THE PHONETICS AND PHONOLOGY OF TONE AND INTONATION IN JAPANESE

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Submitted to the Department of Linguistics and Philosophy on 23 November 1984 in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

This thesis provides a comprehensive, though necessarily incomplete, description of the linguistic factors governing the fundamental frequency contours of Japanese sentences and in so doing addresses several theoretical issues in phonetics and phonology. The topics addressed include the underlying representation of pitch accent, the nature of the tone association rules, the character of the morphological rules of accent placement, the organization of the phonological component, the principles governing intonational phrasing, and the character of post-lexical rules. Chapter Five takes up the question of the phonetic implementation of tones at the phrasal level.

Several important results may be summarized here. First, the typology of morpho-accentual rules is considerably expanded and the attested rules are shown to be simply described in terms of primitives necessary for other types of morphological rules. Second, several phenomena bear on issues concerning the organization of the phonological component of the grammar. These include a clear counterexample to the Adjacency Condition in morphology and an example of a post-lexical rule that requires reference to lexical information. Third, a strictly non-diacritic autosegmental approach to the representation of pitch accent is adopted and a number of cases problematic either for a nondiacritic approach or for purely autosegmental tone association rules are disposed of.

Chapter Five is devoted to an instrumental study of phonetic implementation at the phrase-level, with particular attention to fundamental frequency downdrift. Existing theories of downdrift are generally cast in terms of one of two mechanisms, taken to be mutually exclusive. One mechanism, usually referred to as declination, is a global tonal reference line with respect to which fundamental frequency values are computed. The alternative is a locally computed phonologically governed shifting of the fundamental frequency register, usually referred to as downstep or downdrift. While phonological descriptions often refer to downstep, phonetic descriptions make almost exclusive use of declination. A review of the experimental literature indicates that downstep plays a dominant role, and that no clear demonstration of the existence of declination exists. The data presented here indicate that in Japanese both mechanisms are required. The dominant effect is that of downstep, but even in the absence of downstep a small but consistent decline in fundamental frequency is observed, which may be attributed to declination. Evidence is also presented in favor of a register shift approach to downstep.

Thesis Supervisor: Morris Halle
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INTRODUCTION

This thesis describes the linguistic factors governing the shape of fundamental frequency contours in Japanese. Such a description requires attention to a number of factors: to lexical and morphological influences on tone, to phrasal factors, and to questions of phonetic implementation, the latter in part in order to know what *not* to take into account.

The factual base for this thesis is partly impressionistic and partly instrumental. The description of phrase level effects is based entirely on instrumental data, while the account of lexical and morphological factors is based largely, though not entirely, on impressionistic data. As I shall expand on below, this is due to the fact that impressionistic descriptions of word-level tone patterns seem to be reasonably accurate, while impressionistic accounts of phrasal phenomena are to be treated with suspicion. It is also due to the fact that existing accounts of tone and intonation in Japanese are limited almost entirely to the tone patterns of words, with only limited attention given to higher level phenomena. Thus, although word-level phenomena could certainly benefit from more careful study, it is currently the phrasal phenomena that call for the greatest attention at the descriptive level.

The descriptive literature on the tone patterns of words is substantial and I have drawn on it extensively. The existing literature consists in part of the quite extensive tables of forms and compilations of rules found in such handbooks as Hirayama (1960) and NHK (1966), and in part of more theoretically oriented studies such as McCawley (1968). None of the theoretical treatments is really comprehensive in coverage, nor, for that matter are the handbooks, which omit a number of morphological processes to my knowledge described here for the first time. All forms cited here, both those described elsewhere and those described here for the first time, have been checked with native informants.

1. Methodological Considerations

Methodological considerations loom large in the study of tone and intonation for several reasons. First, the phenomena are of such a nature as to make impressionistic description difficult. This means, on the one hand, that impressionistic descriptions are to be regarded with skepticism, and on the other hand that a whole new set of methodological questions having to do with the interpretation of instrumental data arise. Secondly, it happens that in this area virtually no attention has been paid to the comparison of alternative theories, or even to demonstrating that one's pet theory correctly describes a wide range of the cases it is intended to cover, and that the data on which an author's claims are based are often not presented in such a way as to permit the reader to evaluate the claim. This rather negative evaluation of the literature will, I believe, find its justification in the discussion in Chapter V of previous accounts of Japanase phrasal tonology.

Most phonological studies of phrasal tone make use exclusively of impressionistic data. Needless to say, impressionistic observation plays an important role in phonological description, and well trained phoneticians are capable of surprisingly subtle observations. But even in the domain of non-prosodic phenomena, impressionistic description is difficult. The insensitivity of speakers to distinctions that are allophonic in their native language is part of linguistic folklore. Moreover, it is well known that native speakers tend to believe that utterances are phonetically distinct if they are phonologically, morphologically, or orthographically distinct. Sapir (1933)'s example of a Sarcee speaker who insisted that two phonetically identical utterances were distinct because of an underlying phonological distinction is perhaps the most famous. Even where the investigator's native language does not interfere, careful phonetic description requires a degree of sensitivity and training that is rare. In principle, such difficulties can be overcome with adequate training and by the study of languages of which one is not a native speaker, but it is a sad fact that few phonologists attain any great level of competence in phonetics, much less virtuosity, and that the descriptions that appear in phonological studies are frequently inaccurate.

When we turn to matters of prosody, the situation is worse, since it appears that impressionistic descriptions are quite frequently incorrect, and where they are correct, are not based on the actual content of the speech, but on the observer's knowledge of the language. This is the conclusion of the study by Lieberman (1965) of the transcription of English stress by linguists. He found that phonetics students both disagreed among themselves and produced transriptions that disagreed to a considerable extent with instrumental studies of the same materials. Moreover, when his subjects were asked to transcribe continuous vowels with the same fundamental frequency pattern as the original speech, he found that the accuracy of the transcription dropped precipitously, suggesting that the subjects used their knowledge of the language to compute the expected pattern, not the actual speech.

Finally, when we turn to questions of phonetic realization, some of the questions that must be asked are simply too subtle for impressionistic observation, even by the most accurate observer. For these reasons, it is important to make use of instrumental data in studying phrasal tone.

This is not to say that the availability of instrumental data is a panacea. Such data are only useful if the utterances studied are properly controlled and analyzed, and the data obtained must still be interpreted in a rational way. By and large, existing instrumental studies fail to meet these elementary demands. I turn now to some of the pitfalls in the instrumental study of tone.

The first difficulty in studying F0 arises from the fact that F0 is governed by a multitude of factors. Some of these are linguistic in nature: phrasing, phonological accent and tone, and emphasis, for example. Others are not. Of particular importance is the fact that the observed fundamental frequency is influenced by the segmental composition of the utterance. Vowels are said to have intrinsic pitch, meaning that, *ceteris paribus*, some vowels will have a higher F0 than others. This effect is not to be disregarded; published data on intrinsic pitch (Lehiste & Peterson 1961, Hombert 1977) show a range of nearly 30 hz. between vowels with high and low intrinsic pitch. This difference is larger than many of the effects that are of importance in studying phonetic realization.

In addition to the intrinsic pitch of vowels, the adjacent consonants also influence F0 (Lehiste & Peterson 1961, Lea 1973, Lyberg 1983, Myers 1976, Kawasaki 1983). Voiceless consonants disrupt the F0 curve during their occlusions, and afterwards they perturb F0 upward, while voiced consonants generally perturb F0 downward. These effects are greatest immediately following the consonant, so to some extent they can be avoided by measuring F0 well into the vowel, but as the data in Myers (1976) clearly show, in many cases a perturbation on the order of 2-3 hz. persists throughout the vowel. Moreover, measurement of F0 at a sufficient distance into the vowel is impossible when the vowel is very short. In any case, this procedure is extremely tedious and time consuming. Most investigators use peak measurements instead, and these are quite susceptible to perturbation by the adjacent consonant.

Segmental effects are best evaded in two ways. First, the consonants that have the greatest perturbing effect on the F0 contour should be avoided. This means that voiceless consonants should be avoided, as well as voiced obstruents. Ideally, test utterances should contain no consonants other than nasals, liquids, and glides, as these have a minimal perturbing effect. Secondly, the sets of utterances should be constructed in such a way that compared values are comparable with regard to segmental content. Ideally, identical syllables should be compared, so that whatever segmental effects are present are exerted equally in the two cases. Failing this, a set of utterances with a full range of syllables may be constructed and the measurements averaged, so that any segmental effects are averaged out.

It goes without saying that these considerations render virtually useless studies of randomly collected corpora. It is simply impossible to control in a random corpus for the segmental content of the utterances. Unfortunately, there is a bizarre belief on the part of certain investigators that only the investigation of a random corpus is scientific, and that the use of carefully controlled and constructed sets of utterances is impermissible.

2. The Phonetic Data

2.1. Data Collection & Measurement

All of the data presented here were obtained from a single subject, a middle-aged male native speaker of Tokyo dialect Japanese. Although it would be desirable to extend the investigation to other speakers, given the limitations of time I considered it more important to obtain a reasonably comprehensive description of the behaviour of a single individual rather than a smattering of information about a number of subjects. Moreover, given the fact that even quite gross phonological properties of utterances, such as the accentedness of a given lexical item, are known to vary considerably from individual to individual within the "same dialect", it is in any case necessary to study each individual separately before drawing conclusions about groups.

All of the materials studied were recorded in a sound-proof room. Some materials were recorded directly onto a magnetic disk. Most were recorded on high quality (Scotch Dynarange) audio tape at 7 1/2 ips on a Revox B77 Mark II tape recorder, and then digitized from tape. In both cases the speech waveform was sampled at 10 Khz with a minimum of 12 bits resolution.

The individual utterances were then edited onto separate files, and pitch and amplitude contours, and log-area linear prediction coefficients computed.

A number of methods were available for segmenting the utterances. These include the waveform display itself, which could be displayed at a wide range of resolutions, spectral slices computed over any desired region, the amplitude contour, and the LPC coefficients. In addition, it was possible to play selected portions of a waveform file, or to synthesize any desired portion of an LPC file and play the synthetic speech. When peak and trough measurements were made, the first LPC coefficient and the amplitude contour were available on the same display. To a large extent the first LPC parameter was sufficient since it reliably indicates the location of nasals.

Two types of measurements are reported: peak and trough measurements, and means. Once the region of interest was specified by placing the cursor at the endpoints of the interval and marking these points, the peak or trough was located automatically. Peak and trough measurements were written automatically into two log files, one with full information about the measurement, the other in an abbreviated format that could be read directly into statistics programs. In one experiment I also recorded the mean F0 over selected intervals. These means were computed automatically once the interval was specified by placing the cursor at the endpoints and marking these points.

One question that arises at the beginning is what to measure. As I have indicated, with a single exception I measured only the maximum and minimum F0 occurring within a given region. This was done for several reasons. First, maxima and minima are easy to locate since in most, though not all circumstances they are local maxima and minima so careful segmentation of the utterance is not necessary. One just finds the bumps and the dips between them.[1] Second, most previous studies also measure peaks and troughs. Reporting the same measurements enhances comparability.

More important, peak and trough measurements seem to reflect fairly well the large scale properties of the utterances with which we are concerned. This is itself an interesting empirical result, since nothing in principle would prevent phonetic realization rules, or for that matter phonological rules, from manipulating not the peak height attained but, say, the Q (the relative breadth of the peak or trough), which would indirectly affect the mean F0 over the region. It seems to be the case that the mean F0 in a region and the maximum and minimum F0 in the same region are highly correlated.

Finally, it is worth noting that when the region over which the mean F0 is computed is chosen sufficiently small it approximates the extremes within the same region more and more closely. Since the regions studied were fairly small the discrepancy is in no case large.

The materials recorded were constructed with several points in mind. First, they are all entirely voiced in the regions of interest, and indeed almost entirely voiced throughout. This reduces consonantally induced perturbations of the actual F0 as well as reducing possible sources of error for the pitchtracker. For the same reasons, voiced obstruents were avoided in the regions of interest, although it was not possible to eliminate them completely. Third, they were constructed in such a way as to maximize segmentability. This means, for example,

[1] An important corrollary of this statement is that in some cases the peaks and troughs measured were not local extrema. In this case, careful segmentation of the utterance was necessary in order to determine the region over which the extremum was to be measured.

that words containing nasals were preferred to those containing other sonorants, since nasals are easy to locate both in the waveform and the first LPC coefficient, yet do not cause substantial perturbation of the F0 of the neighboring vowels.

In the following paragraphs I will describe each of the datasets recorded, giving a complete description of the utterances recorded, the manner in which they were written, and the number of tokens recorded. All of the utterances were written on 3 x 5 index cards in normal Japanese orthography, which is to say in a mixture of Chinese characters (logograms) and the two *kana* syllabaries. In every case the informant read over the cards until he was familiar with the utterances desired, the desired interpretation, and the author's less than perfect handwriting. In most cases the index cards were numbered (within a block) in order to facilitate recordkeeping and the subject read the card number aloud (in Japanese) before reading the utterance. Unless otherwise specified the cards were shuffled between blocks in order to avoid ordering or repetition effects.

In order to avoid unnecessary repetition, I note here that many of the utterances were recorded in the frame:

Sore	wa	______	da.
that	topic-particle	______	be

Standard Frame

which means "That's a ____." In this case, the topic phrase *sore wa* forms a separate major phrase[2] from the predicate.

2.2. The Data

In the remainder of this chapter I describe the utterances collected for systematic instrumental investigation. The reader may prefer to skip this section for the time being to return

[2] The term *major phrase* is explained in Chapter III.

to it when the data are discussed. From time to time I will refer to data not described here. In these cases the data were collected in much the same manner, but, because they are used only to illustrate a point made in passing are not described here.

2.2.1. Dataset I

(1) Sore wa hana' da.
(2) Sore wa hana da.
(3) Hana'.
(4) Hana.

Dataset I

These utterances consist of the segmentally homophonous words [hana'] "flower" and [hana] "nose" in isolation and in the carrier sentence. Each utterance was copied onto five 3x5 index cards, and the block of twenty cards thus created was shuffled. The cards were read once, shuffled, and read again, yielding a total of ten tokens of each utterance. The two *hana* were distinguished by their Chinese character representations. The location of the syllable [na] was determined from the amplitude contour and first log-area linear prediction coefficient and the peak F0 value on that syllable was recorded.

2.2.2. Dataset II

The following utterances, which consist of one to three unaccented adjectives followed by the unaccented noun [momo] "peach" were recorded in the standard frame. These sentences mean "That is an Adj* peach." The adjectives used were [amaj] "sweet", [omoj] "heavy", and [maruj] "round". All of the sentences are meaningful. However, in Japanese as in English some orderings of adjectives are more natural than others, so it was necessary to instruct the informant to ignore the meanings of the adjectives in order to avoid focusing of one of the adjectives.

Length 1

(1) Sore wa amai momo da.
(2) Sore wa omoi momo da.
(3) Sore wa marui momo da.

Length 2

(1) Sore wa amai marui momo da.
(2) Sore wa amai omoi momo da.
(3) Sore wa omoi amai momo da.
(4) Sore wa marui amai momo da.
(5) Sore wa omoi marui momo da.
(6) Sore wa marui omoi momo da.

Length 3

(1) Sore wa amai omoi marui momo da.
(2) Sore wa amai marui omoi momo da.
(3) Sore wa omoi amai marui momo da.
(4) Sore wa omoi marui amai momo da.
(5) Sore wa marui amai omoi momo da.
(6) Sore wa marui omoi amai momo da.

Dataset II

The sentences recorded contain all possible permutations of one, two, or three of the chosen adjectives. This permits averaging by position across utterances of the same length in order to eliminate any differences due to consonantally induced perturbations and intrinsic vocalic pitch.

The 15 utterances were read a total of 16 times in separate blocks. The measurements reported here are based on the second through thirteenth blocks recorded. The first block was treated as a practice block. Blocks fourteen through sixteen were not studied since twelve blocks were found to be sufficient.

Figures 0.1, 0.2, and 0.3 present typical pitch contours for each of the three lengths.[3]

[3] Figure numbers consist of the chapter number (taking the introduction to be 0) followed by the cardinal of the figure within the chapter, separated by a period. All figures appear at the end of the chapter.

Notice in the sequence of length three that there are dips between the first and second adjective and the second and third adjective, indicating the presence of a minor phrase boundary,[4] but not between the third adjective and the noun, suggesting that the third adjective and the noun together form a minor phrase. Similarly, in the sequence of length two, there is a dip between the two adjectives, but not between the second adjective and the noun. In the sequence of length one, there is no dip between the adjective and the noun.

Two sets of measurements were made on each pitchtrack. First, the maximum pitch on each adjective was recorded. Since the adjective immediately preceding the noun tended to form a minor phrase with the noun, the noun generally did not have a separate peak. Thus, at most three points were recorded. Secondly, the location of the diphthongs [ai],[oi], and [ui] was determined from the LPC parameters and the mean F0 over the diphthong was recorded.

2.2.3. Dataset III

Ten blocks consisting of one token each of the utterances listed below were recorded. The first block was discarded, leaving nine tokens of each utterance. These sentences consist of sequences of one or two adjectives in various orders, followed by a noun. The nouns are [mi'ruku] "milk", [miriN] "sweet rice wine (for cooking)", and [nomi'mono] "beverage,drink". The adjectives are [amai] "sweet", [uma'i] "tasty", [i'i] "good", and [nuru'i] "lukewarm".

[4] The term *minor phrase* is explained in Chapter III.

(1)	Sore wa amai mi'ruku da.
(2)	Sore wa uma'i mi'ruku da.
(3)	Sore wa uma'i mirin da.
(4)	Sore wa amai mirin da.
(5)	Sore wa uma'i i'i nomi'mono da.
(6)	Sore wa amai i'i nomi'mono da.
(7)	Sore wa uma'i nomi'mono da.
(8)	Sore wa amai nomi'mono da.
(9)	Sore wa nuru'i amai nomi'mono da.
(10)	Sore wa amai nuru'i nomi'mono da.
(11)	Sore wa uma'i nuru'i nomi'mono da.
(12)	Sore wa nuru'i uma'i nomi'mono da.

Dataset III

2.2.4. Dataset IV

The utterances recorded consisted of sentences of the form illustrated below, meaning "There's A and B and C and D." The particle *ya* is a conjunction implying non-exhaustive listing. *ga* is the nominative particle and *aru* is the verb "to exist".

___ ya ___ ya ___ ya ___ga a'ru

Frame for Dataset IV

Into this frame were inserted all 24 permutations of the nonsense words [ama], [ana], [awa], and [ara], with four different accent patterns, to wit:

(1)	+acc	+acc	+acc	+acc
(2)	-acc	-acc	-acc	-acc
(3)	-acc	+acc	+acc	+acc
(4)	+acc	-acc	+acc	+acc

Accent Patterns

All accented words were accented on the final syllable, so that the Low tone fell on the conjunction *ya* or the nominative particle *ga*. The 96 utterances were written on cards, the nonsense words in the *katakana* syllabary, with accent marked by the "akusento-kaku" diacritic commonly used in accentological works in Japan. The cards were shuffled thoroughly and then divided into four blocks of 24, between which the subject paused briefly. The entire list was read twice, but the first recording was treated as a practice set, and only the second set was analyzed, yielding one token of each utterance. Since all measurements were averaged over the 24 utterances with the same accentual pattern, in order to remove segmental effects, this number was considered to be sufficient.[5]

2.2.5. Dataset V

In order to study the F0 contours associated with question intonation the following data were obtained. This dataset consists of sentences of the standard format save for the fact that the copula *da* is missing, as is permissible in certain casual styles of speech. They consist of sequences of two or three adjectives followed by a noun, and preceded by the topic phrase *sore wa* "That". Ignoring the topic phrase, which is in a distinct major phrase, the first two sentences contain only accented words, each of which forms a minor phrase. The remaining six sentences contain no accents at all. As a result of the fact that in A*N sequences the last adjective, especially if unaccented, tends to form a single minor phrase with the following noun, these sentences too contain three minor phrases.

The eight sentences were written on cards, and read in blocks. First, six (6) blocks were recorded with interrogative intonation. These would be appropriate as questions in the game "Twenty Questions". Then, four (4) blocks were recorded with declarative intonation. These would be appropriate as responses in the game "Twenty Questions".

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[5] In the fourth subset (+− ++) one utterance was incorrectly read entirely without accent, so it has been discarded from the data reported. This means that the fourth subset contains only 23 of the 24 permutations. In view of the limited effect of the sonorants that these sentences contain, and of the fact that one utterance in 24 has limited effect on the average, I do not believe that the loss of this sentence is significant.

(A1)	Sore wa nuru'i uma'i nomi'mono.
(A2)	Sore wa uma'i nuru'i nomi'mono.
(U1)	Sore wa amai omoi marui momo.
(U2)	Sore wa amai marui omoi momo.
(U3)	Sore wa omoi amai marui momo.
(U4)	Sore wa omoi marui amai momo.
(U5)	Sore wa marui amai omoi momo.
(U6)	Sore wa marui omoi amai momo.

Sentences for Question Intonation Experiment

In one block the informant mistakenly read A2 twice, omitting A1. As a result, the accented sentences from this block were not considered in the analysis of the data.

2.2.6. Dataset VI

In order to investigate the phonetic effects of emphasis, the following sentences were recorded.

Sentences for Study of Emphasis

(1)	Sore wa amai ao'i kuda'mono da.
(2)	Sore wa amai ao'i kuda'mono da.
(3)	Sore wa uma'i ao'i kuda'mono da.
(4)	Sore wa uma'i ao'i kuda'mono da.

That's a sweet/tasty blue fruit.

Here the underlining indicates that the subject was instructed to emphasize the underlined word. The four utterances were each written once on an index card. The block of four cards was read ten times. The cards were shuffled between blocks. The peak frequency on each of the two adjectives, and the trough in between were measured.

2.2.7. Dataset VII

The following utterances were recorded in order to investigate the effects of phrasing on segmentally identical materials, as well as to provide additional materials for the study of catathesis.[6] They consist of the participles of the verbs *yo'mu* "to read" and *yobu* "to call" followed by [mi'ru]. In each case there are two possible phrasings. Normally, the conjoined reading is associated with the biphrasal rendering and the auxilliary reading with the monophrasal rendering. As discussed below, the accent on *mi'ru* is not realized when it follows another accent within the same minor phrase.

Phrasing Data

(1)	yo'Nde mi'ru	"read and see"
(2)	yoNde mi'ru	"call and see"
(3)	yo'Nde miru	"try reading"
(4)	yoNde mi'ru	"try calling"

Each sentence was written twice, each on a separate card. The intended reading was indicated by using the normal Chinese character for "see" and the character usually used to represent the verb *kokoromiru* "attempt" when the "try V-ing" interpretation was intended. In this case *furigana* (subscripted characters of the syllabary) were added in order to ensure that the character would be read [miru] rather than [kokoromiru]. The eight cards resulting constituted a block. Ten blocks were recorded, the cards being shuffled between blocks. There are thus 20 tokens of each utterance.

[6] The term *catathesis* is explained in Chapter V.

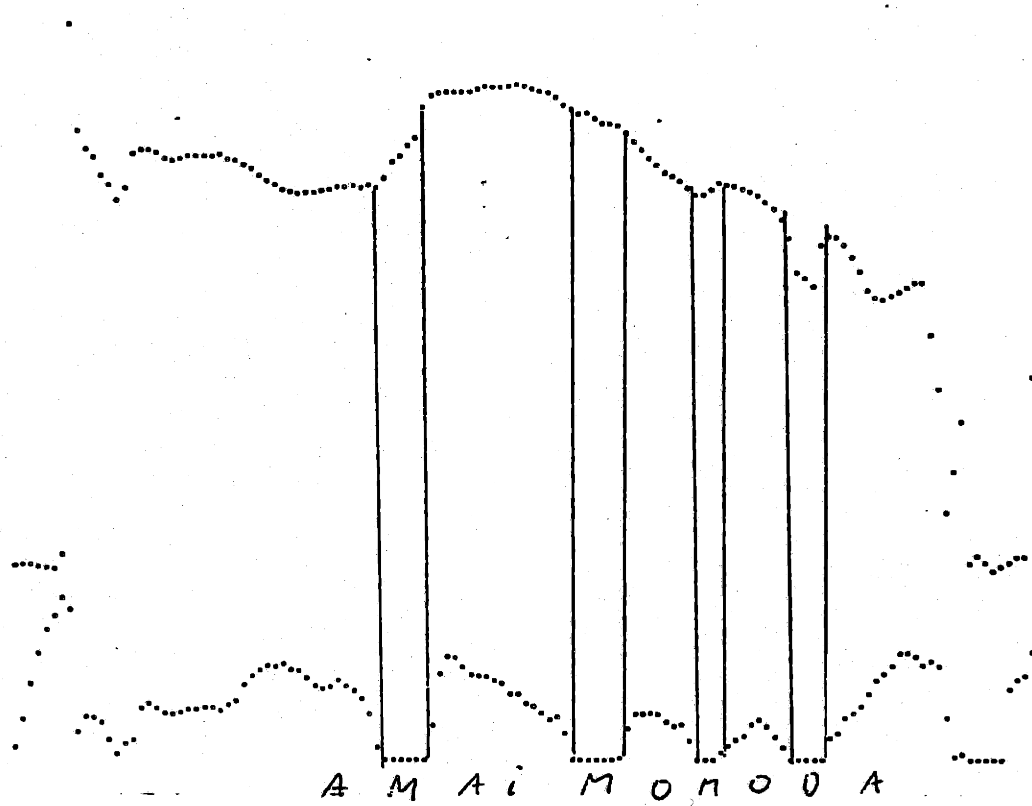
List of Figures

Fig. 0.1
The F0 contour of a typical unaccented sentence of length one. The lower trace shows the first log-area linear prediction coefficient.

Fig. 0.2
The F0 contour of a typical unaccented sentence of length two. The lower trace shows the first log-area linear prediction coefficient.

Fig. 0.3
The F0 contour of a typical unaccented sentence of length three. The lower trace shows the first log-area linear prediction coefficient.

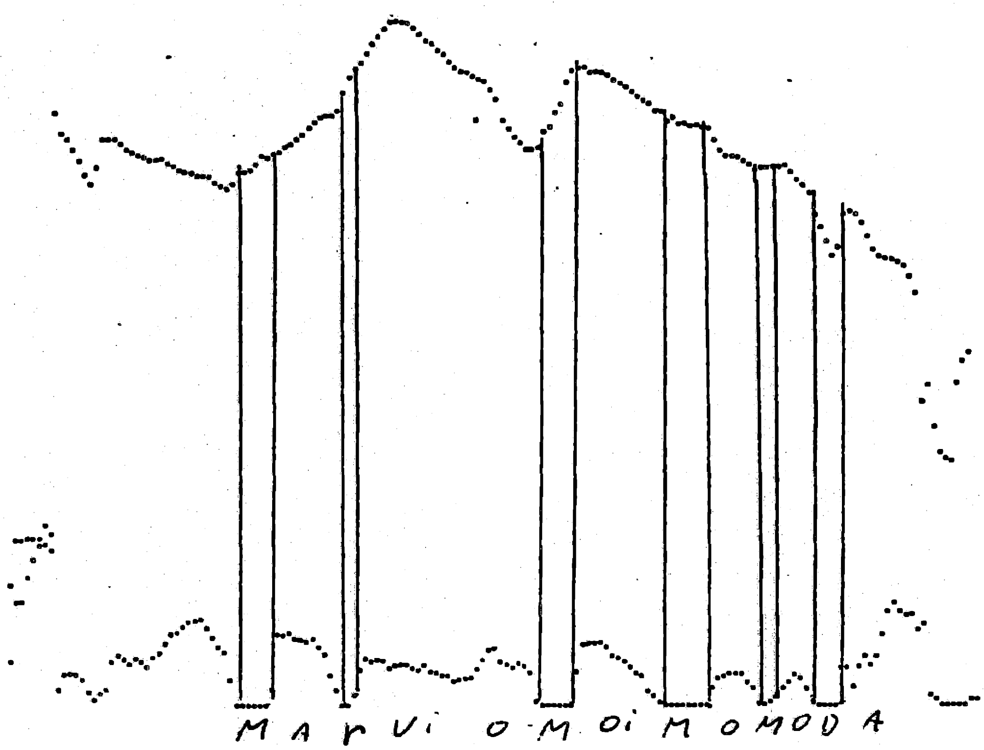
bip3/m2/data/fuj/c2/p2
Sore wa amai momo da.



lpc coefficient one

FIG. 0.1

biP3/m2/data/fuj/c2/P6
Sore wa marui omoi momo da.



lPc coefficient one

FIG. 0.2

bip3/m2/data/fuj/c1/p4
Sore wa omoi amai marui momo da.

lpc coefficient one

FIG 0.3

CHAPTER ONE: TONE AND ACCENT

1. Phonological Preliminaries

1.1. Segmental Phonology

The segmental phonology of Tokyo Dialect Japanese has been dealt with in a number of previous works.[1] Although there are many outstanding questions, the phenomenological description is sufficiently complete that no further discussion of segmental phonology is required in a tonological work such as this, and since the details of segmental phonetics are of no significance for the matters at hand Japanese forms will be represented in the standard phonemic transcription unless it is explicitly indicated that a more or less abstract representation is intended. Consequently, I will begin with a brief description of the prosodic units of Japanese, the syllable and the mora, and then turn directly to the tonology.

1.2. Syllables and Morae

The syllable structure of Japanese is straightforward. I assume here without argument a division of the syllable into two subconstituents, an optional Onset and an obligatory Rhyme. Abstracting away from the effects of productive phonological rules, all possible onsets can be combined with all possible rhymes. Onsets consist of an optional single consonant possibly followed by the glide /j/.

The onset in Japanese is optional, contrary to the assertions of McCawley (1968), Okuda (1970), Haraguchi (1975), Yoshiba (1981) and numerous other works which assert that vowel initial words actually begin with a glottal stop and transcribe them as such. It is

[1] The classic structuralist account is to be found in Bloch (1946ab,1950). The most comprehensive generative account is McCawley (1968). A number of modifications are proposed in Grignon (1980), Maeda (1979), Poser (to appear) and Yoshiba (1981). Useful descriptions of phonetic detail are Edwards (1903), Hattori (1951b) and Mori (1929). Much morphological information is scattered throughout Jorden (1963). Martin (1952) is useful although the analysis is unusually abstract. Extensive though not comprehensive morphological tables may be found in Hirayama (1960). Wenck (1966) contains many interesting observations. The recent paper by Fujiyoshi (1982) cannot be recommended.

simply not true that these words begin with a glottal stop in normal speech, a claim which I make on the basis both of auditory impression and inspection of spectrograms of vowel initial words. This is hardly a unique claim: Edwards (1903) and Hattori (1951a,1961) both explicitly deny that vowel-initial words contain an initial glottal stop.

With the exception of the mora nasal, whose phonemic status is problematic, every Japanese consonant may appear in the onset.

The rhyme generally contains no more than two morae and takes one of the following forms:

(1) a short vowel;

(2) a short vowel followed by the glide /j/;

(3) a short vowel followed by the mora nasal /N/;

(4) a short vowel followed by the first half of a geminate obstruent;

(5) a long vowel;

The first type of syllable contains one mora; the remainder all contain two morae.

The "mora nasal" is a nasal consonant, represented in this thesis as /N/, velar to uvular in isolation and otherwise homorganic to a following consonant, whose manner of articulation depends upon the context in which it occurs. Since geminate obstruents occur only when another vowel follows, the only consonant permitted word-finally is the mora nasal. All vowels occur both long and short, with no significant difference in quality. There are no syllabic consonants.[2]

It is frequently stated that the Japanese rhyme contains only two positions, so that superheavy syllalbles consisting of a long vowel or diphthong followed by a tautosyllabic consonant, or a short vowel followed by the mora nasal and a tautosyllabic consonant are

[2] There are frequent references in the literature to a "syllabic nasal", but this is an error and the reference is to the mora nasal, which is not syllabic. A truly syllabic nasal occurs in Japanese only paralinguistically, in the casual form of assent comparable to English "uh-huh".

excluded. While there is reason to believe that such superheavy syllables are marked,[3] they do indeed exist.

Superheavy syllables consisting of a long vowel followed by a geminate obstruent arise when the suffixes *-ta* "past", *-tara* "conditional", *-te* "gerund", and *-tari* "alternative" are added to the five verbs whose stems in V:C. These are *toor-* "pass", *oow-* "cover", *koor-* "freeze", *hoor-* "hurl", and *ikidoor-* "become angry". The resulting forms are listed below.

tootta	toottara	tootte	toottari
ootta	oottara	ootte	oottari
kootta	koottara	kootte	koottari
hootta	hoottara	hootte	hoottari
ikidootta	ikidoottara	ikidootte	ikidoottari

Superheavy Syllables from Verbs in V:C

Superheavy syllables consisting of a diphthong followed by a geminate obstruent arise when the same suffixes are attached to verbs whose stems end in *-air* such as *hairu* "enter" and *mairu* "go".

haitta	haittara	haitte	haittari
maitta	maittara	maitte	maittari

Superheavy Syllables from Verbs with Vir Stems

Another source of superheavy syllables is the suffix *-kko*, which as indicated contains an inherently geminate consonant. When this is added to a word ending in a heavy syllable, a superheavy syllable results. The examples below illustrate the cases of a long vowel, a diphthong, and a short vowel- mora nasal sequence all preceding a geminate obstruent.

[3] The evidence consists of the way in which sequences of vowels are syllabified and of the treatment of loanwords.

tookyookko	a native of Tokyo
geNdaikko	a modern girl
roNdoNkko	a native of London

Superheavy Syllables from -kko

Other examples are to be found among words of the onomatopoeic stratum.

gooN	boom
gootto	a rumbling sound
ooppira	publicly, openly
pootto	abstractedly
tyuuppara	in a huff

Onomatopoeic Words Containing Superheavy Syllables

There are also a number of loanwords with superheavy syllables of the form V:N.

kuiiNsura'Ndo	Queensland
riNkaaN	Lincoln
tyeeNsutoa	chain store

Superheavy Syllables in Loanwords

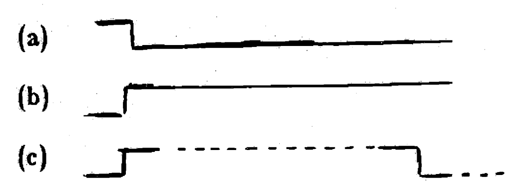
The other phonological unit with which it is necessary to deal is the mora, which plays a major role in Japanese phonology, morphology, and metrics. It is particularly important in the tonology, since many tonal rules refer to it.

A rhyme consisting of a single short vowel is said to contain a single mora. A rhyme consisting of a long vowel, a diphthong, or a short vowel followed by the mora nasal or a geminate obstruent is said to contain two morae. This led McCawley (1977) to observe that the mora is best defined as something of which a light syllable contains one and a heavy syllable two. This, however, is inaccurate, since superheavy syllables count as three morae. The mora in Japanese may more accurately be defined as a terminal node dominated by the rhyme.

2. Tone Patterns

The possible tone patterns of Japanese words are traditionally described in terms of relatively high and relatively low regions, with no further distinctions in height.[4] In the dialect that I describe here, it is necessary to distinguish between words whose first syllable contains two sonorant morae, i.e. a long vowel, diphthong, or vowel-mora nasal sequence, and those that contain only one sonorant mora, e.g. a short vowel alone or followed by a geminate obstruent. For the present purpose I will distort the standard terminology somewhat by referring to the former as heavy and the latter as light.

The possible tone patterns of words with light initial syllables may be schematized as follows.

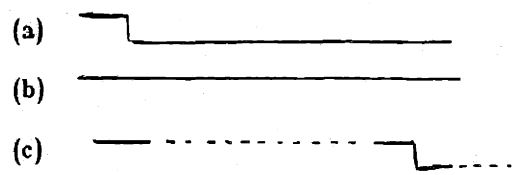


Tone Schemata of Words With Light Initial Syllable

In the first case, the word begins with a single high mora; the succeeding morae are all low. In the second case, the first mora is low, and the succeeding morae are high. In the third case, the first mora is low, some indefinite number of morae are high, and then the tone falls to low again.

The possible tone patterns of words with heavy initial syllable are shown below.

[4] This traditional description is modified in Chapter IV.



Tone Schemata of Words With Heavy Initial Syllable

The first pattern, a single high mora followed by a sequence of lows, is shared with the words with light initial syllable. The other two patterns are just like their counterparts save for the fact that the initial mora is high, not low.

In sum, the tone pattern of a Tokyo dialect word is described by two parameters: the presence or absence of an initial low mora, and the presence or absence of a fall from high to low. Moreover, the presence of the initial low mora is predictable. The initial mora is high if the first syllable is heavy or if the following mora is low; otherwise, the initial mora is low. The distinctive property of words is, then, the presence and location of the fall from high to low.

3. Accents

3.1. The Notion of Accent in Japanese

Early descriptions of Japanese pitch accent are strictly tonal. What was probably the most prominent of these, that of Sakuma (1919), made use of three tone levels. He gives the following transcriptions.

hasi	LM	edge
hasi	LH	bridge
hasi	HM	chopsticks
sakura	LMM	cherry
hibati	HMM	hibachi
otama	LHM	ball
atama	LHH	head

As a strictly phonetic representation this is fairly good. It differs from the standard modern transcription only in its distinction between three tone levels rather than two. The same examples are given in the standard modern transcription below.

hasi	LH	edge
hasi	LH	bridge
hasi	HL	chopsticks
sakura	LHH	cherry
hibati	HLL	hibachi
otama	LHL	ball
atama	LHH	head

Some of the Mid tones in Sakuma's transcription correspond to Low tones in the modern transcription. These are (in terms of the modern transcription) the Low tones that follow a High tone. These are distinguished from word-initial Low tones, which Sakuma transcribes as Low. The motivation for this distinction is unclear. To my knowledge, no systematic study of the relative height of initial Lows and post-high Lows has been made, but my experience is that exactly the opposite relation is true: initial Lows tend to be higher than those that follow High tones.

Some evidence for this statement may be found by inspecting the following data on the peaks of the four syllables of the noun [nomi'mono] taken from Weizman (1970). The same data are presented graphically in Figure 1.1. In every case the initial [no] is significantly higher than the final [no]. A typical F0 contour for this word from my own data is illustrated in Figure 1.2. Here again the initial Low is noticeably higher than the final Low.

	250	310	210	160	200	240	170	140
	260	295	200	160	200	235	170	150
	255	295	200	160	195	225	165	145
mean	255.0	300.0	203.3	160.0	198.3	233.3	168.3	145.0
var	25.0	75.0	33.3	0.0	8.3	58.3	8.3	25.0
	101	150	95	77	150	177	122	95
	103	142	97	73	135	170	130	100
	92	139	92	75	140	172	127	92
mean	98.7	143.7	94.7	75.0	141.7	173.0	126.3	95.7
var	34.3	32.3	6.3	4.0	58.3	13.0	16.3	16.3

Weizman's Measurements of [nomi'mono]

Three Tokens from each of Four Speakers

Other Mid tones correspond to High tones in the modern transcription. These are (again in terms of the modern transcription) the High tones that occur in the relatively high region of words without a fall in pitch. Sakuma's motivation for this distinction was apparently an attempt to incorporate into the phonetic transcription the phonological difference between words like "edge" and words like "bridge" which appears only when something follows. A word whose tone pattern, in Sakuma's transcription, is LH* will cause a following affix to be Low, whereas a word whose tone pattern is LM* will impose on a following affix a continuation of the relatively high pitch of the stem.

As I have indicated, the possible sequences of tones in Japanese are severely limited, so that a purely tonal description like Sakuma's is unsatisfying because it fails to explain the observed systematic restrictions. These restrictions were soon noted. Pletner (1923) clearly realized the limitations on possible tonal sequences, as did Jinbo (1923). Indeed, Jinbo explicitly stated the rule governing Low tone at the beginning of words.

> If the first syllabic unit is low, the second syllabic unit is invariably raised. If the first syllabic unit is of high pitch, the second syllabic unit is invariably low. (1923:664)

It was the observed redundancy of purely tonal accounts that led to the accentual analysis of

Japanese.

The accentual analysis of Japanese is due to Miyata (1927,1928) who made two important observations. First, he observed that the rise at the beginning of a word was predictable, so that it is unnecessary to mark it. Since this Low tone is not marked in the transcription, it is of course unnecessary to distinguish it from the Low that follows a High, so that one of Sakuma's two reasons for making a three way distinction vanished. Second, he observed that the distinction between Mid and High tones was not realized when these words are produced in isolation, so that no distinction need be made between Mid and High. These two observations together led to the conclusion that only two pitch levels, High and Low, are necessary to describe Japanese words. This is known in the Japanese literature as the "Two Tone Theory", in contrast to Sakuma's theory, which is known as the "Three Tone Theory".

Miyata's most important observation was that the only unpredictable property of a Japanese word is the location of a fall from relatively high to relatively low, so that an adequate representation need mark only the location of such a fall, if there is one. This observation underlies all accentual analyses of Japanese.

In such analyses the fall from high to low is ascribed to the presence of a diacritic marker called an accent, and the the existence of words of pattern (b) to the optionality of the this accent. Given the location of the accent, the tone pattern of the word may be generated by rules like the following.

(1) Make everything up to and including the accent high.

(2) Make everything following the accent low.

(3) Make the first mora low if the first syllable is light and the following mora is high.

The examples cited above are represented as follows in the accentual theory. The accent is marked by an apostrophe ('). Note that "bridge" and "hibachi" have no accent, since the distinction between final accented and unaccented words is not realized in isolation.

hasi	edge
hasi	bridge
ha'si	chopsticks
sa'kura	cherry
hibati	hibachi
ota'ma	ball
atama	head

Arisaka (1941) continued Miyata's analysis, with the difference that he was the first to observe the difference between what we would today call underlying and derived accent patterns, which he called "latent" and "actual" patterns. That is, like Miyata he observed that although what are now called final-accented and unaccented words are not distinguished in isolation, they are distinguished when suffixes are added, and unlike Miyata, he observed that this could be referred to a "latent" accent on the underlyingly final-accented words which is lost in phrase final position. Arisaka's transcriptions of the example words would be the same as Miyata's save for the fact that /atama/ would have a "latent" accent on the final syllable. Thus, Arisaka was the first to make the distinction between underlying accent pattern, derived accent pattern, and surface tone pattern. Accentual analyses since Arisaka are all variations on this same theme.[5]

The one accentual view of Japanese accent that differs in any important respect from Arisaka's is that of Hattori (1951b, 1961, 1967, 1968, 1973, 1979). Hattori himself has outlined the differences between his view and previous views, especially those of Arisaka, in Hattori (1967), which is, however, somewhat misleading. He observes first (p.545) that he "...tried to introduce phonological considerations into the field of accent research...". This statement is hardly justified since the work of Miyata, and even more so that of Arisaka, was already pho-

[5] The non-Japanese literature on this point is relatively uninteresting. Bloch (1950) used four pitch levels to describe Japanese, which is inferior to the accentual analysis for the same reasons that Sakuma's was. Curiously, Bloch's student Chew (1971) attributes to himself (1961) the reduction of the tones necessary to describe Japanese from four to two, a result already obtained by Miyata (1927).

nological in that it abstracted to a considerable extent away from the actual pitch pattern, indicating only the non-redundant information. Arisaka went one step further than Miyata in setting up a level of "latent" accent, which is at two levels of abstraction from Sakuma's phonetic transcriptions. Arisaka's description is thus every bit as phonological as Hattori's.

Secondly, Hattori states that (pp.545-6) "Accent patterns do not go beyond the description of the pitch level of each mora, whereas the prosodeme differentiates between distinctive and non-distinctive features." This is true of the distinction between the prosodeme and Sakuma's strictly tonal representation, but not of Miyata's and Arisaka's accentual descriptions.[6]

Finally, Hattori states that (p.545):

> The concept of accent pattern was derived from a consideration of pitch alone, whereas the concept of prosodeme encompasses not only pitch but all of the phonetic features, such as intensity, articulation,etc.

This is a true innovation, in that all previous workers had considered the accentual notion to be merely a phonological description of a pitch pattern. Hattori describes the stress systems of English and other languages in terms of his prosodeme as well, confirming the view that the prosodeme is intended to describe phonetic features in addition to pitch.

Hattori's notion of the "prosodeme" is often interpreted as simply a stress-like accent, but I do not believe that this is an accurate representation of his position.[7] It is important to distinguish between the accent proper, what Hattori calls the "accent kernel" (Japanese

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[6] Hattori's remarks make more sense if taken as a reaction to the waffling not infrequently found in the Japanese tonological literature on the question of whether Japanese words should be described in terms of accents or in terms of sequences of tones. This waffling is due in part to the limited impact of phonological theory on specialists in Japanese, and in part, as Kindaichi (1972d) makes clear, to reluctance to equate the Japanese pitch accent with the stress accent of languages like English.

[7] The difficulty seems to lie in the use of the analogy to the phoneme for a notion that is fundamentally different. His prosodeme is not simply a phoneme of accent; it is also a phonological *constituent*. Hattori's failure to distinguish clearly between phonological elements and phonological constituents, and his combination of the two into a single unit in the form of the prosodeme, has led to the distinction between the accent kernel and the prosodeme being almost completely ignored in the phonological literature. This is all the more unfortunate since his critique of the American structuralist notion of juncture makes clear the fact that he had a notion of phonological constituent quite similar to that now held by most phonologists.

akusento-kaku) and the prosodeme (Japanese *akusento-soo)* . The accent kernel corresponds exactly to the accent mark used by other authors with reference only to pitch. The prosodeme, on the other hand, consists of a phonological phrase (specifically, a minor phrase) together with a possibly null accent kernel. The prosodeme is not simply a mark on the designated syllable of some phonological domain, it is the union of such a mark (if present) and the domain itself. This is what he means when he says (1967:545):

> The prosodeme is assumed to have the force to consolidate the sequence of syllables it covers. At the juncture of two prosodemes, there appears, in various degrees, a change in one or more of the phonetic features mentioned above. For example, even if the pitch continues level, the phones in the initial position of a prosodeme often tend to be pronounced more strongly and articulated more clearly.

The statement that something happens at the *juncture* of two prosodemes makes sense only if the prosodeme denotes a domain, not if it denotes only a diacritic mark. Hattori's example is translatable into the statement that a minor phrase has initial stress.

In sum, Hattori's theory of pitch in Japanese does not differ substantially from that of Arisaka. What is different is his conflation of the marker of the pitch accent and the domain of which it is a property, a domain which has other properties as well.

Before going any further, it is important to point out that in the Tokyo dialect although the tone bearing unit is the mora, the domain of the accent is the syllable. What this means is that in a polymoraic syllable the fall from high to low can occur only following the first mora. There is no contrast between accentuation of the first mora of a syllable and accentuation of some other mora. The tone bearing unit is nonetheless the mora, since the morae of an accented heavy syllable will be assigned different tones, the first high, and subsequent ones low.

The usual treatment of this fact, following McCawley (1968), is to say that accents are assigned to syllables, but that when tones are assigned to syllables, the accent is interpreted as falling on the first mora of the syllable. An alternative is to assign the accent directly to the head of the syllable.

Instead of using tone assignment rules like those given above, it is possible to treat tone assignment autosegmentally. A detailed exposition of an autosegmental account of the various Japanese dialects is given in Haraguchi (1977). I will only sketch this account here, since the details of tone assignment will be of minor concern to us.

In Haraguchi's account, every word is accompanied by an autosegmental melody consisting of a High tone followed by a Low tone. The trick is to associate these tones to the tone bearing units (TBUs) appropriately. Tone association begins with the application of the Initial Tone Association Rule (ITAR) which links the H tone of the melody to the accented TBU, if there is any, and otherwise to the rightmost TBU. The Low tone of the melody is then linked to any morae following the accented mora in order to fulfill the Well Formedness Condition, and for the same reason the High tone spreads to any morae to the left of the accented mora. Finally, the Initial Lowering Rule replaces the High tone on the initial mora with a Low tone subject to the appropriate conditions.

In Haraguchi's original formulation, the Low tone of the melody is linked to the final mora of the word if the word is final-accented or unaccented. Since a falling contour is incorrect, it is necessary to have recourse to a contour simplification rule to remove the Low tone. If we follow more recent developments in autosegmental theory (Clements & Ford 1979, Halle & Vergnaud 1982) such multiple associations are created only by language particular rules, not by the Well Formedness Condition, so that no contour simplification rule is necessary.

3.2. Diacritic and Non-Diacritic Accent

The fact that the distribution of tones over Japanese words is so restricted is what led to the accentual analysis, and similar facts have led to similar analyses of a number of other languages.[8] It is surely true that we would not want to analyze Japanese as having the tone of every mora underlyingly specified, for such representations would contain considerable redun-

[8] See Hattori (1968) and Hayata (1974) for Korean, Odden (1982) for Kimatuumbi, and Goldsmith (1981,1982) for Tonga.

dant information. On the other hand, since the alignment of the tonal melody with the segmental material is not predictable, it will not suffice to say that the tone pattern is a property of a morpheme or word, and that it is associated entirely by convention. Some device must be provided to align the melody differently in different words, and this is the role played by the accent mark in the above analyses.

There is, however, an alternative proposal that accomplishes the same goal, which is that an accent is simply a lexically linked tone. This has been proposed for Japanese by Meeussen (1972) and Kiyose (1979). Clark (1981) gives a brief discussion of this possibility, which she adopts in Clark (1983). For other languages such proposals are discussed by Schadeberg (1973), Leben (1978), Hyman(1982) and Pulleyblank (1983). Under such an analysis, the accent is a linked tone, and the other tones of the melody are filled in, at later points, by rules and conventions. The rules that under the accentual analysis manipulate accents in this analysis manipulate linked tones.

The proponents of such analyses base their proposals on two observations. First, it appears always to be possible to translate accentual analyses into analyses under the linked tone theory so that the linked tone theory is descriptively adequate. Second, they point out that the mechanism of linked tones is necessary within tonological theory quite independently of the existence of the languages that are generally regarded as pitch accent languages. Since the autosegmental theory of tone provides descriptively adequate analyses of pitch accent languages without any additional devices, they argue that no additional devices, in particular the accent diacritic and the association conventions that refer to it, should be introduced. Insofar as the premises are valid, this argument is compelling.

The necessity of autosegmental links in non-accentual languages is well-motivated and uncontroversial, so I take the empirical issue to be whether the linked tone theory is indeed descriptively adequate for all pitch accent languages. To the extent that the accentual theory is descriptively adequate, this question could be answered affirmatively by providing a translation into the linked tone theory. No formal attempt has been made to do so, in part because no complete formalization of an accentual theory exists,[9] and in part because it may be that the accentual theory permits phenomena that are not describable in the linked tone theory, and for which no translation ought to be given since they are unattested. The alternative is to provide an explicit analysis for each pitch accent language within the linked tone theory, and by and large this is what its proponents have attempted to do. Hyman (1982) presents a non-diacritic analysis of Luganda, and Pulleyblank (1983) gives a non-diacritic analysis of Tonga.

In order to justify the claim that all pitch accent languages may be described within the linked tone theory, I will here outline a non-diacritic analysis of Tokyo dialect Japanese. Further details are taken up in Chapter IV.

It is a straightforward matter to replace the accent based tone assignment rules with a linked tone analysis. First, an accent simply translates into a linked High tone. This High tone will spread onto the preceding morae. The Low tone which in the diacritic analysis is part of the melody can then be inserted by a rule that inserts a Low tone following a High tone. This Low will then spread onto every mora to its right. Initial lowering will operate just as before, attaching a Low tone to the first mora of the word if the conditions are satisfied.

The only potentially problematic point is what to do about unaccented words. Under the accentual analyses, such words behave in effect like final-accented words, so that they too receive a High tone on the final syllable. But if we interpret strictly the equation "accent=linked High tone" unaccented words will not receive a High tone. There are two solutions. One is to insert and link a High tone to the final mora of the word at an appropriate point in the derivation. Alternatively, we could simply treat unaccented words as in fact toneless, letting the phonetic realization rules take care of them. The arguments for choosing between these two hypotheses are not compelling: I take up the question again in chapter IV. For the time being note only that both proposals are workable.

