-L
→ σ́ σ				*	
σ́ σ	*!				
σ σ́			*!		
σ σ		*	*	*	*

b. LH class

σ σ | H	DEP-H	*LAPSE-R	IDENT-H	ALIGN-R	*LAPSE-L
→ σ σ́					
σ́ σ́	*!				
σ́ σ			*!	*	
σ σ		*	*	*	*

c. LL class

σ σ <σ> | | L H	DEP-H	*LAPSE-R	IDENT-H	*FLOAT-H	*R-NI	ALIGN-R	*LAPSE-L	IDENT-L
→ σ σ́						*		*
σ σ				*!				
σ σ̌					*!	*		
σ́ σ́	*!					*		*
σ́ σ	*!					*		

(83) demonstrates the accentuation of trisyllabic words. As mentioned above, the regular correspondence rate with MK HXX class is relatively low in HY, and some words from MK HXX appear with LHL or LLH. It is considered here that both MK and HY tend to avoid an HLL accent but they have different repair strategies: shifting the accent location in HY and inserting a tone in MK. Thus, in HY, DEP-H is promoted, whereas IDENT-H is demoted.

(83) Yanbian trisyllabic word accentuation

a. HLL class

σ σ σ | H	DEP-H	*LAPSE-R	IDENT-H	ALIGN-R	*LAPSE-L
→ σ́ σ σ		*		*	
→ σ σ́ σ			*	*	
→ σ σ σ́			*		*
σ́ σ σ	*!				

b. LHL class

σ σ σ | H	DEP-H	*LAPSE-R	IDENT-H	ALIGN-R	*LAPSE-L
→ σ σ́ σ				*	
σ́ σ σ		*	*	*	
σ σ́ σ	*!				
σ σ σ́			*!		*

c. LLH class

σ σ σ́ | H	DEP-H	*LAPSE-R	IDENT-H	ALIGN-R	*LAPSE-L
→ σ σ σ́					*
σ σ́ σ		*	*	*	
σ́ σ σ			*!	*	

d. LLL class

σ σ σ <σ>
    | |
     L H
	DEP-H	*LAPSE-R	IDENT-H	*FLOAT-H	*R-NI	ALIGN-R	*LAPSE-L	IDENT-L

→ σ σ σ́						*	*	*
σ σ σ				*!			*	
σ σ σ̌					*!	*	*	
σ σ́ σ	*!					*		
σ́ σ σ	*!	*				*		

Finally for monosyllabic words, both H and L classes appear as H in isolation. *FLOAT-H, *R >> IDENT-L explains this.

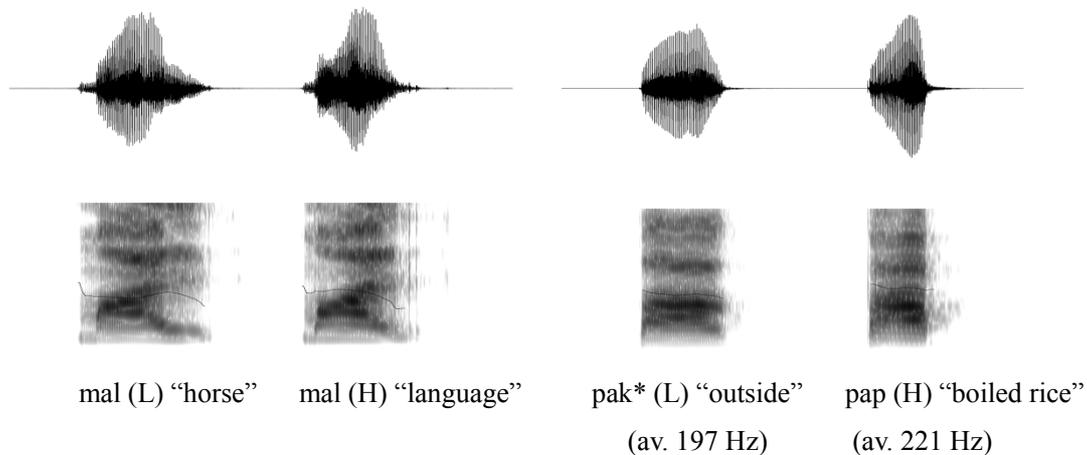(84) Yanbian monosyllabic word accentuation

a. H class

σ | H	DEP-H	IDENT-H	ALIGN-R
→ σ́			
σ		*!	*

b. L class

σ <σ> | | L H	DEP-H	IDENT-H	*FLOAT-H	*R	ALIGN-R	IDENT-L
→ σ́					*	*
σ			*!			
σ̌				*!	*	

Still, in actuality, some Yanbian speakers pronounce the L class as R (when the coda is a sonorant) or L (when the coda is an obstruent) with a relatively longer duration in isolation, as seen in (85)

