Japanese Folk and Children's Songs:

A Generative Textsetting Model

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1. Introduction·

Textsetting attempts to explain the intuitions of speakers regarding the setting of words to music. As Hayes (1994: 2) points out, normally only the first verse of a song is aligned so that the syllables or words correspond with the written music. It is taken for granted that singers are able to set the remainder of the verses to the rhythm of the music by themselves. According to Halle and Lerdahl (1992: 5), textsetting is an "attempt to achieve the best possible fit between the abstract structures representing rhythmic and linguistic surfaces", something which even inexperienced singers are able to do automatically. The theory of rhythmic structure used here is taken from Lerdahl and Jackendoff's *A Generative Theory of Tonal Music* (1983), and will be explained further in section 3.7..

In English, stress is the overriding factor in determining how lyrics are set to music. The more relative linguistic stress a syllable receives, the more rhythmically strong a beat to which it is assigned (Halle & Lerdahl, 1992: 4). Stressed syllables not only tend to fall on stronger beats, but last for a longer duration ~~of time~~ (Hayes, 1994: 7-8). These are well-established facts. If, however, a language lacks the property of stress, by what linguistic criteria does it set text to rhythm? The purpose of this study was to discover this through an analysis of Japanese folk and children's songs. The linguistic criteria examined (Burling) here were chosen somewhat at random; because ~~no~~ little previous work has been done in the area of textsetting in stressless languages, there was little precedent to follow. Accent in Japanese, the closest analog to English stress, was found to have some relevance in textsetting, although not overwhelmingly so (section 5). The sonority patterns of longer, 'heavy' syllables also bear upon textsetting (section 6) as do word and phrase junctures (section 7). Japanese, lacking stress, apparently has a broader, if shallower, base of criteria by which to set text to rhythm than does English.

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2. Overview of Japanese Phonology

Since this topic obviously covers too broad a field to be adequately explained in an "overview", I will confine myself to a simple discussion of the topics directly relevant to this paper: accent, moras, and syllables.

2.1. Accent

As noted above, Japanese does not have stress as we know it in English. In English, stressed syllables are those which take more energy to say (Ladefoged, 1982: 225), resulting in sounds made prominent by the combination of their relative loudness, length, and higher pitch (O'Grady, et al., 1989: 39). In contrast to this stress-accent pattern, Japanese is a pitch-accent language. Each mora (a phonological unit, discussed in 2.2) can have either high (H) or low (L) pitch* within a particular word. Unlike English, in which stressed syllables almost never occur adjacent to one another within a word, Japanese often has sequences of H moras. The following examples illustrate some typical accent patterns:

(1)	a. hakujitsu	LHHH	'broad daylight'
	b. kíndachi	HLLL	'young nobleman'
	c. kobáshiri	LHLL	'trot'
	d. shirabéru	LHHL	'to investigate'
	e. kaminarí	LHHH	'thunder'

The melody of a word can be predicted, given knowledge of which mora, if any, is accented. The typical pattern for an unaccented word is shown in (1a): the first mora is low and the rest are high. Examples (1b)-(1e) illustrate the effect of an accented mora in various positions. The basic pattern is followed until the accented mora is encountered. This accented mora is always high, and those following it are all low. As examples (1a)

* Presented here is the traditional view of Japanese accent. A more recent theory also posits moras without any accent, but that is not important for the purpose of this paper.

tone

and (1e) show, the accent patterns of unaccented words and final mora-accented words in isolation are the same. The difference can be noted, however, when grammatical particles like the topic marker 'wa' are added. The following examples illustrate this as well as the distinctiveness of accent in Japanese:

(2)	a. kása	HL	'umbrella'
	kásawa	HLL	
	b. kasá	LH	'volume, quantity'
	kasáwa	LHL	
	c. kasa	LH	'syphilis'
	kasawa	LHH	

Japanese nouns have a number of possible accent patterns (Vance p. 80). A noun having *n* short syllables would have $n + 1$ possibilities: any of the moras could be accented, or the word could be unaccented. The phoneme sequence *kasa*, for example, has the three possibilities shown in (2), all of which happen to be realized in the lexicon. Given syllables longer than one mora, this situation changes; this will be discussed in the following section. Verbs and adjectives have a more limited choice of patterns (Vance, p. 85-87). If ~~accented~~ it appears at all, the accent appears on the second or third mora from the end, depending on the morphological form of the word. Some verb forms are always accented whether or not the base form of the verb is accented.

(3) naru 'ring' (nonpast) naréba 'ring' (conditional)
(Vance's example, p. 87)

2.2. Moras vs. Syllables

The standard unit of length and rhythm in Japanese is generally agreed upon to be the mora. A mora may phonetically consist of a CV sequence, a vowel, a nasal, or a glottal stop. Both the nasal and glottal stop must be syllable-final, while the CV sequence and vowel may occur anywhere.

(4) a. issei i-?-se-i 'generation'

b. kenen	ke-n-e-n	'be constantly on guard'
c. kenen	ke-ne-n	'fear'
d. bukka	bu-?-ka	'goods'

According to most studies, it takes roughly the same amount of time to say each mora, although there has been controversy of late. (Vance, p. 70) Thus (4b), containing four moras, would take a longer time to say than (4c), which has three moras. Japanese, then, is considered a "mora-timed" language, as opposed to English which is stress-timed.