[9] It is nonetheless obvious that the bulk of what is done by the accent in the accentual theory can be accomplished in the linked tone theory by the linked tone, since the latter serves to distinguish a particular syllable or mora from those with which no tones are associated in the early stages of the derivation.

Thus, if we dispense with diacritic accents and instead take accents to be linked High tones, we need the following rules:[10]

(1) Leftward High Tone Spreading

(2) Initial Lowering

(3) Post-Accentual Low Tone Insertion

(4) High Tone Insertion.

(5) Rightward Tone Spreading

Needless to say, we expect that the spreading can in part be attributed to the operation of the Association Conventions in order to fulfill the Well Formedness Condition. I defer to Chapter IV discussion of the extent to which spreading is to be attributed to the Association Conventions and to what extent it is due to language particular rules. Similarly, some of the tone insertions might be accounted for by Default Autosegment Insertion. Here again, I defer discussion of the partition between conventions and language particular rules to Chapter IV. For the present, it suffices to observe that there exists a straightforward non-diacritic analysis.

4. Other Correlates of the Accent

It is generally believed that fundamental frequency is the major if not the only correlate of the pitch accent in Japanese, and this is certainly the impression that one obtains from listening to the language. There is no audible vowel reduction or other change in vowel quality of the sort observed in English or Russian, nor are there any audible variations in duration like those so readily apparent in English. There is, however, a tendency in the phonetic literature to assume that the accent has a durational correlate, admittedly a small one. This assumption is based on rather flimsy evidence.

Several acoustic studies report durational effects of accent location. Sugito and Mitsuya (1977) compared accented and unaccented monosyllables. They report a small difference in

[10] The fourth rule is of course unnecessary if unaccented words are treated as phonologically toneless.

the total duration of the syllable, with a longer duration for the accented ones. However, it is unclear what this result might represent, since it is widely acknowledged that in normal speech accentual distinctions are not realized on isolated monosyllables. The difference observed may well be an artifact of the speaker's attempt to create an artificial distinction between the two phonological classes of word.

Studies of disyllabic words are equally difficult to interpret. No study reports any effect on the duration of the second syllable. Sugito and Mitsuya (1977) found an effect on the total duration of the first syllable in only one of the eight pairs they studied, while Beckman (1982b) found no evidence whatever for such an effect. However, Beckman did find that when the VOT was considered separately from the duration of the vowel of the first syllable, the VOT was consistently longer in unaccented words than in initial-accented words, with a compensating shortening of the following vowel.

In sum, these studies indicate that there may be some marginal accentual effect on the durational properties of disyllables but the distinction is to be found not in the total duration but in the VOT of the first syllable.

Two perceptual studies of durational correlates of accentuation have been conducted. The first, by Fujisaki, Mitsui, & Sugito (1974) found no effect. Nishinuma (1978,1979) who conducted the second study claims to have established that the accent has a durational correlate, but this conclusion is excessively optimistic. What Nishinuma found was that when the durations of the first two syllables of words with constant fundamental frequency are varied the perceived location of the accent may be manipulated. In particular, he found that when the first syllable is very much shorter than the second (40 ms. vs. 100 ms.) the first syllable is perceived as being unaccented, while when the first syllable is much longer than the second (100 ms. vs. 40 ms.) it is perceived as accented. However, this does not establish that there is any durational correlate to accent in actual speech: in such a forced choice experiment the subject may latch onto any perceptible difference, whether or not it is a normal correlate of the distinction. Moreover, the difference in duration required to influence the perception of accent location in Nishinuma's experiment is much greater than anything reported in the acoustic literature, not to mention the fact that the most reliable conclusion from the acoustic literature points to a difference in VOT, not in overall syllable duration. This suggests that Nishinuma's findings are artifacts of the experimental situation.

Finally, it is important to observe that all of the experiments that purport to show the effect of accent on duration used only contrasts between accented and unaccented initial syllables. As a result, it is impossible to determine whether the reported effects are related to the presence of the accent or to the presence of the initial low tone that is found when the initial syllable is not itself the accented one. In other words, the duration/VOT of the initial syllable might be shorter in syllables with a low tone rather than in unaccented syllables.[11] In the absence of experiments contrasting words accented in different positions there is no basis for the claim that the reported results establish a durational correlate of the accent.

In sum, then, there is marginal evidence for durational differences between words with different tone patterns, but no evidence at all that such differences are consequences of the location of the accent.

There is one other source in the phonological literature for the belief that the "accent" is anything other than a marker of the point at which pitch falls. Hattori Shiroo is often cited as maintaining that the location of the accent has effects other than on F0. However, I do not believe that this is an accurate presentation of his position. Hattori clearly does believe that the Japanese accentual system is of the same formal nature as the English stress system, but that does not imply that he believes that the two systems have the same phonetic exponents. What does suggest that he believes that the accentual system of Japanese has correlates in features other than F0 is his contention that what he calls the prosodeme has, even in Japanese, correlates involving features other than F0. However, as I explained above, it is important to distinguish between the accent itself and the prosodeme. When Hattori asserts that the prosodeme has correlates other than F0 he is not necessarily attributing such corre-

[11] This important observation is due to Mark Liberman.

lates to the accent kernel; he could equally well mean that there are effects on properties other than F0 due to position within the phonological phrase, and indeed the only concrete example that he gives is the claim cited above that every phonological phrase bears an initial stress. Consequently, I do not find any clear evidence that Hattori means to attribute any non-tonal correlates to the accentual system *stricto sensu*.

5. Stress and Rhythm

Japanese is not usually described as exhibiting any sort of stress independent of the pitch accent system. There is nonetheless some reason to believe that Tokyo dialect Japanese has a stress system of sorts. I have already cited Hattori's report that he has the impression of initial stress on words, and other speakers whom I have consulted confirm this subjective impression. Unfortunately, no instrumental investigation of this point has been carried out. In a similar vein, there is some evidence for phrase-final lengthening in Japanese.[12] This suggests that there may be a word-level pattern of increased duration at the end and "stress" at the beginning.

More strongly supported at present is the possibility that Japanese has an alternating rhythmic pattern based upon bimoraic feet constructed from left to right. Some speakers report a subjective impression of such a rhythmic grouping together with the impression that in each foot the first mora is the stronger. This feeling of bimoraic grouping is reflected in speakers' feelings about the relative well-formedness of words. Satta Cotoji has observed that those words sound best in which the morphological structure, the syllable structure, and the rhythmic structure correspond.[13] For example, the word [moNbusyoo] "Ministry of Education" sounds odd because the second rhythmic foot, consisting of /bu/ and /syo/, straddles a morpheme boundary and the two morae of the third syllable belong to different feet. Of course, such judgments are rather weak since such words, including *monbusyoo,* do indeed exist.

[12] Personal communication from Osamu Fujimura, 1983.

[13] Personal communication from Osamu Fujimura, August 1983.

Bimoraic feet also play a role in verse. As Kawakami (1974) points out, one of the two styles of verse recitation in Japanese is based upon such a rhythmic system. Japanese verse is entirely quantitative; there is no true rhyming although there is a certain amount of alliteration. The various types of verse are defined by the number of morae in each line. For example, a *haiku* consists of three lines, containing five, seven, and five morae. A *tanka* consists of five lines, containing five, seven, five, seven and seven morae. In one of the two styles of recitation each line is treated as composed of four feet of two morae each, the missing one or three morae being filled in by pauses at the beginning or, more frequently, at the end of the line. The same is true even of more popular forms of verse. Kindaichi (1957;97-my translation) observes that:

> The rhythm of the so-called *dodoitsu* limerick is not simply a 3 4 4 3 mora sequence; rather, without any doubt it is a 1 2 2 2 2 2 2 1 sequence composed of groups of one and two morae.

More relevant to ordinary speech is the finding by Teranishi (n.d.) that similar effects are found not only in the recitation of verse but in slowly spoken prose as well. He found that other things being equal even-numbered morae, counting from the left, tend to be longer than odd-numbered morae, and that as speech tempo decreases the even-numbered morae, and those odd-numbered morae that cannot be paired with a following mora and so constitute feet by themselves, increase in duration disproportionately to the paired odd-numbered morae.

These observations indicate that there is some sort of rhythmic system in Japanese, whose principal if not only phonetic exponent is found in duration, not F0 or vowel quality. This system resembles a stress system in the alternating pattern of long and short morae, corresponding to the alternation of stressed and unstressed syllables so frequently found in stress systems. Moreover, the phonetic exponent of duration is one of the principal phonetic correlates of stress in English and other stress languages.

There is one other set of facts that bear on the question of stress in Japanese. There is a morphological process that appears to be governed by a binary foot structure of just the sort proposed by Satta and Teranishi. Since this process has never been carefully investigated I will describe it here in some detail.[14]

Japanese has a hypocoristic suffix /tyaN/ ([tšaN]) that is added with full productivity to given names, and with lesser productivity to kinship terms and a few other items.[15] Generally speaking, the suffix may be added either to the full name or kinship term or to a modified, usually truncated, form. Some representative examples of hypocoristics formed without modification are given in (1) below.

(1) Unmodified Hypocoristics

e'mityaN	<	emi
ha'nakotyaN	<	hanako
hirotarootyaN	<	hirotaroo
ka'zuhikotyaN	<	kazuhiko
makototyaN	<	makoto
masaotyaN	<	masao
syooi'tityaN	<	syooi'ti
tosi'akityaN	<	tosi'aki
yo'osuketyaN	<	yoosuke
yu'kityaN	<	yu'ki

Hypocoristic formation without modification is always possible in principle, but it tends to sound rather stiff when addressed to children and to be characteristic of a less intimate and less affectionate style of address than is the hypocoristic formed from a modified stem. Unmodified hypocoristics are likely to be used by schoolteachers or by angry parents speaking to their children, or among adult women who know each other well. More frequently, the hypocoristic suffix is affixed to a modified form of the name or kinship term. It is with such modi-

[14] To my knowledge there is no literature on this topic other than Sasaki (1977). This brief paper reports a number of hypocoristics collected in a survey of pupils in a girls' high school but gives no analysis.

[15] There is a variant [taN] which has a babyish character, presumably reflecting the fact that children acquire stops before they acquire fricatives and affricates. In the literature this suffix is often said to form "nicknames". This is somewhat imprecise, since the nicknames formed with /tyaN/ are a small subset of the total class of nickname. /tyaN/ is always affectionate. Moreover, there are many nicknames in Japanese that refer to a person's features (physical or otherwise) and that are not necessarily complimentary or affectionate. The later are known in Japanese as *adana*. Non-descriptive nicknames are referred to as *yobina* and it is to this subclass that the hypocoristics (Jap. *aishoogo*), most regularly formed with /tyaN/, belong.

fied hypocoristics that the remainder of this section deals.

The most common form of modified hypocoristic is one in which the suffix {tyaN} is preceded by the first CVCV of the base. Innumerable examples of female personal names of the form CVCV followed by the suffix may be given. Some examples are given in (2) below. This may give the impression that modification takes place at morpheme boundary, but this is belied by the fact that modification may affect monomorphemic names, as in the first six examples in (3) or in mid-morpheme in polymorphemic names, as the last two examples show.

(2) Hypocoristics of Female Names of Form CVCV-ko.

ay'atyaN	<	a'yako
ha'natyaN	<	ha'nako
hu'mityaN	<	hu'miko
k'ayotyaN	<	ka'yoko
ki'yotyaN	<	ki'yoko
yo'rityaN	<	yo'riko
yu'mityaN	<	yu'miko
ya'sutyaN	<	ya'suko
yu'kityaN	<	yu'kiko

(3) Truncation in Mid-Morpheme

a'kityaN	<	akira
a'rityaN	<	arisa (< English Alicia)
me'gutyaN	<	megumi
ma'yutyaN	<	mayumi
o'satyaN	<	osamu
ti'katyaN	<	tikara
ma'kotyaN	<	ma(+)koto
wa'satyaN	<	wa+sabu+roo

Moreover, modification of polymorphemic names may occur at places other than syllable boundary. For example, in disyllabic names whose first syllable is short and whose second syllable is long, the modified form consists of the first syllable together with the first mora of the second syllable, in spite of the fact that the second syllable may constitute a single morpheme. Examples of this type are given in (4).

(4) Truncation in Mid-Syllable

ta'rotyaN	<	taroo
zi'rotyaN	<	ziroo

Such examples as these show clearly that modification does not respect morpheme boundaries.

In the examples thus far given the modified stem is disyllabic. This might lead to the hypothesis that the modified stem must be two syllables long, with a further constraint that a final long syllable must be shortened. However, it is not necessarily the case that the modified stem is disyllabic. All possible types of bimoraic monosyllabic modified stem occur.

If the first syllable of the stem contains a long vowel, the modified stem typically consists of the first syllable alone, as exemplified in (5).

(5) First Syllable with Long Vowel

aatyaN	<	aasa(a) (< English Arthur)
syuutyaN	<	syuusuke
yo'otyaN	<	yooko, yoosuke
yu'utyaN	<	yuuzi

Similarly, if the first syllable contains a diphthong it alone will form the modified stem, as seen in the examples in (6).

(6) First Syllable with Diphthong

ke'ityaN	<	keizi, keiko
ta'ityaN	<	taizoo, taiseN

If the first syllable ends in a nasal the modified stem will typically be of the form CVN, as illustrated in (7).

(7) First Syllable Closed by Mora Nasal

zyu'NtyaN	<	zyuNko, zyuN
ge'NtyaN	<	geN
ki'NtyaN	<	kiNsuke

The examples thus far adduced prove that modification is governed by phonological rather than morphological constraints and that the modified form need not be disyllabic. Moreover, I have indicated that all possible truncations to the first two morae of the base form are possible. What then is the constraint? I will show that the constraint is that the number of morae in the stem must be even. In most cases, this means that there must be exactly two morae. I will return below to longer hypocoristics. For the time being let us consider only hypocoristics formed from names of at most four morae. Consider the four mora names in (8). As I have indicated, it is possible to produce hypocoristics without any modification at all, but if modification does occur, it must be to a form two morae in length. Thus, the modified forms longer than two morae are unacceptable.

(8) Possible Hypocoristics of Long Names

kazuhikotyaN	ka'zutyaN	*kazuhityaN	< kazuhiko
kazuyukityaN	ka'zutyaN	*kazuyutyaN	< kazuyuki
masahisatyaN	ma'satyaN	*masahityaN	< masahisa
takatugutyaN	ta'katyaN	*takatsutyaN	< takatsugu

Not only must the modified form not exceed two morae, it must not be less than two morae. Thus, in no case may the base form be truncated to its first mora. This is illustrated by the unacceptability of the examples in (9). Moreover, in the one case of a monomoraic personal name that I have found, the vowel is lengthened, as illustrated in (10).

The astute reader will have noticed that since it is always possible, in principle, to form a hypocoristic without modification, we expect to find hypocoristics based on unmodified monomoraic stems, so that in addition to [ti'ityaN] we should find [tityaN], and indeed we do. Therefore, the mere fact that lengthening is possible does not demonstrate conclusively that in the case of a monomoraic name the stem must be lengthened. It is, nonetheless, possible in principle to make such an argument.

The possibility of such an argument is due to the accentual effects of the modification process. When the suffix [tyaN] is added to an unmodifed stem it is accentually neutral; that is, if the base form is unaccented the derived form is also unaccented, and if the base form is accented, the accent does not shift. In contrast, hypocoristics with modified stems are accented on the syllable containing the penultimate mora, as the various examples cited will attest.[16]

As a result, if my hypothesis that monomoraic stems must be lengthened is correct, we should find that if the base form is unaccented, the unlengthened form will be possible only if it is unaccented, while the lengthened form will be accented on the initial syllable. Therefore, it is possible in principle to prove that lengthening is not optional. Unfortunately, because monomoraic given names are so rare, I can offer only weak evidence to this effect. The name in (11) is accented in isolation, so the fact that the unlengthened form [ti'tyaN] is initial accented need not be attributed to segmentally vacuous modification. The form [kotyaN], from the unaccented stem [ko] must be unaccented, as expected, but the fact that the modified form *[ko'otyaN] does not exist weakens the argument.

(9) Unacceptably Short Hypocoristics

*yotyaN	<	yoosuke
*ketyaN	<	keizi
*hatyaN	<	hanako
*zyutyaN	<	zyuNko

[16] I know of only two exceptions. One is the form [zittyaN] "uncle dear" which is unaccented (Osamu Fujimura, personal communication,1983). The other is one of the variants of the hypocoristic of the name *aiitiroo* discussed below.

(10) Lengthening of Monosyllabic Bases

ti'ityaN	<	ti

To summarize what we have learned so far, modified hypocoristic stems from names less than five morae long must be exactly two morae long, no more, no less. The two morae may be of any form permitted in Japanese, CVCV, CVV, or CVN. To foreshadow material not yet presented, I note that the two morae may also be of the form CVC, thus instantiating the only other type of two mora sequence possible in Japanese, namely a vowel followed by the first half of a geminate consonant.

The modification process may be thought of in two ways. We might suppose that it simply involved counting two morae from the beginning of the word and deleting the remainder. This is probably the null hypothesis, and it is consistent with all but the last fact mentioned so far. An alternative hypothesis is that modification involves the creation of a two mora template which is then either used generatively, as a skeleton which is associated with a segmental melody, along the lines discussed by McCarthy (1978, 1979, 1981a, 1982) or which is used interpretively, as a filter. I will argue that hypocoristic modification is best characterized in terms of a template.

The simple modification hypothesis presupposes that the modified form and the base form will line up segment by segment from the left. Evidence against this hypothesis could be of several forms. First, this hypothesis predicts that the derived stem can be no longer than the base form, yet we have seen, in the one case that I have found of a monomoraic name, that lengthening takes place. This is inconsistent with the simple truncation hypothesis.

Second, if the segmental melody is unmodified but is aligned with the CV skeleton in a novel fashion, we have evidence against the simple modification hypothesis. We have already seen one instance of this phenomenon, in the form of lengthening of the vowel of a monomoraic base form. Here the segmental melody is unmodified but the association of the melody with the CV skeleton is modified.

The same lengthening is possible in polymoraic base forms. Thus, in addition to the more typical CVCV modified forms, a name beginning with CVCV may have a modified stem of the form CVV. This is illustrated in (11).

(11) Lengthening of CVCVX Base Forms

hi'ityaN	<	hi'roko
i'ityaN	<	izumi
ka'atyaN	<	ka'yoko
ki'ityaN	<	ki'yoko
ma'atyaN	<	ma'miko, masae, ma'sako, mayumi
mi'ityaN	<	mieko, midori
ni'ityaN	<	ani "elder brother"
ne'etyaN	<	ane "elder sister"
no'otyaN	<	nobuo, nozomi
ti'ityaN	<	tiemi

In these cases the material that becomes the second mora of the modified stem is neither a mora nor a distinct unit in the melody in the base form. In other cases, the material is present as a distinct unit in the melody, but does not count as a mora. This is exemplified by the cases in (12).

(12) Non-Morae Transformed into Morae

a'ttyaN	<	aasa(a) (< English Arthur)
a'NtyaN	<	ani boyo,punk < elder brother
a'ttyaN	<	a'tuko
bo'ttyaN	<	boo sonny < stick
e'ttyaN	<	e'tuko
ka'ttyaN	<	ka'tuko
mi'ttyaN	<	mi'tiko
mu'ttyaN	<	mutumi
sa'ttyaN	<	sa'tiko, satiyo
ti'ttyaN	<	ti
ya'ttyaN	<	ya'suko

In the second example, the [N] is indeed derived from the melody of the base form, but in the base form it is the onset of the second syllable and therefore does not count as a mora. The next three examples are similar, only here it is a [t], in the base form in the onset of the second syllable and therefore not a mora, that becomes the second mora of the modified stem. The last two examples are cases in which the melody of the second mora of the modified stem is derived from the melody of the hypocoristic suffix, not from the base form at all. These last examples, by the way, fulfill my promise to exemplify the CVC pattern.

These arguments suffice to show that it is not possible to take the base form, with or without the suffix attached, count out the first two morae, and delete the rest. The third problematic phenomenon for the simple modification hypothesis is the fact that the segmental material is not necessarily derived by left to right linkage of the segmental melody of the base form, in spite of which the two mora constraint holds. This can be seen in forms whose segmental melody is irregularly derived, examples of which are given in (13).

In these examples the segmental material comes from the base form, but some material is skipped over. For example, in the first example the second syllable is skipped over.[17]

(13) Irregular Hypocoristics

a'kotyaN	<	a'kiko
mo'kotyaN	<	mo'toko
o'kotyaN	<	yo'siko
o'kotyaN	<	hi'roko
sa'butyaN	<	wasaburoo
ya'ityaN	<	yayoi
yo'kotyaN	<	yo'oko

Another source of segmentally irregular hypocoristic formation is derivation via Chinese characters. Most of the Chinese characters used to write Japanese have two sets of readings. One set (the so-called *kun-yomi*) consists of the native Japanese words represented by that

[17] There is another class of apparently irregular forms whose melodies are nonetheless derived from the melody of the base. These are forms like /me'NtyaN/ < /megumi/ and /no'NtyaN/ < /nobuko/. In these forms the nasal /N/ derives from the voiced obstruent /g/ or /b/, since comparable forms with a nasal are not found when the onset of the second syllable is not a voiced obstruent. This is not entirely unexpected, but as the ordinary phonological rules of Japanese are currently understood (see Kuroda 1965 and McCawley 1968) we do not expect nasalization of voiced obstruents in the absence of voicing of the following consonant. Thus, if the rules governing voicing and nasality are correctly formulated such forms as these must be considered to be irregular. Of course, such forms may show that the existing rules are incorrectly formulated.

character; the other set, (the so-called *on-yomi*) of the nativized forms of the Chinese word represented by that character. Thus, the character 水 may be read either [mizu], the native Japanese reading, or [sui], the Chinese reading, both meaning "water". There are a number of examples of hypocoristics derived by using the segmental melody of another reading of the Chinese character used to write the base form. Some examples are given in (14):

(14) Hypocoristics with Orthographically Derived Melodies

me'gutyaN	<	恵	keeko
mu'ttyaN	<	六	roku
su'zutyaN	<	鈴	riN (< English Lynn)
ga'NtyaN	<	岩	iwao
syo'otyaN	<	照	teruo
bu'utyaN	<	武	takesi

In the first three examples the hypocoristic melody is etymologically Japanese and the base form is Sino-Japanese. In the remaining examples it is the base form that is etymologically Japanese and the hypocoristic melody that is Sino-Japanese.[18]

What is particularly striking about these examples is that even though the segmental melody is derived in a quite irregular fashion, they conform perfectly to the two mora constraint. Indeed, the native word represented by the character 恵 used to write the [kee] of the name [keeko] is the verb [megumu], whose monomorphemic stem is /megum/. Evidently, /megum/ has been modified to /megu/ in order to conform to the two mora requirement. Similarly, the Sino-Japanese readings of the character used to write /takesi/ are [mu] and [bu], both with short vowels. The vowel of [bu] has been lengthened in the hypocoristic in order to conform to the two mora template. [19]

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[18] *muttyaN* "sixie" is the name of a dog who was born in June, the sixth month of the year, which is called *rokugatu* in Japanese.

[19] An interesting property of this derivational process is that the orthographically derived segmental melody always belongs to the opposite class of reading from that used in the name. I know of no examples in which a Sino-Japanese reading is replaced by another Sino-Japanese reading, or a Japanese reading by another Japanese reading, in spite of the fact that a considerable number of characters have multiple readings within each class.

A final point concerns the fact that there is considerable variation in which of the many ways in which a two mora template may be instantiated is actually chosen. A point to which I have alluded but have not yet made fully explicit is that in general a single name admits of multiple hypocoristic derivates, subject to the two mora constraint. Thus, as we have seen above, a name of the form CVCVX will usually form a hypocoristic of the form [CVCVtyaN], but it is perfectly possible to obtain the second mora by lengthening the first vowel instead. We have also seen that the second mora can be obtained by gemination of the [t] of the [tyaN]. In principle, all of these forms are possible for any name. Thus, the names in (15)have all of the various hypocoristics listed.

(15) Multiple Possible Hypocoristics

mi'ityaN	mi'ttyaN	mi'dotyaN	< midori
ki'ityaN	ki'ttyaN	ki'yotyaN	< kiyoko
ha'atyaN	ha'ttyaN	ha'anatyaN	< hanako

There is no way in which a truncation rule can account for the range of possibilities exhibited here. [20]

Several lines of evidence thus lead to the conclusion that the two mora template of modified hypocoristics is independent of the segmental melody in a manner inconsistent with the simple modification hypothesis. First, the segmental melody may be realigned with the CV tier, either in terms of added associations (lengthening) or by movement from the onset into the rhyme. Second, parts of the segmental melody may come from the suffix. Third, the

[20] Althought I have indicated that within the limits imposed by the two mora constraint a number of options are available for forming modified hypocoristic stems, I should note that there are some preferences. For example, names of the form C V t high vowel X almost always have hypocoristics of the form [CVttyaN], due no doubt to the tendency of high vowels in a voiceless environment to devoice and to the existence of morphophonemic rules deleting final high vowels in the first component of compounds of Sino-Japanese morphemes. Indeed Sasaki (1977) in a survey in which he asked pupils in a girls' high school their nicknames, found no examples of other types of hypocoristic formed from names of this shape. Nonetheless, other forms are not entirely impossible. For example, the well known talk show hostess Kuroyanagi Tetsuko is referred to as [te'tutyaN], not *[te'ttyaN], although the latter is, of course, a perfectly acceptable form in general.

segmental melody may be derived irregularly, in spite of which the two mora constraintis obeyed. Finally, the same base form permits multiple modified forms, subject of course to the two mora constraint. All of these lines of evidence are incompatible with the simple modification hypothesis, but are consistent with the hypothesis that a two mora template is used to construct modified hypocoristics.

Let us consider now what happens in the relatively rare cases of names longer than four morae. In this case, as the examples below show, the hypocoristic stem may be either two or four morae in length.[21] As in the case of shorter names, the requisite number of morae may be obtained in more than one way. Moreover, there are a number of cases in which the segmental melody is exceptional, in that the portion of the melody used is not a left substring, and in these cases too the restriction to an even number of morae is observed.

[21] Just as some of the possible instantiations of the two mora pattern are preferred over others, so there are some preferences in the choice of hypocoristic derivative for a long name. The two mora variant tends to be preferred to its four mora counterpart.

(16)

Name	Acceptable	Unacceptable
ai.itiroo	aj.i'tityaN a.iti'rotyaN a.i'tirotyaN aj.i'ttyaN a'jtyaN	*aj.itirotyaN *aj.ityaN *atyaN
gisaburoo	gi'ityaN gisabu'rotyaN	*gisabutyaN *gityaN
keNzaburoo	keNza'butyaN ke'NtyaN	*keNzaburotyaN *keNzatyaN *ketyaN
masanosuke	masano'ketyaN ma'satyaN	*masanotyaN *matyaN
siNzaburoo	siNza'butyaN si'NtyaN	*siNzaburotyaN *siNzatyaN *sityaN
wasaburoo	wasabu'rotyaN wa'satyazN sa'butyaN wa'atyaN	*wasabutyaN *watyaN

Hypocoristics of Very Long Names

Longer names behave just like shorter names with respect to hypocoristic formation.[22] It is just that since they are longer they have enough material in their segmental melody to permit realization of the four-mora possibility as well as the two-mora possibility.

In addition to the hypocoristics in /tyaN/ there are a number of other processes that exhibit similar properties which I have not fully investigated. I describe these briefly in the following paragraphs.

[22] There are two hedges required. First, it does not appear to be possible to form 4-mora hypocoristics by means of lengthening of the third mora. E.g. *[wasabuutyaN]. This is perhaps due to the fact that there is a preference for the shorter form of the hypocoristic, so that the longer form is used in order to maximize the use of the melody. Second, for one of my informants several of the four mora hypocoristics are unaccented, in contrast to the two mora hypocoristics, which are all accented on the syllable containing the penultimate mora.

First, there is a process used to form familiar forms for girls' names that is now largely disused in urban speech. For this reason, my present data are limited. The process involves prefixation of [o] to the name and truncation of the name to its first two morae. Examples are:

(17)

oyuki	$<$ yukiko
ohana	$<$ hanako
osaki	$<$ sakiko
oyoo	$<$ yooko
omido	$<$ midori

Unlike hypocoristic formation, it appears (I am not at all sure) that this process does not allow any variation, for which reason it could reasonably be formulated as a truncation rule, and would be difficult to formulate with a filter. This process shares with hypocoristic formation the property of of causing the accent to appear on the syllable containing the penultime mora of the stem, that is, on the syllable following the [o].

A similar process is that used in forming the names by which geisha refer to their clients. This involves taking the first mora (CV) of the name, lengthening the vowel, and adding the suffix [saN] "Mr.", e.g. /huzimura/ $>$ /ohu'usaN/. The same process is used by bargirls, but without the honorific /o/. In this case there is some variability in that when the first syllable of the client's name is long, it may form the two morae of the derived name as is, or the first mora may be lengthened. For example, the name /hoNda/ yields both /ho'osaN/ and /ho'NsaN/. Like hypocoristic formation and the process deriving girl's names with the prefix /o/, this process also results in penultimate accent (not distinguishable, in this case, from initial accent).

Yet another related set of facts concerns the claim by McCawley (1968) that a rule lengthening short monosyllables applies to "nicknames" (loosely categorized) of all sorts. McCawley notes that those kinship terms denoting close relations that are obligatorily followed by the suffix [saN] "Mr., Ms." and preceded by the honorific particle [o] all have long vowels. The words mentioned by McCawley are [oka'asaN] "mother", [oba'asaN] "grandmother", [oto'osaN] "father", [ozi'isaN] "grandfather", [one'esaN] "elder sister", [oni'isaN] "elder brother". Another form that might be included is [ozyo'osaN] "(someone else's) daughter". All of these forms permit the suffix [saN] to be replaced with the hypocoristic suffix [tyaN], the honorific suffix [sama], or the honorific hypocoristic [tyama] with no change in vowel length or accentuation. To these we might add the forms [ota'asama] "father" and [omo'osama] "mother" used within the Imperial Family. Other terms that have long vowels but do not conform fully to this pattern are [imooto] "younger sister" which lacks both the honorific prefix and the suffix [saN], [otooto'] "younger brother", which lacks the suffix [saN] and whose initial [o] is probably not to be identified with the honorific prefix, and [ne'esaN] "(one's own) elder sister" which lacks the honorific prefix. This last probably illustrates the inessentiality of the honorific prefix to the lengthening pattern. The fact that in the other forms the prefix is obligatory whereas in this case it is not is doubtless due to the fact that within the traditional social system the respect due one's own elder sister is substantially less than that due the other the others, since in general the amount of respect due increases with age, maleness, and membership in another family.

The words [ozisaN] "uncle" and [obasaN] "aunt" constitute apparent counterexamples to this claim, but McCawley claims that in these cases the stems are disyllabic /ozi/ and /oba/ respectively, where the [o] is not the honorific prefix. One fact, not noted by McCawley, that supports this claim is that whereas the [o] in the other cases is written with the *kana* letter お, as the honorific prefix always is, the [o] of these two words is written in each case with a Chinese character that is never used to write the honorific particle. For example, the two characters that together represent the [oba] part of [obasaN] (the suffix [saN] is written in the syllabary) mean "little mother". These writings may indicate a native intuition that the [o] in these cases is not the honorific particle. Another fact that supports this claim is that whereas the [o] of [obaasaN] and [oziisaN] is separable, particularly when *-saN* is replaced by *tyaN*, so that we have the forms [ba'atyaN] and [zi'ityaN], the [o] of [ozisaN] and [obasaN] is not separable, even when *tyaN* replaces *saN*. One difficulty is the fact that *oba'tyaN* and *ozi'tyaN* do not have the penultimate accent expected in hypocoristics. This is perhaps due to the influence of the other kinship terms, which have the accent on the syllable following the honorific [o].

McCawley treats these as on a par with the true hypocoristics in [tyaN] and, taking note of the existence of hypocoristic stems with lengthened vowels, like those in (11), asserts that "a mono- syllabic nickname always has a long vowel" (p.83), a statement which we have seen to be untrue. On the basis of this generalization, McCawley proposes to derive the long vowels of the kinship terms from short vowels by means of a rule lengthening monosyllabic "nicknames".

Strictly speaking, this account will not work, since the correct generalization about hypocoristics permits any two-mora stem, not just a long vowel. On this basis, we would expect to find such nonexistent forms as *[oka'ssaN] "mother" and *[one'ssaN] "elder sister". Moreover, it is unclear in what sense these forms are to be considered "nicknames". They are certainly not hypocoristics, and indeed they retain their long vowels and initial accentuation when the honorific [sama] replaces the neutral [saN]. Consequently, an attempt to derive them synchronically by the same rules that generate true hypocoristics is problematic.

On the other hand, there is some evidence in favor of deriving these items from underlying representations with short vowels. For example, in addition to the cited [ozi'isaN] for "grandfather", there are also the forms [zi'zi] (with and without the honorific prefix [o]) and [zizi'i], apparently derived by reduplication of a stem /zi/ with short /i/. Moreover, although the kinship terms do not exhibit the full range of possibilities found in the hypocoristics, there is at least one example of a variant that does not contain a long vowel but does nonetheless satisfy the two mora constraint. This is [okka'saN], a variant of [oka'asaN] "mother".

These processes share the property of requiring the output to conform to a template consisting of an even number of morae. Moreover, they appear to share the same accentual pattern.

It thus appears that hypocoristics, and perhaps the other items discussed, are based on a template consisting of an even number of morae. What might such a template represent? Two morae look suspiciously like a metrical foot, so I suggest that the rule is that a hypocoristic stem must consist of non-degenerate feet. The segmental melody is linked up from left to right, with the possibility, in special but not infrequent cases, of skipping over portions of the melody. This adds one case to the small number of attested foot-based morphological processes. In addition, there are several unusual features to be noted. One is that the number of feet may be greater than one. Secondly, the maximal expansion of the template need not be taken; indeed if anything the preference is for the minimal expansion. Third, there is an extraordinary amount of freedom in how the template may be filled, and deviations from strict left-to-right linking of the melody are fairly common.

In sum, then, there is evidence for a rhythmic system based upon binary feet, and some evidence for word-level "stress" as well. While this area has only begun to be investigated, it is now clear that Japanese should not be dismissed as having no form of stress or rhythm.

List of Figures

Fig. 1.1
Weizman's [nomi'mono] Data.

Fig. 1.2
A typical F0 contour of the word [nomi'mono]. The first [no] is noticeably higher than the second [no].

Weizman's [nomi'mono] Data

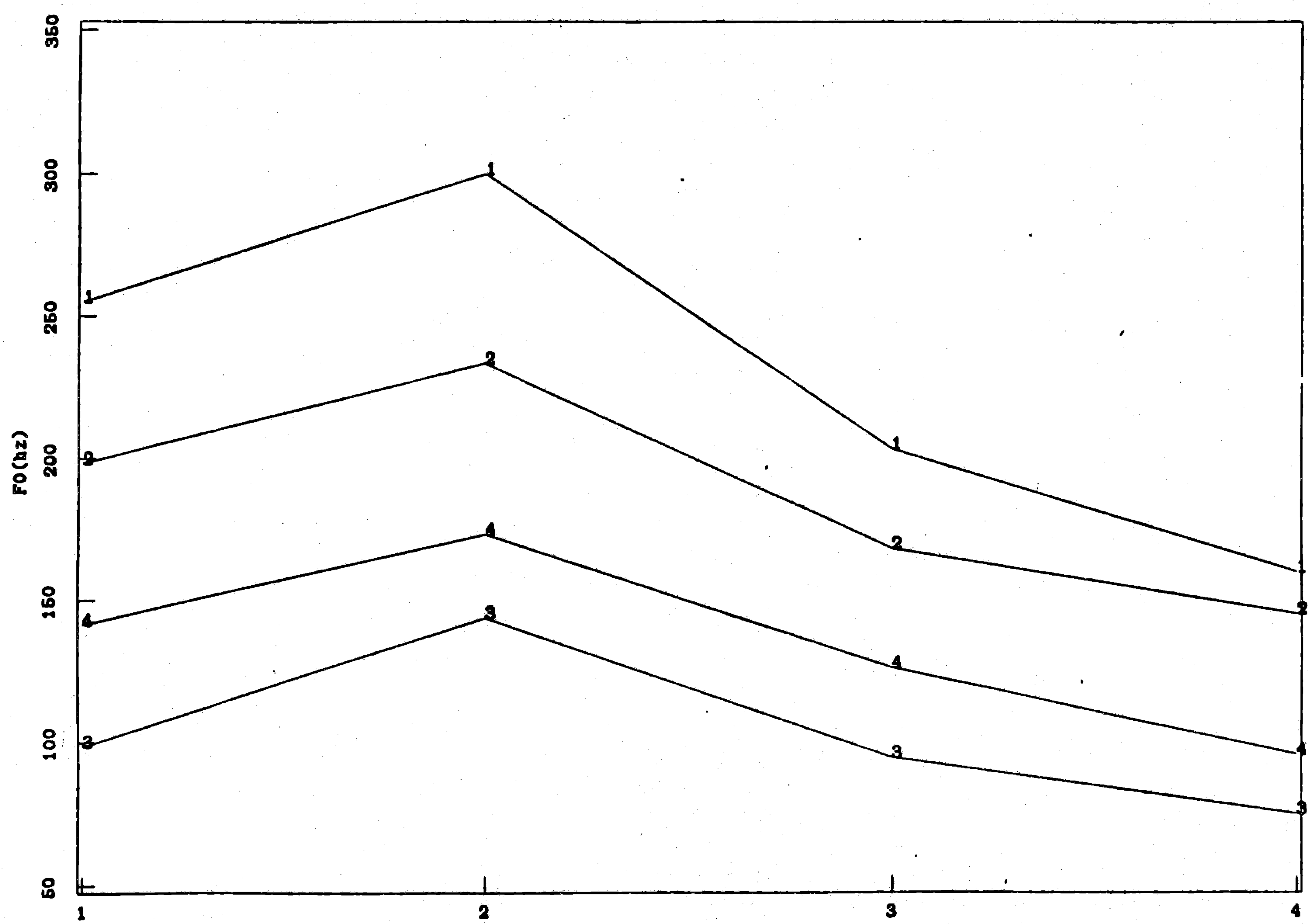
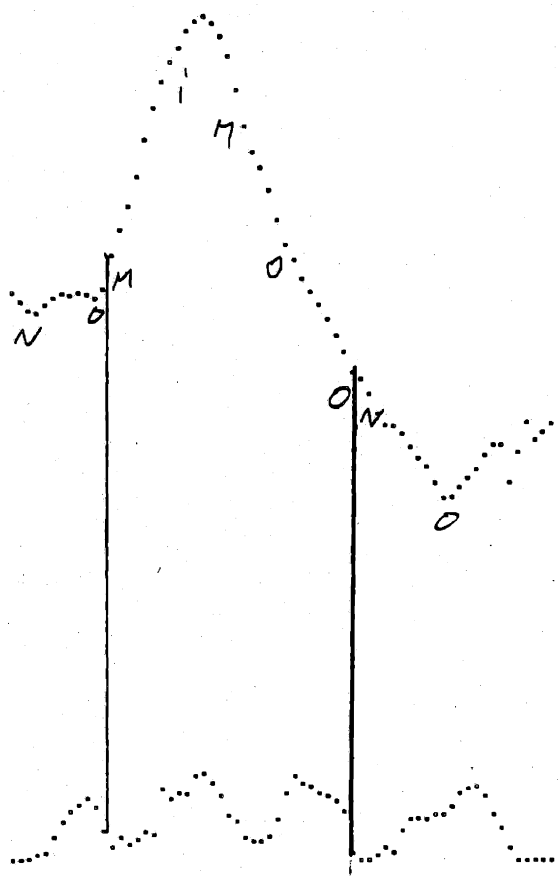


FIG. 1.1

bip2/m1/usr1/fuji/w1/p8
nom?mono



lpc coefficient one

FIG. 1.2

CHAPTER TWO: LEXICAL MORPHOLOGY OF ACCENT

One of the most interesting aspects of the tone pattern of Japanese words is the way in which the tone pattern is determined by the morphology. Derived words as well as non-derived words conform to the restricted set of tonal schemata described in Chapter One, so that the morphological determination of the tone pattern is readily described in terms of rules that manipulate the location of accents.

1. Basic Properties of Morphemes

Morphemes have two types of accentual properties. The first, which I call the basic properties, are those that are straightforwardly attributable to the phonological representation. In addition, particular morphemes and constructions may trigger any of a variety of morphoaccentual rules, which I will discuss below. Of course, it is an empirical question which properties are attributable to the phonological representation *per se* and which must be considered to involve the triggering of rules, so this classification is only preliminary. I return below to the question of what is to be directly attributed to the phonological representation.

1.1. Location of the Accent

1.1.1. Contrast in Accent Location

The first basic property of morphemes is the location of the accent, if any. That this is a distinctive property of morphemes is easily demonstrated by the fact that the accentuation of non-derived nouns is unpredictable. The accent may fall on any syllable, or it may be entirely absent, as such examples as the following demonstrate.[1]

[1] Many of the morphological rules discussed here are well known and may be found in such handbooks as Hirayama (1960) and NHK (1966) as well as in McCawley (1968). When a rule is well known I will give only illustrative examples. When a rule has not, to my knowledge, previously been discussed in the literature, where it has not been adequately exemplified, or where it is of particular importance, I will generally give a larger number of examples.

ha'si	chopsticks
hasi'	bridge
hasi	edge
mo'ti	birdlime
moti'	durability
moti	rice cake

Accentual Contrasts in Root Nouns

Thus, one property of a morpheme is the location of the accent.

1.1.2. Resolution of Accentual Conflicts

One question that immediately arises is this: What happens when a word contains more than one accented morpheme? In Tokyo dialect Japanese at most one accent per word may be realized, so the conflict among the accents must be resolved. The conflict is resolved by deletion of all but one accent. The remaining accents have no surface effects.

Conflicts between accents may be resolved in several different ways, depending upon the construction. Most of the methods of resolution fall into the category of morphoaccentual processes discussed under that heading below. There is, however, one rule that applies quite generally in cases where no rule specific to a morpheme or morphological process applies. This rule is that the leftmost accent in the word remains, all others being deleted. I will demonstrate shortly the utility of such a rule for bound morphemes, but its effect is most readily observed in compounds. Since by definition the constituents of compounds may occur by themselves, we can be confident that they do indeed have independent accent patterns, whereas in the case of bound morphemes a more complex inference is required.

Noun-noun compounds in Japanese fall into at least two classes. Otsu (1980) suggests that there are three classes, which he refers to as "strict", "loose", and dvandva. The majority of Japanese compounds fall into Otsu's "loose" category, and it is these to which the accentual rules usually cited in the literature apply. These rules are discussed below under the heading of morphoaccentual processes.

Otsu's distinction between "strict" and "loose" compounds is based on two observations. First, he notes that some compounds do not undergo the rule known in Japanese as the *rendaku* rule which has the effect of voicing an obstruent at the beginning of the second member of a compound. Second, those compounds that do not undergo *rendaku* even when the other conditions are met frequently fail to conform to the accentual rules for "loose" compounds, at least as these complex rules are presently understood. Noting that these often have more specialized, less semantically transparent meanings than their "loose" counterparts, he suggests that they form a class of "strict" compound. There do not appear to be a great number of these, nor is it clear what rules do govern their accent patterns, so I am not sure whether there is justification for positing a class of "strict" compounds as opposed to recognizing the existence of a small number of exceptional, fossilized compounds, but Otsu's observations deserve further study..

What is much clearer is Otsu's distinction between "loose" compounds and dvandva. As he observes, dvandva compounds generally[2] do not obey the rules that govern "loose" compounds, nor do they ever undergo *rendaku*. Dvandva compounds are subject to the stated general rule: the leftmost accent, if any, wins.[3] The following examples illustrate the four possible patterns.[4]

[2] I say generally because there are a few exceptions to Otsu's generalization. These include *ue'sita* "up and down" (< ue + sita) which should be unaccented by Otsu's rules for dvandva, and, for some speakers, *uti'soto* "inside and outside" (< uti + so'to) which should be (and for Otsu apparently is) accented on /so/ rather than /ti/ by Otsu's rules. The accentuation of these examples is just what would be expected if they were "loose" compounds.

[3] Otsu suggests that dvandva contain a stronger boundary than "loose" compounds, and indeed that they involve compounding of phrasal elements. He does not explicitly justify this, but he may mean his comment that the "leftmost wins" rule for accentuation of dvandva is typical of phrasal collocations to argue for the stronger boundary and phrasal status of the constituents. This is in fact irrelevant, since as we will see below exactly the same rule applies to affixes.

[4] I have given the glosses in the order most natural in English. In some cases, this is the opposite of the Japanese order. These are *nisihigasi, tahata,*and *terihuri.*

- -		
edaha	branches & leaves	< eda + ha
huetaiko	flutes & drums	< hue + taiko
- +		
nisihigasi	east & west	< nisi + higasi'
utiso'to	inside & outside	< uti + so'to
+ -		
a'sabaN	morning & evening	< a'sa + baN
ma'eusiro	front & back	< ma'e + usiro
me'hana	eyes & nose	< me' + hana
o'hire	tail & fin	< o' + hire
+ +		
age'sage	raising & lowering	< age' + sage'
ha'ruaki	spring & fall	< ha'ru + a'ki
ku'rosiro	black & white	< ku'ro + si'ro
kusa'ki	grass & trees	< kusa' + ki'
natu'huyu	summer & winter	< natu' + huyu'
ta'hata	fields & paddies	< ta' + hata'
te'asi	hands & feet	< te' + asi'
teri'furi	rain & shine	< teri' + furi'
yama'kawa	mountains & rivers	< yama' + kawa'

Dvandva Compounds

The same principle will explain the behaviour of many suffixes, if we assume that bound morphemes as well may have underlying accents. In these cases, the accent of the affix is realized if the base form to which it is suffixed is unaccented; otherwise, the accent of the base form is realized. This is illustrated by the postposition *ma'de* "until" which is suffixed to nouns, and by the verbal suffix *tara* "conditional".

miyako ma'de	until the capitol
koko'ro made	until the heart
yoNda'ra	if he calls (< yob + ta'ra)
yo'Ndara	if he reads (< yo'm + ta'ra)

Accent Resolution

Contrast the behaviour of an accented suffix like *tara* with that of an unaccented suffix like *-ta* "past". In the latter case, if the verb stem is unaccented, the form surfaces unaccented.

yoNda	< yob + ta	called
yo'Nda	< yo'm + ta	read

The Past Tense Suffix -ta

The principle that the leftmost accent in a word is realized is quite general, but there are a number of exceptions. These fall into two classes. First, there are a number of morphemes that retain their accent even if there is a preceding accent, in which case the latter is deleted. Such accents are referred to as dominant. Examples are the verbal suffix *-ma's-* , marking politeness to adressee, the suffix *-ra'si-* "seem" which can attach to a wide range items, and the adjective forming suffix *-ppo'-* which attaches to nouns and adjectives.

yomima'sita	< yo'm + ma's + ta	read
yobima'sita	< yob + ma's + ta	called
miyakorasi'i	< miyako + ra'si + i	seems to be the capitol
kokororasi'i	< koko'ro + ra'si + i	seems to be the heart

Dominant Behavior of -ma's- and -ra'si-

aburappo'i	oily	<abura	oil,fat
adappo'i	coquettish	< ada'	charming
egarappo'i	acrid	< ega'ra-	acrid
honeppo'i	bony	< hone'	bone
kazeppo'i	sniffly	< kaze	(head)cold
kizappo'i	affected	< ki'za	affectation
kodomoppo'i	childish	<kodomo	child
kuroppo'i	blackish	< ku'ro-	black
mizuppo'i	watery	< mizu	water
netuppo'i	zealous	< netu'	zeal
okorippo'i	touchy,irritable	< oko'r-	get,be angry
rikutuppo'i	argumentative	< rikutu	reason,logic
simeppo'i	be damp	< simer-	become damp
wasureppo'i	forgetful	< wasure-	forget
yasuppo'i	cheap,tawdry	< ya'su-	cheap
zokuppo'i	vulgar	< zoku	lay,vulgar

Dominant Behaviour of -ppo'-

In addition to the dominant morphemes, there exists a third class of morpheme which I refer to as *dependent*.[5] These are morphemes whose accent is realized only if the baseform to which they are attached is accented. It is not at first glance obvious that such morphemes have their own underlying accent, and indeed on the account that I will ultimately suggest they do not, but I mention them here because on one account this behaviour is attributable to a slight variation on that of dominant morphemes. An example is /te/ "one who Vs" which is attached to the compounding stem of the verb.

[5] I use "dependent" in preference to the term "accent attracting" put forward by McCawley(1968). The reason is that "accent attraction" is appropriate only when it is possible to say that a **formative** causes an accent to move onto itself, whereas any accent placement rule can be characterized as "dependent" whether or not that process has the effect of placing an accent on a formative contributed by the same morphological process. Since there are dependent preaccenting rules, in which the accent is put on the syllable preceding the formative, not on it, and since there are arguably also dependent accent placement rules in which there is no segmental phonological material at all contributed by the morphological process that causes the accent placement, only the accent shift itself, I believe that it is more appropriate to talk about "dependent" accent placement rules than about "attraction" of accents onto formatives.

aite'	companion	< a'u	meet
kakite'	writer	< ka'ku	write
yomite'	reader	< yo'mu	read
katarite	narrator	< kataru	recount, narrate
kikite	hearer	< kiku	hear

Derivatives in -te

I have asserted here that at most one accent is realized per word. This claim has until recently been entirely uncontroversial. In chapter III I will discuss one case in which a single morphosyntactic word is divided into two intonational phrases. This provides one rather limited counterexample to this claim, since my claim is that in this case a single morphosyntactic word is divided into two phonological words.

Another potential counterexample is provided by Sagisaka & Sato (1983) who discuss what they refer to as "secondary accents" in "stem-affix concatenations". What they mean by "secondary accents" is never explicitly defined. Judging by their discussion this term appears to refer to bumps in the F0 contour following the principal accent, which is to say what is normally regarded as *the* accent. They appear to believe that when a word contains two underlying accents, the second of which is non-dominant, the latter is not necessarily deleted outright as is usually claimed, but under some circumstances is realized either as a level stretch followed by a fall,or as a lesser rise, so that a word will have the appearance of having two accents, the second lower than the first. However, it is unclear how to interpret their claims.

Sagisaka & Sato's study is based on a large corpus of randomly selected utterances. They do not give a complete listing of the corpus, nor do they give a list of what they consider to be affixes in the sense of the title of their paper. The data presented consist of averaged schematic pitch contours for utterances of a given length. They do not indicate how the F0 contour was sampled, that is, whether the values reported represent means over some region, peaks, the value at the center of the syllable, etc.

The averaged F0 contours do in some cases show a subsidiary peak or plateau, but given the vague description of their materials and the nature of the F0 values reported it is hard to know how to interpret this. We cannot tell whether these peaks represent accents realized because the "affix" actually belongs to a separate word, or even whether they are not due to the segmental perturbations. The latter is not implausible given the fact that the consonants /t/ and /k/, which induce large local increases in F0, are very frequent in Japanese verbal morphology. In sum, no clear conclusion about the distribution of accents can be drawn from Sagisaka & Sato's paper. Moreover, to the extent that multiple accents are indeed present, it is difficult to say whether this represents failure of deletion or the existence of multiple phonological phrases, with the "reduction" the result of catathesis.

1.2. Accentedness

The location of the accent, if any, would appear to subsume the question of whether a morpheme is accented or not, but there is some reason to treat the accentedness of morphemes and stems as a feature independent of the location of the accent. This is because there are a number of cases in which the accentedness of a form is unpredictable, but given that a form is accented, the location of the accent is predictable. There are, moreover, rules that determine only the accentedness of a form, leaving the location of the accent to be determined by other rules.

