SUMMARY: The level of phonetic realization of lexical accent (reduced level, which, in the case of words with an accent kernel, is exhibited by a low F0 value, or full level) is one of the major determinants of sentence intonation in Tokyo Japanese. Three experiments were conducted to provide evidence to support the author’s previous claim that the reduction of accent level is triggered by semantically restrictive modification, and not by syntax. In Experiment 1, F0 values of the first two constituents of [[A[BC]D]] and [A[[BC]D]] were compared. The results indicated the irrelevance of overall syntactic branching structure for the accent level. In Experiments 2 and 3, peak F0 values of nouns with an accent kernel in semantically restrictive and non-restrictive conditions were investigated acoustically and perceptually. The results supported the prediction: nouns have lower F0 values when they are semantically restricted by the directly preceding modifier than when they are not.

Key words: intonation, intonation phrase, accent reduction, downstep, restrictive modification

1. Introduction

Sentence-final and phrase-final intonation (movement in pitch height) and the level of phonetic realization of the accent of each minimal syntactic phrase comprising a content word possibly followed by particles (henceforth simply “phrase”; strictly speaking, “accent unit”) are major components of intonation in Tokyo Japanese (Kori 2003). The term accent here refers to the pattern of change in pitch height determined as lexical information for each accent unit. In general, accent is characterized by a gradual decline after a rise at the beginning of an accent unit or, if there is an accent kernel, a sharp fall immediately following the kernel mora (cf. Kori 2004). The level of phonetic realization of accent refers to whether the changes in pitch height described above are realized in a quantitatively conspicuous form or in a quantitatively reduced form.

Particularly important as a level of phonetic realization of lexical accent is whether or not there is “weakening”. A more detailed explanation will be given in section 2.1 but in Kyonen Nara no momizi o Yumi to mita ‘Last year I viewed Nara’s fall foliage with Yumi.’, in which the first mora of each phrase bears an accent kernel, the mo of momizi o ‘fall foliage’ is either pronounced with the same height as the immediately preceding mora or is at most slightly higher. Referring to this situation in which the pitch movement due to accent is quantitatively reduced, we can consider the accent of momizi o to have been weakened. In contrast to this, in Kyonen Nara de momizi o Yumi to mita ‘Last year I viewed the fall foliage with Yumi in Nara.’ the mo in momizi o is clearly pronounced with a higher pitch than the surrounding mora. Since the pitch change in this case is realized in a quantitatively conspicuous form, we can consider the accent not to have been weakened.

There is the view that whether or not accent is weakened as in the preceding examples of Nara no momizi o ‘Nara’s fall foliage’ versus Nara de momizi o ‘in Nara the fall foliage’ is determined by syntactic structure, as in a branching tree structure, and this view has been generally accepted. Although they do not use the term “weakening”, Hayata (1972) and Kubozono (1993) are examples of research taking this view. In contrast to this view, the author has argued for some time that whether or not accent is weakened in cases such as these is determined by the presence or absence of semantically restrictive modification (Kori 1992, 1997a, b, 2003, among others). This claim was based on the
results of studies, but the supporting data has only been presented at the time of oral research presentations. This article, then, will present evidence that the presence or absence of semantically restrictive modification determines whether or not there is weakening of the accent and adds new observations, reporting a newly conducted speech study and the results of a perception experiment2).

As a secondary result of the research reported here, the new observation is made that, if the phrase in question and the preceding phrase are both kernel-bearing, a pitch prominence of 40˚ to 50˚ in the phrase in question compared to the preceding phrase is a rough criterion for distinguishing between semantically restrictive modification (corresponding to accent weakening) and non-restrictive modification (corresponding to non-weakening). We also touch upon the fact that that semantically restrictive modification is a determining factor in sentence intonation is true not only of Tokyo Japanese but extends into other regions as well.

In the next section we will give a detailed explanation of the concepts of the level of phonetic realization of lexical accent and semantically restrictive modification. Since it looks like syntactic structure clearly determines the level of phonetic realization of accent in the experimental data presented in Kubozono (1993), we report our follow up experiment. In sections 4 and 5, we consider the correspondence of accent weakening and semantically restrictive modification with an utterance study and its acoustic analysis and with a perception experiment using synthesized speech.

Although this paper deals with Tokyo Japanese, participants include not only speakers from the 23-ward area of Tokyo and the Tama region but also younger speakers from the surrounding area including Yotsukaido in Chiba Prefecture, Koshigaya in Saitama Prefecture, and Yokohama in Kanagawa Prefecture. There is a high degree of commonality among younger speakers in these areas in terms of their prosodic characteristics, so the speech of all of them can be called Tokyo Japanese in a broad sense.

2. Level of Phonetic Realization and Semantically Restrictive Modification

2.1 Level of Phonetic Realization and “weakening”

The level of phonetic realization of accent is essentially a continuum quantitatively, but when we consider the linguistic meaning of the phenomenon, the categorical distinction of whether “weakening” occurs or not is especially important.

The absence of weakening here means that a phrase (strictly speaking, an accent unit) has a pitch change that is felt to clearly retain its independence and the phrase forms its own separate intonation phrase. In contrast, the presence of weakening means that the phrase, while preserving its accent pattern, does not have a pitch change that is felt to retain its independence and in some cases forms a unit with the preceding phrase and is pronounced as if the two together form a single intonation phrase. So-called “downstep” is one form of weakening3). However, as we will see in the next section, what sort of pitch movement is felt to retain the phrase’s independence varies with the phonetic environment and determining a standard that can be applied in any situation as a single value is difficult.

We will explain using the following pair as a concrete example.

(1) Kyonen Nara no momizi o Yumi to mita.
   Last year Nara GEN fall.foliage ACC Yumi with saw
   ‘Last year I viewed Nara’s fall foliage with Yumi.’

(2) Kyonen Nara de momizi o Yumi to mita.
   Last year Nara LOC fall.foliage ACC Yumi with saw
   ‘Last year I viewed the fall foliage with Yumi in Nara.’

Both examples (1) and (2) are composed of kernel-bearing phrases (specifically, accented with first mora high and the rest low (atamadaka-gata)). Figure 1 shows the typical F0 curves for each, derived by averaging 6 repetitions by speaker nk4). Speaker data is presented in Appendix 1. The horizontal axis shows time in seconds and the vertical axis shows pitch height. The scale for pitch is expressed in semitones with 50 Hz as the base. Since 12 semitones are one octave, 12 on the scale corresponds to 100Hz, 24 to 200Hz, and 36 to 400Hz. The vertical line left of the center of the figure marks the beginning edge of the phrase momizi o.

The arrow labeled (a) in the figure indicates the peak of the pitch prominence in momoji o and it is clear that the peak of momizi o in Nara no momizi o from sentence (1) (shown by the curve drawn with a chain
of solid black dots “●”) is strikingly lower than that of
Nara no. This shows that the whole of Nara no momizi
o has become a single unit in terms of intonation and
forms a single intonation phrase. We can consider the
accent of momizi o in this case to have been realized in
a phonetically weakened form, or, put more concisely,
the accent of momizi o has been weakened.

In contrast, the prominence in momizi o from Nara
de momizi o in sentence (2) is only slightly lower than
that of Nara de. The independence of the phrase in
terms of intonation is clearly maintained and Nara de
and momizi o each form separate intonation phrases.
In this case we say that the accent of momizi o has not
been phonetically weakened.

Furthermore, the prominence in mita (arrow (b)) is
strikingly smaller in both sentences (1) and (2), show-
ing that it has been weakened.

The Hiroshima no omiyage o of sentence (3) and the
Hiroshima de omiyage o of sentence (4) are both com-
posed of non-kernel-bearing phrases (with first mora
low and the rest high (heiban-gata)). Figure 2 shows
the typical F0 curves for each, derived by averaging 6
repetitions by speaker nsz. The vertical line left of the
center of the figure marks the boundary between the o
and mi of omiyage.

