Tone Harmony Schema: A Theory of Pitch Accent

TONE HARMONY SCHEMA: A THEORY OF PITCH ACCENT

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Although it is not easy to give a precise definition of pitch accent language as opposed to tone language, something like the following is sufficient for our purpose.

(1) Given the pitch value of an element in a single domain, the overall pitch pattern of the domain is predictable by general rules of grammar.

Therefore, we don't have to give to each word a different melody, as we have to do for tone languages. See McCawley (1976) for some discussion on this topic. Correspondingly, a theory of pitch accent must be restricted enough to exclude certain imaginable but not plausible pitch accent systems and rich enough to characterize a natural class of pitch accent systems of which all the attested systems constitute a subset.

Take, for example, some words from the Tokyo dialect.

(2)	inoti H L L	'life'	kokoro L H L	'heart'
	atama L H H	'head'	koori HH H	'ice'

Using the superscript and the subscript notations, the pitch pattern of Tokyo is represented by the following.

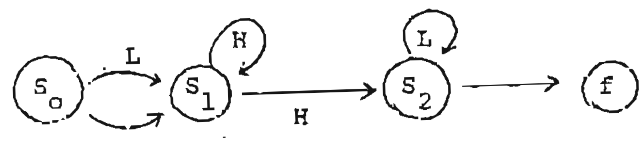
(3) $L_{o}^{1}H_{1}^{n}L_{o}^{m}$

Thus, *LLL and *LLH are not possible melodies in Tokyo. Roughly speaking, the pitch pattern of a word is determinable once it is indicated where a pitch drops (or whether there is a drop at all).

All other dialects of Japanese are representable by a similar schema. Notice, however, that (3) is equivalent to the following representation.[1]

(4) ({L}){H}*{H}{L}*

This is a regular expression, and therefore the set of possible tone sequences can be defined by a finite state system of some sort.

(5) 

This consideration suggests that a theory of pitch accent system should be at most as powerful as the finite state automaton.

However, some of the existing theories of pitch accent do not meet this minimum requirement. Simply, they are too powerful. The autosegmental theory developed in Goldsmith (1976a,b) and applied to Japanese by Haraguchi (1977) is not an exception. The weak generative capacity of the theory is certainly beyond that of a finite state system. Consider a hypothetical pitch accent language whose possible surface melodies are represented by the following schema.

(6) L_o^n (H) H L_o^n

If a string contains an even number of tones, it consists of $\underline{n}$ low tones followed by two high tones and $\underline{n}$ low tones at the end. If a string contains an odd number of tones, there is only one high tone in the middle. This language is described by the following set of rules in the autosegmental framework.

(7) Tone Association 1:

```
  V   X
  :
L H L
```

(8) Tone Association 2:

```
X  V
  /
L H L
```

(9) Universal Tone Association Convention
Haraguchi (1977)(6), p. 11

All tones should be associated with at least one tone bearing unit, and conversely, all tone bearing units should be associated with at least one tone in the tone melody. No association lines should cross.

(10) Tone Simplification:

```
  V         V
 / \   =>   |
L   H       L
```

(mirror image)

(11) Tone Association 3:

```
X V X V X    =>    X V X V X
 \ |/                | | |
 L H L               L H L      (X ≠ Ø)
```

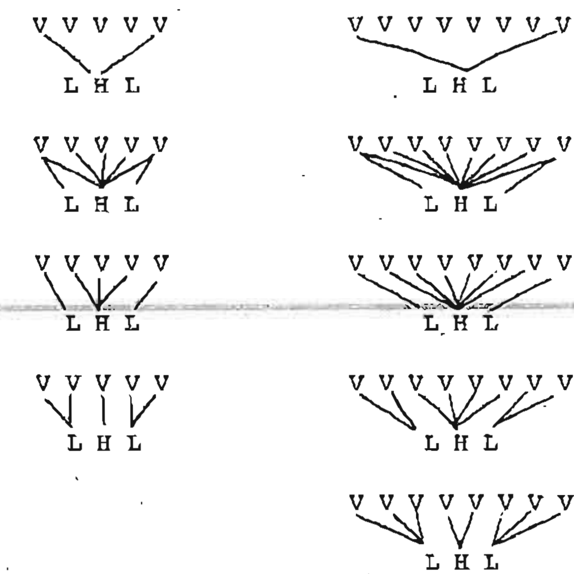
Consider the following derivations.

(12) TA 1 & 2

UTAC

TS

TA 3



All the rules are obligatory and especially TA 3 is an iterative rule.[2] Except TA 3, they are all used in the description of Japanese by Haraguchi (1977). The nature of TA 3 is somewhat controversial. The use of essential variables cannot be challenged, however, in any obvious way. The Q variable is frequently and crucially used by Haraguchi (1977).

(13) Tone Association Rule for Tokyo
Haraguchi (1977), (22), p. 18

Q V
      ⋮
      H

(where Q is the maximal phonological string which does not contain $\overset{*}{V}$.)

As long as the use of variables is concerned, this rule is no less powerful than (11).