Whereas the location of the accent, if any, on non-derived nouns is unpredictable, the same is not true of verb stems. The accentedness of a root verb is unpredictable, as illustrated by the existence of such minimal pairs as the following.

kakeru	be broken
kake'ru	hang
kau	buy
ka'u	raise (an animal)
sukuu	rescue
suku'u	build a nest
ueru	plant
ue'ru	starve

Minimal Pairs for Verbal Accentuation

However, if a verb is accented, the location of the accent is predictable by rule, even when the affixes attached do not themselves determine the accentuation of the verb. An accented verb stem and therefore such forms as the gerund, the participle, and the past tense which have the same accentuation, is always[6] accented on the syllable containing the penultimate mora, as pointed out by McCawley (1968). That means that a vowel stem verb, such as *tabe-* "eat" will be accented on the penult, while a consonant stem verb, such as *nizim-* "blot", is

[6] There are a small number of apparent exceptions. One consists of the cases in which, due to devoicing of the accented vowel, the accent shifts onto a following syllable. Thus, we have [fuki'] "blowing" but [fu'ite] "blowing", [fu'ita] "blew". Secondly, there are a number of verbs whose stems end in /aer/ which are accented on the penultimate syllable of the stem rather than on the ultima as expected, e.g. [ka'eru] "return" instead of [kae'ru]. All such verbs have a contracted form in [ajr], in which shift of the accent to the [a] is exactly what is expected. Pletner (1923) and Fujimura (1967) suggest that this is due to the fact that these verbs are usually pronounced with diphthongs, e.g. [kajr] and Fujimura suggests that the diphthong is underlying and that there is an optional process which vocalizes the glide after the location of the accent has been determined. This account has the advantage of explaining why there are no comparable verbs with other vowel sequences, e.g. we have [nao'ru] "get well" but not *[na'oru]. This would be due to the absence of [aw] diphthongs alternating with [ao]. Whether it is correct actually to posit underlying diphthongs in these cases is uncertain, but it seems clear that the location of the accent is correlated with the possibility of the diphthongal pronunciation. In addition, some periphrastic verbs, consisting of a verbal noun and the verb *suru* "do", are taken to be exceptional by such authors as Hirayama (1960), McCawley (1968), and Kawakami (1973), but their admittedly different accent pattern is truly exceptional only if periphrastic verbs are indeed single lexical items. This is the accepted position, but there are a number of facts that argue in favor of postlexical derivation of these forms. The matter is, unfortunately, too complex to discuss further here. See Poser (in preparation) for extensive discussion.

accented on the ultima.[7] The placement of an accent in some particular position on root verb stems such as these would be quite redundant, since the ultimate location of the accent is entirely predictable. Moreover, the location of the accent would be completely arbitrary, since there is no evidence for any particular choice of accentuation.

Not only are there morphemes which are specified only for accentedness, but there are two verbal affixes which create derived verb stems that have the property that they transmit the accentedness of the verb stem to which they are affixed, without themselves fixing the location of the accent, which, just as in the case of non-derived verbs, is located on the syllable containing the penultimate mora, if the form is accented at all. These are the causative suffix *-(s)ase-* and the passive suffix *-(r)are-*. The following examples illustrate this with the past tense of the basic form, the passive, and the causative of the accented verb yom- and the unaccented verb yob-.

Basic	Passive	Causative	Gloss
yo'Nda	yoma'reta	yoma'seta	read
yoNda	yobareta	yomaseta	call

Accentuation of Derivatives in -sase- and -rare-

This indicates that there is a property of accentedness that can be transmitted to a form without actually assigning an accent.

Further evidence for the independence of accentedness from actual location of the accent derives from the fact that accentedness may be assigned in derived forms whose accentuation is predictable once their accentedness is given. This situation arises in the case of the compounding of two verbs to yield another verb. Verb-Verb compounding is quite produc-

[7] Although I do not give examples here, most inflected adjectives exhibit the same behaviour.

tive. Although it is not the case that the compound of any two verbs actually exists, compounds are formed fairly freely, and virtually all verbs enter as first elements into some compounds, since there is a class of second element that combines freely with other verbs to produce aspectuals and the like. These are listed below.

-dasu	begin abruptly
-hazimeru	begin
-kakeru	begin
-oeru	finish (transitive)
-owaru	finish (intransitive)
-sokonau	fail
-sugiru	do in excess
-tuzukeru	continue (transitive)
-tuzuku	continue (intransitive)

Fully Productive Compounding Elements

Some examples of Verb-Verb compounding are given below. (Examples are in present tense.)

Compound	Gloss	Stem 1	Gloss	Stem 2	Gloss
		(First element a consonant-stem)			
butiko'mu	throw into	bu't	hit	ko'm	be full
hikimeku'ru	peel	hik	pull	mekur	strip off
kakida'su	begin to write	ka'k	write	da's	begin
noriki'ru	ride across	nor	ride	ki'r	cut
oida'su	drive out	ow	chase	da's	put out
oitu'ku	overtake	ow	chase	tu'k	arrive
tukiko'mu	cram	tuk	stab	ko'm	be full
yomioe'ru	finish reading	yo'm	read	oe	finish
		(First element a vowel-stem)			
karitao'su	bilk	kari	borrow	tao'su	cheat
nageko'mu	cast into	na'ge	throw	ko'm	be full
tabeoe'ru	finish eating	ta'be	eat	oe	finish

Examples of Compound Verbs

Verb-verb compounds are all accented, regardless of the accentuation of their members.[8] However, it is only accentedness, not an actual accent, that is assigned, since the accentuation of the various forms of of the verb is the same in the case of compound verbs as in the case of accented simplex verbs.[9]

To summarize, some morphemes are specified only for their accentedness, not for the location of the accent. Other morphemes transmit the accentedness of the base form to the derived form. In addition, there is a rule that assigns accentedness, not the location of the accent. These facts suggest that some mechanism must exist for representing accentedness independently of the location of the accent.

[8] This is true of all speakers whom I have consulted. However, most sources report a different pattern for older speakers, and it is this older pattern that is reflected in the forms cited in most dictionaries. The older pattern is for the accentedness of the compound to be the inverse of that of its prior member. Moreover, there was at least one second member that was simply neutral so that the accent fell on the accented syllable of the prior member. This is *tuke'ru* "attach, join" as in *nira'mitukeru* "glare at" < *nira'mu* "glare at" and *nasu'ritukeru* "rub on,spread over" < *nasu'ru* "rub on,smear".

[9] This statement is subject to one very interesting exception which is discussed in the last section of this chapter.

2. Morphoaccentual Processes

2.1. Accent Placement

2.1.1. Preaccenting Suffixes

A number of suffixes put an accent on the immediately preceding syllable. The suffix *-si* "Mr." is recessive preaccenting.[10]

	Unaccented Stem	
matumoto'si	Mr. Matsumoto	< matumoto
ono'si	Mr. Ono	< ono
yosida'si	Mr. Yoshida	< yosida
	Accented Stem	
a'Ndoosi	Mr. Ando	< a'Ndoo
ha'rasi	Mr. Hara	< ha'ra
nisi'murasi	Mr. Nishimura	< nisi'mura
sa'toosi	Mr. Sato	< sa'too

Recessive Preaccenting by -si

Preaccenting suffixes may also be dominant. The suffix *-ke* "household,family" is an example.

[10] This is true only for some speakers. For other speakers, *-si* itself is accented and recessive. Other recessive preaccenting suffixes are the plural suffixes *-ra* and *-tati* and the negative polarity "only" *-sika*.

aNdo'oke	the Ando family	< a'Ndoo
hara'ke	the Hara family	< ha'ra
matumoto'ke	the Matsumoto family	< matumoto
nisimura'ke	the Nishimura family	< nisi'mura
ono'ke	the Ono family	< ono
sato'oke	the Sato family	< sa'too
yosida'ke	the Yoshida family	< yosida

Dominant Preaccenting by -ke

There are also dependent preaccenting suffixes. The morphemes *ya* "keeper, seller, store", and *mono'* "thing" are preaccenting when affixed to an accented word, and otherwise neutral, yielding unaccented words from unaccented bases.

kona'ya	flour seller	< kona'	flour
kuzu'ya	junk man	< ku'zu	junk
kabuya	stockbroker	< kabu	stock,share
tomaya	mat seller	< toma	mat
kaki'mono	scroll	< ka'ku	write
yomi'mono	reading matter	< yo'mu	read
norimono	vehicle	< noru	ride
wasuremono	forgotten item	< wasureru	forget

Examples of Dependent Preaccenting Morphemes

What may be considered preaccenting also occurs in compounding. When the second member of a noun-noun compound is "short" in the sense explained below, the resulting compound is either unaccented or accented on the final syllable of the first member, depending on the second member. This may be considered a case of preaccenting by these second members.

2.1.2. Postaccenting Prefixes

There are two prefixes which place an accent on the following syllable.

The first is the honorific prefix /o/ which is orthodoxly regarded as postaccenting (Haraguchi 1977, citing Tashiro 1966) when it is attached to a noun. However, my experience is that this is not quite true. Rather, if the result is accented, the accent will indeed fall on the syllable following /o/, with rare exceptions (e.g. *kutu'* => *okutu'*) in which the accent is unchanged. However, there are a considerable number of forms in which the honorific form is unaccented. Examples are:

Base	Honorific	Gloss
hanasi'	ohanasi	lecture
koko'ro	okokoro	heart
noroke	ono'roke	talk about one's lovelife
sakana	osakana	fish
ha'si	oha'si	chopsticks
hasi'	ohasi	bridge
na'	ona	greens
yasai	oya'sai	vegetables
hagaki	oha'gaki	postcard
kimono	oki'mono	clothing
ta'bi	ota'bi	socks
kutu'	okutu'	shoes
tabako	ota'bako	tobacco
kao	okao	face
hana	ohana	nose
mimi'	omimi	ear
me'	ome	eye
kageN	okageN	health
katei	okatei	household
koto'ba	okotoba	word
wakare'	owakare	parting
hima	ohima	leisure
kame'	okame	jar
ka'me	oka'me	turtle
ya'ne	oyane	roof
kayu	okayu	rice gruel
kata'na	okatana	sword

Honorific Prefixation with /o/

A clearer example is the prefix /ma/ "true" which is normally postaccenting, as the following table illustrates. The exceptions almost all involve cases in which the derived form is unaccented. If the derived form is accented, it is nearly always accented on the syllable following *ma*. However, *maNmaru* has a variant with initial accent [ma'Nmaru] and *massaki* has a variant with final accent [massaki'], probably attributable to treatment of the form as a compound.[11] The accent on the [e] of *maue* rather than on the [u] is very likely due to the tendency to pronounce this form [mawe], in which case this accentuation is exactly what we would expect.[12]

[11] See the discussion the accentuation of compounds with second member *saki* below.

[12] The prefix /ma/, though not the homophonous and very likely related compounding element, usually, though not always, triggers gemination of the initial consonant of the base form, which might lead one to treat it as ending in an unspecified C slot, i.e. /maC/. However, this gemination is not completely predictable. Moreover, as the examples illustrate, there are other irregularities in some forms, e.g. the presence of "s-mobile" in /massa'o/ and the skipping of the initial /a/ of /a'ka/ to yield /makka'/.

Base	Gloss	Derivative	Gloss
a'ka	red	makka'	deep red
a'o	blue	massa'o	deep blue
futatu	two	mappu'tatu	exactly half
hadaka	naked	mappa'daka	stark naked
hiruma	noon	mappi'ruma	high noon
kura	darkness	makku'ra	total darkness
ku'ro	black	makku'ro	pitch black
ma'e	front	maNma'e	right in front
mukai	opposite	mamu'kai	directly opposite
mukoo	opposite	mamu'koo	directly opposite
sa'ityuu	amidst	massa'ityuu	in the very midst of
sakari	zenith	massa'kari	in full bloom
sakasama	head over heels	massa'kasama	topsy-turvy
saki	tip	massa'ki	foremost
shikaku'	rectangle	masshi'kaku	a perfect square
shiro	white	massi'ro	snow white
syoozi'ki	honesty	massyo'oziki	downright honest
syoome'N	front	massyo'omeN	straight ahead
su'gu	at once	massu'gu	straight ahead
tadanaka	among	matta'danaka	right in the midst of
taira	level	matta'ira	perfectly level
usiro	back,rear	mau'siro	right behind
yonaka'	midnight	mayo'naka	dead of night
		Exceptions	
fuyu'	winter	mafuyu	dead of winter
hiru'	noon	mahiru	high noon
maru	circle	maNmaru	a perfect circle
na'ka	center,box	maNnaka	dead center,box
ue	top	maue'	right on top
ura	back	maura	right in back
yoko	side,flank	mayoko	just beside, abeam

Prefixation with /ma/

2.1.3. Penult Accenting Processes

There are at least three processes that put accents on the syllable containing the penultimate mora of the stem. One I have already referred to in passing. This is the rule governing the accentuation of accented verb stems, which is realized before such neutral suffixes as the past tense marker *-ta* and in the participle. This is a case of dependent penultimate accentuation, since the accent appears only if the verb stem is accented.[13]

A second is the case of hypocoristic formation described in Chapter I. Inspection of the data presented there will reveal that the accent falls on the syllable containing the penultimate mora, and that this is true regardless of the accentuation of the stem. This is thus a case of dominant penultimate accentuation.

The suffix *-ko*, used to form girls' names, puts the accent on the penultimate syllable of the stem regardless of the accentuation of the stem, thus providing a second example of dominant penultimate accentuation. In the overwhelming majority of cases, the accent appears on the initial syllable since most girls' names have two mora stems. [14] This is illustrated by such examples as the following.

ha'nako	< hana'	flower
ha'ruko	< ha'ru	spring
ki'kuko	< kiku'	chrysanthemum
ku'niko	< kuni	country
na'tuko	< natu'	summer
ra'Nko	< ra'N	orchid
to'miko	< to'mi	riches
ya'suko	< ya'su	ease
yu'kiko	< yuki	snow
yu'riko	< yuri	lily

Girls' Names in -ko with Two Mora Stems

In the relatively rare examples in which the stem contains only a single mora, the accent falls

[13] It is not entirely clear whether the verb stem ever appears by itself, and more generally whether it is correct to say that there is a "basic" accentuation of the verb from which the others are derived. The claim is not based on the accentuation of a form generally acknowledged to be the bare stem. Indeed, although McCawley (1968) considers the pentultimate accent to be basic, Fujimura (1966) takes this to be derived. Insofar as a choice of basic form must be made, McCawley's solution is preferable. The point is that it is less than obvious that any accent pattern is basic. The alternative would be simply to recognize that a number of different forms of the verb induce pentultimate accent, which would of course in no way reduce the validity of the example for my present purpose.

[14] Indeed, longer names are so rare that Seward (1969;78) inaccurately but understandably asserts that "Three syllable female names never take *ko* as a fourth and final syllable."

on the stem.

ma'ko	< ma	demon
mi'ko	< mi	three
wa'ko	< wa'	harmony

Girls' Names in -ko with Monomoraic Stems

That the rule is actually penultimate rather than initial accent can be seen only by examining longer stems. In this case, the preferred accentuation is on the final syllable of the stem, immediately preceding *-ko*.[15] However, it is also possible to retract the accent, and if this is done, the accent must fall on the penultimate syllable, not on the initial syllable.

kaede'ko	kae'deko	*ka'edeko	kaede	maple
midori'ko.	mido'riko	*mi'doriko	mi'dori	green
sakura'ko	saku'rako	*sa'kurako	sakura	cherry

Girls' Names in -ko with Long Stems

2.1.4. Final Accenting Processes

The processes discussed thus far all put the accent on the when the process also attaches an affix. Here and in the following section I deal with processes that do not fall into this category, either because the accent falls on the affix or because it is unclear whether there is any affix.

Accentual rules may put an accent on the final syllable of the derived form. One example involves the rules for accenting deverbal nouns. Deverbal nouns are derived productively

[15] This may be due to such forms being treated as ordinary compounds as a result of the great rarity of girls' names with long stems.

from all Japanese verbs, both simplex and compound.[16] They have a variety of meanings, ranging from "act of V-ing" and "result of V-ing" to "object V-ed" and "agent of V-ing".

As far as segmental phonology is concerned, vowel-stem verbs yield homophonous deverbal nouns, while consonant-stem verbs suffix /i/ to their stems.

What is of interest to us here is the accentuation of the deverbal nouns. This topic has been discussed at some length in a very interesting paper by Kawakami (1973a), and it is from this paper that the basic generalizations are drawn.

For the time being, let us restrict our attention to simplex (i.e. non-compound) verbs. I will return to the case of compound verbs below. If the verb is unaccented, then so will be the deverbal noun. This is illustrated by the following examples. I know of no exceptions to this generalization.[17]

[16] Deverbal noun formation is productive in the sense that there are no systematic constraints on it, and in that new derivatives are freely produced. This does not mean that for every verb there is a corresponding noun listed in the dictionary, or immediately accepted by every speaker. In particular, many deverbal nouns never stand alone; they are used only in compounds. There are, nonetheless, a great many deverbal nouns that are used alone.

[17] The only apparent exception known to me is the pair [ikiru] "to live", [iki'] "life". The accentuations given are those found in Kenkyuusha (1974). This exception is only apparent. NHK (1966) gives exactly the opposite accentuations, namely [iki'ru] but [iki], as does Kawakami who considers this case to be an exception to his rule for accentuation of nouns derived from accented verbs. He attributes this to the fact that the noun *iki* is used largely in expressions where it precedes the genitive particle /no/ which causes deletion of the accent. Actually, what seems to be going on is that the verb *ikiru*, like many others, has variable accent, and that consequently both accented and unaccented forms of the derived noun occur.

Verb		Noun	
kariru	borrow	kari	borrowing
kasu	lend	kasi	lending
moru	serve, dish up	mori	a serving
nagusamu	be diverted by	nagusami	amusement
nemuru	sleep	nemuri	sleep
nigiru	grasp	nigiri	grasp
nozomu	desire, wish	nozomi	desire, wish
okonau	carry out	okonai	carrying out
owaru	end	owari	ending
tumu	load	tumi	shipment,load
utagau	doubt	utagai	doubt

Nominalization of Simplex Unaccented Verbs

If the verb stem is accented, in the overwhelming majority of cases the derived noun is also accented, and if it is accented, it is normally accented on the last syllable.[18] This is illustrated by the examples below.

[18] As Kawakami emphasizes, it is essential to distinguish the derived noun from the segmentally homophonous participle, the so-called *reNyookei*. This latter has the same accentuation as the verb stem, which is to say on the penult.

Verb		Noun	
haji'ru	be ashamed	haji'	shame
hira'ku	open	hiraki'	opening, closet
i'ru	parch	iri'	parching
kase'gu	work,toil	kasegi'	labor, work
kotae'ru	answer	kotae'	answer
koware'ru	break	koware'	breakage
kugu'ru	pass through	kuguri'	a wicker gate
kumado'ru	tint, gradate	kumadori'	shading, gradation
kumo'ru	become cloudy	kumori'	cloudiness
mamo'ru	protect	mamori'	defense, protection
mayo'u	be perplexed	mayo'i	perplexity
more'ru	leak	more'	a leak
mo'ru	leak	mori'	a leak
muku'mu	swell	mukumi'	dropsy
naga'su	drain,sluice	nagasi'	sink
nage'ku	grieve	nageki'	grief
naya'mu	worry	nayami'	worry
neba'ru	be sticky	nebari'	stickiness
nega'u	demand, wish	nega'i	wish, desire, request
neji'ru	twist	nejiri'	torsion
nigiwa'u	flourish	nigiwa'i	prosperity
nigo'ru	become muddy	nigori'	turbidity
niku'mu	hate	nikumi'	hatred
nio'u	smell,stink	nio'i	smell,odor
nira'mu	glare at	nirami'	a scowl, a glare
noko'ru	remain	nokori'	remainder, leavings
nu'u	sew	nu'i	sewing
osae'ru	stop,check	osae'	weight, check
o'ou	cover	ooi'	a cover
oyo'gu	swim	oyogi'	swimming
saba'ku	sell	sabaki'	sale
sonae'ru	furnish,prepare	sonae'	provision,preparation
sone'mu	envy, be jealous	sonemi'	jealousy, envy
tabane'ru	bundle	tabane'	bundle
tetuda'u	help	tetuda'i	helper, help
todome'ru	stop,cease	todome'	coup de grace
to'oru	pass by	toori'	road
tu'mu	be pressed into	tumi'	checkmate
una'ru	groan, moan	unari'	a groan, a moan
ura'mu	bear a grudge	urami'	a grudge
yabure'ru	get torn, rip	yabure'	rupture, tear, rent
yado'ru	take shelter	yadori'	shelter, lodging

Final Accented Deverbal Nouns

Although in the great majority of cases the noun derived from an accented verb is also accented, there are a few exceptions. These include the following.

Verb		Noun	
takura'mu	scheme, plan	takurami(')	a design, a trick
takuwae'ru	store, lay in	takuwae(')	store, hoard
todoro'ku	roar,peal	todoroki(')	a roar, a peal
tumu'gu	to spin	tumugi(')	pongee
tutusi'mu	be discreet	tutusimi(')	discretion

Unaccented Nouns Derived from Accented Verbs

As indicated, all of these also have variants with accent.[19]

We may summarize the case of simplex verbs as follows: If the verb stem is unaccented, the derived noun is invariably unaccented. If the verb stem is accented, then with a handful of exceptions the derived noun is also accented, and in this case the accent regularly falls on the final syllable.

The evidence thus far presented does not demonstrate that this accent is placed by rule; insofar as dependent accentuation can be attributed to the presence of an inherent accent on an affix together with a rule, of a type not yet discussed, that prevents the realization of this accent when the base form is unaccented, the data presented would be compatible with the hypothesis that there is a deverbal noun-forming suffix /i/, which has an inherent accent. In the case of the vowel stem verbs, this /i/ would form part of the same syllable as the stem vowel, transferring its accent to the head of that syllable (i.e. the stem vowel), and then be deleted. Thus, if the /i/ that appears in nouns formed from consonant stem verbs is a morpheme, and if dependent accents are not necessarily placed by rule, the data presented do not illustrate the phenomenon of final accenting by rule.

The status of this /i/ has rarely been discussed in the literature. There are two related cases, however, which are discussed in the literature, and in these cases the /i/ is generally treated as a morpheme. In Poser (1982b) however, I suggested that in all three cases the

[19] Some other examples are only apparent exceptions, since in these cases the accent of the verb itself is variable. Two such cases are *iyasimi* "contempt" < *iyasi(')mu* "despise", and *moyai* "common well" < *moya(')u* "share".

derivational process involves zero-affixation and that the /i/ that appears is epenthetic. Although I cannot here give a full account of Japanese syllabification, I will briefly defend this hypothesis.

Recall that although superheavy syllables do exist, in the usual case the Japanese syllable has at most two positions in the rhyme. Moreover, the second position must be filled by a vowel, glide, or the mora nasal when the syllable is word-final. My proposal is that when this surface syllable template is violated by a form followed by word (including compound) boundary, an epenthetic /i/ is inserted to repair the syllable structure.

The motivation for this rule comes from the rather curious distribution of the vowel /i/ in a number of forms in which it has previously been treated as an affix. Three deverbal forms all acquire a final /i/ if their stem ends in a consonant. These are the deverbal noun, the participle, and the compounding stem.

The first two forms, the deverbal noun and the participle are segmentally homophonous but differ in location of the accent. Some examples of these forms are given below. We have previously discussed the derivation of verbal compounds.

Stem	Gloss	Participle	Deverbal Noun	Gloss
		Consonant-stem Verbs		
mor	leak	mo'ri	mori'	a leak
oyog	swim	oyo'gi	oyogi'	a swim
sawar	hinder	sawari	sawari	a hindrance
		Vowel-stem Verbs		
kari	borrow	kari	kari	debt
osae	press down	osa'e	osae'	a weight
sonae	equip	sona'e	sonae'	provisions

Examples of Deverbal Nouns and Participles

In addition to true compounding, the compounding stem is required by four other affixes, the suffix *-ta-* which forms desiderative adjectives, the suffixes *-yasu-* and *-niku-* which form adjectives meaning "easy to V" and "hard to V" respectively, and the polite suffix *-mas.*[20] These forms are illustrated below. (Examples are in the present tense.)

Derived Form	Stem	Gloss
	Consonant Stem Verbs	
kakiyasui	kak	easy to write
katiyasui	kat	easy to win
nominikui	nom	difficult to drink
	Vowel-stem Verbs	
karinikui	kari	difficult to borrow
otiyasui	oti	easy to fall off
tabeyasui	tabe	easy to eat

Examples of Suffixation with -niku- and -yasu-

[20] The polite suffix was historically an independent verb and this form was therefore a compound.

Derived Form	Stem	Gloss
(Consonant-stem Verbs)		
butitai	but	want to hit
kaitai	kaw	want to buy
nomitai	nom	want to drink
yomitai	yom	want to read
(Vowel-stem Verbs)		
karitai	kari	want to borrow
okitai	oki	want to get up
oritai	ori	want to descend
tabetai	tabe	want to eat

Examples of Suffixation of Desiderative -ta-

Derived Form	Stem	Gloss
(Consonant-stem Verbs)		
butimasu	but	hits
kaimasu	kaw	buys
nomimasu	nom	drinks
yomimasu	yom	reads
(Vowel-stem Verbs)		
karimasu	kari	borrows
okimasu	oki	gets up
otimasu	oti	falls off
tabemasu	tabe	eats

Examples of Polite Suffix -mas-

Under the usual analysis, according to which these forms all contain an affix of the form /i/, there is no explanation for the fact that not only do three morphologically and syntactically unrelated forms have the same segmental form, but the homophonous affixes occur under exactly the same circumstances.[21]

[21] Note that it is not possible to attribute the absence of the /i/ in the vowel-stems to a

Suppose, however, that we say that these are all cases in which there is no affix (segmentally, at least). Root nouns are common cross-linguistically, and compounding regularly involves simple concatenation of stems. The treatment of the participle as the bare verb stem also seems plausible. The fact that the /i/ is due to a phonological rule explains the common behaviour of the three forms, as well as the absence of the /i/ in the vowel- stems. When the stem ends in a consonant, the form will not conform to the surface syllable template, since consonants other than /N/ are not permitted word-finally, so Epenthesis will apply, but when the stem ends in a vowel the surface syllable template will be satisfied and Epenthesis will not be required.

This analysis also explains another otherwise curious property of verb-verb compounding. In addition to the regular and quite productive compounds previously discussed there exists a second class of compounds that I will refer to as reduced compounds. These differ from normal compounds in that no epenthetic /i/ appears when the first element is a consonant-stem, so that the stem-final consonant forms a cluster with the initial consonant of the following stem. This cluster is then adjusted in accordance with the usual morpheme boundary level rules, namely Gemination and Nasalization. A number of examples are given below.

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rule deleting the second vowel in a cluster of two vowels. There can be no such rule, since vowel-vowel sequences are freely permitted both morpheme-internally and across both morpheme and compound boundaries.

Compound	Gloss	Stem 1	Gloss	Stem 2	Gloss[22]
bukkomu	drive into	but	hit	kom	be full
fukkakeru	blow on	huk	blow	kake	cover
funzukeru	step on	hum	step on	tuke	attach
futtobu	blow away	fuk	blow	tob	fly
himmekuru	peel	hik	pull	mekur	rip off
hittateru	support	hik	pull	tate	stand
hittigiru	tear off	hik	pull	tigir	tear
hittureru	get hitched	hik	pull	ture	take along
nokkiru	ride across	nor	ride	kir	cut
ondasu	drive out	ow	chase	das	put out
ottuku	overtake	ow	chase	tuk	arrive
tsukkomu	cram	tuk	stab	kom	be full
tundasu	thrust out	tuk	stab	das	put out
tuttatsu	stand straight	tuk	stab	tat	stand

Reduced Compounds

Not all compounds have reduced forms; reduction is only a semi- productive process. Indeed, it seems that compound reduction is a process of fossilization, whereby a once regular compound ceases to be analyzed as a compound. Formally, I propose that reduced compounds contain only a morpheme boundary, rather than an internal word boundary.

This is quite plausible since reduced compounds tend to be slangier and more emphatic than their unreduced counterparts and frequently have specialized meanings. Moreover, they are generally less transparent semantically. In particular, the first element in a reduced compound often has little semantic content. There are, for example, a large number of reduced compounds whose first element is /hik/ "pull" where this seems to have no function other

[22] The reduced form fukkakeru also means "challenge, provoke". Contrast the unreduced form fukikakeru which has only the literal reading "blow on". This illustrates the point that reduced compounds frequently have special meanings. The gloss on hittureru may require some explanation. In Japanese, when a man proposes marriage to a woman, the proposal commonly takes the form "Will you come along with me?". Consequently, what the man does is properly described as "taking along" the woman. Hence, "to take along" may refer to a man's becoming engaged. I have used the slang expression "get hitched" to convey the tone of the Japanese reduced form. This verb calls to mind the Sanskrit parinayati "to marry" literally "to lead around"(preverb pari- + root ni:), derived from the fact that in the marriage ceremony the groom leads the bride thrice around the sacred fire.

than that of an intensifier.[23] Conversely, although unreduced compounds are by no means all semantically transparent and not all reduced compounds are semantically opaque, it is nonetheless true that such fully productive and transparent compounds as the aspectuals do not have reduced forms.

If we suppose that all compounding involves concatenation of bare stems and that the special property of reduced compounds is that they contain only a morpheme boundary, we immediately account for the absence of the epenthetic /i/, for Epenthesis applies only at word boundary, whereas, since these compounds contain morpheme boundary, the morpheme boundary level rules have already applied to adjust the consonant clusters resulting from concatenation of stems. This explains why the /i/ is absent and why what happens instead is the normal morpheme boundary phonology.

Moreover, this account explains why it is that no vowel-stem verb enters as first element into a reduced compound. If reduced compounds were created by some sort of rule deleting the vowel preceding the second stem, we would expect to find examples of reduced compounds created by deletion of the stem-final /i/ or /e/ of a vowel-stem verb. But there are no such examples. If, however, reduced compounds formed from consonant-stem first elements lack the /i/ simply because Epenthesis has not had a chance to apply, we do not expect the underlying /i/ or /e/ of vowel-stem verbs to disappear. The Epenthesis analysis thus explains the absence of reduced compounds with vowel-stem first elements.

The epenthesis rule proposed here thus explains why three unrelated deverbal forms undergo exactly the same alternation. It also provides a plausible account of the formation of reduced compounds, and explains the fact that reduced compounds are never formed from vowel stem verbs.

[23] This fact seems to have led Backhouse (1982) to posit the existence of a small class of intensive prefixes instead of recognizing the existence of reduced compounding. The principal problem with his hypothesis is that although it is true that there are certain first elements that are particularly common, the number of first elements is quite large, and many of them have no intensive use at all. Moreover, under his hypothesis it remains a mystery why all of the verbal intensive prefixes are closely related to verbs. Indeed, the verbs that are particularly common as first elements of reduced compounds are also particularly common as first elements of unreduced compounds.

Final accenting also occurs in compounding. Compounds ending in /saki/ "tip,end" are accented on the final syllable of the compound if the first member is accented, and are unaccented otherwise.[24] Notice that this accentual pattern is not attributable to the presence of an accent on *saki*; when used independently, *saki* is unaccented.

Unaccented First Member

hanasaki	tip of the nose	<	hana	nose
hudesaki	writing brush tip	<	hude	writing brush
kutisaki	lips,snout	<	kuti	mouth
nokisaki	edge of the eaves	<	noki	eaves
tanasaki	storefront	<	tana	store
tutusaki	pipe tip	<	tutu	pipe
yarisaki	spear point	<	yari	spear

Accented First Member

harisaki'	needle point	<	ha'ri	needle
harusaki'	beginning of spring	<	ha'ru	spring
hasaki'	blade edge	<	ha'	blade
hokosaki'	spear tip	<	ho'ko	spear
keNsaki'	sword point	<	ke'N	sword
mesaki'	foresight,appearance	<	me'	eye
misesaki'	storefront	<	mise'	store
osaki'	tip of the tail	<	o'	tail
tesaki'	fingers	<	te'	hand
yasaki'	arrowhead	<	ya'	arrow
yubisaki'	fingertip	<	yubi'	finger

Compounds with Second Member -saki

2.1.5. Initial Accenting Processes

The status of initial accenting processes in pitch accent languages is unclear. According to Kiparsky (1983) there are cases in Vedic Sanskrit that appear to show assignment of initial accent by a suffix, but he demonstrates that this is a side effect of other types of rules and

[24] This observation is due to Vance (1980:233), from which most of the examples are cited. For some forms there are accentless variants, e.g. *harusaki* "beginning of spring" as well as *harusaki'*. There are, moreover, a few cases in which the accented compound form does not exist even as a variant, e.g *sitasaki* "tip of the tongue".

that it is unnecessary in Vedic to allow initial accenting rules.

In the case of Japanese, the situation is similar, in that, while there are a number of cases in which accent is assigned to the initial syllable of a form, this effect can in most cases be obtained without the use of a rule directly assigning accent to the initial syllable.

A number of morphological processes yield forms that are almost always initial accented and thus might give rise to the impression that these processes are initial accenting. These include the hypocoristic formation rule discussed in chapter I and the rule forming girl's names with the suffix *-ko* discussed below. In both cases it turns out that the rule is not initial accenting at all, and that the appearance of intial accenting is due to the rarity of the cases that show what the rule really is. In examining putative cases of initial accenting rules it is well to keep in mind that one can always simulate initial accenting with a rule that retracts the accent n-units from the end, where the longest form in the corpus examined is n units in length. In fact, this means that any claim to have demonstrated the existence of an initial accenting rule rests on the demonstration that even rather long forms receive the accent on the initial syllable together with the crucial assumption that retraction rules may only retract the accent a certain distance. But insofar as one's theory of retraction permits an accent to be retracted four or five syllables it is impossible to demonstrate the existence of intial accenting.

One case that might be an example of initial accenting but whose status is uncertain is the rule for formation of reduplicated onomatopoeic[25] adverbs, which, if accented, are almost always accented on the initial syllable as the following examples illustrate.

[25] I use "onomatopoeic" as a cover term for the adverbs that describe sound and shape, known in Japanese as *giseigo* and *gitaigo* respectively.

go'rogoro	rumbling
mu'NyamuNya	mumbling
pi'ipii	whistling
pi'ripiri	smarting
po'tupotu	in drops
su'besube	smoothly
ti'bitibi	little by little
za'razara	roughly

Reduplicated Onomatopoeic Adverbs

These appear at first glance to provide evidence for placement of the accent on the initial syllable, since to obtain the same effect by means of a retraction rule would require retraction onto the preantepenult, an impossible rule type on most accounts. However, we must take into account the possibility that the accent is placed prior to reduplication. Since the components of such reduplications are almost always bimoraic, it would suffice for a rule of penultimate to apply to the components before reduplication. Monomoraic forms are completely unknown and forms longer than two morae are quite rare. The examples of the latter type that I am familiar with are consistent with the pentult accenting hypothesis, but do not support it over initial accenting. All of the longer forms are trimoraic, and fall into two subtypes. First, there are examples like *mu'NyamuNya* in which the first syllable is heavy and the second light. The fact that the accent falls on the antepenultimate mora is not a counterexample to the pentultimate accenting hypothesis since the claim is that the accent falls on the syllable containing the penultimate mora, which is in fact the case. The second type consist of trisyllabic examples like *syanari'syanari* "smoothly, gracefully". These are consistent neither with initial accenting nor with pentult accenting; the accent on the final syllable of the first member is presumably to be attributed to these being treated like compound nouns. Crucial examples would be trimoraic forms consisting either of three light syllables or a light syllable followed by a heavy syllable. If the accent fell on the initial syllable of these, they would constitute counterexamples to the penult accenting hypothesis, although still longer forms would be required to rule out the possibility of antepenultimate accentuation. If, on the other hand, the accent fell on the second syllable, this would disconfirm the initial accenting hypothesis. Unfortunately, I have no examples of any of these crucial cases.

In sum, it is possible that reduplicated onomatopoeic adverbs represent initial accenting, but there is a plausible analysis on which they do not.

I am prepared to exhibit only two relatively clear cases of initial accenting processes in Japanese.

The first example involves evidence suggestive of the existence in the past of an initial accenting rule. This evidence consists of exceptions to the rule discussed above for accenting nouns derived from accented verbs, where in the usual case the accent falls on the final syllable.

In a small number of cases, the derived noun is accented on the initial syllable rather than on the final syllable. The clear cases of this type known to me are listed below.

Verb		Noun	
domo'ru	to stammer	do'mori	stammering, a stammerer
hanare'ru	separate	ha'nare	isolation
naga'su	sing from door to door	na'gasi	strolling musician
oro'su	sell at wholesale	o'rosi	wholesale trade
saba'ku	judge	sa'baki	judgement
sawa'gu	to make noise	sa'wagi	noise, hubbub
se'ku	dam up	se'ki	dam
su'ru	pick pockets	su'ri	pickpocket
tano'mu	request,ask	ta'nomi	a request, favor
tata'ru	curse	ta'tari	curse
to'mu	become rich	to'mi	riches

Initial Accented Deverbal Nouns

There are, in addition to these, a number of forms that were probably derived historically in the same manner. The noun *mo'ri* "guard" looks like a derivative of a verb **mo'ru*, though no such verb exists in modern Japanese. There is, however *mamo'ru* "guard, protect", which is perhaps a reduplication based on the same root. Similarly, *mu'ti* "whip" is probably derived from a non-existent verb **mu'tu* "whip,beat", which does indeed occur in some dialects. Modern Tokyo dialect has instead the variants *bu'tu* and *u'tu*.[26] Finally, *ta'kumi* "artisan" is likely derived from a synchronically defective **taku'mu* "contrive". Note the existence of the adjective *takuma'nai* "artless, guileless" which has exactly the form of the negative of the hypothetical *taku'mu*. Compare also *takura'mu* "to scheme, plan, contrive" and *takumi* "art; a plan".

Kawakami (1973) considers these initial accented forms to be the residue of an earlier rule for accenting deverbal nouns, although he advances no arguments for this position. Three facts tend to support his hypothesis. First, the number of initial accented forms is very small and new forms are never added. This formation is not productive. Second, initial accented forms are gradually being replaced by final-accented forms. For example, NHK (1966) lists [o'rosi] as a possible form, but prefers [orosi']. Similarly, for many speakers [sa'baki] has been replaced by [sabaki']. Finally, it is the initial-accented forms that show up as residual forms, such as those discussed above, where no synchronic derivation is possible.[27]

The clearest example of an initial accenting rule arises in the case of noun-noun compounding. If the second member of the compound contains three or more morae, and if it is unaccented or accented on the final syllable, the compound is accented on the first syllable of the second member. If the second member is accented elsewhere, its accent becomes the accent of the whole compound. This is illustrated by the following examples.

[26] The historical and dialectological relations between the voiced obstruents and the corresponding nasals are complex. The historical antecedants of the modern Tokyo dialect voiced obstruents were prenasalized (see Poser 1982b for a summary of the evidence and references). Depending on dialect, as well as other factors, these sometimes gave rise to voiced obstruents, sometimes to nasals. Even within the same dialect it is not uncommon to find doublets, such as Tokyo *samisi'i/sabisi'i* 'lonely', and between dialects such correspondences are common. Indeed, in a comparison between the Satuma dialect forms recorded by Schwartz (1915) and the cognate Tokyo forms, I found examples of all four logically possible correspondences between /m/ and /b/. In this light, my suggestion that *mu'ti* is related to *bu'tu* should not be surprising.

[27] In addition to the archaic initial accented forms, there are a few exceptional forms which arguably belong to the final-accented class. These are variants like [sona'e] and [kota'e] for [sonae'] and [kotae']. All such paroxytone forms have oxytone variants. Moreover, penultimate accent is restricted to forms whose last two syllables are /ae/, that is to say, exactly those nouns derived from verbs that have irregular variants antepenultimate accent in the present tense. Presumably, whatever accounts for the accentuation of verbs like [ka'eru] will also account for the accentuation of the nouns derived from them.

Unaccented Second Member

tyaba'sira	tea stalk	< hasira	pillar
megu'suri	eyewash	< kusuri	medecine
kituneu'doN	noodle dish	< udoN	noodle

Final Accented Second Member

nunobu'kuro	cloth bag	< fukuro'	bag
teka'gami	hand mirror	< kagami'	mirror
yukio'Nna	snow fairy	< oNna'	woman

Non-Final Accented Second Member

haNgaasutora'iki	hunger strike	< sutora'iki	strike
yamahototo'gisu	mountain cuckoo	< hototo'gisu	cuckoo
yudetama'go	boiled egg	< tama'go	egg

Compounds with Long Second Member

This rule appears to provide a clear case of initial accenting, since there is no obvious reanalysis in other terms. In considering the implications of this example for the typology of rules, we should however take into account the fact that this rule is not triggered by a particular morpheme and that it places the initial accent on the initial syllable of the second member, not of the whole compound.

2.1.6. Basic Accent and Accent Placement by the Same Morpheme

It is possible for one and the same morpheme both to have an accent and to attach an accent, depending upon the accentedness of the stem. The provisional suffix *(r)eba* is itself accented on the syllable /(r)e/ if the verb stem is unaccented, but is preaccenting if the verb stem is accented, as illustrated by the following examples.

kakeru	kakere'ba	be broken
kake'ru	kake'reba	hang
kau	kae'ba	buy
ka'u	ka'eba	raise (an animal)
sukuu	sukue'ba	rescue
suku'u	suku'eba	build a nest
ueru	uere'ba	plant
ue'ru	ue'reba	starve
yobu	yobe'ba	call
yo'mu	yo'meba	read

Accentuation of Provisional Form of Verb

This accentual pattern is quite general for the provisional suffix. In addition, for at least one speaker the same pattern holds for the verbal negative suffix *-na-*.[28] This pattern may be accounted for by saying that these suffixes are dependent preaccenting, and have their own accents as well. When the preaccent is inserted, the inherent accent on *-na-* will be removed by the general rule deleting non-leftmost accents.

[28] The pattern described here is that of my principal informant, Osamu Fujimura, who is completely consistent and indeed adamant that this is the correct pattern. Most other speakers conform to the pattern described by Bloch (1946b), Hirayama (1960), and NHK (1966) according to whom *-na-* is preaccenting when suffixed to an accented verb stem and unaccented when suffixed to an unaccented verb stem,i.e. dependent preaccenting. I do not know what this disagreement reflects, but I am confident that the pattern described here exists. One further interesting point is that when I have asked other speakers about the possibility of putting the accent on /na/ when the verb stem is unaccented, they all agree that this is a conceivable way for someone to say it, although not the way they themselves would. This contrasts with their reaction to other alternatives, e.g. to the suggestion that the accent go on the first syllable which is regarded as completely out of the question. The reaction is reminiscent of that of speakers of American English to Western Canadian stress patterns.

kakeru	kakena'i	be broken
kake'ru	kake'nai	hang
kau	kawana'i	buy
ka'u	kawa'nai	raise (an animal)
sukuu	sukuwana'i	rescue
suku'u	sukuwa'nai	build a nest
ueru	uena'i	plant
ue'ru	ue'nai	starve
yobu	yobana'i	call
yo'mu	yoma'nai	read

Accentuation of Negative Verbs

2.2. Accent Deletion Rules

In addition to rules that assign accents, Japanese also has rules that remove them.[29] One such rule is the rule of Pre-No Deaccenting, discussed in more detail in Chapter IV. This rule deletes the accent on a final-accented noun when it precedes the genitive particle or the attributive allomorph of the copula, both of which have the form /no/.

The suffix *-kko* , which attaches to placenames [30] to yield nouns meaning "an indigène of X", deaccents the noun to which it is attached, yielding an unaccented word. [31]

[29] I defer to the following section discussion of McCawley(1968)'s claim that these rules are not actually deaccenting rules.

[30] And occcasionally, by extension, to other words. An example is *geNdaikko* "modern girl" from *geNdai* "modern".

[31] It is not impossible that this construction should be treated as a compound rather than as a case of affixation, in which case this suffix will be just one of the compounding elements discussed below which trigger deaccenting. I treat it as suffixation primarily because the element *-kko* does not occur independently. Etymologically it is very likely derived from *ko* "child".

edokko	<	edo	Tokyo[32]
koobekko	<	ko'obe	Kobe
kyootokko	<	kyo'oto	Kyoto
nagoyakko	<	na'goya	Nagoya
niigatakko	<	niigata	Nigata
nyuuyookukko	<	nyuuyo'oku	New York
oosakakko	<	oosaka	Osaka
roNdoNkko	<	ro'NdoN	London
tookyookko	<	tookyoo	Tokyo

Deaccenting by Suffixation of -kko

Accent deletion also occurs as a result of compounding. When the second member of a noun-noun compound is short (one or two morae) the accentuation of the compound depends on phonological and lexical properties of the second member. A number of second elements yield unaccented compounds, even when the first member is accented. This is illustrated by the following examples.

deNkika	electrification	< de'Nki	electricity
gorufuzyoo	golf course	< go'rufu	golf
komugiko	wheat flour	< komu'gi	wheat
midoriiro	the color green	< mi'dori	green
nihoNsiki	Japanese style	< niho'N	Japan
nihoNzyuu	throughout Japan	< niho'N	Japan
syakaisei	sociality	< sya'kai	society

Unaccented Compounds with Accented First Member

2.3. The Typology of Morphoaccentual Processes

I will here lay out the general properties of morphoaccentual systems as groundwork for the discussion of mechanisms below, deferring a number of details to later. The typology of

[32] Edo is the old name for the city which came to be called Tookyoo in 1868 when it became the imperial capitol. It is often spelt *yedo* in Western works, as indeed it was pronounced before the loss of the glide /j/ before /e/. The difference between *edokko* and *tookyookko* is that the latter refers to any native of Tokyo, while the former has the narrower meaning of someone who is not only a native of Tokyo, but who is imbued with the true Tokyo spirit.

attested morphoaccentual rules is fairly simple. We may break it into three subareas. First, what sorts of rules are there? Second, what sorts of conditions are there on the operation of these rules? Third, how do these rules count?

The answer to the first question is straightforward. Morphoaccentual rules fall into two classes: those that assign accents and those that delete them. The existence of the former class is obvious from the examples cited above. The existence of the latter too would seem to be uncontroversial, but for the contrary claim of McCawley(1968). McCawley puts forward the claim that Japanese has no deaccenting rules but only rules that assign accents, together with a convention for reducing all accents other than the one inserted. This convention, discussed in some detail in Chapter V, plays the role in his system, at the word level, of the rule deleting non-leftmost accents when they are recessive. This claim, motivated solely by McCawley's misguided desire to make the Japanese accentual system behave like English stress, is quite unfounded.

McCawley does not deny the existence of the phenomena cited as evidence for deaccenting. Rather, he proposes an alternative analysis. McCawley proposes that accents reside not on syllables but on syllable boundaries. Since a word begins with a syllable boundary, this permits placement of an accent on the word-initial syllable boundary as well as after each syllable, for a total of N+1 possibilities in an N syllable word, which is the correct number since no accent need appear. He suggests that unaccented words are actually preaccented; i.e. that they bear an accent on the word-initial syllable boundary; all words are underlyingly accented. He then replaces every deaccenting rule with a rule assigning a preaccent to the form in question. Then, he has a single rule (rule C-5 on p.180 of McCawley 1968) that deletes all accents from a preaccented phrase. Thus, the ultimate result of assignment of a preaccent is deaccenting.

McCawley's claim rests crucially on his hypothesis that accents reside on syllable boundaries, and in particular that the word-initial syllable boundary may bear an accent, a hypothesis that I criticize in the following section. But we can see immediately that

McCawley's claim that there are no deaccenting rules is simply false: his own analysis contains two of them. One is the rule that deletes an accent on a word-final mora. More to the point is his rule C-5 which is surely a deaccenting rule. Moreover, rule C-5 is motivated solely by the necessity of making his analysis of deaccenting work out. On grounds of simplicity alone, his analysis is to be rejected, since it converts every deaccenting rule into a preaccenting rule, and requires one rule in addition, namely C-5. I conclude therefore that deaccenting rules do indeed exist.

With regard to the circumstances under which they apply, morphoaccentual rules fall into three main classes. First, there are those that we have called dominant; these assign an accent unconditionally. Second, there are those that we have called dependent; these assign an accent only if the base form contains none. Finally, there are those that we have called dependent; these assign an accent only if the base form contains one. In addition to these, there are rules that require more complex conditions. I will return to these below.

Finally, we must consider how morphoaccentual rules count. Several observations are germane. First, it appears that such rules always count from the end of some domain, and that they do not iterate, so that there are no rules that place an accent on the middle syllable of a word or on every even-numbered syllable. Second, the domain with respect to which rules count may be either the derived form or the base. In the former case we get initial-accenting and final-accenting; in the latter we get post-accenting and pre-accenting. Third, it appears that accentual rules do not count very far in from the edge of the domain. In all of the cases discussed above, and in comparable cases in other pitchaccent languages, rules either assign an accent at the very periphery of the domain (post- and pre-accenting if the domain is the base form, initial and final accenting if the domain is the derived form), or they skip over the peripheral constituent, to assign the accent to the constituent one unit in from the periphery. I have here demonstrated only the existence of penultimate accenting; there are no examples in Japanese of a rule that assigns an accent to the syllable containing the second mora from the lefthand edge of the domain, but this is apparently an accidental gap, due to the rarity of prefixes in Japanese, for examples of this type are readily found in other languages. Morphemes that assign a tone to the second syllable to the right are described by Richardson (1959,1971) for Sukuma, by Williamson (1969) for Ijo, and by Goldsmith (1981) for Tonga. It thus appears safe to say that rules may act upon the peripheral element or upon the constituent one unit in from the boundary, but may not eat farther in.

2.4. Rule vs. Representation

One issue that arises quite generally in morphology and that has been much debated over the years is the extent to which morphology may be seen as concatenation of formatives, possibly represented quite abstractly, and to what extent it is necessary to have recourse to morphological rules of other types. Over the past sesquidecennium the tendency has been to attribute morphological processes as much as possible to concatenation, and with the advent of autosegmental phonology this tendency has increased due to the greater possibilities provided by non-linear concatenation. This tendency has manifested itself in the description of Japanese pitch accent, so that the issue arises of the extent to which the morphological properties of morphemes are to be built into their phonological representation. In this section I take up this question as it arises in Japanese.[33]

The morphological behaviour that has been singled out for special treatment by several authors is the assignment of an accent to the preceding syllable by preaccenting suffixes. Why this is the case is unclear, unless it is either ignorance of the existence of other processes, or a belief that the putative statistical preeminence of preaccenting suffixes has implications for phonological representation. If we consider affixes whose contribution to the accent pattern is not simply the presence or absence of an accent on the formative itself, preaccenting seems to be the most common behaviour. Indeed, according to Kiparsky (1983) the only type of accent placement rule found in Sanskrit is preaccenting. I suggest, however, that this is an artifact of the morphology of Japanese and Sanskrit. It happens that both languages are strongly suffixing and that by and large a suffix and the accent that it contributes tend to be at the same end of the word, so that accent placement at the end of the stem is far more common

[33] For some more general discussion of this question see Anderson (1983).

than accent placement at the beginning. In tone languages in which prefixes are common, e.g. in Bantu languages, effects of prefixes on the tone pattern of the following material appear to be quite common. The relative rarity of post-accenting prefixes as compared with preaccenting suffixes in Sanskrit and Japanese is thus attributable to factors quite independent of the character of phonological representations.

When we turn to the question of the markedness of processes that affect the peripheral unit as compared with those that affect the next unit in, it is true that there may be some statistical preference for the former, but the latter are sufficiently common that they can hardly be considered exotic enough to be excluded in principle. Tokyo dialect Japanese alone has at least three such rules, and they are virtually exceptionless components of common and completely productive morphological processes. The same is true in the Kyoto dialect of Japanese, in which penult accenting processes are common, although I will not illustrate this here. I conclude that there is no special statistical preference for preaccenting suffixes, and insofar as that is true, no special representation should be given them; preaccenting suffixes should simply be treated as formatives contributed by a morpheme that also triggers an accent placement rule.

This, then, is the general objection to all of the proposals advanced in Japanese for special representation of morphological processes: the motivation for such proposals in every case turns on the allegedly special status of preaccenting suffixes. But these suffixes have no special status, and indeed a simple and coherent account of all of the attested morphoaccentual processes of Japanese and Sanskrit is possible that necessarily generates preaccenting suffixes without additional complication. Consequently, all such proposals are fundamentally misguided and entirely unmotivated.