Looking at the curve for Hiroshima de omiyage o in
this figure (shown by the curve drawn with a chain of
faintly colored dots “○”), the rise between o and mi
indicated by the arrow (c) is readily apparent and the
omiyage o forms an independent intonation phrase.
Accordingly, omiyage o does not form a unit with the
preceding phrase and is clearly independent in terms of
intonation and the accent has not been weakened.

On the other hand, in the case of Hiroshima no omi-
yage o, there is no rise between the o and mi of omi-
yage. As a slight rise may be observed depending on
the speaker or in different repetitions by the same speaker,
rather than no rise, it might be better to consider there to
be an extremely small rise. Since the rise between o and
mi is small, Hiroshima no omiyage o as a whole forms
a single unit and has become a single intonation phrase.
In other words, omiyage does not have an individual
pitch movement independent of the preceding phrase
and, accordingly, we say the accent has been weakened.

2.2 Various Factors That Influence the Level of
Phonetic Realization of Accent

The differences in the level of realization of the
accent of Y in the pairs [X no Y o] and [X de Y o] ob-
served above can be thought at first glance to reflect a
difference in syntactic structure. This paper argues that
the differences actually reflect the presence or absence
of semantically restrictive modification, but before
making this argument, let us look at other factors that
affect the level of phonetic realization of accent, to the
extent that they are related to later discussion.

First, there is focus (Kori 1997b). The accent of a
constituent the speaker wants the hearer to pay atten-
tion to, that is the constituent that bears focus, is often
strengthened with the pitch prominence raised. This is,
however, not obligatory but rather may vary with the
The degree of emphasis. What is also important is that the accent of the string of phrases following the focus is weakened (Izumitani 2008), and with this the focused phrase and the phrases that follow form a single intonation phrase.

The level of realization can also vary due to the prosodic environment such as the length of the phrase in question or the location of the accent kernel in the preceding phrase.

(5) Nagoya no miyage o minna ni kubatta.
Nagoya GEN souvenir ACC all DAT passed.out
'I passed out souvenirs from Nagoya to everyone.'

(6) Nagoya no miyagemono o minna ni kubatta.
Nagoya GEN souvenir.goods ACC all DAT passed.out
'I passed out all the souvenir stuff from Nagoya to everyone.'

The difference between sentences (5) and (6) is the just difference in the lengths of the phrases miyage o and miyagemono o, neither having an accent kernel. From the typical curves shown in Figure 3 (speaker: tkm, average of 6 repetitions), it is clear that the prominence in miyagemono o is higher. The height is, in fact, close to the height of miyage o from Nagoya de miyage o spoken by the same speaker shown in Figure 4. But even so, it is much lower than the miyagemono o in Nagoya de miyagemono o showing that, as long as their lengths are the same, the difference in the level of accent realization between the patterns [X no Y o] and [X de Y o] is maintained.

(7) Nara no raamen o ippai tabeta.
Nara GEN ramen ACC lots ate
'I ate lots of Nara ramen.'

(8) Nagoya no raamen o ippai tabeta.
Nagoya GEN ramen ACC lots ate
'I ate lots of Nagoya ramen.'

(9) Nanzenji no raamen o ippai tabeta.
Nanzenji GEN ramen ACC lots ate
'I ate lots of Nanzenji ramen.'
companying a rise at the “end of an accent phrase”), the presence or absence of delimiters like wa [TOP] or mo ‘also, even’, the presence or absence of fillers, or whether or not something is an auxiliary verb all influence what is called the level of accent realization in this paper. Although not using the term level of accent realization, Kubozono (1993) considers a rhythmic factor. In Kori (1997a), it was shown that there is a tendency for a penultimate phrase not to undergo weakening in sentences read aloud, that when there is a sequence of semantically restrictive modifiers, phrases appear along the way that do not undergo weakening, and that in a particular type of emotional expression called “simi-jimi-style”, weakening fails to take place. In addition, there can be thought to be inter-speaker differences and differences due to speech style.

2.3 Acoustic Indicators of Level of Accent Realization: Magnitude of Inter-Peak Change and Magnitude of Initial Rise

As acoustic indicators of the level of accent realization of a given phrase, one can think of the “magnitude of inter-peak change” and the “magnitude of initial rise” in the phrase.

The “magnitude of inter-peak change” is the difference between the highest value of F0 for the phrase under consideration and the highest value of F0 for the preceding phrase (1 in Figure 6). When the preceding phrase is kernel-bearing, as with the momizi o of Nara no momizi o in Figure 1, and this measure has a large negative value, this means that the maximum value of F0 in the phrase under consideration is much lower than the previous phrase and that the accent of the phrase in question has most likely been weakened. If the value is positive, that means the phrase in question is higher than the previous phrase and in that case clearly the accent of the phrase in question has not been weakened. In case the preceding phrase is not-kernel-bearing, as in the second sentence in figure 2, the difference in this value between when the accent is weakened and when it is not is smaller.

On the other hand, the magnitude of initial rise is the magnitude of the rise in pitch of the first half of the phrase under consideration (2 in Figure 6). If the value of this measure is large, as it is for the momizi o of Nara de momizi o in Figure 1, this shows that the phrase is intonationally independent and does not form a unit with the preceding phrase. In such a case, the accent of the phrase in question has not been weakened.

Since magnitude of initial rise can be used without regard to whether or not the preceding phrase is kernel-bearing, in theory this measure alone should be sufficient. However, since, in the analysis conducted in Kori (2007) on discrimination between a semantically restrictive environment and a non-restrictive environment, inclusion of the magnitude of inter-peak change in the discriminant function was effective, we will use both together below.

2.4 Semantic Restriction as a Factor in Determining the Level of Accent Realization

As observed in section 2.1, the level of accent realization of the momizi o in Nara no momizi o and Nara de momizi o is different, as is that of the omiyage o in Hirosima no omiyage o and Hirosima de omiyage o. It looks as though this difference is due to a syntactic difference (the presence or absence of a local modification relation between the two phrases or a difference in the tree structure of the sentence as a whole). In fact, the phenomenon has often been treated as such in previous research.

However, even though it has exactly the same modification structure and exactly the same tree structure as Kyonen Nara no momizi o Yumi to mita ‘Last year I viewed the fall foliage in Nara with Yumi’, in Kyonen Nara no Hooryuzi o Yumi to mita ‘Last year I viewed Hōryūji Temple in Nara with Yumi’, the pitch prominence of Hooryuzi o does not become particularly
lower and accent weakening normally does not occur. Concerning the reason for the lack of accent weakening with Hooryuuzi o, the author considers it to be because Hooryuuzi o is not semantically restricted by the immediately preceding Nara no6). If Hooryuuzi o here were to undergo accent weakening, it would give the impression that, based on the premise that there is another Hōryūjī somewhere other than in Nara, the sentence is restricting discussion to “the Hōryūjī in Nara, not one somewhere else”. However, given the general knowledge that Hōryūjī means the Hōryūjī in Nara, the Nara no is not taken as restricting the concrete object that Hōryūjī refers to but as providing supplementary information as to its location.

In Nara no momizi o, Nara no limits the scope or range of possible referents of momizi o and accent weakening occurs with the momizi o so restricted. In contrast, in the normal interpretation of Nara no Hooryuuzi o, Nara no does not limit the range of possible referents of Hooryuuzi o and in this case accent weakening does not occur. In the same way, in Nara de momizi o, Nara de does not restrict the range of possible referents of momizi o and in that case accent weakening does not occur.

The above observations lead the author to conclude that it is not the syntactic relation but the presence or absence of a semantic restriction (the presence or absence of a restriction on the range of possible referents in the examples above) that determines whether or not accent weakening occurs in such examples. There is, however, another possibility. The frequency of occurrence of semantically non-restrictive noun modification relations like Nara no Hooryuuzi o above is low and this is, thus, a special case. Accordingly, the non-occurrence of accent weakening is an exceptional phenomenon limited to cases in which there is no semantic restriction8). In other words, both the syntactic relation and semantic restriction can be considered to be determining factors for the occurrence of accent weakening. However, the author considers semantic restriction alone to be the determining factor because, although a syntactic modification relation does exist whenever there is a semantic restriction between a sequence of phrases, the reverse is not the case.

