# 2 Mora and Syllable

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## 0 Introduction

In his classical typological study Trubetzkoy (1969) proposed that natural languages fall into two groups, "mora languages" and "syllable languages," according to the smallest prosodic unit that is used productively in that language. Tokyo Japanese is classified as a "mora" language whereas Modern English is supposed to be a "syllable" language. The mora is generally defined as a unit of duration in Japanese (Bloch 1950), where it is used to measure the length of words and utterances. The three words in (1), for example, are felt by native speakers of Tokyo Japanese as having the same length despite the different number of syllables involved. In (1) and the rest of this chapter, mora boundaries are marked by hyphens /-/, whereas syllable boundaries are marked by dots /./. All syllable boundaries are mora boundaries, too, although not vice versa.[1]

(1) a. to-o-kyo-o "Tokyo"
too.kyoo
b. a-ma-zo-n "Amazon"
a.ma.zon
c. a-me-ri-ka "America"
a.me.ri.ka

The notion of "mora" as defined in (1) is equivalent to what Pike (1947) called a "phonemic syllable," whereas "syllable" in (1) corresponds to what he referred to as a "phonetic syllable." Pike's choice of terminology as well as Trubetzkoy's classification may be taken as implying that only the mora is relevant in Japanese phonology and morphology. Indeed, the majority of the literature emphasizes the importance of the mora while essentially downplaying the syllable (e.g. Sugito 1989, Poser 1990, Tsujimura 1996b). This symbolizes the importance of the mora in Japanese, but it remains an open question whether the syllable is in fact irrelevant in Japanese and, if not, what role this second unit actually plays in the language. Moreover, it remains an important question

which aspects of the mora phenomena in Japanese are language-specific and which are universal.

With these fundamental questions in mind, this chapter attempts to examine the role of the mora and the syllable in Japanese from a cross-linguistic perspective. It is laid out as follows. The next section (section 1) describes various roles played by the mora in Japanese phonetics, phonology, and morphology. This includes the roles played by "bimoraic foot," which presupposes the existence of the mora. Section 2 examines the role which the syllable plays in Japanese and demonstrates that this second prosodic unit, too, is indispensable for generalizing a wide range of phenomena from word accent and loanword phonology to morphological patterning. The final section (section 3) summarizes the main discussion of this chapter as well as some interesting questions that must be addressed in the future. In what follows, the term "Japanese" refers to Tokyo Japanese unless otherwise specified.

# 1 Relevance of Mora

The mora in Japanese can be defined in four ways according to its roles: (i) as a basic unit of temporal regulation, (ii) as a unit by which phonological distance is defined, (iii) as a segmentation unit whereby words/speech are broken into discrete chunks in speech production, and (iv) as a segmentation unit used in speech perception. All these roles, with the possible exception of the second one, seem to be specific to Japanese as a mora language.

## *1.1 Temporal regulation*

The crucial reason which compels linguists to posit the mora and not the syllable as a basic prosodic unit in Japanese is that several elements serve as an independent unit although they do not form a syllable on their own. These elements fall into four kinds: (a) a moraic nasal, which occupies the coda position of the syllable; (b) a moraic obstruent, or the first half of a geminate consonant; (c) the second half of long vowels; and (d) the second half of diphthongal vowel sequences. These are exemplified in (2a–d), respectively.

| | | | | | |
|---|---|---|---|---|---|
| (2) | a. | ro-*n*.do-*n* | "London" | a.ma.zo-*n* | "Amazon" |
| | b. | ki-*t*.te | "stamp" | ni-*p*.po-n | "Japan" |
| | c. | kyo-*o*.to | "Kyoto" | to-*o*.kyo-*o* | "Tokyo" |
| | d. | ge-n.da-*i* | "modern times" | ra-*i*.to | "right, light" |

These elements, generally known as "special moras," "moraic phonemes," or "non-syllabic moras," serve as an independent timing unit just as CV moras that constitute a syllable by themselves. Let us first consider traditional verse

forms such as *haiku* and *tanka*, which are characterized by the number of moras contained in each phrase. *Haiku* is made up of a sequence of three phrases in which a seven-mora phrase is flanked by five-mora phrases, i.e. 5–7–5. *Tanka* is a slightly extended version with two seven-mora phrases added to the basic form of *haiku*, i.e. 5–7–5–7–7. In the *haiku* in (3a), for example, the final phrase consists of three units by syllable count but five units by mora count. Likewise, the poem in (3b) involves a trimoraic personal name, *Issa*, which forms a standard seven-mora phrase together with the preceding word *makeruna*; this uniformity would not result if the phonological form of the poem should be defined in terms of the syllable.

(3) a. ka.ki.ku.e.ba ka.ne.ga.na.ru.na.ri ho-o.ryu-u.zi
"I heard the bell of Horyuji Temple toll as I ate a persimmon"
b. ya.se.ga.e.ru ma.ke.ru.na.i-s.sa ko.re.ni.a.ri
"Never give up, thin frog; Issa is here with you"

The mora's role as a timing unit also shows itself in the text–tune relationship in music (Vance 1987). In traditional Japanese songs, mora and note usually have a one-to-one correspondence, with every mora assigned to an independent note and vice versa. In (4), for example, the second moras of the bimoraic syllables, ma*i* and tya*n*, are counted as an independent timing unit.

(4) Inuno Omawarisan "Policeman, the Dog"

ma-i.go.no ma-i.go.no ko.ne.ko.tya-n
"lost, lost little kitten"

More general evidence for the mora as a timing unit comes from the literature on speech rhythm. Japanese is generally characterized as a language with a mora-timed rhythm, where each mora is supposed to take an equal duration of time. Thus four-mora words are said to be twice as long as bimoraic words, whereas nine-mora phrases are three times as long as trimoraic phrases (Homma 1981, Port et al. 1987, Han 1994; see M. E. Beckman 1982 for a critical view, and Nagano-Madsen 1992 and Han 1994 for a review of the literature). This is in accordance with native speakers' intuition on the length of words, which says that four-mora words such as those in (1) take roughly the same duration of time irrespective of the differences they might involve in syllable structure. The isochronous nature of the mora in Japanese can probably be demonstrated in spontaneous connected speech too, in a physical sense as well as in a psychological sense (Sugito 1989).

The mora's role as a timing unit also shows itself in temporal compensation *within* the syllable. Many languages, including English, exhibit a temporal compensation effect between the nuclear vowel and the coda consonant. For example, other things being equal, vowels are phonetically shorter in closed syllables than in open syllables, which is a phenomenon known as "closed syllable

vowel shortening" (Maddieson 1985). Similarly, vowels tend to be phonetically shorter when they precede an intrinsically long consonant, e.g. a voiceless stop, than when preceding an intrinsically short consonant, e.g. a voiced stop (see Port 1981, and other references cited in Maddieson 1985). These durational variations are suggestive of a tight relationship between the syllable nucleus and the coda consonant(s) whose combined durations are to be kept constant. Temporal compensation of this kind is attested in a wide range of languages, but not in Japanese. In Japanese, vowel duration is independent of the difference in syllable structure, i.e. closed syllables vs. open syllables (Han 1962, Homma 1981). Moreover, there is experimental evidence suggestive of a temporal compensation between the onset and the nuclear vowel (Han 1962, Campbell and Sagisaka 1991). These exceptional temporal patterns shown by Japanese can be properly accounted for if the mora is posited as a unit of temporal organization in the language. Namely, closed syllables (CVC) are bimoraic and, hence, take twice as much time as open syllables (CV), which are monomoraic. Moreover, temporal compensation occurs within the domain of the mora rather than within the syllable.[2]

## *1.2 Phonological length*

A second function of the mora in Japanese concerns the phonological length of words and phrases to which phonological and morphological rules refer. Just as poets and composers measure the length of words and phrases by counting the number of moras, various linguistic processes count the number of moras to measure phonological distance.

### *1.2.1 Accent and mora*

A typical case measuring phonological distance in moras is found in the rules of accentuation. The loanword accent rule, for example, places the accent on the antepenultimate mora, or the third mora counted from the end of the word. Thus, the pitch drops suddenly immediately after the antepenultimate mora in a majority of loanwords including those in (5); the accent is marked by the diacritic ('), placed immediately after the accented mora.

| | | | | | |
|---|---|---|---|---|---|
| (5) | a. | bi'.ru.ma | "Burma" | o-o.su.to'.ri.a | "Austria" |
| | | o-o.su.to.ra'.ri.a | "Australia" | | |
| | b. | de-n.ma'-a.ku | "Denmark" | a-i.ru.ra'-n.do | "Ireland" |
| | | re.ba'.no-n | "Lebanon" | | |

The mora plays a similar role in compound accentuation. Compound nouns in Japanese generally form one accentual unit, or prosodic word, by deaccenting their first member (N1), if it is lexically accented at all, and reassigning a compound accent (CA) in or immediately before the second member (N2).[3] A classical account (Hirayama 1960, J. D. McCawley 1968b) divides noun–noun

compounds into two groups according to the unmarked location of the CA, (i) those accented on the final position of N1 and (ii) those accented on the initial position of N2. These two patterns can be predicted by the mora length of N2 in such a way that monomoraic and bimoraic N2s yield the first pattern, whereas three-mora and four-mora N2s yield the second. They are illustrated in (6), where /=/ denotes a compound-internal word boundary.

| | | | | |
|---|---|---|---|---|
| (6) | a. | kyo'oto + si' | → kyooto' = si | "Kyoto City" |
| | | ka'buto + musi | → kabuto' = musi | "helmet, bug; beetle" |
| | b. | so'romon + o'ozi | → soromon = o'ozi | "Solomon, prince; Prince Solomon" |
| | | minami + amerika | → minami = a'merika | "south, America; South America" |

Kubozono and Mester (1995) and Kubozono et al. (1997) have developed this traditional analysis one step further to point out that a new CA pattern emerges if N2 is longer than four moras. Specifically, compound nouns with an N2 of five or six moras generally keep the accentuation, i.e. accentedness and accent location, of N2 while deaccenting N1. This results in unaccented compounds when N2 is originally unaccented, as shown in (7a), or, otherwise, in compounds accented on N2, as in (7b).

| | | | | |
|---|---|---|---|---|
| (7) | a. | nyu'u + karedonia | → nyuu = karedonia | "New Caledonia" |
| | | minami + kariforunia | → minami = kariforunia | "south California" |
| | | nankyoku + tankentai | → nankyoku = tankentai | "South Pole expedition team" |
| | b. | iso'ppu + monoga'tari | → isoppu = monoga'tari | "The Fable of Aesop" |
| | | tiho'o + saibansyo' | → tihoo = saibansyo' | "district, law court; district court" |

The mora's role as a basic unit of phonological measurement is probably not language-specific. Recent phonological work shows that word accent/stress rules in English and many other languages can be generalized with the mora as a basic unit of description (e.g. Hayes 1995). For example, accentuation in Latin and the accentuation of nouns in English place an accent/stress on the penultimate syllable if it is bimoraic, or otherwise on the antepenultimate syllable. In these and other accentuation rules, the mora plays a crucial role as a unit by which the length of the syllable is defined. This function of the mora naturally leads to that of "syllable weight," in which the notion of mora is integrated with that of syllable. This will be discussed in section 2.3.

