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Syllable and Mora Geometry in Japanese*

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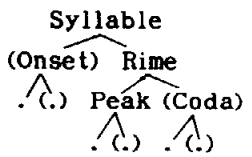
0. Introduction

Japanese is known as a "mora"-counting language. That is, it has been claimed that the linguistic unit mora is a temporal unit in Japanese. And the "syllable" also plays an important role in Japanese phonological phenomena. This paper aims to show how these basic prosodic units are interrelated, and how the syllable and mora structures in Japanese should be represented. I will examine various phonological and morphological evidence taken from such data as speech errors, language games, accentuation, catch phrases in commercials, prosody and word formation process. In order to capture both the syllable-internal constituent structure and mora construction appropriately, I shall introduce the three-dimensional (i.e. two planar) representation of prosodic structures.

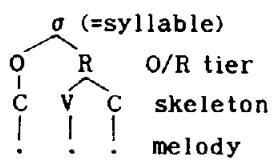
1. Representation of the English Syllable

I begin with a brief summary of the last decade's typical proposal on the English syllable structure within the framework of non-linear generative phonology:

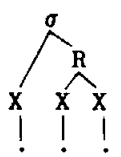
(1) a. Selkirk (1982) etc.



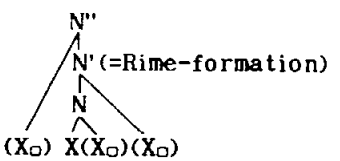
b. Mohanan (1985) etc.



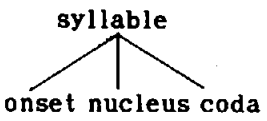
c. Halle & Mohanan (1985) etc.



d. Levin (1985)



e. Davis (1985)



A structure like (1a) has been hypothesized by some phonologists for a long time (e.g. Pike (1967), Fudge (1969)), and it has been accepted by many generative phonologists in principle, too. The conclusion is that the syllable is a phonological constituent hierarchically composed of zero or more consonants, followed by a vowel, and ending with a string of zero or more consonants. Various names have been given to these subparts of the syllable. We will refer to them as the "onset", the "peak" ("nucleus"), and the "coda", respectively. And the peak and the coda together form a unit called the "rime". In (1b) the "skeletal tier" ("CV-tier") mediating between the "melodic tier" ("segmental tier") and the nodes onset and rime is assumed. In (1c) the distinction between skeletal slots linked to vowels and those linked to consonants is abolished, and skeletal slots are all labeled with the single symbol X. In (1d) the notation of X-bar theory is borrowed and the onset and coda are regarded, respectively, as the specifier and the complement of the nucleus. Though showing differences somewhat, the types in (1a)-(1d) are common in that they posit the rime node. On the other hand, (1e) represents a model of the level syllable structure theory where the rime node is eliminated.

If explanatory power is equal, the simpler the descriptive devices for a grammar are, the better the grammar is. Thus, (1e) might be desirable in the sense that its structure is the simplest. However, in so far as English is concerned, as I discussed in Ohta (1989), there is much evidence for the reality of the rime. Consider the following examples, for instance:

(2) a. Blend:

sm/oke + f/og → smog

br/eakfast + l/unch → brunch

b. Pig Latin:

str/eet → /i:tstrey/

p/ig → /igpey/

c. Speech Error:

role of simplicity → soul of simplicity
left hemisphere → heft lemisphere

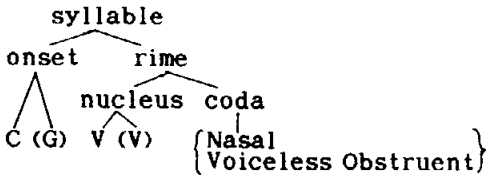
The examples in (2a) show a blending process in which a new lexeme is formed from parts of two or more other lexemes. Those in (2b) show the most common language game of English called "Pig Latin". In this game, children teach it to one another by some such instructions as (though even Pig Latin has dialects): "Take the first sound(s) of each word and put it at the end, then add *a* [ey]." Note here that in these examples the point where words are broken up is the boundary between the onset and the peak. As shown in (2c), this is also true of many speech errors occurring unintentionally.[1] These facts indicate that onset-peak cohesiveness is much smaller than peak-coda cohesiveness. Conversely speaking, the cohesiveness of the peak and the coda is greater than that of the onset and the peak. Therefore it is quite natural to recognize the rime node formed by the constituents peak and coda.

2. The Syllable and Mora Structure in Japanese

2.1. Previous Studies

As the syllable structure of Japanese, Abe (1987) proposes the template shown in (3):

(3)

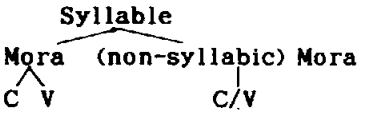


Since Abe does not focus his discussion on syllable structure itself, he might well omit providing sufficient grounds for assuming the structure in (3). But this proposal is sure to meet with some criticism that the template is only an adaptation of the possible consonant + vowel combination of Japanese for the model of (1a) without justification by empirical evidence.