The fact that moras have psychological reality to the Japanese speaker is indisputable. When pronouncing a word slowly for maximum clarification, a speaker will divide the word into moras. An ancient form of poetry, the haiku, employs a strict pattern of three lines, the first and third containing five moras and the second containing seven. On a more theoretical note, Vance (p. 65) claims that some accent rules are much more easily explained by the use of moras as phonological units; e.g. recently borrowed words and nonsense words tend to be accented on the third mora from the end.

The relevance of the syllable in Japanese, by contrast, has been hotly debated. There is no doubt that syllables, as peaks of sonority or prominence, exist in Japanese distinct from moras. For example, [kaasan] 'mother' and [ke?kon] 'marriage' have two syllables each: [kaa-san], [ke?-kon], but four moras: [ka-a-sa-n], [ke-?-ko-n]. The question is whether the division of words into syllables can be justified by phonological or psychological means. Vance (p. 65) is among those who believe the syllable is pertinent in Japanese.

Accepting this view, the majority of moras of the CV and V type are syllables in their own right, but "heavy syllables" of more than one mora also exist. Vance (p. 64) gives the following general schema for the structure of heavy syllables:

(5) $$(C)(y)V\begin{Bmatrix} V \\ N \\ ? \end{Bmatrix}$$

The 'y' indicates an optional palatalization which is not in itself a mora, nor does it add any length to the attached consonant. [?] is a glottal stop.

Falling outside this schema are three-mora syllables, henceforth referred to as superheavy syllables. These are quite rare and usually occur through morphological processes or in loanwords. Their possible forms are shown in the following examples, all from my database:

(6)
a. chii?to $((C)V_1V_1?)$ 'a little'
b. iinda $((C)V_1V_1N)$ 'is good'
c. hai?teku $((C)V_1V_2?)$ 'enter'

The form CVN? is possible only when a word-final CVN is said with particular force. This is a nonstandard variation found written only in cartoons and comics, according to my informant. A typical example would be:

(7) iyan? 'no!'

Vance (p.75) believes that this sort of CVN? utterance is not a superheavy syllable, or even a heavy syllable, but is "squeezed into the duration of a single mora". My informant, however, did not feel that there was any shortening of the moras, nor did she pronounce them in this way.

Vance justifies his belief in the syllable by citing evidence regarding accent rules.(pp. 65-67) The syllable, he claims, is also an "accent-bearing unit" and is a convenient tool with which to make generalizations about accent. As noted in section 2.1, a noun containing n short syllables (and n moras) has one of $n + 1$ possible pitch patterns. However, a noun containing n heavy syllables (and at least $2n$ moras) is also restricted to $n + 1$ possible accent patterns, because the second (and third) moras of a heavy syllable may not be accented. This certainly suggests that the syllable has some phonological reality. As for its psychological reality, I am testing that to a limited extent through this research.

3. Method

3.1. Data Corpus

My data consists of thirteen Japanese folk/children's songs in 2/4 and 4/4 time. Each song is between one and five verses long, and all in total yielded 154 lines of 16 beats. The songs were taken from Fukuda's (ed.) *Kashu: uta no izumi* (1970) and Ito's (ed.) *Nihon no shiika* (1969). These particular songs were chosen for their time signature and because I was already acquainted with them from my own childhood. This familiarity would, I hoped, allow me to encode them more effectively. I also consulted a native speaker of Japanese who was familiar with these songs. My consultant, a 49 year old woman, was raised in Hiroshima City but is also acquainted with the Tokyo dialect of Japanese, which is considered standard. When she specifically mentioned differences between her dialect and standard Japanese, I adhered to the standard in encoding my data.

3.2. Mora Onset

The songs divided into lines of 16 beats each, with one beat having the largest possible rhythmic correlate, depending on the song. Thus one beat corresponded to an eighth note in some songs and a sixteenth note in others. Naturally a beat retained the same value throughout each song. I encoded the onset of each mora as a 1 and the continuation of the same mora or a rest as 0, producing a sequence of 16 1's and 0's for each line. For example, a hypothetical line containing a sequence of moras initiating on every eighth note where the rhythmic correlate was an eighth note would look like 1111111111111111, while the same line with a sixteenth note rhythmic correlate would be 1010101010101010.

For the first verse of each song, I used the textsetting of the books insofar as they did not conflict with my own memory of the way the song should be sung. If a conflict arose, I consulted the native speaker, and on three occasions included two variations of the rhythm in my data. For the rhythm of all subsequent verses, which were not set to the music in the books, I relied on the native speaker's intuition.

3.3. Accent

First, I elicited all of the lines from my consultant in a spoken manner (as opposed to being sung or chanted) and recorded whether I heard these as high or low/neutral. Then I checked my findings against *Kenkyusha's New Little Japanese-English Dictionary* (1965) and the section on accent in Vance's *An Introduction to Japanese Phonology* (1987). I asked the native speaker to repeat those lines where I found irregularity. Next I threw out those irregular pitch differences which were probably caused by sentence intonation, such as a high mora at the end of a question. Finally, I made an informed decision on the rest of the problem spots, generally giving the dictionary's advice precedence over my own imperfect ear. It is possible that there are still mistakes in this area of the data, but for the purposes of this pilot study I believe it to be sufficiently accurate. Accented moras are marked as 1; unaccented moras as 0. Each line has as many 1's and 0's as it has moras. So the line *itsukano yumeno*, in which the moras 'i' and 'me' are accented, would be coded as '1000010'.

3.4. Heavy Syllables

The onsets of all syllables are marked with 1, and the second and third moras of heavy syllables are 0. I relied heavily on Vance (1987) for his definition of a heavy syllable, as well as using my own intuition. The line *ame ame fure fure*, which contains no heavy syllables, would be marked as '11111111', while the following line in the song, *kaasan ga*, would be coded as '10101' since 'ka-a' and 'sa-n' are both heavy.