### *1.2.2 Compensatory lengthening*

Another interesting phonological process for which the mora is indispensable is that of compensatory lengthening. In Tokyo Japanese, diphthongs are frequently monophthongized, especially in colloquial, casual speech. However,

this change in vowel quality is usually accompanied by vowel lengthening, which results in an alternation between a diphthong and a long vowel as shown in (8).[4]

(8) a. daikon ~ deekon "radish"
b. hai ~ hee "Yes, I got it"
c. ikanai ~ ikanee "(I) won't go"
d. omae ~ omee "you!"
e. sugoi ~ sugee "wonderful"

In (8a), for example, the diphthongal vowel sequence of the first syllable /dai/ is amalgamated into a monophthong but retains the bimoraic length of the entire syllable by lengthening the nuclear vowel. In other words, vowel lengthening compensates for a segmental loss which would otherwise result in the reduction of a mora. Compensatory lengthening of this kind is not a phenomenon specific to Japanese. Many quantity-sensitive languages, i.e. languages with a contrast in vowel and/or consonant length, exhibit a similar phenomenon (Hayes 1989).

Interestingly, compensatory lengthening does not occur in syllable-based dialects of Japanese. For example, in the Kagoshima Dialect spoken in the south of Japan, vowel monophthongization is not accompanied by vowel lengthening, as shown in (9a–f); moreover, there are instances where long vowels are simply shortened, as in (9f–h). These processes create an alternation between a long/diphthongal vowel in careful speech and a short monophthongal vowel in casual speech.

(9) a. dai.kon ~ de.kon "radish"
b. hai ~ he "ash"
c. hae ~ he "a fly"
d. tai.gai ~ te.ge "approximately"
e. ti.gau ~ ti.go "wrong, not true"
f. kyoo.dai ~ kyo.de "brother"
g. see.bo ~ se.bo "end-of-the-year present"
h. zii.san ~ zi.san "grandfather, elderly man"

A similar situation is found in Classical Japanese, whose system is believed to have had no contrast in vowel length and have been syllable-based rather than mora-based.[5] In this system, monophthongization of diphthongal vowel sequences as in (10a) as well as vowel deletion as in (10b–c) was not accompanied by vowel lengthening (K. Kindaichi 1976).

(10) a. na.ga + i.ki → na.ge.ki, *na.gee.ki "long, breath; lament"
b. na.ga + a.me → na.ga.me, *na.gaa.me "long, rain; long spell of rainy weather"
c. a.ra + i.so → a.ri.so, *a.rii.so "wilderness, coast; a reefy coast"

### *1.2.3 Word formation and mora*

It is not just accentuation and other phonological rules that require reference to the mora in measuring phonological distance or the length of words. Some morphological rules, too, exert an effect that can only be generalized by the mora. A typical example of this is the blending rule which, as exemplified in (11), produces new words by combining the initial portion of one word with the final portion of another (Kubozono 1990).

| | | | | | |
|---|---|---|---|---|---|
| (11) | a. | go.(ri.ra) | / (ku).zi.ra | → go.zi.ra | |
| | | "gorilla" | "whale" | "godzilla, an imaginary monster" | |
| | b. | kya.be.(tu) | / (ni-n).zi-n | → kya.be.zi-n | |
| | | "cabbage" | "carrot" | (name of a medicine) | |
| | c. | ba-i.(ba-i) | / (sa.yo).na.ra | → ba-i.na.ra | |
| | | "bye-bye" | "good-bye" | "good-bye (colloquial)" | |
| | d. | ba.to.(mi-n.to-n) | / (pi-n).po-n | → ba.to.po-n | |
| | | "badminton" | "ping-pong" | (name of a toy) | |

One important principle underlying this word formation process is that the resultant word has the same phonological length as the right-hand source word, i.e. the source word that leaves its final portion. While this length relationship appears to be universal (Kubozono 1990), it can be defined by the mora in Japanese: the blend word consists of the same number of moras as the right-hand source word. Thus, *gozira* in (11a) is a trimoraic word just like *kuzira*, whereas *kyabezin*, *bainara*, and *batopon* in (11b–d) are four moras long as are *ninzin*, *sayonara*, and *pinpon*. This length relationship cannot be captured by measuring the phonological length of words in terms of the syllable. Thus the trisyllabic blend forms in (11c–d), i.e. *bainara* and *batopon*, have the same syllable length as neither of the source words.

Not surprisingly, this mora-based length rule applies as well to blend errors that are produced in spontaneous speech (Kubozono 1989). This is illustrated in (12).

| | | | | | |
|---|---|---|---|---|---|
| (12) | a. | to.ma.(re) "stop!" | / (su.to)-p.pu "stop" | → | to.ma-p.pu |
| | b. | hi-(i.ta-a) "heater" | / (su).to-o.bu "stove" | → | hi.to-o.bu |

The notion of mora is indispensable for accounting for the regularity underlying other morphological processes as well. This will be discussed in more detail in sections 1.5 and 2.

## *1.3 Segmentation unit*

The mora also enables us to account for the segmentation pattern observed in Japanese. Consider the spontaneous speech errors in (13)–(14) (Kubozono 1985, 1996a).

(13) Metathesis errors

| | | | |
|---|---|---|---|
| a. | a.ra.*bu.zi*-n | → a.ra.zi.bu-n | "Arabic" |
| b. | *ke.tya*-p.pu | → tya.ke-p.pu | "ketchup" |
| c. | *te*-k.ki-n. *ko*-n.ku.ri-i.to | → ko-k.ki-n te-n.ku.ri-i.to | "ferroconcrete" |
| d. | e.*re.be*-e.ta-a | → e.be.re-e.ta-a | "elevator" |

(14) Blend errors

| | | | |
|---|---|---|---|
| a. | (=12a) to.ma.(re) "stop!" | / (su.to)-p.pu "stop" | → to.ma-p.pu |
| b. | (=12b) hi-(i.ta-a) "heater" | / (su).to-o.bu "stove" | → hi.to-o.bu |
| c. | syu-(u.zi) "penmanship" | / (syo).do-o "calligraphy" | → syu.do-o |
| d. | pe.ni-(i) "penny" | / (pe-n).su "pence" | → pe.ni.su |
| e. | ba-(i.ba-i) "bye-bye" | / (a).ku.syu "handshaking" | → ba.ku.syu |

The most important fact about these errors is that words are segmented at a mora boundary, very often at a syllable-internal mora boundary. In the metathesis (transposition) error given in (13a), for example, the word-final syllable, *zin*, is split into *zi* and *n*, of which the first mora is subsequently interchanged with its preceding mora. Similarly, word blend errors in (14) split and subsequently conjoin the two source words at a corresponding mora boundary: e.g. between the first and second moras in each source word in (14b, 14c, 14e) and between the second and third moras in (14a, 14d).

Essentially the same segmentation strategy is employed in substitution errors such as those in (15).

(15) Substitution errors

| | | | |
|---|---|---|---|
| a. | ge-n.*ba*.ku *do*-o.mu | → ge-n.*do*.ku do-o.mu | "Atomic Bomb Dome" |
| b. | ku-*u*.bo mi-*d*.do.we-e | → ku-*b*.bo mi-d.do.we-e | "aircraft carrier Midway" |
| c. | ku.da-*n* ka-*i*.ka-n | → ku.da-*i* ka-i.ka-n | "Kudan Hall" |

The error in (15b) represents an interesting case where the second half of a long vowel has been replaced with the first part of a geminate consonant. Here the second mora of the bimoraic syllable, *kuu*, has been replaced with the corresponding mora of a following bimoraic syllable, *mid*.[6] Vowel-consonant interactions of this kind are almost never observed in English and related languages (Fromkin 1973), where the most typical error pattern involves the interaction of the onset consonant of one word with the onset of another. Some typical examples are given in (16).

(16)

| | | |
|---|---|---|
| a. | Metathesis: *Ch*om.sky and *H*al.le | → Hom.sky and Chal.le |
| b. | Blend: Ch(om.sky) / (H)al.le | → Chal.le |
| c. | Substitution: *Ch*om.sky and *H*al.le | → Hom.sky and Hal.le |

Not surprisingly, many speech errors in Japanese are ambiguous with respect to the segmentation point implied. The error in (13d), for example, can also be

interpreted as a segmental error whereby the onset of one syllable, *re*, changes its position with the onset of the following syllable, *bee*. A similar ambiguity may be pointed out with the errors in (14e) and (15c) too.