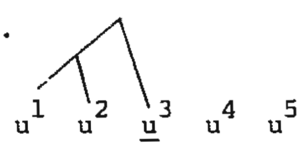
One can, of course, impose certain constraints on the form of tone association rules, thus eliminating (11) from the set of possible tone association rules. For instance, iterative rules can be excluded from the theory. Parallel efforts have been made in syntax to constrain the power of transformations. However, in syntax, we already know that natural languages are not regular languages and therefore the finite state grammar is not capable of describing natural languages. On the other hand, in pitch accent phonology, no proof has yet been made to show that natural languages are not regular sets in that respect. Therefore, instead of starting with a relatively powerful system and adding constraints to it, a more promising approach is to formulate a more limited theory of pitch accent which can describe existing pitch accent languages without redundancy and of course, without losing any significant generalizations.

The autosegmental theory has a potential of describing a non-regular set like (6), which is probably a phrase structure language, and therefore is too powerful as a theory of pitch accent languages although it might be appropriate as a theory of tone languages in general. As is often discussed, the projection problem will arise in such a strong theory. Being unnecessari rich, such a theory will allow a number of equivalent grammars for particular linguistic data. It is unable to explain why a child acquires a particular grammar among a set of grammars consistent with the data he is exposed to. See Clark (1979) for a similar criticism of the autosegmental theory.

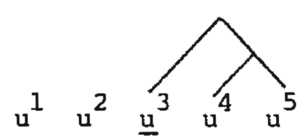
The purpose of this investigation is to formulate a theory of pitch accent that is equivalent in its generative capacity to the finite state grammar, which I believe is the property of pitch accent languages.

In the particular framework that we develop in this paper, the pitch accent phenomenon is treated as a harmony process process, in particular a unidirectional harmony. cf. Vergnaud (1979). Within a certain domain, the feature of the designated element (i.e. the element that triggers a harmo is spread either to the right or to the left depending on the parameter chosen for the language under consideration. The unlabeled harmony tree is used for the purpose of spreading a feature. We assume that the harmonizi feature is either [+High] (often abbreviated as + or H) or [-High] (similarly as - or L). A uniformly branching tree is constructed on a relevant projection in such a way that the designated element is the least embedded element. (See Halle and Vergnaud (1978) for the notion of projection and the assumption that the triggering element has the longest "leg" in the harmony tree. See also Zubizarreta (1979) for a different view.) Given a designated element and a projection, together with the assumption that the maximal tree is to be constructed, there are only two possible trees as shown below (where u^i stands for a relevant unit in the projection and the designated element is underscored).

(14) a.



b.



One of these two options is chosen according to the parameter we mentioned above.

We assume that the designated element is inherently branching.

(15) +High -High

There are two kinds of designated elements: those that are specified in the lexicon and those that are placed by general rules. Let us call the former kind <u>accent</u>.[3] Correspondingly, we say that a word has an accent if it contains a unit which is marked as to the tone feature in the lexicon. The accent is polarized: the branches it dominates are marked as + and -. The left branch is + and the right branch is -.[4]

(16) α High, branching to + and −

$$+\alpha = + \text{ if } \alpha = + \qquad - \text{ if } \alpha = -$$
$$-\alpha = - \text{ if } \alpha = + \qquad + \text{ if } \alpha = -$$

The element (if any) dominated by the + branch will receive the feature [$+\alpha$ High] and the element (if any) dominated by the - branch will receive [$-\alpha$ High] by convention. The other designated elements are not polarized and the elements under the branches will receive the same feature [αHigh] by the feature percolation convention.

There are four reasons for this assumption. First, the designated element counts as branching when we define peripheral elements, which we will discuss immediately below. Second, in dialects like Tokyo where accent is placed on a rime, the second element in the rime is always [-High].[5] Third, in dialects with falling tone, only the final accented words exhibit falling tone but not those words which get H on the final segment/rime by a general rule.[6] Finally, it plays an important role in the description of the Narada dialect, to which we will return later.

Within the domain of harmony, certain elements in a fixed position behave as if they were transparent to the harmony. We call these elements <u>peripheral</u> elements. They appear on one side of the domain to which the harmony is directed. For example, the Tokyo dialect, which has the left branching harmony, may have peripheral elements word initially. On the contrary, dialects with the right branching harmony like Hirosaki may have peripheral elements in the word final position.[7] This correlation is encoded into the grammar as an indexing procedure. All the elements in the projection will receive indices, say natural numbers, from left to right if it is a left branching dialect, and from right to left if it is a right branching dialect.

(17) left branching dialect

$$u^1\ u^2\ u^3\ u^4 \ldots u^n$$

(18) right branching dialect

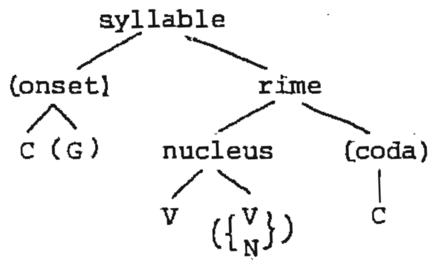
$$u^n\ u^{n-1} \ldots u^3\ u^2\ u^1$$

Only weak elements count as peripheral, where <u>weakness</u> is defined as follows.

(19) x^i is <u>weak</u> for any <u>i</u> iff it is not branching where x is a mora, or nucleus.

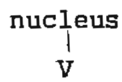
I am assuming the following syllable structure for Japanese.[8]

(20)

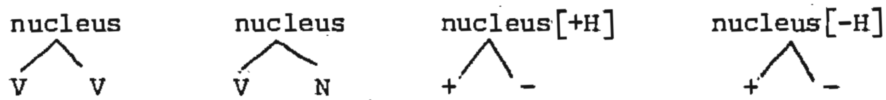


If nuclei are projected, one in (21) count as weak while those in (22) do not.

