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A-head alignment: the case of vowel harmony in Korean*

Duck-Young Lee and Shohei Yoshida

Vowel harmony (VH) in Korean has been viewed as the result of the harmonic opposition between "light" vowels and "dark" vowels. Within a sound symbolic word, all the non-initial vowels belong to the same group to which the initial vowel belongs. However, this harmonic division is not capable of explaining all the combinatorial patterns of vowels in sound symbolic words, as there are cases where light vowels and dark vowels may coexist. These patterns violate the proposed harmonic division and have been treated as exceptions. In this short article, couched in the theory of phonological elements, we will argue that "head-alignment", a phonological phenomenon first proposed in Kaye, Lowenstamm and Vergnaud (1985), can explain all the possible vowel patterns in sound symbolic words without having to resort to the notion of exceptions.

1. Problems with previous studies

Traditionally, the vowels of Korean have been classified using the semantic categories of "light" vowels and "dark" vowels, as shown in (1). It has been claimed that this opposition is responsible for VH (Heo 1965, Kim-Renaud 1976).

(1) *light vowels*: a ɛ o
dark vowels: ə e u i ɨ

In the sound symbolic words given in (2), the vowels are either all light or all dark.

(2)	*light-light-(light)*		*dark-dark-(dark)*		
	kˈaŋcʰoŋ	(a–o)	kˈəŋcʰuŋ	(ə–u)	'skipping'
	cʰalsˈak	(a–a)	cʰəlsˈək	(ə–ə)	'lapping'
	pancˈak	(a–a)	pəncəˈk	(ə–ə)	'flashing'
	kˈolkˈak	(o–a)	kˈulkˈək	(u–ə)	'swallowing'
	soktˈak	(o–a)	suktˈək	(u–ə)	'whispering'
	pˈɛcok	(ɛ–o)	pˈicuk	(i–u)	'protruding'

* This study is a reanalysis of Lee (1994), which treats vowel harmony in Korean as a case of ATR harmony. We would like to thank our colleagues Peter Hendriks and Gi-Hyun Shin for proof-reading the text.

cɛlkaŋ	(ɛ−a)	cilkəŋ	(i−ə)	'chewing'
talkatak	(a−a−a)	təlkətək	(ə−ə−ə)	'rattling'
comollak	(o−o−a)	cumullək	(u−u−ə)	'kneading'

(2) shows that each word has two variants, one with light vowels only and the other with dark vowels only. The light and dark variants are associated with a light impression and a dark impression, respectively. Vowels that belong to different categories can not coexist in either variant.

However, there are combinatorial patterns of vowels which cannot be accounted for in terms of the contrast in (1). The problematic patterns involve the high vowels, [i ɨ u] which are a subset of the dark vowels. (3a) shows that if one of [i ɨ u] is the first vowel in a word, it does not coexist with the light vowels [a ɛ o], as predicted by the traditional light-dark contrast. However, if [i ɨ u] are non-initial, they can unexpectedly co-occur with [a ɛ o] within the same words. For this reason, these high vowels have been labelled as "neutral" or exceptional (Heo 1965, Kim-Renaud 1976, Park 1990).

(3) a. *The high vowels are initial*

dark-dark		*dark-light*		
tʰɨkʰim	(ɨ−i)	*tʰɨkʰam	(ɨ−a)	'stinging'
cikʰəl	(i−ə)	*cikʰal	(i−a)	'chattering'
tʰupək	(u−ə)	*tʰupak	(u−a)	'walking'
suktʰək	(u−ə)	*suktʰak	(u−a)	'whispering'
cilkəŋ	(i−ə)	*cilkaŋ	(i−a)	'chewing'
pʰicuk	(i−u)	*pʰicok	(i−o)	'protruding'

b. *The high vowels are non-initial*

dark-dark-(dark)		*light-dark-(light)*		
pəŋkɨs	(ə−ɨ)	paŋkɨs	(a−ɨ)	'smiling'
təŋsil	(ə−i)	taŋsil	(a−i)	'dancing'
kʰəŋcʰuŋ	(ə−u)	kʰaŋcʰuŋ	(a−u)	'skipping'
kʰukicək	(u−i−ə)	kʰokicak	(o−i−a)	'crumpling'
umcuk	(u−u)	omcuk	(o−u)	'shivering'
pʰitul	(i−u)	pʰɛtul	(ɛ−u)	'zigzag'

A number of researchers (e.g. McCarthy 1993, Sohn 1987, Park 1990) have accounted for VH in Korean by dividing the vowels into [+low] vowels and [−low] vowels as in (4). These researchers claim that all the vowels within a word must agree with respect to the feature [low].