There are a number of different patterns in which there is no semantic restriction and accent weakening does not take place. The pattern we have considered here is the [noun+no+noun] pattern, which Kori (1997a) divides into [1] the case in which the second noun is a proper or quasi-proper noun, with further subcategorization into [1a], the case in which the preceding noun provides supplementary information concerning the second noun (as in Nara no Hooryuuzi ‘Nara’s Hōryūjī’ or Sooseki no “Bottyan” ‘Natsume Sōseki’s “Botchan”’) and [1b], the case in which the second noun provides a concrete name to supplement the preceding noun (as in kanzi no Yuyama-kun ‘Mr. Yuyama, the chair’ or gooza kyakusen no Akireraugoo ‘the luxury passenger ship, Akireraura’) and [2], cases in which the second noun is a common noun and its qualities or qualities it evokes add supplemental explanations to the preceding noun (as in higooohoo no heroin ‘illegal heroin’ or syumi no ongaku kansyoo ‘(his) hobby, listening to music’).

The situation is the same for the [adjective+noun] pattern in which, if the adjective does not limit the range of possible referents for the noun, accent weakening does not occur. Categorization of such cases follows much the same pattern as above. Category [1] is that in which the noun is a proper noun and the adjective adds supplementary information (as in samui Siberia ‘cold Siberia’) and category [2] is that in which the noun is a common noun and the adjective expresses qualities of the noun or qualities the noun evokes (as in kowai kootuuziko ‘frightening traffic accidents’, atui natu ‘hot summer’, or kooka-na daiyamondo ‘expensive diamond’).

In the case of category [2] above, whether or not the preceding noun or adjective expresses a quality of the noun or a quality it evokes is often a subjective judgment based on the speaker’s knowledge or experience. Accordingly, there is room for a semantically restrictive interpretation. For example, if one is conscious of the existence of a summer that is not hot, saying atui natu ‘hot summer’ semantically restricts the kind of summer. Without a context, then, ambiguity arises easily.

On the other hand, the cases where the preceding phrase restricts the range of possible referents also fall into two categories; category [1] includes cases like Nara no momiji [Nara GEN fall.foliage], which selects the Nara fall foliage out of the many other various possibilities as the foliage that was viewed, that is, cases that restrictively select one part of the set of possible references, and category [2] includes cases like ima no Hooryuuzi [now GEN Hōryūjī ‘Hōryūjī (as it is) now’] which selects one of the many aspects that could vary by time and conditions, that is, cases that restrictively select one part of the set of various possible aspects.

Accent weakening is also found on the predicates in constructions of the form “adverbial modifier+predicate” and “complement element+predicate”. These, too, can be explained in terms of having a restrictive relation.
For example, accent weakening is found on mita ‘saw’ in kyonen mita ‘saw last year’, zikkuri mita ‘watched carefully’, or soto kara mita ‘saw from outside’ because the action or state of being expressed by the predicate is restricted by the modifying element. In other words, one part of the set of possible actions or states of being is restrictively selected. Further, in “complement element+predicate” cases like watasi ga mita ‘I saw’ or momizi o mita ‘(Someone) saw fall foliage’ as well, considering the complement element to have the function of restricting the actor or the patient with regard to the predicate, that is, considering them to restrictively select from possible complement elements what the concrete complement elements are, we can see this as accent weakening due to semantically restrictive modification.

It could be thought that the level of realization of accent weakening differs somewhat depending on whether what is modified is a noun or a verb. However, when the case of “complement element+verb” and that of “element selecting part of a set+noun”, both composed of a similar sequence of sounds and occurring in a sentence-final or clause-final position were compared, the results showed no difference between them in the level of realization of accent weakening 10).

The author’s interpretation that it is the presence or absence of semantic restrictions rather than syntactic structure that determines whether accent weakening takes place or not is explained above. However, there are two problems that must be resolved in order to demonstrate the correctness this interpretation.

The first is whether or not one can really say that accent weakening does not take place unless there is a semantic restriction even when the phrase in question is modified by the preceding phrase. When a speaker is asked to read a sentence like Nara no momizi o Yumi to mita ‘I viewed the fall foliage in Nara with Yumi’, in which the modification relation and the semantic restriction relation match, in normal pronunciation, the accent of momizi o is weakened. However, when asked to read a sentence like Nara no Hooryuuzi o Yumi to mita ‘I viewed Hōryūji in Nara with Yumi’, which includes a phrase like Hooryuuzi o that is modified but not semantically restricted, the accent on Hooryuuzi o occasionally appears with a weakened pronunciation. In order, therefore, to say with confidence that it is the presence or absence of semantic restriction that decides whether accent is weakened or not, it is necessary to confirm with data that such a pronunciation is exceptional; it is necessary to confirm this with speech data. It would be even more certain if it were also confirmed at the level of perception. And, if the pronunciation of Hooryuuzi o with weakened accent described above is exceptional, it is necessary to explain the reason it is easy for such exceptions to appear.

The other is the fact that experimental data has been adduced in previous studies that appear to show clearly that syntactic structure determines the level of realization of accent weakening. Section 3 will first report a follow up experiment to previous studies and then in sections 4 and 5 we will examine the correspondence between semantic restriction and accent weakening.

3. Does Branching Structure Determine the Level of Accent Realization?

3.1 Situating the Problem

In Kubozono (1993: 210 ff), Kubozono compared [Ayako no [men no erimaki no ]] iro moyoo ‘the color pattern on Ayako’s cotton scarf’, which has the structure [[A[BC]]D], with [aoi [[Yumiko ga anda] erimaki]] ‘the blue scarf that Yumiko knit’, which has the structure [A[[BC]]D] and presented data showing that the peak value for F0 and the magnitude of initial rise were larger in the Yumiko ga of the latter, in which the right branch is deep, than in the men no of the former, in which the right branch is shallow.

The test words are all kernel-bearing and were embedded in the carrier sentence Kare wa ··· to itta ‘He said ···.’ which was recorded by a single speaker whose voice was analyzed acoustically. Figure 7 shows the data for just the first two phrases, converted from the average frequency units of the original to semitone units with 50 Hz as the base. “Peak 1” shows the F0 peak of the first phrase (Ayako no, aoi) and “Peak 2” the F0 peak of the second phrase (Yumiko ga, men no).

These results, Kubozono argued, lead to the conclusion that the contribution of branching structure to what he called “metrical boost” (concretely, a boost in pitch) was not fixed but changed with the constituent structure of the entire phrase. In the terms used in this paper, the claim is that the branching structure of the entire string of phrases is what determines the level of accent realization of a phrase included in the string and that it is not determined by the local relation with the adjacent phrase. If this were true, it would show decisively that it is the branching structure that determines the level of accent realization. This would mean that, with the addition of the observations in the previous section, it is necessary to consider both branching structure and semantically restrictive modification as factors determining the level of accent realization in a case like this.
However, in the sentence pairs given above that Kubozono used, the number of mora making up the phrases are not the same and the position of the accent kernel within the phrases is also different, so the number of mora separating the accent kernels is different. In order to show the metrical structure of each of the initial pairs of phrases, let us represent the accent kernel as ● and other mora as ○. Ayako no men no is made up of 4 mora + 3 mora in the structure ●○○○●○○ and the accent kernels are separated by 3 mora. On the other hand, aoi Yumiko ga is made up of 3 mora + 4 mora and has the structure ○●○●●○○ so the accent kernels are separated by 1 mora. That is quite a difference. As touched on in section 2.2, the F0 peak value and the magnitude of the phrase-initial rise can vary according to the length of the phrase under consideration and the location of the accent kernel in the preceding phrase. The pair that Kubozono used, therefore, cannot be said to be directly comparable. In addition, the data is only from one speaker.