3.5. Junctures

Junctures were marked as if moras continued all the way through to the onset of the next mora. Thus they are considered as occurring in the position directly before the onset of the following mora. For example, in a boundary occurring between two words, one word ending before position 6 and the next starting on position 9, the juncture would be counted on position 8. To illustrate, the two-word line *sakura sakura*:

(8)

position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	sa	-	ku	-	ra	-	-	-	sa	-	ku	-	ra	-	-	-

The word boundaries would be coded on positions 8 and 16.

Five types of junctures are encoded in this data. A 0 indicates no boundary, and a 1 stands for a morpheme boundary within a word or a word-phrase. Japanese can have long noun phrases or verb phrases tied together with enclitics in which the distinction blurs between word and morpheme boundaries. (e.g. the noun phrase *goyou-no-nai-mono*: "business"-possessive marker-"not/isn't"-"thing": "something that doesn't have business [being there]") My consultant also was not certain whether these consisted of one word or many but agreed that they were different from words that were more recognizably separate. I decided, therefore, to include them along with verbal morphology under juncture 1. I excluded noun and adjective morphology because I think this generally has less psychological reality to the speaker. Just because a noun is written with two ideophones doesn't necessarily mean it is still thought of in those terms, whereas verb forms are systematic and learned. Juncture level 2 designates a particle host boundary, the gap between a word and its suffixed enclitic. Juncture 3 denotes a definite word boundary or a particle, and juncture level 4 stands for anything larger than that: a phrase or sentence. A marking of juncture 4 indicates that a level 3 juncture is also present. The following lines illustrate juncture coding:

(9)

a.

0 2	3	0 2	3	0 2	4
kago	*no*	*naka*	*no*	*tori*	*wa*
basket	possessive marker	inside	poss. marker	bird	topic marker

"The bird inside the basket..."

b.

0 3	0 3	0 0 4
itsu	*itsu*	*deyaru*
when	when	come out

"...when, when will [it] come out..."

3.6. Statistics

Each line was coded by hand for mora onset, accent, heavy syllables, and junctures. The statistics for rhythm, accent, and heavy syllables were then compiled by hand and verified by computer (program written by Bruce Hayes); the juncture statistics were done entirely by computer. The statistics are presented in a three-line format below a representation of the metrical grid. The first line indicates the positions in the line from 1 through 16. The second gives the actual figures of the data: the number of mora onsets, accented moras, and heavy syllable onsets corresponding to each position. The figures for junctures should be read as occurring between the position on which they are coded and the next. Therefore a figure of 8 level one junctures corresponding to position 12 should be interpreted as 8 level one junctures occurring between positions 12 and 13. The third line in the statistics for accents, heavy syllables, and junctures presents the data as ratios adjusted for the tendency of moras to occur more frequently in some line positions than in others. The actual ratios used are:

(10)

a. accents (heavy syllable onsets) in x position/ total accents (heavy syllable onsets)
----
moras in x position/ total moras

and

b. level y junctures in x position/ total level y junctures
----
moras in x + 1 position/ total moras

which give the frequency of each statistic relative to the average frequency of moras starting in x position. A ratio larger than 1 indicates a greater than average propensity for heavy syllable onsets, accented moras, or junctures to occur there, taking into account the natural distribution of moras.

3.7. Definitions

The following is a grid marking relative metric strength in a sixteen-beat line, as per Lerdahl and Jackendoff's metrical well-formedness rules (1983: 69, 72). Each level of X's represents a greater strength than the one below it, and the time interval between beats is consistent. The parentheses represent groups within the levels.

(11) Position Strength

(X								X							)l
(X				X			)h	(X				X			)h
(X		X	)d	(X		X	)d	(X		X	)d	(X		X	)d
(X	X)f	(X	X)f	(X	X)f	(X	X)f	(X	X)f	(X	X)f	(X	X)f	(X	X)f
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

(Lerdahl & Jackendoff, *A Generative Theory of Tonal Music*, 1983)

(12)

Boundaries:

l = line h = hemistich d = dipod f = foot

(13)

Extremely Strong Positions: 1,9

Strong Positions: 1,5,9,13

Semi-Strong Positions: 3,7,11,15

Weak Positions; 2,4,6,8,10,12,14,16

4. Mora Onset

4.1. Inviolable Constraints

(14) **Each mora initiates in only one position.**

This is self-evident.

(15) **Each mora initiates in a separate position.**

This relates to rule (29) in section 7.1.. A possible violation to (15) and (29), in which syllables may be the units that correspond to positions, will be discussed in section 8. In general, however, the evidence indicates that the mora is the relevant unit.

4.2. Trends

(16) **Moras gravitate towards stronger positions.**

This is evident by the following data, in which the extremely strong positions at the beginning of hemistiches, 1 and 9, have the most moras. Position 9, in fact, is filled in all 154 lines in my data. The positions having the next greatest numbers of moras are the strong positions 5 and 13, and then the semi-strong positions 3, 7, and 11. Positions 4 and 8 are special cases which I will discuss later.

