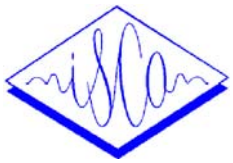

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Asymmetric Distribution of Accents and the Related Issue of Vowel Duration

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Abstract

This paper offers a phonological analysis of the compatibility between vowel quality and lexical accent in Standard Japanese (SJ). This work benefits not only from phonological considerations but also from phonetic analysis. Analyses from these two perspectives converge on the claim that the vowel /a/ attracts lexical accents, while on the other hand /u/ repels lexical accents. Acoustic measurements of vowel duration suggest that the longest vowel attracts lexical accents most, and the shortest vowel, the least. However, we encounter a difficulty in establishing the pecking order of the other 3 vowels in SJ. A phonological analysis couched in the theory of Phonological Government provides an account of which vowel tends to attract or repel accents, calling upon the notion of licensing relations holding between Phonological Elements.

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1. Introduction

This paper highlights the distribution of lexical accent in Japanese and its relation to the quality of the vowels with which it co-occurs. On the question of the asymmetric distribution of the five vowels in Standard Japanese (SJ) in relation to accent, I report that /a/ and /i/ show a strong tendency to carry lexical accents in native SJ nouns. /u/ on the other hand, is the least likely to be accented. The most popular and the least vowels reflect their duration measured acoustically, however, the other 3 vowels, namely /i/, /o/, and /e/ fail to show the same correlation. The phonological elements proposed in Government Phonology (GP) (Kaye, Lowenstamm, Vergnaud [9], [10], Charette and Göksel [2], Harris & Lindsey [5]) directly account for such an asymmetric distribution of lexical accents: the headedness of the simplex melodic expressions A and I. The occurrence of the metrical head of a word-domain thus depends upon the quality of the melodic expression occurring in that domain.

2. Pitch Accent in Standard Japanese

This study focuses on native nouns with inherent lexical accents comprising two (C)V pairs. This word size enables us to explore an abundance of samples, 513 words, with fairly equal distribution of accents, without being affected by metrical operations taking place in SJ (see Yoshida [14] for metrical accent assignment). Three (C)V words, unlike native words exceeding four (C)Vs in length, are plentiful; however, they are subject to changes in accent pattern, resulting in a choice of alternative pitch patterns for each item [14].

2.1. Lexical Accent

As previous work has shown (e.g. Haraguchi [3], [4]; McCawley [11]), words in SJ can be either accented or accentless. If accented, the location of the accent may be either metrically predictable or otherwise lexically designated. A drop in pitch marks the location of the accent, and the pitch patterns are predictable once the location of the accent is identified: all the morae to the left of the accented mora should be high pitched except for the word-initial mora (unless this initial mora is itself accented). The distinction between words without any accents and those with word-final accents becomes clear only after a case-marker such as *–ga* (nominative marker) is suffixed. The data in (1) represent all three accent types occurring in bimoraic words: 2 lexically accented class and the accentless class of SJ nouns. The common understanding is that lexical accent may be located on any vowel in the word. A bar over segments indicates that the relevant part is high-pitched, and a * denotes the lexical accent.

(1) Contrast: Lexically accented and accentless terms

a. Words comprising two morae (O)N(O)N

i) ha si ‘chopstick’ ha si –ga ‘chopstick –nom.’

ii) ha si ‘bridge’ ha si –ga ‘bridge–nom.’

iii) ha si ‘edge’ ha si –ga ‘edge –nom.’

The next section presents data illustrating the distribution of vowels and lexical accents.

3. 5 Vowels and Distribution of Accents

The study focuses on the quantitative distribution of the five vowels in *Yamato* (native) words, in relation to accented positions in the word. An exhaustive list of native words is available from the database of Osaka and Tokyo Accent (Sugito [13]), which contains 65,928 words with pitch information. The advantage of using this database for the present study is that it includes information concerning whether or not individual entries existed in the Heian period (AD 794-1192). This assists in the collection of genuine native terms.

3.1. Distribution of Vowels

The classification of native words according to vowel quality is done in an attempt to establish whether the quality of the vowel shows any relevance to the pitch accent. Tables (1a-c) show the distribution of vowels and lexical accents in native nouns comprising two ((C)V)s. Three accentual patterns are possible: the accent on the initial V, V_1, the accent on V_2, or accentless. Table 1 allows readers to refer to the distribution of vowels, regardless of whether accent location is taken into account.

