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1. Introduction

In this paper, I discuss the accentuation of four-mora English loanwords in Japanese, on the one hand, and constraint interactions involved in the accent assignment, on the other. I will draw on the model of a constraint-based approach in which constraints are violable and an optimal harmonic candidate is chosen in terms of dominance hierarchical relations among the constraints. Through these analyses, I will claim that the location of a word-accent in Japanese is measured with morae and foot-structures they belong to and the correct accentuation results from the constraint interactions.

In section 2, I examine past analyses of foot structure in Japanese and discuss the nature of the foot structure involved in accentuation of loanwords. I will also refer to problems of mora assignment of diphthongs, geminates, and syllable-final nasals. I illustrate them with Japanese verses referred to as *Haiku* and prove that morae are necessarily involved in those components of prosodic words and that they play a key role in regular rhythmic time-counting in *Haiku*. In section 3, I propose that the accentuation of Japanese four-mora loanwords be accounted for in terms of constraint interactions that include those of bi-moraic foot-structure. I finally argue that an adequate account for the phenomena at issue cannot be attained in terms either of ordered rules or of a syllable-based approach that poses problems in the accentuation.

2.1. Mora and bi-moraic foot-structure in Japanese

In Ito (1990), such examples as the abbreviation of hypocoristic names and loanwords are analyzed as bi-moraic. Ito bases the analysis on Poser's (1984) argument that the system of hypocoristic name shortenings involves mapping to a bi-moraic foot structure, and proposes a general bi-moraic template in Japanese.

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(1) Hypocoristic name shortenings
From the source name *Mariko*:
a. mari(-tyan) [2 morae] b. riko(-tyan) [2 morae]
c. mako(-tyan) [2 morae] d. maa(-tyan) [2 morae]

(2) Loanword abbreviations
a. kone [2 morae] b. puro [2 morae]
'connection' 'professional'
c. baa-ten d. kon-bi
2 2 2 2
'bartender' 'combination'

In the case of poly-moraic examples such as (2c) and (2d), Ito analyzes that their internal structures are divided into a stem and a suffix element, and proposes two types of minimality requirements, i.e. Minimal Stem Requirement (hereafter MSR) and Minimal Word Requirement (hereafter MWR). MSR stipulates that a minimal prosodic stem must be bi-moraic, whereas MWR stipulates that a minimal prosodic word must be minimally bi-syllabic, i.e., longer than one syllable. Given the two minimality requirements, her argument appears consistent with the impossibility of (3b).

(3) a. demo
2 morae [2 syllables]
'demonstration'
b. *de-mon
1 2
[intended: 'demonstration']

Ito claims that the first element *de* in (3b) is a stem with only one mora and the second element *-mon* is a suffix, and as a result (3b) violates the minimal stem requirement, whereas in (3a) the word itself simply has bi-syllabic structure that satisfies the minimal word requirement.

She also adds an additional condition to the minimality templates that the templates apply only to derived forms, not to underived forms. In fact, as she admits, this distinction is inevitable to her analysis anyhow, since in Japanese lexicon there are a good number of monomoraic words most of which seem to belong to Sino-Japanese vocabulary. In order to maintain the minimality templates, she will have to avoid, by the additional condition, their application to the examples in (4) that are monomoraic.

(4) a. ta 'rice field' b. yu 'hot water' c. ki 'tree'
d. ko 'child' e. e 'picture' f. te 'hand'

However, the minimality templates together with the additional condition still pose a problem, as seen in (5).

(5) a. pan 'panning'
b. guu 'good'
c. pin 'pinta' [a Portuguese word that means 'one or a side with one dot of a dice']

In (5), abbreviated loanwords are monosyllabic, not disyllabic. The requirement for derived words is apparently violated. Another example is shown in (6) that poses the same problem with the two minimality templates.

(6) a. si-mai 'elder sister and younger sister'
b. ka-si 'sweets'
c. tai-ka 'authority, master'

They seem to belong to Sino-Japanese vocabulary some of which Ito raises as monomoraic examples, as in (4). In (6), neither of the two elements in each example can occur by themselves alone.