(85) Sample waveforms and spectrograms (Yanbian young female speaker)

mal (L) "horse"   mal (H) "language"   pak* (L) "outside"   pap (H) "boiled rice"

                                             (av. 197 Hz)   (av. 221 Hz)

For these speakers, we must assume the ranking *H-NR, IDENT-L >> *FLOAT-H >> *R, as shown below. This fact in turn shows that the L class has a floating H tone in Yanbian.

43

(86) Yanbian monosyllabic word accentuation (the L class, for some speakers)

a.   L class (with a sonorant coda)

σ <σ> | | L H	DEP-H	IDENT-H	*H-NR	IDENT-L	*FLOAT-H	*R	ALIGN-R
→ σ̌						*	*
σ́				*!			*
σ					*!		

b.   L class (with an obstruent coda)

σ <σ> | | L H	DEP-H	IDENT-H	*H-NR	IDENT-L	*FLOAT-H	*R	ALIGN-R
→ σ					*		
σ̌			*!			*	*
σ́				*!			*

Kyengsang accent is interpreted in the same way as HY, except for the absence of atonic classes (LL, LLL) with a floating H tone. Here we examine the accentuation of the disyllabic/trisyllabic words in the North Kyengsang dialect.[31] First, (87) shows the accentuation of disyllabic words.

(87) North Kyengsang disyllabic word accentuation

a.   HH class

σ σ or σ σ | | ∨ H H H	DEP-H	*LAPSE-R	IDENT-H	*LAPSE-L	ALIGN-R
→ σ́ σ́					
σ́ σ			*!		*
σ σ́			*!		

b.   HL class

σ σ | H	DEP-H	*LAPSE-R	IDENT-H	*LAPSE-L	ALIGN-R
→ σ́ σ					*
σ́ σ́	*!				
σ σ́			*!		

c.   LH class

σ σ | H	DEP-H	*LAPSE-R	IDENT-H	*LAPSE-L	ALIGN-R
→ σ σ́					
σ́ σ			*!		*
σ σ		*	*	*	*

Next, (88) shows the accentuation of trisyllabic nouns. The relative irregularity of the MK LHX

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class (expected HLL class in Kyengsang often appears with LHL) is explained by the constraint ranking *LAPSE-R, IDENT-H >> *LAPSE-L >> ALIGN-R.[32]

(88) North Kyengsang trisyllabic word accentuation

a. HHL class

σ σ σ or σ σ σ | |　　　　∨ H H　　　　H	DEP-H	*LAPSE-R	IDENT-H	*LAPSE-L	ALIGN-R
→ σ́ σ́ σ					*
σ́ σ́ σ́	*!				
σ́ σ σ		*	*		*
σ́ σ σ			*!		*
σ́ σ σ			**!	*	

b. HLL class

σ σ σ | H	DEP-H	*LAPSE-R	IDENT-H	*LAPSE-L	ALIGN-R
→ σ́ σ σ		*			*
→ σ σ́ σ			*		*
σ́ σ σ	*!				*
σ σ σ́			*	*!	

c. LHL class

σ σ σ 　| 　H	DEP-H	*LAPSE-R	IDENT-H	*LAPSE-L	ALIGN-R
→ σ σ́ σ					*
σ́ σ σ		*	*		*
σ́ σ σ	*!				*
σ σ σ́			*!	*	

d. LLH class

σ σ σ 　　| 　　H	DEP-H	*LAPSE-R	IDENT-H	*LAPSE-L	ALIGN-R
→ σ σ σ́				*	
σ́ σ σ		*	*		*
σ́ σ σ	*!		*		*
σ σ́ σ			*!		*