(4) [+low]: a ɛ o
[−low]: ə e u i ɨ

This feature-based analysis has the advantage of being able to define the vowel contrast articulatorily, unlike the traditional semantic contrast where vowels are arbitrarily grouped. However, the feature-based analysis only replaces the terms "light" and "dark" with [+low] and [−low], and the problem of the exceptional patterns in (3b) remains unsolved.

Let us concentrate on the fact that VH can be violated only in the case of dark/[−low] vowels that are high and non-initial. The presence of this internal regularity within the exceptions makes us suspect the adequacy of the traditional harmonic division. Utilising a theory of segmental representation where the primes of segments are monovalent elements and not bivalent features (Kaye, Lowenstamm and Vergnaud 1985, Harris 1990, 1994, Harris and Lindsey 1992, 1995, Kaye 1995, Brockhaus 1995), we will claim that VH in Korean is a result of elemental head alignment and not due to the light/[+low] vs. dark/[−low] contrasts.

2. Phonological elements

In orthodox distinctive feature theory, the primes of segments are bivalent features. Single features do not enjoy autonomous phonetic realisation. A feature is phonetically realised only as a member of a complete feature matrix, which contains the values of many features which are necessary to allow the matrix to be articulated as a segment. In contrast to this approach, other researchers such as Anderson and Jones (1974), Schane (1984), Kaye, Lowenstamm and Vergnaud (1985), Rennison (1990), Goldsmith (1985), van der Hulst and Smith (1985) have proposed that the primitive vowels are the peripheral vowels [i], [a] and [u], and that mid vowels are derived by combining [a] with [i] or [u]. The vocalic primitives (I), (U), (A) proposed by Kaye, Lowenstamm and Vergnaud (1985) are called elements and are phonetically realisable in isolation as well as in combination.

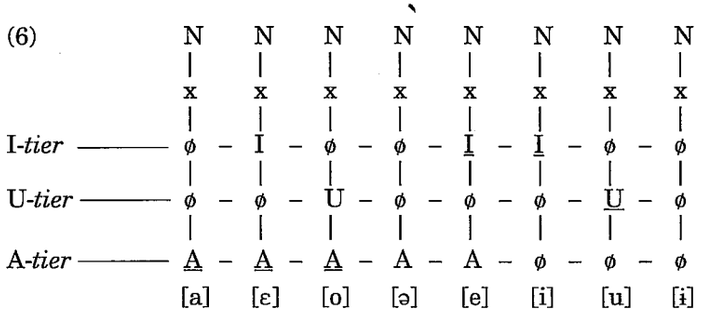
(5)

Element	*Phonetic realisation*	*Salient property*
I	[i]	nonback (palatality)
U	[u]	roundness
A	[a]	nonhigh (pharyngeality)

(I), (U) and (A), when not combined with other element(s), are phonetically realised as [i], [u] and [a], respectively. More than two elements may combine to form complex segments. The salient property of an element contributes to the phonetic realisation of a complex segment. The salient property of an element has more influence on the overall phonetic realisation of a complex segment if this element is the head of the complex segment rather than the operator. For example, the complex segment (I•U) may be either I-headed (I•U) or U-headed (I•U). The I-headed (I•U), where (I) is the head and (U) is the operator, is interpreted as a rounded [i], i.e. [y], whereas the U-headed (I•U), where (U) is the head and (I) is the operator, is interpreted as a fronted [u], i.e. [ü].