A rather different syllable structure model can be found in Kubozono (1985, 1989). Observing the role and reality of the mora in Japanese through analysis of speech errors and other linguistic phenomena, he proposes the

syllable structure setting up a separate mora-layer.

(4)



This structure is favored for the account of such error data as those given in (5) where the non-syllabic mora of one long syllable is replaced by the non-syllabic mora of another long syllable (the mora boundary is marked by a period).[2]

(5) a. mo.R.ta.R ba.J.ku 'motorbike'

→ mo.J.ta.R ba.J.ku

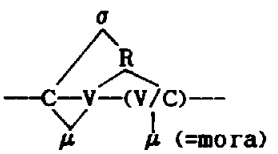
b. zi.N.ke.N mo.N.da.J de ko.ma.Q.te

'troubled with the problem of human rights'

→ zi.N.ke.N mo.N.da.J de ko.ma.N.te

The important role of the mora has been much pointed out in Japanese phonetics and phonology. However, there is little literature which gives a definite representation of the hierarchical relation between the mora and another linguistic unit syllable. Thus, the structural representation in (4) might be prized as a proposal properly capturing the characteristics of Japanese prosodic structures. However, I cannot approve of the deletion of the rime node which is often asserted to be a universal syllable constituent.[3] As I suggested in Ohta (1989), we should employ the so-called three-dimensional phonological representation in order to manifest the coexistence of the mora and rime tiers, as roughly illustrated in (6):[4]

(6)



In the following sections, the role and reality of the syllable, the mora and the rime in Japanese will be demonstrated, and the model shown in (6) will be refined.

2.2. Syllable-Invoked Cases

One of the typical examples in Japanese which make use of the syllable is the accent assignment rule for foreign origin words. In McCawley (1968), it is pointed out that the bearer of accent is the syllable, though the distance measured in locating that syllable is in terms of moras. Consider the following loan words' accent patterns (the accent is marked by an apostrophe immediately after the accented mora. The syllable boundary, which is consistent with the mora boundary, is marked by "-", and "." indicates the mora boundary which does not accord with the syllable boundary):

(7) a. do'-ra-ma 'drama'
re-ko'.R-do 'record'
gu-ri'.R.N 'green'
b. ri-ra'.Q-ku-su 'relax'
e-re-be'.R-ta.R 'elevator'
ka-re'.N-da.R 'calendar'

Only in terms of the mora, are we unable to capture the general accent pattern of borrowed words like those in (7); for while those in (7a) assign the accent to the antepenultimate mora, those in (7b) accent the fourth mora counting from the end and show a different accent pattern from (7a)'s. On the other hand, adopting a syllable-based account, we can get the correct rule, applicable to both (7a) and (7b): "place accent on the *syllable containing the antepenultimate mora*".

Another interesting case referring to syllables rather than moras can be found in the complex words' accent shift (facts from Tabata (1989)). In such complex nouns as place name plus the suffix *-si* /ʃi/ 'city' (I will adopt the "Kunrei system" of romanizing Japanese in example presentation, thus /ʃi/, for instance, is represented as not *shi* but *si*), the accent is generally shifted to the last mora of the base as illustrated in (8a). But this rule does not apply to the examples in (8b) which end with a non-syllabic (but moraic) segment.

(8) a. Kyo'Rto → KyoRto'-si
Sizu'oka → Sizuoka'-si
b. Muro'raN → Murora'N-si

Se'NdaJ → SeNda'J-si

Also in this case, recognizing the syllable as the accent-bearing unit, we can formulate a single rule that is applicable to both (8a) and (8b). That is, the accent is on the last *syllable* immediately before the suffix.

Let us next examine a non-accentual syllable-related phenomenon. The following paradigm shows a quantifier set formed with numerals and an auxiliary numeral *-hoN* (*-poN*, *-boN*) used for counting long and thin objects ("-" indicates the syllable boundary):

(9) i-ti 'one' + hoN → iQpoN
ni 'two' + hoN → nihoN
saN 'three' + hoN → saNboN
si 'four' + hoN → yoNhoN
go 'five' + hoN → gohoN
ro-ku 'six' + hoN → roQpoN
si-ti 'seven' + hoN → nanahoN
ha-ti 'eight' + hoN → haQpoN
kyuR 'nine' + hoN → kyuRhoN
zyuR 'ten' + hoN → zyuQ(ziQ)poN

Notice the euphonic change in *iQpoN*, *roQpoN* and *haQpoN*. From the viewpoint of the mora, the pair items *iti-iQ*, *roku-roQ* and *hati-haQ* are all two mora morphemes, and the reason for the change is left vague. In terms of the syllable, however, we are given an account for this change. In counting up quantities of objects successively, the economical utterance would be required. Efficiency can be achieved by reducing the number of *syllables*, i.e. disyllabic *iti*, for example, is reduced to monosyllabic *iQ*. Thus, the syllable seems to play a role as a measuring unit in this case.