(17) Number of Times a Mora Begins in Each Position

X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	**3**	4	**5**	6	**7**	8	**9**	10	**11**	12	**13**	14	15	16
145	29	**86**	109	**150**	34	**87**	80	**154**	25	**69**	63	**106**	13	23	25

4.3. Rhythmic Patterns - Dotted Songs

There is a certain type of children's song in Japanese that has the same, almost invariable rhythm. Fifty-five lines in my data, out of a total of 154, belonged to songs of this sort. The rhythm of these songs involves alternating lines of 1001100110011001 and 1001100110000000 as in the following example of the consecutive lines *ame ame fure fure* and *kaasanga:*

(18)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
a	-	-	me	a	-	-	me	fu	-	-	re	fu	-	-	re

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
ka	-	-	a	sa	-	-	n	ga	-	-	-	-	-	-	-

I will henceforth refer to songs with these rhythms as "dotted", since they contain sequences of a dotted eighth note followed by a sixteenth. All other songs I will call "undotted".

Obviously, the mora onset data for dotted songs alone will be different from undotted songs. This is why the weak positions 4 and 8 have, in the full corpus (17), so many moras.

(19) Number of Times a Mora Begins in Each Position: Dotted Songs Only

X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	3	**4**	**5**	6	7	**8**	**9**	10	11	**12**	**13**	14	15	**16**
55	0	0	**52**	**53**	3	3	**48**	**55**	1	0	**25**	**27**	3	0	**21**

The anomalous moras found in positions 6, 7, 10, and 14, as well as the lack of the full complement of 55 moras in positions 4, 5, and 8, are located in only seven lines of the data. The other 48 lines of the dotted data are rhythmically completely regular, as exemplified in (18). Of the seven irregular lines, three are the same unusual line repeated thrice in a three-verse song: *ohayoo ohayoo*, which seems to be 1001110010011100 rather than 1001100110011001: (can you prove this?

(20)

1	2	3	4	5	**6**	7	8	9	10	11	12	13	**14**	15	16
o	-	-	ha	yo	**o**	-	-	o	-	-	ha	yo	**o**	-	-

Because the misplaced moras on 6 and 14 are the second moras of heavy syllables and the same vowels as the preceding moras, it is impossible to hear exactly where they are placed, where the moras initiating on 5 and 13 end and the next begin. If they were coded as initiating on 8 and 16, it would not change the way the song sounds, and the rhythm would conform to the normal dotted pattern. However, the actual notes of the music were printed not in a dotted rhythm, but as if (20) were the correct mora onset coding. Another anomalous dotted line is shown in (34).

4.4. Rhythmic Patterns - Undotted Songs

Undotted songs have a much greater variety of possible mora onsets. One common rhythm is 1010101010101000, as shown for the consecutive lines *itsu itsu deyaru* and *yoakeno banni*:

(21)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
i	-	tsu	-	i	-	tsu	-	de	-	ya	-	ru	-	-	-
yo	-	a	-	ke	-	no	-	ba	-	n	-	ni	-	-	-

Another possibility is 1111111111111000, as found in the consecutive lines *chii?to tooshite kudashanse* and *goyounonaimono tooshasenu*:

(22)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
chi	i	?	to	to	o	shi	te	ku	da	sha	n	se	-	-	-
go	yo	u	no	na	i	mo	no	to	o	sha	se	nu	-	-	-

These two are the main rhythms found, but their structure is by no means as rigid as the dotted songs. Each undotted song has for its basic rhythm one of the above structures, but within the song there is variation around this theme. For example, the line following those in (21) is a variant in the form of 1011101110111000:

(23)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
tsu	-	ru	to	ka	-	me	to	su	-	be	?	ta	-	-	-

The line preceding those in (22) also varies; 1111011111111000:

(24)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
te	n	ji	n	-	sa	ma	no	ho	so	mi	chi	ja	-	-	-

Thus the statistics for mora onset in undotted songs also show a much greater variety:

(25) Number of Times a Mora Begins in Each Position: Undotted Songs Only

X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	**3**	4	**5**	6	**7**	8	**9**	10	**11**	12	**13**	14	15	16
90	29	**86**	57	**97**	31	**84**	32	**99**	23	**69**	38	**79**	10	23	4

As can be seen, more moras occur on the strong and semi-strong beats, as stated originally in (16). Position 15 contains surprisingly few mora onsets, considering it is a semi-strong beat, and positions 14 and 16 are likewise relatively empty, even for weak positions. This is because the base undotted rhythms, as shown in (21) and (22), do not have mora onsets on the last three beats.

(26) **For undotted songs, the last three positions in a line are minimally filled.**

4.5. Dotted Song Theory

It is possible that the dotted songs should be coded not in 16-beat lines but in 32-beat lines, with a sixteenth note remaining the rhythmic correlate, thus collapsing every two lines together. It would make more sense to have an invariable one-line repeating pattern rather than the two-line sequence posited in 4.3.. Also, this would better fit the general tendency shown in undotted songs towards lacking mora onset on the last three positions in a line (26), and on position 16 especially (25).

Hayes (personal communication) has suggested that the dotted songs be coded in a 16-beat line, but with an eighth note rhythmic correlate. A necessary extra stipulation would be that two eighth notes together be realized unevenly in the rhythm, i.e. as the "dotted rhythm" of a dotted eighth plus a sixteenth. This is perhaps an even better alternative. It has the additional benefit of explaining why dotted songs never have, in the analysis given in 4.3., more than eight moras per line. This would also account for the fact that moras on sixteenth notes are never found together. Each mora would still be assigned its own position, and would not conflict with (15). The statistics for the rest of this study were done according to the 4.3. analysis, but it would certainly be worthwhile to consider this method as well.

5. Accent

Accent in Japanese is a subtler thing than stress in English. The average native speaker finds it difficult to explain the patterns, and students of the language are not even taught that it exists. It was therefore particularly gratifying to find that accent indeed has bearing on textsetting, although it is not the powerhouse that its closest analog is in English.