(17) a. (=13d) e.*r*e.*b*e-e.ta-a → e.be.re-e.ta-a
b. (=14e) b(a-i.ba-i) / a.ku.syu → ba.ku.syu
c. (=15c) ku.d*a-n* k*a-i*.ka-n → ku.da-i ka-i.ka-n

It is worth emphasizing, however, that almost all of these ambiguous instances can be interpreted as a moraic error, too, as already shown in (13)–(15). More importantly, there are quite a few instances such as those in (13a–c), (14a–d), and (15a–b) that can only be interpreted as cases in which one mora interacted with another mora. These errors, after all, call for a mora-based analysis and eventually argue for the importance of the mora as a behavioral unit in Japanese.

It is important to point out here that speech errors are not an isolated source of evidence from performance data for the mora in Japanese. Exactly the same segmentation strategy is seen in the process of speech disfluency known as stuttering (Ujihira and Kubozono 1994). Adult stutterers of Japanese typically exhibit the disfluency pattern shown in (18a), where the word-initial mora is repeated, often separated from the rest of the word at a syllable-internal mora boundary. This disfluency pattern contrasts sharply with the pattern illustrated in (18b), which is typically shown by stutterers in English.

(18) a. do do do do do-mo-ri "stuttering"
ro ro ro ro ro-n-do-n "London"
b. s s s s stuttering
m m m m member

## *1.4 Perceptual unit*

The mora plays a crucial role in speech perception just as it does in the various speech production processes outlined in the preceding section. Kubozono (1995b) conducted a word blend experiment in which native speakers of Japanese were presented with pairs of monosyllabic English words as auditory stimuli and were asked to blend them into a new one. The purpose of this experiment was to see where the subjects segment the source words, i.e. whether they segment the words before the nuclear vowel, as in (19a), or after it, as in (19b). The result of this experiment showed that native speakers of Japanese choose the response in (19b). This result contrasts sharply with the results of Treiman's (1986) similar experiments with native speakers of English, who predominantly preferred the response in (19a). Kubozono interpreted this interesting cross-linguistic difference as suggesting that Japanese speakers make a CV-based, i.e. mora-based, segmentation when they hear words – namely, that they segment auditory stimuli mora by mora.

(19) Source words: Dick, fog
Response: (a) dog (b) dig

More sophisticated perceptual experiments were conducted by Hayashi and Kakehi (1990) and Otake et al. (1993). Hayashi and Kakehi measured the time that Japanese listeners needed to respond to certain targets in speech. They concluded that Japanese listeners respond to mora-sized units (i.e. CVs) more quickly than segments or phonemes. Using a similar target-monitoring task, Otake et al. demonstrated that Japanese listeners respond to mora-sized units more readily than syllable-sized units.

## *1.5 Relevance of foot*

The argument for the mora in Japanese can be reinforced by the evidence for foot structure. Many phonological and morphological structures of Japanese can be generalized if a sequence of two moras is thought to form a larger (or higher) prosodic unit. A typical example of this is the morphological process of compound clipping, whereby long compound nouns and phrases are shortened. The unmarked phonological pattern of this morphological process is the one illustrated in (20), where the first two moras of each member are combined to form a four-mora word. What is important here is that syllable structure is not directly relevant: The first two moras can be either monosyllabic or bisyllabic and, moreover, bimoraic syllables may be split if they happen to involve the second and third moras of the word, e.g. ri.*mo*(*o*.to). This basic pattern can be defined in a simple manner if sequences of two moras are thought to form a prosodic unit, or "foot." On this analysis, the morphological process is defined as combining the initial foot of each component word: [ ] denotes a foot boundary.[7]

(20) a. se.ku.syu.a.ru ha.ra.su.me-n.to → [se.ku][ha.ra] "sexual harassment"
b. ri.mo-o.to ko-n.to.ro-o.ru → [ri.mo][ko-n] "remote control"
c. ha-n.ga-a su.to.ra-i.ki → [ha-n][su.to] "hunger strike"
d. ha-n.bu-n do-n.ta.ku → [ha-n][do-n] "a half day off (= a half + holiday)"

The notion of bimoraic foot plays an important role in hypocoristic (nickname) formation too (R. A. Mester 1990, Poser 1990). The unmarked pattern of this word formation process is that of creating a bimoraic base out of the source word (a given name) and adding an ending, *tyan* or *kun*, to it. The base is usually the initial two moras of the source word as in (21a), but it can also be formed by lengthening the initial mora as in (21b) or by adding a non-syllabic mora to it as in (21c). Note that the most productive pattern, i.e. (21a), often combines two moras across a morpheme boundary in the source word, e.g. *mi#sa.to* → *[mi.sa].tya-n*. All the changes in (21a–c) conspire to yield a

bimoraic base form, which suggests that base forms of a monomoraic length are ill formed. An analogous constraint is observed in the interesting morphological process found in the formation of a secret language (Tateishi 1989b, Itô et al. 1996).

(21) ma.sa.ru → (a) [ma.sa].ku-n, (b) [ma-a].ku-n, *ma.ku-n
mi.sa.to → (a) [mi.sa].tya-n, (b) [mi-i].tya-n, (c) [mi-t].tya-n, *mi.tya-n
no.ri.ko → (a) [no.ri].tya-n, (c) [no-n].tya-n, *no.tya-n
a-i.ko → (a) [a-i].tya-n, *a.tya-n

This analysis leads to the idea of word minimality, a constraint by which the minimal length of words is defined. In Japanese as in many other languages (Hayes 1995), this constraint is defined in terms of bimoraic foot. This constraint shows itself very clearly when words are morphologically shortened. When numerals were shortened in the course of the history of Japanese, for example, the resultant forms became bimoraic or longer as exemplified in (22). The most productive pattern is shown in (22a), where the word-initial monomoraic syllable is lengthened.[8,9] In (22b), in contrast, two moras are taken from the beginning of the word, whereas no shortening takes place in the forms in (22c).

(22) a. hi-i (<hi.to.tu) "one," hu-u (<hu.ta.tu) "two," mi-i (<mi.tu) "three," yo-o (<yo.tu) "four," mu-u (<mu.tu) "six," ya-a (<ya.tu) "eight"
b. i.tu (<i.tu.tu) "five," na.na (<na.na.tu) "seven"
c. ko.ko.no.tu "nine," to-o "ten"

It seems difficult to predict which word exhibits which pattern in (22). However, it is important to point out that the resultant forms are never monomoraic. An analogous situation is found in the process of loanword clipping to be discussed in section 2.2.[10]

The notion of foot plays a crucial role in word accent phenomena, too. Poser (1990) proposed that the accentuation of noun–noun compounds described in (6) above can be stated more simply if the foot is incorporated as a basic unit of accentuation. According to this analysis, compound nouns in (6a) and (6b) can be defined as containing an N2 of one foot and two feet, respectively. Note that the definition of foot here is slightly different from the one used in the morphological processes described in (20)–(22) in that in compound accentuation feet are formed within each morpheme. What this means is that every morpheme will form at least one foot – or, equivalently, monomoraic morphemes form an independent foot on their own.

Kubozono and Mester (1995) and Kubozono (1995a) critically extended this analysis in two crucial ways. First, the CA patterns described in (6a–b) can now be generalized as a pattern whereby a CA is placed on the penultimate foot, or on the nonfinal, rightmost foot, to be more precise. Secondly, the same foot-based analysis can be extended to cover the compound nouns with a longer N2, i.e. those in (7): this class of compound nouns can now be defined as compounds with an N2 of three feet. All these foot-based analyses have

been further elaborated by Kubozono et al. (1997), who propose that noun–noun compounds in Japanese generally fall into three classes according to the phonological length of N2 and the typical phonological pattern it yields. These are summarized in (23).

(23) a. (= 6) N2 = 1 or 2 feet
ka'buto + [musi] → kabuto'] = [musi]
minami + [ame][rika] → minami] = [a'me][rika]
b. (= 7) N2 = 3 feet
nankyoku + [tan][ken][tai] → nankyoku] = [tan][ken][tai]
minami + [kari][foru][nia] → minami] = [kari][foru][nia]
tiho'o + [sai][ban][syo'] → tihoo] = [sai][ban][syo']
c. N2 ≧ 4 feet
ni'tibei + [an][po][zyo'o][yaku] → [ni'ti][bei] [an][po][zyo'o][yaku]
"Japan–US Security Treaty"
to'oa + [koku][nai][ko'o][kuu] → [to'o][a] [koku][nai][ko'o][kuu]
"Toa Domestic Airlines"

If N2 is one or two feet long as in (23a), a default CA falls on the penultimate foot while N1 is deaccented (if it is accented at all). If N2 consists of three feet as in (24b), then it retains its own accent pattern, i.e. its accentedness and accent location, while deaccenting N1. The crucial difference between (23a) and (23b) is that N2 loses its prosodic independence in (23a) but not in (23b), whereas N1 loses its independence in both cases. Finally, if N2 consists of four or more feet, both N1 and N2 retain their prosodic independence, i.e. their own accent pattern, and, consequently, result in two prosodic words. This last pattern is identical to the accent pattern of phrasal constructions, which do not change the accentuation of their components: e.g. *ao'i tora'kku* → *ao'i tora'kku* "blue truck"; *ao'i enpitu* → *ao'i enpitu* "blue pencil." In more general terms, the three accent patterns sketched in (23) represent a prosodic continuum from the accentuation of the compound word to that of the phrase, with (23b) representing an intermediate prosodic stage between the two. The essence of the analysis described in (23), then, is that this prosodic continuum can be defined essentially in terms of the phonological length of N2 which, in turn, is to be defined in terms of the prosodic unit "foot."

There is still room for discussion about the principle of foot formation in Japanese (see section 3.2). It is nevertheless worth emphasizing that the complexities of the CA rules can be reduced to a very simple picture if one adopts the notion of foot, which is bimoraic in unmarked cases.