2.4.1. Preaccents

McCawley(1968) proposed that accents reside not on syllables but on syllable boundaries. As a result, a word of N syllables could be accented not simply in N positions, i.e. after each syllable, but also on the syllable boundary preceding the initial syllable, thus providing N+1 possibilities. In phonological representation, a Tokyo dialect word would necessarily be accented on one of these N+1 syllable boundaries. If a word reached the surface with an accent on the intial syllable boundary, that accent was to be deleted, so that the class of superficially unaccented words was represented as having an initial accent, or "preaccent", in phonological representation. If, however, a morpheme came to follow another, then provided that no rules applied to modify the outcome, the result would be the assignment of an accent to the syllable preceding that morpheme. Thus, McCawley proposed that preaccenting suffixes be represented as suffixes that are accented on the initial syllable boundary.

The first and foremost problem with McCawley's proposal is that in terms of current theories of phonological representation it is formally impossible. When McCawley made his proposal, boundaries of all types, both morphosyntactic and phonological,[34] were conceived of as segmentoid units, each a column vector of features in a strictly linear phonological representation, that happenned to have less direct phonetic realization and different feature specifications (among them, crucially, [-segment]) from other "segments". But over the past decade the view has developed that phonological constituents are not properly viewed as open intervals bounded by segmentoid boundary symbols but rather as hierarchically organized tree structures. This is the position convincingly argued for syllables by Kahn (1976) and for morphosyntactic constituents by Rotenberg (1978). Under this conception, there are no segmentoid syllable boundaries that an accent or a tone could belong to, or sit upon, or be a feature of. So insofar as we accept the more recent conception of phonological constituency, and in my view this conception is one of the solidest advances in phonological theory in the past decade, we must reject McCawley's proposal as impossible in principle.

Haraguchi (1975;27-29) gives another argument against McCawley's suggestion that accents reside on syllable boundaries rather than on syllables. He notes that there are many words (e.g. *niho'N*) in which the accent falls on the first mora of a two mora syllable. If the

[34] Although I reject McCawley's conception of the syllable, credit is due him for making use of such a unit at all at a time when phonological constituency was being wrung out of generative phonological theory.

accent is actually in its surface location, accents could not reside on syllable boundaries, since these accents are intra-syllabic. McCawley (1968;170, ftnt.28) took this into account, suggesting that the actual location of the fall in pitch is a consequence of the pitch assignment rules (although he does not formulate them this way), and that the accent actually follows the long syllable in phonological representations. This is possible since in Tokyo dialect there is no contrast in location of accent within the syllable. Haraguchi responds by pointing out that the same approach cannot be taken in dialects such as the Osaka dialect in which the domain of the accent is the mora, not the syllable, and where contrasts in location of the accent within the syllable are possible. Haraguchi is quite correct in claiming that this renders untenable the universal claim that accents reside on syllable boundaries, but a proponent of McCawley's approach could perfectly well respond that in languages in which the mora is the domain of the accent, the accent resides on a mora boundary. More generally, the idea would be that accents reside on the boundary of the appropriate domain, whatever that may be.

There is always the possibiity that the theoretical decision that renders McCawley's proposal impossible might have been wrong, and indeed we might find that the advantages of his proposal were so great that the theory of phonological constituency should be changed so as to allow it, so it is worthwhile examining the motivation for McCawley's proposal.

McCawley obtains three advantages from his preaccenting proposal. First, he claims to eliminate deaccenting rules in favor of rules that place an accent on the initial syllable. As we have seen, it is simply false that deaccenting rules are eliminated, nor is there any valid motivation for eliminating them, since, as I shall argue at some length in Chapter V, it is quite wrong to think that the Japanese pitch accent system is formally identical to, or indeed even similar to, the English stress system. This "advantage" can then be dismissed without further ado.

The second putative advantage of the preaccenting proposal is that it provides a mechanism for dealing with preaccenting suffixes. But I have argued above that this is quite unmotivated.

McCawley's final argument in favor of his proposal concerns the accentuation of noun-noun compounds whose second member is short, i.e. only one or two morae. Such compounds fall into three main classes:

(1) Those in which the compound is unaccented;
(2) Those in which the compound is accented on the last syllable of its first member;
(3) Those in which the compound is accented on the initial syllable of its second member.

The three cases are illustrated below. The second members are /ga'/ "picture", /tama'/ "sphere", /syoo/ "ministry", /musi/ "insect", and /i'to/ "thread".

	Compound Nouns with Short Second Member		
Compound	Gloss	First Member	Gloss
rataiga	nude picture	ratai	nude body
saNsuiga	landscape painting	sa'Nsui	landscape
garasudama	glass bead	garasu	glass
zyuzudama	rosary bead	zyuzu'	rosary
	Unaccented		
gaimu'syoo	Foreign Ministry	ga'imu	foreign affairs
keNsetu'syoo	Ministry of Construction	keNsetu	construction
abura'musi	cockroach	abura	oil
kabuto'musi	beetle	ka'buto	helmet
	Accented on Final Syllable of First Member		
momeNi'to	cotton thread	momeN	cotton
tumugii'to	pongee thread	tumugi'	pongee
	Accented on Initial Syllable of Second Member		

Chew (1964) observed the following correspondences between the phonological shape of the second member and the accentuation of the compound.

(1) Compounds of type (1) usually have final accented second members.
(2) Compounds of type (2) usually have unaccented second members.
(3) Compounds of type (3) are always initial-accented.

Accepting these observations, McCawley proposes the following account.

(1) In all noun-noun compounds, delete the accent of the first member;

(2) If the second member is long, and if it is unaccented or accented on the final syllable, put the accent on the first syllable of the second member;

(3) If the second member is short and final accented, deaccent (i.e. assign an accent to the initial syllable) the compound.

In other words, the accent of the first member is deleted, and the accent of the second member, if any, surfaces except in the two special cases described by rules (2) and (3).

Consider now the explanatory power of this analysis. The first case, while adequately dealt with, is not in any way explained. McCawley simply posits a rule that yields the correct result. The third case too is adequately dealt with-the underlying accent of the second member surfaces- but nothing here depends on the preaccenting proposal. The crucial case is the second one, where McCawley is able to explain the correlation between the preaccenting behaviour of the second member with the fact that it is unaccented when used in isolation.

There are, of course, other mechanisms that will yield preaccenting; the crucial thing is the correlation between preaccenting and lack of accent in isolation. Insofar as this correlation is perfect, McCawley has a point.

The problem is that the correlation is not perfect, as McCawley notes. There are two classes of exception to Chew's generalization. First, there are second members like *saki* discussed above which are unaccented in isolation, but rather than being preaccenting themselves acquire an accent on the final syllable. Second, there are some preaccenting second members that are not unaccented in isolation. Examples are /uta'/ "song" and /nu'si/ "master" as in /hayari'uta/ "popular song" (< *hayari'* "fashion") and /yado'nusi/ "landlord" (< *ya'do* "house"). McCawley correctly points out that these latter can, in his system, be dealt with by treating them as doubly accented, i.e. /'uta'/, /'nu'si/, but this only shows that his account is descriptively adequate. Both McCawley's theory and such alternatives as that defended here are descriptively adequate; the argument in favor of McCawley's proposal as opposed to the others rests on the putative correlation between preaccenting and lack of accent in isolation, and since that correlation is imperfect, there is no argument.[35]

In sum, the entire advantage of McCawley's proposal is that it "explains" an imperfect correlation between preaccenting and lack of accent in isolation.

Not only is the motivation for the preaccenting theory weak, but there are a number of disadvantages to it. First, it increases the number of rules required since for every deaccenting rule it substitutes a preaccenting rule, and then in addition requires Preaccent Deletion (C-5), a rule that is otherwise unmotivated.

Secondly, dependent accenting becomes more complicated. Under McCawley's proposal, a dependent accent is placed if the baseform is accented somewhere other than on the initial syllable. Under other proposals, any accent will do.

Both of these arguments are arguments against the equation of unaccented words with preaccented words, but not against allowing preaccented bound morphemes. They could be evaded by allowing preaccenting suffixes to be preaccented while allowing unaccented free standing words to be truly unaccented. This would create N+2 categories of N syllable word, since there could be accents in any of N+1 positions, or no accent at all. One of these categories, the category of preaccented free morphemes, would be mysteriously uninstantiated, for in order to avoid the complication of the dependent accenting rule described above he would have to ban preaccented free morphemes from the lexicon. If there were preaccented free morphemes we would expect to find that some words that are unaccented in isolation would behave like truly unaccented words with respect to dependent suffixes, i.e. no accent would be assigned to them, while others, the preaccented ones, would behave like accented words with respect to dependent suffixation, i.e. would have an accent assigned to them. Since in fact all unaccented words behave alike, the category of preaccented free morphemes would have to be banned. But once this is done, McCawley's account of noun-noun com-

[35] Notice that in order to make this work McCawley must arrange for word-initial accents not to delete following accents. This can be accomplished by making Preaccent Deletion a word-level rule and deferring Accent Resolution to the phrase level, or more generally by any ordering of Preaccent Deletion before Accent Resolution.

pounding becomes impossible, and any advantage that might have accrued to his proposal disappears.

There is another argument based on the creation of an extra, systematically and mysteriously uninstantiated accentual possibility put forward by Haraguchi (1977;314-15) and repeated by Bennett (1981), which as it stands is unconvincing. McCawley's theory creates a somewhat curious asymmetry between underlying and derived phonological representations in requiring an accent somewhere on free morphemes in underlying representation, but permitting unaccented words in derived representations, but this proposal, though perhaps bizarre, is certainly consistent. Haraguchi argues, however, that McCawley cannot mean this, because in some cases he must permit unaccented words even in underlying representations.

Haraguchi observes that McCawley's description of the Kyoto-type dialects seems to require him to allow unaccented words in underlying representations. In these dialects the presence of an initial Low stretch is unpredictable, so that in addition to an accent of the Tokyo type, indicating the location of a fall in pitch, information as to whether the word begins High or Low must be provided. McCawley proposes to do this by marking Low-initial words as preaccented, on the grounds that what an accent does is assign a Low tone to the syllable to its right. Haraguchi points out that on this basis High-initial words should not bear a preaccent. Insofar as there are High-initial words that bear no other accent, there must be words in these dialects that on McCawley's analysis bear no accent at all. This deduction is entirely correct, but the next step in the argument does not follow. Since McCawley must permit unaccented words in the Kyoto-type dialects, so, Haraguchi argues, must he admit this possibility in the case of the Tokyo dialect. But this done, the mysterious gap discussed above is created.

Haraguchi is right to argue that Tokyo might in principle have permitted the possibility of accentless words, but wrong to argue that within McCawley's system the gap is accidental. The Tokyo dialect and the Kyoto-type dialects differ in one crucial respect: whereas in the Tokyo dialect Initial Lowering is predictable, in the Kyoto-type dialects the presence of an initial Low is not. So McCawley could legitimately argue that universally there are indeed N+2 possible accentuations of an N syllable word, but that there is a parametric difference depending on whether or not the accent may be absent. If so, one gets dialects of the Kyoto-type; if not, one gets dialects of the Tokyo-type.

I do not wish to maintain that this is the correct parametrization of pitch accent languages, merely that McCawley's position is not in fact incoherent.[36]

2.4.2. Some Other Proposals

In addition to McCawley(1968)'s proposal that preaccenting morphemes are preaccented, two other proposals have been made to encode the preaccenting behaviour of these morphemes into their phonological representations. One proposal is Bennett (1981)'s suggestion that preaccenting morphemes be provided with a floating diacritic accent which would be associated to the syllable preceding the morpheme by a general rule, applying on every cycle, that attached a floating accent to the rightmost syllable in its domain, exclusive of the suffix itself. To this proposal one might object that it makes use of a diacritic accent, but the floating diacritic may be replaced with a floating High tone under a non-diacritic theory with no other change in its properties. The problem with this proposal is that it provides only for preaccenting suffixes: it cannot account for post-accenting prefixes since it makes crucial use of a principle that docks a floating accent/tone at the right edge of the domain. It would seem that the proposal could be modified to overcome this objection by generalizing the docking principle. We might say that a floating accent/tone docks on the syllable at the edge of the baseform adjacent to the formative that provides the floating accent/tone. But once we say this it is no longer a general phonological rule that docks the floating accent/tone, but rather a morphological rule, since it crucially refers to the location of the formative that provides the accent/tone. Moreover, even this generalization of Bennett's proposal is inadequate,

[36] Aside from the reasons explained above for disbelieving in the claim that accents reside on syllable boundaries, McCawley's account of the Kansai dialects makes Accent Resolution difficult to formulate since it is necessary to prevent the preaccent from deleting accents to its right.

since it cannot provide both for preaccenting and penult accenting, or more generally, both for processes that dock the accent/tone at the periphery and those that dock it one unit in from the periphery. How far in from the edge an accent docks is a property of the morpheme that assigns it, not of any general phonological rule. This means that no proposal that attributes the position of an accent to general rules, treating only the existence of the accent as a property of a specific morpheme, can be adequate.

The other proposal is due to Clark (1983) who proposes that a preaccenting morpheme is one that has an underlying linked Low tone. In addition to a rule that fills in Low tones after a linked High tone, as proposed here, Clark also requires a rule to fill in High tones before a linked Low. Clark's proposal is subject to the same objections as Bennett's; it can account only for preaccenting suffixes. Moreover, it is impossible to generalize her proposal even to account for postaccenting prefixes, so in this respect it is worse than Bennett's.

In sum, all of the proposals to provide some special representation for preaccenting suffixes fail to take into account the attested typology of rules. All are designed to deal only with preaccenting suffixes, on the assumption that these are somehow special, and none can be generalized to account for the full range of possibilities. Since examination of the attested types of rule fails to suggest any special status for preaccenting suffixes, and since coherent accounts that generate the entire typology without recourse to special treatment for preaccenting suffixes are readily available, special representation of these suffixes is unmotivated, and if attempted serves only to create an artificial gap in the typology of morphoaccentual processes.

2.5. The Mechanism of Morphoaccentual Rules

I will describe here some proposals for the mechanisms by which morphoaccentual rules operate, giving a number of basic operations and possibilities of combination that generate the attested typology of morphoaccentual processes. I believe that the proposals advanced are very nearly correct in the possible rules that they license, but these proposals, like all others in this domain, should nonetheless be approached with caution. There are two reasons for this. First, the empirical base upon which proposals in this area have thus far been based is less than adequate. For example, such previous accounts of Japanese accentual morphology as Bennett (1981) and Clark (1983) ignore the existence of post-accenting prefixes and penultimate accenting suffixes, and other studies fail to account for the existence of processes evidently known to their authors. Moreover, some languages entirely lack processes attested elsewhere. For example, of the inventory of processes attested in Tokyo dialect Japanese, Sanskrit has only preaccenting suffixes. A morphological theory based exclusively upon Sanskrit facts would therefore be quite wildly wrong. Finally, it is essential to make use not of superficial facts about accentual patterns but of careful analyses of each accentual rule and morphological process. The correct analysis is often less than obvious. Sanskrit appears, for example, to have initial accenting suffixes, but on Kiparsky(1983)'s analysis this behaviour turns out to be artifactual. Similarly, I have noted several cases above where processes that turn out to be penultimate accenting processes appear at first glance to be initial accenting. The number of languages for which careful and extensive descriptions of the accentual morphology exist is very small, quite possibly limited to Sanskrit and Tokyo dialect Japanese. In general, an adequate morphological theory must rest on a foundation of carefully analysed facts about a range of languages, and as yet we have only a portion of the requisite foundation.

The other caveat is this: it is not enough to provide an account of morphoaccentual processes in isolation. There is no *a priori* reason to believe that morphoaccentual processes are subject to different constraints than other morphological and phonological processes are, yet a number of existing accounts not only fail to take into account rules of a type attested in other morphophonological domains, but actually make explicit use of properties unique to accentual systems. Insofar as accentual rules are subject to different constraints from other rules, an account is required, and insofar as other rules are subject to the same constraints as morphoaccentual rules, we should be wary of an account of morphoaccentual rules that does not extend to other classes of rules.

With these caveats in mind, I put forward the following suggestions as to the mechanisms underlying the morphoaccentual rules of languages like Japanese.

2.5.1. Micro-operations

I propose to decompose the taxonomic categories of accent placement and accent deletion into further micro-operations which when combined yield the various attested possibilities.

2.5.1.1. Deletion

One operation that is clearly necessary is accent deletion. The existence of such an operation is independently motivated by the existence of cases in which the sole effect of an accentual process is to remove all accents from the stem, resulting in an unaccented derived form. But once such an operation is available, further use can be made of it. If a deletion operation is followed by an accent assignment operation, we will obtain the effect of dominant accent placement, as Kiparsky (1983) has noted.

The alternative would be to mark dominant accents with a rule exception feature, exempting them from Accent Resolution. Leftward spreading of the High tone would then fill in the interval between the first and second accents, bleeding Post-Accentual Low Tone Insertion. The result would be as if only the righthand accent were present.

I favor the deaccenting account for two reasons. First, deaccenting is a strictly local operation and is diacritic only in that the morpheme that triggers it must be so marked. The alternative of marking dominant accents with a rule exception feature is global in character and moreover requires a different and I believe more unpleasant sort of diacriticity. Typically, rule exception features are features of morphemes, but in this case it would be necessary to mark tones, not morphemes, with the rule exception feature. Second, this account turns on the perhaps accidental presence of leftward spreading of the High tone. It predicts that if a dialect does not have leftward spreading of High tone, as the Kansai dialects of Japanese do not, then dominant suffixes will not have the effect of removing the accents preceding them, resulting in multiple accents. I do not believe that this prediction is correct, though further research is required.

Thus, accent deletion is both independently motivated and combines with accent placement.[37]

2.5.1.2. H-Insertion and the Treatment of Accentedness

Accent placement rules that place accents on unaccented bases evidently do two things: introduce a High tone, and link it to the appropriate syllable. These two operations, High Tone Insertion and linking might be conceived of as inextricably merged into a single accent placement operation, but there are advantages to decomposing this operation into its constituent parts, for as I shall argue there are cases in which one or the other micro-operation is required in the absence of the other.

Consider first the possibility that H-insertion might operate without linking taking place on the same cycle. What would be the result? The result would be that the output would be seen as accented by subsequent rules sensitive to accentedness. This provides us with a means of dealing with the cases discussed above in which we seem to have need of a notion of *accentedness* distinct from the notion of *location of an accent*. Specifically, I propose the following. What it means for a form to be accented is for it to contain a High tone, linked or unlinked. The lexical specification of verbs and adjectives is then one in which there may be a High tone, in which case the verb or adjective is accented, or there may not be one, in which case it is unaccented. Positing an unlinked High tone avoids the arbitrariness of marking the location of the accent in such forms. This done, the treatment of affixes like *-sase-* and *-rare-* which preserve accentedness is simple. These extend the segmental content of the word

[37] Although I here use the term deletion I do not mean to exclude the possibility of delinking without deletion of the autosegment itself. Delinking operations without deletion of the autosegment are clearly required in some cases, e.g. in Kikuyu tone (Clements & Ford 1979) and in disharmony systems (Poser 1982a). The status of deletion of autosegments is less clear, and depends very much on the resolution of a number of unsettled issues concerning the operation of the autosegmental association conventions. It may be that the term deletion should be replaced throughout this discussion by delinking, or that both are required, but I have discovered no phenomena in Japanese that bear on the issue, and so I use the term deletion with a systematic ambiguity.

without having any effect whatever on its tonal tier. If the verb stem came provided with a High tone, that tone will continue to be present, and so the derived verb stem will be accented; if the verb stem lacks a High tone so will the derived stem and as a result it will be unaccented. Nothing further need be said.

Finally, consider the analysis of verb-verb compounding, the result of which is always accented, but where the location of the accent follows exactly the same rules as for all other verbs. All we need say here is that the compounding process introduces a floating High tone, rendering the compound accented. In short, representing accents of unknown location by means of a floating High tone provides us with a means of dealing with accentedness independently of the location of the accent, while permitting the introduction of a High tone without simultaneous linking permits us to treat verb-verb compounding non-arbitrarily.

2.5.1.3. Linking & the Treatment of Dependent Accents

Just as High Tone Insertion is possible without linking, so is linking possible without High Tone Insertion. If a rule does not insert a High tone, what could it possibly link? Obviously only a High tone that is already present. I suggest that the operation responsible for dependent accentual processes is linking without High Tone Insertion. A dependent accentual rule will be one that links an existing High tone to a designated syllable, simultaneously deleting any other High tones so as to prevent these from subsequently deleting the High tone linked by the rule at hand. Since a pure linking rule can only link a High tone that is already present, it follows that such a rule will leave unaccented words unaffected. Notice that on this account dependent accentuation is always the result of a rule, even when the accent falls on the formative itself, as in the case of the suffix /te/.

2.5.1.4. Against an Alternative Treatment of Dependence

There is an alternative analysis of dependent accent that does not make use of pure linking. We might suppose that dependent accentuation is really just like dominant accentuation, the parametric difference being in the precise nature of the accent deletion operation. In the case of dominant accentuation, the accent deletion operation would be restricted to the accents inherent in the baseform, perhaps by ordering accent deletion before accent placement. In the case of dependent accentuation the accent deletion operation would delete the leftmost accent in the derived form. If the baseform were accented, the accent of the base would always be the one deleted, leaving the accent assigned on the current cycle untouched. But if the baseform were unaccented the leftmost accent would be the accent assigned on the current cycle, so that accent would be deleted, leaving the form unaccented[38]

Although this proposal provides a clever means of dealing with dependent accenting, it is inferior to the linking proposal. It makes what appears to be an incorrect prediction about which rules can be dependent. Since the preservation of the accent assigned on the current cycle when the baseform is accented is attributed to the presence of an accent to the left which bears the brunt of the deletion rule's attack, it follows that it is impossible for an initial accenting rule to be dependent, for in this case there will never be an accent to the left of the accent assigned on the current cycle. But if the initial accented deverbal nouns discussed above are taken to demonstrate the existence of an initial accenting rule in a preceding stage of the language, we must abandon this hypothesis, for these initial accented forms obey the same generalization as do the regular, final-accented forms; they are accented only if the verb stem is accented. Thus, insofar as dependent initial accenting is possible, as it appears to be, this hypothesis must be rejected. [39]

To summarize, I propose that there are three micro-operations, all potentially independent, from whose combination the various accentual rules are obtained. These are High Tone Insertion, which inserts a floating High autosegment, Linking, which links an autosegment already present to a designated position, and Deletion (or Delinking), which deletes (or del-

[38] Unless the suffix had an inherent accent as well, as in the case of the negative suffix *-na-*, in which case the inherent accent would surface.

[39] Note that this proposal will not work unless Accent Resolution applies cyclically, which is otherwise unmotivated. Since Accent Resolution must in any case apply at the minor phrase level, on this account it is necessary for Accent Resolution to apply both in the lexicon and post-lexically.

inks) all High autosegments in its domain. High Tone insertion alone yields accentedness assignment (as in verb-verb compounds). Linking alone yields dependent accent placement. Deletion alone yields simple accent deletion. High Tone Insertion together with Linking yields non-dependent accent placement. If Deletion also applies, accent placement is dominant; if it does not, accent placement is recessive.[40] The other logical possibilities are Deletion and Linking without High Tone Insertion, which has the same effect as one or the other alone depending on the order of application, and Deletion and High Tone Insertion alone, which has no effect if Deletion applies first and is the same as Deletion alone if it applies second.[41]

2.5.2. Counting

In the preceding section I discussed the micro-operations necessary to account for the operation of morphoaccentual rules and how they combine. The other crucial aspect of the mechanism of morphoaccentual rules is how such rules count. Recall the basic observations. First, rules count from one end of the domain or the other. Second, the domain may consist either of the base form alone or of the derived form. Third, accent placement rules may eat in only a limited distance from the end of the domain. In particular, there are rules that place an accent on the first or last unit of a domain, and rules that skip the peripheral unit to place the accent on the second or penultimate unit, but no rules that eat farther in. I will suggest that these observations follow from the operation of two types of rule: the End Rules and Invisibility Assignment.

[40] Recall that an independent Accent Resolution rule will apply later to remove the non-leftmost accent, so that placement of an accent yields recessive accenting as a default.

[41] Deletion followed by High Tone Insertion could in principle produce an effect if there were situations in which a form with an unlinked High Tone was not later subjected to a dependent accenting rule. One possibility would be that some default rule would apply, in which case the output might differ from the input. The other possibility would arise if some later rule were sensitive to the location of the linked High, which in the case of a floating High would either be indeterminate or would be equivalent to that of an unaccented word. The only such case with which I am familiar is that of the suffix *-ziN-* discussed below, and it is never affixed to a form which I have reason to believe has a floating High tone. Thus, although there is a small gap it is one whose probability is in any case fairly small, so that it does not create much of a problem for typology induced by my proposal.

2.5.2.1. The End Rules

The fact that rules count from one end or the other may be accounted for by permitting two types of tone assignment rule, both of which assign the tone to the end of the domain by scanning from one end of the form to the other, assigning the tone at the end of their scan. The Left End Rule will scan from right to left, leaving the tone at the left edge of the domain; the Right End Rule will scan from left to right, leaving the tone at the right edge of the domain. Rules of a similar nature have previously been suggested for tone assignment (Haraguchi 1977), stress tree construction (Hayes 1980) and metrical grid construction Prince (1983). These rules then have the effect of putting tones at one end of the domain or the other.

It is important to note that this restriction is less trivial than it might seem. After all, most other possibilities for counting, e.g. from the center, seem intuitively more complex and indeed baroque. But there is one sort of rule that is excluded by this proposal that is intuitively quite natural and whose absence requires some explanation. It seems to be the case that the location of a link is always determined with respect to the edge of the domain, as proposed, never with respect to the location of a link already present in the base form. Thus, although there are rules that "move" an accent to a position whose location can be specified with respect to the edge of the domain (where the domain may be either the derived form or the base, as discussed above), there are no rules that shift the accent a fixed distance in one direction or the other, regardless of the location of the edge of the domain. It is the absence of these "shift" rules that requires some explanation. The current proposal encodes the observation that the role played by existing accents is almost entirely limited to the presence or absence of the High tone, the presence and location of the link playing a very small role, one presumably severely limited by locality conditions.[42]

[42] I have described thus far only two rules sensitive to the location of a link, namely the two special noun-noun compound rules. The first I will suggest below is actually not directly sensitive to the location of the accent. The second one apparently is, but note (a) that this is one of the cases in which Chew's correlation is imperfect, so that the rule may be spurious, and (b) that the crucial aspect is whether the final syllable is accented, which means that a fairly restrictive theory, one allowing conditions access only to the edges of domains, would be

2.5.2.2. The Role of Invisibility

The remaining facts about how rules count will be attributed to what I refer to as *invisibility.* This is a notion closely related to extrametricality; I make the distinction for reasons explained below. The central notion is that a constituent may be stipulated to be invisible to a particular rule, so that that rule can neither consider the invisible constituent in its structural description nor affect it in performing the structural change.

The notion of invisibility immediately allows us to account for the fact that some rules take the derived form as their domain, while others take the base form as their domain. We have only to say that in the later case the affix is invisible with respect to the End rule. Initial accenting and final accenting result if the Left and Right End Rules apply to forms containing no invisible constituents. Postaccenting and preaccenting result if the Left and Right End Rules apply to forms whose peripheral constituents are invisible. For example, a preaccenting suffix is one that triggers application of the Right End rule, but which is itself invisible, so that when the End Rule assigns a tone at the right edge of its domain, the suffix itself does not form part of that domain, and so the tone falls on the syllable preceding the suffix.

It remains to account for the existence of prepreaccenting suffixes and postpostaccenting prefixes, and more generally for rules that assign a tone to the penultimate or second unit of the base form. This possibility can be accounted for if we admit a further kind of rule, one that assigns the invisibility property to an adjacent constituent. For example, we suppose that penult accenting suffixes are suffixes that are both invisible themselves and that assign invisibility to the preceding constituent. The Right End Rule then applies, and since neither the suffix itself nor the preceding mora is visible, assigns the accent to the penultimate mora of the base form. A postpostaccenting prefix will do just the opposite: it will render the following mora invisible, with the result that the Left End Rule will place the accent on the second constituent of the base form.

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possible. The other rule of this type with which I am familiar, is the rule for compounds with second member *-ziN* discussed below, which would also fall under such an adjacency condition.

We have thus accounted for the possibility of a rule applying to the derived form, the peripheral constituent of the base, and the constituent one in from the periphery of the base, which is exactly the correct schema if the typology given above is correct. I should note here that there are occasional examples of rules that affect the antepenultimate syllable or mora. Such rules provide apparent problems for the account given here.

In Japanese there are no clear cases of these; the only candidate is a rule noted by McCawley(1968) that puts the accent on the antepenultimate mora in certain nonsense sequences, as when the syllabary is recited, and in the same position in loanwords where the accentuation of the loanword is not governed by its phonological shape in the source language (Ichikawa 1930). No regular morphological process of Japanese has this character, and it is unclear what to make of this phenomenon. In other languages, and in particular in stress systems, antepenultimate stress is not uncommon. I believe that all such cases can be dealt with by the mechanisms discussed below. Antepenultimate stress need not involve direct reference to the antepenultimate syllable. Rather, if the ultima is extrametrical antepenultimate stress will result from construction of binary left-dominant stress feet. This would explain why antepenultimate stress is common, but antepenultimate pitch accent is rare. In the latter case, as argued below in Chapter Six, no metrical structure is created by the rule, so that the mechanism that yields antepenultimate stress is inapplicable. Antepenultimate accentuation in a pitch accent language could only result from assignment of invisibility to the adjacent foot.

The examples cited thus far involve cases in which the role of invisibility is to render a constituent unavailable as a landing site for a tone, that is, as the focus of the rule. But there is no theoretical reason why such a restriction should obtain, and indeed there is one phenomenon that suggests that invisibility is also useful in simplifying the structural description of a rule. Recall that in loose noun-noun compounds whose second member is long, the accent of the compound is that of the second member unless the second member is either unaccented or final-accented, in which case the accent falls on the initial syllable of the second member. Why should unaccented and final-accented forms form a natural class? In every formulation of this rule that I can think of, a disjunction is required, unless invisibility is brought into play. Suppose that we say that the structural condition for the rule assigning initial accent to the second member of the compound is simply absence of a linked High tone, and that the final syllable is invisible. Then the form will appear to have no linked High tone either if it is unaccented or if it is final-accented, yielding exactly the required result without a disjunction. This role of invisibility in the environment of tone assignment rules is parallel to the well known cases in which the function of extrametricality in stress systems is to affect whether or not a form satisfies the structural description of a rule.

Thus, the notion of invisibility and the possibility of assigning invisibility to an adjacent constituent provide all of the attested possibilities, without permitting any of the unattested ones. Rules that eat farther into the domain are impossible because no mechanism is provided for long-distance transmission of invisibility. It thus appears that the mechanism of invisibility can be used to provide a restrictive account of the observed limitations on the way in which morphophonological rules can count.

I should note here that specification of invisibility is sometimes context sensitive in relatively complex ways. The typical case of extrametricality in a stress system is that a particular morpheme is inherently extrametrical, or that some constituent is extrametrical when adjacent to a boundary. The additional possibility advanced here is that of assignment of extrametricality by another morpheme. But there is at least one case in Japanese in which a more complex condition appears to be necessary. This is the case of the suffix *-zin* "person". In this case, the accent falls on the syllable preceding *-zin* unless the base is accented on the final syllable, in which case the accent falls on *-zin* itself.

Derivative	Gloss	Base	Gloss
	Final Accented		
nihoNzi'N	Japanese	niho'N	Japan
taiwaNzi'N	Taiwanese	taiwa'N	Taiwan
tyooseNzi'n	Korean	tyoose'N	Korea
	Non-Final-Accented		
amerika'ziN	American	amerika	America
doitu'ziN	German	do'itu	Germany
huransu'ziN	French	huransu	France
ippa'Nzin	generalist	ippaN	general
tyuugoku'ziN	Chinese	tyu'ugoku	China

Suffixation of -ziN

This situation can be accounted for if we say that *zin* is invisible unless it immediately follows a syllable with a linked High tone. This said, we need only treat *zin* as dominant, i.e. deleting accents to its left, and inserting a High tone which is linked by the Right End Rule. Thus, if the final syllable of the stem is accented, *zin* will not be marked invisible, the accent of the stem will be deleted, and a High tone will be inserted and linked by the Right End Rule to *zin* itself. Otherwise, any accents already present will be deleted and a High tone will be inserted and linked by the Right End Rule to the final syllable of the stem, *zin* being *hors de combat*.

Let us consider now the possibility of persistence of invisibility. In the examples thus far discussed, invisibility is relevant only to rules applying on the same cycle, and this is what we expect given the arguments in the literature on stress that extrametricality must vanish at the end of the cycle.[43] There is, however, one phenomenon in Japanese that may be taken to argue for persistence of invisibility.

[43] Paul Kiparsky (personal communication) informs me that in an unpublished paper which I have not seen D. Archangeli has argued that there are cases in which extrametricality persists.

I have already discussed the postaccenting prefixes *o* and *ma*. Consider now what happens when both of these are added to a noun or uninflected adjective.In such cases, *o* must appear to the left of *ma* . Recall from the preceding discussion that *ma* is postaccenting and that *o* is either postaccenting or deaccenting. If we add these two prefixes one at a time, first *ma* and then *o* ,we expect the resulting form to be either unaccented or accented on the syllable following /o/, i.e. /ma/. On the first cycle *ma* will put an accent on the following syllable. Then, on the second cycle *o* will either delete this accent, resulting in an unaccented word, or assign its own accent to /ma/, resulting in the ultimate deletion by Accent Resolution, of the accent assigned by *ma*. However, this is not what happens. Instead, the accent assigned by *ma* to the following syllable is the one that survives. Thus, we have [omakku'ro] "black" and [omakku'ra] "dark", not *[oma'kkuro] and *[oma'kkura] or *[omakkuro] and *[omakkura]. The problem is to account for this phenomenon.

In effect, we need somehow to say that the accent assigned by *ma* is dominant, but this is not entirely straightforward. If accentual dominance is the result of application of a deaccenting rule at the time of the addition of the affix, *ma* cannot exert any dominance over the accent contributed by *o* since that accent will not be assigned until the next cycle. There appear to be two possible solutions. One is to abandon the proposal that accentual dominance is the result of deaccenting, instead making it a diacritic property of some morphemes or accents. Then the accent assigned by *ma* could exert its dominance over that assigned by *o* after the latter morpheme had been attached, when Accent Resolution applied. But this is too general, since the addition of inflectional affixes shifts the accent off the syllable following *ma* to the right, so that it is located in the same place as in any other inflected adjective. Thus we have the present affirmative forms [omakkuro'i] and [omakkura'i]. The dominance diacritic would therefore have to indicate that no rule applying from the *left* could affect the dominant accent, leaving rules applying from the right free to remove it. This is not only a bizarre sort of rule diacritic to permit, but one that is literally incoherent insofar as morphological processes are not thought of as triggered by formatives per se but by abstract morphemes.[44] In this case it makes no sense to refer to a morphological process as applying from one direction or the other, even if it happens that one exponent of the morpheme is a formative added at one end or the other of the stem.

A second possibility is to resolve the accentual conflict between *o* and *ma* before these are added to the stem. If these two prefixes form a separate cycle, then no matter what effect *o* has, *ma* will be free to put its accent on the following syllable and to delete any other accent, when the prefix cluster is attached to the stem. This proposal not only yields the correct location of the accent but also correctly predicts that in this case, unlike in other cases, *o* never deaccents the stem to which it is attached. On the other hand, it requires the two prefixes to form a morphological constituent, and yet, in violation of Adjacency Condition, requires *ma* to exert its postaccenting effect on the next cycle. Neither of these solutions is attractive.

Consider now the consequences of considering postaccenting to be accomplished by application of the Left End Rule together with invisibility of the prefix. First *ma* will assign its accent to the first syllable of the stem, Then, on the next cycle, *o*, itself invisible, will trigger another application of the Left End Rule. If invisibility were lost at the end of the cycle, this would result in placement of the accent on *ma*. But if invisibility persists, both *o* and *ma* will be invisible and the accent will be placed, as before, on the syllable following *ma*. Thus, a possible way of accounting for the accentuation that results when both *o* and *ma* are prefixed is to admit the possibility of the persistence of invisibility.

One further observation about invisibility is relevant. Where it is a peripheral element that is invisible, it suffices to say that an invisible element is not present in the representation at which the rule looks, i.e. that the rule looks at a projection of all elements that are not marked as invisible. However, when an invisible element is not peripheral, a difficulty arises. Consider the case in which a suffix has the property of making the last syllable of the stem invisible. If we then apply the Right End Rule, the result will be application of the rule to

[44] See Anderson (1983) for arguments against the position that morphemes are simply formatives.

the suffix itself, since the effect of invisibility is simply to make the rule skip over the invisible constituent. This is evidently not the desired result, which is to force the Right End Rule to stop on the syllable preceding the invisible syllable. In the example at hand, this effect could be achieved by attributing to the suffix not only the property of making the last syllable of the stem invisible, but also the property of being invisible itself. This is possible as an option, but since I know of no cases in which it is necessary to permit a suffix that assigns invisibility to be visible itself I propose the following modification of the notion of invisibility:

Extended Invisibility Principle

> Let R be a directional rule applying in direction α, where α ranges over S(inistrad) and D(extrad), meaning that the rule scans from the right to the left, or from the left to the right, respectively. Let I be an invisible constituent in a string X. Then the closed substring bounded on one side by I and extending in direction α to the boundary of X is invisible to rule R.

The consequence of adopting this proposal is that it is unnecessary to specify that a suffix is invisible if it assigns invisibility to a constituent that precedes it in the scan.[45]

This principle lends itself to the solution of a problem in the description of stress in Turkish to which hitherto only an *ad hoc* solution has been available.[46]

In Turkish stress generally falls on the last syllable of the word. This is true both of non-derived forms and of derived forms, as the examples below attest.

[45] It is not only this constraint that applies only to directional rules. The very notion of invisibility itself appears to be restricted to rules that scan across a representation. Rules that do not never involve invisibility, so that, e.g., it never happens that a local assimilation rule fails to apply just in the first or last syllable. Notice that my suggestion that the condition on accentuation of noun-noun compounds with long second member be stated in terms of invisibility does not run afoul of this constraint if we take the evaluation of Boolean conditions (in this case, is there a linked High tone in the domain) to involve scansion across the domain.

[46] The Turkish facts are described in Underhill(1976). I am grateful to Jaklin Kornfilt for bringing these facts to my attention.

ada'm	man
adam+la'r	men
adam+lar+a'	to the men

Normal Turkish Stress

Exceptions to this rule are of two kinds. First, there are a number of words with inherent stress on some non-final syllable.[47] In this case, the stress does not shift when suffixes are added.

ma'sa	table
ma'sa+lar	tables
ma'sa+lar+a	to the tables

Turkish Words with Fixed Stress

The second class of exception is more interesting. There are a number of suffixes that never bear stress. Most forms of the copula fall into this category, as do the verbal negative suffix /mE/ and the past tense morpheme /DI/.[48] Note the following contrasts.

adam+i'm	my man
ada'm+im	I am a man
git+me'	going
gi't+me+di+m	I did not go

Unstressable Suffixes

If, as in the examples thus far given, the unstressable suffixes always came at the right hand edge of the word, with no stressable material intervening, we could account for the

[47] Many such cases are entirely idiosyncratic, but there are some generalizations. For example, nearly all placenames have initial stress.

[48] As is traditional Turcological practice, capital letters are used to denote archiphonemes. E represents the [e]~ [a] alternation, I the [i]~ [ı]~ [u]~ [ü] alternation, and D the [d]~ [t] alternation.

Turkish facts using the simple notion of invisibility. At the point at which the Right End Rule applies, these suffixes would simply be invisible and stress would fall on the rightmost stressable syllable. However, it is possible for an unstressable suffix to be followed by a stressable suffix. In this case, the simple invisibility theory predicts that the unstressable suffix should simply be skipped over, allowing stress to fall on the stressable suffix to its right. But as the following examples show, this is not the case.

yorgu'n+dur	he is tired
yorgunla'r	they are tired
yorgu'n+dur+lar	they are tired

Blocking of Stress Scan by Unstressable Suffix

The first example shows that when the third person copular ending /DIr/ is affixed to the adjective *yorgun* it is unstressable, leaving the stress on the last syllable of *yorgun*. The next example shows that when the third person plural copula consists only of the plural suffix /lEr/ this suffix may be stressed. However, when the full form of the third person plural copula is used, consisting of the unstressable /DIr/ followed by /lEr/, as in the third example, the presence of /DIr/ blocks the stressing of /lEr/ as well, leaving the stress on the syllable preceding /DIr/.

The correct generalization about Turkish stress is that stress falls on the syllable immediately preceding the leftmost unstressable syllable, and on the rightmost syllable of the word if there is no unstressable syllable. In other words, the stress rule scans from left to right, leaving the stress where it stops. The effect of an unstressable syllable is to prevent the scan from moving onto and across the unstressable syllable. This behaviour is exactly what is predicted by the Extended Invisibility Principle if we say that the unstressable suffixes are invisible. In contrast, this behaviour does not fit into the existing theory of stress, which provides only for syllables that must be stressed or that are inherently heavy. Such syllables block the further incorporation of material into the stress foot by attracting the stress to themselves. No provision is made for inducing stress on a neighboring syllable.

2.5.2.3. The Status of Invisibility in Phonological Theory

As I have indicated above, the notion of invisibility is closely related to, and indeed derived from, the notion of extrametricality. I have chosen to call it invisibility rather than extrametricality because, in spite of the obvious similarity in the role played by the two notions, there is an important conceptual difference between the two notions.

The notion of extrametricality entered phonological theory from the theory of metrics. In metrics, an element is said to be extrametrical if it does not count for the purposes of versification, that is, if it is ignored in determining whether scansion is proper. In this interpretation of the term, extrametricality is, fine details aside, the same as invisibility. In the original usage of extrametricality in phonological theory, in the theory of stress developed in Hayes (1980), a constituent was said to be extrametrical if it did not count for the purposes of some stress rule, which is, at first glance, the very same notion. But in Hayes' theory of stress, and in subsequent work in this tradition, there is a very important difference in the mechanism by which extrametricality is taken to operate. In the case of stress, extrametricality of a constituent is taken to indicate that at the time at which a given rule applies the constituent is literally not part of the relevant metrical structure. In other words, extrametricality was taken to be a fact about phonological representations, not a fact about phonological rules. The crucial difference, then, is that invisibility is taken to be a fact about phonological rules. A constituent may be marked as invisible to a given phonological rule, but this is a fact about the application of that rule, not about the representation of the material to which it applies.

The reason for interpreting invisibility as a part of the theory of rules rather than as a fact about phonological representations is simple. So long as the only cases in which invisibility/extrametricality applies are cases in which there is reason to believe that metrical structure is involved, i.e. stress rules, it is reasonable to believe that it was a property of the representation not of the rule. But as soon as we discover that the very same notion is useful in cases in which there is not a shred of evidence for metrical structure, as in the tonal cases discussed by Pulleyblank(1983ab) and the pitch accent cases discussed here, the notion that the extrametrical constituent is invisible because it does not belong to the relevant metrical constituent becomes absurd. Of course, if invisibility is interpreted as a part of the theory of rules, the facts about extrametricality in stress systems immediately follow, since stress rules, like all other rules, are subject to the theory of rules. Just as a constituent invisible to a tone-linking rule can neither be assigned a tone nor figure in the structural description of the rule, so a constituent that is extrametrical in a stress system can neither be incorporated into the metrical structure nor figure in the determination of quantity or in counting off the terminal nodes in a foot. The phenomena of extrametricality in stress follow from the theory of invisibility to phonological rules; the converse is not the case. Consequently, I maintain that extrametricality is a misnomer, since incorporation into metrical structure is irrelevant to invisibility.

It is worthwhile remarking on the parallel between the status of invisibility and the status of certain other aspects of the ways in which phonological rules can count, in view of the similar historical development. One of the early important observations about stress systems incorporated into the metrical theory of Hayes (1980) is the fact that stress feet are either unbounded or binary. At the time, this was taken to follow from constraints on metrical structure, and so, when I made the same observation about harmony (and disharmony) systems, I took this to be evidence for the existence of metrical structure in harmony and proposed that the existing metrical theory of harmony, as developed by Vergnaud & Halle (1978) and Halle & Vergnaud (1981), which provided only for unbounded harmony feet, be augmented with bounded, binary harmony feet, thus paralleling the theory of stress (Poser 1981). But although this proposal met with some acceptance I believe that it was misguided, as I have argued at length in Poser (1982). There I argued that the constraint that the domains of phonological rules must be either binary or unbounded is true of all types of phonological rule, including those that do not involve any sort of metrical structure. Consequently, these constraints should be taken to be constraints on rules. The fact that stress feet are either binary or unbounded will then follow from the fact that metrical structure is created by rule, and that stress rules, like all other rules, are subject to the proposed constraints.

In the same place I observed that this parallel between stress rules and other rules was true not only of rules that iterate across a phonological domain but of rules that count from the end.(Poser 1981a:148-9)

> Hayes claims that stress feet are all binary or unbounded, just like harmony (and disharmony) domains. Indeed, it appears to be possible to extend this claim to all phonological rules, since lengthening rules and shortening rules also obey it, as far as I have been able to determine. It even extends to phonologically arbitrary allomorphy rules, in those cases where such rules refer to position in the string. Such rules occasionally refer to initial or final position, or to second or penultimate position, but never to any higher number of elements from the periphery, e.g. antepenultimate or third position.

This is essentially the same observation that I made above about the morphoaccentual rules of Japanese. The fact that I now suggest that invisibility is the appropriate mechanism for constraining morpho-phonological rules only strengthens the claim that invisibility/extrametricality is not a property of metrical structure, and more generally that constraints on metrical structure construction follow from constraints on the way phonological rules count, not the other way around.

3. Rule Application and Interaction

In addition to characterizing the rules that govern accent patterns it is necessary to know how these rules apply and how they interact. Although there has been considerable research on the former topic, there has been virtually no work on rule application and interaction in Japanese, nor indeed on any aspect of morphological structure and the organization of the phonology. Existing work in this area is limited to Bloch (1946b), which distinguishes a number of different types of derivation, the boundary-strength proposals of McCawley (1968) and Maeda(1979), and the previously discussed paper by Otsu (1980) which contains some proposals for the structure of different types of compounds. In view both of the complexity of Japanese morphology and of the unsettled state of affairs in morphological theory an adequate treatment of this topic lies far beyond the scope of this thesis. I will limit myself here to a few basic observations and to one or two points where it appears that a firm conclusion can be drawn even in the absence of a more complete account.

3.1. The Lexical Status of Accentual Rules

As the title of this chapter implies, I assume that most of the rules described apply within the lexicon rather than at some later point. There is one rule that may well apply post-lexically. This is Accent Resolution which may apply only at the Minor Phrase level. This question is discussed in Chapter IV. The status of the majority of the rules is, however, clear. There is no reason for any of them to apply later. Moreover, since these rules are triggered by particular morphemes, and since, as I will show, they are sensitive to morphological structure, they cannot be post-lexical.

3.2. The Importance of Morphological Structure

The fact that the various morphological rules are triggered by particular morphemes is sufficient to show that they are lexical rules, but it is still possible that the various accentual rules might apply without regard to morphological structure. In fact, it is essential in a number of cases to make reference to morphological structure. The bracketting required is, with the one possible exception that is discussed in the following section, exactly the bracketting expected if affixes are added cyclically. I will illustrate with three examples.

First, consider what happens when a noun-noun compound is formed whose second element is itself a deverbal noun. The following examples show that the correct accentuation of noun-noun compounds requires that the rule determining the accentuation of deverbal nouns apply before the accentual rule triggered by noun-noun compounding. If there were no bracketting the noun-noun compounding rule would be indeterminate. If the deverbal noun-forming suffix were in the outermost layer, we would have to account for the fact that the intermediate noun-verb compounds are generally non-occurring and for the fact that this bracketting would incorrectly predict that all compounds of this type would be either unaccented or final accented.[49]

misebi'raki	opening of business	<	hira'ku	open
tebi'kae	hanging back	<	tebikae'ru	hang back
tega'wari	substitute	<	kawaru	turn
tego'tae	response	<	kotae'ru	answer (kota'e)
teku'bari	arrangments	<	kuba'ru	distribute
tewa'tasi	hand delivery	<	watasu	deliver
teza'wari	feel,touch	<	sawaru	touch
tezu'kami	holding in fingers	<	tuka'mu	grasp
tokoroba'rai	eviction	<	hara'u	sweep,expell
te'buri	waving one's hand	<	furu	wave
te'dasi	meddling	<	da'su	put out
wakado'siyori	person with young-old face	<	tosiyo'ru	grow old

Noun-Noun Compounds with Long Deverbal Second Member

The following examples illustrate that noun-noun compounds whose second member is deverbal behave just like other nouns in that, when the second member is short, the resulting compound is either unaccented or final accented.[50]

[49] Note that these forms could be accounted for without actual cyclic rule application if appropriate violation of the adjacency condition were permitted. Since deverbal nouns are either final accented or unaccented, it suffices to know that they are deverbal to get the accent in the right place in the compound. In other words, in this case it would be possible to build into the noun-noun compounding rule the ability to place accents correctly on these forms. But this requires an unnecessary complication of the compounding rule (unnecessary since the rule for accenting deverbal nouns is independently motivated) and in any case does not change the conclusion that the bracketting is crucial to the correct operation of the accentual rules.

[50] The two possibilities represent the persistence of the accent of the second member, as is the usual case, and the application of the rule deaccenting a compound with short final-accented second member.

tebori	hand carving	<	ho'ru	carve
tegaki	handwriting	<	ka'ku	write
teori	hand weaving	<	o'ru	weave
teosi	hand gilding	<	osu	gild
teyaki	hand baking	<	yaku	bake
tezuri	handline angling	<	turu	angle
teuti'	closing of a deal	<	u'tu	beat
tewake'	division of work	<	wake'ru	divide

Noun-Noun Compounds with Short Deverbal Second Member

Second, consider the result of adding suffixes to compound nouns. It is essential that the compound form a single constituent to which the suffixes are then added. If no bracketting at all were provided, the accent of recessive and dependant morphemes would be indeterminate, since these must refer to the accentedness of the form to which they are added, and without any bracketting at all it is impossible to determine what the form to which they are added is. If the suffixes are bracketted with the second member of the compound the wrong accentuation will result. The crucial case is that of a dependant or recessive morpheme suffixed to a noun-noun compound with long second member, both of whose members are unaccented. For concreteness, let us use the recessive suffix *ma'de* "until". If the accent of either of the components of the compound individually determined the accentedness of the suffix, the accent on *ma'de* would survive since both members are unaccented. If, on the other hand, *ma'de* were bracketted with the second member of the compound, and this derived second member were then compounded with the first member, the resulting compound would be accented on the /ma/ of *ma'de* . The result of attaching *ma'de* to the unaccented second member would be a form accented on the /ma/ of *ma'de* . When this long second member was compounded with the first member, the resulting compound would keep the accent on /ma/. On the other hand, suppose that the two nouns are bracketted together, so that a compound accented on the first syllable of the second member results. If *ma'de* is then affixed to this compound, the accent on the compound will delete the accent on *ma'de* , resulting in a form accented on the first syllable of the second member of the compound. As the following examples show, this latter is the correct result. Since the accent that causes deletion of the accent on the suffix results from the compounding process, it follows that compounding must take place first.

tya=hasira+ma'de	=>	tyaba'siramade	*tyabasirama'de
kitune=udoN+ma'de	=>	kituneu'doNmade	*kituneudoNma'de

As a final example, consider the case were a noun is followed by a dependent suffix and then a recessive suffix. If these are bracketted in the expected fashion, i.e. the first suffix with the stem, we predict that when the stem is accented the ultimate accent will fall in the location determined by the dependent suffix, while when the stem is unaccented the recessive accent will surface. In contrast, suppose that there were no such bracketting. The result will be indeterminate if dependent affixes are restricted to looking to the left. If they can look at the entire form, since the recessive suffix has an accent the dependent suffix will place its accent regardless of the accentuation of the stem. Since that accent is to the left of the recessive suffix, Accent Resolution will delete the recessive accent, so that regardless of the accentuation of the stem the accent will surface int he location determined by the dependent suffix. The correct prediction is that made by the bracketting hypothesis: the ultimate accentuation depends on the accentuation of the stem. If the stem is accented, the dependent suffix determines the location of the accent, but if the stem is unaccented the accent on the recessive suffix surfaces.