(21)



(22)



A nucleus with accent is branching even when it does not dominate two segments. A mora (=constituent dominated by a nucleus) is not branching unless it is accented. For the dialects that we will consider either nuclei or morae will be projected, though other logical possibilities have not yet been eliminated.

Only a continuous sequence of weak elements (up to a limitation imposed by a language specific parameter) on either side of the projection (also determined by another parameter) are considered as peripheral.

(23) x^i is <u>peripheral</u> iff (a) $0 < \underline{i} < \underline{p}$
(b) x^i is weak
and (c) for all $\underline{j}$ (j>0), if $\underline{j} \leq \underline{i}$, then x^j is weak

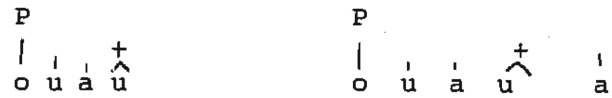
<u>p</u> is the parameter, which we will call the peripheral index, chosen for each dialect. We take <u>p</u> to be 0, 1, or 2.[9]

Let us consider the case of <u>Tokyo</u>.[10] Tokyo is a left-branching dialect with the peripheral index being 1. A peripheral element is defined on the projection of nuclei and a left branching harmony tree is constructed on the projection in such a way that the maximal tree does not contain any peripheral element.

For example, take a final accented word <u>rokugatu</u> 'June'.

(24) rokugat$\overset{+}{u}$ rokugat$\overset{+}{u}$ ga (<u>ga</u> = nominative)

We will have the following projections, in which the first nucleus is peripheral.[11] Remember that the peripheral element will appear on the left end in this dialect because it is a left branching dialect.

(25) 

A left branching tree is constructed on the projection. Branchingness of nucleus does not count when a harmony tree is built (cf. Halle and Vergnaud (1978)).

(26) 

The feature of the designated element is copied onto the root of the harmony tree and spread into the other terminal nodes by the feature percolation convention.

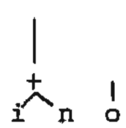
There is a convention which assigns the other value (- if the harmonizing feature is +, + if the harmonizing feature is -) to the yet unspecified elements in the projection. Since Tokyo has no falling tone, it has the following readjustment rule.

(27) 

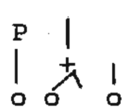
As a result, we get the following surface melodies.

(28)	[ro ku ga tu]	[ro ku ga tu ga]
	L H H H	L H H H L

For initial accented words and second accented words (if the first nucleus is not branching), a degenerate (=non-branching) tree is constructed.

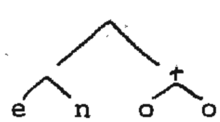
(29) 

[sinpo] 'progress'
HL L

(30) 

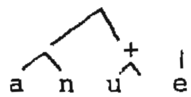
[ko ko ro] 'heart'
L H L

If the initial nucleus is branching, it is realized as H since it does not count as peripheral and therefore will be included in the harmony tree.

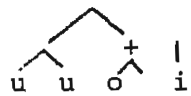
(31) 

[ben too] 'lunch'
HH HL

(31) cont.



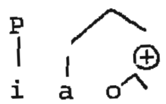
[kan zu me] 'can'
HH H L



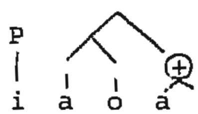
[fuu do ki] 'topography'
HH H L

For unaccented words, there is a general rule that assigns +H to the last element in the projection. Let us call this rule Unmarked Assignment (UA).[12]

(32)



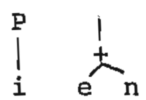
[mi ya ko][13] 'capital'
L H H



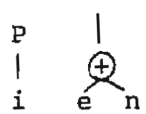
[mi ya ko ga][14] 'capital' + nom.
L H H H

There is no contrast between unaccented and final accented words unless the final nucleus is branching in both cases. Thus, we have minimal pairs like:

(33)



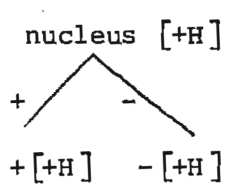
[si ken] 'exam' <u>accented</u>
L HL



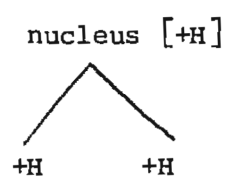
[si ken] 'personal opinion'
L HH <u>unaccented</u>

The difference is attributed to the fact that the lexically marked tone has polarized branches.

(34)



vs.



by feature percolation

As we have seen, the set of possible pitch patterns of a language is obtained by fixing a small number of parameters relevant to the harmony. It is now explicitly claimed that any pitch accent language can be described by the same schema.