With this analysis, we can assume that both MK and contemporary dialects have the same set of constraints, but the rankings are different: both avoid a lapse at the right edge of the word; MK does it by alternating tone insertion, while HY and Kyengsang do so by shifting initial H to other positions. Although the surface accentuation looks different between Kyengsang and HY, they at least share a part of the ranking: DEP-H >> *LAPSE-R, IDENT-H >> *LAPSE-L, ALIGN-R (*LAPSE-L >> ALIGN-R in Kyengsang).[33]

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[32] Alternative analysis using NON-FINALITY (a final syllable is extra-metrical, Hung 1994) is also possible.

[33] At least some Yanbian speakers seem to have a stronger version of *LAPSE-L, which bans three successive L tones at the left edge of the word. In their speech, quadrisyllabic simplex nouns with final accent class appear as LHLH. This

How can we understand the shift from an MK-type accent to the Kyengsang accent? Following Ramsey (1978), it is assumed that the general change is the leftward H tone shift in an LH sequence in the surface: the leftward H tone shift took place not only in a stem but also in a suffix or across the boundary between a stem and a suffix. (89) shows the hypothetical changes from MK to Kyengsang in monosyllabic stems. Since MK had tonal alternations based on a right-to-left iambic accent system, the same accent class appeared differently after the first H. For example, the MK H class appeared as H(H) with a one-syllable suffix and H(LH) with a two-syllable suffix. For the MK H class, there was no Kyengsang accent shift in the isolation form (H) and the inflected form with a one-syllable suffix (H(H)), because there was no LH sequence. However in inflectional forms with a two-syllable suffix (H(LH)), the Kyengsang leftward H tone shift took place in the suffix, resulting in H(H□), where "□" indicates a tonally empty syllable slot. We assume that a default L tone was assigned to this empty slot, leading to H(HL). Thus, the Kyengsang double-H class emerged from the MK H class. In the MK L class, there was a floating TBU associated with an H tone in isolation form L<H>, and so the leftward H tone shift resulted in the isolation H tone which merged with the MK H class (= Kyengsang H(H) class). In inflectional forms with a one-syllable suffix (L(H)), the leftward H tone shift left a tonally empty slot in the suffix (H(□)), which then became H(L). In inflectional forms with a two-syllable suffix, the earlier MK form was L(HH) due to the attachment of the floating H and ALIGN-R. Two pitch peaks appeared as a result of the leftward H tone shift, as seen in H(□H) → H(LH). However, this tonal pattern changed to H(LL) due to the *CULMINATIVITY constraint in Kyengsang: every word must have only one (non-separated) pitch peak (Hayes 1995). Double-H was permitted since there was one peak over two syllables. These changes led the MK H and L classes to be differentiated by the accent of a following suffix in Kyengsang.

(89) Hypothetical accent changes from MK to Kyengsang (monosyllabic)

MK class			Kyengsang
H	isolation	H	H
	+ 1 syll. suff.	H(H)	H(H)
	+ 2 syll. suff.	H(LH)	H(H□) → H(HL)
L	isolation	L<H>	H<□> → H
	+ 1 syll. suff.	L(H)	H(□) → H(L)
	+ 2 syll. suff.	L(HH)	H(□H) → H(LH) → H(LL) *CULMINATIVITY

The same analysis holds true for disyllabic stems. As for the MK HX class, the isolation forms did not have any change since there was no LH sequence. In the inflectional forms with a one-syllable suffix (HL(H)), the leftward H tone shift resulted in HH(□), which became HH(L). In the inflectional forms with a two-syllable suffix (HH(LH)), the leftward H tone shift led to HH(H□) → HH(HL). It is assumed that HH(HL) changed to HH(LL) due to a constraint against three successive H tones, which is a dispreferred prosodic structure in Korean in general, including MK (W-C. Kim 1973, Lee and Davis 2009). In this way, the MK HX class changed to the double-H class (HH). In the MK LH class, isolation forms changed to H□ → HL. In the inflectional forms with a one-syllable suffix (LH(H)), the leftward H tone shift resulted in H□(H) → HL(H), which changed to HL(L) due to *CULMINATIVITY. Finally in the MK LL class, the isolation form with a floating

TBU associated with an H tone L<u>L</u><<u>H</u>> changed to LH due to the Kyengsang retraction. The inflectional form with a one-syllable suffix L<u>L</u>(<u>H</u>) changed to LH(□) → LH(L). The inflectional form with a two-syllable suffix L<u>L</u>(<u>H</u>H) changed to LH(LL) due to *C<small>ULMINATIVITY</small>: LH(□H) → LH(LH) → LH(LL).