5.1. Trends

(27) **Accented moras gravitate towards stronger positions.**

This can be seen in the following statistics:

(28) Positions of Accented Moras

X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	**3**	4	**5**	6	7	8	**9**	10	11	12	13	14	15	16
45	3	**22**	8	**29**	3	8	4	**28**	2	9	2	12	2	2	0
2.08	.69	**1.71**	.49	**1.29**	.59	.61	.33	**1.22**	.53	.87	.21	.76	1.03	.58	0

They also seem to prefer the strong positions occurring in the first hemistich of each line, and the closer to the first position, the higher the ratios of accent placement (except for the semi-strong position 7). One possible explanation for this is the phenomenon of downdrift in Japanese phrases. Within a phrase, the first H accent is of a relatively higher pitch than the next, which is in turn higher than the third H, and so on. As we will see in section 8, phrase onsets tend to coincide with line onsets. Because of downdrift, perhaps the closer to the beginning of the phrase, or the beginning of a line, an accent is placed, the stronger and more preferable the position is seen as.

5.2. Other Topics

As mentioned in 2.1. and exemplified in (2b) and (2c), unaccented words and words with final-mora accent have identical pitch pattern in isolation. It would be interesting to know whether word-final accents in words without enclitics have reality in textsetting; that is, whether they follow (27). Unfortunately, there were so few true examples of this in my data corpus (two), that I was unable to test this. Further research could help to clarify this. The complete lack of accented moras falling on position 16 reflects not only the infrequency of mora placement there, but this infrequency of word-final accent in words without particles.

Additional investigation could also be done on the relevance of phrase accent in textsetting. I concentrated on the accents of individual words in the above section, but according to Vance (p. 103), a larger context for accent also exists depending on how speakers divide up phrases.

6. Heavy Syllables

6.1. Inviolable Constraints

(29) **Heavy syllables of two moras always occupy at least two positions in a line; superheavy syllables of three moras occupy at least three positions.**

According to Vance (1987: 72), syllables of three moras are usually reduced to the length of a two mora syllable in conversational speech. Rule (29) serves as evidence that superheavy syllables have at least the psychological re~~al~~ity value of three moras. The validity of this rule is discussed further in section 8.

(30) **2. A heavy syllable will never be initiated on position 16.**

This is obvious if one considers that there are no cases in which words carry over line boundaries; i.e. a word never starts on one line and ends in the next. It is thus evident that syllables also do not carry over lines. There have been no instances where it was necessary to compress two moras into one position in a line (15), and since a heavy syllable by definition always consists of at least two moras, its onset will never occur in the last position in a line.

Although in my data, heavy syllables were also never introduced on positions 10 or 15, this could occur in a different sample. These are not optimal positions for heavy syllables, as I will explain later, and there are relatively few mora onsets of any kind in these positions (25 and 23 respectively, of a total of 1197). There are however no *rigid* constraints against this occurrence.

6.2. Trends

(31) **The position of the onset of a heavy syllable should be stronger than the positions of the second (and third) moras of the syllable.**

This statement is overwhelmingly supported by my data. Out of 146 instances of heavy syllables, 134 of them are metrically matched according to the above rule, and only 12 are mismatched.

(32) **Corollary: The onset of a heavy syllable tends to gravitate toward stronger ~~syllables~~ positions.**

The truth of this corollary can be seen in the following statistics:

(33) Positions of Heavy Syllable Onsets

X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	3	4	**5**	6	7	8	**9**	10	**11**	12	**13**	14	15	16
38	3	10	3	**33**	3	3	1	**24**	0	**12**	1	**15**	2	0	0
2.15	.85	.95	.23	**1.80**	.72	.28	.10	**1.28**	0	**1.42**	.13	**1.08**	.63	0	0

The dipod-initial positions of 1, 5, 9, and 13 all have above-average frequencies of heavy syllables, as expected. What is somewhat surprising is the high ratio of heavy syllable onsets in position 11, which is only semi-strong.

One of the rare anomalous lines within the dotted songs had the following onset pattern of 1001100011000000 rather than the expected 1001100110000000.

(34)

X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	3	4	5	6	7	**8**	**9**	**10**	11	12	13	14	15	16
i	-	-	chi	ni	-	-	-	**sa**	**n**	-	-	-	-	-	-

In order for this line to be regular according to the dotted songs, *sa* should initiate on the eighth position and *n* on the ninth. However, this would go against the above stated rules (31) and (32) of where heavy syllables ought to initiate. Here (31) and (32) appear to have won out over the dotted regulation of rhythm. This is not always the case, however; there are five examples in the dotted songs of mismatched heavy syllables, disobeying (31).

6.3. Superheavy Syllables

There are only three occurrences of superheavy syllables, containing three moras, in my figures, all of which are shown in (6). Two of these were initiated in the first position and the remaining one in the ninth position. Although there are not enough instances of superheavy syllables here to validate the extrapolation of hard-and-fast rules, I find it notable that all three occur in extremely strong positions at the onsets of hemistiches.

(35) Positions of Superheavy Syllables

X								X							
X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	3	4	5	6	7	8	**9**	10	11	12	13	14	15	16
2	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0
5.50	0	0	0	0	0	0	0	**2.59**	0	0	0	0	0	0	0

Given more data, one might investigate whether the more phonological or psychological weight a syllable carries, the stronger the position at which it prefers to initiate. This seems here to be the case.

