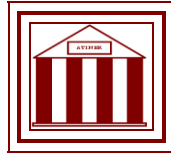


**Athens Institute for Education and Research
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**Phonological Behavior of /i/ and /e/
in Old Japanese**

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Phonological Behavior of /i/ and /e/ in Old Japanese

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Abstract

The aim of this paper is to delve into the vocalic system of Old Japanese. Then we will clarify that i0 and i1 represented the same sound while i2 represented a different sound, and e0 and e2 represented the same sound while e1 represented a different sound. It will be demonstrated that this claim is on the basis of their phonological behaviors in the three phonological and morphological phenomena: the co-occurrence condition, the occurrence position and the conjugation.

Keywords: Old Japanese, Phonological behavior, /i/, /e/

Introduction

Old Japanese was spoken in the 8th Century, and thus no one knows exactly how Old Japanese sounded. However, there remain a small number of documents in which Old Japanese was described in Chinese characters. Based on these old documents, Japanese linguists have reconstructed the pronunciation of the old language in comparison with the Early Middle Chinese pronunciation of the characters. As for consonants, it has been well-attested that there were 13 consonants: /p, b, m, t, d, n, r, s, z, k, g, j, w/. On the other hand, the vocalic system in Old Japanese is still controversial. The reason is that the orthographic distinctions of front vowels are highly complicated. More specifically, four orthographies (i_1 , i_2 , e_1 , and e_2) were used for front vowels in certain phonological environments, but only two orthographies (i_0 and e_0) were used for front vowels in the other environments:

1. Orthographic distinctions of front vowels

- a. When the onset consonant is a peripheral stop (p, b, m, k, g), two orthographies are distinguished in front high vowels and front mid vowels: i_1 vs. i_2 and e_1 vs. e_2 .
- b. Otherwise, one orthography is used to refer to a front high vowel and a front mid vowel respectively: i_0 and e_0 . (i.e. when the onset consonant is one of the following consonants /t, d, n, r, s, z, j, w/ or when there is no onset consonant¹).

These generalizations can be summarized as follows:

2. Distribution of orthographies for front vowels

Front High Vowels		Front Mid Vowels	
i_0 used elsewhere: /t, d, s, z, n, r, j, w/ + in a word-initial onsetless syllable	i_1 vs. i_2 used after peripheral stops: /p, b, m, k, g/	e_0 used elsewhere: /t, d, s, z, n, r, j, w/ + in a word-initial onsetless syllable	e_1 vs. e_2 used after peripheral stops: /p, b, m, k, g/

Although there have been a certain number of studies about front vowels in Old Japanese, their relationship remains nearly unclear.

As with the general accepted idea, we assume that i_0 was actually identical to either i_1 or i_2 and e_0 was actually identical to e_1 or e_2 . Based on this general accepted idea, we will argue that the following vocalic system existed in Old Japanese, i.e. i_0 and i_1 represented the same sound while i_2 represented the different sound, and e_0 and e_2 represented the same sound while e_1 represented the different sound:

¹ Note that the occurrence of an onset less syllable is limited to the word-initial position in Old Japanese.

3. Our claim about the vocalic categorization

Front High Vowels		Front Mid Vowels	
$i_0 = i_1$	i_2	$e_0 = e_2$	e_1

It will be demonstrated in this paper that the relationship ($i_0 = i_1$ vs. $i_2 / e_0 = e_2$ vs. e_1) is supported by three phonological and morphological phenomena, i.e. the co-occurrence condition, the occurrence position and the conjugation. It will be shown that i_0 and i_1 behave similarly but i_2 does not, and e_0 and e_2 behaves similarly but e_1 does not. According to Flemming (2005), "It is one of the most basic generalizations in phonology that only certain sets of sounds pattern together in phonological processes, and that these sets can be characterized in terms of shared phonetic properties." Hence, we may conclude that two sounds were phonologically identical, if two sounds behave similarly in some phonological phenomena.

This paper is organized as follows. In the next section, we will clarify the data used in this study. After that, we will examine the three phonological and morphological phenomena: the co-occurrence condition, the occurrence position and the appearance in the verbal conjugation. In the last two sections, we will propose the phonological categorization of the front vowels on the basis of the generalizations over the last three sections; and finally, we will summarize this paper.