(90) Hypothetical accent changes from MK to Kyengsang (disyllabic)

MK class			Kyengsang
HX	isolation	HH	HH
	+ 1 syll. suff.	H<u>L</u>(<u>H</u>)	HH(□) → HH(L)
	+ 2 syll. suff.	HH(<u>LH</u>)	HH(H□) → **HH(H**L) → HH(LL)　　*HHH
LH	isolation	<u>LH</u>	H□→ HL
	+ 1 syll. suff.	<u>LH</u>(H)	H□(H) → HL(H) → HL(L)　　*CULMINATIVITY
	+ 2 syll. suff.	<u>LH</u>(<u>LH</u>)	H□(H□) → HL(HL) → HL(LL)　　*CULMINATIVITY
LL	isolation	L<u>L</u><<u>H</u>>	LH<□> → LH
	+ 1 syll. suff.	L<u>L</u>(<u>H</u>)	LH(□) → LH(L)
	+ 2 syll. suff.	L<u>L</u>(<u>H</u>H)	LH(□H) → LH(LH) → LH(LL)　　*CULMINATIVITY

Trisyllabic words showed the same changes. (91) exemplifies the case of the MK HXX class. As can be seen, in both isolation and inflected forms, the double-H class (HHL) emerged.

(91) Hypothetical accent changes from MK to Kyengsang (trisyllabic HXX class)

MK class			Kyengsang
HXX	isolation	H<u>LH</u>	HH□ → HHL
	+ 1 syll. suff.	HH<u>L</u>(<u>H</u>)	HHH(□) → **HHH**(L) → HHL(L)　　*HHH
	+ 2 syll. suff.	H<u>LH</u>(<u>LH</u>)	HH□(H□) → HHL(HL) → HHL(LL)　　*CULMINATIVITY

If these hypothetical changes are correct, then we can conclude that all accent classes in Kyengsang including the typologically unusual double-H class result from the leftward H tone shift in an LH sequence in an MK-type accent system, which had the right-to-left iambic accentuation. Thus, from the historical point of view, the Kyengsang accent system is simply explained as a result of sound changes from the MK-type accent; but the synchronic analysis has become complicated, as discussed by Ramsey (1978). How we should interpret the synchronic grammar of Kyengsang accent is a complex problem. See Lee and Davis (2009) for a recent analysis.

5. Summary and conclusion

In this paper, we have examined the accent systems of Middle Korean and contemporary dialects (North/South Kyengsang, Hamkyeng/Yanbian) both synchronically and diachronically, focusing on native simplex nouns. In the analysis of the MK accent system, we clarified correlations between segmental shapes and accent classes, and proposed some reconstructions with regard to Proto-Korean accentuation. On the other hand, through a comparison between MK and contemporary dialects, we showed regular correspondences among them as well as presented an OT model to explain some irregular patterns. Our major findings in this paper are summarized as follows:

a. Proto-Korean had /*ï/, a counterpart of /i/ in its vowel harmony system, which appears as /jə/ in MK. This hypothesis is supported by its high type-frequency in native nouns relative to other rising diphthongs, and its phonotactic patterns that are similar to those of monophthongs.

b. MK (and probably Proto-Korean) had a minimal word restriction, prohibiting CV nouns. Apparent exceptions are either bound forms/pronouns or derived from original diphthongs as well as disyllabic words which resulted in aspirate/cluster onsets.

c. Consonant clusters resulted from weak vowel syncope between voiceless obstruents, which is confirmed by the segmental distribution of disyllabic nouns. The process of weak vowel syncope may have eliminated monosyllabic noun stems *OʌO/OɨO (O = simplex obstruent) from Proto-Korean, given the complete lack of such stems in MK. It is assumed that *OʌO/OɨO words changed the nucleus to avoid the syncope.

d. The monosyllabic H class is divided into two subcategories (H-a and H-b): the former appears with H uniformly, whereas the latter alternates to L before a locative suffix or when it becomes the first member of compound words. These two classes as well as the L and R classes correlated with the segmental shapes of syllable onsets, nuclei, and codas:

   (a) No word with an aspirate/cluster onset including /h/ appears in the R class as a rule; simplex onsets appear with H-b more frequently, while aspirate/cluster onsets tend to prefer the H-a class.