The discussion above shows the need for caution in accepting the claim that overall branching structure determines the level of accent realization based on Kubozono’s data and further shows the need to test its appropriateness with pairs with matching metrical environments and using material from multiple speakers. The next subsection reports the results of such an investigation.

### 3.2 Test Sentences

As shown in Table 1, two pairs of sentences with different metrical structures were prepared for each branching structure. The sentence corresponding to Kubozono’s test sentence Ayako no men no erimaki no iro moyoo in the metrical structure of the first two phrases is sentence (10). No sentence directly corresponds to Kubozono’s aoi Yumiko ga anda erimaki, but sentence (13) is the closest. Figure 8 shows the average of six repetitions of sentence (13) by speaker ymg.

### 3.3 Recording and Acoustic Analysis

The phonetic materials consist of recordings of 6 to 10 repetitions by 9 speakers (igy, kb, mk, ngs, sk, sn, st, trm, ymg). The acoustic values targeted for analysis were the indicators of the level of accent realization described in section 2.3, namely, the magnitude of inter-peak change (the difference between peak 1 and peak 2 in Figure 8) and the magnitude of initial rise (the magnitude of the change in Figure 8 from the valley to peak 2), and also, in order to match Kubozono’s method, the height of the peak in the second phrase (peak 2), the height of the peak in the first phrase (peak 1), and the height of the valley between them were also collected. The metrical structure and the phrase structure were taken as fixed factors and an analysis of variance was performed with speaker as the random factor. The reason for treating speaker as the random factor was that, although there may be some differences by speaker with regard to this problem, such variations follow a standard distribution and it was considered that there were no sub-dialect peculiarities.

### Table 1 Branching structure and intonation test sentences.

<table>
<thead>
<tr>
<th>Sentence number</th>
<th>Branching structure</th>
<th>Test sentence</th>
<th>Metrical structure of first 2 phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10)</td>
<td>[[A[BC]]D]</td>
<td>[[Miyoko no [ao no sukaato no] nedan wa]] ikura?</td>
<td>4 + 3 mora ●○○○●○○</td>
</tr>
<tr>
<td>(11)</td>
<td>[[Mao no [midori no sukaato no] nedan wa]] ikura?</td>
<td>3 + 4 mora ●○○○●○○</td>
<td></td>
</tr>
<tr>
<td>(13)</td>
<td>[[A[BC][D]]]</td>
<td>[Ao no [[Miyoko ga yooi-sita] saihu wa]] doko?]</td>
<td>3 + 4 mora ●○○○●○○</td>
</tr>
</tbody>
</table>

(10) ‘How much was the price of Miyoko’s blue skirt?’
(11) ‘How much was the price of Mao’s green skirt?’
(12) ‘Where is the green purse that Mao prepared?’
(13) ‘Where is the blue purse that Miyoko prepared?’

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3.4 Results and Observations

Figure 9 shows the average values of the 9 speakers for the peaks and valley. An analysis of variance table is given in Appendix 2.

As can be seen from the figure and the analysis of variance table, there is no significant difference (p < 0.05) due to the branching structure in either the magnitude of inter-peak change or the magnitude of initial rise, and also no significant difference in the peak or valley heights (compare ○ with ▲ and □ with ● in Figure 9). All significant differences are due to metrical structure. That is, the differences Kubozono observed can be thought to be due to differences in the number of mora in the phrasal constituents and to the resulting difference in distance between accent kernels. In fact, if one compares just the sentences most similar to Kubozono’s, (10) (symbol ○) and (13) (symbol ●) in Figure 9, their F0 values closely resemble those of Kubozono’s sentences in Figure 7.

From the above, it is clear that the overall branching structure of a string of phrases does not determine the level of accent realization of a phrase contained within it11).

4. Semantic Restriction and the Level of Accent Realization: Speech Study

4.1 Objectives

As mentioned in section 2.4, when asked to read a sentence like Nara no Hooryuuzi o ... ‘I viewed Hōryūji in Nara ...’, which includes a semantically non-restrictive modifier, the accent of Hooryuuzi o occasionally appears with a weakened pronunciation. Thus, in order to say for sure that it is the presence or absence of semantic restriction that determines whether or not accent weakening takes place, it is necessary to show with data that such a pronunciation is exceptional. This section examines this problem using recordings of the reading aloud of 8 pairs of sentences.

4.2 Test Sentences

Sentences with the first two phrases in a noun modification relation were constructed and those in which those phrases have a semantically restrictive relation (“restrictive modification environment”) and those in which they did not (“non-restrictive environment”) were compared. In order to allow direct comparison of the two environments, the sentence pairs shown in Table 2 were constructed so that the number of mora and the location of the accent kernel (all were kernel-bearing) were the same and, in addition, the phrase phonetic structures were made as alike as possible. Using question words and the like made the focus fall on the third phrase or later, making the initial two phrases in question old information and insuring that they would not bear focus.

The non-restrictive environment sentences are all of the pattern [1a] described in section 2.4, namely the one in which a proper noun in second position is modified by the preceding noun, which supplies supplementary information about it12). The reason pattern [2] with a common noun is not included is that, as mentioned before, it is easy for ambiguity to develop as to whether or not the modification is non-restrictive.

4.3 Recording and Acoustic Analysis

The phonetic data consists of single recordings by six speakers (ngs, sk, sn, st, trm, ymg). The sentence Suisu wa biiru tte yoku nomu n desu ka ‘As for Switzerland, do they drink a lot of beer?’, which has a non-restrictive, non-modifying environment corresponding to the sentences of (14) was also recorded for contrast. Before recording, the speakers were shown all the sentences and were either told that or confirmed in their knowledge that the “Biel”, “Botchan”, “Un-met”, “Mirage”, “Nile”, and “Ai-chan” appearing in the non-restrictive environments were proper nouns, and they were asked to record the sentences carefully considering their meaning. They were asked to pronounce the noun zidoosya (which has an alternative
4.4 Results and Observations

Figure 10 is a typical example from speaker sk showing the F0 curve for the pair of sentences in (14) and the contrast sentence. The restrictive modification environment of *Suisu no *biiru (beverage)* tte donna azi desu ka* and the non-restrictive modification environment of *Suisu no *Biiru (place name)* tte donna *toko desu ka are clearly differentiated in the figure. The peak in *Biiru* of the latter (place name) and the peak in *Biiru* of the latter is roughly the same in height as the contrast sentence.

The magnitude of inter-peak change between the first two phrases and the magnitude of initial rise of the second phrase for all six speakers are shown in a scatter plot in Figure 11. Filled triangles (▲) mark the non-restrictive environment utterances and open triangles (▲) the restrictive environment ones. There is quite a bit of overlap between them, but on the whole, the former are higher and further to the right than the latter and it is clear that on the average the realization level of the accent of the second phrase is larger.

Analysis of Variance

In order to determine if the differences between the restrictive and non-restrictive environment sentences are significant, analysis of variance was conducted for each of magnitude of inter-peak change and magnitude of initial rise with restrictive or non-restrictive and sen-

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**Table 2** Sentence pairs to test for a correspondence relation between the presence or absence of semantic restriction and the level of accent realization.