(7) a. *si b. *mai c. *ka d. *si e. *tai f. *ka

This is how Ito distinguishes a stem from a word status in the cases of (2c), (2d), and (3b).

(8) a. *baa b. *kon c. *de

Given the distinction, if *si-* of (6a), *ka-* of (6b), and *tai-* of (6c) are stems instead of suffixes, Ito would have to say that they all violate the minimal bi-moraic requirement of MSR. She would unless she appeals to the underived status of counterexamples. Especially (6b) violates the template, irrespective of whether the first element *ka-* or the second *-si* may be a stem or not. The problem with these examples lies in the two types of minimality requirements and the distinction of stems from other elements in an overly simplex, otherwise unmotivated way.

In the case of (2c), (2d), and (3b), it seems practically impossible to tell or define what a stem is. Such examples as abbreviated loanwords particularly will not give us any productive, identifiable stem units, unless there is any independent evidence that shows the productivity of assumed stems such as *baa*, *kon*, or *de* in (8). These elements never appear as stems in other words with any related meanings. They are considered as an inseparable part of the

whole single, meaningful units morphologically. Importantly, we would not have problems that the two minimality templates pose, if there is no such MWR about bi-syllabicity and if bi-moraicity is merely a necessary condition for a derived prosodic word. A prosodic word can be longer than two morae. Examples in (2c), (2d), and (3a) are accepted forms. They all satisfy the minimal bi-moraicity, if there is a left-edge in the formation of two morae.

The impossibility of *de-mon* in (3b) does not derive merely from the bi-moraicity violation of *de-*, but rather the result of the interactions of different constraints I will shortly propose. It suffices to say here that *de-mon* cannot be parsed as bi-moraic in any possible way because of an inseparable third syllable-final mora ***n*** of the second syllable.

2.2. Foot structure in Japanese

Traditionally, proposals of foot structure have been limited to the ones for assigning tone that seem to be irrelevant to stress feet. However, according to a number of data I raise, a rhythmic system that is composed of bi-moraic foot seems to exist in Japanese, the implications being that such metrical foot may coexist with an independent pitch accent system.

Poser (1990) proposes that Japanese has foot structure based on bi-moraic templates and he gives examples that should be analyzed in terms of a moraic foot. Some of the representative examples are given in (9) quoted from his hypocoristic data.

(9) a. yootyan←*yotyan [<yosuke]
b. keetyan←*ketyan [<keeji]
c. hanatyan/haatyan←*hatyan [<hanako]
d. jyuntyan←*jyutyan [<jyunko]
e. kintyan←*kityan [<kinsuke]

As illustrated with (1d), a name like *mariko* is usually shortened in hypocoristics, but if the shortened one has only one mora, its vowel will be lengthened for one more mora, whence *maa(-tyan)*. The examples of (9) also show the same kind of increments to get two mora heads. These names all avoid the monomoraic form and lengthen the vowel or preserve the following moraic form of the original names. As a result, their stem units all have two morae.

The example (10) quoted also from Poser (1990) shows that a transformed stem maintains two mora status, with the addition of either the onset [t] of the suffix *tyan* or the addition of the onset of the next syllable in the original name, as in (10d) and (10e).

(10) a. at-tyan < atuko
b. et-tyan < etuko
c. sat-tyan < satiko, satiyo
d. an-tyan < ani
e. yai-tyan < yayoi

The stems are all mono-moraic, and, later in the surface representation, geminates, nasals, and diphthong occur, as if they achieve a fixed template like bi-moraicity. If it is the case that there is a bi-moraic template with them, then I could claim that the first part of the geminates, syllable final nasals, and the second part of diphthongs are all analyzed as mora-constituting elements in each word. I will argue this issue in the next section.

In the examples of (11), the two units of which are reversed from their original words, Poser argues that both the first and second part of the reversed words maintain the bi-moraic foot of each other, and then raises (12) as a set of the exceptions to these musicians' wordings of (11).

(11) a. hiikoo←coohii 'coffee'
b. zyaamane←maneejyaa 'manager'
c. siimee←mesi 'meal'
d. nnpaa←pan 'bread'
e. iihii←hi 'fire'
(12) a. gotosi←sigoto 'work'
b. domoko←kodomo 'child'
c. yanopi←piyano 'piano'

However, I occasionally hear those words and notice a variation of (11), as observed in (13).