## 2 Relevance of Syllable

The discussion so far has abundantly shown the importance of "mora" and, furthermore, of the notion "foot" based thereon. Arguments along this line

may and in fact have led to the claim that Japanese does not need a unit equivalent to the syllable. This claim is challenged in this section, where it is shown that the conception of the mora as an indispensable unit in a language is not incompatible at all with the idea that the syllable too plays a certain role in the same system.

## *2.1 Word accent*

### *2.1.1 Bearer of word accent*

The first evidence for the syllable in Japanese comes from the facts about word accent. Many Japanese accent rules refer to the mora structure of the word and, thereby, determine the location of word accent by counting the number of moras. Recall, for example, that the loanword accent rule sketched in (5) places an accent on the antepenultimate mora, i.e. the third mora counted from the end of the word. This rule, however, fails to account for the accent patterns of words as in (24), which are accented one mora leftward. In most cases the antepenultimate mora of these words is one of the nonsyllabic moras described in (2).

(24) a. mya'-n.ma-a "Myanmar," ro'-n.do-n "London,"
wa.si'-n.to-n "Washington"
b. sa'-i.pa-n "Saipan," su.pa'-i.da-a "spider," de.za'-i.na-a "designer"
c. sa'-a.ka.su "circus," pe'-e.pa-a "paper," pi'-i.na.tu "peanut"
d. so'-k.ku.su "socks," de.ra'-k.ku.su "deluxe," pi'-t.tya-a "pitcher"

The best way to generalize this pattern with the antepenultimate pattern described in (5) is to assume that the syllable is the bearer of the accent (Shibatani 1990). The antepenultimate rule sketched in (5) will then be reformulated as in (25) (J. D. McCawley 1978).

(25) Loanword accent rule: Place an accent on the *syllable containing the antepenultimate mora*.

The conception of Tokyo Japanese as being a "mora-counting, syllable language" (J. D. McCawley 1978) allows us to generalize accent variations found in other accentual phenomena.[11] Compound accentuation, for example, exhibits the pattern in (26) as a variant of (6a). This variant pattern can be generalized with the regular pattern if the syllable is regarded as the bearer of the accent. That is, the accent patterns in (6a) and (26) can be attributed to a rule which places the CA on the final *syllable* of N1.

| (26) | | | |
|---|---|---|---|
| | se'ndai + si' | → senda'i = si | "Sendai City" |
| | itoo + si' | → ito'o = si | "Ito City" |
| | so'romon + o'o | → soromo'n = oo | "Solomon, king; King Solomon" |
| | cf. (6a) kyo'oto + si' | → kyooto' = si | "Kyoto City" |

Another interesting case in which the syllable plays a role as the bearer of accent is that of a personal name *zi'roo*. This noun exhibits an exceptional but highly predictable CA behavior when combined with a prefix-like element, to form a larger personal name (see Akinaga 1981 for a traditional analysis). Unlike the ordinary noun–noun compounds such as those in (6) and (7), the accentuation of X-ziroo compounds is determined by the lefthand member (N1). If N1 is monomoraic as in (27a), it yields an unaccented word. If N1 is bimoraic as in (27b) and (27b′), it attracts a CA on its final position. Finally, if N1 contains more than two moras as in (27c), the CA falls on the initial mora of N2 (*zi'roo*) – or, equivalently, the lexical accent of N2 is preserved in the resultant compound. Only this final case can be accounted for by the general CA rule described in (6b) and (23a).

| | | | | | |
|---|---|---|---|---|---|
| (27) | a. | ko | "little" + zi'roo | → | ko = ziroo |
| | b. | kane | "money" + zi'roo | → | kane' = ziroo |
| | b′. | ki'n | "gold" + zi'roo | → | ki'n = ziroo |
| | c. | tikara' | "power" + zi'roo | → | tikara = zi'roo |
| | | karee | "curry" + zi'roo | → | karee = zi'roo |

The three accent patterns described in (27) can basically be generalized in terms of the mora. Namely, bimoraic, monosyllabic N1 such as *kin* patterns with the bimoraic, bisyllabic form *kane* and not with the monosyllabic form *ko*. Moreover, trimoraic, bisyllabic N1 like *karee* patterns with trimoraic, trisyllabic forms like *tikara*, not with bimoraic, bisyllabic forms such as *kane*. However, it is necessary to refer to the syllable structure of the output in order to generalize the patterns in (27b) and (27b′), where the CA is placed on the final syllable of N1: *Kane' = ziroo* and *ki'n = ziroo* would appear to exhibit different CA patterns under a purely mora-based analysis.

We need information on syllable structure to generalize not only the output of phonological rules but their input forms as well. A classical case to demonstrate this is the "pre-*no* deaccenting rule" (Akinaga 1981, Poser 1984), which has the effect of deaccenting finally accented nouns followed by the genitive particle *no*. This rule is subject to two major constraints, both of which require information on syllable structure. One of them requires the noun undergoing the rule to be accented on the final syllable. Thus the rule readily applies to nouns accented on the final bimoraic syllable, as in (28b), as well as those accented on the final monomoraic syllable, as in (28a).

| | | | | | |
|---|---|---|---|---|---|
| (28) | a. | uma' + no | → | umano | "of the horse" |
| | | otoko' + no | → | otokono | "of the man" |
| | b. | niho'n + no | → | nihonno | "of Japan" |
| | | kino'o + no | → | kinoono | "of yesterday" |
| | | cf. koko'ro + no | → | koko'rono | "of the heart" |
| | c. | me' + no | → | me'no | "of the eye" |
| | | ki' + no | → | ki'no | "of the tree" |
| | d. | kyo'o + no | → | kyo'ono | "of today" |
| | | ka'i + no | → | ka'ino | "of the shellfish" |

A second constraint on the deaccenting rule requires that the word be more than one syllable long in order for it to undergo the rule. Thus monosyllables do not undergo the deaccenting rule irrespective of whether they are monomoraic as in (28c) or bimoraic as in (28d).

So far we have presented evidence that the syllable rather than the mora is the bearer of word accent in Japanese. This finding itself may not be surprising in the context of general linguistic theory since the syllable plays the same role in a large number of languages in the world – so many so that Hayes (1995) proposes that this is universally true. What is truly interesting about accent phenomena in Japanese is that the syllable plays some other crucial roles in this putatively mora-based system and that most of these roles are also found in the syllable-based systems of other languages.

### *2.1.2 Other accentual phenomena*

In addition to the role as the bearer of the accent, the syllable plays an indispensable role in various accentual phenomena in Japanese. Consider compound accentuation, which was outlined in (23) above. If the second member (N2) is one foot long, a default CA falls on the final syllable of N1, which is contained in the penultimate foot of the entire compound noun: e.g. kabuto'] = [musi] in (23a). A major exception to this is the case where N2 is bisyllabic and originally accented on its non-final syllable. In this particular case, N2 very often retains its accent in the resultant compound, as shown in (29a). This contrasts sharply with the case where N2 is originally accented on the final monomoraic syllable as in (29b) as well as with the case where N2 is an accented monosyllable as in (29c). In these latter cases the accent of N2 almost never survives as the CA and, consequently, a default CA appears on the penultimate foot just as it does in (29d), where N2 is originally unaccented.[12]

| | | | | | |
|---|---|---|---|---|---|
| (29) | a. | pe'rusya + ne'ko | → | perusya][ne'ko] | "Persian cat" |
| | | ti'izu + pi'za | → | tiizu][pi'za] | "cheese pizza" |
| | b. | a'kita + inu' | → | akita'][inu] | "Akita dog" |
| | c. | sakura + ka'i | → | sakura'][gai] | "cherry shell" |
| | | ne'kutai + pi'n | → | nekuta'i][pin] | "necktie pin" |
| | d. | ka'buto + musi | → | kabuto'][musi] | "beetle" |

The seemingly peculiar contrast between (29a) and (29b–c) can be attributed to the general principle of Nonfinality, whereby word-final accents are disfavored (Prince and Smolensky 1993). In the particular case under consideration, this principle can be defined as a constraint prohibiting a CA on the final *syllable* of the compound (Kubozono 1995a, 1997).

Another interesting accentuation rule that requires information on syllable structure concerns compound nouns whose second member is a personal name *ta'roo*, e.g. *kin* = *taroo*, *momo'* = *taroo* and *tikara* = *ta'roo*. Just like *zi'roo* discussed in (27), *ta'roo* exhibits an exceptional CA behavior when combined with a prefix-like element, or N1, in that its CA patterns cannot be accounted for by the

general CA rule described in (6b) and (23a). However, like *zi'roo*, its CA behavior is highly predictable on the basis of the phonological length of N1 (see Akinaga 1981 for a traditional mora-based account). X-taroo compounds exhibit identical accent patterns with the X-ziroo compounds described in (27) above except that they require information on syllable structure as well as mora structure. Specifically, *ta'roo* exhibits two different CA patterns when combined with a bimoraic N1: monosyllabic N1 in (30b) yields an unaccented compound just as the monomoraic N1 in (30a), whereas bisyllabic N1 attracts a CA on the final syllable, as illustrated in (30c). Here, the distinction of bimoraic sequences in terms of their syllable structure turns out to be crucial just as it did in compound accentuation described in (29). Curiously, the third CA pattern described in (30), i.e. (30d), can be defined in terms of the mora, and not the syllable, as bisyllabic, trimoraic N1 such as *karee* patterns with trisyllabic, trimoraic forms like *tikara*.

(30)

| | | | | |
|---|---|---|---|---|
| a. | ki “devil” + ta'roo | → | ki = taroo |
| | ne “sleeping” + ta'roo | → | ne = taroo |
| b. | ki'n “gold” + ta'roo | → | kin = taroo |
| | ma'n “ten thousand” + ta'roo | → | man = taroo |
| | kyu'u “Q” + ta'roo | → | kyuu = taroo |
| c. | momo “peach” + ta'roo | → | momo' = taroo |
| | kane “money” + ta'roo | → | kane' = taroo |
| d. | tikara' “power” + ta'roo | → | tikara = ta'roo |
| | karee “curry” + ta'roo | → | karee = ta'roo |
| | urutora'man “superman” + ta'roo | → | urutoraman = ta'roo |

The argument for syllable structure is further reinforced by the data of loanword accentuation. A vast majority of loanwords are accented according to the rule described in (25) above, but about 10 percent of loanwords are unaccented. Interestingly, a majority of these unaccented loanwords have two common features: They are four moras long and end with a sequence of two monomoraic syllables (Kubozono 1996b). (31) lists some typical examples of placenames.