<table>
<thead>
<tr>
<th>Sentence number</th>
<th>Restrictive modification environment</th>
<th>Non-restrictive modification environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(14)</td>
<td><em>Suisu no biiru</em> (beverage) <em>tte donna azi desu ka</em></td>
<td><em>Suisu no biiru</em> (place name) <em>tte donna toko desu ka</em></td>
</tr>
<tr>
<td>(15)</td>
<td><em>Kyomen no Gion Maturi</em> <em>tte doo desita ka</em></td>
<td><em>Kyoto no Gion Maturi</em> <em>tte itu yaru n desu ka</em></td>
</tr>
<tr>
<td>(16)</td>
<td><em>Soo-san no bottyan</em> <em>tte donna okosan desu ka</em></td>
<td><em>Sooseki no “Bottyan”</em> <em>tte donna hanasi desu ka</em></td>
</tr>
<tr>
<td>(17)</td>
<td><em>Beetooben no unsei</em> <em>tte donna unsei desu ka</em></td>
<td><em>Beetooben no “Unmei”</em> <em>tte donna kyoko desu ka</em></td>
</tr>
<tr>
<td>(18)</td>
<td><em>Mitubisi no zidoosya</em> <em>tte norigokotti wa doo desu ka</em></td>
<td><em>Mitubisi no Miraazyu</em> <em>tte donna kuruma desu ka</em></td>
</tr>
<tr>
<td>(19)</td>
<td><em>Kenkyuu nessin-na dansaa</em> <em>tte dare no koto desu ka</em></td>
<td><em>Kenkyuu nessin-na Dan-san</em> <em>tte Dan-sensei no koto desu ka</em></td>
</tr>
<tr>
<td>(20)</td>
<td><em>Tinpanzii no aisatu</em> <em>tte donna aisatu desu ka</em></td>
<td><em>Tinpanzii no Ai-tyan</em> <em>tte nande yuumei nan desu ka</em></td>
</tr>
<tr>
<td>(21)</td>
<td><em>Gooka kyakusen no naibu</em> <em>tte donna huu ni natteru n desu ka</em></td>
<td><em>Gooka kyakusen no Nairu</em> <em>tte donna hune desu ka</em></td>
</tr>
</tbody>
</table>

(14) ‘What kind of flavor is Swiss beer?’
(15) ‘What kind of place is Biel, Switzerland?’
(16) ‘What kind of child is Mr. Sō’s son?’
(17) ‘What kind of fortune is a Beethoven fortune?’
(18) ‘What kind of piece is Beethoven’s Fifth Symphony?’
(19) ‘Who do you describe as a research-loving dancer?’
(20) ‘What kind of greetings are chimpanzee greetings?’
(21) ‘What kind of ship is the luxurious passenger liner like?’

non-kernel-bearing form) with the kernel on *do (zi do’o sya)*. The subjects were all either graduate students or undergraduates from classes in foreign language education or linguistics, but it was confirmed that they had no knowledge concerning factors determining the level of accent realization in Japanese. Acoustic analysis was conducted on the magnitude of inter-peak change between the first two phrases and on the magnitude of initial rise of the second phrase.

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Can It Be Said That Accent Weakening Does Not Occur in the Non-restrictive Environment?

Is it correct to say that the accent of the second phrase is not weakened in non-restrictive environments? In order to determine this, the data from sentences (14) through (21) were compared with data from other non-restrictive, non-modifying environment utterances and with restrictive modification environments.

Figure 12 is a scatter plot showing the magnitude of inter-peak change between the first two phrases and the magnitude of initial rise of the second phrase in the speech of 10 subjects, middle-aged or younger, who recorded each of the set of “ramen sentences” below six times (a subset of the data from Kori 2007). The “ramen sentences” consist of four pairs of sentences that differ only in that one is of the pattern “X no Y o” and the other of the pattern “X de Y o”; the specific pairs are: Nara no/Nara de raamen o ippai tabeta ‘I ate my fill of Nara Ramen/I ate my fill of ramen in Nara’, Nagoya no/Nagoya de raamen o ippai tabeta ‘I ate my fill of Nagoya Ramen/I ate my fill of ramen in Nagoya’, Nanzenji no/Nanzenji de raamen o ippai tabeta ‘I ate my fill of Nanzenji Ramen/I ate my fill of ramen at Nanzenji’, Nagoya no/Nagoya de raamen-teisyoku o ippai tabeta ‘I ate my fill of the Nagoya Ramen lunch/I ate my fill of the ramen lunch in Nagoya’. In all the sentences, the first two phrases bear an accent kernel on the initial mora. The “X no Y o” pattern shows restrictive modification and, in normal pronunciation, the accent of the second phrase is weakened. In contrast, the “X de Y o” pattern shows neither restriction nor modification and so, in normal pronunciation, the accent of the
second phrase is not weakened.

In Figure 12, restrictive modification utterances are shown by open circles (○) and the non-restrictive, non-modifying utterances are shown by filled circles (●). Although the distributions of the acoustic values for the restrictive environments and the non-restrictive non-modifying environments are different, it is clear from this figure that there is also an area where the two overlap. This overlap can be thought to arise from, in addition to the variation that naturally occurs each time the same sentence is uttered, the fact that the metrical environment of each sentence is different and the fact that there is inter-speaker variation.

In addition to the differences in mora structure and balance in kernel location between the ramen sentences in Figure 12 and sentences (14) through (21) in Figure 11, the types of the sentences and the speakers are also different, making it impossible to simply compare them, but let us look at the patterns seen in the two figures. It is clear that the region in which the magnitude of inter-peak change and magnitude of initial rise in non-restrictive modification environments in Figure 11, shown by filled triangles (▲), and those of non-restrictive, non-modifying environments in Figure 12, shown by filled circles (●) overlap to a large degree. There are a few utterances that overlap in the region that is exclusively filled by restrictive modification environment utterances (○) in Figure 12, but there are only a few. That is, while there may be some utterances that do not fit, the level of accent realization in the non-restrictive environment of sentences (14) through (21) are largely of the same level as the level of accent realization in non-restrictive, non-modifying environments and, accordingly, it appears we can say that weakening does not take place in the majority of non-restrictive modifying environment utterances. This point will be further confirmed in the listening perception experiments in section 5.

**Inter-Speaker and Sentence Pair Variation**

Figure 13 shows the average values for the magnitude of inter-peak change and initial rise for each speaker over the eight sentences (14) through (21) in order to isolate the tendencies of each speaker. Data from the same speaker are connected by lines with the large symbols indicating non-restrictive environments and the small symbols restrictive environments. Looking at this figure, it appears that only speaker sn did not have a difference between restrictive and non-restrictive utterances. In reality this speaker’s level of accent realization in non-restrictive environments was small for all the sentence pairs (14)–(21), pronouncing them with accent weakening. Conducting an analysis of variance for each speaker individually, it was apparent that this speaker alone could not be said to differentiate between

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**Figure 13** Averages for 8 sentence pairs by speaker. (Large symbols show non-restrictive environment)

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**Figure 14** Kyonen/Kyooto no Gion Maturi and Gooka-kyakusen no naibu/Nairu. (Large symbols show non-restrictive environment)
restrictive and non-restrictive modification\(^{13}\). It is not the case, however, that this speaker did not distinguish between them at all intonationally, as will become clear from the listening perception test in the next section. This speaker’s behavior was a phenomenon that occurred exceptionally at the time of speech and fundamentally all speakers can be thought to distinguish restrictive and non-restrictive modification intonationally.

Looking at differences by sentence pair, there ended up being no apparent difference between restrictive modification and non-restrictive modification in the three sentences (15) kyonen/Kyooto no Gion Matsuri, (19) kenkyuu nessin na dansaa/Dan-san, or (21) gooka kyakusen no naibu/Nairu\(^{14}\). However, it is not the case that no speakers distinguished them; there were also speakers who did. Figure 14 shows the situation with sentences (15) and (21). Data from the same speaker are linked by a line in the figure.

Cases Where a Distinction Is Not Made between Restrictive and Non-restrictive Modification

Among the cases in which individual speakers did not distinguish in speech between restrictive and non-restrictive environments, there were many cases in which no difference appeared because the level of accent realization in the non-restrictive environment was small, but there were also cases in which, to the contrary, there was no difference because the level of accent realization in restrictive environments was not small. Which sentences pairs did not show a difference varied by speaker.