Data

Our data comes from the dictionary, *Jidai-betsu Kokugo Dai-jiten Jōdai-hen (The Japanese Dictionary in the 8th Century)*. This dictionary is based on the old documents in which Old Japanese was described in Chinese characters, and was edited mainly by Hisataka Omotaka in 1967. In this dictionary, front vowels are usually labeled as i_0 , i_1 , i_2 , e_0 , e_1 and e_2 . We collected words that contain these front high vowels, resulting in a corpus of 1,153 words. These words include 1,213 syllables that are headed by the front vowels. Note that the following discussions are based on this data:

4. Outline of our data

Orthographies	Number of words	Number of syllables	Examples
i_0	440	479	ani_0, si_0ba
i_1	346	366	$aki_1, kapi_1$
i_2	40	40	$ki_2ru, kabi_2$
e_0	170	171	$apare_0, tane_0$
e_1	62	62	$sake_1bu, pe_1datu$
e_2	95	95	ke_2dasi, ube_2
SUM	1,153	1,213	

Co-Occurrence Condition

Now, let us consider their phonological behaviors in the co-occurrence condition. Fukuda (1970) and Matsumoto (1995) examined only disyllabic words and clarified that two orthographies i_0 and i_1 can co-occur with various kinds of syllables, whereas the other front vowels i_2 , e_0 , e_1 and e_2 cannot. In this section, we will examine trisyllabic words as well as disyllabic words and generalize the following phonological behaviors:

5. Generalization of the co-occurrence condition

- a. i_0 and i_1 behave similarly but i_2 behaves differently in both the number and the kinds of syllables that they cannot co-occur with.
- b. e_0 and e_2 behaves similarly but e_1 behaves differently in the kinds of syllables that they cannot co-occur with.

First of all, we will explain the generalization in (5a) more in detail. We found through the analysis of disyllabic and trisyllabic words that i_0 and i_1 behave similarly but i_2 behaves differently in the number of syllables that they cannot co-occur with. In particular, i_0 cannot co-occur with 12 kinds of syllables, i_1 cannot co-occur with 14 kinds of syllables, and i_2 cannot co-occur with 58 kinds of syllables. Namely, i_0 and i_1 behave similarly in that their co-occurrence conditions are weak whereas i_2 behaves differently in that its co-occurrence condition is strong:

6. Number of syllables that each front high vowel cannot co-occur with:

i_0 (12 kinds of syllables): Weak co-occurrence condition

gi₂, ge₁, zu, ze₀, zo₁, zo₂, di₀, do₁, pi₂, be₁, mi₂, ye₀

i_1 (14 kinds of syllables): Weak co-occurrence condition

ki₂, ke₁, ke₂, ge₁, go₂, ze₀, zo₁, de₀, no₁, bi₂, be₂, bo₀, ro₁, we₀

i_2 (58 kinds of syllables): Strong co-occurrence condition

a, e₀, ki₁, ki₂, ke₁, ke₂, ko₂, ga, gi₁, gi₂, ge₁, ge₂, go₁, go₂, se₀, so₁, za, zu, ze₀, zo₁, zo₂, ta, te₀, to₁, to₂, di₀, de₀, do₁, do₂, ni₀, nu, ne₀, no₁, pi₂, pu, pe₁, pe₂, ba, bi₁, bi₂, bu, be₁, be₂, bo₀, mi₂, mu, me₁, me₂, yu, ye₀, yo₁, ri₀, re₀, ro₁, ro₂, wa, wi₀, we₀

In addition, we have found that i_0 and i_1 behave similarly but i_2 behaves differently in the kinds of co-existent syllables. Through our analysis, it turned out that there are 25 kinds of syllables that can co-occur with i_0 and i_1 , but cannot co-occur with i_2 . In other words, i_0 and i_1 share preference for coexistent syllables, but i_2 does not:

7. Kinds of syllables that i_2 cannot co-occur with, but i_0 and i_1 can

	i_0	i_1	i_2		i_0	i_1	i_2
a	18	24	0	ne ₀	3	10	0
ki ₁	17	9	0	pu	42	15	0
ko ₂	12	9	0	bu	11	4	0
ga	5	3	0	mu	27	11	0
so ₁	5	8	0	yu	8	5	0
ta	42	32	0	ri ₀	8	9	0
to ₂	8	10	0	ro ₂	7	6	0
ni ₀	6	6	0	wa	6	6	0
nu	6	2	0				

In sum, i_0 and i_1 share common features in both the number and the kinds of co-occurring syllables, but i_2 does not. This finding is basically identical to the findings of Fukuda (1970) and Matsumoto (1995), but their data was limited to disyllabic words. Hence, our finding is significant in that we demonstrated that the co-occurrence restriction exists in trisyllabic words as well.