(35) Tone Harmony Schema (THS)

THS is a quintuple (D, F, B, p, P)

D: domain of harmony, D $\in$ {syllable, phonological word, phonological phrase, ..., etc.}

F: harmonizing feature, F $\in$ {+H, -H}

B: direction of harmony, B $\in$ {right branching, left branching}

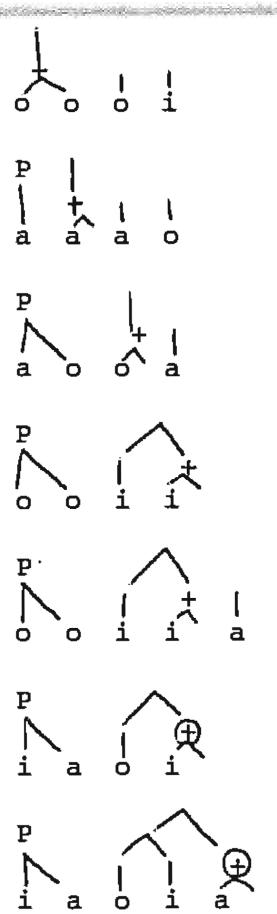
p: peripheral index, p $\in$ {0, 1, 2}

P: projection, P $\in$ {nucleus, mora}

For the dialects that we consider in this paper, D is always a phonological word. It is assumed that a phonological word consists of a single free morpheme (e.g. Noun) and one or more bound morphemes (e.g. case particles). Thus, Tokyo has (w, +H, left, 1, nucleus).

The Nagoya dialect has exactly the same pitch accent system as Tokyo except that the former has 2 for the peripheral index. Therefore, we may have at most two peripheral elements in this dialect.

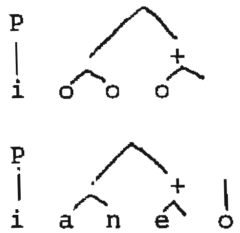
(36)



[koo mori] HL L L	'bat'
[a sa ga o] L H L L	'morning glory'
[a o zo ra] L L H L	'blue sky'
[no ko gi ri] L L H H	'saw'
[no ko gi ri ga] L L H H L	'saw' + nom.
[ni wa to ri] L L H H	'chicken'
[ni wa to ri ga] L L H H H	'chicken' + nom.

If the second nucleus is branching, it will be included in the harmony tree because it is not peripheral. In this case only the first nucleus is peripheral and is realized as L.

(37)

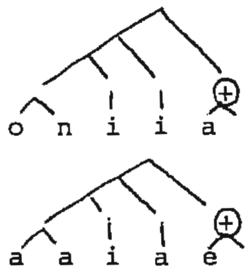


[i moo to] 'sister'
L HH H

[si ran ke do] 'I don't know'
L HH H L

If the first nucleus is branching, then there is no peripheral element.

(38)



[kon ni ti wa] 'Hello'
HH H H H

[kyaa ri ga ke] 'on one'a way home'
HH H H H

The last two examples are especially interesting because no simple explanations work. For example, one might say that in Nagoya the initial two morae will get L with the restriction that a nucleus cannot contain LH. Thus, in the case of <u>imooto</u>, it does not receive the melody L-LH-H because of the restriction, and is realized as L-HH-H instead. However, in the case of <u>konnitiwa</u>, nothing will exclude the melody LL-H-H-H, because it does not violate the restriction.

Alternatively, one could separate the process into two parts, which is essentially the same approach as taken by Zubizarreta (1979). Suppose Nagoya has the Tokyo-type initial lowering and the following extra rule.

(39) ## L H $\Rightarrow$ ## L L

We need another adjustment rule to eliminate impossible LH in a single nucleus.

(40) nucleus (L H) $\Rightarrow$ nucleus (H H)

The derivation of <u>imooto</u> will proceed as in the following in this analysis.

(41)

	imooto
	H HH H
initial lowering	L HH H
(39)	L LH H
(40)	L HH H

(39) is crucially ordered before (40). Otherwise, *L-LH-H will be derived,

assuming the strict order hypothesis. However, consider the derivation of konnitiwa.

(42)

	[kon ni ti wa]
	HH H H H
initial lowering	LH H H H
(40)	HH H H H
(39)	------

In this case, we have to have the bleeding order (40)-(39). Otherwise, *LL-H-H-H will be derived. Consequently this analysis has resulted in an ordering paradox, which shows it is untenable.

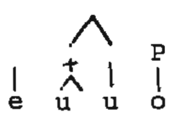
Let us now turn to the Hirosaki dialect, which is very interesting in the sense that it is a mirror image of the Tokyo dialect. The data is taken from Uwano (1977).[15] Hirosaki has (w, +H, right, 1, nucleus). It is a mirror image of Tokyo with respect to the direction of harmony. Since it is a right branching dialect, the peripheral elements may appear on the right end of the domain.

(43)

[u ru ko me] 'non-sticky rice'
H H H L

[u ru ko me mo] mo = 'also'
H H H H L

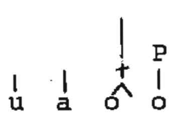
(44)



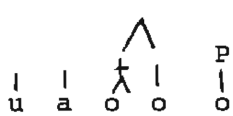
[te bu ku ro] 'glove'
L H H L

[te bu ku ro mo]
L H H H L

(45)

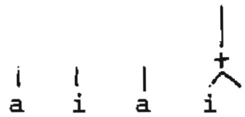


[ku da mo no] 'fruit'
L L H L

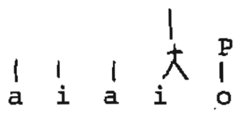


[ku da mo no mo]
L L H H L

(46)

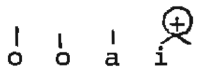


[ka mi na ri] L L L HL 'thunder'

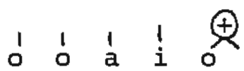


[ka mi na ri mo] L L L H L

(47)



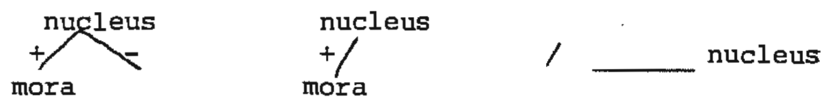
[to mo da ti] L L L H 'friend'



[to mo da ti mo] L L L L H

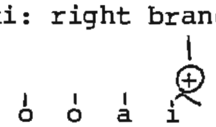
The same convention that we proposed for Tokyo also applies to give -H to the elements of the projection that are not included in the harmony tree. Hirosaki, however, has a slightly different readjustment rule from Tokyo.