Table 1: *Vowel distribution for all accent types (native $(C)V_1(C)V_2$ nouns).*

a. Initial Accent

	V_1	V_2	total
/a/	71	41	112
/i/	30	59	89
/u/	37	26	63
/e/	5	28	33
/o/	37	26	63
Total	180	180	360

b. Final Accent

	V_1	V_2	total
/a/	70	68	138
/i/	34	63	97
/u/	54	12	66
/e/	2	24	26
/o/	26	19	45
Total	186	186	372

c. Accentless

	V_1	V_2	total
/a/	42	39	81
/i/	31	50	81
/u/	31	7	38
/e/	7	25	32
/o/	36	26	62
Total	147	147	294

We see less accents falling on /u/ as for V_2 position, and /e/ for V_1. The likelihood of an accent falling on each vowel on V_1 and V_2, is as follows. The majority of word-final accents cluster on /a/ (38%) and /i/ (25%), while the two mid vowels /o/ (20%) and /e/ (8%) attract fewer accents. Not many lexical accents appear on /u/ (13%).

Now, although we know how likely it is for each of the 5 vowels to attract an accent, it should be noted at the same time that the numbers of tokens of each vowel occurring in the samples are not evenly distributed. In fact, we see immediately an uneven distribution of vowels: both word-initial position and word-final position take /a/ or /i/ more frequently than the other vowels. This suggests that simply comparing the numbers of accented vowels does not necessarily show the real tendency of accent distribution. The proportion of accented vowels should instead be calculated in relation to the total number of the vowel in question.

3.2. Accent Ratio per Vowel

In order to test the 'accentability' of all 5 vowels in SJ, this section examines the ratio for each accented vowel out of the total number of tokens of that vowel.

Below are the tables showing how all the vowels are distributed for the 3 accentual patterns. Both vowels are extracted from all $(C)V_1(C)V_2$ native nouns, giving a total of 1,026 (513x2=1,026) in all 513 samples.

Table 2: *Accented /x/ vs .total /x/*

	Accented /x/	Total /x/	Ratio
/a/	139	331	42.0 %
/i/	93	267	34.8 %
/u/	49	167	29.3 %
/e/	29	91	31.9 %
/o/	56	170	32.9 %
Total	366	1026	

42% of all /a/s are accented whereas only 29.3% of all /u/s are found with accents.

3.3. Recapitulating the order

If we were to decide the pecking order of the five vowels in terms of their 'accentability' in accordance with Table 4, we should take /a/ (42%) as the most popular, followed by /i/ (34.8%), /o/ (32.9%), /e/ (31.9%), and the least /u/ (29.3%). Note that this order does not correspond to the size of the total occurrence of the vowels: more tokens of /u/ are found (167) than token of /e/ (91).

4. Phonological Elements – Accents and the Head of the Word Domain

The distribution of accents on the 5 vowels finds an explanation in the theory of Government-Licensing [1], [2], [5], [7], [10] in which Phonological Elements contract licensing relations between themselves. In fact, the nuclear position that dominates a phonological expression with a potential licensor element has the strong tendency to be the head nucleus of its word domain, that is, the accented V.

(2) **Licensing Principle [7]**
All phonological positions save one must be licensed within a domain. The unlicensed position is the head of the domain.

Of course every phonological domain is subject to this principle, which necessarily includes the word-domain where one nuclear position serves as the head, i.e. the nucleus with the primary accent of that word in question (see also [14]).

4.1. Phonological Elements and Licensing

The 5-vowel-system of SJ provides a good illustration of how Phonological Expressions (PEs) are composed of the 3 Phonological Elements, A (non-high), I (front/palatal) and U (labial/round), proposed in GP. These three elements are cognitively defined objects; moreover, they are univalent units, only one term being considered phonologically significant for each element. In other words, each is

monovalent, being present in one class of segments and absent from the complement set (Harris & Lindsey [5]).

In accordance with the realization of PEs in SJ, I propose the simplex PEs to be A, I and U, where underlining represents headedness. The simplex PEs, A, I and U are interpreted as the vowels /a/, /i/ and /u/, respectively. Note here however, that the phonetic value of /u/ in SJ is actually [ɯ], an unrounded high back vowel. Lacking the salient property of the U-element, this simplex expression U is a non-headed PE. A and I are headed simplex PEs. Section 4.2 below explicates in detail this claim that only U is a headless expression unlike A and I.

Given these facts concerning the structure and headedness of simplex PEs, a hypothesis is made on the relation between pitch accent and vowel quality in SJ. A pitch accent, lexical or assigned, is the manifestation of the headship of a word-domain (Yoshida [14]). If the melodic content manipulates a position to take the domain headship, then it seems natural that a position dominating a headed expression should attract the word accent.

(3) Headedness of a PE at the melodic tier projects up to the word level.

This hypothesis is put to the test in the subsequent subsection.

When we observe another stratum of words, loan words with vowel epenthesis, we see there is a correlation between the headedness of the PE and accentedness [15]. It is said that the epenthetic vowel /u/ rarely attracts the word accent; for this reason, then, it is appropriate to consider this vowel in the data being tested for accent-distracting elements. On the other hand, the distribution of lexical accents on native nouns would reveal accent-attracting elements.