Next, let us move onto the generalization in (5b). According to Fukuda (1970) and Matsumoto (1995), all the three orthographies for front mid vowels (e_0 , e_1 and e_2) have strong co-occurrence conditions. Similar results were obtained from our data. More specifically, e_0 cannot co-occur with 41 kinds of syllables, e_1 cannot co-occur with 51 kinds of syllables, and e_2 cannot co-occur with 46 kinds of syllables. Namely, all the three front mid vowels show strong co-occurrence conditions:

8. Syllables that front high vowels cannot co-occur with

e_0 (41 kinds of syllables): Strong co-occurrence condition

e_0 , ki₁, ki₂, ke₁, ke₂, gi₂, ge₁, ge₂, go₁, go₂, se₀, zi₀, ze₀, zo₁, zo₂, ti₀, te₀, to₁, di₀, de₀, do₁, ne₀, no₁, no₂, pi₂, pe₁, pe₂, bi₂, be₁, be₂, bo₀, mi₂, me₁, me₂, ye₀, yo₁, re₀, ro₁, wi₀, we₀, wo₀

e_1 (51 kinds of syllables): Strong co-occurrence condition

e_1 , ki₂, ke₁, ke₂, ko₁, ko₂, gi₁, gi₂, gu, ge₁, ge₂, go₁, go₂, se₀, za, zi₀, zu, ze₀, zo₁, zo₂, te₀, di₀, du, de₀, do₁, do₂, ni₀, nu, ne₀, no₁, pi₂, pe₁, pe₂, po₀, bi₁, bi₂, be₁, be₂, bo₀, mi₂, me₁, me₂, yu, ye₀, yo₁, yo₂, re₀, ro₁, ro₂, wi₀, we₀

e_2 (46 kinds of syllables): Strong co-occurrence condition

e_2 , ki₂, ke₁, ke₂, ko₁, gi₁, gi₂, ge₁, ge₂, go₂, se₀, za, ze₀, zo₁, zo₂, ti₀, te₀, to₁, di₀, de₀, do₁, do₂, nu, ne₀, pi₂, pe₁, pe₂, ba, bi₁, bi₂, bu, be₁, be₂, bo₀, mi₂, me₁, me₂, mo₀, ye₀, yo₁, yo₂, re₀, ro₁, ro₂, wi₀, we₀

However, we found that the situation is different in the kinds of syllables that they can co-occur with. That is, it turned out that e_0 and e_2 behave similarly whereas e_1 behaves differently in the kinds of coexistent syllables. In

particular, the following six syllables cannot co-occur with e_1 nearly or completely, but they can co-occur with e_0 and e_2 :

9. Kinds of syllables that cannot co-occur with e_1 but can co-occur with e_0 and e_2

	e_0	e_1	e_2
ko ₂	4	0	4
gu	5	0	3
du	3	0	4
po ₀	4	0	3
a	11	1	6
pa	9	1	5

Besides, there is one syllable that can co-occur with e_1 but cannot with e_0 and e_2 :

10. Kinds of syllables that can co-occur with e_1 but cannot with e_0 and e_2

	e_0	e_1	e_2
ti ₀	0	2	0

In sum, all the three orthographies for front mid vowels (e_0 , e_1 and e_2) share common features in the number of coexistent syllables, but e_0 and e_2 behave similarly while e_1 behaves differently in the kinds of syllables that they co-occur with. The former finding was already pointed out by Fukuda (1970) and Matsumoto (1995) as well, but it is significant to find that the restriction in the number of coexistent syllables is observed in trisyllabic words as well. The latter finding is totally new, because the previous studies did not clarify their difference in the kinds of syllables that they co-occur with.

To summarize, i_0 and i_1 behave similarly in the co-occurrence condition but i_2 does not, and e_0 and e_2 behave similarly but e_1 does not. In particular, i_0 and i_1 behave similarly but i_2 behaves differently in both the number and the kinds of co-existent syllables and e_0 and e_2 behave similarly but e_1 behaves differently in the kinds of syllables that they cannot co-occur with.