(48)

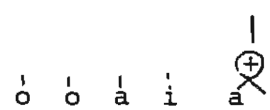


Since this rule applies only word medially, the word final accent is realized as a falling tone: <u>kaminari</u> L-L-L-HL. For unaccented forms, UA, which is independently needed in Tokyo, applies. The only difference is, again, the direction of harmony.[16] Compare <u>tomodati</u> 'friend' in Hirosaki and Tokyo.

(49) Hirosaki: right branching

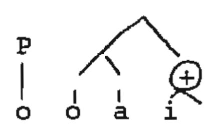


[to mo da ti] L L L H

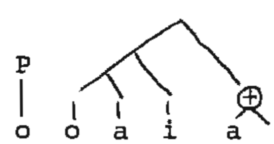


[to mo da ti ga] L L L L H

(50) Tokyo: left branching



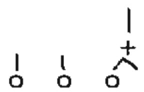
[to mo da ti] L H H H



[to mo da ti ga] L H H H H

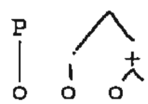
Certain words have accent in exactly the same position in the two dialects but they are realized differently due to the difference in the directionality of harmony. Compare the realizations of <u>otoko</u> 'man' in the two dialects.

(51) Hirosaki



[o to ko]
L L HL

(52) Tokyo



[o to ko]
L H H

The difference between Tokyo and Hirosaki is the instanciation of B in THS (and also the formulation of the readjustment rule), but it is possible that we get a dialect with totally different pitch accent system by changing other parameters. For example, we can change F and P in the schema. Let us first consider the case of (w, −H, left branching, 1, mora), where the harmonizing feature is −H and the projection is mora. Narada has this pattern. Observe the following data, which is also taken from Uwano (1977).

(53) Narada

[kabuto] L H L	'helmet'	[ka bu to ga] L H L L
[kokoro] H L H	'heart'	[kokoro ga] H L H L
[kagami] H L L	'mirror'	[kagami ga] H L L H
[sakura] H L L	'cherry blossom'	[sakura ga] H L L L

As we can see from the second word <u>kokoro</u>, this dialect allows two HL contours in a minimum domain, which is not the case for other dialects. The first H is predictable; if the second is L, the first is H. Many different approaches were taken to account for this particular dialect, including Haraguchi (1977)' autosegmental analysis. (See Haraguchi (1977) for a good summary and comparison of these different analyses). However, most of them could not give a simple account because the accent was regarded as +H in those analyses. For example, Haraguchi (1977) needs the star shift rule, which moves the lexically marked accent one mora to the right whenever there is one and deletes it if it is the last mora in the domain.

(54) Star Shift (Haraguchi (1977), (5), p. 262)

$$\overset{*}{V}\ (C_oV) \qquad V(C_o\overset{*}{V})$$

In this analysis, kagami has the accent on the final mora and it is deleted when the word is used in isolation, and it is moved onto the enclitic (case particle) vowel when there is one. Thus he is able to account for the difference between accented kagami and unaccented sakura, which are not distinguishable from each other when used in isolation. To make this star shift rule a general one, all the underlying forms have accent on the mora immediately preceding the surface H(L): k$\overset{*}{o}$buto and kok$\overset{*}{o}$ro.

The present analysis is immune to this kind of star manipulation because we take the harmonizing feature as -H. Then, Narada is another mirror image of Tokyo with respect to a different dimension (abstracting away a couple of other differences). It is a left branching dialect with the peripheral index of 1. First, moras are projected and peripheral elements are defined.

(55) projection of kagami ga[17]

```
P
|  |  |  |
a  a  i  a
```

A maximal left branching tree is constructed over the projection.

(56)

```
P   /\
|  |  |  |
a  a  i  a
H  L  L  H
```

The big difference between Narada and Tokyo is, however, the sequence of L's that follows LH.

(57) [kokoro ga]
H L H L

[asagao ga] 'morning glory' + nominative
H L HL L

[koomori ga] 'bat' + nominative
LH L L L

If it were the complete mirror image, kokoro ga and asagao ga would be realized as HLHH and HLHHH, respectively (cf. kokoro ga LHLL and asagao ga LHLLL in Tokyo.) Before we solve this problem, consider how pitch patterns are assigned to unaccented forms in Narada. As is obvious from sakura 'cherry blossom' and sakura ga, UA is exactly the same as Tokyo except that it assigns -H in Narada.

(58)

```
P   /\
|  /  ⊖
a  u  a
```

sa ku ra
H L L

(58) cont.

sa ku ra ga
H L L L

We can now formulate the universal unmarked assignment rule.