(13) a. hii-ko 'coffee' b. sii-me 'meal' c. ii-hi 'fire'
("–" means a syllable boundary.)

Instead of claiming that both the two units of a reversed word maintain bi-moraic foot, I argue that the first part of the reversed word transforms to two morae and the second part fades or remains unparsed at the word-final position. There seems to be a constraint operative concerning non-finality, and I will claim in the final section that this non-finality constraint will play a major role in the accentuation together with violability of constraints as observed in (12) and (13). (12) will not pose a problem as an exception to the bi-moraic foot argument. Rather, the final foot possibly violates a constraint

such as Non-Finality Constraint, Rhythm Type, etc.

In summary, evidence and arguments presented above demonstrate the important role of the bi-moraic foot in Japanese phonology. The foot structure I have discussed will help account for a number of phenomena such as hypocoristics and their abbreviations. I will also argue in the final section that foot structure provides a right account for the accentuation of loanwords within our constraint-based model approach.

2.3. The status of mora in geminates, nasals, and diphthongs

In this section, I specifically argue the status of the first element of geminates, syllable-final nasals, and the second element of diphthongs and claim that they all have morae involved in their positions at issue, based on the observation of Japanese formal verses called *Haiku*.

The Haiku consists of three lines or blocks, the first containing five morae, the second seven morae, and the third five morae. When the syllables are all light, the syllable count and the mora count agree. However, when a syllable is heavy, the number of syllables will be less than that of the morae. The Haiku's well-formedness depends on the mora count, not the syllable count, as in (14).

(14) samidareya taigaomaeni ieniken.
5 morae 7 morae 5 morae
'In the peak of spring rain in May, two small cottages stand on the brink of a big overwhelming river. They look unsafe and lonesome.'

In the second block I notice the diphthong [ae] in [mae] and another diphthong [ie] in the third block. They demonstrate that each vowel in a diphthong is counted as one mora, as in (15) for (14).

(15) [=(14)] sa mi da re ya ta i ga o ma e ni i e ni ke n
1 2 3 4 5 1 2 3 4 5 6 7 1 2 3 4 5

Therefore, diphthongs are proven to be counted as two morae like double vowels.

Likewise, in (16a), a diphthong [ao] in the second block turns out to be counted as two. In contrast, another sequence of two vowels, [o] and [u], in the third block have a phrasal boundary between them, and do not constitute a diphthong.

(16) a. yuukaze-ya mizu-ao-sagi-no sune-o-utu.
b. yu u ka ze ya mi zu a o sa gi no su ne o u tu
1 2 3 4 5 1 2 3 4 5 6 7 1 2 3 4 5
'On a winter day, a lonely (Eastern grey) heron stands on the vacant rice field with cold wind on the slender shin,'
c. aoi 'mallow or hollyhock'

(16c) is an instance of season words often used for a particular season of the year as a kind of protocol. Water birds like heron are also another example of season words for winter. [Aoi] has three adjacent vowels in one word and is usually counted as three morae, aside from the problem about the location of a syllable boundary.

Therefore, a minimal count unit in versification is the mora that exists in each vowel of a diphthong, and syllables cannot be utilized for the rhythmic components of versification in Japanese.

Geminates also have the same kind of examples from the Haiku verses which demonstrate that each component of a geminate pair is counted as one mora, as in (17).

(17) ume-ga-ka-ni not-to-hi-no-deru yamaji-kana.
1 2 3 4 5 12 3 4 5 67 1 2 3 4 5
'When I walk along a mountain path on a day of early spring, plum's fragrance fills the air and all of a sudden the sun rises between the trees.'

In (17), a geminate [t] occurs as the duplicate of the onset of the following syllable and is counted as one mora. Along the same line, some more characteristics of mora assignment can be observed in (18).

(18) sumi-uri-ni kagami-misetaru onna-kana.
1 2 34 5 1 2 3 4 5 6 7 123 4 5
'A woman kindly tells a charcoal seller about his smudged face with charcoal by showing a mirror.'