   (b) The minimal vowels /ʌ/ and /ɨ/ rarely appear in the R class, suggesting that they had shorter durations than other vowels.

   (c) The L and H-b classes are preferred by obstruent codas, whereas the R and H-a classes are preferred by sonorant codas.

e. Among native monosyllabic nouns, only the H-b class originally consisted of monosyllabic stems and other classes (L, H-a, R) resulted from disyllabic (or longer) words. The hypothesis that the MK L class developed from disyllabic stems with CV.Cʌ/CV.Cɨ structure is supported by evidence from its locative construction.

f. It is assumed that native nouns in Proto-Korean did not have a distinctive pitch accent. A default final accent was assigned for each stem.

g. MK (as well as Proto-Korean) had a right-to-left iambic accent system. The unaccented class had a floating H tone underlyingly, which blocks the application of tonal alternation.

h. The accents found in contemporary dialects regularly correspond to the accents of the MK accent, except for those in several accent classes. Shared irregularities among these contemporary dialects are observed in the MK HX class. They are probably due to the conservative tonal representation found in MK texts, which was faithful to the etymological accent once the tonal distinctions had been established.

i. The MK/Hamkyeng/Yanbian dialects show a more conservative accent system than the Kyengsang dialect. Based on the accent patterns of Sino-Korean words, it is assumed that a leftward accent shift (the "Kyengsang accent shift") took place after Sino-Korean words were introduced into Korean.

j. All dialects including MK tend to avoid a lapse at the right edge of the word (*Lapse-R). MK avoids it by alternating tone insertion (Ident-H >> Dep-H), while HY and Kyengsang do so by shifting initial H to other positions (Dep-H >> Ident-H).

k. All accent classes in Kyengsang, including the typologically unusual double-H class, result from the leftward H tone shift in an LH sequence in an MK-type accent system with the right-to-left iambic footing discussed in 3.3, which led to the complicated synchronic grammar of the Kyengsang accent.

Acknowledgement

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Appendix: The list of Middle Korean monosyllabic native nouns

MK monosyllabic native nouns discussed in this paper are sorted alphabetically. "H" indicates the H class whose subcategory (H-a or H-b) is unknown. When the accent is unclear, it is indicated as "?". Two words (*na* "I" and *nu* "who") with alternating accent patterns are shown with "*".

acʰ	H	reason
aj	R	bowels
alh	H	egg
alpʰ	L	front
amh	H	female
anh	H-b	inside
apʰ	L	front
əm	R	bud
əm	R	fang
ənh	H-b	dam
i	H-a/H-b	this
i	H	person
il	R	work
ip	H-b	mouth
ipʰ	H-b	gate, door
is	L	moss
isk	L	moss
jak	L	turtle
jaK	H	spices
jəj	R	Japanese
jəlh	H-a	ten
jəlh	L	hemp seed
jəs	H-a	candy
jəT	R	now
jo	L	mattress
oj	R	gourd
ol	R	stripe
oL	R	whole
olh	L	this year
oM	R	scabies
on	H	hundred
os	H-b	clothing
os	L	lacquer
uh	L	upper part
ulh	H-b	fence
um	R	bud
umh	H	hole
uT	H	the side of shoes
cah	H	a unit of length
caj]	H	mountain pass
caŋ	R	pedestal
cas	R	pine nuts
cas	H-a/H-b	castle
cə	L	oneself
cək	L	time
cək	L	salt water
cəl	H-a	bow, obeisance
cəs	H	salted and fermented fish guts
cicʰ	H-b	feather
ciL	H/L	tame
cim	H	load
cip	L	house
ciz	R	appearance
cjəc	H-a/H-b	breast, milk
cjəN	R	line, frame
cjoŋ	R	servant
cjuK	L	rice scoop
coh	L	millet
coK	L	indigo
coM	H	moth
coM	R	hilt of bow
coM	R	a handful amount
cuj	H	mouse
cul	H	the way how to
cul	H-a	string
cuL	R	rasp
cum	R	a handful amount
cʌj	H-a	ash
cʌm	H	sleep
cʰaj	H	whip
cʰaj]	H	a unit for counting houses
cʰaŋ	?	bottom
cʰəj	H	sieve
cʰi	H	object
cʰi	H	a unit of length
cʰɨ]	H	a unit of length
cʰɨk	H-a	heel
cʰilk	H	arrowroot
cʰjaŋ	L	bottom
cʰjəŋ	L	membrane
cʰjəŋ	L	Korean shoes
cʰjo	H-a/L	candle
cʰoj]	H	bandage
cʰuj]	?	edible wild plants
cʰum	H	dance
cʰum	H-a	saliva
cʰʌlh	H-b	origin
ha	H	one's belongings