2.3. Relating to the Mora

The fundamental Japanese system of writing is "kana", which children master first before mastering "kanji" (Chinese characters) or "Romaji" (Roman letters). The kana letters generally correspond to the mora, i.e., one kana letter is practically equivalent to one mora; except cases involving the palatal glide, /CyV/, which are represented by the sequence of two letters /Ci/ and /yV/, e.g., /kya/=/ki/+/ya/. Thus, being conscious of kana,

Japanese recognize *niNgeN* and *supuriNgu*, for example, as a four and five beat (or mora) word, respectively, though the former is a two letter word in Chinese characters and the latter is a monosyllabic word in English as illustrated below:[5]

(10) niNgeN: にんげん (kana, spec. "hiragana") 人間 (Chinese character)
supuriNgu: スプリング (kana, spec. "katakana") spring (English)

The kana letter recognition, i.e., the mora-counting measurement is made use of in artistic works such as "haiku". A definition of haiku given in *NKDZ* is approximately "a Japan-specific short poem which is completed in three lines containing 17 *letters* composed of 5, 7 and 5 *letters* in each line." Letters mean moras in this case. In *Webster III*, by contrast, haiku is defined as "an unrhymed Japanese poem of three lines containing 5, 7, and 5 *syllables* respectively." This definition is incorrect. Consider the following haiku examples composed by a famous haiku poet Issa Kobayashi:[6]

(11) a. SuQpoN mo toki ya tukuraN haru no tuki
tortoise also hour INT. may tell spring GEN. moon
'The turtle also may tell the hour,--This spring moon!'

b. Uguisu no kyoRdaJ zure ya onazi koe
bush warbler GEN. brother couple INTERROG. same voice
'The uguisu,--Are they brothers? The same voice!'

The underlined parts of these haiku must be of 5 units in (11a) and 7 units in (11b) respectively. Note that in mora-counting this requirement is met, but if we count the syllables, the lines in question would be of 3 and 5 units respectively. These examples prove that the mora provides a unit for meter.

Such mora-based rhythmic phenomena do not only exist in artistic works, but are also found in language usages such as commercial catch phrases; cf. Yoshiba (1981). Copywriters make use of five-mora and seven-mora phrases to write memorable advertisements--as we see from the examples in (12) below (the subscripts of brackets stand for the number of moras in the phrase bracketed; and corporation and brand names, underlined for the latter, are shown in parentheses):

(12) a. [itaku naQ tara]$_{7}$ [sugu sedesu]$_{5}$
painful feel if at once a brand
of medicine
'When you feel a pain, take Sedesu at once.'
(Shionogi Phar. Co. Sedesu)

b. [nizyuRyozikaN]$_{7}$ [tataka e masu ka]$_{7}$
24 hours struggle can HONORIFIC INTERROG.
'Can you struggle twenty-four hours?'
(Sankyoo Phar. Co. Regain)

c. [marumaru yaQ te]$_{7}$ [marumaru yasui]$_{7}$
all do and entirely cheap
'We will do all the things at very low charges.'
(Yamato Transportation Co. Hikkoshi Rakuraku Pakku)

d. [zeQseJ no]$_{5}$ [sedaN desu]$_{5}$
matchless GEN. sedan is
'This car is the matchless sedan.'
(Nissan Motor Inc. Presea)

In the commercial strategy, as well as verse cases, it is clear that the mora provides the unit for meter.

2.4. Evidence for the Rime

The rime of the syllable plays an important role in English poetry. Rhyming, which makes use of the repetition of the same sound and adds to an aesthetic feeling, though not indispensable, is found in most of modern English verse. And the existence of the unit "rime" is crucial and apparent especially in end rhyming. For example:

(13)
I saw a sower walking slow (R)
Across the earth, from east to west; (R)
His hair was white as mountain snow, (R)
His head drooped forward on his breast. (R)

-----J. R. Lowell: *The Sower.*

On the other hand, the unit of rime is not so apparent in a Japanese rhymed verse with a fixed form. This is because the majority of Japanese syllables are open short syllables--those without a consonant or the second element of complex vowels at the end. Therefore, rhyming, in many cases, is done by using the same-in-whole syllable and embodied in the same letter. As an example, take the sonnet of S. Katoh's "ImoRto-ni (to my sister) II," as exemplified in the first four lines:

(14) ごらん　月は　　夢を　　描く
GoraN　tuki-wa　yume-o　egaku
look　moonTOPIC　dreamACC.draw
'Look! The moon depicts dreams

青い　空の　夜の　なかに
Aoi　sora-no　yoru-no　nakani
blue　skyGEN.　nightGEN.into
in the blue-sky night,

春の　花の　眠る　ときに
Haru-no　hana-no　nemuru　tokini
springGEN.flowerNOM.　sleep　when
when spring flowers sleep,

大きな　暈を　いつも　明るく
ORkina　kuma-o　itumo　akaruku
big　shadeACC.always　brightly
lighting the big dark of it.'