(31) a.me.ri.ka “America,” e.zi.pu.to “Egypt,” sa-n.ho.ze “San Jose,” ho.no.ru.ru “Honolulu,” yo.se.mi.te “Yosemite,” a.ri.zo.na “Arizona,” a-i.da.ho “Idaho,” a-i.o.wa “Iowa”

That the above generalization is correct can be borne out by the accentuation of nonsense words. The words in (32a–b), for example, obey the rule in (25), thereby attracting an accent on the syllable containing the antepenultimate mora. In contrast, nonsense words in (32c) do not follow this rule but tend to be unaccented.[13] The most crucial difference between the two groups is that only the latter end with a sequence of monomoraic syllables.

(32)
a. re.ba'.no-n, re.no'.ba-n
b. re.ba'-n.no, re.no'-n.ba
c. re-n.ba.no, re-n.no.ba

Another aspect of loanword accentuation in which syllable structure plays a crucial part concerns an exceptional accent pattern shown by some trimoraic loanwords. Most trimoraic loanwords are accented on the antepenultimate mora, as correctly predicted by the rule in (25). Some examples are given in (33a–b). However, some words such as those in (33c) are accented on the penultimate mora. Careful analysis of the data reveals that these words almost always end with a bimoraic syllable preceded by an epenthetic vowel (Kubozono 1996b). The trimoraic forms in (33a) involve an epenthetic vowel in the initial syllable but do not end with a bimoraic syllable. Those in (33b) end with a bimoraic syllable but do not contain an epenthetic vowel in the initial syllable. Trimoraic words in (33c) satisfy both of these conditions.

(33) a. pu'.ra.su "plus," gu'.ra.su "glass," do'.re.su "dress," to'.ri.o. "trio"
b. ha'.wa-i "Hawaii," ri'.re-e "relay," i'.ra-n "Iran," se'.da-n "sedan"
c. do.ra'-i "dry," bu.ru'-u "blue," su.ri'-i "three," tu.i'-n "twin"

In sum, all of the accentual phenomena described in (29)–(33) can be properly accounted for if the syllable is incorporated as a basic unit of description.

## 2.2 *Word formation*

Morphological processes, too, require reference to the syllable structure of words. Consider the process of loanword clipping illustrated in (34) (Itô 1990). Loanwords in Japanese are generally very long as a result of the vowel epenthesis which takes place during the borrowing process. Once borrowed into Japanese, these relatively long words are often shortened to the length of two to four moras, as illustrated in (34a–c) respectively: ( ) shows the truncated portion.

(34) a. de.mo(-n.su.to.re-e.syo-n) "demonstration," su.to.(ra-i.ki) "strike"
b. te.re.bi.(zyo-n) "television," a.ni.me-(e.syo-n) "animation"
b'. pa-n.hu.(re-t.to) "pamphlet," pa-a.ma.(ne-n.to) "permanent wave"
c. ri.su.to.ra.(ku.tya.ri-n.gu) "restructuring,"
i.ra.su.to.(re-e.syo-n) "illustration"

This process is interesting in two respects. First, it embodies the minimality constraint discussed in section 1.5: the resultant word must consist of at least one foot, i.e. two moras, as shown in (34a). A second fact, which is of interest here, is that the resultant form must be at least *bisyllabic*. This can be seen by the comparison of the clipped forms in (34a) and those in (34b'). In (34a), all the resultant forms are bimoraic and bisyllabic. In (34b'), in contrast, the original loanwords begin with a bimoraic syllable and result in a trimoraic form when shortened, e.g. *pa-n.hu*, **pa-n* for *pa-n.hu.re-t.to*. This difference is suggestive of a constraint by which the resultant word must be more than one

syllable long.[14] This second constraint cannot be defined by the mora alone but requires information on the syllable structure of the source word. Four-mora forms such as those in (34c) satisfy both the moraic and syllabic constraints discussed here.[15]

## *2.3 Syllable weight*

In addition to the various phenomena discussed in the preceding section, there are many more linguistic processes for which the notion of syllable seems indispensable. Many of these processes can be defined in terms of "syllable weight" or "syllable quantity," a notion which has been proposed to account for the phonological length of syllables (Allen 1973).

Syllables generally fall into two or three categories according to their phonological weight and their characteristic phonological behavior: light syllables, heavy syllables, and superheavy syllables. Generally speaking, short vowels count as one phonological unit, whereas long vowels and diphthongs count as two units. Coda consonants often serve as an independent unit so that closed syllables with a short vowel (CVC) count as being as long as open syllables with a long vowel or diphthong (CVV). Closed syllables with a long vowel or diphthong (CVVC) count as three units and are longer than any other syllable type. Onset consonants do not contribute to syllable weight so that the presence or absence of an onset does not change the weight of the particular syllable.

The notion of syllable weight is closely related to the phonological notion of "mora" discussed in section 1.2. Syllable weight, in fact, is a notion in which the two notions, "syllable" and "mora," are integrated: namely, light syllables (V or CV) are monomoraic, heavy syllables ((C)VV or (C)VC) are bimoraic, and superheavy syllables ((C)VVC) are trimoraic.

### *2.3.1 Compensatory lengthening*

The first case in which "syllable weight" plays a crucial role is that of compensatory lengthening discussed in section 1.2.2 above. As illustrated in (8), Tokyo Japanese exhibits vowel lengthening occurring concomitantly with vowel monophthongization. A global effect of this process is to keep intact the total length of words as measured in terms of the mora. Seen from the viewpoint of syllable weight, it can be redefined as a process whereby the phonological length of the relevant syllable is kept intact. In the *daikon* ~ *deekon* alternation stated in (8a), for example, the first syllable, *dai*, keeps its bimoraic length as the monophthongized vowel, [e], is lengthened. Compensatory lengthening in Tokyo Japanese always occurs within the domain of the syllable, which implies that the primary motivation of the process is to preserve the phonological length of syllables.[16]

### *2.3.2 Generality of accent rules*

The notion of syllable weight also enables us to understand the general linguistic nature of accent rules in Japanese. Consider, for example, the antepenultimate accent rule in (25). This rule would produce the outputs in (35) should it be interpreted in terms of syllable weight: "H" and "L" stand for heavy (bimoraic) and light (monomoraic) syllables, respectively.

(35) a. ...LH'L# b. ...LH'H# c. ...HH'L# d. ...HH'H#
e. ...L'LL# f. ...LL'H# g. ...H'LL# h. ...HL'H#

The effects described in (35) look quite similar to those of the accent rule of classical Latin and many other languages including modern English. The accent rule of Latin is claimed to be sensitive to the weight of the penultimate syllable in a straightforward manner (Prince and Smolensky 1993, Hayes 1995).

(36) Latin accent rule: Place an accent on the penultimate syllable if it is heavy and on the antepenultimate syllable if it is light.

This rule yields the results in (37).

(37) a. ...LH'L# b. ...LH'H# c. ...HH'L# d. ...HH'H#
e. ...L'LL# f. ...L'LH# g. ...H'LL# h. ...H'LH#

The similarity between (35) and (37) is obvious: they differ in just two out of the eight phonological environments, i.e. (f) and (h). More interestingly, modern Japanese exhibits a striking variation in these two environments (Kubozono 1996b, Kubozono and Ohta 1998). Thus loanwords in (38) yield the patterns in (35f, 35h), whereas those in (39) exhibit somewhat new patterns which are identical to those shown in (37f, 37h). Moreover, words in (40) show a fluctuation between the old patterns in (38) and the new patterns in (39). In a historical perspective, the lexical variation between (38) and (39) and the fluctuation in (40) represent an ongoing accentual change whereby the traditional mora-based rule in (25) seems to develop into the Latin-type rule in (36), which is primarily syllable-based.

(38) a. ...LL'H# i.e'.me-n "Yemen" bi.ta'.mi-n "vitamin"
e.su.ki'.moo "Eskimo"
b. ...HL'H# ka-n.ga'.ru-u "kangaroo" ba-a.be'.kyu-u "BBQ"

(39) a. ...L'LH# to'.ro.fi-i "trophy" a'.ma.zo-n "Amazon"
te'.ne.si-i "Tennessee"
b. ...H'LH# i'-n.ta.byu-u "interview" ba'-a.ku.re-e "Berkeley"

(40) a. ...LLH# re.ba'.no-n ~ re'.ba.no-n "Lebanon"
do.ra'.go-n ~ do'.ra.go-n "dragon"
e.ne.ru'.gi-i ~ e.ne'.ru.gi-i "energy"

b. ...HLH# myu-u.zi'.sya-n ~ myu'-u.zi.sya-n "musician"
e-n.de'.ba-a ~ e'-n.de.ba-a "(Space Shuttle) Endeavor"
ha-n.ga'.ri-i ~ ha'-n.ga.ri-i "Hungary"

In sum, the basic similarity between the Japanese loanword accent rule in (25) and the Latin-type accent rule in (36) can be revealed if the mora-based rule in (25) is reinterpreted in the light of syllable weight. Moreover, the general linguistic nature of the synchronic lexical variation described in (38)–(40) can best be understood if syllable weight is adopted as a relevant descriptive notion. Since "syllable weight" presupposes the notion of syllable, all these observations clearly demonstrate the importance of the syllable in Japanese.