6.4. Mismatched Heavy Syllables

Those heavy syllables initiating in the weak positions 2, 4, 6, 8, 12, and 14, twelve in total, do not obey (31), as their second moras fall on stronger beats than do their onsets. Unfortunately, there are few significant generalizations to be made about these misfits. The distribution is fairly evenly spaced across the weak beats in lines, and all types of heavy syllables (CVN, CVglottal stop, CV_1V_2, CV_1V_1) are represented.

7. Junctures

7.1. Inviolable Constraints

(36) **Phrasal boundaries (level 4) may only occur directly before extremely strong positions (between hemistiches).**

(37) **Corollary: Level 4 phrases must be initiated on extremely strong beats.**

(38) **A level 3 juncture always occurs at the end of a 16-beat line; words may not carry over to the following line.**

(39) **Corollary: Junctures 1 and 2 may not occur line-finally because they indicate by definition a word in progress.**

It appears that particles are considered part of their host word to the extent that they are never split on different lines.

(40) **Junctures of level 3 or greater may not occur in immediate post-strong position.**

In other words, there are no cases where words initiate in positions 2, 6, 10 or 14. Level 2 junctures also are very unlikely to occur directly after the first position in a dipod. In my data, I have only one example of this; one level 2 juncture falls after beat 9.

7.2. Trends

(41) **The onsets of words and phrases overwhelmingly gravitate toward strong positions.**

This is borne out by my data showing a preponderance of level 3 junctures in positions 4, 8 and 16. Level 4 junctures, as stated above, occur exclusively in positions 8 and 16. The results were as follows:

(42) Level 3 Junctures

X								X							
X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	3	**4**	5	6	7	**8**	9	10	11	12	13	14	15	**16**
0	2	2	**50**	0	2	6	**101**	0	4	2	12	0	0	2	**154**
0	.08	.07	**1.18**	0	.08	.27	**2.33**	0	.21	.11	.40	0	0	.28	**3.77**

(43) Level 4 Junctures

X								X							
X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	**16**
0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	**89**
0	0	0	0	0	0	0	.86	0	0	0	0	0	0	0	**7.35**

Starting at level 3, the larger the juncture, the more likely it is to seek a stronger position.

Results regarding junctures 1 and 2 were not so clear-cut as to whether these smaller junctures play a role in the positioning of moras within a line. Juncture 2 was an experiment to see how important the psychological boundary was between a Japanese word and its enclitic; for our purposes they seem to be treated as essentially one entity. The data for juncture 2 can be mostly explained by reference to level 3 data, since particles and word boundaries always follow particle host boundaries. For example, the large ratio of level 2 on position 15 is explained by the large ratio of level 3 on position 16. It is worth mentioning again, however, that the strong positions are almost empty.

(44) Level 2 Junctures

X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	3	4	**5**	6	7	8	**9**	10	11	12	**13**	14	15	16
0	2	26	7	**0**	18	19	16	**1**	2	9	18	**0**	4	14	0
0	.20	2.10	.41	**0**	1.82	2.09	.92	**.35**	.26	1.26	1.49	**0**	1.53	4.93	0

Juncture 1 shows somewhat more promise. It is possible that trends would be more evident given a more elaborate morpheme coding system. In this data, there is a slight tendency toward weak positions, notably beats 4, 6, 10, 12, and 14 (although position 7 also has a relatively large ratio). This would show that the onsets of word internal morphemes have a slight preference to occur on strong and semi-strong beats.

(45) Level 1 Junctures

X				X				X				X			
X		X		X		X		X		X		X		X	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	2	3	**4**	5	**6**	7	8	9	**10**	11	**12**	13	**14**	15	16
3	7	5	**38**	3	**14**	14	10	2	**15**	7	**21**	0	**4**	1	0
.86	.68	.38	**2.11**	.73	**1.34**	1.45	.54	.67	**1.81**	.92	**1.65**	0	**1.45**	.33	0

8. Problems

Possible violations of (15) and (29), the requirement that each mora initiate ~~on~~ its own beat, may be found within the first four lines of the song "*Chuuri?pu*":

(46)

	X				X				X				X			
	X		X		X		X		X		X		X		X	
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
a)	sa	-	i	-	ta	-	-	-	sa	-	i	-	ta	-	-	-
b)	chu	u	ri	?	pu	-	no	-	ha	-	na	-	ga	-	-	-
c)	na	-	ra	n	da	-	-	-	na	-	ra	n	da	-	-	-
d)	a	-	ka	-	shi	-	ro	-	ki	-	i	-	ro	-	-	-

Each position here is coded as correlating to a sixteenth note, with two measures of two beats each per line. The first and third lines, a) and c), and the second and fourth lines, b) and d), have the same melody. As coded in (46), it presents no challenge to (15) and (29). However, there is a possibility that these should actually be coded as eight-beat lines with each beat an eighth note correlate.