Probing for the reasons why there was no differentiation between restrictive and non-restrictive environments is quite difficult, especially given that there is only one token from each of the 6 speakers. However, one reason that can be considered is the possibility that there was a disparity in the semantic interpretation of the sentences by speaker. This is because, in general, there is room to interpret a non-restrictive modifier as restrictive. Among the sentences that did not show a difference between restrictive and non-restrictive, in (21) it may have been especially easy to draw attention to the fact that “the luxurious passenger ship Nile” is not “the river Nile” and for that reason there may have been speakers who weakened the accent on the second phrase. There may also have been speakers who imagined a “Mr not-research-loving Dan” to go with “Mr research-loving Dan” and those who failed to realize that the Gion Matsuri is unique to Kyoto. If the accent was weakened for any of these reasons, there would be no difference from restrictive environments.

In contrast, the pair *Suisu no biiru* with *biiru* meaning either the beverage or the place name Biel, which most speakers did differentiate, form a minimal pair between restrictive and non-restrictive and that may have induced them to make more of an effort to distinguish them.

Also, since with overwhelming frequency, modification environments are also semantically restrictive environments, there were probably more than a few cases in which the modification environment caused accent weakening across the board. This probably especially fits the case of speaker sn. There is also the possibility that other phonetic factors may have been involved\(^{15}\).

5. Semantic Restriction and the Level of Accent Realization: Listening Perception Experiment

5.1 Objectives

From the results of the speech study reported in the previous section, it appears that we can say that, even when there is a noun modification relation, there is no second phrase accent weakening unless there is also semantic restriction. A listening perception experiment using synthesized voices was conducted in order to confirm this at the perceptual level.

5.2 Test Sentences

From the sentence pairs used in the previous section, I selected the pair using *Suisu no biiru*, which formed a minimal pair between the restrictive and the non-restrictive environments and, for contrast, included a sentence with *Suisu wa biiru*.

(22) *Suisu wa biiru* tte yoku nomu n desu ka.
*Suisu* TOP *biiru* QUOT often drink NMLZ COP Q

‘As for Switzerland, do they often drink beer?’

(23) *Suisu no biiru* tte yoku nomu n desu ka.
*Suisu* GEN *biiru* QUOT often drink NMLZ COP Q

‘Do you often drink Swiss beer?’

(24) *Suisu no biiru* tte donna toko desu ka.
*Suisu* GEN *Biel* QUOT what.kind.of place COP Q

‘What kind of place is Biel, Switzerland?’

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5.3 Synthesized Voices
Voices for test sentence (24) were created first. As shown in Figure 15, the height of the F0 peak (in the middle of biiru) recorded by speaker sk was modified in fifteen 1 semitone steps from a near match to the height of the peak of suisu (initial rise of biiru+13.0 st, magnitude of inter-peak change -0.5 st, 6.0 st higher than the original) at the high end to a gentle fall with no visible peak in the middle of biiru (1.0 st fall from beginning of biiru, 8.0 st lower than the original) at the low end using PSOLA (16 bit, 22.050kHz) with the span from the beginning point of biiru through the peak (the middle point of biiru) to the end of biiru filled in a linear manner. The heavy line in the figure shows the voice with the magnitude of initial rise set at ʴ7.0 st, which this experiment showed to correspond for the most part to the dividing line between restrictive and non-restrictive interpretations. The synthesis was done using Praat 4.5.

Next, the voices for test sentence (23) were created. This was done by substituting the part te yoku nomu n desu ka from the recording of Suisu wa biiru tte yoku nomu n desu ka (sentence 22) by the same speaker sk for the latter part of sentence (24), te donna toko desu ka.

Finally, the voices for test sentence (22) were created by substituting uwa from the latter part of Suisu wa in Suisu wa biiru tte yoku nomu n desu ka recorded by the same speaker sk for the uno in the latter part of Suisu no in sentence (23).

5.4 Listening Perception Experiment
Using a web browser, voice files stored on the internal hard disk of the computer were linked to buttons on the monitor and the number of times, the intervals between recordings, and the order in which the respondents listened to the recordings were left to the respondents. Respondents were asked to indicate with a mouse click for each voice how appropriate on a five-point scale: “completely inappropriate”, “can’t decide”, “somewhat appropriate”, and “completely appropriate” the intonation of each voice was for the question posed. The questions are described below.

For sentence (22): What sort of intonation would be appropriate when asking someone knowledgeable about Switzerland, “As for Switzerland, do they often drink beer?”

For sentence (23): What kind of intonation would be appropriate when asking someone knowledgeable about Switzerland, “(Do you yourself) often drink Swiss beer?”

For sentence (24): What kind of intonation would be appropriate when asking someone knowledgeable about Switzerland, “What kind of place is Biel, Switzerland?”

The experiment was conducted in a quiet room with few echoes with the voices presented from a speaker at a volume the respondents were comfortable with. The respondents were the same 6 speakers who had participated in the speech experiment described in section 4 (including the speaker who had provided the original recording for the test sentences). Six months had passed since the speech experiment. In order to accustom the respondents to the experiment, after they had responded to all the stimuli once as a trial, they were asked to respond again for the main experiment. When answering, they were told they could listen in any order, as many times as they liked, that they could revise their answers as often as they liked, and to listen repeatedly until they were confident of their answers. The data used below are from their single final answers. The time for each respondent was not restricted, but it took about 15 minutes for all three questions. In the end, they answered after listening to each stimulus 2 or 3 times.

5.5 Results and Discussion
The averages of the six respondents’ judgements of the appropriate intonation for each sentence are shown...
in Figure 16. For convenience, the 5-step judgement scale was treated as if an interval scale with 1 point assigned to “completely inappropriate” and 5 points assigned to “completely appropriate” and the arithmetic mean calculated and shown in Figure 16 as “average appropriateness rating”. Looking at voices that scored above 4 (“somewhat appropriate”) in Figure 16, the peak in biiru in the intonation appropriate to the non-restrictive modification Suisu no Biiru tte (place name, shown with open circles (○)) is higher than that for the restrictive modification (beverage, shown with filled circles (■)), having a prominent peak close to the size of the peak in Suisu no. This intonation was the same as the intonation appropriate for the non-restrictive, non-modification Suisu wa biiru tte (shown by filled squares (■)). This fact means that a voice without accent weakening is judged appropriate for the non-restrictive modification environment. Accordingly, it is confirmed at the perceptual level that it is the presence or absence of a semantically restrictive modification relation that determines whether or not accent weakening takes place.

**Variation among Respondents**

Next, looking at the results by respondent, shown in Figures 17, 18, and 19, it is apparent that the responses of all six have similar tendencies. Testing for the conformity of the respondents’ ratings with Kendall’s coefficient of concordance, the values for sentences (22), (23), and (24) were 0.866, 0.571, and 0.748, respectively, all with p=0.000, showing that the respondents’ ratings did conform.

However, comparing the three figures, it is clear that, depending on the individual, the intonation held to be appropriate could be very different from the overall tendency. The range speaker trm held to be appropriate for both the restrictive modification environment (beverage) and the non-restrictive modification environment (place name) was extremely broad, allowing both those in which the peak in biiru was high and those in which it was low. Speaker ngs also gave high ratings to voices in which the magnitude of initial rise was large for both restrictive and non-restrictive modification environments. These two speakers distinguished restrictive and non-restrictive in the speech experiment (section 4), but they did not distinguish them in this perception experiment. Speaker sn, on the other hand, had a very small initial rise in both environments in the speech experiment, not distinguishing between them, but made a clear distinction here. We can confirm that respondents other than trm and ngs regarded different intonations as appropriate for the two Suisu no Biiru from the fact the Kendall’s rank correlation coefficient for trm and ngs takes on a significant large positive value whereas it takes on a significant negative value or shows no correlation for other respondents.

Looking at the Kendall’s rank correlation coefficients for the ratings for the non-restrictive, non-modification environment Suisu wa biiru and the non-restrictive modification Suisu no Biiru (place name) environment, all the respondents except trm show a significant positive correlation. That is, other than
there is no evidence that branching structure deter-
mines the level of accent realization. This shows that
there is a connection between the depth of right branch-
ing relation; it is sufficient to consider just semantic
syntactic modification relation and the semantic restric-
tion relation do not coincide appear only infre-
quently, it is possible to view the syntactic relation as
an approximation of the determining factor, it is not the
primary factor.