### *2.3.3 Trimoraic syllable ban*

A more convincing argument for syllable weight in Japanese comes from the analysis of trimoraic syllables. Trimoraic syllables are reported to be disfavored in a number of languages including English and other Germanic languages (Árnason 1980), Koya and Fula (Sherer 1994), and Pali (Zec 1995), to mention just a few. This constraint, as formulated in (41), provides a principled account of many phonological processes including the vowel length alternation in English illustrated in (42). Traditionally interpreted as vowel shortening in closed syllables (Myers 1987),[17] this process can be reinterpreted, as shown in (43), as a case where trimoraic syllables are converted into bimoraic ones to satisfy the constraint in (41).

(41) $*\sigma_{\mu\mu\mu}$

($\sigma$ = syllable, $\mu$ = mora.)

(42) a. keep-kept, wise-wis.dom, house-hus.band
b. go-gone, do-done, say-said

(43) $\sigma_{\mu\mu\mu} \rightarrow \sigma_{\mu\mu}$

Interestingly, the constraint in (41) has been shown to play a role in the phonology of other Indo-European languages including Latin and most Germanic languages (Árnason 1980, Sherer 1994). To make the matter more interesting, there are several independent pieces of evidence which suggest that the constraint on the well-formedness of syllable weight restricts Japanese phonology, too. Japanese has traditionally been an open-syllable language and, hence, did not originally have such a complex syllable structure as /CVVC/. However, an analysis of loanword phonology reveals that Japanese makes every effort to avoid creating such a syllable structure in the process of borrowing. To begin with, let us consider the vowel shortening phenomenon known as "pre-nasal shortening (PNS)" (Lovins 1975): /N/ denotes a moraic nasal, which normally appears in the coda of a syllable.[18]

(44) a. range → /re-N.zi/, */re-i-N.zi/
change → /tye-n.zi/, */tye-i-N.zi/
stainless → /su.te-N.re.su/, */su.te-i-N.re.su/;
stained glass → /su.te-N.do.gu.ra.su/, */su.te-i-N.do.gu.ra.su/
b. ground → /gu.ra-N.do/, *?/gu.ra-u-N.do/;
foundation → /fa-N.de-e.syo-N/, */fa-u-N.de-e.syo-N/
c. machine → /ma.si-N/, */ma.si-i-N/
cornbeef → /ko-N.bi-i.hu/, */ko-o-N.bi-i.hu/
ice cream → /a-i.su.ku.ri-N/, */a-i.su.ku.ri-i-N/

In (44), the second half of long vowels and diphthongs has dropped when it appears before a nasal which is to be borrowed as a moraic nasal. The most revealing case is that of the word *ice cream* in (44c), which permits two forms in Japanese. If the word-final nasal is adopted as a moraic nasal in Japanese, the form with a short vowel, i.e. /a-i.su.ku.ri-N/, results. If, on the other hand, the nasal is adopted as the onset of a new syllable, then the original bimoraic length of the vowel is retained to produce the form /a-i.su.ku.ri-i.mu/. This second form is the standard form in modern Japanese, whereas the form with a shortened vowel is an archaic or dialectal one. What is most interesting here is the fact that a third form, /a-i.su.ku.ri-i-N/, has never been attested. This indicates that Japanese permits the parsing of either the original vowel length or the coda nasal; if the original bimoraic vowel length is to be maintained as in the contemporary form, the word-final consonant cannot be parsed as the coda of the same syllable; if the original coda nasal is to be parsed as a coda consonant as in the archaic/dialectal form, the original bimoraicity of the vowel must be abandoned. This trade-off between vowel length and the coda consonant embodies exactly the same syllable weight constraint that yields the English vowel alternations stated in (42).

The constraint responsible for the vowel shortening in (44) also accounts for coda deletion in (45). This phenomenon might look entirely different from the vowel shortening in (44) but, seen from the viewpoint of syllable structure, it can be attributed to the constraint that prohibits creating trimoraic syllables.

(45) entertainment → /e-N.ta-a.te-i.me-N.to/, ??/e-N.ta-a.te-i-N.me-N.to/
alignment → /a.ra-i.me-N.to/, *?/a.ra-i-N.me-N.to/
cf. eight → /e-i.to/, right → /ra-i.to/,
entertainer → /e-N.ta-a.te-i.na-a/, */e-n.ta-a.te.na-a/

The constraint prohibiting trimoraic syllables accounts for an antigemination effect in loanword phonology, too. Obstruents in the coda position are often geminated in Japanese, yielding bimoraic syllables as illustrated in (46a). This gemination process is invariably blocked, however, if the obstruent is preceded by a long vowel or diphthong. This antigemination effect is illustrated in (46b).

(46) a. cut → /ka-t.to/, */ka.to/; hip → /hi-p.pu/, */hi.pu/
b. cart → /ka-a.to/, */ka-a-t.to/; kite → /ka-i.to/, */ka-i-t.to/

The gemination–antigemination contrast in (46) reveals a trading relationship between vowel length and consonant gemination. This relationship can be explained by the ban on trimoraic syllables, although, again, the phonotactic effect of the phenomenon itself seems to have little in common with the effects of the phenomena in (44)–(45).

Another interesting phenomenon arguably attributable to the syllable weight constraint in (41) is that of compound accentuation. There are quite a few loanwords in contemporary Japanese which seem to form exceptions to the processes described in (44)–(46) and, hence, to the constraint in (41). The words given in (47), for example, contain a sequence of segments which apparently forms a superheavy syllable of the form /CVVN/.

(47) a. /aiN/ ra-i-N "line, Rhine," de.za-i-N "design," ba.re-N.ta-i-N "Valentine"
b. /auN/ ta-u-N "town," da-u-N "down," ka-u-N.ta-a "counter"
c. /eiN/ su.pe-i-N "Spain"
d. /oiN/ ko-i-N "coin," po-i-n.to "point"
e. /$V_i$ $V_i$ N/ ri-N.ka-a-N "Lincoln," tye-e-N "chain," ku.re-e-N "crane"

An accentual analysis of these words, however, suggests that the /CVVN/ sequences in question actually form a sequence of two syllables. As mentioned in (6a), the CA rule in Japanese places a default CA on the final syllable of the first member (N1) if the second member (N2) is either monomoraic or bimoraic. This rule correctly predicts the CA pattern in (48), where the CA docks onto the nucleus of the final syllable of N1.

(48) a. te'.mu.zu + ka.wa' → te.mu.zu' = ga.wa "the Thames River"
b. a'.ma.zo-N + ka.wa' → a.ma.zo'-N = ga.wa "the Amazon River"
c. ka'.ga.ku + ha'.ku → ka.ga.ku' = ha.ku "Science Exposition"
d. mi'.ra-i + ha'.ku → mi.ra'-i = ha.ku "Future Exposition"
e. ha.ya.ri' + ka.ze → ha.ya.ri' = ka.ze "epidemic, cold; influenza"
f. ho-N.ko'-N + ka.ze → ho-N.ko'-N = ka.ze "Hong Kong Flu"

However, the words in (47) show an unexpected behavior when they form the N1 of a compound noun. In such compounds, the CA generally docks onto the penultimate mora of N1, not on the antepenultimate mora. This is shown in (49), where the trimoraic sequences in question are tentatively assumed to form one syllable, i.e. a trimoraic syllable.[19]

(49) a. ra'-i-N + ka.wa' → ra-i'-N = ga.wa, *ra'-i-N = ga.wa "the Rhine River"
b. de.za'-i-n + ha'.ku → de.za-i'-N = ha.ku, *de.za'-i-N = ha.ku "Design Exposition"

c. ba.re-N.ta-i-N + de'-e → ba.re-N.ta-i'-N = de-e, ?ba.re-N.ta'-i-N = de-e
"Valentine's Day"
d. ta'-u-N + si → ta-u'-N = si, *ta'-u-N = si
"a local magazine"
e. su.pe'-i-N + ka.ze → su.pe-i'-N = ka.ze, *su.pe'-i-N = ka.ze
"Spain Flu"
f. ko'-i-N + syo'-o → ko-i'-N = syo-o, *ko'-i-N = syo-o
"coin dealer"
g. ri-N.ka'-a-N + ha'-i → ri-N.ka-a'-N = ha-i, ?ri-N.ka'-a-N = ha-i
"Lincoln Cup"

What appears to be a mysterious CA pattern in (49) can be properly accounted for if one assumes that the trimoraic sequences in question actually consist of two syllables with a syllable boundary between the first and second moras, i.e. /CV.VN/. This analysis allows us to represent the CA in (49) as in (50), which can now be generalized with the regular CA pattern in (48).

(50) a. ra'.i-N + ka.wa' → ra.i'-N = ga.wa, *ra'.i-N = ga.wa
b. de.za'.i-n + ha'.ku → de.za.i'-N = ha.ku, *de.za'.i-N = ha.ku
c. ba.re-N.ta.i-N + de'-e → ba.re-N.ta.i'-N = de-e, ?ba.re-N.ta'.i-N = de-e
d. ta'.u-N + si → ta.u'-N = si, *ta'.u-N = si
e. su.pe'.i-N + ka.ze → su.pe.i'-N = ka.ze, *su.pe'.i-N = ka.ze
f. ko'.i-N + syo'-o → ko.i'-N = syo-o, *ko'.i-N = syo-o
g. ri-N.ka'.a-N + ha'-i → ri-N.ka.a'-N = ha-i, ?ri-N.ka'.a-N = ha-i

Another revealing case for the bisyllabic status of the trimoraic sequences in question is the accentuation of the word /deza'iN/ "design" and its related words. These are shown in (51), where only mora boundaries are given to avoid confusion.