Occurrence Position

Next, let us move onto the second phonological evidence. In this section, we will consider the occurrence position of the six orthographies for the front vowels (i_0 , i_1 , i_2 , e_0 , e_1 and e_2). Ōno (1977) examined their distributions in *Manyōshū* (the oldest anthology of poems in Japan) and claimed that i_2 , e_0 , e_1 and e_2 are likely to appear at a word-final position. In this section, we will examine their distribution in the dictionary *Jidai-betsu Kokugo Dai-jiten Jōdai-hen* and generalize the following facts:

11. Generalization of the occurrence position

- a. i_0 and i_1 behave similarly but i_2 behave differently in that the formers can appear freely at any positions whereas the latter tends to appear at word-final position.
- b. e_0 and e_2 behave similarly but e_1 behaves differently in that the formers tend to appear at word-final position whereas the latter can appear freely at any positions.

To begin with, let us examine the generalization in (10a) more in detail. We found through the analysis of disyllabic and trisyllabic words that i_0 and i_1 behave similarly but i_2 behaves differently in their occurrence position. In particular, i_2 clearly prefers to appear at word-final position, whereas the others do not show this preference:

12. Number of each position

i. Disyllabic words ($\sigma_1\sigma_2$)

	i_0	i_1	i_2
σ_1	76 (46.3%)	60 (51.7%)	7 (31.8%)
σ_2	88 (53.7%)	56 (48.3%)	15 (68.2%)
SUM	164	116	22

ii. Trisyllabic words ($\sigma_1\sigma_2\sigma_3$)

	i_0	i_1	i_2
σ_1	108 (49.5%)	44 (27.2%)	0 (0%)
σ_2	52 (23.9%)	48 (29.6%)	2 (20.0%)
σ_3	58 (26.6%)	70 (43.2%)	8 (80.0%)
SUM	218	116	10

As the above charts clearly indicate, i_2 clearly prefers to appear at word-final positions. It is notable that 80% of i_2 in trisyllabic words appear at word-final positions. On the other hand, the other two vowels do not show this preference for a word-final position, i.e. their distribution is homogeneous. In fact, this generalization agrees with the generalization by Ōno (1977), which is based on *Manyōshū*.

Next, let us examine the generalization in (10b) more in detail. We found through the analysis of disyllabic and trisyllabic words that e_0 and e_2 behave similarly but e_1 behaves differently in their occurrence positions. In particular, e_0 and e_2 clearly prefer to appear at word-final positions, whereas e_1 does not show this preference:

13. Number of each position

i. Disyllabic words ($\sigma_1\sigma_2$)

	e_0	e_1	e_2
σ_1	22 (27.8%)	60 (51.7%)	6 (12.2%)
σ_2	57 (72.2%)	56 (48.3%)	43 (87.8%)
SUM	79	116	49

ii. Trisyllabic words ($\sigma_1\sigma_2\sigma_3$)

	e_0	e_1	e_2
σ_1	11 (19.3%)	4 (17.4%)	6 (21.4%)
σ_2	18 (31.6%)	11 (47.8%)	7 (25.0%)
σ_3	28 (49.1%)	8 (34.8%)	15 (53.6%)
SUM	57	23	28

It is obvious from the above charts that e_0 and e_2 prefer to appear at word-final positions, but e_1 does not. Especially when they appear at disyllabic words, their difference is outstanding: e_1 appears equally at both word-initial and word-final positions but the distribution of e_0 and e_2 is deviated to the word-final position. Note that this generalization is different from the generalization by Ōno (1977), which is based on *Manyōshū*. He claimed that all the three front mid vowels prefer to appear at word-final positions. That is, this fact was not uncovered until we delved into the *Jidai-betsu Kokugo Daijiten Jōdai-hen* dictionary.

In sum, we have seen that i_0 and i_1 behave similarly but i_2 does not, and e_0 and e_2 behave similarly but e_1 does not in their occurrence position. More specifically, i_0 and i_1 can appear freely at any positions but i_2 is likely to appear word-finally, and e_0 and e_2 prefer to appear at word-final positions but e_1 does not.

Conjugation

Finally, we will consider their appearance in verbal conjugation. In this section, we will examine their appearance in verbal conjugation and generalize the following phonological facts:

14. Generalization of the verbal conjugation

- a. i_0 and i_1 behaves similarly but i_2 behaves differently in that the formers are widely used in verbal conjugation whereas the latter is not.
- b. e_0 and e_2 behaves similarly but e_1 behaves differently in that the formers are widely used in verbal conjugation whereas the latter is not.