4.2. Headedness in Conflict

The vowels /e/ and /o/ are represented as complex PEs: [e] as A and I, and [o] as A and U. To determine the head element between the two combined elements is a straightforward matter for /o/: this vowel combines the licensor expression A and the headless expression U, with A simply passing on its headedness to the compound expression to license U. For /e/, however, the combination of the two headed expressions A and I creates a headedness conflict. The headedness of both cannot be combined to boost the licensing potential of the complex PE; rather, they suppress each other's licensing power. The low occurrence of /e/ in the samples provides evidence for this conflict of headedness. This is why /o/ is permitted to bear more accents than /e/ does.

The simplex headed expressions A and I attract accent most frequently, followed by the two complex expressions /o/ and /e/; finally, the headless expression U attracts the fewest accents. The PEs that attract an accent are A and I, both of which are headed, whereas a headless PE, U, appears to repel accents. The fact that /a/ and /i/ attract an accent whereas /u/ does not can only be explained with reference to this PE system; a feature-based theory cannot group together a high front vowel /i/ and a low (backish) vowel /a/.

The Compositionality of a PE helps to weaken its licensing potential from the melodic level to the prosodic (accentual) level. The combination of the elements I and A results in /e/, and that of the elements U and A gives /o/. I assume here that A takes the role of the head within those PEs; however, those two combined PEs are less likely to attract accents to the nuclear position involved. This suggests that licensing power is consumed when elements are combined, thereby weakening the ability of the head element to transmit potential to support the headship at the prosodic level.

Yet this line of argument leads to another implication: the headedness of a PE is passed on to become the headship of the word-domain. The PE for /e/ should be headed to account for the higher percentage of /e/ to be accented than that of the headless PE U for /u/.

5. Remarks on Vowel Duration

5.1. Vowel Duration and Lexical Accents

Okada [12] reports that the longest vowel is /a/, and that the shortest is /u/ in terms of the duration obtained from spectrographic analysis. The first hypothesis is made on the basis of the correlation between the relative duration and the accentability of /a/ and /u/ in SJ, as follows:

(4) **Hypothesis:**
The longer the duration, the more accents are attracted to that segment.

Pursuing this line of analysis, I used spectrographic tools (SP4WIN Custom) to measure the duration of all five vowels. A set of data below is read twice by a 38-year-old female native speaker. The table below shows the mean duration for each vowel when accented. All the lexical items in the list carry word-initial accents. Samples are selected: voiced consonants for C_2 are avoided, which tend to prolong the duration of the preceding vowel as in the example of /kibi/ 'millet' (65 msec). In the data list, most terms with /i/ or /e/ have a voiced C_2. Note that /kita/ with initial accent does not exist in SJ, unlike its finally accented counterpart meaning 'north', and thus is treated as a nonsense word. Two Sino-words, /kuko/ 'Chinese matrimony vine' and /seki/ 'dam', are used for this purpose.

(5) **Duration of Accented V_1 (in msec)**

	'gloss'	**1st**	**2nd**		**mean**
/kata/	'shoulder'	65	68		67
/kate/	'food'	77	74		76
				/a/	**72**
/kita/	(nonsense word)	66	50		58
/miso/	'bean paste'	58	64		61
				/i/	**60**
/kuda/	'pipe'	58	56		57
/kuko/	'Chinese matrimony vine'	46	58		52
				/u/	**55**
/keta/	(nonsense word)	65	59		62
/seki/	'dam'	56	63		60
				/e/	**61**
/koto/	'Japanese harp'	65	57		61
/hoko/	'pike'	62	62		62
				/o/	**62**

In terms of duration, this gives us the following order: /a/ (72 msec) is the longest, followed by /o/ (62 msec), then /e/ (61 msec), /i/ (60 msec), and finally /u/ (55 msec). It is true that the longest vowel /a/ attracts lexical accents, and on the other hand /u/ repels lexical accents. Acoustic measurements of vowel duration suggest that the longest vowel attracts lexical accents most, and the shortest vowel, the least. However, we encounter a difficulty in establishing the order of the remaining vowels, i.e. /i/ is the second shortest, that is, no longer than /o/ and /e/, but attracts accent more than the two mid-vowels.

Indeed, measurements of vowel duration seem to vary from one study to another. In fact, Homma [6] reports the durational order as o>e>a>i>u. Nevertheless, all studies agree that the vowel /u/ is the shortest.

(6)	Homma's	o>e>a>i>u
	Okada's	a>o>e>i>u
	Yoshida's	a>o>e>i>u

At least, I can conclude that the shortest vowel, /u/, does not provide a suitable landing site for an accent.

6. Conclusion

This paper has demonstrated how accent distribution can be accounted for in the theory of Government. The difference between the popular vowels and the least popular vowel lies in the headedness of the respective PEs which represent the relevant segments. To parallel that, acoustic studies identify /u/ as the shortest vowel in the system, a fact which may be linked to its status as an unfavorable accent site. However, further research will be needed to establish clearly whether vowel duration really influences the ability of a vowel to attract accents.

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