(59) Unmarked Assignment: Assign F on the final element in the projection.

Note that the value of F is the value of the harmonizing feature. In most dialects, (59) is accompanied by the following proviso.

(60) If the whole domain D does not contain any tone feature

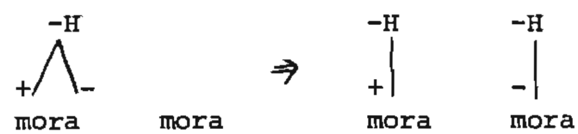
Thus, in Tokyo, Hirosaki, and Nagoya, (59) applies only to the unaccented forms. Let us call this rule UA-1. In Narada, however, it has a different proviso.

(61) in the maximum subdomain of D which does not contain any tone feature

Let us call this rule UA-2.[18]

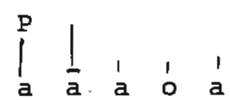
The existence of H immediately after the accent –H is now accounted for by the following local rule, which we call Distribution (of the accent).

(62) Distribution (Dis)

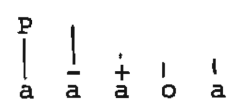


Consider the derivation of <u>asagao</u> <u>ga</u>.

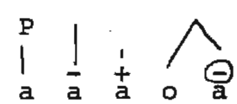
(63) projection



by Dis

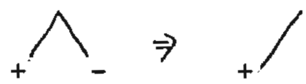


by UA-2

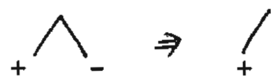


Since Narada has no falling tone,[19] the readjustment rule proposed for Tokyo applies to forms like <u>kagami</u>, which has the final accent. We need to generalize the rule as follows:

(64) Readjustment-1



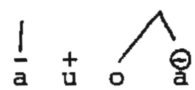
(65) Readjustment-2

 / word medially

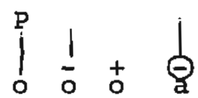
RA-1 applies in Tokyo, Nagoya, and Narada, while RA-2 applies in Hirosaki. RA-1 follows Distribution in Narada.

A couple of more examples are given below.

(66)



ka bu to ga
L H L L



ko ko ro ga
H L H L

Hasuada has a very similar pitch system, which is (w, -H, left branching, 2, mora). It is different from Narada only in the value of the peripheral index.

(67)

[niwatori] H H L L	'chicken'	[niwatori da] H H L L L
[koomori] LH L L	'bat'	[koomori da] LH L L L
[asagao] H M HL	'morning glory'	[asagao da] H M HL L
[aozora] HH L M	'blue sky'	[aozora da] HH M H L
[nokogiri] H H L L	'saw'	[nokogiri da] H H L L M

Assuming that the middle tone in this dialect can be derived from either H or L by the following set of rules in (68), the pre-surface melodies of the preceding words are listed in (69).

(68) A. H## → M##
B. HLH → HMH

A is crucially ordered before B.

(69) HHLL   HHLLL
LHLL   LHLLL
HLHL   HLHLL
HHLH   HHLHL
HHLL   HHLLH

The underscored tone in (69) will undergo either of the changes indicated in (68) to become M. Now let us consider the derivation of each word in (67).

(70) projection   i a o i a

UA-2   ⊖
i a o i a

Harmony & convention   p   ⊖
i a o i a

[ni wa to ri da]
H H L L L

(71) projection   ō o o i a
\- +

Dist.   o o o i a
\- +   ⊖

UA-2   o o o i a

Harmony   - +   ⊖
o o o i a

[ko o mo ri da]
L H L L L

(72) projection   a ā a o a
\- +

Dist.   a a a o a
\- +   ⊖

UA-2   a a a o a

Harmony & convention   p - +   ⊖
a a a o a
H L H L L

B   H M H L L
[a sa ga o da]

```
(73)  projection          a   o   ō   a
                                  -   +
      Dist.               a   o   o   a

                            P     |
      Harmony &            /\     -   +
      convention          a   o   o   a
                          H   H   L   H

      A                   H   H   L   M
                         [a   o  zo  ra]
                                  -
(74)  projection          a   o   o   a   a
                                  -   +
      Dist.               a   o   o   a   a
                                  -   +   -
      UA-2                a   o   o   a   a

                            P     |       |
      Harmony &            /\     -   +   -
      convention          a   o   o   a   a
                          H   H   L   H   L

      B                   H   H   M   H   L
                         [a   o  zo  ra  da]
                                      -
(75)  projection          o   o   i   i

                            P      /\
      Harmony &            /\     /  -
      convention          o   o   i   i

      Read.-1            [no  ko  gi  ri]
                          H   H   L   L
                                      -
(76)  projection          o   o   i   i   a
                                      -   +
      Dist.               o   o   i   i   a

                            P      /\
      Harmony &            /\     /  -    +
      convention          o   o   i   i   a
                          H   H   L   L   H

      A                   H   H   L   L   M
                         [no  ko  gi  ri  da]
```

As we have just seen, we can describe the Hasuda dialect with a couple of pre-surface adjustment rules. The underlying system itself is within the domain of the tone harmony schema.