The following examples show the result of adding the dependent preaccenting suffix *ya* followed by the recessive suffix *ma'de* to an accented noun and an unaccented noun. When the noun is accented the ultimate accent is that due to *ya* . When the noun is unaccented, the accent on the recessive suffix *ma'de* surfaces.

ku'zu+ya+made	=>	kuzu'yamade
kabu+ya+made	=>	kabuyama'de

These examples illustrate the role played by morphological structure in the accentual system of Japanese. In general the correct result follows from the assumption that affixes are attached cyclically and that the accentual rules apply on this cycle. There is, however, one problematic case.

3.3. The Adjacency Condition

One condition on the application of morphophonological rules is the Adjacency Condition proposed by Siegel (1977) according to which a rule may not refer to the internal morphological structure of the base form to which it applies. An equivalent condition is proposed in work within the framework of Lexical Phonology by Pesetsky (1979), Mohanan (1981), and Kiparsky (1981) in the form of the Bracketting Erasure Convention, according to which internal bracketting is erased on every cycle. The accentual rules of Japanese provide one clear counterexample to this proposal together with a potentially problematic case.

I have already discussed the accentuation of deverbal nouns derived from simplex verbs. In that case, the noun is accented if and only if the verb is accented, and if it is accented the accent regularly falls on the final syllable.

When we turn to the case of nouns derived from compound verbs, the situation is quite different. Kawakami (1973a) makes the following important observation. If the verb is a compound, then regardless of its accentuation, the noun derived from it is unaccented. There are no exceptions to this generalization. [51] Examples are given below.

[51] I know of only a single apparent exception to this generalization. This is the noun *neboke'* "sleepiness" which is derived from *neboke'ru* "to be half-asleep", a compound of *neru* "lie down, rest" and *boke'ru* "grow dim, senile". Kenkyuusha (1974) lists this noun as final-accented, but for my informants it is unaccented, as predicted by Kawakami's generalization.

Verb		Noun	
hiki-age'ru	pull up	hikiage	pulling up
hiki-awase'ru	introduce	hikiawase	introduction
hiki-da'su	draw out, take out	hikidasi	drawer
hiki-hana'su	separate	hikihanasi	disengagement
hiki-hara'u	evacuate	hikiharai	evacuation
hiki-kae'ru	exchange, convert	hikikae	exchange,conversion
hiki-mawa'su	lead around	hikimawasi	guidance
hiki-noba'su	stretch out	hikinobasi	prolongation
hiki-nu'ku	pull out	hikinuki	pulling out
hiki-sage'ru	pull down, reduce	hikisage	lowering, reduction
hiki-sime'ru	tighten	hikisime	tightening
hiki-tate'ru	favor, patronize	hikitate	favor, patronage
hiki-tu'gu	take over duties	hikitugi	taking over duties
hiki-tuke'ru	have convulsions	hikituke	convulsion
hiki-tu'ru	have a cramp	hikituri	a cramp
hiki-uke'ru	be responsible for	hikiuke	undertaking
hiki-utu'su	trace	hikiutusi	a tracing
hiki-wata'su	deliver	hikiwatasi	delivery
humi-ki'ru	take off	humikiri	a take off
ii-a'u	quarrel	iiai	quarrel
ii-nao'su	rephrase	iinaosi	correction
ii-narawa'su	be handed down by tradition	iinarawasi	tradition, legend
kai-ko'mu	purchase	kaikomi	a purchase
kasi-ki'ru	make reservations	kasikiri	reservations
kiri-to'ru	cut off	kiritori	a cut
kui-noko'su	leave food uneaten	kuinokosi	leftover food
mi-oboe'ru	recognize	mioboe	recognition
mi-oto'su	overlook	miotosi	oversight
moti-hako'bu	carry	motihakobi	carrying
nage-ire'ru	throw into	nageire	free-style flower arrangement
nage-ko'mu	throw into	nagekomi	a throw
neko'mu	fall asleep	nekomi	sleep
nigiri-tubu'su	pigeonhole	nigiritubusi	pigeonholing
ni-ko'mu	stew	nikomi	stew (sp.)
oitate'ru	drive away	oitate	eviction
oki-kae'ru	replace	okikae	replacement
omoi-aga'ru	be conceited	omoiagari	conceit, vanity
omoi-ki'ru	resign onself	omoikiri	resignation
omoi-tu'ku	think of, hit upon	omoituki	plan, idea
ori-ko'mu	weave into	orikomi	weaving in
oyogi-da'su	begin to swim	oyogidasi	beginning to swim
sonae-tuke'ru	furnish	sonaetuke	equipment
urenoko'ru	remain unsold	urenokori	unsold goods
utaida'su	burst into song	utaidasi	bursting into song

Nouns Derived from Compound Verbs

The consequences of this generalization should be obvious. In order to determine the accentuation of a deverbal noun, it is necessary to know whether the verb is a compound or not. This means that the internal structure of the verb must be available to the noun-formation rule. This violates the Adjacency Condition, and for the same reason is inconsistent with the principle that brackets are erased at the end of every cycle.

An alternative to abandoning the Bracketting Erasure Convention entirely is to modify it so that brackets are erased only at the end of every stratum, not on every cycle. The facts discussed thus far would be consistent with such an approach, since compounding and deverbal noun formation plausibly belong to the same stratum. However, it appears to be impossible to maintain even this weaker version of the Adjacency Condition.

Recall that in addition to ordinary verb-verb compounds, Japanese also possesses a class of reduced compounds, which, I have argued, contain only a morpheme boundary. Within a level ordered morphology, this distinction which I have stated in terms of boundaries will presumably translate into a distinction in terms of the stratum to which the morphological processes belong. If brackets are erased at the end of every stratum, reduced compounds should behave like simplex verbs rather than like ordinary compounds. That is to say, if the verb is accented, so should be the derived noun. In fact, as the examples below show, reduced compounds behave just like ordinary compounds.

Verb		Noun	
hikkaka'ru	be involved	hikkakari	involvement
hikkake'ru	hang, trap	hikkake	a hook
hikko'mu	withdraw	hikkomi	withdrawal
hikko'su	move	hikkosi	house-moving
hikkurika'esu	upset, overturn	hikkurikaesi	topsy turvy
ottate'ru	drive away	ottate	ejection, eviction
tukki'ru	cut across	tukkiri	cutting off
tukko'mu	dig into	tukkomi	digging into
tuppa'ru	stretch (a limb)	tuppari	a prop, a brace

Nouns Derived from Reduced Compounds

The nouns derived from reduced compounds are invariably unaccented, in spite of the fact that, like ordinary compounds, the verbs are all accented.

Thus reduced compounds count as compounds for the purposes of deverbal noun formation. Insofar as it is correct to derive reduced compounds at a different level than ordinary compounds, this means that even the revised bracket erasure convention is untenable.

There is a second potential violation of the Adjacency Condition in the precise formulation of the notion "long" second member in the rule for accenting noun-noun compounds. I stated above that the second member counts as long if it contains three or more morae. There is another situation in which the second member counts as long even if it contains only two morae; that is when it is itself a compound, as Kindaichi (1960) has observed. Stated this way, the noun-noun compounding rule violates the Adjacency Condition, since in order to determine which subcase of the rule to apply it is necessary to have information about the internal structure of the second member.

[52] Mark Liberman has pointed out to me (personal communication, 1983) that violation of the Adjacency Condition might be avoided if the relevant constraint did not refer directly to the internal structure of the second member but referred rather to its metrical structure, the latter in turn being dependent upon the internal structure. In particular, suppose that a "long" noun is one that contains more than one rhythmic foot. Then a noun that contains three or more morae will necessarily contain more than one rhythmic foot, and so will be long. But insofar as Sino-Japanese compounds contain a boundary across which a foot may not be constructed, even a two mora compound word will contain two feet and so will count as long. Thus, if the compound accentuation rule is conditioned on foot structure, and if Sino-Japanese compounds necessarily form two feet, the compounding rule can be stated without reference to the internal morphological structure of the second member since the rhythmic foot structure will preserve the requisite information. This hypothesis depends crucially on the claim that a foot may not straddle a Sino- Japanese compound boundary. The rhythmic system is as yet poorly understood, so it is hard to make any definite statement about this.The intuition of the one speaker I have consulted on this point was that the components of Sino-Japanese compounds may indeed belong to separate feet, but I am hard put to reconcile this with the description of the hypocoristic formation rule given in Chapter I. More careful study of the rhythmic system is necessary before this question can be settled.

CHAPTER THREE: INTONATIONAL PHRASING

1. Phrase Types and their Properties

I assume the existence of at least two types of intonational phrase larger than the phonological word, which, following McCawley (1968) I refer to as the minor phrase and the major phrase. The minor phrase is the unit which has the properties that we have hitherto attributed to the word. Although I will argue momentarily for a distinction between the phonological word and the minor phrase, this distinction does not manifest itself directly in the shape of the F0 contour. The phonological word plays a role in the assignment of accents, and in the choice of phrasing, but it is the minor phrase that is the smallest unit at which the shape of the F0 contour is determined. Thus, it is the minor phrase that receives a tonal melody, it is the minor phrase that is the domain of initial lowering, and it is the minor phrase that has the property of containing at most one (realized) accent.

These properties are generally attributed to words rather than to minor phrases simply because most discussions of Japanese phonology are limited to the word level. Of course, a word uttered in isolation constitutes a minor phrase by itself, so it is true that an isolated word will have all the properties of a minor phrase.

Sequences of several phonological words may be combined into a single minor phrase, in which case the several components have no individual intonational properties, and it is the phrase as a whole that is assigned a tonal melody. If, after the rule of Pre-No Deaccenting, discussed in Chapter IV, has applied, one or more of the individual components of the minor phrase is accented, the minor phrase will be accented. It is invariably the case that it is the leftmost accent that is manifested.

The properties that I have mentioned thus far are the properties of the minor phrase that are relevant to fundamental frequency, but I hasten to add that the role of intonational phrasing is broader than this implies. The discussion of stress and rhythm in Chapter I should be taken to apply to the minor phrase rather than the word. Hattori's observation about initial stress was evidently intended to refer to what I call the minor phrase, and there is some evidence in favor of a final-lengthening effect whose domain is again the minor phrase.[1] Moreover, the minor phrase is the domain of pause and pseudo-pause.[2]

The second type of phrase is the major phrase, which consists of one or more minor phrases. The major phrase is the domain of downstep, and of phrase-final tone insertion.

Whether the major phrase is also the domain of declination is unclear. Declination extends over at least the major phrase, but since my investigation of larger intonational units is fragmentary, I cannot say with any confidence whether it is restricted to the major phrase.

Before turning to the problem of how phrasing is determined, let us consider two simple examples of the contrast between the two phrasings. Japanese allows two constructions in which the so-called gerund of one verb (the verb stem followed by the suffix /te/) is followed by another verb, the latter fully inflected. In one construction the sequence is interpreted as a conjunction. The detailed semantics depends on the particular case; the sequence may be interpreted as indicating that two events took place in sequence, or the first clause may be adverbial to the second. But in all cases each verb has an independent interpretation. In principle, all verbs may enter into this construction.

In the other construction, which only certain verbs may enter into as second members, the second verb functions as a sort of auxiliary, and the overall interpretation is idiomatic. One particularly common example of this construction occurs when the verb *mi'ru* "to see" is the second verb. In this case the sequence means "to try V1-ing" that is "to V1, with the purpose of seeing how it comes out".

These two constructions generally induce different phrasings. When intended as a conjunction, the sequence typically forms a major phrase, within which each of the verbs constitutes an independent minor phrase. When intended to mean "try V-ing", the two verbs

[1] Personal communication, Osamu Fujimura, 1983. This final-lengthening effect may well indicate the existence of a higher level of hierarchical organization imposed on the binary-branching foot structure discussed by Teranishi.

[2] See Uyeno et al. (1980,1981) for discussion of pause in Japanese.

generally form a single minor phrase. This contrast is illustrated in Figures 3.1 and 3.2 where I give two examples of the contrast between the two phrasings of identical segmental material, with identical underlying accentuation. The two utterances differ only in phrasing. In both cases the verbs are /yo'nde/ "reading" and /mi'ru/ "to see". The first sentence means "reads and sees", the second "tries reading".

These pitchtracks nicely exemplify the difference in phrasing. In the conjoined case each verb has a separate high stretch (the latter reduced), between which we see the post-accentual Low tone of the first verb. In contrast, in the "try V-ing" case, only the first verb retains its accent, and the second verb forms part of the domain of the Low tone contributed by the accent on the first verb.[3]

A similar situation arises in sequences of a family name followed by a surname. This combination may optionally be realized either as two phrases or as one. The following examples are taken from Hirayama (1960;914-15).

[3] It is perhaps worth adding that in informal experiments in which an informant is asked to say which reading was intended on hearing one of these utterances, he is able to do so with great reliability.

(1)

Two Phrases	One Phrase
ono masao	ono masao
yosida itiroo	yosida itiroo
ono akiko	ono akiko
yosida tosiaki	yosida tosiaki
hara masao	hara masao
aNdo itiroo	aNdo itiroo
hara akiko	hara akiko
aNdo tosiaki	aNdo tosiaki

Notice how combination into a single minor phrase causes the initial lowering on the surname to disappear when the first word is unaccented, and how, when the first word is accented, the accent on the second word is unrealized.

Given the limited role just ascribed to the phonological word in determining the fundamental frequency contour one might wonder whether it is not best dispensed with altogether. The answer is no: the phonological word does indeed play a role in the phonology. With regard to fundamental frequency the role played by the phonological word is this: it is the phonological word that is the domain of accentual dominance. As I have indicated, within the word just as within the phrase it is generally the case that the leftmost accent wins. But there is an important difference between the two cases. Within the word leftmost prominence is the default but there are many cases in which it does not apply. In contrast, within the minor phrase, once the accentuation of the component words has been determined, leftmost dominance is exceptionless.

This effect is readily seen in a slight variation on the example of Verb-Verb sequences just presented. Suppose that we attach to the second verb the polite suffix *-mas*, whose accent is dominant, so that the accent in the second verb, *miru* shifts from /mi/ to the /ma/ of *-mas* when it is a phrase all by itself and when the first verb is unaccented even when it forms part of the same minor phrase as the first verb. However in the "try V-ing" construction, where the sequence of verbs is normally produced as a single minor phrase, it is the accent of the first verb that dominates when the first verb is the accented verb *yo'm*. If there were no level intermediate between the morpheme and the minor phrase, nothing would prevent the dominant suffix *-mas* from dominating over the whole minor phrase. But if we suppose that the phonological word forms an intermediate level and that dominance is restricted to the this level, we can explain the fact that the dominant suffix dominates over the preceding accent within the same word but not over the preceding accent in a different word of the same phrase. The facts just described are illustrated by Figures 3.3-3.6 which show the four combinations of the accented and unaccented gerunds /yo'Nde/ and /yoNde/ (from /yo'm-/ "read" and /yob-/ "call" respectively) followed as above by the verb *miru* "see/try", but this time with the polite suffix attached.

There are two additional reasons for distinguishing the phonological word from the minor phrase. First, although a minor phrase may consist of more than one phonological word, it is generally true that every phonological word can, in principle, constitute a separate minor phrase. This is not true of morphemes in general; some sequences of morphemes may constitute a minor phrase by themselves, while others may not. The ones that can correlate very well with what on other grounds is referred to as the phonological word. Thus, it makes sense to say that there are entities called phonological words, and that these are concatenated to form minor phrases.

Second, recall that an underlying accent on the final mora of a word uttered in isolation is not realized. This, like most other tonological properties usually attributed to words might be taken to be a property of the minor phrase instead, but as I will show in Chapter IV it is in fact a property of words. Thus, Final Deaccenting requires the phonolgical word as its domain.

For these reasons, I will distinguish the phonological word from the minor phrase, in spite of the fact that it is the minor phrase that is the smallest unit to have independent intonational status.[4]

2. Principles Governing Phrasing

I turn now to the question of how intonational phrasing is determined. I should emphasize at the outset the tentative nature of the account presented here. The topic is a difficult one, and it has not been the primary focus of my research. Consequently, there are numerous gaps in the data, and many topics about which I will have nothing to say.

I attempt here to present enough of an account of intonational phrasing to accomplish three goals. These are: first, to give some context to the utterances used in the experiments described below; second, to bring out such theoretically interesting points as seem reasonably clear in spite of the tentative nature of the account; and, third, to correct a number of inaccuracies in previous accounts.

2.1. Major Phrase Divisions

Consider first the location of major phrase boundaries. Beyond the elementary fact that they coincide with minor phrase boundaries, there is no previous work on this topic, and I have little to add beyond a few brief observations about places in which they tend to occur. These are the following.

First, the topic phrase (marked by the particle *wa*) is generally set off from the rest of the sentence by a major phrase boundary, as indicated by the fact that it seems to have no effect on the following material. Moreover, it is typically lower than the following material, as can be seen in many of the example sentences below. Second, major phrase boundaries tend

[4] One other property that one is tempted to attribute to the phonological word is the satisfaction of the phonotactic constraints. In fact, as we have seen in part in the previous chapter, the phonotactic constraints are satisfied at what we might call the "internal word boundary" or "compound boundary" level, internal to the phonological word.

to occur at clause boundaries of the following types.

When two or more clauses are conjoined, and the verbs are not adjacent, a major phrase boundary typically appears between each pair of sentences. Thus, a sentence like the following will generally be pronounced with two major phrases, as indicated by the brackets.

(2)	[Taroo	ga	yama	e	itte],	[Hanako	ga	umi	e	itta.]
	Taro	N	mountain	AD	going	Hanako	N	sea	AD	went

Taro went to the mountains and Hanako went to the sea.

A subordinate clause not headed by a noun frequently forms a separate major phrase from the matrix clause. Thus, in a quotation like that in the following example the quotative clause terminating in the quotative complementizer *to* constitutes a separate major phrase from the matrix clause, even though, as the use of the verb kuru "come" rather than iku "go" indicates, this is not a direct quotation. This is because the choice of directional verb is governed by different principles in Japanese than in English. One uses the verb *iku* to describe motion toward the location of someone else, and *kuru* to describe motion toward one's own position. Thus, if A invites B to visit A's house, B assents with *iku* rather than (See Soga 1977 for discussion of directional verbs.) In the example sentence, the fact that the speaker uses kuru guarantees that the reported speech is not a direct quotation.

(3)	[Tanaka-saN	ga	kuru	tumori	da	to]	[Hanako	ga	kotaete	itta].
	Tanaka Mr.	N	come	intention	be	Comp	Hanako	N	answering	said

Hanako answered that Mr. Tanaka intends to come.

2.2. Minor Phrases

We turn now to the distribution of minor phrases, about which there is much more to say. We begin by defining the minimal minor phrase, that is, the class of sequences of morphemes that must form a single minor phrase, and then turn to the conditions under which multiple minimal minor phrases may form a single minor phrase.

2.2.1. The Minimal Minor Phrase

The minimal minor phrase is the phonological word, consisting of a lexical item (Noun, Verb, Adjective, Determiner or Adverb) plus any particles[5] that follow it.[6] The particles in question include the following.

(1) The case particles *ga* "nominative", *o* "accusative", *ni* "dative", *de* "instrumental-locative", *kara* "ablative", *yori* "comparative", *made* "allative", *e* "adessive".

(2) The topic particle *wa*.

(3) The quantificational particles *mo* "even", *sae* "even", *dake* "only", *nomi* "only", *sika* "only (negative polarity)".

(4) The sentence-final particles *ka, kai* , *dai* , and *no* "interrogative", *wa* , *yo* , *zo* and *!ze* "emphatic", and *ne* "n'est-ce pas".

(5) The conjunctions *to* , *ya* , *yara* and *nari*.

(6) The copula *da* in its various forms.

Notice that such particles do not necessarily belong to the same syntactic phrase as the word to which they attach. Rather, they attach to the rightmost word of the constituent to which they belong. This may be as small as a Noun Phrase, as in the case of the case particles, or as large as an entire sentence, as in the case of the sentence-final particles.

There is one apparent exception to the generalization that the minimal minor phrase is the lexical item plus some particles. Aoyagi (1969) points out that some prefixes form words that have tone patterns of the form H+L(L)H+L*. In our terms, such a tone pattern is

[5] The term *particle* (Japanese *josi* "auxilliary word") is used in Japanese grammar to describe a large and varied class of morphemes whose unifying property is that they are relatively loosely bound to the word to which they are attached. They might, and have been, described as clitics, but the latter term, while nearly as imprecise, might be taken to imply that they are clearly separate syntactic terminals, when in fact this is quite unclear.

[6] This is essentially what Hashimoto (1934) describes as the *buNsetu*.

incompatible with the word constituting a single minor phrase. Some examples are given below.

Such tone patterns are incompatible with single minor phrase status in two ways. In all cases, the presence of two distinct Highs is incompatible with membership in the same minor phrase. Moreover, in some cases the first syllable of the stem is Low, indicating that Initial Lowering has applied, and Initial Lowering occurs only at the beginning of a minor phrase.

(4) Examples of Phrase Boundary Prefixation

hi	un-	higooriteki	illogical
ki	your (honorific/formal)	kisyokaN	your letter
mo'to	former	motodaiziN	former minister
zeN'	former	zeNsyusyoo	the former premier
hoN	this, the present	hoNkaigi	this conference here

The conditions under which a minor phrase boundary occurs between the prefix and the stem are difficult to describe, although Aoyagi makes a number of interesting observations. It is not the case that the boundary is in some sense inherent in the prefix. The very same prefix is followed by a phrase boundary in some words but not in others.

One circumstance, Aoyagi points out, under which the prefix tends to be followed by a phrase boundary is when it is emphasized or contrasted. Thus, if one wishes to contrast, say, "social" and "anti-social" behaviour, "anti-social" will likely be pronounced as follows:

(5) haNsyakaiteki

Secondly, the phrase boundary may be used only when it has wide semantic scope, that is, scope over the whole word. Thus, Aoyagi points out that when the prefixes in question are affixed to adjectives ending in the adjectival suffix /-teki/, the prefix is usually followed by a minor phrase boundary. But when the wide scope translation is impossible, as in the word "inhuman", as distinct from "not humane, not human" the word must be pronounced as a single minor phrase, so that "inhuman" can only be pronounced as in (6a), not as in (6b).

(6)

(a) hiniNzyooteki

(b) hiniNzyooteki

Although the morphemes in question have always been described as prefixes, we might entertain the possibility that this description is inaccurate, and that they are more properly treated as closely bound but phrasal modifiers, like the determiners *kono* "hoc", *sono* "iste", *ano* "ille" and *a'ru* "certain". In this case, they would pose no problem for the claim that no sub-lexical element can form a separate minor phrase. No definitive answer can be given to the question of whether these morphemes should be considered prefixes or determiners without further investigation of the domains of various phonological rules and manner in which semantic scope is determined, but there is some evidence that these morphemes should indeed be considered to be prefixes rather than determiners.

First, these morphemes can attach only to the word that they modify, unlike determiners, adjectives and other phrasal modifiers which may attach to whole phrases. This contrast is illustrated below. The determiner *sono* may precede either a single noun or a whole Noun Phrase, but the morphemes *ki* and *mo'to* must attach to a single noun.

(7)

sono daigaku	that university
kidaigaku	your university
motodaiziN	former minister
sono yuumei na daigaku	that famous university
*ki yuumei na daigaku	your famous university
*moto yuumei na daiziN	a formerly famous minister

Contrast in Attachment Domain between Prefixes and Determiners

In the same vein, a phrasal modifier may have semantic scope over a whole phrase but the morphemes in question have scope only over the immediately following word. This is illustrated below.

(8) Contrast in Scope of Determiners and Prefixes

sono	uma	no kubiwa
that	horse	G collar

the collar of that horse (narrow scope)
that horse-collar (wide scope)

moto	daiziN	no komoN
former	minister	G adviser

adviser to the former minister (narrow scope)
*former adviser to the minister (wide scope)

Since these morphemes attach exclusively to words and have semantic scope only over words, it is difficult to see how they could be treated phrasally.

Yet another fact argues in favor of the lexical rather than phrasal status of these prefixes. One striking and pervasive fact about Japanese morphology is the stratification of the lexicon. Japanese has in the course of history borrowed thousands of Chinese morphemes. By and large these morphemes do not stand alone; they must occur in combination with other morphemes. Moreover, although there are occasional exceptions, morphemes of one lexical stratum combine only with morphemes of the same stratum. Sinitic morphemes combine with Sinitic morphemes; Native Japanese morphemes combine with native Japanese morphemes. The majority of the prefixes in the class in question are of Sinitic origin (of the examples cited only *moto* is a native Japanese morpheme) and just like other Sinitic morphemes they generally combine only with other Sinitic morphemes. With the exception of *moto* I am unable to cite any well-formed examples of combinations of the cited morphemes with native Japanese words.

Needless to say, membership in a lexical stratum is a lexical property, and this sort of constraint is typical of lexical processes, but quite unheard of for a phrasal collocation. This strongly suggests that these prefixes should be considered to be affixed in the lexicon, that is that they are indeed prefixes and not tightly bound phrasal modifiers.[7]

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[7] There is one other fact that is worth noting in this regard, although it is not conclusive. Japanese has a rule known as the Rendaku Rule, which, subject to incompletely understood

It thus appears that there are prefixes which may constitute minor phrases by themselves. If so, this shows minimally that units smaller than syntactic words may constitute phonological phrases.

This fact has further theoretical implications. There are two approaches to the conditioning and domain of post-lexical rules. One, represented especially by the work of E. Kaisse (Kaisse 1984, Lobeck 1983, Lobeck & Kaisse 1984, Manzini 1983), makes no use of supra-lexical phonological constituents, preferring instead to make direct reference to syntactic structure where necessary. The other, represented especially by the work of E. Selkirk (1984), proposes that there are supra-lexical phonological constituents, whose construction is conditioned in part by syntactic structure, and that it is these phonological constituents that govern post-lexical phonological rules. The fact demonstrated here, that minor-phrase boundaries may be delimited in part in the lexicon, argues in favor of the latter approach, for in any theory in which words are syntactically unanalyzable the post-lexical rules that refer to the minor phrase could not analyze the words that contain the prefixes in question and could therefore treat them only as single minor phrases.

2.2.2. Compression of Minimal Minor Phrases

We have now determined which sequences of morphemes constitute minimal minor phrases. It remains to discuss the ways in which minimal minor phrases may be combined to form larger minor phrases. The traditional assumption is that the possible intonational phrases are a subset of the proper analyses of the syntactic tree. McCawley (1968) in effect claimed that this was true of Japanese, since his hypothesis that boundary markers are deleted cyclically is equivalent to the proper analysis theory. Recently, Selkirk (1978) has

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conditions, voices the initial consonant of the second member of a compound. Otsu (1980) points out that *reNdaku* is also generally triggered by prefixes. However, none of the prefixes that can be followed by a phrase boundary ever trigger *reNdaku*, which suggests that they do not belong to the same phonological word as the stem. However, this argument is not conclusive, since there are, as Vance (1980) points out, a few prefixes that do not trigger *reNdaku* which do not belong to the class in question. These include the honorific prefixes *o* and *go*, which have accentual effects on the word to which they are attached, and so presumably must belong to the same word.

argued that in English there are cases in which intonational phrases are not constituents at any level of analysis. As we shall see, such cases occur in Japanese as well.

By and large, the proper analysis theory works well for Japanese. The possible analyses of the tree are bounded below by the definition of minimal minor phrase. It is not clear whether there is any strict upper bound on the proper analyses, although it is certainly true that speakers tend to avoid extremely large minor phrases. A good candidate for a strict restriction is that minor phrase boundaries may not be deleted in the locations in which major phrase boundaries tend to occur.[8] Thus, it is possible for a Noun Phrase consisting of an Adjective and a Noun to be produced as either one minor phrase or two, depending on the level at which the analysis of the tree stops.

There is at least one situation in which reanalysis of the syntactic tree is required. This occurs in relative clauses. In Japanese a relative clause is formed by preposing the sentence, with a gap corresponding to the head noun, to the head. Since Japanese is rigidly verb final, this means that the verb of the relative clause always immediately precedes the head noun. The verb and the following head noun frequently form a single minor phrase which, however, does not include the remainder of the relative clause, This cannot be accounted for in terms of proper analysis, since the verb must be extracted from its parent constituent and adjoined to the head noun. [9]

A similar situation arises in Noun Phrases consisting of a series of adjectives followed by a noun. In such cases it frequently happens that the last adjective forms a minor phrase with the noun, to the exclusion of the preceding adjectives. However, here the case that this cannot be handled by proper analysis is inconclusive, since it is unclear whether the string of adjectives forms a constituent. If not, that is if each adjective depends from a different level of a binary-branching NP, then the rightmost adjective forms a constituent with the noun and no

[8] It is axiomatic that if there are any obligatory major phrase boundaries, a minor phrase may not be constructed across such a site.

[9] It is tempting to speculate that the function of this phrasing is to prevent gardenpathing. Otherwise, the material up to and including the verb might look like a complete sentence.

reanalysis is required.

Whether or not reanalysis is necessary in the latter case, both examples can be handled by a rule that adjoins a verb (and possibly adjective) to the head of its grandparent. It is not clear how this rule should be constrained, but it is not fully general. In a structure of the form [[Adjective Noun] Genitive Noun] it is not possible for the first noun to be combined into a single phrase with the second noun, to the exclusion of the Adjective. The latter phrasing is perfectly possible, but it is interpreted with wide scope of the adjective. This indicates either that there is some constraint on what material may precede the extracted word, or that there is a constraint on the extracted word itself, perhaps that it must be a verb or adjective.

Finally, given that there are some cases of reanalysis of this type, let us consider the example that motivated McCawley's cyclic analysis. His argument was based on the observation (attributed to Akira Komai) that the sentence "Doo ittara ii desu ka?" "How would it be best to go?" has the phrasings listed below.

(9) Phrasings of McCawley's Example Sentence

Doo ittara ii desu ka
how go-if good be ?

(a) [do'o] [itta'ra] [i'i desu ka]

(b) [do'o ittara] [i'i desu ka]

(c) [do'o ittara ii desu ka]

(d)*[do'o] [itta'ra ii desu ka]

If only proper analyses are permitted, the above pattern is exactly what is predicted. But if adjunction of a verb to the head of its grandparent is permitted, how can we account for the impossibility of (4)? It seems that there are a number of possible accounts. First, it is not clear whether the apodosis should count as the head of the sentence. I know of no syntactic analysis of the structure of such sentences, so I cannot say whether or not the apodosis is the syntactic head of the utterance. If it is not, then there is no problem, since adjunction is only to heads. Even if the apodosis is the head, we might restrict the adjunction rule to lexical heads, which would solve our problem since the apodosis is surely clausal. Yet another possibility is to say that only tensed constituents are candidates for adjunction. Assuming that the conditional form of the verb is not tensed, adjunction would be ruled out in the example in question.

We have seen that there are two mechanisms by which minimal minor phrases may be combined to form larger minor phrases, unification of syntactic constituents, and adjunction to the head of the grandparent. It remains to consider what factors govern the choice of phrasing in a particular environment.

A variety of factors influence the choice of phrasing. First, there is a semantic factor. A focused constituent always forms a minor phrase of its own.

Second, there are phonological factors of two kinds. The size and number of the minor phrases within a parent constituent influences the decision as to whether to unify the parent. There is a tendency to avoid constructing excessively large minor phrases. The accentuation of the non-rightmost constituents is also relevant. Other things being equal, an unaccented word is more likely to be attached to the word to its right than is an accented word.[10]

Finally, the syntactic structure has an important influence on the phrasing chosen. We have already seen one aspect of this, in the formulation of adjunction to heads, which makes use of the syntactic notion of head of a phrase. Another important syntactic factor is deducible from the constraint that, abstracting away from reanalysis, only proper analysis are permitted. This is the fact that the scope of a modifier determines whether or not it may form a phrase with the immediately following material. If the modifier has narrow scope, such a phrasing is possible, but if it has wide scope, it may not form a phrase with the following word to the exclusion of the remainder of the constituent. This follows from the proper analysis constraint if we make the common assumption that modifiers with wide scope are

[10] A possible functional explanation is that an unaccented word has no effect on the accentuation of the word to which it is adjoined, so no information is lost, whereas adjunction of an accented word has the effect of deleting any accent on the following word.

attached higher than modifiers with narrow scope.

There is one other syntactic effect that is not deducible from other principles. This is the fact, discussed above in the section on the properties of phrases of different types, that Verb Verb sequences of different types have different typical phrasings. When the two verbs have independent readings, as in the case of sentential conjunction or subordination, the two verbs typically form separate minor phrases, whereas when the second verb has a quasi-auxilliary status, as in the use of *miru* in expressions meaning "try V-ing", then the two verbs generally form a single minor phrase.

To summarize, the minimal minor phrase is approximately the same as the phonological word. Any proper analysis of the syntactic tree is also a possible minor phrase, bounded below by the minimal minor phrase, and possibly with some upper bound. However, there are situations in which reanalysis of the syntactic structure takes place, namely when adjunction to the head of the grandparent occurs. Finally, the choice among the possible phrasings is governed by focus, syntactic structure, and phonological form.

3. Criticism of Previous Accounts

There is little previous discussion of intonational phrasing in Japanese, and most of it bears only on small details. The only attempts at comprehensive accounts with which I am familar are due to McCawley (1968) and Miyara (1981).

3.1. McCawley (1968)

McCawley has nothing to say about the division of an utterance into major phrases, other than that major phrase boundaries occur only at minor phrase boundaries. He restricts himself to the partition into minor phrases, of which he claims to give a comprehensive account.

McCawley claims that a minor phrase boundary is inserted after every Noun Phrase, Adverbial Phrase, Verb, Auxiliary, and subordinate clause. Insertion of these boundaries is not optional; any phrase boundary that does not surface is deleted by rule.

McCawley posits two rules that delete minor phrase boundaries, both cyclic. These he states as follows (1968;181):

(1) Lower % to # if no <1 acc> either precedes or follows it.

(2) Optionally lower all %'s to #'s.

McCawley uses % to represent minor phrase boundary and # to represent word boundary, so these rules have the effect of deleting minor phrase boundaries. The first rule is apparently incorrect as stated, since in the text (pp.177-8) McCawley twice describes it as deleting the minor phrase boundary if either of the phrases is unaccented, rather than only if both are.

Since the second rule subsumes the first, McCawley apparently means to claim that minor phrase boundary is more likely to be deleted between constituents one of which is accented than between between constituents one or both of which is accented. This is partially true: boundary deletion is more likely if the first phrase is unaccented than if it is accented, but I do not believe that the accentedness of the second word makes any difference. McCawley may have been confused by the very low relative F0 of an unaccented word following an accented word within the same major phrase. In this position an unaccented word has a very low F0 since it is both downstepped and unaccented, as I will explain in some detail below. This could easily be mistakenly attributed to its belonging to the same minor phrase and therefore being Low toned.

In sum, McCawley's position is that intonational phrasing is constructed by taking some proper analysis of the syntactic tree. The only factor governing the choice among proper analyses that he mentions is the accentedness of the component phrases.

As far as it goes, then, McCawley's account is substantially correct. It errs in claiming that there is no reanalysis of the syntactic structure. Beyond this, it is merely incomplete in not mentioning more of the factors that can influence the choice of phrasing.

3.2. Miyara (1981)

Miyara (1981) presents a radically different account of phonological phrasing, arguing that intonational phrasing is not governed by the syntactic structure at all. All that he refers to is the terminal string and the category labels of its elements. He devotes much effort to demonstrating that intonational phrases do not correspond to syntactic constituents. While there is indeed some evidence for this, Miyara's arguments are not all compelling, and certainly do not justify the radical theory that he proposes.

Miyara has one good example of non-isomorphism of syntactic and phonological structure. This is the example, discussed above, of the verb and the nominal head of a relative clause forming a single minor phrase.

Beyond this, his arguments are weak. One argument involves the fact that clitics, such as the topic particle *wa*, cliticize to the head of the phrase to which they are attached. It is perfectly true that such a phrasing is not compatible with a strict proper analysis, but such examples are well known and even the adherents of the proper analysis theory have always recognized this limited exception.

Other arguments are completely incomprehensible. Why Miyara (1980;85) should consider it problematic for the proper analysis theory that the conditional form of the verb, consisting of the verb stem plus the suffix *-tara,* constitutes a single minor phrase, I do not know.

All in all, the only real argument that Miyara presents against the proper analysis theory is the observation about phrasing in relative clauses. While this does show that some sort of reanalysis is necessary, the fact that non-isomorphism appears in such a limited form should warn against too readily adopting the radical proposal that he makes.

Miyara's account of phonological phrasing is limited to the construction of minor phrases. He claims that phonological phrasing is determined by applying a single template to the terminal string, without regard for hierarchical structure, and constructing maximal minor phrases from left to right. Anything left over at the end of the utterance also forms a separate minor phrase. His template is the following:

(10) Miyara's Template for Minor Phrases

X (particle) (quantifier) (particle)

where X is any string that does not contain a particle.

The problems with this approach are threefold. First, the claim that phrasing is determined entirely by a maximal parse into units matching some single template fails to allow for the observed variability of phrasing. It is simply not true that any given utterance permits only a single phrasing.

Second, the claim that syntactic structure is irrelevant to phrasing is untrue, as argued above at some length. The fact that intonational phrasing is not exactly equivalent to a proper analysis of the syntactic tree is not equivalent to the claim that syntactic structure is irrelevant.

Third, the particular template proposed makes a number of incorrect predictions. First, it predicts that a sequence of the form Noun Particle Quantifier, as in examples (11) and (12), will necessarily constitute a single minor phrase. This is not true. In fact, in such sequences the quantifier normally constitutes a separate minor phrase; it is rare for it to form a single phrase with the preceding noun.

(11)

```
Biiru o   nihon      motte    kite kudasai.
 beer A  2-bottles   carrying come  please
 N    P    Q
```

''Please bring two bottles of beer.''

(12)

```
Taroo no tomodati ga minna  kita.
 Taro   G friends   N all    came
             N      P  Q
```

''All of Taro's friends came.''

Similarly, Miyara incorrectly predicts that a family name and following surname must be part of the same minor phrase since no particle intervenes, when in fact such a sequence may be parsed into either one or two phrases, as Hirayama (1960) points out.

Third, Miyara's template predicts that determiners like kono "hoc", sono "iste", ano "ille" and a'ru "certain" must form a single minor phrase with the following noun. This is not true. Such a phrasing is entirely possible, but it is also possible for the determiner to form a phrase by itself, especially if it has wide scope so that the immediately following noun is not the head of the smallest NP containing the determiner.

Finally, consider sequences of the form Adjective* (Noun) or Verb* (Noun). Miyara's template makes two predictions in such cases. First, if the sequence ends in a noun the preceding adjective or verb must belong to the same minor phrase. Second, whether or not the sequence ends in a noun, all of the adjectives and all of the verbs must form a single minor phrase.

Neither of these predictions is correct. In the former case, it is possible for the verb or adjective to form a phrase with the noun, but it is by no means obligatory. In the latter case, it is again possible, under some circumstances, for the adjectives and verbs all to form a single phrase, but it is not obligatory, and indeed in some circumstances it is nearly impossible. For example, when two verbs are conjoined, as in the examples discussed above in the section on properties of different phrase types, it is usual for them to form separate phrases. Similarly, if one of the adjectives is focused, it must form a minor phrase by itself, and even if it is not focused it may well do so. Figure 0.2 shows an example of a major phrase consisting of two adjectives followed by a noun. As evidenced by the separate peaks, the two adjectives belong to separate minor phrases.

Miyara's account is thus subject to two objections. First, the particular template he proposes is incorrect. Second, regardless of the template chosen, no account of this type can be correct given the observed variability of phrasing, and the range of factors that govern it.

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Example of contrast between two phrasings of [yoNde miru]. The upper trace contains two minor phrases, the lower trace a single minor phrase. Both traces are to the same scale.

Fig. 3.2
Example of contrast between two phrasings of [yoNde miru]. The upper trace contains two minor phrases, the lower trace a single minor phrase. Both traces are to the same scale.

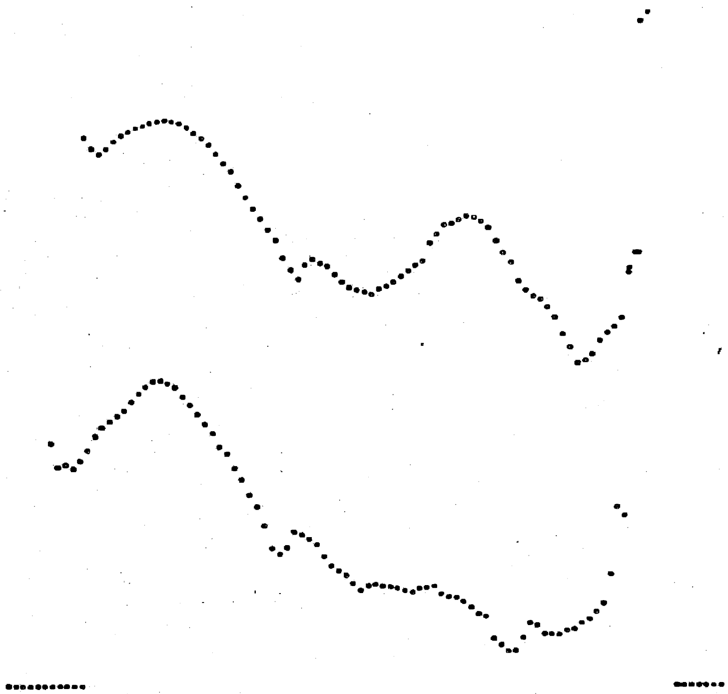
Fig. 3.3
[yo'Nde mima'su] read as two phrases with meaning "read and see". The upper trace (#13) is the F0 contour. The middle trace is the first log-area linear prediction coefficient. The lower trace is amplitude.

Fig. 3.4
[yo'Nde mima'su] read as one phrase with meaning "try reading". The upper trace (#13) is the F0 contour. The middle trace is the first log-area linear prediction coefficient. The lower trace is amplitude.

Fig. 3.5
[yoNde mima'su] read as two phrases with meaning "call and see". The upper trace (#13) is the F0 contour. The middle trace is the first log-area linear prediction coefficient. The lower trace is amplitude. The marked dip in the F0 contour in the middle of the peak is due to the /d/.

Fig. 3.6
[yoNde mima'su] read as one phrase with meaning "try calling". The upper trace (#13) is the F0 contour. The middle trace is the first log-area linear prediction coefficient. The lower trace is amplitude.

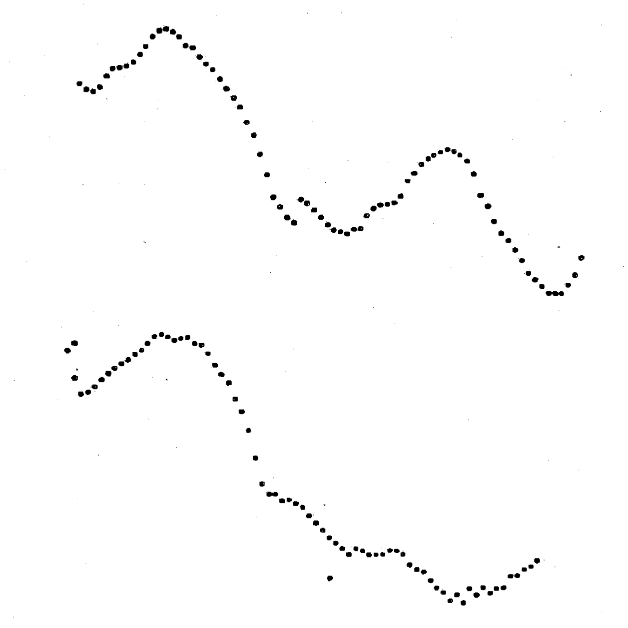
pdpdisc/11/mnt3/usr2/ym1/p4
yōnde mīru (read and see)



yōnde miru (try reading)
pdpdisc/11/mnt3/usr2/ym1/p8

FIG 3.1

pdpdisc/11/mnt3/usr2/ym8/p8
yōnde mīru (read and see)