We propose internal structures for the Korean vowels in (6). The underlined elements are the heads of segments.

(6)



The ϕ's at the intersections indicate the absence of an element. The vowel [ɨ] is represented as an empty nucleus, lacking (I) (nonback), (U) (round) and (A) (nonhigh). Since there is no vocalic element in an empty nucleus, there is no salient property which actively contributes to the phonetic realisation of this position either. Therefore, this empty nuclear position is interpreted as back, nonround and high, i.e. [ɨ].[1] [ɛ] and [e] are "isomers" (Kaye, Lowenstamm and Vergnaud 1985), composed of identical elements. The difference between [ɛ] and [e] is due to their different heads: [ɛ] is A-headed and [e] is I-headed. Likewise, [a] and [ə] are also isomers, the difference being that [a] is A-headed and [ə] is headless. Given the fact that [o] corresponds to the half-low rounded vowel [ɒ] of the IPA system, we represent this vowel as an A-headed complex segment rather than its U-headed counterpart, which is realised as a half-high rounded vowel.

3. Analysis

3.1. Element-based classifications of the vowels of Korean

(7) shows the distribution of the first and second vowels that can co-occur within sound symbolic words.

(7)

1st vowel \ *2nd vowel*	a	ɛ	o	ə	e	u	i	ɨ
a	+	+	+	–	–	+	+	+
ɛ	+	+	+	–	–	+	+	+
o	+	+	+	–	–	+	+	+
ə	–	–	–	+	+	+	+	+
e	–	–	–	+	+	+	+	+
u	–	–	–	+	+	+	+	+
i	–	–	–	+	+	+	+	+
ɨ	–	–	–	+	+	+	+	+

[1] See Lee (in press) for detailed discussion.

It is possible to classify the vowels into three classes based on their distribution, as in (8).

(8) a. a ɛ o b. ə e c. u i ɨ

It should be recalled that if one of the vowels in (8a) is the first vowel, then the same vowel and the vowels in (8c) may follow it but not the vowels in (8b). If one of the vowels in (8b) and (8c) is the first vowel, then the vowels in (8b) and (8c) may follow it but not those in (8a). In (9), we define the common features of the vowels of each group.

(9)

	A-HEADED	NON-A-HEADED
A IS PRESENT	a ɛ o (A) (A•I) (A•U)	ə e (A) (A•I)
A IS ABSENT		u i ɨ (U) (I) (ϕ)

As seen in (9), [a ɛ o] and [ə e] both contain an A-element, [a ɛ o] and [ə e] being A-headed and not A-headed, respectively. [u i ɨ] do not contain the A-element and are therefore not A-headed.

3.1. Head alignment

Having classified the vowels in terms of elements and their headedness, we propose the following constraint for VH in Korean.

(10) A-HEAD ALIGNMENT IN KOREAN

Within a head alignment domain, an A-element dominated by a licensed nucleus (N_2) can be the head of a segment iff a nucleus (N_1) that licenses (N_2) has an A-element as the head of a segment.

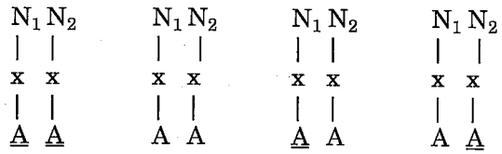
The domain of A-head alignment is the sound symbolic word. Following the general observation that the first vowel in a word is the determiner of VH, we assume that the first nucleus is the nucleus that prosodically licenses the remaining nucleus/nuclei. The constraint in (10) predicts the following cases.

(11)

a. *If the domain-initial nucleus contains an A-headed segment then all the other A-elements within this domain must also be the heads of segments.*
b. *Otherwise, i.e. if (A) is not in initial position or if it occurs in initial position as an operator, an A-element in non-initial position must be an operator.*

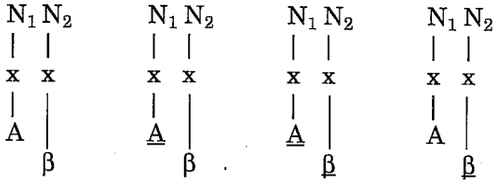
Let us apply A-head alignment to the following structures.