(51) a. de-za'-i-N "design"
b. (= 24b) de-za'-i-na-a "designer"
c. (= 50b) de-za-i'-N = ha-ku "Design Exposition"

The word /de-za'-i-N/ in (51a) attracts an accent on its antepenultimate mora, as correctly predicted by the loanword accent rule stated in (25). Note that this accent pattern alone does not reveal the syllable structure of the trimoraic sequence /za-i-N/, since the loanword accent rule determines the basic docking site of accent by counting the number of moras. /de-za-'i-na-a/ in (51b), in contrast, attracts an accent on the fourth mora from the end. This, too, can be accounted for by the loanword accent rule in (25), which predicts that the accent will dock on /za'i/, or the syllable containing the antepenultimate mora. What is relevant here is the fact that the second half of the vowel sequence, i.e. /i/ in /ai/, does not form the nucleus of the syllable. However, this is not always the case, as clearly demonstrated by the accent pattern of the word

in (51c), which, by the CA rule described in (26), should be accented on the final syllable of the first member, /dezain/. This word contains the same vowel sequence /ai/, but actually attracts a CA on /i/ rather than on /a/. The comparison of (51b) and (51c) reveals that the second half of the vowel sequence /ai/ functions as a syllable nucleus in (51c), but not in (51b), which, in turn, suggests that /ai/ forms one integral syllable in (51b) but is divided into two syllables in (51c). In more general terms, vowel sequences like /ai/ generally form one syllable except when they are followed by another nonsyllabic mora such as the moraic nasal /N/. This otherwise mysterious behavior of vowel sequences can be explained by the constraint in (41) in a straightforward manner.

Similarly, what appears to be a peculiar contrast in compound accentuation between the words in (52a) and (52b) below can also be accounted for by the constraint prohibiting trimoraic syllables. With a monomoraic or bimoraic second member, these compound nouns are expected to be accented on the final syllable of the first member, just as are the compound nouns in (48). However, they are actually accented on different loci: e.g. /roNdo'N = basi/ is accented on the penultimate mora of /roN.doN/, whereas /roNdoN'k = ko/ is generally accented on the final mora of the same word, namely, on the moraic nasal.

(52) a. ro-N.do-N + ha.si' → ro-N.do'-N = ba.si
"London, bridge; London Bridge"
ge-N.da-i + zi'-N → ge-N.da'-i = zi-N
"modern, people; the moderns"

b. ro-N.do-N + ko → ro-N.do.N'-k = ko, *?ro-N.do'-N-k = ko
"London, child; Londoner"
ge-N.da-i + ko → ge-N.da.i'-k = ko, *?ge-N.da'-i-k = ko
"modern children"

The CA difference illustrated in (52) can be attributed to the fact that the onset consonant of the second member is geminated in (52b) but not in (52a). Since gemination adds an extra mora to the preceding syllable, the compound noun in (52b) comes to involve a trimoraic sequence, i.e. /CVNC/ or /CVVC/, at the end of its first member. In view of syllable weight, this is comparable to the situation illustrated in (49), where the first component word ends with a trimoraic sequence which, from a purely phonotactic point of view, would seem to form a trimoraic syllable. What happens in (52b) is that the final mora of N1, i.e. the moraic nasal or the second half of a diphthongal vowel sequence, becomes a syllable nucleus and thereby attracts an accent on itself. Obviously, this is triggered by the gemination of the following heterosyllabic consonant, which has created an extra nonsyllabic mora at the end of the first component word. In short, the accentual difference between (52a) and (52b) can be attributed to a difference in syllable structure, which, in turn, is attributable to the presence or absence of an extra mora at the end of the first component word. This whole story, too, can be accounted for by the constraint on syllable weight in (41).

To summarize, many seemingly independent phenomena conspire to avoid creating trimoraic syllables in Japanese. Stated conversely, postulating a constraint prohibiting trimoraic syllables as in (41) allows us to generalize a number of phonological phenomena in Japanese which would otherwise appear to be totally unrelated to each other. Since the same constraint has been shown to constrain the phonology of English and many other languages, positing the same syllable well-formedness constraint in Japanese phonology also leads us to understand the general linguistic basis of syllable weight phenomena in the language. All these arguments for the existence of the syllable weight constraint reinforce the argument developed throughout this section, namely, that the syllable is a unit no less indispensable than the mora in Japanese.

# 3 Summary and Future Work

## *3.1 Summary*

In this chapter we have considered various roles played by the mora and the syllable in Japanese. Japanese has traditionally been labeled a "mora language" as opposed to a "syllable language." In the first half of this chapter we saw a wide range of phenomena – phonetic, phonological, and morphological – for which the notion of "mora" is indispensable. We considered functions played by the mora from four different viewpoints: (i) as a phonetic unit to define temporal organization of speech, (ii) as a phonological unit by which phonological distance or length is defined, (iii) as a segmentation unit in speech production, and (iv) as a perceptual unit relevant in speech perception processes. In addition to these four roles, the mora plays an important role in defining the notion of phonological "foot," which allows us to generalize a number of seemingly unrelated phenomena in the same language. It was suggested that the second function of the mora and the role of the foot which derives from it may be observed in other languages as well, whereas all the other functions seem to be characteristic of Japanese as a "mora language" in Trubetzkoy's classical sense.

In the second half of this chapter we challenged the traditional view that the syllable plays little or no role in the putatively mora-based system. Starting with the classical role of the syllable as the bearer of word accent, we demonstrated that many accent-related phenomena can be generalized by positing the syllable as a basic unit of description. Particularly important is the distinction of bimoraic words in terms of their syllable structure, i.e. monosyllabic vs. bisyllabic. The arguments for syllable and syllable structure in Japanese have been reinforced by evidence for syllable weight, a notion that is used to define the phonological weight or length of syllables. This new notion provides a principled account of a number of phenomena from vowel shortening and antigemination in loanwords to peculiar accentuation in compounds. All these data

provide strong evidence that the syllable forms an integral part of Japanese phonology, quite contrary to Pike's (1947) characterization of the unit as simply a "phonetic syllable."

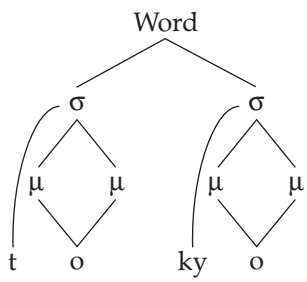
The arguments developed in this chapter as a whole challenge the claim implicitly assumed in the classical literature, namely, that the syllable and the mora are mutually exclusive in a single prosodic system. Our arguments demonstrated, quite contrary to this traditional hypothesis, that both the mora and the syllable are indispensable for generalizing linguistic phenomena in Japanese and, indeed, for understanding their true meanings in the context of general linguistic theory.

## *3.2 Future agenda*

We have seen in section 1 various kinds of evidence for the centrality of the mora in Japanese. Unlike the evidence for the syllable, the evidence for the mora is more or less language specific, i.e. specific to Japanese as a "mora language." Given this characterization of the mora phenomena in Japanese, it is quite natural to ask why Japanese is unique in this respect. This question can be tackled from two different perspectives, one from a phonological viewpoint and the other from the viewpoint of language acquisition.

Considered from a phonological viewpoint, the mora phenomena we have seen prompt the question of how they can be related to the prosodic organization of speech or, more specifically, to the organization of the syllable. Particularly interesting in this respect is the proposal of Moraic Phonology (Hyman 1985, Kubozono 1985, Hayes 1989, Katada 1990) that the mora is an integral part of the syllable. According to this theory, the mora (μ) rather than the unit known as the "rhyme" forms a constituent of the syllable (σ). This is illustrated in (53) with the Japanese word /tookyoo/ "Tokyo."[20]

(53)




This analysis provides a very straightforward account of the phonological function discussed in section 1.2 above, namely, that the mora serves as a basic unit of phonological length in Japanese and many other languages. It also seems to explain the evidence described in sections 1.3 and 1.4 showing that the mora serves as a segmentation unit in speech production and perception in Japanese. However, it fails to explain the crucial differences between

Japanese and English (and other languages) with respect to the roles of the mora described in sections 1.1, 1.3, and 1.4. These inter-language differences seem to suggest the need to distinguish Japanese as a truly mora-based system from English and other languages, where the mora is only partially relevant. These differences will also require serious attention when we attempt to develop the analysis illustrated in (53) – or any analysis related to syllable structure – in our future work.

Turning to the acquisition side of the mora phenomena, there are several hypotheses to account for mora phenomena in Japanese, including those phenomena which seem to be specific to the language (see Kubozono 1995b, 1996a, for details). One such hypothesis is that native speakers of Japanese acquire the prosodic unit of mora under the influence of the essentially mora-based writing system. Two of the three writing systems used in Japanese, namely, *hiragana* and *katakana*, are mora-based systems in which each letter corresponds to a mora.[21] Notably, all the nonsyllabic moras described in (2) are written with independent letters. This orthography-based hypothesis may account for the peculiar phenomena Japanese exhibits with respect to temporal regulation and speech segmentation, although the details need to be considered more carefully.

This said, it must be emphasized that not all the mora phenomena discussed in section 1 can be attributed directly to the orthographic systems. It is highly implausible that the mora evidence from speech errors, for example, is a direct result of orthography, since this kind of performance data is produced by an unconscious process which should in principle be independent of orthography. If the mora evidence could be linked to orthography at all, it would probably mean that the basic structure of the writing system is somehow integrated into the phonological competence of the speakers, which then shows itself in linguistic phenomena.

In connection with this, it is probably worth adding that some of the linguistic evidence putatively supporting the mora in Japanese may well simply reflect the speakers' explicit knowledge of orthography. This probably includes raw data from various word games such as *siritori* and *babibu* languages (Katada 1990, Haraguchi 1996). Unlike speech errors and other data discussed in section 1, linguistic data from word games seem explicitly dependent on the speakers' knowledge of orthography and, therefore, may only be evidence that the Japanese writing system is mora-based. These data can be used as independent linguistic evidence for the mora itself if and only if the mora hypothesis has successfully been tested with preliterate children. In order to avoid methodological problems of this kind, we must carefully examine the processes in which Japanese-speaking children come to acquire the prosodic unit of mora. This is indeed a very important line of research to pursue in the future.[22]

In addition to the questions directly related to the mora, there are a number of important issues that are indirectly related to this prosodic unit. The formation of "foot," for example, raises many interesting questions: e.g. whether it proceeds from left to right or from right to left, whether (or when) it permits

a monomoraic (i.e. degenerate) foot, whether an unfooted syllable may be allowed, and whether it is entirely independent of syllable structure as assumed by Poser (1990). None of these questions has been settled in the literature.