The sameness of the rime, however, is utilized obviously in some language-game-like poems as in (15):

(15) KonoheN donoheN　HyakumaNbeN
here　where　a temple's name
'where is here?　HyakumaNbeN is.

tatisyoNbeN-wa akimaheN
urinating outdoors Topic don't
Don't urinate outdoors.'

KonoheN donoheN MyuNheN
here where München
'Where is here? München is.
peNpeNgusa mo haema heN
shepherd's-purse even sprout not
Even sheperd's-purse does not come up.'

Kono heN nani heN heNna heN
this radical what radical strange radical
'What is this strange radical (of Chinese characters)?
teNde yome heN wakara heN
not at all read not know not
I cannot read it at all. I do not know it.'

-----S. Tanikawa: "KonoheN"

In this poem, the author does not make much of the meaning of phrases itself, but think much of the same sounding of *heN*, *beN* and *peN*. Notice that though the onset segments of these syllables are different, the rimes of these syllables are common: R.
eN

As a second example suggesting the existence of the rime in Japanese, it is possible to refer to the names of a former pair of giant pandas in Ueno Zoo: *KaNkaN* and *RaNraN*, which are represented in kana-writing as カンカン, ランラン respectively (【康康】 kāng kāng, and 【蘭蘭】 lán lán, respectively in the original Chinese name). One might argue that the rhyming of these names is due to only the commonness of "ン"(=N). If so, Japanese should feel the same rhyming in such name pairs as *KaNkaN-ReNreN*, *KoNkoN-RaNraN* or *KaNkaN-RiNriN*. However, in these pairs rhyming effect is much less as compared with *KaNkaN-RaNraN*. Therefore, it can be inferred that Japanese grasp the rime /aN/ as the rhyming unit unconsciously.

As a third example for the rime, consider a commercial catch phrase of

an antiphlogistic anodyne:

(16) KiNkiN KiNniku BiNbiN BiNdas
muscle a brand name of liniment
'For muscular pain, take BiNdas Lotion.'
(Hisamitsu Phar. Co. Bindas Lotion)

In this catch phrase, the commonness of the rime *-iN*, not only that of the coda *-N*, of *kiN* and *biN* plays an important role to make consumers memorize the liniment's name.

Finally, consider more decisive examples for the rime taken from speech error data:[7]

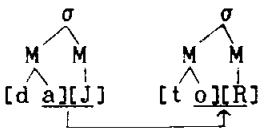
(17) a. daJtoRryoR → daJtaJryoR
'president'

b. yoNtoR-no koQkaJ taJsaku → yoNtaJ-no koQkaJ taJsaku
'four parties' measures in the Diet'

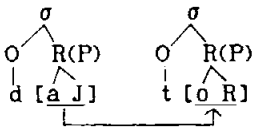
c. kaNkyoo oseN → kaNkeN oseN
'environmental pollution'

According to Kubozono's proposal for the syllable-mora template cited in (4), we must assume the switching of elements which do not form a constituent as in (18a); on the other hand, if we postulate the rime node and/or the peak node, we can give a natural account for the substitution of segments shown above as in (18b), for the segments in question form a constituent:

(18) a.



b.



I therefore recognize the notion of rime as a Japanese syllable constituent in contrast with Kubozono (1989) who suggests that the rime is not a constituent of the syllable in Japanese.

2.5. More on Non-Syllabic Moras

In the previous discussion, I have treated /N/, /Q/, /R/ and /J/ as one class of segments, viz. non-syllabic moras. Kunihiro (1967), for example,

regards these segments as the same group segments, and calls them "mora phonemes". They indeed have some things in common: they do not make a syllable independently, and cannot occur in the beginning of a word or syllable. However, close examination will demonstrate that /N/, /Q/ should be in a separate slot from that of /R/, /J/.