(12) a. b. *c. *d.

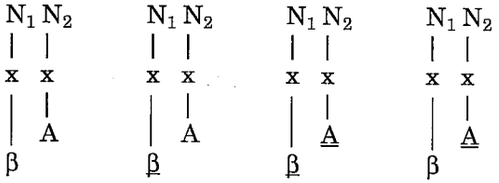


(12a) and (12b) are well formed. In both cases, the two A-elements in N_1 and N_2 are either both heads or both operators. (12c) and (12d) are ill formed since the headedness of the A-elements is not aligned. (13) shows cases in which one of the two nuclei has (β), which symbolises an element other than (A).

(13) a. b. c. d.



e. f. *g. *h.



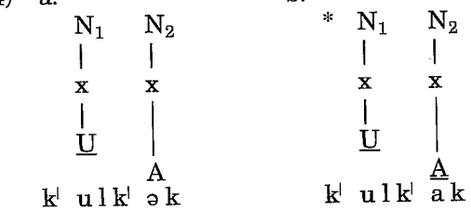
In all the structures in (13), N_1 and N_2 are occupied by two different elements: (A) and an element other than (A), i.e. (β). (13a-f) are well formed since on the one hand an element other than (A) can freely be a head or an operator if it occupies N_2 (13a-d) or N_1 (13e,f), and on the one hand, an A-element in N_1 can freely be a head (13b,c) or an operator (13a,d). However, (13g) and (13h) are ill formed since N_2 is A-headed despite the absence of a headed (A) in N_1.

We are now ready to show how the A-head alignment constraint works for VH in Korean.

3.2. High vowels

Let us first examine cases which involve the high vowels [u i ɨ]. In the forms in (14) one of the high vowels appears in N_1. (14a) is an actual sound symbolic word meaning 'gulping', whereas (14b) is non-existent.

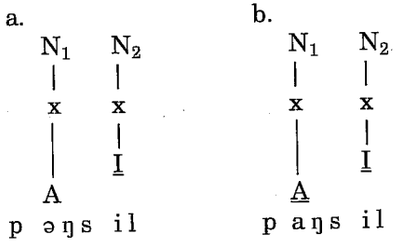
(14) a. b.



The A-element in the licensed nucleus N_2 cannot be a head as there is no headed A-element in its licenser N_1. As a result, (A) in N_2 must be non-headed, giving rise to a schwa, as in (14a), rather than headed, producing the low vowel [a] as in (14b). The same argument would apply to cases where N_1 is occupied by [i] or [ɨ].

Next, let us consider cases where N_1 contains the A-element and N_2 contains a high vowel. The following variants [pəŋsil] and [paŋsil] 'laughing' are both well formed.

(15) a. b.



The licensing nucleus N_1 does not impose any constraints on segments occurring in this position. Therefore, nothing prevents the A-element in N_1 from being headed as in (15b). The same argument accounts for cases where N_2 is occupied by other high vowels.

Having reached this point, let us compare the element-based analysis with previous analyses where [ɛ a o] – [u i ɨ] are viewed as exceptions. Let us recall that in previous studies the patterns *[u i ɨ] – [ɛ a o] are treated as ill formed because they contain vowels that belong to different groups, i.e. dark-light, or [–low]-[+low]. Such an analysis, however, has nothing to say about the mirror image of this pattern [ɛ a o] – [u i ɨ], which does occur. In contrast, the A-head alignment condition and the directionality it entails predicts that the patterns [ɛ a o] – [u i ɨ] will be well formed, but not the set *[u i ɨ] – [ɛ a o].

3.3. Mid vowels

Let us now consider cases which involve mid vowels. As mentioned earlier, the vowel groups [ɛ a o] and [ə e] cannot coexist within a VH domain by virtue of the fact that all the A-elements within a VH domain must agree with respect to their headedness. For this reason, the structures in (16) cannot exist where (α) and (β) are either zero or some elements other than (A).