A more fundamental question may be raised concerning the nature of the foot itself. As discussed in section 1.5, the notion of bimoraic foot plays important roles in Japanese phonology and morphology. However, it remains largely unanswered why bimoraic form functions as an optimal structure at all. Note that the notion of foot binarity as proposed by Prince and Smolensky (1993) does not answer this question; it is no more than a restatement of the observation that bimoraic foot serves as an unmarked foot form in a number of languages. This question naturally leads us to ask whether bimoraic foot is a phonological notion at all. Given the fact that bimoraicity can readily be attained by simply lengthening monomoraic syllables at the phonetic level as shown in (22a), it may not be so unrealistic to suspect that what is truly relevant is a bimoraic phonetic duration, and not the bimoraic configuration in phonological representation (Kubozono 1995d). This is another interesting topic for future research.

Finally, the second prosodic unit discussed in this chapter, i.e. syllable, raises as many questions as the mora. The biggest question of all concerns the range of linguistic phenomena which can be generalized in terms of this prosodic unit. Given the several different kinds of evidence for this unit in section 2, it is highly probable that a new analysis based on this unit should provide a more satisfactory and principled account of a wider range of phenomena in Japanese. The key to this new stage of research hinges crucially upon how successfully we can free ourselves of the conventional idea that the mora and the syllable are incompatible with each other in a single prosodic system.

## NOTES

1 The traditional phonemic transcriptions known as *kunreisiki* are used throughout this chapter: e.g. /si/ for [ʃi], /zi/ for [ʤi], /ti/ for [ʧi], /sya/ for [ʃa], and /ky/ for the onset of *Kyoto*.

2 A phonological process which seems fundamentally similar to this phonetic process of temporal compensation is that of vowel epenthesis in loanword phonology. A language with a very simple syllable structure, Japanese inserts a vowel wherever necessary when it borrows words from a foreign language with a more complex syllable structure. Interestingly, the value of the epenthetic vowel is determined by the phonetic quality of the preceding consonant (Lovins 1975), suggesting a tight relationship within the unit of CV: (i) /i/ is epenthesized after [ʧ] and [ʤ] (e.g. *match* → [mat.ʧi], *edge* → [ed.ʤi]) and marginally after /k/ (e.g. *ink* → /in.ki/, *strike* "industrial action" → /su.to.rai.ki/); (ii) /o/ is epenthesized after /t/ and /d/

(e.g. *pet* → /pet.to/, *bed* → /bed.do/), and (iii) /u/ is epenthesized elsewhere (e.g. *box* → /bok.ku.su/). The same cohesiveness between the onset and the vowel also shows itself in the phonetic assimilation of consonants. Namely, an onset consonant tends to assimilate to the quality of the following vowel, not of the preceding vowel. Thus /s/ shows an allophonic variation between [ʃ] (before /i/) and [s] (before any other vowel), and /h/ exhibits an alternation between [ç] (before /i/), [Φ] (before /u/), and [h] (elsewhere). This contrasts with the assimilation of consonants to their preceding vowel which is observed in many languages; in German, for example, the voiceless velar fricative /x/ assimilates to [ç] when it appears after a front vowel, e.g. *ich* [iç] vs. *Buch* [bux].

3 The vocabulary of Japanese falls into two classes, accented and unaccented words. Unaccented words are defined as words which have a flat pitch, i.e. no abrupt pitch drop, at the phonetic output. The accentedness of a particular item is largely lexical and is not readily predictable on the basis of its linguistic information (some exceptions are discussed in section 2.1.2). A statistical study cited in Hayashi (1982: 331) shows that unaccentedness is not exceptional but actually accounts for a majority of Japanese words, especially words of native and Sino-Japanese origins. This chapter employs the conventional notation whereby unaccented words are not marked by a diacritic or anything equivalent to it.

4 This lengthening process is often apparently blocked in sentence-final positions, where vowel length may be neutralized by an independent vowel shortening process: e.g. /itai/ → /ite:/ ~ /ite/ "ouch!"

5 Classical Japanese had only CV syllables except in word-initial position, where an onsetless syllable was also allowed.

6 This mora-based change can be understood more easily if the moraic obstruent is represented by an abstract symbol (/Q/ in the following transcription): i.e. kuu.bo mi*Q*.do.wee → kuQ.bo miQ.do.wee.

7 Exceptions to this generalization include trimoraic forms such as *so.re-n* (<so.(bi.e.to) re-n.(po-o) "Soviet Union") and *da-n.pa* (<da-n.(su) pa-(a.ti-i) "dance party") as well as the unusual bimoraic form of *be.a* (<be-(e.su) a-(p.pu) "base-up").

8 The bisyllabic input forms in (22a) have a geminate consonant in modern Japanese: e.g. mit.tu (<mi.tu), yot.tu (<yo.tu).

9 Essentially the same situation is found in the citation of modern numerals. Thus monomoraic forms, e.g. /ni/ "two" and /go/ "five," are lengthened to attain bimoraic length and, moreover, bimoraic forms such as /yon/ "four" and /kyuu/ "nine" are chosen in preference to their monomoraic variants, /si/ "four" and /ku/ "nine" (Itô 1990). Similarly, the minimal bimoraic length is kept when the twelve horary signs in the traditional calendar are pronounced in sequence: i.e. [nee, usi, tora, uu, tatu, mii, uma, hituzi, saru, tori, inu, ii] for /ne, usi, tora, u, tatu, mi, uma, hituzi, saru, tori, inu, i/ "mouse, ox, tiger, rabbit, dragon, snake, horse, sheep, monkey, chicken, dog, wild boar."

10 A crucial difference between (Tokyo) Japanese and other languages with a minimality

constraint is that underived words in Japanese are exempt from this constraint: Japanese permits monomoraic content words such as /te/ "hand" and /ka/ "mosquito." In other words, the minimality constraint applies only to derived words, or words produced via a productive word formation process in Japanese. Note that this distinction between derived and underived words may not be necessary in Kinki Japanese spoken in Kyoto and Osaka, where monosyllabic CV words are generally lengthened to bimoraic length: e.g. [te:] for /te/ and [ka:] for /ka/. In this dialect, the minimality constraint applies to all the vocabulary just as it does in many other languages sensitive to a similar constraint.

11 The same typology by J. D. McCawley (1978) would classify Kinki (Osaka/Kyoto) Japanese as a "mora-counting, mora language." A crucial difference between Tokyo Japanese and Kinki Japanese is that moraic nasals and other special moras often bear an accent on their own in the latter: for example, in such words as *on'gaku* "music" and *kin'tetu* "Kinki Railways" only the moraic nasal bears a high tone. It remains a question, however, whether the syllable is totally irrelevant in the description of this dialect.

12 There are some exceptions to the regularity described in (29a): e.g. ni'ngyo + hi'me → ningyo'][hime] "mermaid, princess; Little Mermaid;" yoyaku + se'ki → yoyaku'][seki] "reservation, seat; reserved seat" (Kubozono 1997). Note that the existence of these exceptions does not constitute evidence against the Nonfinality constraint described here.

13 Hypothetical words of the syllable structure in (32a) often permit a variant pattern whereby an accent is located one mora leftward: e.g. re'.ba.no-n and re'.no.ba-n. This reflects a new accent pattern illustrated in (39) in section 2.3.2 below.

14 The same constraint is seen to operate in the less productive cases of loanword clipping where the word-initial portion is truncated: (he.ru).me-t.to "helmet," (a.ru).ba-i.to "Arbeit, part-time job," (a.do).bai.zaa "adviser." Note that the last example cannot be reduced to the monosyllabic form, *zaa*.

15 See Haraguchi (1996) for additional morphological evidence for the syllable in Japanese.

16 Apart from compensatory lengthening, the notion of syllable weight provides a unified and insightful account of many processes which have hitherto been described as segmental and/or moraic phenomena. These include the historical process of *onbin* and the structure of children's language or "motherese:" see Kubozono (1995c) for a new analysis of these phenomena.

17 The lefthand member of the pairs in (42a) was originally bisyllabic and was stressed on the initial open syllable: e.g. *wí.se*. The righthand member of the same pairs, on the other hand, had a closed stressed syllable throughout the history of English: e.g. *wís.dom*.

18 This shortening process is quite productive in the loanword phonology of Japanese and can be differentiated from many sporadic instances involving vowel shortening such as /po.su.to/, */pou.su.to/ "post" and /fi.ru.daa/, */fii.ru.daa/ "fielder."

19 Some speakers of Tokyo Japanese accept the pronunciation in which the CA docks onto the final mora of N1, or the moraic nasal in these compound expressions: e.g. /raiN' = ga.wa/, /de.zaiN' = ha.ku/. These speakers usually place a CA on the final mora in other compound nouns such as those in (48) too, e.g. /amazoN' = gawa/, which implies that the moraic nasal has established itself as a syllable nucleus in their grammar. However, the existence of this variant accent pattern does not invalidate the argument here: what is relevant is the fact that the CA almost never docks onto the initial mora of the trimoraic sequences, i.e. */ra'iN = ga.wa/, */de.za'iN = ha.ku/.

20 Opinions differ on whether the onset consonant(s) belongs to the mora (Hyman 1985, Kubozono 1985, Itô 1989) or directly to the syllable (Hayes 1989).

21 The sole exception to this is in writing moras involving a consonant-glide sequence in the onset position, e.g. /to-o.*kyo*-o/, which is represented with two letters, one of which is a subscript.

22 This is a research area largely unexplored. See Mazuka et al. (1996) and Ito and Tatsumi (1997) for experimental work on this topic.