yōnde miru (try reading)
pdpdisc/11/mnt3/usr2/ym5/p2

FIG. 3.2

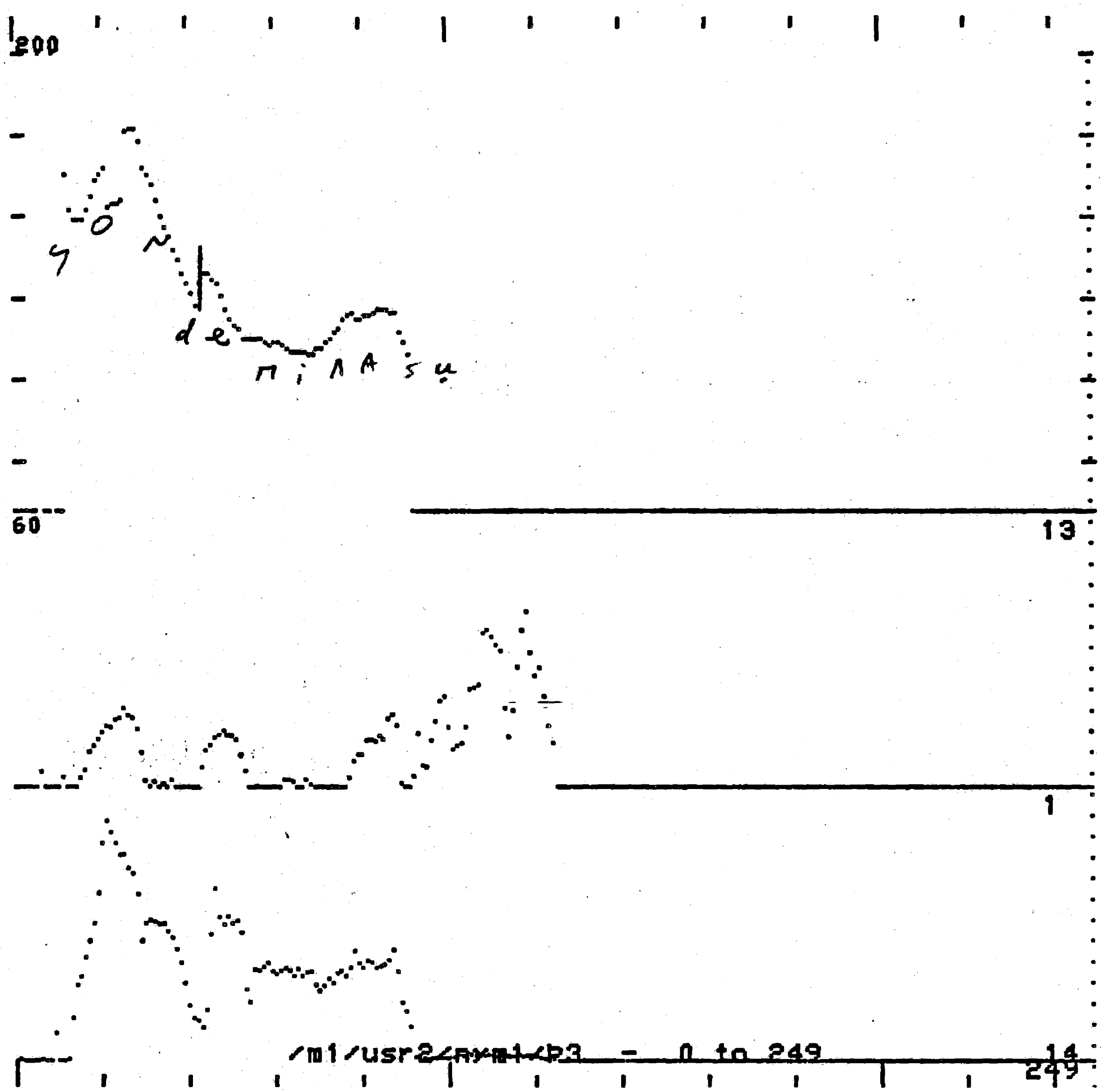


FIG. 3.3

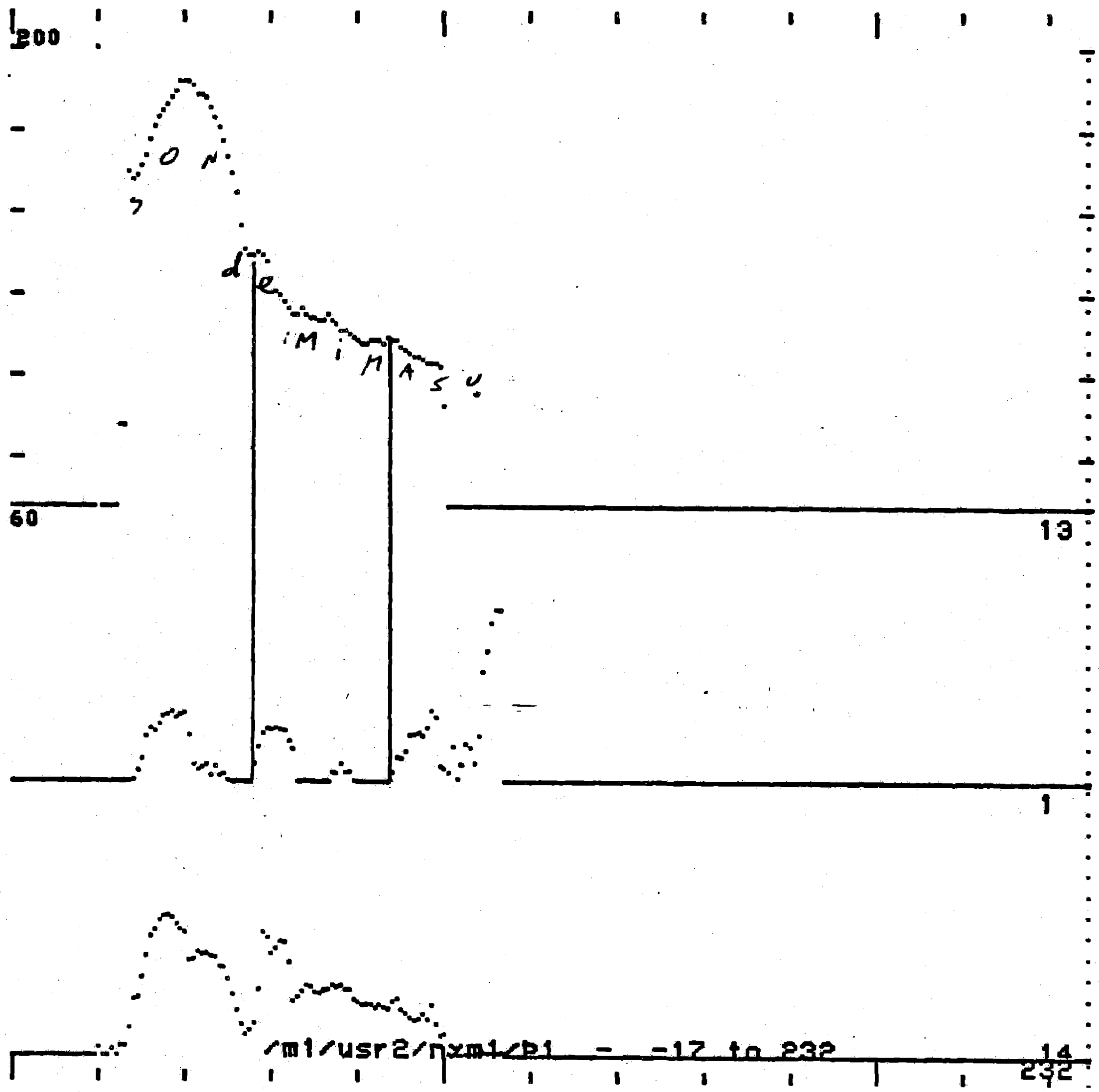


FIG 3.4

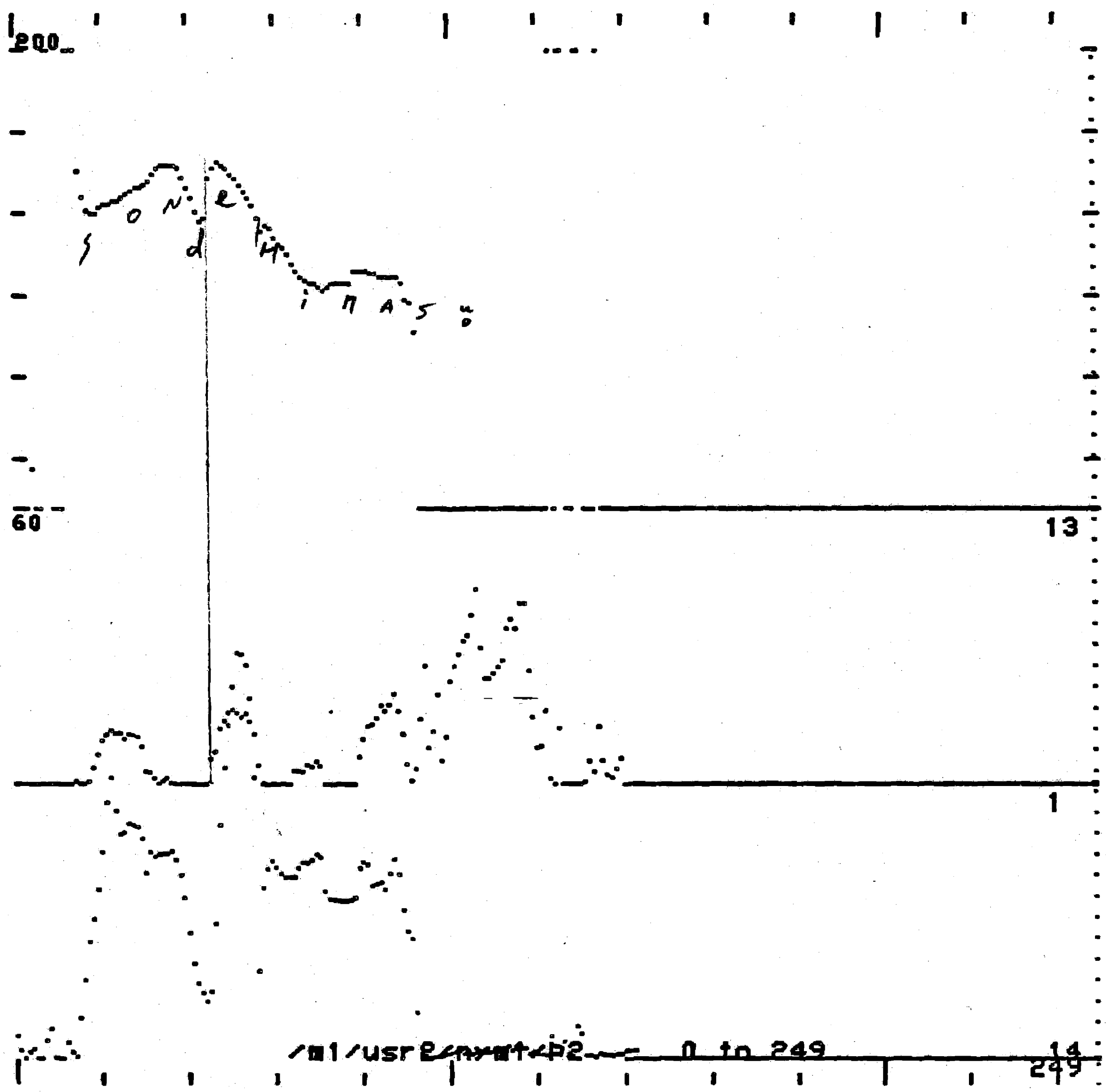


FIG. 3.5

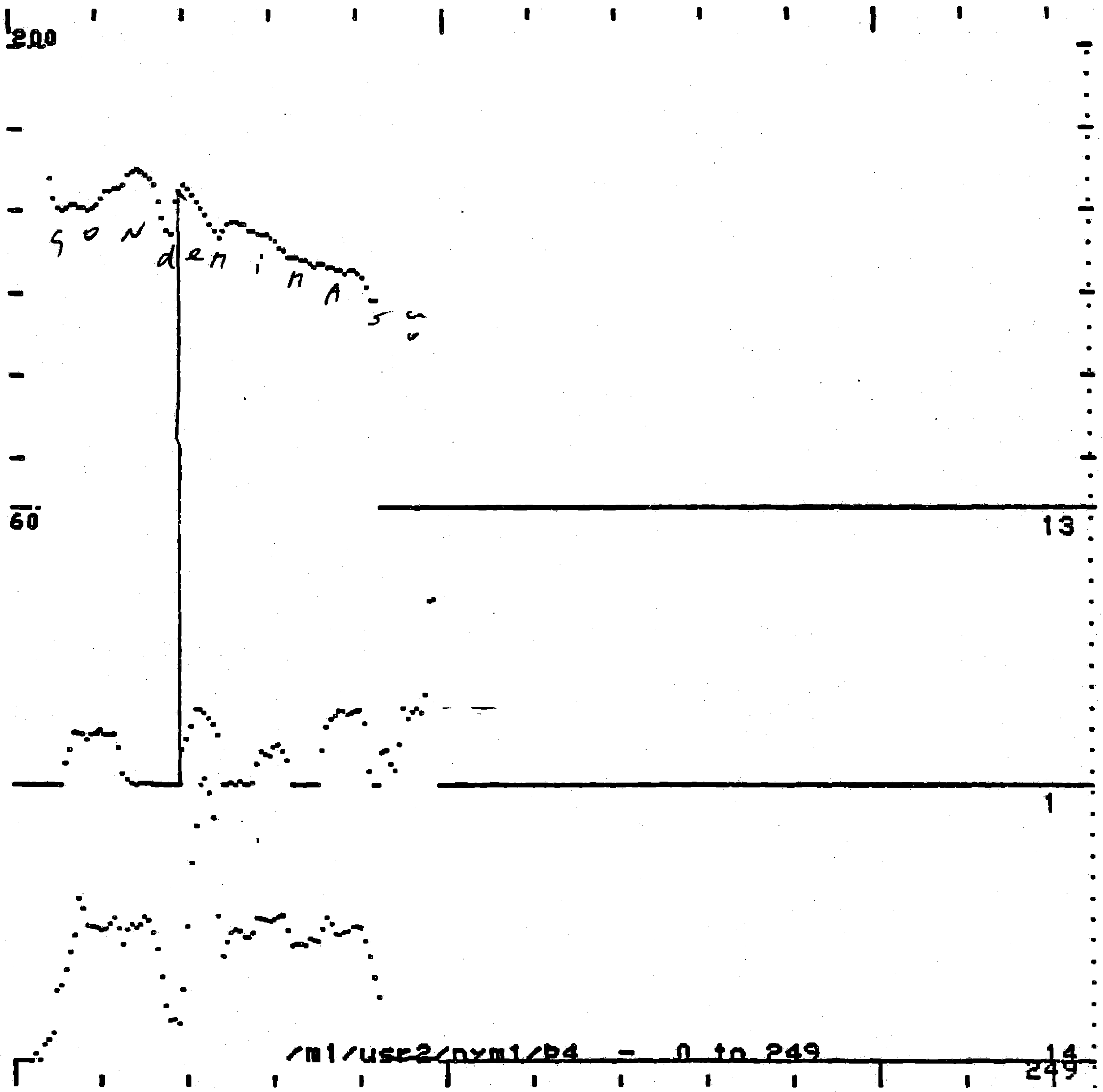


FIG. 3.6

CHAPTER FOUR: POSTLEXICAL PHONOLOGY

In this chapter and the next I describe what happens when words are combined into phrases. All of this is, by definition, post-lexical; what may be controversial is which part is phonology. The division made here may be justified in two ways: in terms of the method of investigation and in terms of more strictly theoretical considerations. The present chapter is based primarily upon impressionistic data and concerns the topology of the F0 contour. The following chapter is based entirely on instrumental data and concerns the metrical properties of the F0 contour. Moreover, while there is every reason to believe that the phenomena described in the present chapter are phonological, which is to say describable in terms of accents and/or tones, the phenomena described in the following chapter are continuous in nature and it is dubious whether the rules involved can be described as having the same character as more clearly phonological rules. Finally, it happens that the present chapter, aside from a brief discussion of major phrase_level boundary tones, deals exclusively with phenomena internal to the minor phrase, whereas the following chapter deals with the relationship between successive minor phrases within the same major phrase.

I will divide the postlexical rules into three categories. First, there are the rules that resolve conflicts of accents at the phrasal level. Second, there are the rules that assign tone patterns to phrases. Finally, there is at least one other rule that most apply post-lexically. This is the rule of Pre-No Deaccenting. There may well be other rules in this category, but at present I can describe only this one with any confidence.[1]

---

[1] There are a number of particles that have accentual effects on the preceding word whose syntactic status is unclear. On some analyses, these might turn out to be independent syntactic words that would have to be attached post-lexically, but in the absence of clear evidence of this I take them to be lexically attached. In addition, I have found that the so-called unaccented adjectives become accented in certain environments which it appears can be characterized as predicative position. At first glance this appears to require a post-lexical rule, but if I am correct in characterizing the opposition as attributive/predicative then we may have recourse to a morphological solution, since segmental morphological marking for this distinction is not unknown, being the norm in Korean as well as Classical Japanese.

1. Pre-*No* Deaccenting

In addition to the rules that create intonational phrases and give them their properties, there is one other rule that must be postlexical. This is a rule that, subject to various conditions that I will discuss shortly, deletes the accent of a noun preceding two morphemes both of which have the segmental form /no/.

1.1. The Various Particles *no*

It is important to distinguish a number of particles all of which have the segmental form *no*. The ones that are of interest to us are the genitive particle, which marks possession, as well as subjecthood in certain constructions and the prenominal allomorph of the copula. A typical example of the genitive is a phrase like (1).

(1)

Taroo	no	hoN
Taro	G	book

Taro's book

The second type of *no* is one of the pre-nominal allomorphs of the copula *da*. This usage is exemplifed in a phrase like that in (2), when it is interpreted as a relative clause. Of course, this segmental sequence could also represent the genitive particle, so it is ambiguous between "uncle, who is a doctor" and "doctor's uncle".

(2)

isya	no	ozisaN
doctor		uncle

There are two reasons for treating this use of *no* as an allomorph of the copula. First, it explains the semantics of phrases like (2). If *no* were always the genitive particle we should have no explanation for the fact that the relative clause interpretation is always possible. Second, *no* replaces a number of other forms of the copula. Some of these are listed below.

(3)

Prenominal Copular Expressions	
gakusei no hanako	Hanako, who is a student
gakusei de aru hanako	Hanako, who is a student
gakusei de wa nai hanako	Hanako, who is not a student
gakusei datta hanako	Hanako, who was a student
geNki na hanako	Hanako, who is healthy
byooki no hanako	Hanako, who is ill
utyooteN na hanako	Hanako, who is ecstatic
utyooteN no hanako	Hanako, who is ecstatic

The first sentence provides a nearly unambiguous example of the copular interpretation of *no*, since the interpretation "the student's Hanako" is unlikely. The second is synonymous, but *no* has been replaced by the more formal form *de aru*. The next two examples show that *no* is replaced by other forms when the copula is negated or made past tense.

The last four examples illustrate the relationship between copular *no* and the other non-formal present affirmative allomorph of the copula, *na*. Some nominals, such as *geNki* "healthy", select *na*, while others, such as *byooki* "ill", select *no*. The choice of *na* or *no* is a lexical property of the nominal, and is subject to some variation from speaker to speaker. Moreover, as the last two examples show, the same speaker may permit either *na* or *no* following certain nominals. These examples show that *no* occupies a slot in the paradigm of the copula *da*. For these reasons, it is generally admitted that one type of *no* is an allomorph of *da*.[2]

The third usage of *no* is as a dummy head noun. In a variety of constructions that require a semantically empty nominal head, the head is realized as *no*. For example *no* serves as the equivalent of English "one" in pseudocleft constructions, as we see in the following

[2] The idea that *no* is an allomorph of *da* is due to Bloch (1946).

examples.

(4) Examples of *no* as Head of Pseudoclefts

akai	no		
red-pres			

"the red one"

hanako	ga	katta	no
Hanako	Nom	bought	

" the one that hanako bought"

Finally, *no* serves as a replacement for the interrogative particle *ka* in intimate speech.

(5) Interrogative *no*

iki-mas-u	ka
go-polite-present	?

ik-u	no
go-pres	?

Both sentences mean "Are you going?". The first is polite, while the second could only be addressed to a child or other intimate, and is moreover a bit feminine in style.

There are thus at least four different usages of the particle *no*: [3]

(1) genitive case

(2) attributive copula

(3) dummy head noun

(4) interrogative particle

---

[3] The taxonomy presented is by no means exhaustive. I have not illustrated all of the circumstances in which *no* serves as a dummy head noun (others include as the nominalizer in perception verb complements and in pivot-independent relative clauses) nor have I included cases whose status is unclear, such as the *no* in the *no da* construction. For my present purpose, it is important only that at least these four categories exist. I defer discussion of Kitagawa & Ross (1982)'s proposal that a single rule inserting *no* in certain environments can subsume all of the different usages of *no* to the end of this section.

1.2. Deaccenting *no*

Of these various types of *no*, only the genitive particle and the copula trigger deaccenting. Thus, in the following example the noun /onna'/ loses its accent regardless of which interpretation the phrase is given.[4]

(6) Deaccenting before Genitival and Copular *no*

onna	no	yaoya
woman		grocer

the woman's grocer
the woman, who is a grocer

On the other hand, neither the nominal *no* nor the interrogative particle *no* triggers deaccenting. The failure of the nominal *no* to trigger deaccenting is illustrated by the example below. The alternative, with deaccenting, is unacceptable in this sentence.

(7) Failure of Nominal *no* to Trigger Deaccenting

Da'isuki	na	no	wa	kuro'i	no	da.
preference	be		T	black-pres		be

The one that (I) prefer is the black one.

The failure of the interrogative *no* to trigger deaccenting is illustrated by such examples as the following.

(8) Failure of Interrogative *no* to Trigger Deaccenting

kuro'i	no?
black-pres	

Is it black?

[4] McCawley (1968), Okuda (1970) and Haraguchi (1975) all refer only to the genitival use of *no* as triggering deaccenting, but at least in the speech of my principal informant, Osamu Fujimura, this is not true. Given the complicated conditions on the application of this rule, it is easy to attribute failure of deaccenting to occur to factors other than those that are actually relevant, as I have found several times in the course of studying this rule. Notice, incidentally, that the fact that the genitival and copular *no* have the same accentual behaviour removes one obstacle to treating them as the same morpheme.

1.3. Configurational Conditions on Deaccenting

Pre-*no* Deaccenting is subject to conditions on the configuration in which the noun appears. These provide the most important evidence that Pre-*no* Deaccenting is a post-lexical rule. McCawley (1968) observed that deaccenting is generally blocked if the noun has any modifiers. As the examples below show, any type of modifier blocks deaccenting.

```
(9) Blocking of Deaccenting by Modification

    kono uma'  no kubiwa
    this horse  G collar
    the collar of this horse

    a'ru        uma'  no kubiwa
    a certain   horse G  collar
    the collar of a certain horse

    ane           no uma'  no kubiwa
    elder sister G  horse G  collar
    the collar of (my) elder sister's horse

    akai uma'  no kubiwa
    red  horse G  collar
    the collar of the red horse

    nete     iru  uma'  no kubiwa
    sleeping is   horse G  collar
    the collar of a sleeping horse
```

The first two examples show modification by the determiners *kono* "this" and *aru* "a certain". The next shows modifcation by another genitive phrase. The penultimate example shows modification by an adjective, while the last shows modification by a relative clause. In all of these cases deaccenting is normally blocked.

It is only within the smallest NP containing the final-accented noun that modification is relevant. If a preceding modifier is a modifier of the head, rather than of the noun itself, deaccenting takes place. Thus, there is a contrast between /sono uma' no iro'/ 'the color of that horse' where deaccenting is blocked, and /sono uma no iro'/ 'that horse-color', where deaccenting applies since the determiner *sono* is a modifier of the whole phrase rather than of the noun *uma'* alone. This is illustrated in Figure 4.1.

Were we to take the constraint on modification to be purely syntactic, we might formulate it more elegantly as follows.[5]

A final-accented polysyllabic noun immediately preceding the genitive or copular particle *no* is deaccented if and only if the noun c-commands *no*.

There is, however, yet another condition in which deaccenting is blocked. This is when the noun followed by *no* constitutes a minor phrase by itself. This is illustrated by the following examples.[6]

(10) Influence of Phrasing on Deaccenting

yama no ue ni ie ga atta
mountain top D house N existed

There was a house on top of a mountain.

yama no ue ni wa ie ga atta
mountain top D T house N existed

On top of the mountain, there was a house.

In the first example, *yama* belongs to the same minor phrase as *ue*, so deaccenting takes place. But in the second example, where *yama* and *ue* belong to different minor phrases, deaccenting is blocked. It thus appears that we must add the condition that deaccenting applies only if *no* is not minor-phrase final.

Once we adopt this constraint, however, we can explain why modification of the noun blocks deaccenting. Recall that in our account of phrasing we observed that possible phrasings correspond, with the exception of the cases accounted for by the rule of adjunction to the head of the grandparent, to proper analyses of the syntactic structure. Thus, when there are no modifiers it is possible for a noun followed by *no* to form part of the same minor phrase as the following noun. But when there are modifiers, the noun cannot be extracted from the NP of which it is head to form a phrase with the following noun. Since in this case *no* terminates a minor phrase, deaccenting is blocked. Consequently, we may attribute the failure of

[5] This formulation is due to Morris Halle.

[6] I am grateful to Osamu Fujimura for bringing this phenomenon to my attention.

deaccenting to apply when the noun is modified to the influence of the syntactic structure on phrasing, rather than attributing it directly to the syntax.

It should now be obvious that Pre-No Deaccenting must be post-lexical. It is necessary to know the ultimate intonational phrasing of the utterance before one can determine whether to apply the rule, and the determination of phrasing is surely postlexical.

1.4. Phonological/Lexical Conditions on Deaccenting

Not all nouns are deaccented before *no*. One condition is clearly phonological: only nouns accented on the final syllable may be deaccented. Thus, a noun like *oNna'* 'womman', which is accented on the final syllable may be deaccented, but a noun like *u'mi* 'the sea' is not deaccented, as illustrated below.

(11) Immunity of Non-Final Accented Nouns to Deaccenting

```
U'mi no iro  wa ao'i.
sea     color T  blue

The color of the sea is blue.
```

Whether there are additional phonological conditions is problematic. McCawley (1968) claimed that for a noun to be deaccented it must be polymoraic, basing his constraint on the observation that monomoraic nouns never lose their accent before *no*. Okuda (1970) observed that monosyllabic nouns, whether monomoraic like /na'/ "vegetable" or bimoraic, such as /a'N/ "beanpaste jam" or /kyo'o/ "today" are not subject to deaccenting, so that the correct constraint is that the noun must be polysyllabic. This is illustrated by Figure 4.2. Note that both /na'/ and /a'N/ retain their accents as evidenced by the sharp fall in F0.

This account implies that all polysyllabic final-accented nouns are subject to deaccenting, whether the final syllable be light or heavy, and indeed Okuda (1970) and Haraguchi (1977) give examples of nouns with heavy final syllables that undergo deaccenting, though Haraguchi does note that the noun *seNse'i* "teacher" is not deaccentable. It turns out that it is not *seNse'i* that is exceptional: most nouns with heavy final syllables are not subject to deaccenting. The following table lists examples of nouns that are not subject to deaccenting.

(12)

eho'N	illustrated book
huko'o	misfortune
koohi'i	coffee
ryuukyu'u	Ryukyu Islands
sato'o	sugar
seNse'i	teacher
sike'N	examination
taiwa'N	Taiwan
tyoose'N	Korea
zizi'i	grandpa

The only deaccentable nouns with heavy final syllables that I have encountered are /niho'N/ "Japan", /nippo'N/ "Japan", /kino'o/ "yesterday" and /ototo'i/ "day before yesterday". It thus appears that there is a constraint to the effect that only nouns with light final syllables may be deaccented, although there are some exceptions to this constraint. Notice that this constraint does not entirely subsume the constraint that the noun must be polysyllabic, since it fails to prevent light monosyllables from losing their accent, but it does raise the question of whether heavy monosyllables fail to lose their accent because they are monosyllables or because they have heavy final syllables.

A further complication is introduced by data cited by Akinaga (1966). She cites only one phonological condition on deaccenting, namely that nouns that become final-accented as a result of accent shift induced by devoicing of the penultimate syllable never lose this accent. This can be accounted for by ordering High Vowel Devoicing and Accent Shift after Pre-*no* Deaccenting. Akinaga does not mention any constraint on the weight of the final syllable, and indeed she lists a number of the examples just cited as undeaccentable as deaccentable. She does, however, give examples of all phonological shapes that idiosyncratically fail to undergo deaccenting. In addition to words with heavy final syllables, she gives examples of words with light final syllables that are not subject to deaccenting. My informants do not agree with all of her examples, but there are nonetheless examples of the type mentioned by Akinaga.[7]

[7] In view of the fact that the intonational phrasing imposes a constraint on Pre-*no* Deaccenting, it is essential to exclude the possibility that these words might have the idiosyncratic property of blocking combination of phonological words into a single minor phrase, i.e. that

The following are words that my informants consider undeaccentable.

(13)

iti'	one
hati'	eight
roku'	six
tugi'	next
yoso'	other, strange

The constraints on Pre-*no* Deaccenting may be summarized as follows:

(1) Monosyllables never lose their accent;

(2) Polysyllables with light final syllables are usually subject to deaccenting, but there are exceptional words that are not;

(3) Polysyllables with heavy final syllables usually are not subject to deaccenting, but there are exceptional words that are.

The constraint that words with heavy final syllables may not be deaccented is thus statistically true, but there are exceptions in both directions. This indicates that Pre-*no* Deaccenting requires access to lexical information.

1.5. Haplology of *no*

An interesting property of Pre-*no* Deaccenting is its interaction with a rule of syntactic haplology. Given the range of uses of *no* outlined above, it is not surprising that there are a number of environments in which a sequence of two *no* will be generated. There are three such cases.[8]

they act like words that are focused. This hypothesis is ruled out by the fact that these words do not lose their accent even when the following material can be shown to belong to the same phrase by the fact that it is entirely Low toned. For example, it is possible to produce the phrase /iti' no zizyoo/ "the square of one" with a High tone only on /ti/.

[8] The interrogative particle *no* never enters into combination with any of the other *no*. It cannot be the first member of such a sequence since it appears only sentence final. It cannot be the second member of such a sequence since it must be preceded by a tensed verb, ruling out the possibility of the nominal *no* or the genitive *no* preceding it, and it is not a noun so the pre-nominal allomorph of the copula cannot precede it. The remaining possibility is the sequence nominal-copula. No syntactic constraint rules out such a sequence, but I have found no case in which such a sequence is semantically and pragmatically acceptable.

(1) Nominal Genitive

(2) Genitive Nominal

(3) Copula Nominal

The first possibility is exemplified by (14), where the first *no* is the nominal and the second *no* is the genitive particle. In this case, both appear on the surface.

(14) Nominal *no* Followed by Genitval no

akai no no futa
red-pres lid

the red one's lid

*akai no futa

The second possibility would be expected to occur in the translation of expressions like "John's" where "something belonging to John" is intended. Such an expression is parallel to (17) "the black one", only the adjective is replaced by "John's". We thus expect "John's" to come out /ZyoN no no/, and indeed such expressions though exceedingly rare, are not completely impossible. But normally only one *no* surfaces, so that "John's" is realized as /Zyo'N no/.

The same is true of indefinite expressions with a copular relative clause. We would expect a phrase like "the one who is ecstatic" to come out as in the first example below but here again only one *no* appears on the surface.

(15)Haplology of Copula and Nominal no

*utyooteN no no wa Hanako da.
ecstatic COP NOM T Hanako be

''The one who is ecstatic is Hanako.''

utyooteN no wa Hanako da.
ecstatic NOM T Hanako be

Of course, since *utyooteN* also permits the allomorph *na* of the copula, the first example above becomes grammatical if the first *no* is replaced by *na*.

How are we to account for the fact that in these cases only one *no* appears on the surface? A rule of haplology is evidently called for, deleting one *no* when adjacent to another. This rule may be formulated as in (16).

(16) No-Haplology

no $> \emptyset$ / ___ no

Condition: no NP boundary may intervene between the two *no*.

The condition is added in order to prevent application of the rule when the first *no* is the nominal and the second is the genitive particle. An alternative would be to specify which morphemes (indeed, which allomorphs, since *na* is not subject to the rule) are subject to haplology, but the syntactic constraint seems to be simpler and more general.

No-Haplology is apparently post-lexical, since it is conditioned by the phonological form of the nominal head of the phrase.

In formulating (16), I have assumed that it is the first of the two *no* that is deleted. This assumption, which I will now justify, is crucial to the argument that Pre-No Deaccenting is post-lexical.

Consider the case where the first *no* is the genitive particle, and suppose that it was in fact the second *no* That was deleted by the haplology rule. In this case, at every level of derivation, the noun would be adjacent to the genitive particle, so provided that the noun be unmodifed, final-accented, and polysyllabic, we should expect it to be deaccented. On the other hand, if it is the first *no* that is deleted, two possibilities arise, depending on the ordering of No-Haplology and Pre-No Deaccenting. If deaccenting applies first, as it must if it is a lexical rule, we expect the noun to be deaccented. But if deaccenting follows No-Haplology, it will be bled and the noun will retain its accent. Thus, deaccenting of the noun is consistent with either hypothesis, but retention of the accent is consistent only with the hypothesis that it is the first *no* that is deleted and that Deaccenting follows No-Haplology.

As it happens, the noun is never deaccented in this environment, as we see in the examples below. Pitchtracks illustrating these examples are shown in Figures 4.3 and 4.4.

```
(17)
    uma    no wa'ra wa kore desu
    horse  G  straw T  this be-polite-pres
    ''The horse's straw is this here.''

    uma'  no wa kore desu
    ''The horse's is this here.''


(18)
    kore wa inu no kubiwa daroo
    this T  dog  G collar be-tentative
    ''This must be the dog's collar.''

    kore wa inu' no daroo
    ''This must be the dog's.''
```

In each case we see the contrast between the case in which a the noun phrase has a definite head noun, and in which deaccenting takes place, and the case in which the head is replaced by the indefinite *no*, where the noun retains its accent.

The astute reader might argue that in such cases deaccenting fails because the topic phrase constitutes a separate minor phrase, and that *no* occurs therefore minor phrase final. In this case it is necessary to argue that such clitics as *wa* are attached later, an assumption which is otherwise unmotivated. More compelling is the fact that deaccenting fails even when a phrase of this type begins a single longer minor phrase, as the following example attests.

```
(19)Failure of Deaccenting in Large Minor Phrase

    inu' no o mita      *inu no o mi'ta     <  inu' no o mi'ta
                                               dog      A saw

    (I) saw the dog's (indefinite thing).
```

In this case *no* is clearly followed within the minor phrase by non-clitic material, yet deaccenting is impossible. Consequently, the failure of deaccenting in these cases is not attributable to the phrasing constraint.

This justifies the conclusion that it is the first of the two *no* that is deleted, as well as the conclusion that Deaccenting follows No-Haplology. Since the latter is a post-lexical rule, it follows that Deaccenting must also be post-lexical.[9]

Since Pre-No Deaccenting requires access to phrasal information, and since it follows a phrase level rule, I conclude that it must be post-lexical. This is of interest for two reasons. First, it means that the phrase-level distribution of accents is not attributable entirely to intonational phrasing.

Secondly, it is important to note that this rule requires access to lexical information of two sorts. First, of the various particles whose segmental form is *no*, only the genitive particle and the copula deaccent the preceding word. This is not attributable to any phonological properties of these particles; it is simply a lexical property of these morphemes that they trigger deaccenting. Moreover, although whether or not a noun is subject to Deaccenting is largely predictable from its phonological shape, there are deviations in both directions from the general rule, so that lexical exceptions must be recognized. Pre-No Deaccenting presents us with an example of a postlexical rule that requires access to lexical information. This is interesting in that it contradicts the claims of Kiparsky (1981) and Mohanan (1981) that only lexical rules may make use of lexical information.

In this respect it is interesting to note that there is evidence that this rule is moving into the lexicon. M. Enomoto (personal communication, April 1984) has checked the phrasing condition on Pre-*no* Deaccenting with ten speakers. Of these, only one agrees with my description of the facts. The other nine have no syntactic or phrasing constraint at all. He also observes that the nine speakers who do not have the constraint are 30 years old or

[9] Stemberger (1981) has claimed that haplology is always analyzable as zero-affixation; that is, that haplology consists of selection of a zero-allomorph of an affix when the end of the stem to which it is attached has the same phonological shape as the full form of the affix. The example cited here is a counterexample to Stemberger's claim on two grounds. First, the rule is phrasal, not lexical, so it cannot be an allomorphy rule. Second, even if it were lexical, it would not be reanalyzable as zero-affixation, since it is not the peripheral element that fails to surface. In any case, that haplology should be constrained as Stemberger suggests is unlikely given the examples of morphological truncation provided by Aronoff (1976). I do not see why there could not be cases of truncation in which it happened that the morpheme deleted was one whose phonological form is the same as that of the affix attached.

younger, whereas the speakers who do have such a constraint tend to be older. This suggests that the phrasing constraint on Pre-*no* Deaccenting is in the process of being lost, and that the rule is becoming lexical. This is, of course, what we would expect given the oddness of the condition and the existence of lexical exceptions.

1.6. The Status of *no*-Insertion

In this section I have assumed that it is an accident that there are a number of different particles all with the segmental shape *no*. In a recent article, Kitagawa and Ross (1982) have proposed an alternative analysis of *no*, according to which all occurrences of *no* are accounted for by two rules. The first, Mod-Insertion, inserts *no* before any modified NP. The second, No-Deletion, deletes *no* in the same position, if the NP is not phonologically null and the preceding material is [+tense]. These rules are repeated below.

(20) Mod-Insertion

[X NP] > [X no NP]

(21) No-Deletion

[X no NP] > [X NP]

where (a) NP $\neq$ [e]
and (b) X is [+tense]

Kitagawa and Ross give a number of reasons for preferring this analysis to the traditional one under which there are a number of homophonous morphemes. Two of the three reasons seem rather weak. The first is that under the traditional analysis the derivation of a phrase such as /Zyo'N no/ "John's" is ambiguous; the *no* could be either the nominal or the genitive particle. I fail to see why this would be an argument against the analysis. The second reason is that the nominal *no* never occurs unmodified. If the indefinite NP is phonologically null, and *no* is inserted only when a modifier precedes it, this is predicted. But there is no reason under the traditional analysis to expect unmodified *no* to occur. Since *no* is claimed to be semantically empty, it could not occur without a modifier. The two proposals do not differ in this respect.

The third reason is more interesting. It is simply that an unnecessary profusion of homophonous morphemes should be avoided. One can hardly disagree with this sentiment, although I note that even if Kitagawa & Ross's proposal were otherwise adequate they would still not have succeeded entirely in unifying the various uses of *no*, since their proposal does not account for the interrogative use of *no*, which they do not discuss.

Even so, if in fact the remaining three *no* could be unified in the manner proposed this would still obtain a desirable reduction in the number of distinct morphemes posited. Unfortunately, Pre-No Deaccenting, which Kitagawa & Ross did not consider, poses a problem for the unified approach.

Observe first that their proposal does not account for the fact that the different *no* differ in their accentual behaviour. Only the genitive particle and the copula deaccent a preceding noun. Insofar as the nominal *no* appears only after verbs and adjectives, this can be accounted for by restricting the deaccenting rule to nouns.

But suppose that we take this or some other approach to account for the difference in accentual behaviour between the genitive/copula and the dummy head noun. As it stands, Kitagawa & Ross's proposal would still yield an incorrect prediction regarding the accentuation of nouns in sentences like examples (17) and (18). Under their analysis there is no distinction between the *no* following the final-accented noun when the head is a dummy and when the head is full. Consequently, they predict that there will be no difference in accentuation between the two cases, but in fact there is the distinction that we have noted, namely that deaccenting is blocked when the head noun is a dummy.

It is not impossible to modify the statement of Pre-No Deaccenting so as to permit Kitagawa & Ross's analysis. What is necessary is to block deaccenting when the head noun is phonetically null. Notice that this cannot be accomplished simply by reference to the phonological phrase, since deaccenting is blocked even when a particle like *wa* prevents *no* from being phrase-final. The question is, then, whether a phonological rule should be permitted to contain a condition of this type. In the absence of a complete theory of rules it is difficult to say. It is presumably legitimate for a rule to require that something occur in a given position, since this is simply the result of specifying no features in that position but requiring the occurrence of the position. The question is then whether a phonological rule ought to be able to refer to the head of a syntactic phrase directly rather than through the intermediary of rules of phonological phrase formation. In sum, if Kitagawa & Ross's account is to be maintained, Pre-No Deaccenting, and therefore phonological rules in general, must be permitted (a) to make direct reference to syntactic structure and (b) to specify only the occurrence of **something** in a given position, without specifying any of its features.

In addition to the fact that Kitagawa & Ross's analysis requires these perhaps impermissible conditions on Pre-No Deaccenting, there are some other difficulties for their proposal. First, recall that although haplology is normal when an underlying sequence of two *no* arises, as in /Zyo'N no no/ "John's", such sequences may surface without haplology. Kitagawa and Ross cannot account for the occurrence of such phrases. Since there is only one modifier-noun sequence, their proposal will only generate one occurence of *no*.

Hoji (1983)has adduced additional evidence against Kitagawa & Ross's proposal. He points out that in his native Kochi dialect, whose syntax is in most respects the same as that of the Tokyo dialect, the dummy head noun has the form /ga/, rather than /no/, and so is distinct from the genitive particle and attributive copula, which are both *no*. As a result, there is no haplology of *no*. In this dialect, then, it is not the case that the dummy head noun is the same morpheme as the the attributive copula and the genitive particle.

In sum, although the possibility of reducing the number of homophonous morphemes is attractive, Kitagawa & Ross's proposal presents a number of difficulties.[10]

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[10] Although Kitagawa & Ross's account is problematic for adult speakers, there is some reason to believe that Japanese children adopt such an account before acquiring the correct one. In adult speech a phrase like **akai no uma* "red horse" is ungrammatical, since neither the genitive particle nor the attributive copula may follow an inflected adjective, but, as Kazuko Harada has pointed out to me, children do say such things. This would make sense if these children had posited a rule like Kitagawa & Ross's Mod Insertion rule.

1.7. The Mechanism of Deaccenting

Finally, let us consider exactly how the deaccenting rule should be formulated. Within a diacritic accent theory we might say that it deletes an accent on the final syllable. An alternative would be to wait until tone assignment had taken place, and then delete a Low tone from the final syllable if a High tone were linked to the same syllable. This stipulation is necessary to prevent deaccenting of a word with accent on the penultimate syllable. Within a theory with diacritic accents, the accentual analysis is somewhat simpler and therefore preferable. Moreover, depending on how the difference between unaccented and accented Highs is handled, Low Tone Deletion may introduce further complications. If unaccented words are analyzed as having no tone or Mid tone, rather than High tone, it will be necessary to delete the High tone left behind, or to change it to Mid. Consequently, it seems simpler to treat this rule as deleting an accent, before tone assignment.

In a theory without diacritic accents, deleting an accent translates into deleting a H tone linked to the final syllable.

Another possibility was proposed by McCawley (1968). McCawley proposed that the rule did not simply delete the accent from the noun, but rather it attracted it onto *no*. Since in deep structure *no* is always minor phrase final[11] and since McCawley has a rule that deletes the accent on a word with accented final mora immediately preceding minor phrase boundary, this accent will never surface, effectively yielding deaccentuation of the preceding noun with no other effects.

Haraguchi (1977) has raised one objection to this account, which is that *no* is not, in fact, always minor-phrase final. He cites the example of phrases in which a noun (in the examples *kawa* "river" and *nihoN* "Japan") is followed by *no* which in turn is followed by the clitic *ne* "n'est-ce pas" and points out that in such cases no accent surfaces on *no*, contrary to our expectation, if the accent of the noun has been attracted onto *no*. I repeat his examples

[11] Recall that in McCawley's account of phrasing, discussed above, the combination of potential minor phrases into a single minor phrase is performed by a cyclic rule.

below.

(22) Haraguchi's Examples of *no* followed by *ne*

kawa no ne (<kawa')
river

nihoN no ne (<niho'N)
Japan

There is one way potential escape from this argument. McCawley could claim that clitics such as *ne* are attached by cyclic rules, so that at the point at which the attraction of the accent onto *no* takes place, no is indeed minor phrase final. Then, assuming that the deletion of accents on minor-phrase final morae is also cyclic, the accent will be deleted, and the above examples will surface correctly, without accent. But the latter assumption cannot be correct, since a final accented noun that directly precedes *ne* is not deaccented, as illustrated below.

(23) Failure of Final Accented Noun to Deaccent before *ne*

kawa' ne ?

"It's a river, isn't it?"

uma' ne ?

"It's a horse, isn't it?"

There is yet a more fatal flaw in the accent attraction account. This account depends crucially on the assumption that the accent attracted onto *no* will be deleted on the cycle corresponding to the minimal minor phrase. But since we know that deaccenting only takes place once intonational phrasing is complete, this is impossible.

Finally, I should note that one other account exists, also due to McCawley (1968).[12] McCawley proposes to treat all deaccenting rules, including accent deletion before no, as

[12] In the main text (p.179), McCawley states a preference for the accent attraction account, but in the list of rules in section 3.10 (pp.180-82) he gives the preaccenting formulation. This seems to have confused Haraguchi (1977), who incorrectly attributes the accent attraction idea to Okuda (1971), who in this respect was merely following McCawley.

preaccenting rules, that is, as assigning an accent to the syllable boundary at the beginning of the word. Then the preaccent, along with any other accents, will be deleted by a rule that deletes all accents from a phrase whose initial syllable boundary bears an accent.[13] This is equivalent to the accent deletion proposed here, save for the fact that it makes use of McCawley's proposal that accent deletion is really placement of an accent on the word-initial syllable-boundary, which I have criticized above.

2. Accent Resolution

One important property of the minor phrase is that at most one accent may be realized in a single phrase. Since there are sources for multiple accents within a minor phrase, some rule must resolve the conflict among these. I have already pointed out that there is a difference between Accent Resolution within words and across words. If two accented words are combined into a surface minor phrase the leftmost accent invariably wins. But within a single word, although it is usually the leftmost accent that wins, there are many cases where it is some other accent that wins. I argued that this justifies allowing the accentual rules to apply cyclically, first within the word and then within the minor phrase. There are a number of questions left open.

First, to what should we attribute the fact that leftmost dominance is exceptionless at the phrasal level but has exceptions within the word? The most attractive solution is to derive this fact from the principle that lexical rules may be lexically governed but post-lexical rules may not. Since Accent Resolution at the phrase level is post-lexical it may not have lexical exceptions, but at the word level lexical exceptions are permitted.

Although this is the most attractive proposal it is not entirely unproblematic since there are two examples known of post-lexical rules that have lexical exceptions. One example is due to Dresher (1983) who argues that a number of rules of Biblical Hebrew depend upon the position of a word in the syntactic structure and yet have lexical exceptions. It appears that

[13] This is McCawley's rule C-5 on page 181.

this difficulty may be evaded by lexical insertion in surface structure, as suggested by Pranka (1983) so it may not provide a lethal counterexample to the claim. The second example is the rule of Pre-*no* Deaccenting discussed below. This rule appears to be more damaging to the claim that post-lexical rules may not avail themselves of lexical information, since lexical insertion in surface structure is not sufficient to account for the fact that the rule depends upon the actual intonational phrasing, not simply the syntactic configuration. Insofar as either of these cases constitute counterexamples to the claim, it will be impossible to derive the difference between word-level and phrase-level Accent Resolution from the principle that post-lexical rules are exceptionless.

A second question that we may ask is where Accent Resolution applies. One possibility is that it applies both at the word-level and at the phrase-level, and that at the word-level there are morphemes that have the property of inverting its normal application so that the accent that these morphemes assign rather than the leftmost accent is the one that dominates. This is essentially what McCawley (1968) proposes although he does not argue explicitly for the distinction between word-level and phrase-level Accent Resolution. But there is another attractive possibility. Recall that in Chapter II I pointed out that the special property of dominant and dependent affixes might be that they trigger a rule deleting preceding accents. Suppose that this is in fact the mechanism of exceptional accentual dominance. Then it appears that it is quite unnecessary for Accent Resolution to apply within the word at all. If a minor phrase contains no dominant morphemes phrase-level application of Accent Resolution will have the correct effect of leaving in place only the leftmost accent. If there are dominant morphemes, each of these will delete any preceding accents within its word, so that these non-dominant accents will be *hors de combat* when the time comes for phrase-level application of accent resolution. This permits a simple formulation of the Accent Resolution rule with no provision for inversion of direction. The only situation in which it would be necessary for Accent Resolution to apply within the lexicon would be if there were a lexical rule whose correct operation depended on the number of accents present rather than on their simple presence or absence. I know of no such cases. In sum, it is sufficient for accent resolution to apply only at the phrase-level, with only exceptional accentual dominance accomplished within the lexicon.

(24) Accent Resolution

Delete all but the leftmost accent within a minor phrase.

On this account, the only rules that apply within the lexicon are the morphological rules of accent placement and deaccenting. All other rules apply post-lexically.

I should note that this account does not provide an alternative explanation for the fact that exceptional accentual dominance is restricted to the word-level. Insofar as there is only a single, phrase-level rule of Accent Resolution, it immediately follows that we need not explain why Accent Resolution applies differently at the two levels. But we must still explain why there are not rules of exceptional accentual dominance, i.e. morphologically or lexically triggered rules that delete an accent to the left in favor of one that they assign or one that belongs inherently to some formative, that apply at the phrase-level. This simply transfers the problem from the Accent Resolution rule to the deaccenting rules.

At the phrase-level Accent Resolution applies fairly late, since it must follow Pre-*no* Deaccenting. To see this, consider what happens when a single minor phrase is composed of two words, the first final-accented, joined by *no*. If Accent Resolution preceded Pre-*no* Deaccenting, the accent on the second word would be deleted by the accent on the first word. The accent on the first word would then be deleted as a result of its preceding *no*, yielding an unaccented minor phrase. On the other hand, if Pre-*no* Deaccenting applies first, it will delete the accent on the first word, bleeding Accent Resolution so that the resulting minor phrase will retain the accent of the second word. The following example should make this more concrete.

(25)

uma' no wa'ra	
	AR
uma' no wara	
	PND
*uma no wara	
uma' no wa'ra	
	PND
uma no wa'ra	
	AR
uma no wa'ra	

If Accent Resolution applies first, the phrase ends up unaccented. If Pre-*no* Deaccenting applies first, the phrase ends up accented on the /wa/ of *wara*. As we have seen above, the latter is the correct result.

3. Tone Association

In addition to the High tones that constitute the accents, it is necessary to associate tones to the remainder of the tone-bearing units. This is accomplished in large part at the level of the minor phrase but I shall suggest that there are, in addition, some tones associated with the major phrase.

3.1. Boundary Tones

Effects that are not attributable to the tones associated with minor phrases are generally attributed to global properties of the intonation contour. However, some effects may well be attributable to the presence of additional tones associated with major phrase boundaries. Pierrehumbert (1980) has argued that certain intonational inflections in English should be accounted for by such boundary tones, and in Japanese as well there are phenomena that can be nicely accounted for in this way.

The phenomena that are associated with major phrase boundary in Japanese are all associated with the major phrase final position. I will show below in the discussion of declination, that the declination curve shows a sharp drop in final position. This drop is characteristic of the intonation of declarative sentences. In principle we might attribute this drop to the shape of the declination curve itself, but this does not appear to be a particularly good move. First, the magnitude of the slope of the declination curve appears to be decreasing, not increasing, from left to right. Treating the sudden final drop as an inherent property of the declination curve requires us to posit a rather odd declination function. Secondly, we will see that whereas the declination curve appears to be computed from left to right, the sharp drop occurs at the very end, regardless of the length of the utterance, so that it is in effect computed from the right, not the left. These considerations suggest that it might be appropriate to interpret the final lowering as the result of the presence of a Low boundary tone, introduced in declarative sentences at the righthand edge of every major phrase.

The hypothesis that final lowering results from the presence of a Low boundary tone is supported by the overall pattern of major phrase final effects. Jinbo (1923) and Han (1961) observe that major phrases may have any of three endings, depending upon whether the sentence is an assertion, a question, or "suspended", an observation with which Beckman, Hertz & Fujimura (1983) and my own observations concur. Question intonation differs from declarative intonation in that, instead of a final drop, the F0 contour exhibits a sharp rise. This rise is restricted to the last syllable of the major phrase. Indeed, when the intimate style interrogative particle *no* is added to a question that is marked as such only by intonation, the final rise shifts rightward onto the particle *no*. When a major phrase is neither an intonationally marked question nor strongly asserted, it exhibits neither a final rise nor a final drop, but falls only gradually, as we would expect if the declination curve continued without deformation. In sum, the three possibilities for the end of a major phrase are a sharp fall, a sharp rise, or no change. If we attribute major phrase final effects to the presence of boundary tones, these are exactly the predicted possibilities, the sharp rise being attributed to a High boundary tone, the sharp fall being due to a Low boundary tone, and the absence of inflection being attributed to the absence of a boundary tone.

3.2. Melody Tones

3.2.1. Tone Association in Autosegmental Phonology

I have thus far assumed some version of the Autosegmental Theory without presenting my assumptions in detail. Before describing the details of tone association it is necessary to do so. While the most general principles of the theory are fairly clear and uncontroversial, a number of important details are unsettled and the issues have not been presented clearly in the literature, so it will be necessary to take a more historical approach than would otherwise be necessary. Since it is not here my purpose to argue in favor of a particular version of the theory I will present only enough to state clearly the fundamental assumptions and to make comprehensible the subsequent discussion of Japanese.

3.2.1.1. Phonological Representations

The central aspect of the Autosegmental Theory is its conception of phonological representation. In the standard theory of Chomsky & Halle (1968) a phonological representation was taken to be a sequence of column vectors, each column vector corresponding to one segment and containing a binary valued specification for each distinctive feature. If we consider each distinctive feature separately and distinguish between segment slots and the feature specifications associated with them, the standard theory may be characterized as requiring that the mapping between the ordered set of segment slots and the ordered set of specifications for each feature be bijective and order preserving. The central claim of the Autosegmental Theory is that the bijectivity constraint is too strong. Injectivity is not required at any level of representation either of the relation or its inverse. Surjectivity is not required in underlying representation but, in the original theory of Goldsmith (1976) was required both of the slot-to-specification relation and its inverse at subsequent points in the derivation. Goldsmith's conception of a well-formed phonogical representation is summed up in his Well Formedness Condition, restated here in slightly modified form for ease of exposition.

(1) Association lines may not cross.
(2a) Every feature specification must be associated.
(2b) Every feature-bearing unit must be specified.

Goldsmith's Well Formedness Conditions

Condition (1), more formally put, the requirement that the slot-to-specification relation and its inverse must be order-preserving, holds at all levels of representation. Condition (2) however does not hold of underlying representations. Goldsmith further assumed that a set of universal Association Conventions would apply to eliminate violations of the WFC whenever they arose.

Since Goldsmith's work there have been two modifications proposed to the Well Formedness Conditions. The first was the abandonment of clause (2a) proposed by Clements & Ford (1979) and Halle & Vergnaud (1982). This modification is uncontroversial and requires no further discussion.

The second modification pertains to the point at which clause (2b) must be satisfied. For Goldsmith the WFC had to be completely satisfied at every non-underlying level. However, quite early in the development of the theory violations began to appear. Haraguchi (1977) required language-specific Initial Tone Association Rules to align the melody properly with the accent in pitch accent languages before the Association Conventions applied. Similarly, Clements & Ford (1979) made use of such an Initial Tone Association Rule in their analysis of Kikuyu. At this point the assumption seems to have been that Goldsmith's proposal was basically correct, that the Association Conventions did apply immediately whenever the WFC was violated, but that there was a special class of Initial Tone Association Rules that were permitted to set up the alignment of the two tiers of the representation before the Association Conventions. [14] The transition to the current position was the authors' proposal (Poser 1981b, 1982) that the WFC should be taken to be a constraint on systematic phonetic

[14] I do not know of any explicit statement of such a position. This is my own reconstruction based on the literature and on my memory of the discussion among Autosegmentalists at the time.

representation, a position since argued for at some length by Pulleyblank (1983). The result of this evolution has been the splitting of the Association Conventions into two parts. One is the convention that unassociated feature specifications are linked to free feature-bearing units one-to-one and left-to-right, originally proposed by Williams (1976). This is assumed to apply immediately. The remaining portion of the Association Conventions, which spread linked autosegments onto unlinked feature-bearing units, is taken to apply only at the end of the derivation or not at all.

We may summarize the current view of autosegmental representations as follows. Goldsmith's clause (2a) has been eliminated, while clause (2b) holds only of systematic phonetic representation. This view of the representations is fairly uncontroversial. What is controversial is how the Well Formedness Condition is fulfilled.

3.2.1.2. Association Rules and Conventions

The Well Formedness Conditions are statements about the well-formedness of representations; they do not specify how an ill-formed representation is to become well-formed. One possibility, of course, is that language-particular rules will operate to rectify ill-formed representations, and that in the absence of such rules the derivation will block. The assumption has been, however, that there are certain universal conventions that apply to rectify ill-formed representations, the point at which these conventions apply depending on when the Well Formedness Conditions must be met. One convention is that unspecified feature-bearing units are linked to any autosegment in whose domain they fall, with conflicts resolved by means of a priority clause. This is referred to as Automatic Spreading.[15] The second convention is one proposed originally by the author in Poser (1979,1980) to deal with the case in which a feature-bearing unit does not fall in the domain of any autosegment. In this case, I

[15] Note that by "automatic spreading" I mean spreading due to the universal application of the spreading clause of the Association Conventions for the purpose of fulfilling clause (2b) of the Well Formedness Conditions. This term has been used in a somewhat confusing fashion, the other sense referring to the automatic application of the Association Conventions whenever the Well Formedness Conditions are not met. The two notions are distinct, since it is possible to abandon the latter without abandoning the former.

proposed that a convention would apply to insert an autosegment whose value was the unmarked value for that feature. This convention, as modified by Halle & Vergnaud (1981,1982) and Pulleyblank (1983), is known as Default Autosegment Insertion.[16]

The current status of these conventions is controversial. Halle & Vergnaud (1981,1982) proposed that linked autosegments are not subject to Automatic Spreading, a proposal adopted by Pulleyblank (1983). They claim that spreading results only from language-particular rules, and that where such rules are absent Default Autosegment Insertion applies instead. However, the cases used by Halle & Vergnaud and Pulleyblank to motivate this claim are equally well dealt with by the assumption that clause (2b) of the WFC need not be fulfilled until the end of the derivation together with the proposal of Clements & Ford (1979) that free autosegments take precedence over linked autosegments in association. And since spreading from linked autosegments seems to be the typical case (Clements 1976, 1981, Poser 1981, 1982, van der Hulst & Smith 1982) it appears to be advantageous to retain Automatic Spreading.

The status of Default Autosegment Insertion is less controversial. There is no argument over the existence of this convention, only over where it applies. The original proposal was that it applied only at the end of the derivation in order to prevent it from blocking. More recent proposals (Pulleyblank 1983) allow it to apply at earlier points in the derivation.

To summarize, I will continue to assume that Automatic Spreading exists, always keeping in mind that if necessary the role played by this convention can readily be assumed by language-particular rules. I will also assume that some version of Default Autosegment Insertion exists, and that this convention applies at the end of the derivation. In the cases at hand, this last assumption appears not to conflict with other proposals.