The last two dialects that we considered present an instance in which the theory of pitch accent proposed in this paper can capture a true generalization while the autosegmental theory cannot. It is concerned with the treatment of unaccented forms in both theories. Haraguchi (1977) proposes the following tone association rule for Narada.

```
         (*)
(77)  ##Q V
          ¦                         (*)
          H    (where Q contains no  V ).
```

The interpretation of this rule is: associate H with the leftmost vowel with * if there is any, otherwise associate H with the leftmost vowel. Thus, the derivation of an unaccented form will look like the following:

```
(78)  V V V V                   V V V V                    V V V V
       LHL      universal         LHL     simplification     HL
                conventions
```

The problem with this analysis lies in the fact that the first H in unaccented forms is derived by the tone association rule, and not by the initial raising rule which he proposes for other forms. There is a piece of evidence, indirect but strong, which disconfirms this view.

A kind of sandhi phenomenon occurs when two words are combined. If the first word ends in L, the second word is realized as the same pitch pattern that it would have had when used in siolation or phrase initially.

```
(79)  usi    'cow'     usi ga   'cow' + nominative
      H L              H L  L

      naku   'cry'
       H L

(80)  usi ga naku      'a cow moos'
      H L  L  H L
```

However, if the first word ends in H, the second word cannot begin with H and it will have L instead.

```
(81)  inu    'dog'     inu ga   'dog' + nominative
      H L              H L  H

(82)  inu ga naku      'a dog barks'
      H L  H  L L
```

Haraguchi proposes a H deletion rule to handle this process. However, there is a very similar phenomenon in Tokyo.

```
(83)  inu    'dog'     inu ga
      L H              L H  L

      naku
       L H
```

```
(84)  inu ga  naku    'a dog barks'
      L H  L   L H

(85)  usi   'cow'    usi ga
      L H            L H  H

(86)  usi ga  naku
      L H  H   H H
```

In the case of Tokyo, the initial L changes into H if the preceding word ends in H. The true generalization concerning these seemingly separate phenomena is this: in the autosegmental terminology, the initial changing (either lowering or raising) process fails to apply if the preceding word ends in H, or in our terminology, the initial element does not count as peripheral if the preceding word ends in H. This is possible only if one regards the initial H in Narada as the result of the initial raising process. In fact, Haraguchi (1977) cites an example in which the sandhi rule applies to an undoubtedly-initial-raising H.

```
(87)  atama ga      'head' + nominative
      H L L  H

      ookii         'is big'
      HL LH

(88)  atama  ga  ookii      '(his) head is big'
      H L L   H  LL LH
```

The reason why Haraguchi has to assume the derivation in (78) is because there is no natural way to get rid of HL in the case of unaccented words. Since he assumes the basic melody for Narada is LHL, which I believe is inevitable in his framework, H is associated with * and therefore, is the most prominent tone. As far as such a deletion of the prominent tone is unjustifiable in the autosegmental theory, there is no other option left.

Unfortunately, that option simply does not work for Hasuda, which is just like Narada. Because this dialect, as we have already seen, has the peripheral index of 2, which means the initial two moras can be raised.

```
(89)   niwatori ga  'chicken' + nominative
        H H L L  L
```

However, the same tone association rule cannot be used for this dialect for an obvious reason, and what is worse, there is no natural way to modify the rule so that H could be associated with the second vowel. Even the observational adequacy is at stake in this case. One can always solve such a problem by postulating another totally unrelated rule just for this purpose, of course, at the cost of giving up the descriptive adequacy. The tone harmony schema, on the other hand, can collapse the two raising processes in Narada and Hasuda under one generalization, and furthermore it can extract the underlying similarity between dialects like Tokyo and Nagoya on the one hand, and dialects like Narada and Hasuda on the other, using the notion of peripheral element.

We stated at the beginning of this paper that one of the goals of this research is to formulate a more restricted theory of pitch accent system so that one can set a reasonable limit to the variations of pitch accent systems and therefore take a step forward to the understanding of the true nature of such systems. The tone harmony schema allows only a small number of variables. It claims that one can get any existing pitch accent system by giving appropriate values to the parameters designated by the schema. It is too early to conclude that it is not undergenerating possible pitch accent systems, but I suspect it is not. At least, the possible core systems are within the limits set by the tone harmony schema.[20]

Footnotes

*I would like to thank Emmon Bach, Alan Prince, Lisa Selkirk, Jean-Roger Vergnaud, and two anonymous reviewers for valuable comments and suggestions. Remaining errors are all mine.

[1] $(\{x\})\cdot Y$ is an abbreviation of $\{x\}\cdot Y \cup Y$, where Y is an arbitrary expression. It is proved that a union of two regular sets is a regular set.

[2] In this respect, the same criticism applies to any SPE type segmental theory as long as iterative application and the mirror image rule convention are allowed in that theory. I owe this observation to G.N. Clements.

However, this result is not surprising at all since we know that the usual format of the phonological rule is of context-sensitive phrase structure type, hence, potentially stronger than context-free phrase structure grammar.

[3] In some dialects, the accent is placed by general rules. For example, Kagoshima nouns are divided into two morphological classes: accented and unaccented classes. In the former class, the accent is placed on the penultimate syllable.

```
hana    'nose'    hana ga
 H L               L H  L

sakura   'cherry blossom'     sakura ga
 L H L                         L L H  L
```

For unaccented words, by a universal rule which will be discussed later, the final syllable gets +H.

```
hana    'flower'      hana ga
 L H                   L L  H

usagi    'rabbit'     usagi ga
L L H                 L L L  H
```

As expected, the former class exhibits a falling tone, whereas the latter class does not.

```
na   'name'       na ga
 HL                H  L

na 'vegetable'    na ga
 H                 L  H
```

For monosyllabic accented words, the syllable gets the accent.