haN	L	shovel
hɨlk	L	ground
him	H-a	strength
him	H-a	muscle
hjə	H-a	tongue
hjə]	L	egg of lice
hjuŋ	L	scar
hoK	H	bump
hoM	H	ditch
hʌj	H-a	year, sun
hʌlk	L	ground
hwaj	H-a	torch
hwaj	H-a	hanger
hwal	L	bow (and arrow)
kacʰ	L	skin
kaj	H-a	inlet
kaj	R	dog
kal	H	knife
kalh	H-b	knife
kaM	R	persimmon
kan	H	fraction
kaps	H-b	value
kas	L	woman
kas	L	things
kas	H	leaf mustard
kat	H	woven hat
kəcʰ	L	skin, surface
kəj]	R	crab
kəl	R	river
kəs	L	things
kɨ	L	it
kic	H-b	share
kic	H-b	collar
kil	R	length
kɨl	H-a	poetry, sentence
kilh	H-b	road
kilh	?	profit
kim	R	breath
kɨm	H	intellect
kɨm	H	fold, crack
kinh	H-b	string
kip	R	silk gauze
kis	H-b	diaper
kis	H	collar
kis	H-b	nest
kiS	H	straw spread in a cowhouse
kɨs	L	stroke
kɨt	L	pillar
kɨtʰ	H-b	end, edge
kjə	H	rice bran
kjəc	H	secret transmitted orally
kjəcʰ	H-a/H-b	secret transmitted orally
kjəcʰ	H	patterns and coloring of cloth
kjəl	H-a	wave
kjəp	H	pile
kjətʰ	L	side
ko	H	mallet
ko	H	measure for grain

koc	L	flower
koc	H-b	skewer, container to put something in
kocʰ	L	flower
koh	H-b	nose
koh	H	knot
koj	R	cat
kol	R	valley
kol	L	shape, appearance
koL	L	oil
koL	R	rush, bulrush
koL	R	materials for a coffin
koL	R	alley
koL	R	box, chest
kolh	?	village
kols	?	a route to one direction
kom	R	bear
koM	R	mold
koN	H	swan
koP	H	mucus
kot	H-b	place
kot	H	things
kuj	H-a/H-b	ear
kuk	L	soup
kuL	R	chimney
kuL	H	oyster
kup	H	hoof
kus	L	corner
kuS	H	exorcism
kut	H-b	hole
kʌjK	L	end of plow
kʌl	H	reed
kʌlp	H-a	pile
kʌN	H	salty seasoning
kʌz	R	end, edge
kʰi	H	winnow
kʰij	H	size, height
kʰoŋ	L	soy bean
ma	H	about, approximately
ma]	H	potato
ma]	?	drizzle
maj	H-a	mortar
maj	H	whip
maj	R	hawk
mal	R	language
mal	H-b	measure
malh	H	stake
man	R	after an interval of
mas	H-a	taste
maT	H	shellfish
matʰ	L	place, spot
məc	L	cherry
məj	?	place
mək	H	ink
məT	L	cherry
mil	R	beeswax
mɨl	H-a	water
mɨL	H	dyestuffs