It is frequently stated that the Japanese syllable is relatively simple and its rime contains only two positions, so that superheavy syllables consisting of a long vowel or a diphthong followed by a consonant, or a short vowel followed by two consonants are excluded. While such superheavy syllables are marked in Japanese, they do exist (e.g. guriRN in (7a)).[8]

Superheavy syllables consisting of a long vowel or a diphthong followed by a geminate obstruent /Q/ arise when the suffix *-ko* (roughly meaning 'person') attaches to a word ending in a heavy syllable:[9]

(19) toRkyoRQko 'Tokyoite' < toRkyoR + ko
taJsyoRQko 'a man of the Taishoo era' < taJsyoR + ko
geNdaJQko 'a child of today' < geNdaJ + ko

These examples show that /R/ and /J/ can co-occur with /Q/ within one syllable. Note, however, that /Q/ can hardly occur after /N/, unlike /R/ and /J/, within a syllable as the following examples show:

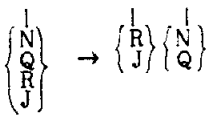
(20) a. roNdoNko 'Londoner'
?roNdoNQko
b. obaRsaNko 'a child brought up by a grandmother'
??obaRsaNQko
obaRtyaNko
*obaRtyaNQko

The examples in (19) and (20) suggest that the slot of /R/ and /J/ is separate from that of /Q/, therefore they can co-occur, but /N/ and /Q/ are in the same slot and make the alternative choices, so cannot coexist.[10]

Further, /R/ shows a characteristic different from that of /Q/ and /N/. As I have already shown in table (9), *-hoN* is usually changed to *-poN* after a moraic obstruent /Q/, and *-boN* after a moraic nasal /N/, respectively: *iQpoN*, **iQhoN*, *saNboN*, **saNhoN*; whereas, /R/ does not cause such a change,

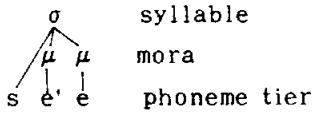
e.g., *kyuRhoN*, **kyuRboN*, **kyuRpoN*.[11]

By these observations, we conclude that four non-syllabic mora segments should be divided into two separate slots as shown in (21):

(21) 

2.6. Against Pierrehumbert and Beckman (1988)

Before concluding our discussion, let us examine another recent proposal for the prosodic tree. In the prosodic structure representation for Japanese, Pierrehumbert and Beckman (1988), following McCarthy and Prince (forthcoming), assume that onset consonants are linked only to syllable nodes, and only the vowels in the phoneme tier are linked to moras as represented in (22) below:

(22) 

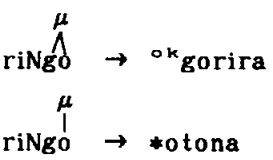
This assumption probably originates in an influential article by Prince (1983), in which the following statement is made:[12]

> (23) Assuming that long vowels are sequences,
> a. The first vowel of a syllable is a mora;
> b. The segment immediately following the first vowel, if it is in the same syllable as that vowel, may be a mora, subject to language-specific constraints. (p. 52)

The prosodic tree shown in (22), however, is incompatible with evidence drawn from the Japanese traditional word game called "shiritori" 'hip-taking'. This game is so named because players in turn give a word that starts with the last sound unit of the word given by a previous player (In Japanese, "shiri" figuratively means 'the end' or 'the last'). The game is carried on, e.g., *neko* 'cat' — *kotori* 'little bird' — *riNgo* 'apple' — *gorira* 'gorilla', etc. If a player gives *gohaN* 'rice', for instance, instead of *gorira*, then the player loses and the game is over because no word begins with /N/ in Japanese, so the next player cannot continue to give a word. This indicates that the game is not a syllable-based game, but is, rather, mora-based. If it were syllable-based, then *haNsya* 'reflection', e.g., would

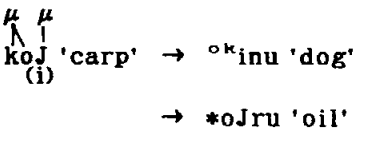
be possible after *gohaN*. Moreover, *otona* 'adult', for example, cannot follow *riNgo* instead of *gorira*. Accordingly, it is evident that both the onset consonant and the peak (or rime) vowel participate in mora-assessing as illustrated in (24) below.[13]

(24)



Incidentally, as the following examples show, long vowels or diphthongs are treated as separate units in shiritori:

(25)

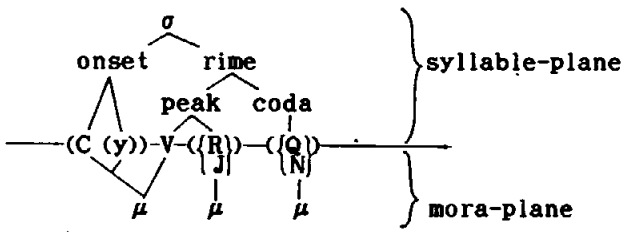


3. Concluding Remarks and Further Clarification

3.1. Summation

To summarize, I have argued that the rime constituent should be recognized as a syllable-internal unit also in Japanese (sec. 2.4.), that superheavy syllables corresponding to three moras can be found in Japanese (sec. 2.5.), and the consonants in the onset should also be linked to the mora node (sec. 2.6.). Further, the syllable and the mora play important roles independently of each other, and thus the mora should not be regarded as only a subconstituent of the syllable (sec. 2.2.-2.3.). In order to fulfill these requirements, I propose the following three-dimensional structural representation:[14]