In summary, all the examples of diphthongs, geminates, and syllable-final nasals that are often problematic for mora assignment in fact clearly demonstrate the existence of a mora for each component of their internal structures. This observation will be one of our bases to claim a unified treatment of accentuation of loanwords in the next section.

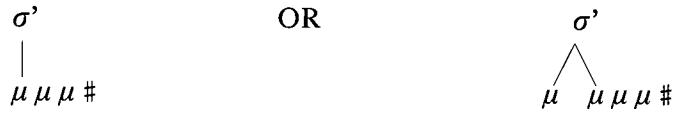
3.1. Rule-based approaches in loanword accentuation

I have so far argued that Japanese has bi-moraic foot structure in words, but this bi-moraicity is not a sufficient condition to stipulate the exact size of minimal stems. I have also demonstrated that each component of geminate, diphthongs, and syllable-final nasal has a mora assigned.

In this section, I discuss a system of loanword accentuation, but first argue that some of the syllable-based rules for that purpose, as in Kubozono (1994), pose problems in spite of the reformulation of rules.

Traditionally, the accents of loanwords are considered to be placed on the syllables containing an *antepenultimate* mora. Such a rule is given in (19).

(19)



[σ --- syllable; μ --- mora]

For the specificity of my argument, I exclusively consider four-mora loanwords, especially those of place names that are the most popular loanwords and the most problematic as well.

Kubozono (1994) demonstrates the accent patterns of four-mora loanwords that the traditional rule (19) cannot accout for, together with the cases of unaccented words. Accented four-moraic examples are illustrated in (20).[1]

(20) a. $\sigma'\mu\ \sigma\mu\ \sigma\mu\mu$ ex. [a'mazon] 'Amazon'
b. $\sigma\mu\ \sigma'\mu\ \sigma\mu\mu$ ex. [ie'men] 'Yamen'
c. $\sigma'\mu\ \sigma\mu\ \sigma\mu\ \sigma\mu$ ex. [ma'dorasu] 'Madras'
d. $\sigma\mu\ \sigma'\mu\ \sigma\mu\ \sigma\mu$ ex. [sia'toru] 'Seattle'

He claims that it is the syllable structure of word-final two morae that determines the accent patterns of whole words. Based on this, he proposes his first accent rules shown in (21).

(21) No.1: Where the word ends with a heavy syllable, accent is placed on the initial syllable, whether this is a heavy syllable or a light syllable.
No.2: Accent is placed on the penultimate heavy syllable, which is followed by a light syllable.
No.3: If the word ends with a sequence of light syllables, it becomes unaccented.

With this, the case of (20a) and some other unaccented cases are accommodated in (21), but patterns such as (20b), (20c), and (20d) still remain unexplained. He recognizes that the accent pattern in (20c) has the final two light syllables and therefore should fall incorrectly under the unaccented case of No.3 in (21). Then, in order to distinguish the accented pattern (20c) from the unaccented case, he proposes another rule merging the final syllable with a vowel [u] into the preceding light syllable, ending up making a heavy syllable. He treats the [u] as epenthetic, since it will not occur at the base-underlying level, as in the example of [u] in (20c) [ma'dorasu]. He summarizes his argument to the effect that words involving an epenthetic vowel */u/* word-finally show the same accentual pattern as words ending with a heavy syllable, which implies that the two structures are phonologically neutralized before accentuation rules apply. He further introduces a rule shown in (22).

(22) $\sigma\mu\ \sigma\mu$ /u/ # $\longrightarrow$ $\sigma\mu\mu$ #
[*/u/* --- an epenthetic vowel]

However, as he admits in his argument, he still leaves problems with (20b) and (20d) to be solved, although his rules has increased the degree of predictions of accent. The problems with the rules (21) and (22) seem to derive from his syllable-based approach and from his syllable-assignment of mora. I will therefore pursue a right kind of approach other than the approaches summarized here in order to deal with the remaining problems with (20b) and (20d).