milh	H	wheat	nom	H	person, man, fellow
miS	L	rudder	non	H-b	rice field
miS	L	bottom	nu	*H, R	who
misk	L	bait	nuj	H-a	who
mitʰ	L	bottom	nuj	R	world
mjəcʰ	H	some	nun	R	snow
mjək	L	throat	nun	H-b	eye
mjəL	R	chameleon plant	nʌcʰ	L	face
mjəs	H	earth dug out by rats, crabs, or ants	nʌj	H-a	smoke
mo]	L	young rice plant	nʌl	H	warp
moh	H-b	corner	nʌl	L	raw things
moj]	H	meal	nʌlh	H-b	blade
mojh	R	mountain	nʌlh	H	warp
mok	L	neck	nʌm	H-b	another person
mok	?	share	pa	H-a	place
mom	H-b	body	pacʰ	H-a	toward which one's feet ordinarily lie when one sleeps
mos	H-b	pond	pak	H-b	gourd, calabash
mot	H	nail	pal	R	curtain
mul	H-a	crowd	pal	H/R	fish trap
mus	L	bundle	pal	H-b	foot
mutʰ	L	land	pal	R	a unit of length
mʌjh	H-b	field	paL	H	flag
mʌl	L	horse	pam	R	chestnut
mʌl	L	feces and urine	pam	H-a/H-b	night
mʌL	H	alga	pap	H-b	boiled rice
mʌt	L	the head	pask	L	outside
na	*H, R, L	I	patʰ	L	field
nac	H-b	daytime	pəl	R	bee
nacʰ	R	piece	pəm	R	tiger
nah	H-b	age	pət	R	friend
naj	L	I (before GEN)	pi	H-a	rain
naj	H	smell	picʰ	H-a/H-b	light, color
najh	R	river	pɨl	H-a	fire
naks	L	tax	pɨl	H-a	paste
naks	H-b	fishing	pis	H-b	comb
nal	H-b	day	pɨs	?	kitchen
nap	L	monkey	pɨsk	L	a unit counting the number of moxa
naP	L	square beam	pit	L	debt
nat	R	grain	pjə	H	rice plant
naT	H	sickle	pjəcʰ	H	cockscomb
natʰ	R	piece	pjəK	H	the flat of one's hand
nə	L	you	pjəl	R	star
nəj	L	you (before GEN)	pjəs	H-b	cockscomb
nəjh	R	four	pjəT	L	edge of a plow
nəks	L	soul	pjətʰ	L	sunlight
nəl	R	board	po]	H	plow
ni	H	louse	poh	L	wrapping cloth
ni	H-a	tooth	poh	L	beam
ni]	R	rice, non-glutinous rice	poj	H	cloth
nɨc	L	symptom	pom	H-b	spring
nim	R	master	poM	R	a unit of length
nipʰ	H-b	leaf	poS	H	bark of white birch
njəj	R	old times	puj	H	broom
njək	L	direction	puK	L	shuttle
njəkʰ	L	direction	puL	L	kidney
njəp	L	side	pun	R	only, nothing but
noh	L	rope	pun	R	esteemed person