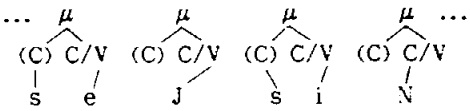
(26)



Notice that I do not claim that in the representation of (26) there exist

moras which are associated only with { /R/, /J/ } or { /Q/, /N/ } . I assume that the mora has its own template as the syllable does. The association between moras and *seJsiN* 'spirit' in the segmental tier, for example, can be illustrated roughly as in (27) through the skeletal tier (CV-tier) serving as the anchor points for elements on the other tiers:

(27)



3.2. Further Evidence

It is well known that Japanese verse is read as if each line contained four bimoraic unit, and "tanka" poems, for example, that contain 5-7-5-7-7 moras in each line are read by the insertion of pause or prolongation of vowels like (2, 2, 2, 2)-(2, 2, 2, 2)-(2, 2, 2, 2)-(2, 2, 2, 2)-(2, 2, 2, 2) beats. This rhythmic pattern which consists of two beats plays an important role in cases other than versification. Bekku (1977) points out that such words as *tebukuro* 'gloves' (*te* 'hand', *fukuro* 'case'), *hanarabi* 'set of teeth' (*ha* 'teeth', *narabi* 'row') should be divided into *te-bukuro*, *ha-narabi* in terms of their meanings. However, their actual pronunciations are *tebu-kuro*, *hana-rabi*. That is, two moras function as a unit. Poser (1990) calls this unit the "foot".

In the discussion of phonological constituents such as feet, we must fix the two main parameters of them, i.e. their domain and the direction in which they are erected. In the case of foot, we have already stated that its size is two moras. The directionality of foot construction is more problematic. In order to set the direction, let us next consider examples of a secret language. As far as I notice, there are three types of the secret language which is formed by changing the order of moras:

(28) a. tuNpa ← paNtu 'pants'
b. batako ← tabako 'tobacco'
c. derumo ← moderu 'model'

The example in (28a) is formed by arranging moras reversely. In (28b), the intermediate mora is moved to the front. In (28c), the example is divided into two parts and then the two parts are interchanged in the order.

Though, as shown in (28), there are some variations of the mora-order changing secret language, the most general pattern is that of (28c). The following list of secret language includes all the examples found in Umegaki (1956) which are three or more mora loan words written in katakana (brackets and arrows show the process of forming secret words)[15]

(29) keQtoma ← [maR][keQto] 'market'

saadaN ← [daN][saR] 'dancer'

syatuwaJ ← [waJ][syatu] 'shirt'

sugara ← [gara][su] 'glass'

tuNpa ← paNtu 'pants'

teepaa ← [paR][tiR] 'party'

dorobii ← [biR][doro] 'vidro = glass'

bakota ← [ta][bako] 'tobacco'

batako ← tabako

baNzi ← [zi][baN] 'gibão = underwear for use with kimono'

hiiko ← [koR][hiR] 'coffee'

birose ← [se][biro] 'business suit'

boNzu ← [zu][boN] 'trousers'

yaJta ← taJyaR 'tire'

rubii ← [biR][ru] 'beer'

The evidence seems to favor right-to-left foot construction.[16] Note especially trimoraic [ta][bako] → *bakota* and [se][biro] → *birose* in which feet are constructed from right to left, and the penultimate foot consists of the first mora alone.

If the assumption that the Japanese foot is bimoraic and its construction is made from right to left is on the right track, we can give a good account for the accentuation of noun-noun compounds, as Poser (1990) discusses

astutely. As the accentuation rules for compounds with long (meaning three or more moras) second member, Poser (1990: 99) states:

(30) a. Mark the final foot of the second member as invisible;
b. If the visible portion of the second member is unaccented, assign an accent to its initial syllable;
c. Otherwise, leave the existing accent in place.