3.2. Constraint interactions in the formation of loanwords

In Kubozono's (1994) analysis, the cases of (20b) and (20d) remain unexplained, and I argue that these cases will be accounted for, once it is noted that the other cases in the patterns of (20) also have the same distribution of accent location as the aforementioned cases concerning the initial two morae in terms of foot structure. A close examination reveals that the observation made with (20) is basically true, and, moreover, that the whole accent patterns of four-mora foreign place names at issue are associated with their initial two morae. This seems to mean that a bi-moraic foot structure is operative with them. (23) illustrates the whole patterns of the four-mora place names except for unaccented words.

(23) a. (oha')io b. (a'ma)zon c. (su'u)dan
d. (a'n)desu e. (ma'do)rasu f. (ie')men
g. (sia')toru

Based on these data, we seem to be ready to develop some mechanism of accentuation with loanwords. In fact, we can accommodate the unexplained cases such as (23f) and (23g), which correspond to problematic (20b) and (20d) respectively.

There are a number of constraints involved in the accentuation of these examples. First, it should be pointed out that Non-Finality (hereafter Non-Fin) constraint is involved in (23): that the accent in a word does not lie on the final foot. Second, since I posit feet in a prosodic word, I will have either Trochee or Iambus in terms of the bi-moraicity I am based on. Here I simply posit a constraint formula such as "Rhythm Type = Trochee" (hereafter *RhTyp = T*) through the earlier examinations and statistic probability, and I will see how it will work in the interactions of constraints of an Optimality Theoretic model. Once I assume the *RhTyp = T*, I will need to account for the exceptional cases such as (23f) and (23g). I notice that both [ie'men] and [sia'toru] hold sonority of the two sequences of vowels in assigning the accent, as observed in (24).

(24) Low V > High V > Liquid > Nasal > Vd. Fric. > Vl. Fric.
> Vd. Stop > Vl. Stop
[Prince & Smolensky (1993) and Dell & Elmedlaoui (1985)]

It is clear that [e] is more sonorous than [i] in [ie'men] and [a] than [i] in [sia'toru]. Notice that No.1 of Kubozono's syllable-based rules in (21) incorrectly predicts the accent on the first syllables such as [i] for [ie'men] and [si] for [sia'toru] respectively. His syllabification for these two words is illustrated in (25).

(25) a. σ σ σ b. σ σ σ σ
| | | | | | |
i e men si a to ru

In the case of (25b), another rule (22) applies to the [u], and the last two syllables merge into a heavy syllable that falls under the rule No.1 of (21). Therefore, I posit a constraint involved in the sonority of sounds within foot and name it after Rhythmic Harmony Constraint that is a class of Peak Prominence: Foot Sonority Harmony (FtSonHrm) constraint. One might also consider other constraints such as Foot Binarity (FtBin), Edgemost (Left, Foot), Edgemost (Right, Pitch-Accent), Weight-to-Stress Principle (WSP), and parsing-related constraints. Later it turns out, however, that after the permutational operations, harmonic constraints will be narrowed down particularly for the accentuation of four-mora foreign place names.

Here I consider the interactions of more harmonic constraints for this particular phenomena than others: especially FtSonHrm, Non-Fin, RhTyp = T, WSP, etc. I now demonstrate how dominance rankings will be organized in the proposed approach.

(26)a. [su'udan]

suudan	FtSonHrm	RhTyp = T	NonFin	WSP
☞ (su'u)(dan)				*
(suu')(dan)	*!	*?		*
(suu)(da'n)			*!	
su'udan		*!		

(26)b. [a'mazon]

amazon	FtSonHrm	RhTyp = T	NonFin	WSP
☞ (a'ma)(zon)				*
(ama')(zon)		*!		*
(ama)(zo'n)			*!	

The two tables in (26) show how the constraint interactions hold for [su'udan] and [a'mazon], which do not pose a problem for either my approach or a syllable-based one. So far we have a constraint ranking of (27).

(27) FtSonHrm, RhTyp = T {>> or ,} Non-Fin >> WSP

However, a problem arises with (27), as illustrated in (28).