(47)

	1	2	3	4	5	6	7	8
a)	sa	i	ta	-	sa	i	ta	-
b)	chu u	ri ?	pu	no	ha	na	ga	-
c)	na	ra n	da	-	na	ra n	da	-
d)	a	ka	shi	ro	ki	i	ro	-

It is not possible to determine which is the correct representation, simply from this data. Perhaps the fact that the only contents of the weak positions in the 16-beat lines are the second moras of heavy syllables is only a coincidence, in which case the 16-beat analysis is probably correct. On the other hand, if the 8-beat line is correct, this signifies a case in which each position in a line holds one syllable, as opposed to one mora. This problem certainly merits further consideration; perhaps with a larger data corpus, more clear-cut examples of this sort might be found. The overwhelming majority of my data, however, seems to carefully allow for enough space in which to fit all the moras in a line. The following lines, for example, contain five heavy syllables and one superheavy syllable while maintaining the mora-packed rhythm of 1111111111111000:

(48)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
chi	**i**	**?**	to	**to**	**o**	shi	te	ku	da	**sha**	**n**	se	-	-	-
go	**yo**	**u**	no	**na**	**i**	mo	no	**to**	**o**	sha	se	nu	-	-	-

9. Conclusion

Japanese textsetting is based on accent, heavy syllables, juncture patterns, and possibly other criteria yet unknown. One can expect that analysis of textsetting in other languages lacking stress will be similar in the amount of pertinent linguistic criteria. As Hayes (personal communication) points out, if languages do not have stress they seem to "reach out" for a variety of other linguistic information on which to base textsetting. Languages like English that do contain stress use this factor almost exclusively for textsetting.

This field is as yet so neglected that this study only begins to touch upon the possible topics here for discussion. It leaves open an infinite number of important questions, both general and specific. It is difficult to say just how many generalizations can be made about languages lacking stress, in reference to textsetting. Japanese textsetting itself is still largely a morass of uncertainty. The next step to be taken in the analysis of Japanese might be to create a grammar of the sort proposed by Hayes in "An Optimality-Theoretic Approach to Textsetting" which could weigh conflicting rules against one another to produce something close to the intuitively correct results. This pilot study confirms the amount of work left to be done in the field of Japanese, or any non-stress-based, textsetting, but also shows that an analysis not based on stress is possible.

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Nice work! Clear, well-written, + scientifically conscientious.

A +

Kagome kagome
1000101010101000 rhythm
003004 0-no b., 1-morph b. within 'word', 2-particle host b. 3-particle,definite word b.
111111 first mora of syllable
001001 1 = accented mora

kagono nakano toriwa
1011101110101000
023023024
111111111
000100000

itsu itsu deyaru
1010101010101000
0303014
1111111
1010010

yoakeno banni
1010101010101000
1023024
1111101
0100000

tsuruto kameto subetta
1011101110111000
0230230014
1111111101
1001000100

ushirono shoumen dare
1111111110001000
0023010304
1111101011
0000001010

Sakura sakura
1010100010101000
003003
111111
000000

yayoino sorawa
1010101010101000
0023024
1101111
0000100

miwatasu kagiri
1010101010101000
0103004
1111111
0000100

kasumika kumoka
1010101010101000
0024024
1111111
0000100

nioizo izuru
1010101010101000
0013104
1101111
0100010

izaya izaya
1010100010101000
004004
111111
100100

mini yukan
1010101010000000
23004
11110
10000

Otete tsunaide
1010100010111000
1330013
1111101
0110000

nomichio yukeba
1010101010101000
1023104
1111111
1000010

minna kawai*
1010100010101000 1001100010101000
003004
101110
000000

kotorini natte
1001101010011000
1023104
1111101
0000100

utao utaeba
1000101010101010
0230104
1111111
0100001

kutsuga naru
1010100110000000
02304
11111
01000

hareta misorani
1000101010101010
1031023
1111111
1000000

kutsuga naru
1010100110000000
02304
11111
01000

hanao tsundewa
1010100010111000
0230023
1111011
0100000

otsumuni saseba
1010101010101000
1023004
1111111
0000001

minna kawai*
1010100010101000 1001100010101000
003004
101110
000000

usagini natte
1001101010011000
0023014
1111101
0000100

hanete odoreba
1000101010101010
0030104
1111111
1000001

kutsuga naru
1010100110000000
02304
11111
01000

hareta misorani
1000101010101010
1031023
1111111
1000000

kutsuga naru
1010100110000000
02304
11111
01000

Tooryanse tooryanse
1010111011111000
0100301004
1010110101
0010000100

kokowa dokono hosomichijya
1011101111111000
02302301023
11111111111
00010001000

tenjinsamano hosomichijya
1111011111111000
000102301024
101011111111
000000001000

chiitto tooshite kudashyanse
1111111111111000
0003010301003
1001101111101
1000100000100

goyounonaimono tooshyasenu
1111111111111000
0023030301004
1101101110111
0100100000000

kono kono nanatsuno oiwaini
1111111111111000
0323012310023
1111111111101
0000010000000

ofudao osameni mairimasu
1111111111111000
1023002300104
1111111110111
0000010000010

ikiwa yoi yoi kaeriwa kowai
0111111111111110
12301040023003
11110101111110
00010100000010

kowainagaramo tooryanse
0111111110101110
001000301004
110111110101
010000000100

Teru teru bouzu teru bouzu
1111111011111000
030300303003
111110111101
101000010000

ashita tenkini shiteokure
1011111111111000
003002301004
111101111111
011100000000

itsukano yumeno
1010101010001010
0123023
1111111
1000010

sorano yoni*
1001101010000000
02324
11111
10010

haretara kinno
1010101010001010 1010101010101000
0003023
1111101
1000100

suzu ageyo
1010101010000000
03024
11111
00000

Donguri korokoro domburiko
1111111111111000
0003000300003
1011111110111
0000000010000

oikeni hamatte saa taihen
1111111111111100
10230013030004
11111101101010
00100000000000

dojyouga detekite konnichiwa
1111111111111000
0023111400003
1101111110111
0000100010000

botchyan isshyoni asobimashou
1111111111111100
01030023001004
10101011111110
10000000000010