With these rules, the accentual patterns of the following compounds can be explained (< > stands for invisibility):

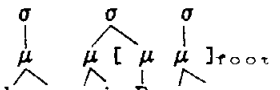
(31) yume' + monoga'<tari> → yumemonoga'tari 'dream story'
ni' + ku<ruma> → nigu'ruma 'cart'
isi' + a<tama'> → isia'tama 'hard head'
sato + ko<ko'ro> → satogo'koro 'homesickness'
suki'N + kuri'<Rmu> → sukiNkuri'Rmu 'skin cream'
ha'NgaR + sutora'<Jki> → haNgaRsutora'Jki 'hunger strike'

Such examples as skiNkuriRmu, haNgaRsutoraJki are crucial supporting evidence for the proposal of biplanar representation in (26) and counter-evidence for the representation in (4). Poser (1990) contains a clear statement of the gist:

> ...the fact that the Japanese foot consists of morae rather than syllables points to the independence of the mora as a phonological constituent. It also poses a problem for advocates of the position that morae are subconstituents of syllables, since the boundaries of feet, composed of morae, need not coincide with syllable boundaries. (p.103)

The point of this statement is represented schematically as in (32).

(32) a.



b.

Notice that in (32a) the foot is constructed interrupting the syllable constituency. On the other hand, in (32b), natural prosodic construction is realized.

4. Residual Issue

To close, let us take up a hypothesis on phonological representation

which is an apparent counter-hypothesis to our conclusion, but rather strengthens our claim from a different standpoint.

Hayes (1989), with Selkirk (1984, 1986), stipulates the following conditions on prosodic structure:

(33) STRICT LAYER HYPOTHESIS. The categories of the Prosodic Hierarchy may be ranked in a sequence C_1, C_2,...C_n, such that
   a. all segmental material is directly dominated by the category C_n, and
   b. for all categories C_i, $i \neq n$, C_i directly dominates all and only constituents of the category C_{i+1}.

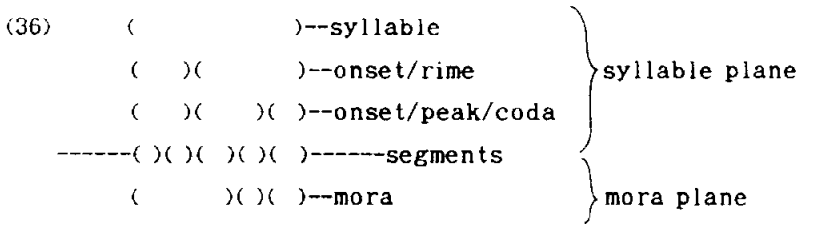
Diagrammatically, the conditions allow such hierarchical arrangements of prosodic categories as in (34a), but rule out those like (34b):

(34) a.
```
(                )—C1
(        )(      )—C2
(    )(  )(      )—C3
( )( )(  )( )(   )—C4
```
b.
```
(                )—C1
(       )(       )—C2
(    )(          )—C3
( )( )(  )(  )(  )—C4
```

Notice here that if we take the mora in Japanese to be a unit intermediate between the syllable and segments, we will get the following arrangement ill-formed in the light of conditions (33):[17]

(35)
```
(            )—syllable
(   )(       )—onset/rime
(      )( )( )—mora
(   )(    )( )—onset/peak/coda
( )( )( )( )( )—segments
```

This, however, results from assuming that the mora is in the same plane as that of the syllable. If we posit, as shown in (26) and repeated in (36) for convenience in the parenthesis-used form, that the mora forms a plane independent of the plane in which syllable constituents are found, moreover, if we assume that the conditions in (33) are applied to the constituents which are in the same plane, the conditions of (33) will be observed:



The conditions in (33) are not a counter-hypothesis at all to our claim and rather support the proposal that the mora and the syllable should be in separate planes.

NOTES

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[1] Examining the error corpus in Fromkin (1973), Fudge (1987) concludes that cases supporting the onset-peak split outnumber those supporting the peak-coda split by about four to one.

[2] /R/, /J/ represent the second element of long vowels and diphthongal vowel sequences respectively. And /N/, /Q/ represent the moraic nasal and the moraic obstruent, respectively, both of which are homorganic with the following consonants.

[3] Kubozono (1985, 1989) does not clarify the motive for introducing the mora as a subconstituent of the syllable instead of the onset, the rime, etc. His claim is that speech error data in Japanese hint at cohesiveness between

the onset and the peak rather than between the peak and the coda. Then, he should introduce such a term as "body" which assigns each syllable the union of its onset and peak (see Vennemann (1988)).

Moreover, I am skeptical about such simple correspondence between the syllable weight and the mora count as light = monomoraic, heavy = bimoraic, superheavy = trimoraic. If such interchangeability is always valid, the distinction between mora-counting languages and syllable-counting languages is meaningless. In my experience, however, foreign students in Japan whose mother tongues are syllable-counting, before mastering Japanese rhythmic properties, utter *kiQte-o kaQta* 'bought a stamp', for instance, like *kite-o kata*. This hints that the syllable count and the mora count are different in nature and that the mora is in a different plane from that of the syllable and invisible in syllable counting. Also for this reason, I cannot admit the position that moras are subconstituents of syllables.