(28) [ie'men]

iemen	FtSonHrm	RhTyp = T	NonFin	WSP
(ie')(men)		*!		*
(i'e)(men)	*!			
X ☞ (ie)(me'n)			*	

The ranking (27) gives rise to an incorrect candidate like [(ie)(me'n)] in (28) where the accent is put on the final foot. The incorrect candidate observes Trochaic foot and therefore sacrifices non-finality. Moreover, we would have a counter-feeding relation of Non-Fin to FtSonHrm on the last candidate in (28), if Non-Fin comes at the top. As a result, Non-Fin must be placed in a higher hierarchical position of the dominance rankings than RhTyp = T, but at the same time Non-Fin cannot come at the top.

Finally, with some changes, the ranking will look like the following.

(29) FtSonHrm > > Non-Fin > > RhTyp = T > > WSP

The ranking (29) does not pose any problem, as (27) did in the table (28). This is shown in (30).

(30) [ie'men]

iemen	FtSonHrm	NonFin	RhTyp = T	WSP
☞ (ie')(men)			*	*
(i'e)(men)	*!			
(ie)(me'n)		*!		

We have finally come to an optimal word with (29). I further demonstrate how the last problematic pattern of [sia'toru] will be dealt with in terms of (29). This is illustrated in (31).

(31) [sia'toru]

siatoru	FtSonHrm	NonFin	RhTyp = T	WSP
☞ (sia')(toru)			*	*
(si'a)(toru)	*!			
(sia)(to'ru)		*!		*

I have shown the optimal candidates both for unexplained cases above and for ordinary examples in terms of the constraint interactions within an Optimality Theory framework. The approach of bi-moraic foot structure, combined with a constraint-based theory, seems to give us a better, consistent account for the accentuation of words in Japanese than others. In the case of

unaccented words, Vance (1987) and Hirayama (1960) state that, when an initial long syllable is unaccented, it is pronounced Low High in a sequence, as NHK (1966) suggests with similar data. If this turns out true of all the unaccented words, a possible account obtains in terms of constraint interactions such as those observed in (32) for [maiami].

(32) [maiami]

	FtSonHrm	NonFin	RhTyp=T	WSP	FtBin
(☞) maiami					
(mai')(ami)	*!		*	*	
(mai)(a'mi)		*!		*	
(mai)(ami')	*!		*	*	
(ma'i)(ami)					*?

Unless we have an unparsed, unaccented candidate, as seen on the top row in (32), we would have to choose a candidate on the bottom in (32). This candidate does not violate any higher constraint except for the lowest FtBin. Instead, it is possible to treat unaccentedness in terms of the ranking (29) plus Foot Binarity (FtBin), the optimal candidate being unparsed, unfooted. This issue of unaccentedness is important, since those words amount to about half of the whole vocabulary. We, however, have to wait for future research concerning further discussions of the issue.

4. Conclusion

Accentuation has become one of the major issues in Japanese phonology, but it will be best captured by an approach that has harmonic interactions of various, relevant constraints for an optimal candidate. I have demonstrated how the interaction with a dominance ranking such as (29) comprehensively accounts for the accentuation of loanwords. This implies that the approach I have argued for has potential for explaining systematically Japanese phonological phenomena in general without depending on stipulative rule-bases nor on syllable-based approaches that seem to be subject to otherwise unmotivated, local rule such as epenthesis.

The argument developed here has limited to four-mora place names of Japanese loanwords, and has excluded the issue of unaccented words in

general. Those problems still remain unaccounted for. In a future research relevant to this issue, however, we may predict a system of accentuation in a wider perspective in terms of the current argument, thereby coming to grips further with the universality of this constraint-based approach.

Note(s):

1. As an anonymous reviewer points out, the tonal structure of [siatoru] seems to vary nowadays concerning the first two moraic units: H-L in opposition to L-H that Kubozono (1994) assigned. However, [ai'owa] 'Iowa', [kio'suku] 'Kiosk', [yuu'reka] 'Eureka', or [dia'buro] 'Diablo' could replace the example of [siatoru], with the L-H assigned in Kubozono's scheme. Therefore, for consistency according to the discussion laid out in this paper, I will maintain the L-H structure with [siatoru].

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key words:

the accentuation of four-mora loanwords; harmonic interactions; optimal candidates; violability of constraints; and Optimality Theory.

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