Old Japanese verbs were conjugated in six moods (irrealis, adverbial, conclusive, attributive, realis and imperative), and they are categorized to eight types in terms of their inflectional ways. This conjugation can be summarized as follows:

15. Conjugation in Old Japanese

	irrealis	adverbial	conclusive	attributive	realis	imperative
quadrigade	a	i_0 / i_1	u*	u*	e_0 / e_2	e_0 / e_1
upper monograde	i_0 / i_1		i_0ru / i_1ru	i_0ru / i_1ru	i_0re / i_1re	i_0yo_2 / i_1yo_2
upper bigrade	i_0 / i_2		u	uru	ure ₀	?**
lower bigrade	e_0 / e_2		u	uru	ure ₀	e_0yo_2 / e_2yo_2
k-irregular	ko ₂	ki ₁	ku	kuru	kure ₀	ko ₂
s-irregular	se ₀	si ₀	su	suru	sure ₀	se ₀ yo ₂
n-irregular	na	ni ₀	nu	nuru	nure ₀	ne ₀
r-irregular	ra	ri ₀	ru	ru	re ₀	re ₀

*: Segments are identical, but supra-segments are different.

** : No example remains.

Note that white cells indicate parts in which all the front vowels (i_0 , i_1 , i_2 , e_0 , e_1 , and e_2) appear; light-grayed cells indicate parts in which only two front vowels (i_0 and e_0) appear; thick-grayed cells indicate parts in which no front vowels appear.

Obviously from (15), i_0 , i_1 , e_0 and e_2 are widely used in verbal conjugation whereas i_2 and e_1 are hardly used in verbal conjugation. (i_2 and e_1 are used in one cell respectively: i_2 appears at an irrealis and an adverbial form of a quadrigade verb; e_1 appears at an imperative form of a quadrigade verb.) Namely, we can obtain the generalization in (15) from these facts.

Let us examine the appearance of the two vowels (i_2 and e_1) in verbal conjugation more in detail. We would like to claim that they were employed only in special occasions. As for i_2 , we claimed that it was employed to emphasize distinction between homophonic upper bigrade verbs and quadrigade verbs when they were followed by an affix $-te$, cf. Yanagida (2001). For instance, two verbs *oku* ‘stand up’ and *oku* ‘put’ preserve their contrastiveness by means of i_2 and i_1 respectively. That is, their contrasts would be neutralized unless they employ the distinction between i_2 and i_1 . It is interesting that this distinction was replaced by another contrast between i vs. \emptyset in Middle Japanese:

16. Emphasis of distinction

	Old Japanese	Middle Japanese
Upper bigrade verb <i>oku</i> ‘stand up’ followed by $-te$	$o_0ki_2 - te_0$	<i>oki</i> - te
Quadrigade verb <i>oku</i> ‘put’ followed by $-te$	$o_0ki_1 - te_0$	<i>oi</i> - te

As for e_1 , we argue that it was employed as “the last resort.” That is, it was used for an imperative form of a quadrigade verb because there are no other vowels that can be employed. As the chart in (15) indicates, a mid back vowel

(i.e. *o*) is not employed basically in any verbal conjugations. (Note that a mid back vowel appears exceptionally in an imperative form of a k-irregular verb.) Besides, *a*, *i₀*, *i₁*, *u*, and *e₂* were already employed for other moods of a quadrigrade verb. Hence, only *e₁* is available to an imperative form of a quadrigrade verb, and thus it was employed to make a contrast among all the moods of a quadrigrade verb.

To sum up, we have seen in this section that *i₀*, *i₁*, *e₀* and *e₂* are widely used in verbal conjugation whereas *i₂* and *e₁* are hardly used in verbal conjugation. That is, the front vowels show the same phonological behaviors as in the co-occurrence condition and the occurrence position, i.e. *i₀* and *i₁* behave similarly but *i₂* behaves differently in their appearance in verbal conjugation, and *e₀* and *e₂* behave similarly but *e₁* behaves differently. In addition, we argued that the two front vowels *i₂* and *e₁* are employed only in special occasions: the emphasis of distinction and the last resort.

Phonological Categorization

The upshot of the last three sections is that *i₀* and *i₁* behave similarly but *i₂* behaves differently and *e₀* and *e₂* behave similarly but *e₁* behaves differently in the three phonological and morphological phenomena: the co-occurrence condition, the occurrence position and the conjugation. It is, now, time to consider what these linguistic facts imply.