Note that Kagoshima is a non-harmony dialect: the feature of the designated element (= the accent or the feature placed by the universal unmarked rule) is not spread to either direction. The existence of such dialects does no harm to the present theory of harmony. We assume that a language has a choice of the harmony and non-harmony modes. See Zubizarreta (1979) for an alternative treatment of non-harmony dialects.

[4]We assume that this is a universal convention.

[5]Therefore, you don't find a contrast between CVVCV and CVVCV
                                                   HL L   HH L
or between CVNCV and CVNCV. In other words, if the accent is placed on
             HL L   HH L
a branching rime, it is realized as HL, and otherwise it is realized as HH.

[6]Since the final tone placed by this rule is not an accent in our sense, it has no polarized branches. We are assuming that
H
H^H
is not distinguishable from
H
|
H
.

[7]This is an empirical claim, not a necessary consequence of the theory.

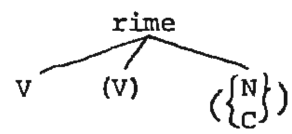
[8]The status of coda is not very clear at this point. We rarely find a syllable of the form (C)VVC, and we never find a syllable of the form (C)VNC.

[zuut.to]	'for a long time'	"." is used to indicate a syllable boundary.
[suut.to]	'quietly, feel relieved'	

These are onomatopoeic adverbs and most of them are intensive forms of the corresponding short forms.

[zut.to]
[sut.to]

One might even propose the following structure for the rime on the basis of some other onomatopoeic adverbs.



[piin.to] 'with tension'
[tuun.to] 'head-clearingly'

The present theory, however, does not depend heavily on any particular theory of syllables in Japanese.

[9] Again, this is an empirical claim. It is more desirable if we could find a principled explanation as to why it is limited to 0, 1, and 2. However, such an explanation being unavailable, we have to stipulate this property.

[10] The author is a native speaker of this dialect.

[11] For convenience' sake, we use "P" to indicate peripheral elements. It is not intended to mean any prosodic configuration.

[12] We keep assuming that this is a property of universal grammar, rather than of a particular language.

[13] We use ⊕ and ⊖ to indicate tones assigned by UA, which should be distinguished from lexically marked tones indicated by + and −.

[14] It is possible to assume that case particles have accent, and it is deleted in a domain if the domain contains another accent preceding it. At least for some particles, we have to assume this.

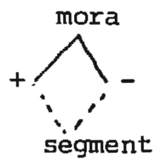
atama	'head'	atama ga	atama sae	<u>sae</u> = 'even'
L H H		L H H L	L H H LL	
miyako		miyako ga	miyako sae	
L H H		L H H H	L H H HL	

Thus, <u>sae</u> has the accent on the first syllable.

[15] The data in Haraguchi (1977), which is taken from Konoshima's work, is slightly different from the data presented in Uwano (1977). We use Uwano's data in this study.

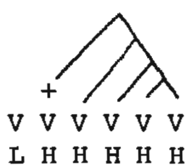
[16] Due to the lack of relevant data, we could not determine whether Hirosaki is a mora language or a nucleus language. We arbitrarily assume that it is like Tokyo for the purpose of exposition.

[17]Since this is a mora language, and a mora never dominates two segments, the definition of peripheral element is vacuous except when a mora has accent.



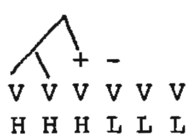
Our theory predicts that in Narada the first mora is always H unless it has accent.

[18]Naturally, we have to include the choice of UA-1 and UA-2 as another parameter. It is also possible that the choice is determined by the direction of harmony: only left branching dialects have this option and right branching dialects uniformly choose UA-1. If the right branching dialect chooses UA-2, then it would not be distinguishable from a right-branching dialect with the peripheral index of 0.

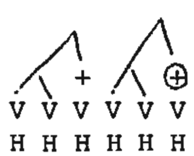


It is conceivable that it is correlated with the value of the harmonizing feature. So far, we need UA-2 only for dialects in which F = -H. The decision awaits further investigation.

Note that Distribution and UA-2 are one parameter rather than two. A dialect with Distribution and UA-1 is indistinguishable from one with no Distribution, and a dialect with no Distribution and with UA-1 will result in a level pitch due to the readjustment rules.



vs



[19]Haraguchi (1977)'s data is different from Uwano (1977)'s in this respect, too. Haraguchi states that both accented and unaccented forms have a falling tone, while Uwano states that there is no falling tone in this dialect. If Haraguchi's data is correct, we have to admit the possibility of a tone being polarized even when it is assigned by UA.

[20] It does not exclude a dialect with two different pitch systems. For example, Osaka and Kobe have two morphological classes, one of which is (w, +H, left branching, 0, mora), and the other is a non-harmony type (see footnote 2).

Class A.	kabuto	'helmet'	suzume	'sparrow'
	L H L		L L H	
	nokogiri	'saw'	tukemono	'pickles'
	L L H L		L L L H	
Class B.	otoko	'man'	sakura	'cherry blossom'
	H H L		H H H	
	uguisu	'nightingale'	niwatori	'chicken'
	H LL L		HH H H H	

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