pupʰ	H-b	drum	səl	R	new year
puS	L	soil surrounding the root of a plant	səl	R	age
pusk	L	a unit counting the number of moxa	səlk	L	wicker suitcase
pusk	L	seed	səm	H	stairs
put	H-b	writing brush	səp	L	firewood
pʌj	H-a/H-b	belly	səp	L	eyebrow
pʌj	H-a	boat	sicʰ	H	interval
pʌj	L	pear	sil	R	thread
pʌjcʰ	L	oar	sin	H-b	shoes
pʌl	H	-times	sit	L	maple
pʌl	H-a	valley	sjə	H	rafter
pʌlh	L	arm	sjəj]	R	vertical row
pʰa	H	leek	sjəK	H	reins
pʰi	H-a	blood	sjəks	H	reins
pʰɨl	H-a	grass	sjəks	L	duty
pʰɨl	H-a	paste	sjəm	H-b	a unit of volume
pʰum	H-b	breast, width	sjəm	R	island
pʰʌcʰ	H	red bean	sjəŋ	R	anger
pʰʌl	H	fly	sjo	H	cow
pʰʌsk	H	red bean	sjoh	L	layman
pcak	L	one of a pair	so	?	inside
pcok	L	fragment	so]	H	content of steamed bun
psi	H	seed	soh	H-b	deep pool
psuk	H-a	moxa	soh	H	mold
psʌl	H-a	rice	soj	H	key
psʌm	H	wrapped thing	soj	H	iron
pskaj	H	sesame	sok	R	inside
pski	H	time	sol	R	brush
pski	H	a unit for counting the number of meals	sol	H	pine tree
pskɨ	H-a	time	soL	R	target
pskɨj	H-a	time	son	H-b	hand
pskɨL	H	chisel	son	L	guest
pskim	H-a	crack	sop	R	inside
pskɨm	H-a	crack	sotʰ	L	pot
pskul	H-a	honey	suh	H	forest
pskul	H	chisel	suh	H	male
pstaj	H-a	time	suj]	H	paddy ear
ptəj	H	raft	sujn	R	fifty
pti	H-b	wheel	sul	L	wine
ptɨl	H	garden	sul	H-a	spoon
ptɨlh	H-b	garden	sum	R	breath
ptɨt	H-b	will	supʰ	H-b	forest
ptuj	H	thatch plants	susk	L	charcoal
ptʌj	H-a	dirt	sʌ	H-a	things, fact
sacʰ	?	interval	sʌcʰ	H	rope
saj	H	new thing	sʌjm	R	spring, fountain
saj	R	bird	sʌlh	H-b	flesh
saj]	R	grass	sʌlk	L	raccoon dog
saK	H	bud	sʌn	H	man, male
saks	H	bud	skaj]	H	sesame
saks	L	wages	skɨL	H	chisel
sal	H-a	arrow	skɨM	H	crack
sal	H	spoke	skinh	H	string
salp	H	shovel	skoj	H-a	trick
sam	H-a	hemp	skol	H	fodder
satʰ	L	mat made of reed	skul	H-a	honey
səjh	R	three	skum	H-a	dream
			skwəŋ	L	pheasant

spam	H-b	cheek
spɨl	H-a	horn
spjə	H-a	bone
spoŋ	L	mulberry leaves
ssi	H	weft
stah	H-b	ground, land
stək	H	rice cake
stɨj	H-b	belt
stɨM	H	moxa
stɨM	H	sweat
stoŋ	L	feces
stʌl	H	daughter
stʌlh	H-b	origin
stʌm	H	sweat
taj	H-a	bamboo
taj	H-a	mast
taK	L	paper mulberry
taL	R	reed
tam	H-a/H-b	wall
taN	R	tuck
tas	L	fault
taT	L	anchor
tək	L	shelf
təŋ	H	a vehicle for carrying princesses
təs	L	illness
tət	H-b	short time
tɨj	H-a	place
tiL	L	earthenware
tiŋ	L	back
tipʰ	H	straw
tjə	H	that, he
tjə	L	flute
tjəh	L	flute
tjəj	L	over there
tjəl	H-b	temple
toj	R	barbarian
toj	H-a	measure
tok	L	earthenware pot

tolh	R	stone
tolh	H-a	ditch
tols	H-b	one cycle
ton	R	money
toŋ	L	bundle
toŋ	L	scrap
top	L	nail
tosk	L	mat
tosk	L	sail
totʰ	L	pig
tuj]	H	thatch plants
tujh	R	back
tulh	R	two
tʌ	H-a	place
tʌj	H-a	place
tʌl	H-a	moon
tʌlk	L	chicken
tʌs	H	seeming as if
tʰal	R	illness, accident, reason
tʰas	L	fault
tʰəh	H-a/H-b	base
tʰəj	L	edge
tʰəl	L	hair, fur
tʰɨj]	H	dust
tʰɨl	H-a	frame
tʰɨM	H	crack
tʰjəj	H	class, type
tʰok	H-a	elbow
tʰoŋ	H	internal organs of animals
tʰoŋ	H-a	axis
tʰop	H-a/H-b	nail
tʰop	H	saw
tʰʌk	H-b	chin
zjoh	L	mattress
zjuS	L	Four-Stick Game
zuS	L	Four-Stick Game