[16] Halle & Vergnaud proposed that the default value was inserted not at the autosegmental level but at the core. The term Default Autosegment Insertion is due to Pulleyblank who revived the claim that it was an autosegment that was inserted.

3.2.2. Tone Assignment in Japanese

3.2.2.1. Some New Data

3.2.2.1.1. The Initial Lowering Rule

All descriptions of Tokyo dialect Japanese assert that the initial mora of a minor phrase is usually low but sometimes high. All accounts agree that the initial mora is high if the first syllable is accented. Most of the more recent accounts add to the list of cases in which the first mora is high the case where the initial syllable contains two sonorant morae, which is to say two tone-bearing units. In all other cases the initial mora is said to bear a Low tone.

What I wish to argue here is that, although there is indeed a difference in F0 pattern between the cases in which the initial mora is said to be Low and those in which it is said to be High, the difference does not lie in the presence or absence of a Low tone. In point of fact, there is reason to believe that **every** minor phrase begins with a Low tone, the difference between the various cases being a matter of this tone's realization.

The evidence for this position is quite straightforward. Consider first the case in which the phrase is initial accented, as exemplified by the words [no'mu] "to drink" and [no'omu] "agricultural affairs". The standard description would lead us to expect these words to begin with a high-pitched region and then fall to a low pitch. In fact, as Figures 4.5-4.7 illustrate, these words do not begin with a high-pitch. Rather, the pitch starts fairly low and rises steeply to a peak within the first syllable, whence it falls as expected. The point is, the pitch does not start anywhere near the peak; it begins low, very much as we would expect if Initial Lowering applied to initial-accented phrases just as it does to other phrases.

The same phenomenon is observed when we consider words whose first syllable contains two tone-bearing units. These are illustrated by the words *noomeN* and *noonoo* in Figures 4.8 and 4.9. Here again we see that the F0 starts low and rises to a peak within the first syllable. On the basis of these examples, then, it seems that the traditional description is incorrect, and that in fact all minor phrases begin with a Low tone.

To this hypothesis the objection might be raised that the examples given consist of words uttered in isolation, and that in such circumstances it is to be expected that words will not begin at peak F0, the relatively low start being attributable not to the presence of a Low tone in the phonological representation but to physiological constraints on tone production. I am not at all convinced that there is any basis to postulate such constraints, but in any case this objection is easily confuted by an examination of cases in which the minor phrase is not initial in the utterance.

The utterances of Dataset VII beginning with the unaccented participle [yoNde] provide us with the materials for studying this case. As observed in chapter III, when the utterance is intended to mean "try V-ing" it is typically produced as a single minor phrase, whereas when it is intended to mean "V and see" it is typically produced as two minor phrases. The effect is particularly dramatic when the first word is accented, for in this case the choice of phrasing determines whether one or two accents are realized. However, we have every reason to suppose that the difference in phrasing will be preserved when the first word is unaccented.

Consider now how this difference in phrasing might be realized. Since the first word is unaccented, the phrasing will have no effect on whether or not the accent of the the second word, [mi'ru], is realized. The only difference that we can expect the choice of phrasing to make is in the presence or absence of Initial Lowering on the second word. Insofar as [mi'ru] constitutes an independent minor phrase we expect Initial Lowering to be applicable, while if [mi'ru] is incorporated into a single minor phrase with the preceding word we expect Initial Lowering to be applicable only to [yoNde]. But in the present case the second word is initial accented, so that if Initial Lowering is inapplicable to initial accented words we should expect to find no difference between the two phrasings when the first word is unaccented.

In point of fact, this is not what we find. As Figures 4.10-4.13 illustrate, the two phrasings are readily distinguished.[17] When the utterance contains two phrases there is a noticeable

[17] The difference is sufficiently clear and consistent that the author, on viewing the pitch tracks in the random order in which the recordings were made 8 months after his last look at the chart identifying the utterances was able to classify all 40 with no errors.

dip beginning somewhat before the [mi] of [mi'ru]. This dip is absent when there is only one phrase. This suffices to demonstrate that every minor phrase begins with a rise in pitch, regardless of its phonological shape. Although the precise shape of the initial region does indeed depend upon the phonological shape of the phrase, the presence of the initial Low tone is invariable. Consequently, I will hereafter suppose that every minor phrase begins with a Low tone.[18]

One property of this initial Low is noteworthy. Insofar as a Low tone is implemented as a descent below the current level, we should expect to find that the F0 at the very beginning of [mi] in the monophrasal case should be higher than in the biphrasal case, since in the latter but not in the former a Low tone is realized. In point of fact, the descent from the high point of [yoNde] to the beginning of the [m] of [mi'ru] (as determined from the first log-area linear prediction coefficient) is identical in the two cases. The mean fall in the biphrasal case is 14.04 hz. (Var=7.21, N=20). In the monophrasal case it is 14.29 hz. (Var=13.26, N=20). The difference between the means of -0.25 hz is not significant (T=-0.247, 38 df, p=0.40).[19] This of course need not present any difficulty for the hypothesis that the Low tone is present in the one case and absent in the other-it may simply reflect a fact about the character of the

[18] One of course wonders why impressionistic observers have claimed that some phrases do not begin with a Low tone. The answer very likely is that they are responding not to the height of the initial region as such but to the very real difference in the shape of the initial region. In the cases previously described as beginning with a Low tone, there is generally a level Low stretch, as may be seen in the pitchtracks of the word [nomi'mono] in Chapter I, while in the cases previously described as beginning High there is no level stretch but rather a steep rise from the initial Low.

[19] All variances reported here are the unbiased estimator of the population variance:

$$s^2 = \frac{\sum_{i=0}^{i=n-1} (\bar{x}-x_i)^2}{n-1}$$

where n is the sample size, rather than the raw sample variance:

$$m_2 = \frac{\sum_{i=0}^{i=n-1} (\bar{x}-x_i)^2}{n}$$

phonetic implementation rules-but it is an unexpected fact worthy of contemplation.

3.2.2.1.2. The Representation of Unaccented Words

By and large the traditional description of the tone pattern of minor phrases appears to be accurate. There is, however, one respect in which it is not entirely accurate, namely in the treatment of unaccented words. According to the traditional description, the relatively high stretch of unaccented words is just as high as the relatively high stretch of accented words; the difference between accented and unaccented words lies solely in that in the former the pitch ultimately falls, while in the latter it does not.

Unsystematic observation suggested that this description might be incorrect, so I undertook a more systematic investigation.[20] Only one experiment was conducted for the express purpose of exploring the relationship between accented and unaccented Highs. However, due to the necessity of using matched pairs of accented and unaccented words in many of the experiments performed for other purposes, it is possible to corroborate the results of this experiment with much additional data.

3.2.2.1.2.1. Evidence from Dataset I for Difference in Height

The data in Dataset I were obtained in order to study the effect of the presence or absence of the accent on the height of the high region of the minor phrase. The measurements, which consist of the peak F0 on the syllable [na] of [hana] in context and in isolation, are tabulated below.

[20] Han (1961) reports an observation that presumably reflects this fact, namely that the rise from the initial Low toned syllable to the following High toned syllable is greater when the second syllable is accented than when it is unaccented. From her observation it is impossible to determine the source of the difference, but if the level of the initial Low is unaffected by the accent then this effect will be generated by the difference in the height of the High toned syllable reported here.

	Accented	Unaccented
	148.4	149.0
	149.5	138.9
	154.8	143.3
	145.3	141.6
	145.1	138.7
	153.6	147.7
	153.6	144.3
	154.8	145.1
	152.0	150.6
	155.8	139.7
Mean	151.29	143.89
Var	15.77	18.03

Peak F0 on Syllable [na]-Words in Context

These data indicate that accented Highs are indeed higher than unaccented Highs. The mean difference is 7.4 hz, which yields p (T=4.025,18df) <.001, which is extremely significant.

The data obtained in isolation do not show this effect.

	Accented	Unaccented
	141.8	150.4
	146.0	142.9
	143.9	141.4
	142.2	144.3
	135.3	145.3
	148.4	154.8
	148.1	148.8
	152.2	144.1
	152.2	147.3
	147.7	149.7
Mean	145.78	146.9
Var	26.72	16.63

Peak F0 on Syllable [na]-Isolated Words

The mean difference is -1.12 (that is, the unaccented words are higher), but p (T=-0.538,18df) = 0.299 which is not significant. This is consistent with the claim that the distinction between final accented and unaccented words is neutralized when the accented mora is in absolute word-final position.

3.2.2.1.2.2. Evidence from Dataset III for Difference in Height

Further evidence for the greater height of accented words than unaccented words comes from Dataset III, which contains numerous pairs of sentences differing only in whether one of the words is the accented adjective *uma'i* or the nearly homophonous but unaccented *amai*. The following table lists the comparable sentences. The first column gives the letter by which I will refer to the particular comparison. The second column gives the numbers of the sentences compared. In each case the sentence containing the unaccented word is listed first.

Comparable Sentences from Dataset III

(a)	1:2
(b)	4:3
(c)	6:5
(d)	8:7
(e)	10:11
(f)	9:12

The data for each of these comparisons are listed in the following tables. In each case the first column contains the measurements of the unaccented word *amai*, and the second column contains the measurements of the accented word *uma'i*.

Comparison of Sentences One and Two (A)		
	169.5	171.8
	166.7	171.8
	172.4	178.6
	172.4	180.5
	167.5	171.8
	168.9	174.8
	177.9	178.6
	174.5	177.0
	170.1	178.9
mean	171.1	175.9
var	12.7	12.2

Comparison of Sentences Four and Three (B)		
	161.8	174.2
	163.4	174.2
	167.8	173.0
	163.9	175.7
	167.8	175.7
	169.8	173.0
	167.5	172.4
	166.7	173.6
	171.8	174.2
mean	166.7	174.0
var	10.2	1.3

Comparison of Sentences Six and Five (C)

	171.5	172.4
	169.5	161.3
	168.6	177.6
	169.5	174.8
	174.2	175.4
	166.7	177.0
	173.9	176.4
	168.6	179.2
	170.4	173.3
mean	170.3	174.2
var	6.2	27.85

Comparison of Sentences Eight and Seven (D)

	169.2	174.2
	168.9	174.5
	169.2	174.2
	173.9	175.1
	173.9	174.8
	170.4	174.2
	173.3	180.2
	172.4	183.2
	165.0	177.9
mean	170.7	176.5
var	8.81	10.66

Comparison of Sentences Ten and Eleven (E)		
	174.2	175.1
	168.4	175.1
	170.1	179.5
	167.2	181.8
	164.7	181.8
	168.9	175.1
	171.5	177.9
	172.4	178.9
	178.3	174.8
mean	170.6	177.8
var	16.33	8.37

Comparison of Sentences Nine and Twelve (F)		
	174.2	175.1
	168.4	175.1
	170.1	179.5
	167.2	181.8
	164.7	181.8
	168.9	175.1
	171.5	177.9
	172.4	178.9
	178.3	174.8
mean	170.6	177.8
var	16.33	8.37

The differences between the accented and unaccented words are summarized in the following table.

Summary of Differences (All 16 df)			
Comparison	Mean Difference	T	P
A	4.8	2.89	<.01
B	6.3	6.46	<.001
C	3.9	2.01	<.05
D	5.8	3.94	<.001
E	7.2	4.35	<.001
F	10.0	4.75	<.001

In every case the accented High is higher than the unaccented High, and as the above figures show this difference is in every case statistically significant. Comparisons A-E illustrate the difference when the word in question is the first word in the major phrase. Comparison F shows that the difference remains when the words in question comprise the second minor phrase.

3.2.2.1.2.3. Evidence from Dataset IV for Difference in Height

Additional evidence for the difference between accented and unaccented Highs comes from the nonsense word data of Dataset IV, which provides assurance that the difference is not an artifact of the semantics of the words chosen in the other datasets. The comparanda are the high tones on the first words in the ++++ sequence and the – +++ sequence. The relevant data are summarized in the following table.

Accented and Unaccented Nonsense Words		
	++++	– +++
mean	167.72	160.07
var	15.36	8.98

The accented word is 7.65 hz. higher than the unaccented word (p (T=7.60,df=46)<.0001).

This supports the hypothesis that accented words are higher than unaccented words.[21]

3.2.2.1.2.4. Evidence From Dataset VII for Difference In Height

Further evidence is obtained by comparing the peaks on the word [yoNde] in the data from Dataset VII in which [yoNde] forms a separate minor phrase from [miru]. The measurements are the following.

	170.9	156.5
	172.7	158.0
	181.5	154.8
	170.9	156.7
	175.7	155.0
	170.1	154.1
	182.8	160.5
	165.8	162.1
	172.4	164.5
	171.2	160.5
	175.7	157.0
	173.0	162.6
	180.2	168.4
	170.1	165.3
	174.5	163.7
	171.8	162.1
	170.9	160.0
	165.3	154.8
	172.1	162.9
	175.4	159.7
mean	173.15	163.37
var	20.49	17.00

Peaks on Accented and Unaccented [yoNde]

The accented peaks are a mean of 9.78 hz. higher. This difference is highly significant ($p\ (T=7.143, 38\ df) < .0001$).

[21] I have not discussed the other two sequences in Dataset IV since they are not strictly comparable. Nonetheless, they yield comparable values. The mean peak F0 on the unaccented first word in the – – – – sequence is 161.92, closely comparable to the 160.07 of the – +++ sequence. Similarly, the mean peak F0 on the accented first word of the +– ++ sequence is 167.54, indistinguishable from the 167.72 of the ++++ sequence.

In sum, across a number of environments and using a number of different words, including nonsense words, we find that the high stretch of accented words is consistently higher than the high stretch of unaccented words. We summarize the magnitude of this difference in the following table, in which are given both the absolute magnitude of this difference and the percentage increase of the accented value over the unaccented value. Although as we have seen the effect is extremely consistent, it is by no means large, ranging in absolute terms from 3.9 to 10.0 hz. and in percentage terms from 2.3% to 6.0%.

Comparison		Absolute	Percentage
I		7.4	5.1
III	(a)	4.8	2.8
	(b)	6.3	3.8
	(c)	3.9	2.3
	(d)	5.8	3.4
	(e)	7.2	4.2
	(f)	10.0	5.9
IV		7.7	4.8
VII		9.8	6.0

Difference Expressed Absolutely and as Percentage of Unaccented Mean

Four accounts of this fact, embodying three hypotheses as to the phonological representation of unaccented words, spring to mind. The three candidates are the following:

(1) High Tone;

(2) Mid Tone;

(3) No Tone

The first proposal is the traditional one, that unaccented words bear High tones just as accented words do. Under such a proposal we cannot account for the phonetic difference between accented and unaccented high stretches directly in terms of the tones that they bear, since both are High. We must, rather, permit the phonetic realization rules to make reference to some property distinguishing unaccented words from accented words. There are two such properties. The first, and the most obvious, is that the phonetic rules might refer directly to a diacritic accent. I can advance no empirical objection to this proposal, only the observation that this is impossible in a theory without diacritic accents and that the non-diacritic theory is, *ceteris paribus* to be preferred. Consequently, I discard this proposal for the present, fully aware that it could in principle be correct.

The second property that distinguishes accented words from unaccented words is that the High tone of an accented word is followed by a Low tone, while the High tone of an unaccented word is not, at least not by a realized (or associated) Low tone. Consequently, we might propose a phonetic rule that raised a High tone before a Low tone. This proposal too is empirically adequate. Its worst feature is that it requires us to violate the proposal of Pierrehumbert (1980) that tonal realization rules operate in a strictly left-to-right fashion, that is, that they never look ahead.

On the third hypothesis, we may consider the high stretch of unaccented words to be tonally distinct from that of accented words–in that the former bear a Mid tone while the latter bear a High tone. This proposal too is empirically adequate.

There is nonetheless one reason to shy away from this proposal. The difference between accented and unaccented words, though consistent, is quite small, typically on the order of 5 hz. The greatest difference that I have measured in any context is 10 hz. Although we have, unfortunately, no general theory of tonal realization from which unambiguous predictions might be derived, it seems rather unlikely that a difference in phonological tone should be consistently manifested by such a small phonetic difference.

Finally, let us consider the last hypothesis, under which unaccented words have no tone at all other than the Low tone introduced by Initial Lowering. Under this hypothesis, something must of course be said about the phonetic interpretation of toneless morae. We might interpret toneless morae as lying directly on the reference line in a theory like that of Liberman and Pierrehumbert (1983). This will result in toneless regions lying a small distance below the High tones, the distance varying with position in accordance with the manner in which High tones are scaled above the reference line.

This proposal has none of the disadvantages of the alternatives. It does not require diacritic accents, it is consistent with strictly left-to-right tonal implementation, and it does not lead us to expect a larger phonetic difference than there is. However, it is inconsistent with the autosegmental Well Formedness Condition in that tone-bearing units are permitted to reach the surface without being associated with a tone.

As I have indicated, none of these hypotheses can at present be ruled out on empirical grounds. Resolution of this question must await further phonetic data and a better elaborated theory of phonetic implementation. For the present, I will assume that the traditional account is correct and that these words do have High tones, which are raised when a Low tone follows within the same minor phrase, but whenever the representation of these words is crucial I will consider all of the possibilities.

3.2.2.2. The Account

Before turning to the tone assignment rules a word must be said about the tone-bearing unit. As I have noted, the syllable is the tone-bearing unit at early levels of the derivation, e.g. for the purpose of assigning accents. However, when other tones are assigned, the mora is clearly the tone-bearing unit. Thus, it appears that the shift from syllable to mora as TBU corresponds approximately to the lexical/post-lexical distinction. Some additonal evidence bears on this question.

First, notice that the post-lexical rule of Pre-No Deaccenting does not in general apply to nouns whose final-syllable is heavy. This constraint could be the result of a formulation of the rule as "delete an immediately preceding H tone". Since the post-lexical TBU is the mora, only a High on a short final syllable would be subject to deletion. The second fact is one brought to my attention by M. Enomoto.[22] Enomoto points out that the accent contributed

[22] This fact is discussed in his forthcoming Stanford University Master's Thesis.

by the dummy head noun *no* to the final syllable of a preceding adjective[23] falls on the final mora of the adjective, even when the adjective ends in a heavy syllable. Since the particle *no* is a clitic that is attached either post-lexically or at a late point in the lexical derivation, it is not suprising that the accent it assigns should fall on the preceding mora, not the preceding syllable, if the tone bearing unit shifts from the syllable to the mora at a late point in the lexical derivation, or at the boundary of the lexicon.

These facts make it clear that whereas the TBU is the syllable at most points in the lexical derivation, it is the mora in the post-lexical phonology. What is not entirely clear is whether the shift from syllable to mora occurs precisely at the lexical boundary, or whether it occurs earlier, at the beginning of the last lexical stratum. One argument in favor of the latter approach is the fact that pre-accenting is a morphological phenomenon that depends on lexical information. Insofar as post-lexical rules are not permitted access to lexical information, *no* must be suffixed in the lexicon. In sum, the tone-bearing unit has become the mora by the end of the lexical derivation, quite possibly at the lower boundary of the last stratum of the lexicon.

I turn now to the rules of tone assignment. These may be summarized as follows.

(0) Final Accent Deletion

(1) Initial Low Insertion

(2) Initial Low Linking

(3) High Tone Insertion on Last Mora

(4) Leftward Spreading of High Tone

(5) Post-Accentual Low Insertion

(6) Linking & Spreading of Post-Accentual Low Tone

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[23] This particle is preaccenting for some but by no means all Tokyo dialect speakers. For other speakers it is accentually neutral.

These rules represent one possible approach to tone assignment in Japanese. I have stated them in such a way that as much as possible each rule describes a phenomenon that must be described somehow. Both as a result of empirical uncertainties and the unsettled state of the theory at the current time, it is difficult to choose among the many descriptively adequate accounts, so I will concentrate on explaining the various possibilities and elucidating their consequences and plausibility rather than on arguing that things must be precisely this way.

Rule (0) deletes a linked High tone from the final mora of a word, accounting for the fact that words accented on their final mora are not distinguishable from unaccented words. One might think that this would follow from the tone association procedure alone, without there being any need for a separate rule to accomplish it, simply by virtue of the fact that the accent would only be realized distinctly if the post-accentual Low tone were linked to the final mora, and since in the Tokyo dialect such HL contours are not permitted the Low will not be linked. Such an account is possible only if the domain of Final Accent Deletion is the same as the domain of tone assignment, which is to say the minor phrase level. But in fact Final Accent Deletion must apply not at the minor phrase level but at the word level. The argument is due to McCawley (1968;178) who points out that when a word that is accented on the final mora is followed within the minor phrase by another word, the accent on the final mora fails nonetheless to be realized, although by rights it should dominate over any following accents. For example, the dative particle *ni* is accented, as shown by examples such as /tookyooni'wa/ "in Tokyo" where the topic particle *wa* permits realization of the accent on *ni*, but in a phrase like /tookyoonisumima'su/ "lives in Tokyo" the accent on /ni/ is lost. This follows if Final Accent Deletion applies at the word-level rather than at the phrase-level. Consequently, I suppose that a separate rule of Final Accent Deletion, applying at the word level, must be posited.

I have broken Initial Lowering into two pieces, Initial Low Insertion and Initial Low Linking, simply because of the conceptual distinctness of the two components. These two rules could perfectly well be collapsed into a single rule. In light of the data adduced above indicating that the initial Low is always present, rule (1) must be unconditioned, applying to insert a Low tone at the beginning of every minor phrase. This tone is linked by rule (2) to the first mora of the minor phrase regardless of whether that mora is already linked to a High tone, which it will be when the accent falls on the first syllable. I note that Initial Lowering cannot be accounted for in terms of Default Autosegment Insertion since the Low tone is present even when the mora to which it is associated already has a tone at the time.

Rule (3), High Tone Insertion on Last Mora is one way of dealing with unaccented words. This rule would link a High tone to the last mora of a minor phrase. Accent resolution would be ordered after this rule, so as to delete this High tone if the minor phrase is accented elsewhere. If not, this rule suffices to make the non-initial portion of unaccented words high. This rule, or a rule introducing a Mid tone instead, could be formulated as a Default Autosegment Insertion rule if High or Mid rather than Low is taken to be the unmarked value for tone, and if the derivation is arranged to ensure that at the point at which it applies no other tones are available to spread. This could be accomplished either by delaying Initial Low Insertion until the very end of the derivation (which would also require Default Autosegment Insertion to apply prior to the end of the derivation) or by adopting the proposal that linked tones do not spread except by language particular rule. Pulleyblank (1983) argues that Low is the unmarked value for tone, and while the evidence is not all in this seems the best bet. Consequently, I suppose that this rule is not a default rule.

Rule (4), Leftward Spreading of High Tone, is required to spread the High tones that constitute the accent as well as the High tones introduced by rule (3), onto all of the preceding morae but the first, which at this point is already occupied by the Low introduced by rules (1) and (2). The effects of this rule might be construed as resulting from the application of the spreading clause of the Association Conventions, in which case the spreading would necessarily be delayed until the end of the derivation. This would require either a language particular inversion of the Priority Clause for autosegmental spreading in order to account for the failure of the initial Low tone to spread instead of the High or that Initial Low Insertion be delayed until after Leftward Spreading of High Tone. In the latter case, in order to account for the difference in contour between initial accented words and other words it would be necessary to make the first mora invisible to rule (4) so that a rising contour on the first mora would occur only on initial accented words. The possibility of language-particular inversion of the Priority Clause has been proposed by Poser (1981b) and Odden (198x), but the matter is unsettled.

Rule (5), Post-Accentual Low Insertion, inserts a Low tone after a every High tone. Together with rule (6), which links this Low tone to every free mora within its domain, this rule accounts for the fall in pitch asociated with realized accents. The effects of rules (5) and (6) might well be attributed to the application of Default Autosegment Insertion, as D. Pulleyblank (Talk at Stanford University, March 1983) has suggested. This will work only if the proposal that linked tones spread only by language particular rule is adopted. A further relevant point is that what appears to be the same phenomenon in other dialects cannot be treated in this way. In these dialects the post-accentual Low tone surfaces even when there are no free tone bearing units in its domain. Whereas in the Tokyo dialect final accented words are not distinct from unaccented words, in many dialects of the Kansai group final accented words have a falling tone on the last mora instead of the High tone that unaccented words have. This means that the post-accentual Low is inserted regardless of the availability of free tone bearing units; the difference between these dialects and the Tokyo dialect is that in the former but not in the latter the post-accentual Low is always linked, to an already associated mora if need be. Thus, whereas rule (5) might be treated as a default rule in the Tokyo dialect, depending upon the version of the theory adopted, the same is not true in the Kansai dialects.

3.2.2.3. The Domain of Tone Assignment

On the account proposed here the tone assignment rules are partly lexical and partly post-lexical. The rules that assign accents are lexical, as is the rule deleting word-final accents. The remaining rules, i.e. the rules that resolve conflicts between accents within a minor phrase, the rule of Pre-*no* Deaccenting, and the tone insertion and association rules, are post-lexical. There are two alternatives to this approach: all tone assignemnt rules could be lexical, or all could be post-lexical. There are excellant reasons for rejecting both of these possibilities.[24]

3.2.2.3.1. Against Purely Lexical Tone Assignment

There are two proposals that may be subsumed under this heading. The first is that tone assignment is completed within the lexicon, so that there are no post-lexical tone rules at all, as some authors, e.g. Bennett (1981) and Clark (1983) have assumed. This possibility can be dismissed without further ado, for it provides no account of major phrase final boundary tone insertion and linking, nor of the more fundamental fact that the topology of the F0 contour is determined only at the minor phrase level, after the accent resolution rules and Pre-*no* Deaccenting have applied.

The second possibility is that words might leave the lexicon completely specified for tone, with the tonal specifications subject to subsequent modification by the post-lexical rules. It appears to be possible to formulate an account along these lines, but the account that I have given above seems nonetheless to be preferable.

The reasons for favoring that proposal are twofold. First, there is simply no reason for assigning any tones in the lexicon other than the High tones that correspond to accents. The only reason that might be offered for assigning other tones is the possibility of representing preaccenting suffixes as bearing an inherent Low tone, but I have argued in Chapter II that it is dubious that preaccenting suffixes should have any such special status. Second, fully specifying tone in the lexicon requires that the post-lexical rules be made more complex and indeed that they take on a rather baroque form.

Consider first the form taken on by Accent Resolution. This must be formulated as follows.

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[24] Of course within the class of analyses in which some rules are lexical and others are post-lexical there are accounts that differ in detail from that presented here.

Accent Resolution

> Delete all tones to the right of the first word-internal HL sequence in the minor phrase, and spread the remaining Low tone to the right.

This is only somewhat more complex than the proposed Accent Resolution rule. Moreover, if Initial Lowering is postponed until after Accent Resolution (thereby reducing the lexical tone assignment rules to accent placement, Default High Insertion, and Post-Accentual Low Insertion), the condition "word-internal" can be removed.

Matters get much worse when we consider what to do about Initial Lowering. If Initial Lowering applies in the lexicon, we must undo its effects at the minor phrase level. A rule like the following is required.

Initial Unlowering

> Delete a Low tone if it is word-initial but not minor phrase initial and spread the following High tone to the mora thus vacated.

It will not do to delete all Low tones that are not minor phrase initial since that would remove all Low tones due to accents. The alternative would be to leave High tones on initial syllables in the lexicon and to let Initial Lowering replace those tones at the phrase level, in effect adopting, for this rule, the post-lexical analysis.

Finally, consider how Pre-*no* Deaccenting would be formulated in a theory in which words were fully specified for tone. The rule must eliminate both the High tone due to the accent and the following Low, and then put a High tone in the vacated positions. Furthermore, not only must the Low tone on *no* itself be deleted, but in the cases in which the final accented syllable is heavy, the Low tone on the final mora of the noun must be deleted. This requires a rule like the following.

Pre-*no* Deaccenting

> Delete a Low tone on the syllable preceding *no* provided that that Low tone be preceded in the same syllable by a High tone. Delete a High tone on the syllable preceding *no*. Delete a Low tone on *no*. Then put High tones on all of the toneless syllables.

Of course the rule only applies if *no* is not final in the minor phrase. Notice that the complex statement of the first clause of the rule is necessary to prevent the last Low syllable of a word that is not final-accented from being raised to High.

If all of the tone assignment rules that I have assigned to the minor-phrase level apply in the lexicon, the rules necessary to undo their effects at the phrasal level are outrageously complex. If Initial Lowering is postponed to the phrasal level, the required rule of Accent Resolution is still cumbersome, and Pre-*no* Deaccenting takes on a Gothic complexity. In the absence of compelling evidence in favor of lexical assignment of tones other than accents, the post-lexical account of tone assignment given above is clearly preferrable.

3.2.2.3.2. Against Purely Post-Lexical Tone Assignment

Little need be said in criticism of a purely post-lexical approach. Such an approach is literally impossible under a non-diacritic account, since the accents are linked tones, and some of these must be present in lexical representations since they are lexically contrastive. Moreover, where accent placement is morphologically determined it is necessary to have recourse to lexical information, which is not permitted to post-lexical rules. Although we have pointed out one difficulty for this restriction, exceptions are sufficiently rare that it should not gratuitously be flaunted.

3.2.3. The Metrical Theory of Pitch Accent

I have thus far assumed that some variant of the Autosegmental Theory of tone is appropriate for dealing with pitch accent, and indeed we have encountered no great difficulty in describing Tokyo dialect Japanese within a purely Autosegmental theory. There is, however, an alternative proposal for the description of pitch accent languages that treats them as quite different from tone languages. This is the Metrical Theory of pitch accent.

Zubizarreta (1982) was the first to propose a version of the Metrical Theory of pitch accent.[25] Other proposals are due to Abe (1981), Bennett (1981) and Halle (1982). What all of the proposals have in common is the assumption that pitch accents are interpreted by a

[25] The date of publication is misleading. This paper was written and circulated in 1979.

mechanism that makes use of metrical tree construction, along lines vaguely similar to those proposed for stress in Hayes (1980)'s development of the Metrical Theory of Liberman & Prince (1977). In essence, the appropriate domain (taken by these authors to be the phonological word in the cases they discuss, although some authors admit other possibilities[26]) is divided into two parts on the basis of the location of the accent mark, if there is one. One part forms a binary branching foot whose leftmost or rightmost element (depending on the setting of a parameter) dominates the accented terminal. This foot is called the accent foot. The other part consists of the remaining terminal nodes, each Chomsky-adjoined to the root of the foot containing the accented mora. If a word is unaccented the foot created by the first rule will contain the entire domain, so that the second part will be empty. This much is common to all four proposals.

The four theories differ only on one significant point with regard to tree construction. In some versions of the theory, those of Abe (1981) and Halle (1982), one or more peripheral nodes on the side of the word at which the accent foot is constructed may be excluded from the accent foot and Chomsky-adjoined to its root like the nodes on the other side of the accent. This is used to account for Initial Lowering.

The other area in which the theories differ significantly is in how tone assignment is carried out. Once the domain has been divided into the accent foot and the possibly null remainder, tone is assigned. In Bennett's theory, there are no restrictions on the tone assignment rules. The other proposals all make use of variants of Zubizarreta's tone assignment schema. The central idea is that a single tone is assigned to the head of the accent foot and that the tones assigned to the terminals outside of the accent foot are the opposite of that assigned to it, so that the tree is said to be polarized. Tone within the accent foot is either uniform or polarized;in the latter case the tone of every element in the accent foot other than the head is the opposite of that of the head.

[26] Specifically, Abe (1981) explicitly permits a range of domains, Bennett (1981) explicitly restricts the domain to the phonological word, and Zubizarreta (1979) and Halle (1982) are silent on this point.

For the sake of concreteness, let us take as an example the system proposed by Bennett (1981). Bennett denotes the accent foot by the symbol @, and accents by the symbol *. She uses the term *-maximal to characterize a foot which has the property that it contains only one *, where, moreover, this * is either the leftmost node, in which case the foot is said to be left *-maximal or the rightmost node, in which case the foot is said to be right *-maximal. She proposes the following universal conventions (Bennett 1981: 35-36).[27]

a) The phonological word contains one and only one @.

b) The @ is *-maximal.

c) i. Each morpheme has at most one lexical marker *.
The * is usually attached to some * bearing unit
but may also be floating.

ii. A floating * docks on the nearest *-bearing unit of
the node dominating the phrasal head.

d) The phonological word is structured into a binary
branching tree .

e) i. The pitch markers H (high) and L (low) are defined
on the binary branching nodes.

ii. The surface pitch of a terminal element is the same
as the marker of the node immediately dominating it.

Bennett's Universal Conventions for Accent Systems

In addition to these universal conventions, the following parameters must be set (Bennett 1980: 36).

[27] These conventions and the following list of parameters are quoted almost verbatim. I have ommitted Bennett's definition of the term *-maximal, and in the list of parameters have changed her rather vague "What is the structure of the tree?" to the more precise question given below, which is what I believe she intended.

a) What is the *-bearing unit?

b) What is the direction of branching of the tree?

c) Is the language right or left *-maximal?

d) How are the nodes labelled?

Bennett's Language Particular Parameter Choices

To make the example more concrete, consider the derivation of the tone pattern of some words in the Tokyo dialect. The parameter settings for this dialect are as follows.

a) The syllable is the *-bearing unit.

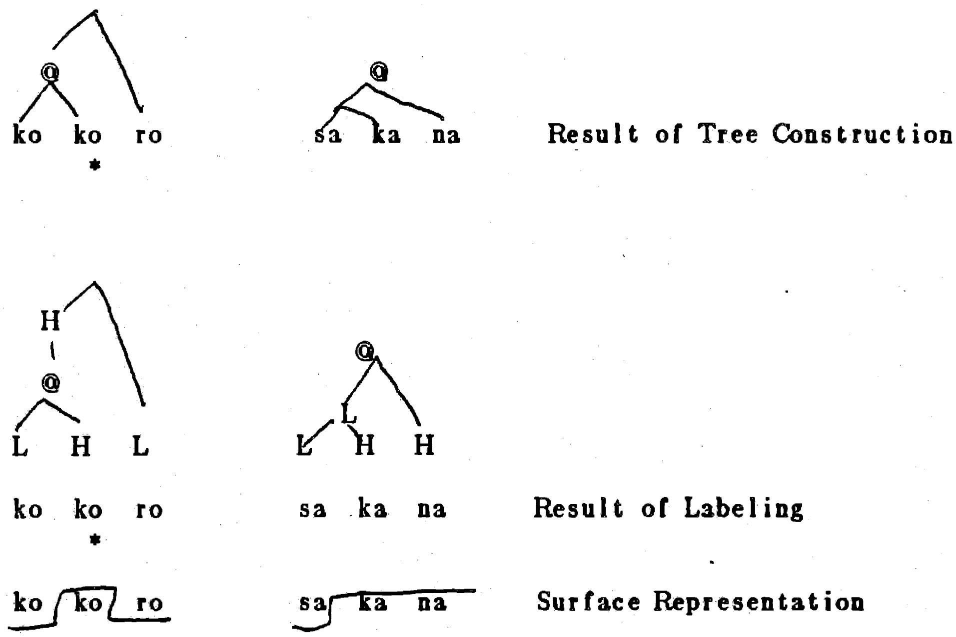
b) The tree is left-branching.

c) It is a right *-maximal language.

d) The right node is H within @; elsewhere the right node is L.

Bennett's Parameter Settings for the Tokyo Dialect

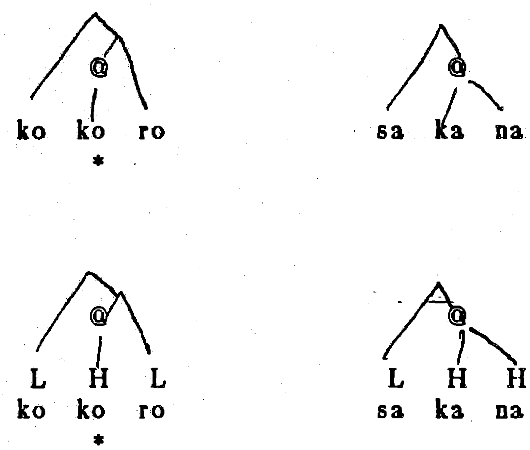
Consider now the nouns /koko'ro/ and /sakana/. Left-branching accent feet are constructed in both cases. In the case of /koko'ro/ this foot contains the first two syllables, since it must be right *-maximal. In the case of /sakana/ the accent foot covers the entire word, since there is no accent. The feet thus constructed are then labeled in accordance with the rule in (d) above, so that we obtain the representions below.



Sample Derivations under Bennett's Theory

As it stands Bennett's proposal has the unfortunate property that it incorrectly predicts that when the accented syllable is heavy the pitch will fall after this syllable rather than after its first mora. In the case of final-accented words with heavy final syllable, which in fact show a pitch fall after the first mora of the final syllable, the prediction is that there will be no fall in pitch at all. This is a consequence of the fact that Bennett takes the underlying domain of the accent, in the Tokyo dialect the syllable, to be the domain of tone assignment, so that the entire accented syllable is incorporated into the accent foot with the result that both morae receive High tone. This is not a defect of the metrical approach as such since nothing prevents shifting the domain of the accent from syllable to mora prior to the point at which the accent tree is constructed, though this is quite impossible in Bennett's theory since the accent tree is constructed prior to the application of the morphoaccentual rules. The identical shift is required in the diacritic autosegmental theory of Haraguchi (1977), and a parallel shift is proposed above for the non-diacritic autosegmental theory in which it is the domain of tone association rather than the domain of the accent that shifts.

The derivations are comparable on the other theories, but there instead of Bennett's ad hoc labeling rule the rule is simply "Label the accent foot H" with the automatic consequence that the nodes outside of the accent foot are Low. The fact that the High tone spreads to the left is accounted for by making the accent foot non-polarized. In order to account for the fact that the first mora of the word is low under certain circumstances, these accounts treat it as extrametrical, that is, as not preset in the representation at the time at which the accent foot is constructed, and then later adjoin it so that it ends up outside the accent foot and is therefore Low. The derivations are therefore as follows.



Result of Tree Construction

Result of Labeling

Sample Derivations under Other Theories

What the various versions of the Metrical Theory have in common is the idea that construction of some sort of tree structure is necessary. There is no consensus as to the interpretation, and therefore content, of this largely notational proposal, nor do most of the proponents of this theory demonstrate any clear conception of what they mean to claim when they characterize their proposal as metrical. This vagueness is reflected in the four arguments advanced in support of the theory. We may summarize these as follows.

(1) Pitch accent is formally the same as stress. Since stress requires metrical structure, pitch accent does too. (Zubizarreta, Bennett, Halle)
(2) The Metrical Theory appropriately constrains the possible tone patterns in a pitch accent language. (Abe)
(3) The Metrical Theory appropriately constrains morphological placement of accents. (Bennett)
(4) The Metrical Theory correctly predicts the direction of accent shift when tone-bearing units are deleted. (Bennett, Halle)

The first argument is made without any detailed statement of the properties that are taken to be analogous, so it is impossible to determine what the common properties of the theory are supposed to be. The second depends on the assignment of tone by polarization, not on the existence of constituent structure. The third depends neither on the tone assignment procedure nor on the existence of constituent structure. The fourth argument depends on the existence of constituent structure but not on the tone assignment principles. In short, the various arguments in favor of the theory do not depend on any common properties of the theories. I turn now to more detailed consideration of these arguments.

The first argument, offered by Zubizarreta, Bennett, and Halle is the belief that pitch accent is typologically similar to stress and so should be dealt with in a comparable fashion. They do not, however, give any argument to support the claim that stress and pitch accent are similar. I argue in Poser (in preparation-b) that in fact pitch accent and stress are typologically quite dissimilar, in ways, moreover, that suggest that one important difference between them is the role played by metrical structure in stress systems and its absence in pitch accent systems, but the matter is too complex to take up here. Thus, insofar as the Metrical Theory succeeds in forcing stress and pitch accent into the same mold, that is indeed a defect of the metrical approach.

Even on their own assumptions, however, the claim is questionable, since the Metrical Theory of pitch accent and the Metrical Theory of stress are not identical. If the two phenomena were really the same, we would expect the formal devices to be the same, with the difference between stress and pitch accent a matter only of the phonetic interpretation of increased metrical prominence. This is indeed the position taken by advocates of the position that stress and pitch accent are the same phenomenon. But in fact the Metrical Theory of pitch accent and the Metrical Theory of stress are quite distinct, the simplest evidence for which is the fact that Zubizarreta, Abe, and Bennett all felt compelled to elaborate separate theories of pitch accent rather then attempting to demonstrate the applicability of the existing Metrical Theory of stress. To take two examples, whereas in the case of stress feet may be either unbounded or binary, pitch accent feet are always unbounded. While stress foot construction may be quantity sensitive, pitch accent foot construction may not. Thus, it is dubious that putative analogies between stress and pitch accent can be used to motivate a role for metrical structure in pitch accent systems.

The second argument, due to Bennett (1981), is that her theory provides a a more constrained account of the morphology of accent. She observes that the class of actions performed by the morphological rules that govern accent placement in Tokyo dialect Japanese is restricted to a small number of simple operations, and that previous formulations of the accent shift rules fail to predict this. In particular, she takes McCawley (1968) and Haraguchi (1977) to task for making use of accent attraction rules, that is to say, rules that shift an accent a given amount toward an attracting morpheme.

The problem with Bennett's argument is that the metrical formalism plays no role whatever in constraining the rules governing accent placement. The reformulation of accent attraction in terms of preaccenting does not depend on the metrical tree. Nor does any other part of her morphological analysis. In her system, a morpheme can be accented (i.e. with an associated accent), preaccenting (i.e. with a floating accent), or unaccented. Orthogonally, a morpheme may or may not have the property of deleting other accents. None of this depends in any way on the metrical formalism. Indeed in his work on Sanskrit accent Kiparsky (1982, 1983) makes use of an identical typology within a non-metrical framework. There is no reason whatever that Bennett's constraints on the morphology of accent could not be duplicated within Haraguchi's Autosegmental account or for that matter within McCawley's theory. Indeed, the correct aspect of her theory is subsumed in the theory proposed in Chapter II which in no way depends upon metrical structure. The mere fact that Bennett's theory invokes metrical structure in order to interpret accents once assigned does not argue in favor of metrical structure. In sum, whatever the validity of Bennett's proposals regarding the morphology of accent, they provide no support whatever for the Metrical Theory.

The third argument is due to Abe (1981) and holds equally for the theories of Zubizarreta (1979) and Halle (1982). Since it depends crucially on the notion that pitch assignment is done by polarization of the tree, it does not support Bennett (1981)'s proposal.[28]

Abe's argument is based on the weak generative capacity of the metrical system as compared to that of the autosegmental system proposed by Haraguchi (1977). Here he takes the "language" to be the set of possible tonal melodies in the language, where by tonal melody I refer not to the abstract autosegmental melody but to the surface sequence of tones. For example, the word /sakana/ in the autosegmental analysis bears only two tonal autosegments LH, but for Abe's purpose it has the melody LHH, since the H tone extends over two morae.

Abe correctly observes that in a metrical system in which tone is assigned by polarization, the possible tonal melodies are fairly restricted; in particular, they can be written as regular expressions. He then proposes to demonstrate that in Haraguchi's autosegmental framework it is possible to generate tonal melodies that are not regular. Specifically, he claims that it is possible to generate the string $L^n(H)HL^n$, which is not a regular expression.

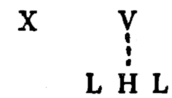
Abe uses the following rules to produce the derivation below.[29]

[28] In fact, since Bennett's proposal imposes no constraints whatever on pitch assignment rules, it is subject to all of the criticisms of purely segmental theories of pitch assignment that argue in favor of the Autosegmental Theory.

[29] Cited verbatim from Abe (1981:2-3).

(a) Tone Association 1:

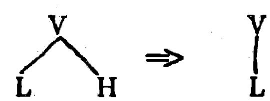
(b) Tone Association 2:



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

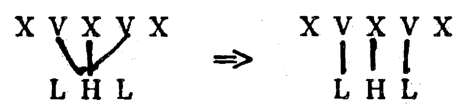
All tones should be associated wih at least one tone bearing unit, and conversely, all tone bearing units should be associated with at least one tone in the tone melody. No association lines should cross.

(d) Tone Simplification:



(mirror image)

(e) Tone Association 3:

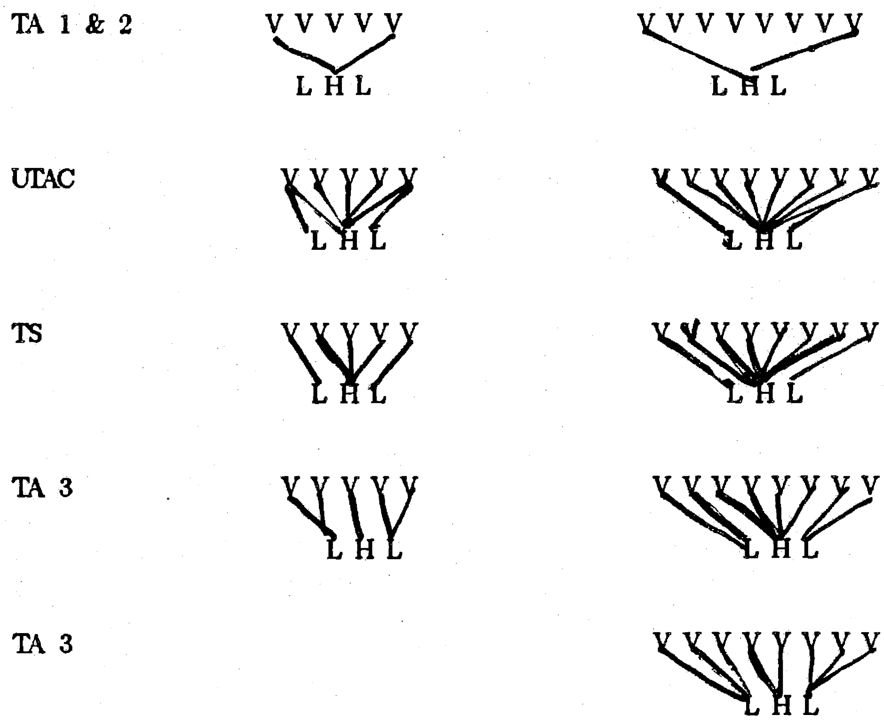


(X≠0)

Abe's List of Rules

The first two tone association rules are Haraguchi's Initial Tone Association Rules. Abe reproduces them incorrectly, so that their interpretation is unclear. The intention is to associate the chosen tone with the leftmost accent and no accent being present, the rightmost tone bearing unit or with the rightmost accent and no accent being present, the leftmost tone bearing unit. The third rule is Haraguchi's Universal Tone Association Convention. The fourth is indeed of a type found in much autosegmental work, while the fifth, because it performs two operations at different points simultaneously, is of a type unknown in the literature.

Abe uses these rules in the following derivation, which he claims demonstrates that the Autosegmental Theory permits the generation of non-regular tone patterns.



Abe's Sample Derivations

I will advance three objections to Abe's argument, to wit: First, that his theory's putative advantage in restrictiveness in no way depends upon the use of metrical structure; second, that there is every reason to suppose that appropriate constraints can be imposed within the Autosegmental Theory; and third, that he has not demonstrated that his theory yields a net gain in restrictivness.

The first point should be quite obvious. The essential aspect of his theory is the mechanism of tone assignment, in particular the principles of polarization of the tree, and harmony or polarization within the accent foot. The tone assignment rules depend upon the structure of the tree only in a limited way, one that can readily be modified so as to eliminate reference to the tree structure. In the case where the accent foot is constructed at the left end of the word, the exterior of the tree is simply the part to the right of the accent together with the invisible part. If the accent foot is constructed at the right end of the word, the exterior of the tree will be the part to the left of the accent together with the invisible part. Thus, reference to the exterior of the tree for purposes of polarization does not require reference to metrical structure. In the harmonic case, the entire interior of the tree has the same tone as the accented constituent, so that no further analysis is required. In the non-harmonic case everything in the word but the accented constituent has the same tone, so again no further analysis is required. In sum, the use that Abe makes of the metrical tree is inessential, the whole burden of the restrictiveness of his theory being borne by the procedure for tone assignment. Consequently, even if his argument is in every respect correct as regards the relative restrictiveness of the two theories, it provides no evidence whatever for the existence of metrical structure.

Consider now Abe's restrictiveness claim in more detail. What aspects of the derivation permit the generation of non-regular tone patterns? There are three aspects of his derivation that are suspicious. These are the application of both forms of the Initial Tone Association Rule within the same derivation, the iterative application of Tone Association Rule Three, and the form of the this same rule.

If we take Abe's argument at face value and ask whether or not he is justified in assuming that he is permitted these three suspicious aspects, it is easy to overcome it. The first objection we might raise is to the application of both forms of the Initial Tone Association Rule in the same derivation. Abe justifies himself with the argument that Haraguchi's theory permits both rules, but Haraguchi never applies both versions of the ITAR within the same derivation, nor, for that matter within the same dialect. The two versions of the rule are taken to be mutually exclusive. This is only to be expected, since the purpose of the ITAR is to provide the initial alignment of the melody with the string of tone-bearing units. Thus, Abe's procedure was certainly not envisioned by Haraguchi. Similarly, it is not at all clear that Haraguchi envisioned iterative application of the type required for Tone Association Rule Three in Abe's derivation. Finally, consider the form of Tone Association Rule Three, which performs two operations, on either side of the word, in synchrony. Neither Haraguchi's study nor any other work within the autosegmental framework makes use of such a rule, nor, in fact, have I ever seen anyone formulate a phonological rule of any type with this property. Although it is true that the Autosegmental Theory of tonal representation *per se* does not preclude the possibility of such a rule, there is every reason to believe that a properly formulated theory of phonological rules of all types will prohibit such a rule. Note that such a constraint is not an *ad hoc* addition to the Autosegmental Theory that is unnecessary in the metrical theory. If that were the case, Abe could correctly argue that in this respect the metrical theory is superior. The point is that the impossibility of such rules is not a property of pitch accent systems in particular; it is, rather, a general fact about phonological rules and as such belongs to the theory of phonological rules and not specifically to the theory of pitch accent systems. So if the issue is whether Abe's derivation is possible in Haraguchi's theory, the answer is probably no.

Of course, this is not the real issue. The real issue is whether or not the Autosegmental Theory actually generates non-regular tone patterns, and we must contend with the possibility that Abe's non-regular language could be produced by more orthodox procedures within the Autosegmental Theory. This may indeed be the case. Consider, for example, the objection to the form of Tone Association Rule Three. This objection is in fact irrelevant, since it is possible to replicate Abe's derivation of a non-regular language without using a rule of this form. Specifically, it suffices to replace Tone Association Rule Three with two rules, one the mirror image of the other (or, if one prefers, with a mirror image rule, it does not matter) so that the operations on the two sides of the High tone (s) are no longer linked. If these rules are permitted to apply iteratively so long as their environment is met, as Tone Association Rule Three is, the outcome will be the same where the number of tone bearing units is odd. Where the number of tone bearing units is even the precise outcome depends on exactly how the two relinking rules are formulated, but in any case the language generated is non-regular.

The same is true of the objection to the application of both forms of the ITAR within the same derivation. This is quite unnecessary. Any procedure that associates a High tone to every tone-bearing unit and inserts Low tones before and after this High will set up the environment for the relinking performed by Tone Association Rule Three.[30]

The questions that we must answer are then two: First, is it possible to generate the representation in which every TBU is linked to H with Lows on either side, and second, is it possible to relink the Lows from both sides so that the H ends up in the middle? The answer to the first question is clear. It is easy to generate the requisite representation. Simply link a High tone first to one end of the string and then to the other, or link the High to every TBU at once. Then insert Low tones both before and after the High. There can be no objection to either of the these latter insertions, nor is there any argument against rules that link a tone to one end of the string or the other, or to every TBU at once. Thus, it appears that we must admit this representation.