(16) a. *N_1 N_2 b. *N_1 N_2

x x x x

A A A A

α β α β

Bearing this in mind, let us examine the two sound symbolic words 'a long neck is being cut off' in (17).

(17) a. *(A) = head* b. *(A) = non-head*

N_1 N_2 N_1 N_2

x x x x

I I

A A A A

t ɛ ŋ k a ŋ t e ŋ k ə ŋ

In (17a) the two vowels [ɛ] and [a] are both A-headed, whereas the two vowels [e] and [ə] in (17b) are both non-A-headed.

4. Conclusion and infinitive verb forms

We have so far argued that VH in Korean is a manifestation of A-head alignment. The present analysis can account for all the existing vowel patterns of sound symbolic words, including those regarded as exceptions in other frameworks. There is, in addition, another area in Korean phonology which involves VH, namely, infinitive verb forms.

(18)

mək-ə	'eat'	cap-a	'grasp'
cuk-ə	'die'	nok-a	'melt'
me-ə	'carry'		
ki-ə	'crawl'		
nic-ə	'be late'		

As seen in (18), the infinitive suffix alternates between [ə] and [a] depending on the vowel in the verb stem. When the stem vowel is [a] or [o] the suffix appears as [a]. Otherwise, the suffix is [ə].[2] This alternation can also be accounted for in terms of the A-head alignment constraint. The underlying representations of [cuk-ə] and [nok-a] are given in (19). We assume that the underlying suffix contains a non-headed A-element. In (19a) the stem vowel [u] does not contain A-element and therefore the suffixal element (A) cannot be headed, resulting in schwa. On the other hand, the stem vowel [o] in (19b) is an A-headed segment, and therefore the suffixal (A) can become headed, surfacing as [a].

[2] There is a problematic case where the stem vowel [ɛ] is followed by the suffixal vowel [a] rather than [ə]. We refer the reader to Lee (1994) who suggests that this unexpected alternation is due to historical factors.

(19) a. O N O N *head alignment* → O N O N

x x x x x x x x

c k c k

U U

A A

[cukə]

b. O N O N *head alignment* → O N O N

x x x x x x x x

n k n k

U U

A A A A

[noka]

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An integrated approach to nasality and voicing*

Kuniya Nasukawa

1. Introduction

The nature and systematic role of voice specification in languages has been debated in various phonological approaches. Many recent theories strongly maintain the position that voice is a privative prime (Piggott 1992, Rice 1992, Itô and Mester 1993, Harris 1994, Harris and Lindsey 1995, Itô, Mester and Padgett 1995, Lombardi 1995). In such frameworks, there is some degree of controversy surrounding the specification of voicing and its relationship to the prime [nasal]. It is usually assumed that nasal sounds contain voice in their internal structure, and consequently, that they trigger, for example, postnasal voicing assimilation in many languages. However, Japanese presents a challenge to this assumption, since this system seems to recognise two types of nasals, differentiated according to phonological context: in postnasal voicing assimilation, nasals appear to be specified for voice; on the other hand, in Rendaku (which I shall describe in 2.2.3), nasals behave as if they have no voice prime.

In order to overcome this paradox, I shall propose that the phonological properties of nasality and voicing are expressed by the same object, and the headship distinction on such an object determines its phonetic interpretation: the headless prime contributes nasality and its headed counterpart manifests itself as voicing. In conjunction with the version of Element Theory developed in, for example, Kaye, Lowenstamm and Vergnaud (1985), Harris (1990, 1994), and Harris and Lindsey (1993, 1995), I shall provide an alternative analysis of the voicing specification on nasals in Japanese.

The structure of this paper is as follows. Section 2 will review the paradoxical behaviour of nasals in Yamato Japanese (e.g. where voice is active for nasals in the context of post-nasal voicing, but inactive in Rendaku). In 3, I shall present my analysis, which accounts not only for the paradoxical behaviour of nasals seen in postnasal voicing and Rendaku, but also for *b* ~ nasal alternations in Japanese verbal inflexion. This will be achieved by assuming a unified structure of nasals within Element Theory.

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