Actually, looking at the situation in natural conver-
sation, it is not always the case that accent weakening
occurs even though there may be semantic restriction
(Kori 2007). However, accent weakening does not oc-
cur when there is no semantic restriction. In order to
explain this, we can say that accent weakening is only
possible in natural conversation when there is semantic
restriction (focus and other conditions being equal).
Thus, the fact that semantic restriction is the determi-
ning factor in accent weakening is not contradicted by
the case of natural conversation.

Furthermore, although the results will be reported
in more detail in the future, in dialects other than the
Tokyo Japanese taken up in this article, including the
dialects of Nagoya, Uozu, Hiroshima, Fukuoka, Osaka,
and Kochi, at least in the speech of the younger gen-
eration, there is a difference between restrictive and
non-restrictive modification environments in the level
of accent realization, as confirmed with a study using
slightly modified versions of test sentences (14)–(21).
The fact that, although the pairs vary by the individual
speaker, there were pairs for which no difference was
apparent is also compatible with the Tokyo speakers re-
ported in this article. In addition, the behavior of Osaka
Japanese speakers was confirmed using a listening per-
ception experiment like that of section 5 of this article.
Furthermore, in the speech of younger speakers in the
region around Fukui City, where lexical accent does
not have a distinctive function, there was a sentence
intonation difference between the two environments.
It thus appears that semantic restriction as one factor
determining intonation is applicable over a wide area.

6. Summary and General Discussion

In support of the claim that it is the presence or ab-
sence of semantic restriction that determines whether
or not the accent of the second phrase is weakened in a
string of phrases like "Nara no momizō o ‘(See) Nara’s
fall foliage’, Nara de momizō o ‘(See) fall foliage in
Nara’ and Nara no Hooryuuzi o ‘(See) Nara’s Höryūzī’,
this paper reports the results of three investigations.

In section 3 it was shown that we cannot say that
there is a connection between the depth of right branch-
ing and the level of accent realization. This shows that
there is no evidence that branching structure deter-
mines the level of accent realization. From this it can
be said that we need not consider overall branching
structure as a determining factor in the level of accent
realization. However, this does not mean that we can
reject the presence or absence of a modification relation
between neighboring phrases as a factor determining
the level of realization of accent.

From the results of the speech experiment in sec-
tion 4, we can say that the level of accent realization
differs in restrictive and non-restrictive environments.
Through comparison with other materials, it was clear
that the level of accent realization in non-restrictive
modification environments was more-or-less the same
as that in non-restrictive, non-modification environ-
ments. Accordingly, it appears we can say that accent
weakening does not take place in non-restrictive
modification environments. This was confirmed at the
perceptual level in section 5.

However, there were utterances in which accent
weakening occurred in non-restrictive environments.
The fact is that generally there is room to interpret non-
restrictive modification as restrictive and that, over-
whelmingly, modification environments are at the same
time semantically restrictive, so there can be thought to
be a tendency to carry out accent weakening across the
board in modification environments.

In a string of phrases in which there is a semanti-
cally restrictive relation, there is also at the same time
a modification relation. However, the contrary is not
necessarily true. Accordingly, when considering the
determining factors for accent weakening in such en-
vironments as "Nara no momizō o and Nara de momizō
o, it is not necessary to consider the two factors of the
syntactic modification relation and the semantic restric-
tion relation; it is sufficient to consider just semantic

From the results of the experiment in section 4, we can say that the level of accent realization differs in restrictive and non-restrictive environments. Through comparison with other materials, it was clear that the level of accent realization in non-restrictive modification environments was more-or-less the same as that in non-restrictive, non-modification environments. Accordingly, it appears we can say that accent weakening does not take place in non-restrictive modification environments. This was confirmed at the perceptual level in section 5.

However, there were utterances in which accent weakening occurred in non-restrictive environments. The fact is that generally there is room to interpret non-restrictive modification as restrictive and that, overwhelmingly, modification environments are at the same time semantically restrictive, so there can be thought to be a tendency to carry out accent weakening across the board in modification environments.

In a string of phrases in which there is a semantically restrictive relation, there is also at the same time a modification relation. However, the contrary is not necessarily true. Accordingly, when considering the determining factors for accent weakening in such environments as "Nara no momizō o and Nara de momizō o, it is not necessary to consider the two factors of the syntactic modification relation and the semantic restriction relation; it is sufficient to consider just semantic

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is larger than half the peak of *Suisu no*, the appropriateness rating for a non-restrictive reading increases and if it is smaller, then the appropriateness rating for a restrictive rating increases.

These results are only those of an experiment using one set of sentences asking about a limited number of intonations. However, in reality they match the results of the speech study to a great degree.

Figure 20 is a histogram that shows the distribution of the height of the peak of the second phrase in the ramen sentence set shown in Figure 12, that is four pairs of sentences containing kernel-bearing phrases as pronounced by 10 speakers. As an indication of the height of the peak in the phrase in question compared to the preceding phrase, the value arrived at by calculating [magnitude of initial rise / (absolute value of magnitude of inter-peak change+magnitude of initial rise)] is converted to a 100-point scale. The value (absolute value of magnitude of inter-peak change+magnitude of initial rise) used here is the height of the peak in the preceding phrase as measured from the following valley. Figure 21 shows the distribution of peaks in the second phrases in the material presented in Figure 11, that is, sentences (14)–(21).

Looking at Figure 20, a magnitude of 50% of the preceding phrase is the boundary between where the restrictive interpretation is favored and where the non-restrictive interpretation is favored. In Figure 21, the boundary is between 40% and 50%.

From the above we can conclude that, although we cannot make an absolute statement given that there is quite a bit of difference depending on the phonetic environment and the speaker, if we limit ourselves to the case in which both the phrase in question and the preceding phrase are kernel-bearing, whether the magnitude of the peak in the phrase in question is less than or greater than 40% to 50% of the peak of the preceding phrase is one indication of whether the phrase in

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<table>
<thead>
<tr>
<th>Height of Peak compared to Preceding Phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Figure 20" /> Distribution of height of peak in second phrase: ramen sentences. (☐: Restrictive environment. ■: Non-restrictive environment)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height of Peak compared to Preceding Phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2.png" alt="Figure 21" /> Distribution of height of peak in second phrase: sentences (14)–(21). (☐: Restrictive environment. ■: Non-restrictive environment)</td>
</tr>
</tbody>
</table>
question is semantically restrictive (with concomitant accent weakening) or non-restrictive (without accent weakening).  

Notes

1) An independent word that has the prosodic characteristic that it has only one sharp fall in pitch or else has no fall forms one “accent unit”. Compound words may have more than one accent unit, as in na’ikaku soorida’izin ‘Prime Minister’. So-called ‘ancillary words’, including the particles no ‘GEN’ and de ‘LOC’ used in the test sentences in this article, are generally considered not have a phonetic shape until they are attached to an independent word and thus do not form an accent unit on their own; rather the whole phrase with the ancillary word attached to the independent word forms a single accent unit. Thus, concretely speaking, an accent unit may be a word, a phrase, or some part thereof, but in the text, most are phrases.

2) Fukuda (1996) proposes the cognitive factor “activation” as a factor determining the level of accent realization in noun modification expressions, but, since she does not look at whether or not it can be applied to expressions other than noun modification, its role is not certain. Since the idea of semantically restrictive or non-restrictive is applicable to expressions other than noun modification, we will restrict our investigation to this concept.

3) Accent weakening includes both “downstep” and “intonation phrase formation” from Kubozono (1995).