Based on these descriptive generalizations, we claim that the pronunciations of *i₀* and *i₁* were identical while that of *i₂* was different, and the pronunciations of *e₀* and *e₂* were identical while that of *e₁* was different. Actually, it has been believed by many Japanese linguists that *i₀* was actually identical to either *i₁* or *i₂* and *e₀* was actually identical to *e₁* or *e₂*. According to Flemming (2005), “It is one of the most basic generalizations in phonology that only certain sets of sounds pattern together in phonological processes, and that these sets can be characterized in terms of shared phonetic properties.” Building on the general accepted idea and the most basic generalization, we may conclude that *i₀* and *i₁* represented the same sound while *i₂* represented a different sound, and *e₀* and *e₂* represented the same sound while *e₁* represented a different sound. That is, we claim that two high vowels (*i₁* and *i₂*) and two mid vowels (*e₁* and *e₂*) were contrastive after peripheral stops (p, b, m, k, g), but their contractiveness was neutralized respectively after the other consonants (t, d, s, z, n, r, j, w) and in word-initial onset less syllables so that only one high vowel (*i₀* = *i₁*) and one mid vowel (*e₀* = *e₂*) occurred in these environments:

17. Our proposal of the vocalic contrast

High Vowels		Mid Vowels	
$i_0 (=i_1)$ elsewhere: /t, d, s, z, n, r, j, w/ + in a word-initial onsetless syllable	i_1 vs. i_2 after peripheral stops: /p, b, m, k, g/	$e_0 (=e_2)$ elsewhere: /t, d, s, z, n, r, j, w/ + in a word-initial onsetless syllable	e_1 vs. e_2 after peripheral stops: /p, b, m, k, g/

Next, let us consider the deeper question, “how did each orthography (i.e. i_0 , i_1 , i_2 , e_0 , e_1 and e_2) sound in Old Japanese?” As was clarified in (17), we claim that i_0 and i_1 represented the same sound while i_2 represented a different sound, and e_0 and e_2 represented the same sound whereas e_1 represented a different sound. Then, what sound did they represent actually? We propose that i_0 and i_1 represented a front high vowel /i/ while i_2 represented a central high vowel /i̯/, and e_0 and e_2 represented a front mid vowel /e/, while e_1 represented a central mid vowel /ə/. This proposal can be summarized as follows:

18. Our proposal of phonetic values of each vowel

i. Relation between orthographies and sounds

High Vowels			Mid Vowels		
i_0	i_1	i_2	e_0	e_1	e_2
i	i	i̯	e	ə	e

ii. Vocalic system in Old Japanese

High Vowels		Mid Vowels	
i elsewhere: /t, d, s, z, n, r, j, w/ + in a word-initial onsetless syllable	i vs. i̯ after peripheral stops: /p, b, m, k, g/	e elsewhere: /t, d, s, z, n, r, j, w/ + in a word-initial onsetless syllable	e vs. ə after peripheral stops: /p, b, m, k, g/

The hypothesis of this vocalic system is supported by two general phonological concepts: coronal fronting and Harmonic Alignment. Firstly, this hypothesis is supported by the fact that it is common for coronal sounds to cause their following vowels to be front (Hume 1992, Flemming 2003 among others). If we postulate the vocalic systems in (18ii) and we assume that the coronal fronting process existed in Old Japanese, then we can explain why two high vowels and the two mid vowels are neutralized after coronal stops /t, d, s, z, n, r, j/ to one high vowel and one mid vowel. The reason is that the central vowels /i̯, ə/ are affected by coronal sounds to be front, and they are neutralized to their front correspondents /i, e/ after coronal sounds. The following tableaux with well-attested constraints demonstrate that the central vowels are affected by the preceding coronal sounds to be neutralized to their front correspondents:

19. Coronal fronting in Old Japanese

a. Constraints

Agree [coronal]: Assign one violation mark for every pair of adjacent segments that differ in their specification of [coronal].²

b. Ranking

Faith (consonant) >> Agree [coronal] >> Faith (vowel)

c. Demonstration

i. Coronal Sounds (e.g. /t/) + Front Vowels (i.e. /i/ and /e/)

/ti/	Faith (consonant)	Agree [coronal]	Faith (vowel)
ti			
t̥i		*!	*

ii. Coronal Sounds (e.g. /t/) + Central Vowels (i.e. /ɨ, ə/)