Kompira fune fune
1010101010101010
00030303
10111111
10001010

oiteni hoagete
1010101010101010
00231004
10111111
00000000

mawareba shikoku
1010101010001010
0103003
1111111
0001100

sanshuu nakanogoori
1010101011101110
0003001003
1010111101
0000100000

zouzusan kompira
1110101010101010
001030003
101101011
000001000

daigongen
1010101010100000
000004
101010
001000

Saita saita
1010100010101000
013013
101101
000000

chuurippuno hanaga
1111101010101000
000023023
101011111
011000010

naranda naranda
1011100010111000
00130014
11011101
01000100

aka shiro kiiro
1010101010101000
0303004
1111101
1010000

dono hana mitemo
1010101010101000
0303123
1111111
1001100

kirei da na
1010101010000000
00224
11011
10000

Baraga saita baraga saita
1011111010111110
023014023014
111101111101
000000000000

makkana baraga
1111101010000000
0003023
1011111
0010000

sabishikatta bokuno niwani
1011111010111011
001003023023
111101111111
001000100000

baraga saita
1011101010000000
023014
111101
000000

tatta hitotsu saita bara
1111101010111010
00300301303
10111110111
00001000000

chiisana baraga
1111101010000000
0003023
1011111
0010000

sabishikatta bokuno niwaga
1011111010111011
001003023023
111101111111
001000100000

akarukunatta
1111101010000000
0001004
1111101
0000100

barayo barayo
1000101010101000
023023
111111
000000

chiisana bara
0011101010001000
000304
101111
001000

sonomamade
0010101010001000
01023
11111
00000

sokoni saitete okure
0111111110101000
0230111004
1111011111
0000000000

baraga chitta baraga chitta
1011111010111110
023014023014
111101111101
000000000000

itsuno manika
1011101010000000
023233
111111
100000

bokuno niwawa maeno youni
1011101110111011
023023023023
111111111101
100000100000

sabishiku natta
1111101010000000
0003014
1111101
0010100

bokuno niwano baraga chitte
1011101110111110
023023023013
111111111101
100000000000

shimattakeredo
1111101010000000
0001004
1101111
0100000

sabishikatta bokuno kokoroni
1011111010111111
0010030230023
1111011111111
0010001000100

baraga saita
1011101010000000
023014
111101
000000

barayo barayo
1000101010101000
023023
111111
000000

kokorono bara
0011101010001000
002304
111111
010000

itsumademo
0010101010001000
01023
11111
10000

kokode saiteteokure
0111111110101000
0230111004
1111011111
0000000000

baraga saita baraga saita
1011111010111110
023014023014
111101111101
000000000000

bokuno kokoroni
1011101110000000
0230023
1111111
1000100

itsumademo chiranai
1011101010011010
010230103
111111110
100000000

makkana baraga
1111101010000000
0003024
1011111
0010000

Yuuyake koyakede higa kurete
1111111111111000
0003002323014
1011111111111
0000000000000

yamano oterano kanega naru
1011111111111000
023102302304
111111111111

010001000000

otete tsunaide mina kaero
1011111111111000
113000303014
111110111111
011000000000

karasuto isshoni kaerimasho
1111111111111000
0023002301004
1111101111111
1000000000001

kodomoga kaetta atokarawa*
1111111111111000
0023001401023
1111110111111
0000100010000

marui ookina otsukisama
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003000310104
110101111111
000100000100

kotoriga yumeo mirukorowa
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102302301023
111111111111
000001010000

soraniwa kirakira kin no hoshi
1111111111111000
0233000302304
1111111110111
1000100010000

Ame ame fure fure
1001100110011001
01030103
11111111
10101010

kaasanga
1001100110000000
01023
10101
10000

jyanomede omukai
1001100110011001
00231003
11111110

00000000

ureshiina
1001100110000000
00024
11101
00100

kakemashyo kaban o
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01030023
11111101
00010000

kaasanno
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01023
10101
10000

atokara yukoyuko
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01030103
11111111
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kanega naru
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02304
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araara anokowa
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zubunureda
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yanagino nekatade
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naiteiru
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10111

10000

kaasan bokunoo
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01030233
10101111
10001000

kashimashoka
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01024
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00000

kimikimi konokasa
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sashitamae
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kaasanno
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01023
10101
10000

ookina jyanomeni
1001100110011001
0003
10111111
10000000

haitteku
1000101110000000
00104
10011
10000

Ohayoo ohayoo
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00040004
11101110

00000000

yoga aketa
1001100110000000
23014
11111
10000

kireina asadayo
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00030234
11011111
10001000

tobiokiro
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01014
11111
00010

tokeiga natteru
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00230103
11011011
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yondeiru
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00104
10111
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ohayoo ohayoo
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00040004
11101110
00000000

genkidana
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10111
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hayaoki suru kowa
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01030323
11111111
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jyoubuna ko
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00234
10111

00000

chyunchyuku suzumemo
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10111111
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yondeiru
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00104
10111
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ohayoo ohayoo
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00040004
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sutekidana
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makkana makkana
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00030003
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00100010

ohisamada
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tobidero kakedero
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00100010

ichi ni san
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11110
10100

Mukashi mukashi
1001100010011000
003003
111111

000000

sono mukashi
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03004
11111
00000

shiinoki bayashino
1001100110011001
01130023
10111111
10000110

sugu sobani
1001100110000000
03024
11111
10100

chiisana oyamaga
1001100110011001
00031023
10111111
00100010

attatosa
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marumaru bouzuno
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waraimono
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korekore suginoko
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ohisama
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nikoniko
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0004
1111
1000

koe kaketa
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03004
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koe kaketa
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