4) Recording of utterances was conducted with the sentences in random order and with other sentences not used in this paper interspersed. When there was a clear mistake or hesitation in an utterance, the speaker was asked on the spot to repeat, but if such were discovered after recording, they were excluded from analysis. The same procedure was followed with the other test sentences in this article as well. The average F0 value was calculated by taking a fixed measurement point (the vertical line in the figures, the beginning of momizi o in sentence (1)) as time 0 and calculating the averages over several speakers at 10 msec before and after time 0. Normalization of duration (correction of misalignment due to differences in length by speaker) was not conducted. Before taking the averages, abnormal values, such as double pitch, were corrected visually. Utterances for which the F0 of a given span could not be extracted were excluded from calculation of the average for that span.

5) Rather than the parallel use of the raw data for two indicators, one could also use a synthesized score such as a discrimination score obtained by the application of a discriminant function, but, in order to preserve the intuitive easiness of understanding, the approach in this paper was adopted. If the preceding phrases are limited to kernel-bearing phrases, then the ratio of the height of the peak in the phrase in question to the peak in the preceding phrase could show the relative height of the peak in the phrase in question, which is intuitively easy to understand (and used in section 6), but here we have chosen the two indicators as values that do not depend on the accent environment.

6) Another possible reason is that in this sentence Hooruyuzi contains more mora than momizi. However, a difference is also observed between Kyooto no tooki wa ‘Kyoto pottery’ and Kyooto no Toozi wa ‘Tōji Temple in Kyoto’. Thus, the number of mora is not a primary reason.

7) There is another Hōryūji in Yokohama so, if one were to utter the sentence thinking, “it’s not that Hōryūji but the one in Nara,” the accent of Hōryūji would probably be weakened.

8) It has been argued that it is because a non-restrictively modified noun bears focus that accent weakening does not take place (Kinsui 1986: wording here by Kori). However, in normal pronunciation there is no focus on Hōryūji in Kyonen Nara no Hooruyuzi o Yumi to mita ‘Last year I viewed Hōryūji in Nara together with Yumi’ or Nara no Hooruyuzi wa sekai saiko no mokuzoo-kentiku desu ‘The Hōryūji in Nara is the world’s oldest wooden structure’ but accent weakening does not take place, arguing against this proposal.

9) Kori (1997a) raised as cases in which accent weakening does not take place even though there is a semantically restrictive relation “whole-part” relations like Oosaka Daigaku no honbu ‘the main offices of Osaka University’ or kyonen no kugatu ‘September of last year’, “thing-type” relations like biru no oobin ‘beer in a big bottle’ or uisukii no mizuwarī ‘whiskey diluted with water’, and targets of comparison like kyoo no gogo yori asita ‘morning tomorrow rather than afternoon today’. I now think these can all be considered cases of “contrastive focus” (Gundel 1999).

10) The targets for analysis were the underlined clause-final and sentence-final portions of the sentence pairs given below.

(1) Nominal restriction
(As a present)
Yumi wa mahuraa no an de, Reeko wa borero no an da.
‘Yumi proposed a muffler and Reiko proposed a bolero.’

Verbal restriction
Yumi wa mahuraa o ande, Reeko wa borero o anda.
‘Yumi knit a muffler and Reiko knit a bolero.’
An analysis of variance was performed on clause-final and sentence-final examples recorded by six speakers (ngs, sk, sn, stm, trm, ymg) separately with part of speech and sentence pair as fixed factors and speaker as the random factor. The results showed no significant effect by part of speech on either the magnitude of inter-peak change or the magnitude of initial rise and no significant interaction with sentence pair. To avoid complications, the statistical results for part of speech and sentence pair interaction are listed here. Effect of part of speech on magnitude of inter-peak change clause-finally: \( F(1, 5.20) = 1.713, p = 0.245 \), sentence-finally: \( F(1, 5.23) = 4.618, p = 0.082 \), interaction with sentence pair: \( F(1, 5.19) = 0.640, p = 0.459 \) and \( F(1, 5.11) = 0.070, p = 0.802 \). Effect of part of speech on magnitude of initial rise clause-finally: \( F(1, 5.12) = 0.620, p = 0.466 \), sentence-finally: \( F(1, 5.05) = 0.916, p = 0.382 \), interaction with sentence pair \( F(1, 5.35) = 0.748, p = 0.424 \) and \( F(1, 5.17) = 0.460, p = 0.527 \).

In order to see the individual characteristics of each speaker, an analysis of variance was conducted on the magnitude of inter-peak change and magnitude of initial rise for each speaker. The results showed two speakers (ngs, sk) whose pronunciation followed Kubozono’s claim and three speakers (kb, mk, sk) whose pronunciation was exactly the opposite of Kubozono’s claim. The statistical values are omitted here.

The phrase *tinpanzii no Ai-tyan* ‘Ai-chan, the chimpanzee’ in sentence (20) and *gooka kyakusen no Nairu* ‘the luxurious passenger liner, Nile’ in (21) could be interpreted as category [1b] (the case in which the second noun provides a concrete name to supplement the preceding noun) if used alone but in the test sentences used here, *Ai-tyan* and *Nairu* are not supplementary information, instead it is the preceding phrases *tinpanzii no* and *gooka kyakusen no* that provide supplementary information.

The significance values for each speaker for the effect of restrictive versus non-restrictive were as follows. Magnitude of inter-peak change–ngs: 0.014, sk: 0.004, sn: 0.403, st: 0.006, trm: 0.047, ymg: 0.042. Magnitude of initial rise–ngs: 0.130, sk: 0.036, sn: 0.175, st: 0.029, trm: 0.036, ymg: 0.038.

The significance values for each sentence pair for the effect of restrictive versus non-restrictive were as follows. Magnitude of inter-peak change–sentence (14): 0.022, sentence (15): 0.097, sentence (16): 0.059, sentence (17): 0.029, sentence (18): 0.011, sentence (19): 0.167, sentence (20): 0.048, sentence (21): 0.249. Magnitude of initial rise–sentence (14): 0.022, sentence (15): 0.266, sentence (16): 0.003, sentence (17): 0.118, sentence (18): 0.616, sentence (19): 0.392, sentence (20): 0.012, sentence (21): 0.136.

The elements in latter part of sentence (15) following *kyonen/Kyooto no Gion Maturi* are longer than in the other sentence pairs. As seen in section 2.2, if the later elements are long, there is a tendency for the accent realization of the latter part to be larger even in a restrictive environment. There are cases for which it could be thought that the difference that ought to be there is obscured by this tendency. Also, since the phrase *gooka kyakusen* of sentence (19) is difficult to pronounce, there may have been cases in which the intended pronunciation was not realized.

The reason this method, which differs from the usual psychophysics measuring method, was adopted is that, since the problem demanded delicate judgements on the appropriateness of intonation, the goal was to obtain responses about which the respondents were confident.

The correlations were high for trm (\( r = 0.845, p = 0.000 \)) and ngs (\( r = 0.679, p = 0.002 \)). The other respondents (sk (\( r = -0.473, p = 0.044 \)), sn (\( r = -0.059, p = 0.791 \)), stm (\( r = -0.227, p = 0.146, p = 0.527 \)) either showed significantly negative correlations or no correlation.

Respondent trm was \( r = 0.395, p = 0.086 \); the others were: sk: \( r = 0.784, p = 0.001, sn: r = 0.898, p = 0.000, stm: r = -0.647, p = 0.005, ymg: r = 0.756, p = 0.002, and ngs: r = 0.753, p = 0.001 \).

If the preceding phrase is non-kernel-bearing, there is probably no sense in tying the height of the peak in the phrase in question to accent weakening.

References


(Received Feb. 26, 2008, Accepted Mar. 23, 2008)
Accent Reduction and Restrictive Modification in Tokyo Japanese

Appendix 1 Speaker information

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<tr>
<th>Speaker</th>
<th>Year of birth</th>
<th>Sex</th>
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<th>Speaker</th>
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Appendix 2 ANOVA table for effects of branching structure and metrical structure

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## Appendix 3  ANOVA table for effects of semantic restriction

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