[4] A similar idea is developed in Lawrence (1989). See also Tanaka (1989) for another extensive discussion supporting the postulation of the biplanar representation.

[5] Even in the preliterate stage, children may recognize the mora. My own son, at the age of 47 months when he did not yet read kana, reacted to my question (practiced in the bathroom by beating the water in the bathtub) as follows (F=father, S=son):

F: Your father's name *Sa/to/si* is three beats. Is it right? Then, what about your name?

S: *Si/N/ri*. (he hit the water three times)

F: Then, what about *kareR* 'curry'?

S: *ka/re/e*.

F: Then, what about *kaQpa* 'Japanese mischievous river-sprite'?

S: *Ka/a/pa*.

The examples used in this question are two-syllable words involving non-syllabic mora /N/, /R/ and /Q/. Notice that my son's response is mora-based.

[6] English translations are from Blyth (1981).

[7] For the rime-changing speech errors such as those in (17), see Tabusa (1982: 154-71). Speech errors of this type are rather often found, and so

cannot be disregarded as exceptions.

[8] Poser (1984) presents as an example of superheavy syllables such inflected words as *haiQta* (< *hair* 'enter' + *-ta* 'PAST'). This argument, however, is not appropriate. In the discussion of syllable structure, we must exclude inflected forms; for inflection is a process of syntax, and the syllable template of a language is determined before syntactic process, I suppose. If we make the English syllable template, for instance, on the basis of such inflected words as *texts*, *sixths*, we must make an absurd assumption that the coda of English syllable is quadripartite. The English coda is generally recognized to be binary, or ternary at most.

[9] Shin-ichi Tanaka (p. c.) points out that if *-kyoRQ-* of *toRkyoRQko*, for example, is a superheavy syllable, the accent should be assigned to its head, i.e. *toRkyo'RQko*; but, in fact, the accent contour is *toRkyoR'Qko*. Therefore, he suggests that *-kyoRQ-* should be divided into *-kyo-* and *-oQ-*. In the light of accent, Tanaka's suggestion may be on the right track. But, in my intuition, the underlined syllables of the examples in (19) contain one long vowel or one diphthong, and not two separate vowels. Hence, I keep assuming that the strings in question are superheavy syllables.

[10] Yukiko Kazumi and Masao Okazaki (p. c.) inform me that in their speech /Q/ can occur after /N/, that is, *roNdoNQko*, for instance, is rather natural. More interestingly, in that case, they assign the accent on the second /N/, i.e. *roNdoN'Qko*; while, they accept *roNdoNko* in unaccented pronunciation. In such cases, the troublesome problems of regional and personal dialectal varieties and of the relation between accentuation and syllable structure are involved. As far as I surveyed, however, the judgment of the majority of informants checked with mine. In passing, Shibata (1980) also remarks that /R/ and /J/ are in a separate position of the syllable from that of /N/ and /Q/ in the Tokyo dialect.

[11] The same as *-hoN* is true of such auxiliary numerals beginning with /h/ as *-hiki*, *-haJ*, *-heN*: *iQpiki*, *saNbiki*, *kyuRhiki*; *iQpaJ*, *saNbaJ*, *kyuRhaJ*; *iQpeN*, *saNbeN*, *kyuRheN*. Cf. Ohta (1990).

[12] More precisely, Prince (1980: 526) has already written: In short, "mora" means 'immediate constituent of the rime'.

[13] See Katada (1990) who follows Hyman's (1985) proposal, and Tanaka (1990) for the same position on this point. In particular, Tanaka (1990)

illuminatingly demonstrates that the assumption that onsets consonants are linked only to syllable nodes conflicts with the Strict Layer Hypothesis (see (33)).

[14] /R/ and /J/ may be considered to be vocalic; hence they are put in the second slot of peak and not in the slot of coda.

[15] In the case of *yubiwa* (指輪) 'finger ring', for example, which can be written in Chinese characters, by the influence of letters or morpheme boundaries, we tend to divide the word into *yubi* (指) 'finger' and *wa* (輪) 'ring'. Thus, so as to exclude such non-phonological factors, I present only words written in katakana.

[16] Notice that *keQtoma* and *rubii* cannot be used as supporting evidence for left-to-right foot construction. Since /Q/ and /R/ cannot occur in the beginning of a syllable, such foot construction and secret language formation as [ma][Rke][Qto] → [Qto][ma][Rke], [bi][Rru] → [Rru][bi] are impossible from the outset.

[17] I assume here that the conditions (33) also govern the arrangement of the internal constituents of the syllable. In fact, I posit that there exist two layered levels in a syllable qualified as levels in the prosodic hierarchy; one comprising the onset, the peak and the coda, and the other, which is a higher level, comprising the onset and the rime.

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