/ti/	Faith (consonant)	Agree [coronal]	Faith (vowel)
t̥i		*!	
ti			*

Next, the hypothesis in (18ii) is also supported by Harmonic Alignment. It is well-known that central vowels are less prominent than their front and back correspondents. Hence, in some languages, central vowels cannot appear at stressed positions (= prominent position), e.g. the occurrence of a central vowel /ə/ is limited to unstressed position in English. In addition, it is well-attested that initial positions are more prominent than non-initial positions. This is supported from both psychological and phonological evidence, cf. Beckman (1999, Ch.2). That is, the following two prominence scales are obtained from these facts:

20. Two prominence scales

a. Vowel Prominence: Non-central vowels > Central Vowels

b. Positional Prominence: Initial position > Non-initial position

From these two prominence scales, we can deduce the following constraint hierarchy by aligning the less prominent element with the more prominent position and aligning the more prominent element with the less prominent position³:

² Note that coronal consonants and front vowels are specified [coronal] (Clements and Hume 1995) whereas central vowels are not.

³ This way of deducing the constraint hierarchy is called Harmonic Alignment (HA), cf. Prince and Smolensky (2004: 161-162). This concept is based on the idea that the more prominent position prefers the more prominent elements and the less prominent position prefers the less prominent elements. In other words, it is unlikely for the less prominent elements to appear in

21. Two deduced hierarchies

- a. *Central Vowels/Initial Position (*CV/IP)
 - >> *Non-Central Vowels/Initial Position (*NCV/IP)
- b. *Non-Central Vowels/Non-Initial Position (*NCV/NIP)
 - >> *Central Vowels/Non-Initial Position (*CV/NIP)

If we postulate the vocalic system in (18ii) and the deduced hierarchy (21a), then we can explain why two high vowels and the two mid vowels are neutralized in word-initial onset less syllables. It is because the appearance of central vowels at the word-initial position is highly marked because of the hierarchy (21a), and thus two central vowels /i, ə/ are neutralized to their front correspondents /i, e/ at word-initial position. The following tableaux demonstrate this fact:

22. Neutralization at word-initial position

a. Non-central vowels at word-initial position

[WORD <i>i</i>]	*CV/IP	Faith (vowel)	*NCV/IP
☞ [WORD <i>i</i>]			*
[WORD <i>i</i>]	*!	*	

b. Central vowels at word-initial position

[WORD <i>i</i>]	CV/IP	Faith (vowel)	NCV/IP
[WORD <i>i</i>]	*!		
☞ [WORD <i>i</i>]		*	*

In this way, our proposal of the vocalic system in (18) is supported by two general linguistic concepts: the coronal fronting and Harmonic Alignment.

In this section, we have clarified the following two points: (i) i_0 and i_1 represented the same sound while i_2 represented the different sound, and e_0 and e_2 represented the same sound whereas e_1 represented the different sound and (ii) front vowels /i, e/ and central vowels /i, ə/ are contrastive after the peripheral consonants /p, b, m, k, g/, but they are neutralized to the front vowels /i, e/ in the other contexts. The former proposal is supported by the fact that i_0 and i_1 behave similarly but i_2 behaves differently and e_0 and e_2 behave similarly but e_1 behaves differently in the three phonological and morphological phenomena: the co-occurrence condition, the occurrence position and the conjugation. The latter proposal is supported by the fact that we can reasonably account for why two high vowels and two mid vowels are neutralized to one high vowel and one mid vowel in certain environments on the basis of the coronal fronting and Harmonic Alignment given that we postulate the vocalic system in (18ii). These two findings are really significant,

the more prominent position and for the more prominent elements to appear in the less prominent position.

but we have one problem to solve in future studies. Attentive readers may realize that there is one more phonological environment in which two high vowels and two mid vowels are neutralized to one high vowel and one mid vowel: a position immediately after a round approximant /w/. This environment is neither a coronal sound nor an initial position. Further investigation is required about why this environment also neutralizes the two high vowels and the two mid vowels.

Summary

In this paper, we delved into the vocalic system of Old Japanese. Then we clarified that i_0 and i_1 represented the same sound while i_2 represented a different sound and e_0 and e_2 represented the same sound while e_1 represented a different sound. This claim is on the basis of their phonological behaviors in the three phonological and morphological phenomena: the co-occurrence condition, the occurrence position and the conjugation.

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