This leaves the question of whether it is possible for the Low tones to eat in from the ends in the requisite fashion. Relinking rules of this type are apparently necessary, so that the form of the rules themselves is not to be questioned. What is to be questioned is the iterative application of these rules. The theory of Directional Iterative rule application was developed by Howard (1973) primarily to deal with stress and harmony, so with the advent of the Metrical Theory of Stress and the Autosegmental Theory of harmony, it came to be tacitly assumed that iterative rule application was unnecessary. In point of fact it appears that some form of iterative rule application is necessary, in that stress feet and similarly harmony and disharmony domains are constructed in a directional iterative fashion,[31] but there is a crucial difference between this revised theory of iterative rule application and that of Howard. In the current framework it appears to be possible to constrain directional iterative rule application to the delimitation of mutually exclusive rule domains, so that it is never the case that one application of the rule feeds the next. If this constraint is correct, it is not possible to reconstruct Abe's derivation, and his argument fails.

[30] To make things work exactly right, the rule must either be reformulated very slightly to perform the relinking whether or not the Low tones are linked, or additional rules to link the floating Lows must apply before Tone Association Rule Three.

[31] This aspect of the theory of stress rules of Hayes (1980) was extended to harmony and disharmony by Poser (1981a).

To summarize this objection, Abe's rules and derivation in the form in which he gives them present a dubious picture of the possibilities under Haraguchi's theory. Whether in fact the class of tone patterns at issue is generable under the Autosegmental Theory depends upon the correctness of the proposed constraints on iterative rule application.

Finally, consider whether Abe's theory actually provides a net gain in restrictiveness. There is no proof that it does. Abe assumes that there are two well-demarcated classes of languages, tone languages and pitch accent languages, and he provides a restrictive account of the latter without providing any account of the former. But this only means that the unattested non-regular class of languages to whose generation he objects is impossible within the class of pitch accent languages. This tells us nothing whatever about the class of languages that it is possible to generate. It only tells us that a language of this type cannot be classified as a pitch accent language. Until Abe shoulders the burden of proof of demonstrating that the class of languages he objects to are not generable as tone languages, he has failed to make a *prima facie* case.

Indeed, insofar as it is true that existing versions of the Autosegmental Theory would generate Abe's non-regular language, there is every reason to believe that it would be generable as a tone language. Of the rules involved in Abe's derivation, only the Initial Tone Association Rules are characteristic of pitch accent languages. As they are used by Abe, the reference to accents is unnecessary; it is the end-linking aspect that is crucial. Even if end-linking should prove to be unnecessary in non-accentual languages, so long as it is possible within a non-accentual language to link the same tone to every tone bearing unit in a domain and then to insert other tones on either side, it will be possible to generate Abe's language as a tone language, assuming of course that the relinking rules may be applied iteratively in the requisite fashion.

To sum up, Abe's argument is subject to three objections. First, the restrictiveness of his account does not depend upon the existence of metrical structure, so at best it provides an argument for special restrictions on tone-association in pitch accent languages. Second, the existing theory is appropriately constrained. Finally, Abe has failed to show that his theory creates a net gain in restrictiveness, and to the extent that the proposed constraints on the existing theory are untenable, there is every reason to believe that his theory is not in fact any more restrictive than the pure Autosegmental Theory. For these reasons I do not find Abe's arguments persuasive either as evidence for a different theory of tone association or for the role of metrical structure in pitch accent systems.

The fourth and last argument in favor of the metrical approach is due to Bennett (1981) and was modified slightly by Halle (1982), whose formulation I will discuss. It is based on the displacement of accent that allegedly results when a high vowel is devoiced by an incompletely understood rule that devoices high vowels in voiceless environments, i.e when they are not adjacent to a voiced segment.

The empirical claim, based on the description by Haraguchi (1977),[32] is that when an accented high vowel is devoiced, and it is in the first or second syllable of the word, the accent is displaced onto the following syllable~~,~~ while if it is in any other syllable the accent is displaced onto the preceding syllable. The advantage of the Metrical Theory is claimed to lie in the fact that it predicts the direction in which the accent is displaced.

Consider first the case in which the accent lies on some syllable other than the first or second. In this case, the accent shifts to the left. Why? Because the preceding syllable is now the rightmost tone-bearing syllable in the accent foot. The fact that if the accented syllable is the first syllable it is the second syllable onto which it is displaced intuitively requires little explanaton; there is no syllable to its left onto which it could move. The same is true of the second syllable; since the first syllable is treated as extra-metrical, it is not not available to bear the displaced accent.

What is less clear is why the accent shifts at all, since nothing in the metrical formalism *per se* requires that the accent foot be reconstituted when the only node that it dominates vanishes. That it must be reconstituted is an *ad hoc* stipulation of the theory. Even so, insofar

[32] Another primary source of observations is Kawakami (1970).

as the Metrical Theory predicts the direction of the shift, this would indeed be an advantage.

I must here point out that the facts underlying this argument are far from clear, for the consequences of High Vowel Devoicing for the F0 contour have yet to be adequately elucidated. The actual location of the accent is not always clear, and even where the location is clear the examples do not necessarily demonstrate the effects of High Vowel Devoicing. For example, Haraguchi (1977) and following him most subsequent authors cite as illustration of the rightward shift of the accent deadjectival adverbs such as [tika'ku] "near" instead of [ti'kaku]. There is no argument over the location of the accent, but these examples do not bear at all on the devoicing question, since they merely reflect the normal accentual pattern for these forms of the adjective. For a great many speakers the accent on such forms falls either on the penult or on the ultima of the adjective stem, regardless of the voicing of the penult, so that we have, for example, both [ta'kaku] and [taka'ku] for "high", and indeed for some speakers only the latter form is acceptable. Thus, these forms provide no evidence at all for a shift of accent induced by High Vowel Devoicing.

This is not to say that there are no examples of the rightward shift of the accent. Other examples, involving accent patterns that are not observed when High Vowel Devoicing does not take place, have been presented, e.g. the example of present tense verbs acquiring the accent on the ultima when the penult is devoiced mentioned by Kawakami (1973) and the examples of past tense verbs normally accented on the antepenult with accent on the penult when the antepenult is devoiced discussed by McCawley (1968). However, even in these cases it is unclear whether the accent always shifts. The following passage from McCawley (1968;155), which seems to have been ignored by subsequent authors, claims that in some cases the expected shift simply does not take place.

> There are in addition a number of verbs which many speakers pronounce with the normal accentual alternation even though the accented syllable is devoiced, for example, tuke'ru/tu'keta "attach", huke'ru/hu'keta "grow old", tuki'ru/tu'kita "(supply) is exhausted", susuke'ru/susu'keta "get sooty".

There is also some question of whether a perceived rightward shift in accent necessarily results from a change in the F0 pattern. Takahasi (1980) examined the spectrograms and pitch contours of a number of pairs of segmentally homophonous words both of which contained a voiceless syllable, but where one word was underlyingly accented on the voiceless syllable and the other somewhere else. He found, for example, that the pitch contours of the words [si̥'kai] "dead sea" and [si̥ka'i] "dentist" were distinct, contrary to previous phonological claims, and that they closely resembled those of words with fully voiced vowels with the same accentual pattern.[33]

The question then arises of why a shift in accent might be perceived in the absence of an acoustic change. Mark Liberman (personal communication, 1983) has suggested that if speakers use as their criterion for determining the accented syllable the point at which there is a significant downward trend, speakers will perceive a rightward shift if the accent is on the first or second syllable simply because in both cases there is no decline before the syllable following the originally accented one. And indeed Takahasi (1980) reports that this is the criterion that speakers use. The problem is that it is unclear why this does not result in a perceived rightward shift in the case where the accent is not on the first or second syllable.

When we examine the putative leftward shift of accent, it becomes doubtful whether there is any shift to account for at all. Consider first whether there is any evidence of a change in tone pattern under devoicing of the accented syllable. The alternative is that the phonological tone sequence remains undisturbed to be realized articulatorily just as if the devoiced syllable were voiced, the only difference being that since the signal generated is not periodic it has no detectable fundamental frequency, and therefore no perceptible pitch. This is entirely plausible from a phonetic point of view. Sawashima (1971) has shown that the devoicing of high vowels in Japanese is accomplished by abduction of the vocal folds. While this prevents periodic vocal fold vibration and therefore the production of sounds with a fundamental frequency, it in no way interferes with the tensing and laxing of the vocal folds which is the principal mechanism of F0 control. Thus, a phonological tone could be realized articulatorily even though the articulatory gestures had no acoustic consequences. Moreover,

[33] I should note that in my copy of Takahasi's paper the spectrograms and pitch contours are nearly illegible, so that I am taking his word for these observations.

in spite of the fact that devoicing destroys F0, it is known that to some extent perception of tonal distinctions is preserved in whispered speech, presumably through secondary effects of the articulations associated with tone production on vowel spectrum and perhaps other properties of the signal (Abramson 1969). This, suggests that in these cases the articulations associated with the tonal pattern are indeed maintained in spite of the impossibility of the tone pattern being given its principal realization in terms of F0. In sum, it is entirely plausible that the phonological tone pattern might be preserved without any modification whatever when a syllable is devoiced.

This possibility is entirely consistent with Haraguchi's description of the putative leftward accent shift. He does not indicate that the pitch of any toneful syllable changes; he says only that the position of the last High shifts to the left. But, as Prince (1982) has pointed out, this is exactly what will happen if there is no change in the phonological tone pattern at all; the last perceived High tone will be the one preceding the devoiced, originally accented syllable. There is, moreover, some reason to suppose that this is what happens. If there is no phonological change in the tone pattern, we should expect the F0 contour on the surrounding syllables to be unperturbed, whereas if there is a shift we would expect to find some perturbation. Takahashi (1980) reports that the F0 contour of [yasasi̥'katta] "was easy" was different from that of [yasa'si̥katta], the same adjective intentionally pronounced with accent on /sa/, where it putatively shifts, and that this difference was what one would expect if the former form retained accent on the voiceless vowel.

It appears, then, that there is no phonological, or even articulatory, shift in tone pattern in the cases described as involving a leftward shift in accent.

Supposing that there is some evidence of a change in the phonological or articulatory tone pattern, must we attribute this to accent shift? Not necessarily. Osamu Fujimura (personal communication, 1983) has made measurements of laryngeal height (a measure well correllated with F0) that show that when an unaccented vowel immediately following the initial Low tone is devoiced it is produced with a Low tone, e.g. [seki̥ta'N] has the pattern

LLHL. This suggests that a devoiced syllable is automatically lowered if it is adjacent to a low tone, i.e. that lax vocal folds is the default state. If this is the case, the putative accent shift could be the result of the application of this default rule.

In sum, there is little reason to suppose that there is any phonological phenomonen of leftward shift of accent. So far as the existing data are concerned we may treat these cases as involving no more than deletion of the devoiced syllable from the string of tone bearing units, and possibly not even that.

Whereas a descriptively adequate account of accent shift is available under the Autosegmental Theory, there is in fact reason to question the plausibility of the metrical account. In the metrical account, High Vowel Devoicing necessarily precedes the assignment of tone within the minor phrase. Now, the conditions on High Vowel Devoicing are poorly understood, but among them is the following, attributed to Osamu Fujimura by Lovins (1976). When an utterance ends in a high vowel preceded by a voiceless consonant, the final vowel may devoice, since it is in a voiceless environment. But this is true only with declarative or continuative intonation. If the sentence is uttered with interrogative intonation, and the high vowel in question is in absolute major phrase final position (i.e. is not followed by an interrogative particle) so that the sharp rise of the interrogative intonation is realized on it, then it may not be devoiced.[34] This gives rise to paradigms like the following.

(a) koko ni ima'su. "He's here."
here D be

(b) koko ni ima'su ka ? "Is he here?"
here D be Q

(c)*koko ni ima'su ? "Is he here?"
here D be

Devoicing of the /u/ of imasu is possible in (a) which is uttered with declarative intonation, and in (b) which is a question with interrogative particle *ka* where /u/ does not bear the

[34] I may add that I have confirmed this observation with other speakers.

interrogative rise. When /u/ bears the interrogative rise, as in (c), it cannot be devoiced.

Consider now how this restriction might be stated. It is not simply a block on devoicing in interrogative sentences. It depends on whether or not the interrogative rise falls on the candidate for devoicing. If High Vowel Devoicing Follows the association of the tones, both the minor phrase level tones and the major phrase-final boundary tones which I have suggested are responsible for the major phrase final intonational effects, then it will be trivial to prevent Devoicing from applying to a vowel bearing the High boundary tone. But on the metrical analysis, High Vowel Devoicing precedes tone association, so we must either have recourse to a global condition on High Vowel Devoicing, or associate the major phrase level High boundary tone prior to High Vowel Devoicing, whence by transitivity prior to the association of the minor phrase level tones. Under standard assumptions about rule ordering, which prohibit global conditions and which prohibit the application of rules to a larger constituent prior to application of rules to smaller constituents, the metrical account is impossible. In order to allow the metrical account we must permit either global rules or anti-cyclic rule application, neither of which is an attractive possibility. This seriously undermines the plausibility of the metrical account of accent shift.

It remains to consider the extent to which the Autosegmental Theory can account for the accent shift facts. I take it to be demonstrated that there is no reason to believe that any leftward shift of accent actually takes place, so that what we must account for is the fact and manner of the rightward shift. There are three questions that we may pose:

(1) Why does accent shift at all under Higher Vowel Devoicing?
(2) Why does accent shift only when it lies on one of the first two syllables?
(3) When accent does shift, why does it shift to the right?

Consider first why accent shifts at all. On Haraguchi's autosegmental account accent shift is attributed to the removal of the devoiced vowel from the class of tone bearing units, the consequent floating of its tone, and the reassociation of that tone. Both Haraguchi and Bennett and Halle assume that when a vowel is devoiced it is removed from the class of tone bearing units by universal convention. As I have pointed out above, this is incorrect. It is possible for a vowel to remain tone bearing when it is devoiced. This fact alone means that on both the autosegmental and the metrical accounts accent shift is not necessary, since it is a language particular fact that voicelss vowels cease to be tone-bearing.

In the Metrical Theory the fact that shift occurs once the orignally accented vowel is removed from the set of tone bearing units is attributed to a convention that forces reconstruction of the accent foot. In Haraguchi's autosegmental account the fact that the floated tone reassociates is due to the clause of the Well Formedness Condition that forces every tone to be associated. Since this clause has been abandoned, the Autosegmental Thoery no longer forces reassociation of the floated tone. This might seem to be an indication that the Autosegmental Theory is weaker than the Metrical Theory, but this is not true. First, notice that we have no evidence bearing on whether, in pitch accent languages, the floated town always reassociates. Second, notice that on no account do we obtain the prediction that devoicing of the vowel will lead to accent shift. Finally, observe that there is no reason to believe that floated tones should reassociate. If we take pitch accent languages to be tone languages of a particular sort, as argued here, then reassociation is not to be expected, since floating of a tone can have any number of outcomes; it may reassociate, it may continue to float, or it may be deleted.[35]

Secondly, consider why accent shifts only when it is the first or second syllable that is devoiced. On the metrical account this is because it is only in these two cases that deletion of the devoiced vowel from the set of terminals results in the destruction of the accent foot. A parallel account is available within the Autosegmental Theory. It is only if the devoiced accented syllable is the first or second syllable that this syllable is the only one associated to the High tone, so that only in this case will removal of the accented syllable from the string of tone bearing units result in floating of the tone.

[35] See Goldsmith (1976) and much subsequent literature.

Finally, why is it that when the accent does shift it shifts to the right? Clearly no elaborate explanation of this is needed for the case where the devoiced syllable is the first syllable. In this case there is no syllable to the left to which the accent could shift. The question is, then, why does the accent shift to the right rather than to the left when it is the second syllable that is devoiced? In Bennett's version of the theory, this is because Initial Lowering has already applied to the first syllable, so that leaving the first syllable as the only member of the accent foot and therefore its head and the accented syllable, would result in a violation of her node labeling conventions which require the head of the accent foot and the root to agree. In Halle's version the initial syllable is extrametrical and therefore not part of the accent foot. The fact that a destroyed accent foot is reconstructed by taking the following syllable rather than the preceding one is apparently just a stipulation of the theory. In both cases, a stipulation that otherwise plays no role in the theory is used to predict the direction of accent shift.

In the Autosegmental Theory there are several routes open to us. First, we might make use of the fact that the floated tone tone will preferentially associate to a free tone bearing unit. If High Vowel Devoicing applies prior to Post-Accentual Low Insertion but after Initial Low Linking the first syllable will already be linked whereas the third syllable will not be, so that the floated tone will dock to the right. Recall, however, that High Vowel Devoicing is a major phrase level rule. This means that if this account is adopted Post-Accentual Low Insertion and Post-Accentual Low Linking & Spreading must apply at the major phrase level. Nothing in fact prevents the application of these two rules rules from being delayed to the major phrase level, so that this is a tenable account.

The alternative is for High Vowel Devoicing to follow all of the tone association rules. In this case both of the neighboring morae will be occupied, so we must appeal to some other principle to explain the direction of the docking. One possibility is that there is a default direction for reassociation just as there is for initial association.[36] In sum, the Augtosegmental

[36] If this account is adopted, the docking of the floated tone will create a falling contour on the first mora of the third syllable. This will presumably be eliminated by convention since

Theory provides as good an account of the accent shift facts as the Metrical Theory is claimed to.

The facts underlying the accent shift argument are obscure. The metrical account of accent shift under High Vowel Devoicing is impermissible under existing theories of rule application. An account is available within the Autosegmental Theory that is not only descriptively adequate but provides as much of an explanation for the precise nature of the accent shift phenomenon as can reasonably be expected. For these reasons, the accent shift argument for the Metrical Theory of pitch accent is not compelling.

In sum, of the four arguments that have been offered in favor of the Metrical Theory, only one actually bears on the existence of metrical structure, and none of the four arguments is capable of withstanding careful scrutiny.

3.2.4. The Diacriticity of Pitch Accent

As I have previously noted, one issue in the study of pitch accent languages is whether it is necessary to make use of diacritic accents, or whether it is sufficient to take accents to be linked tones. Arguments in favor of the diacritic approach are for the most part based upon asymmetries in the behaviour of accented and unaccented tones. Hyman (1982) and Pulleyblank (1983) have dealt with a number of these asymmetries, showing that they do not force reliance upon diacritic accents. I briefly discuss here several apparent arguments for a diacritic approach to Japanase pitch accent.

The first argument is an indirect one, namely that to the extent that the metrical theory of pitch accent is correct, pitch accent must be diacritic, since the metrical theory is inherently diacritic. This argument depends on acceptance of the arguments in favor of the metrical theory, so in light of the critique in the preceding section it may be dismissed without further ado. But even were one to accept some of the arguments in favor of a metrical approach, it would not be necessary to adopt a diacritic approach to pitch accent. Although as actually formulated all four versions of the metrical theory are indeed diacritic, it

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such contours are not permitted in Tokyo dialect Japanese.

is not true that metrical theories must be diacritic, nor is it the case that the arguments offered in favor of the theories actually proposed bear directly on the diacriticity issue.

The first point is the easiest to see. Simply take any of the proposed versions of the metrical theory and replace the diacritic accent mark with a linked High tone. Use this tone rather than the diacritic to delimit the accent foot, otherwise building the metrical structure exactly as in the original theory. This yields the same structure as in the diacritic theories. In the case of Bennett's theory we are done, since in her theory there are no constraints whatever on the tone assignment rules, so whatever could be done in the original theory can be replicated in the non-diacritic version. In the case of the other theories, in which tone assignment is performed by a special, constrained mechanism, everything is the same but for one feature. Whereas in the diacritic theories the choice of the tone to be assigned to the accented unit is a freely variable parameter of the language, in the non-diacritic theory this tone is fixed as High.[37] To this extent, then, the non-diacritic metrical theory is more constrained than its diacritic counterpart. Since this constraint appears to be correct this is an advantage rather than a disadvantage. In sum, the diacritic and non-diacritic notions of accent are equally consistent with the existence of metrical structure.

The second point requires more careful attention. The first argument for the metrical theory, that of similarity to stress, begs the question. Insofar as pitch accent really is exactly like stress, it must be diacritic, but one of the questions that must be answered in order to determine whether stress and pitch accent are the same phenomenon is whether both are diacritic. The second argument, based on constraints on possible tone patterns, does not in any way depend on the diacriticity of the accent. As I have pointed out above, Abe's constraints can easily be recast in a non-diacritic theory. The third argument, based on constraints on the morphology of accent, depends on the character of the rules that manipulate accents. These do not in any way depend on the diacriticity of the accent. The fourth argument, based on accent shift, depends only on the claimed existence of certain labeled

[37] This is true of the non-diacritic theories that have been proposed, but one can imagine a less constrained non-diacritic theory in which accents are represented as any linked tone.

constituents, not on the nature of the accent.

In sum, although the metrical theories of pitch accent that have actually been proposed are all diacritic, the diacriticity issue is in fact orthogonal to the question of the role of metrical structure.

The next two arguments involve asymmetries in the behaviur of accented and unaccented tones. The first asymmetry arises in the Tokyo dialect and has already been dealt with. This is the fact demonstrated above that accented high tones are phonetically higher than unaccented high tones. This fact can quite adequately be treated without recourse to diacritic accents, as I have shown above, so this asymmetry in fact provides no support for a diacritic approach.

The second asymmetry arises in a number of dialects, especially those of the Kansai group, including Kyoto, Osaka, and Kameyama. Whereas in the Tokyo dialect there is no falling tone on final-accented words with short final syllables and thus no phonetic distinction between such words and unaccented words, in the dialects in question there is a difference: final-accented words have a falling tone on the final mora whereas unaccented words have a level high tone. In Haraguchi (1977)'s autosegmental analysis of these dialects, this behaviour is attributed to the application of a language-particular rule that simplifies tonal contours, but only when the mora in question is unaccented. In other words, the universal tone association conventions link both the High and the Low of the melody to the final mora of both final-accented and unaccented words, creating a falling tone in both cases. This contour remains when the final mora is accented but is simplified when the final mora is unaccented.

Since Haraguchi's work it has become generally accepted that the universal tone association conventions do not create contour tones. As a result, if no reference were made to the accent, we would expect that neither final-accented nor unaccented words would exhibit a falling tone. In order to create the asymmetry we would simply invert Haraguchi's analysis, adding a language-particular rule that links the floating Low tone of the melody to the last mora only if that mora is accented. So long as we maintain the traditional notion of melody, it appears to be necessary to appeal to the accentual diacritic to produce the observed difference between final-accented and unaccented words.

However, if we treat accents as linked High tones and insert the Low tone of the melody by rule, as proposed above for the Tokyo dialect, there is no difficulty in producing the asymmetry. The post-accentual Low tone is introduced only following a High tone. If unaccented words lack a High tone at the point at which Post Accentual Low Insertion appies, whether because they never receive a High tone or because the rule that inserts it follows Low Insertion, then the Low tone will never be inserted in unaccented phrases, and if it is not present it cannot be linked. These dialects can in fact be analyzed in exactly the same way as the Tokyo dialect, the only difference being the presence in these dialects of a rule lacking in the Tokyo dialect that links a floating Low tone to the final mora of the phrase even if it is already linked. The fact that some dialects distinguish between unaccented and final-accented phrases does not therefore require reference to a diacritic accent.

The fourth and last argument is based on the rule for accenting noun-noun compounds in the Osaka dialect. The facts are described by Wada (1942) and Maeda (1953). A brief discussion in English is given by Haraguchi (1977).

In the Osaka dialect, in addition to the location of the accent there an additional distinction between words is possible, namely whether or not the region extending from the beginning of the word up to (but not including) the accented mora is low toned. It is sufficient, as Haraguchi points out, to describe this in terms of the presence or absence of an intial Low tone which if present spreads up to the accented mora. In Haraguchi's terms there are then two melodies: HL as in Tokyo, and LHL. The location of the accent and the choice of melody are independently variable.

The crucial fact about the accentuation of noun-noun compounds in the Osaka dialect is this: whereas the location of the accent of the compound is determined primarily by the properties of the righthand member, and if present always falls either on the righthand member or on the last mora of the lefthand member, the melody of the compound is that of the lefthand member. Thus described, it appears that the melody and the accent are selected independently, which is surely impossible if there is no diacritic marker of the location of the accent independent of the melody as is the case in the linked tone theory. If it were true, for arbitrary melodies, that pitch accent languages could have rules that selected the location of the accent and the melody independently, this would indeed be an argument for a diacritic accent. However, as Mark Liberman (personal communication, April 1983) has observed, the fact that in the present case the choice is between HL and LHL is crucial. Suppose that in the Osaka dialect words may have, in addition to linked High tones, floating Low tones which precede the High tone if the latter is present. Then to generate the Osaka compounding facts we need only assume that the rules that place the accent are rules that link a High tone in the appropriate place (on the righthand member or the last mora of the lefthand member) and that in addition there is a prior rule, just as there is in the Tokyo dialect, that deletes any linked High tones on the lefthand member. In other words, the there are three operations which apply in the following order:

(1) Delete High tones on the lefthand member.

(2) Delete all tones on the righthand member.

(3) Link a High tone to the appropriate mora (if any).

Rule (3) of course subsumes a fairly complex set of accent placement rules. The crucial point is that rule (1) affects only High tones, so that an initial Low tone, if present, will remain. If no accent is place by rule (3), the resulting form will have only this Low tone. If rule (3) does attach an accent, the resulting compound will have an initial floating Low followed by a High linked somewhere to its right. This is exactly the representation of a Low intial word. Thus, there is no selection of a melody as a unified object-the tone that is linked to the accented syllable does not depend on the melody of the lefthand member.[38] Thus, the

[38] Notice that Tokyo dialect requires rule (1), and that in fact the rule can be formulated in exactly the same way, since in the Tokyo dialect there are no Low tones to be concerned with.

Osaka facts can be dealt with quite straightforwardly without recourse to diacritic accents.

List of Figures

Fig. 4.1
F0 contours of the sentence [sore wa sono uma no iro da to itta]. Both traces are to the same scale. The upper trace shows the absence of an accent on [uma] in the wide scope reading. In this case the accent of [iro] is realized. The lower trace shows the presence of the accent on [uma] in the narrow scope reading. In this case the accent on [iro] is deleted since it is preceded within the same minor phrase by the accent on [uma]. The cursor marks the boundary between the [a] of [uma] and the [n] of [no].

Fig. 4.2
F0 contours showing the failure of the monosyllabic nouns [aN] and [na] to lose their accents before the particle [no]. The cursor is aligned at the boundary between the [a] of [na] and the [n] of [no] in the upper trace and between the [a] of [aN] and the [N] of [aN] in the lower trace. Both traces are to the same scale.

Fig. 4.3
F0 contours illustrating the failure of deaccanting of a final-accented noun before the particle *no* when *no* functions as the head of a noun phrase. In the upper trace deaccenting applies permitting the accent on [wa'ra] to be realized. In the lower trace deaccenting does not occur. The cursor is aligned at the boundary between the [n] and the [o] of the particle *no*. Both traces are to the same scale.

Fig. 4.4
F0 contours comparable to those in Fig. 4.3 illustrating the failure of deaccenting of a final-accented noun before the particle *no* when *no* functions as the head of a noun phrase. In the upper trace deaccenting applies. In the lower trace deaccenting does not occur. The cursor is aligned at the boundary between the [n] and the [o] of the particle *no*. Both traces are to the same scale.

Fig. 4.5
Typical F0 contours of the initial-accented words [no'mu] "to drink" and [no'omu] "agricultural affairs". Both words begin well below the peak. The two traces are aligned at the boundary between the [n] and the [o], illustrating the fact that the fall in F0 on an accented long syllable occurs on the first mora.

Fig. 4.6
The F0 contour of the same token of [no'mu] as in Fig. 4.5 is shown in the upper trace. The lower trace shows the first log-area linear prediction coefficient.

Fig. 4.7
A typical F0 contour of the initial-accented word [da'NdaN] "steps, stairs" is shown in the upper trace. The lower trace shows the first log-area linear prediction coefficient.

Fig. 4.8
A typical F0 contour of the unaccented word [noomeN] "Noh mask". The lower trace shows the first log-area linear prediction coefficient. Notice the initial rise.

Fig. 4.9
A typical F0 contour of the unaccented word [noonoo] "at ease". (For some speakers, but not this one, the word is accented on the second syllable.) The lower trace shows the first log-area linear prediction coefficient. Notice the initial rise.

Fig. 4.10
F0 contours illustrating the two phrasings of the words [yoNde mi'ru]. The two traces are to the same scale. Notice the presence of a bump before the final fall in the upper trace, where there are two minor phrases, in contrast to the smooth shoulder in the lower trace where there is only a single minor phrase. The triangular dip in the middle of the level region is a segmental effect due to the [d].

Fig. 4.11
A typical F0 contour of a biphrasal reading of [yoNde mi'ru] is shown in the upper trace. The lower trace shows the first log-area linear prediction coefficient. The cursor is aligned at the beginning of the [m] of [mi'ru].

Fig. 4.12
The F0 contour of another token of a biphrasal reading of [yoNde mi'ru] is shown in the upper trace. The lower trace shows the first log-area linear prediction coefficient. The cursor is aligned at the beginning of the [m] of [mi'ru].

Fig. 4.13
A typical F0 contour of a monophrasal reading of [yoNde mi'ru] is shown in the upper trace. The lower trace shows the first log-area linear prediction coefficient. The cursor is aligned at the beginning of the [m] of [mi'ru].

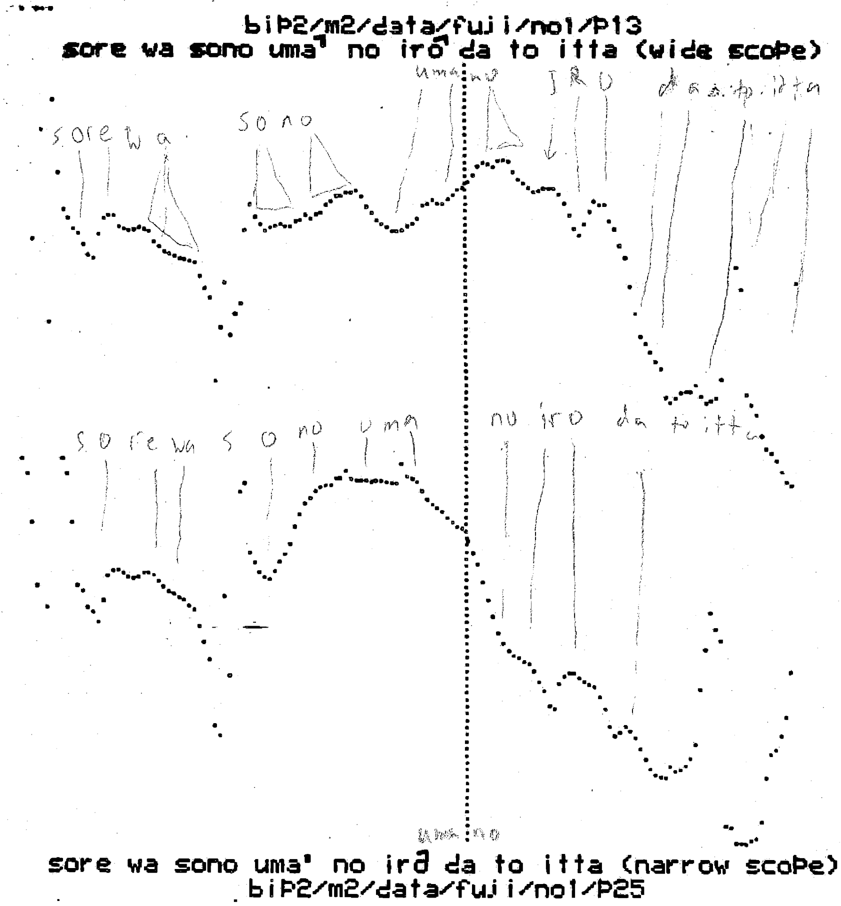

biP2/m2/data/fuji/no1/P13
sore wa sono uma' no iro' da to itta (wide scope)
sore wa sono uma' no irō da to itta (narrow scope)
biP2/m2/data/fuji/no1/P25

FIG. 4.1

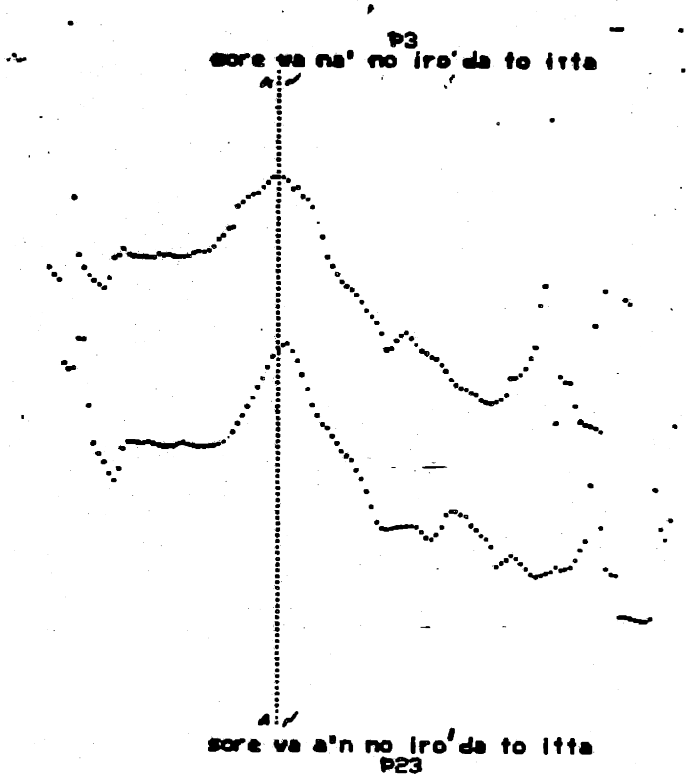


FIG. 4.2

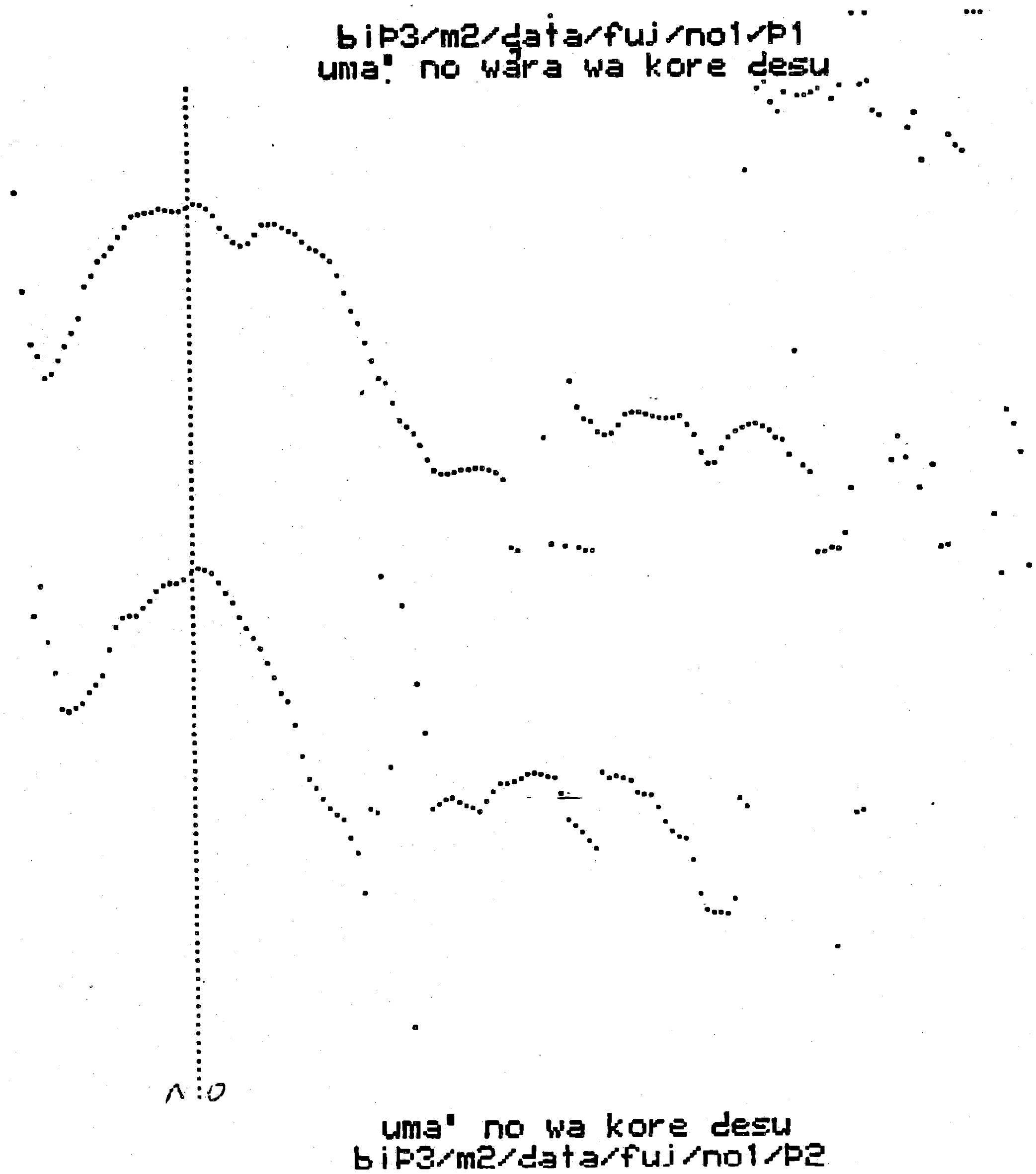
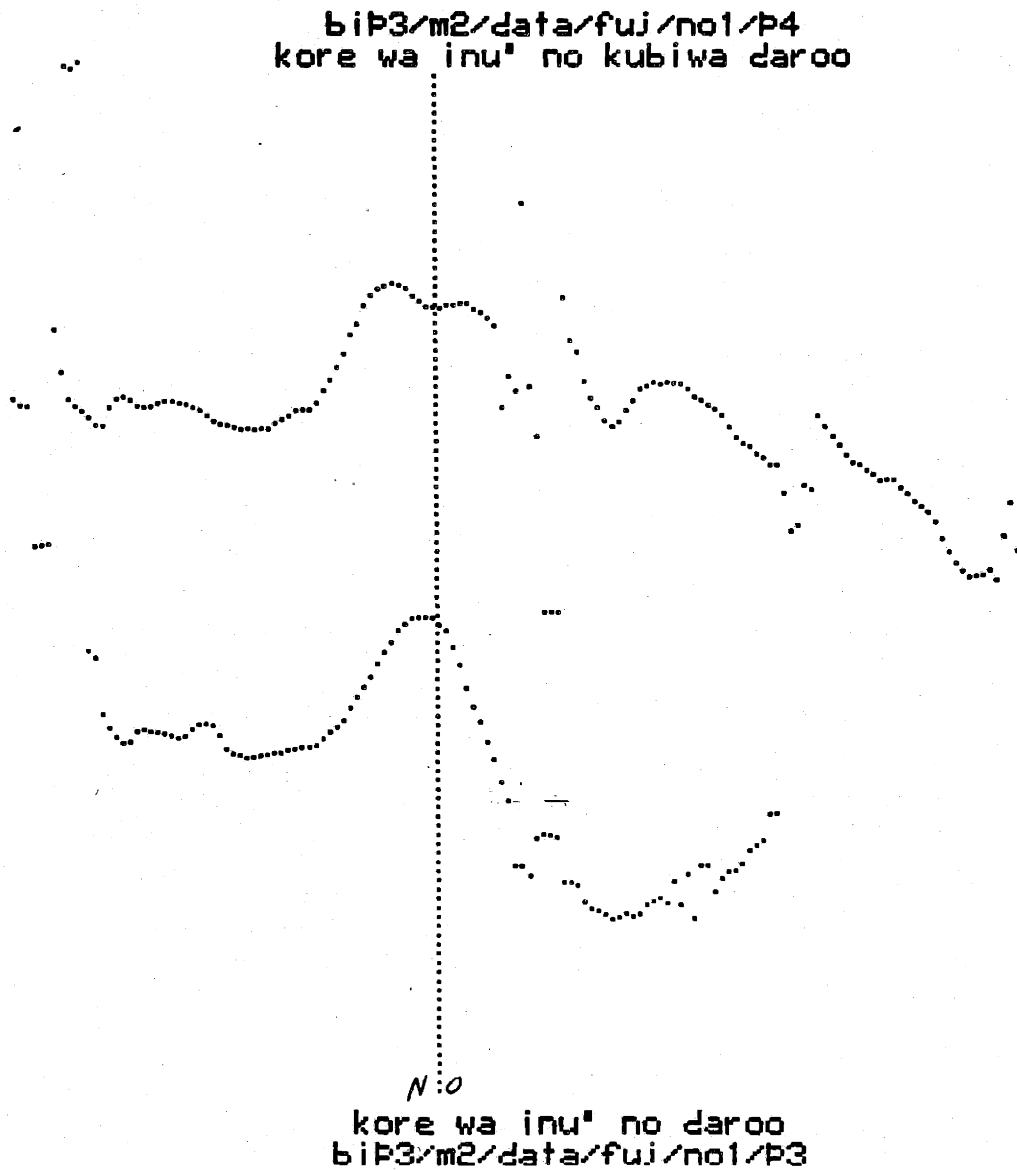

biP3/m2/data/fuj/no1/P1
uma' no wara wa kore desu
uma' no wa kore desu
biP3/m2/data/fuj/no1/P2

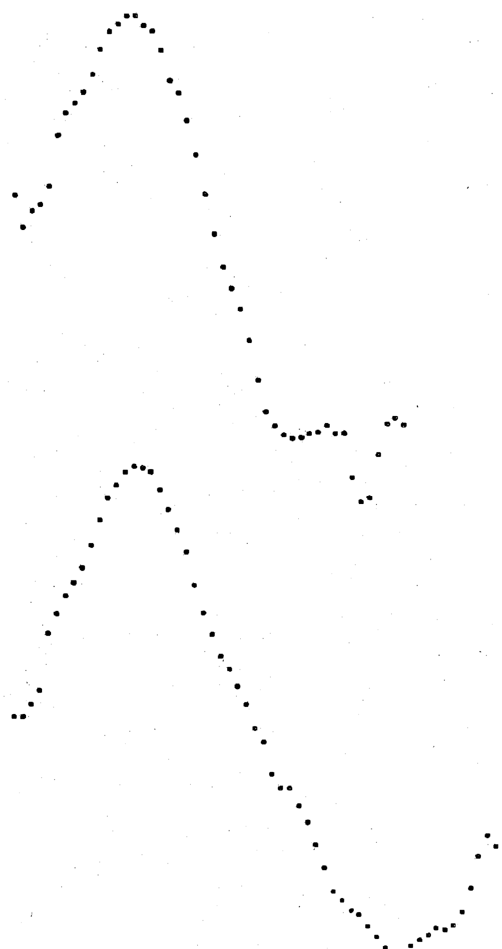
FIG. 4.3



biP3/m2/data/fuj/no1/P4
kore wa inu* no kubiwa daroo
N:0
kore wa inu* no daroo
biP3/m2/data/fuj/no1/P3

FIG. 4.4

bip2/m1/usr1/fuji/w1/p2
no⌝mu (to drink)



no⌝omu (agricultural affairs)
bip2/m1/usr1/fuji/w1/p4

FIG. 4.5

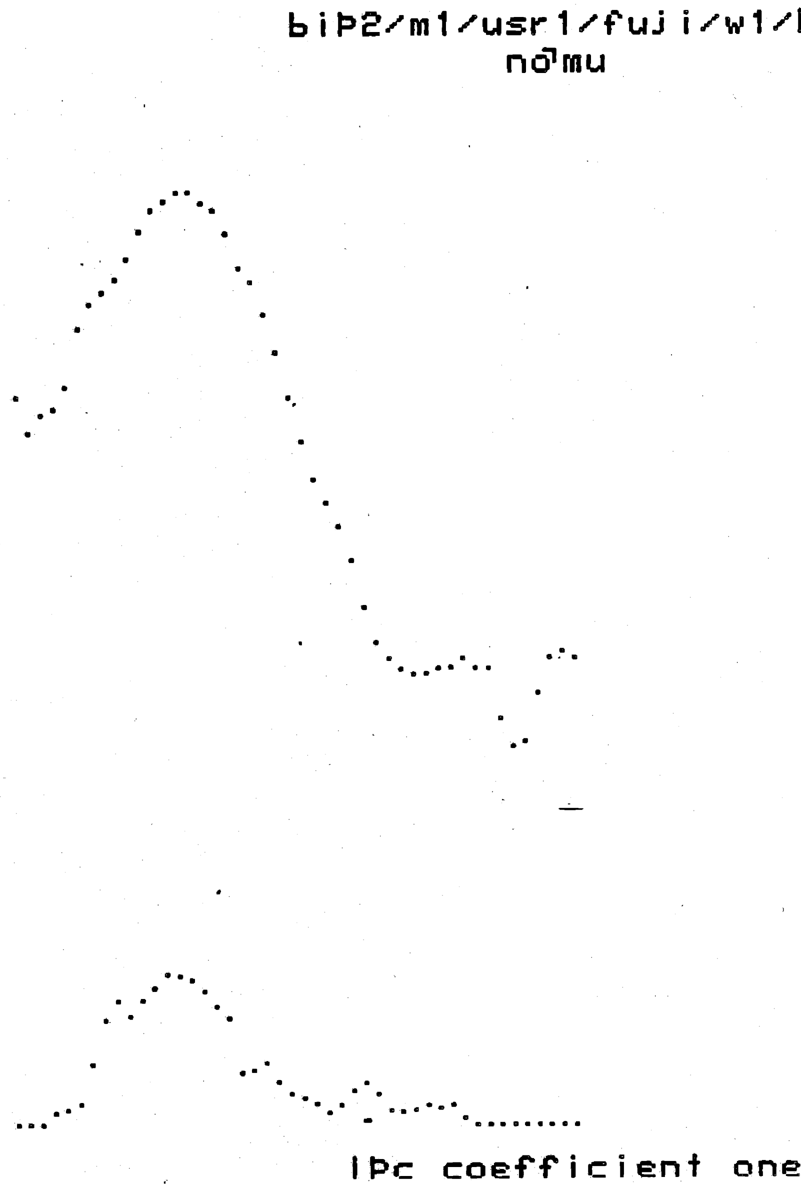
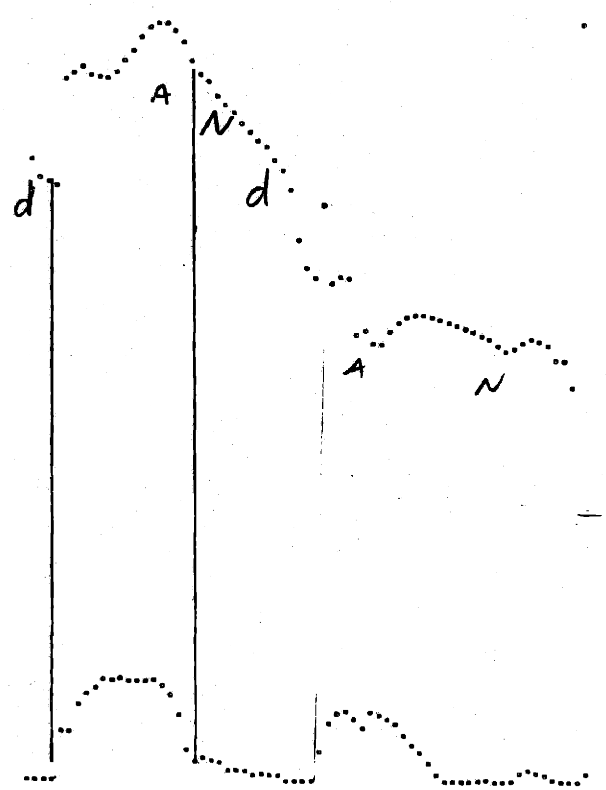


FIG. 4.6

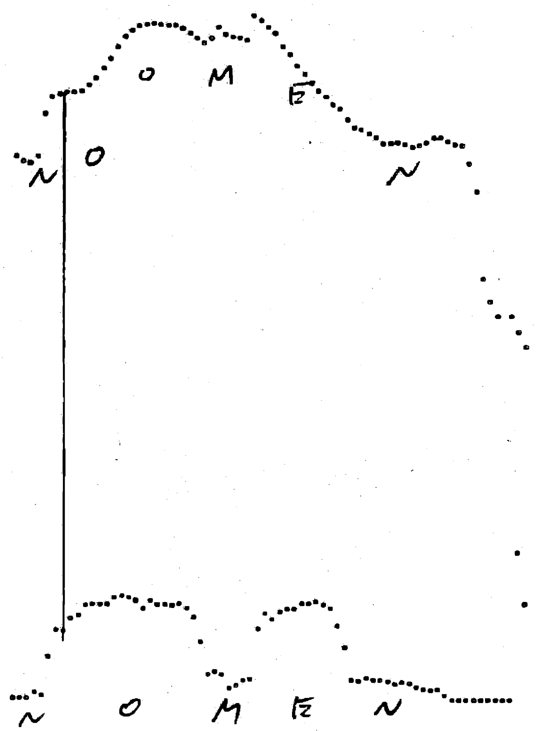
bip2/m1/usr1/fuji/w4/p7
dãNdan



lpc coefficient one

FIG. 4.7

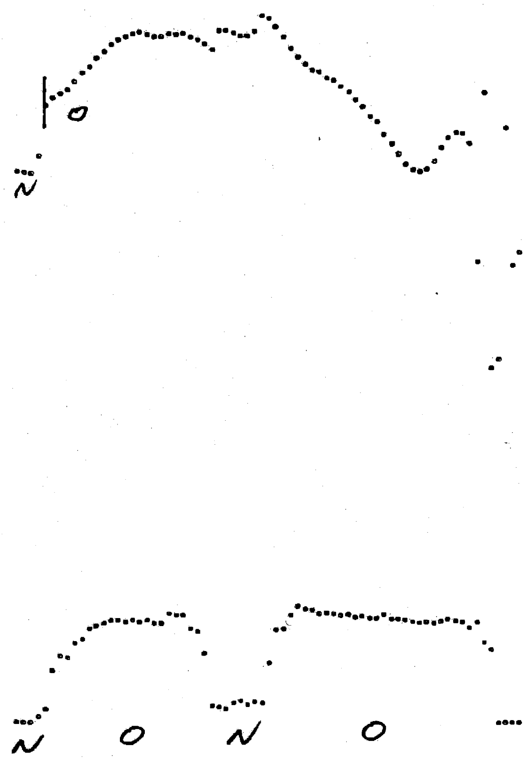
bip2/m1/usr1/fuji/w4/p6
noomeN



lpc coefficient one

FIG. 4.8

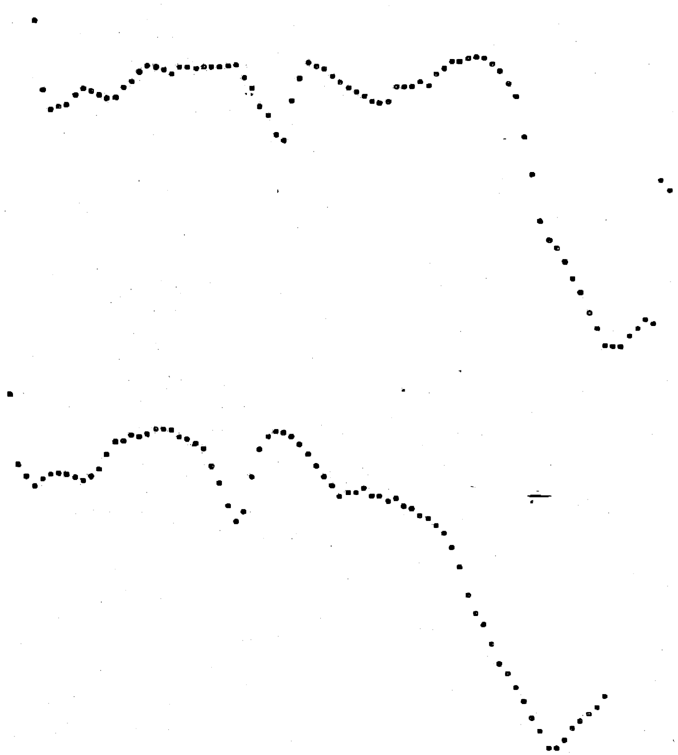
bip2/m1/usr1/fuji/w4/p5
noonoo



lpc coefficient one

FIG. 4.9

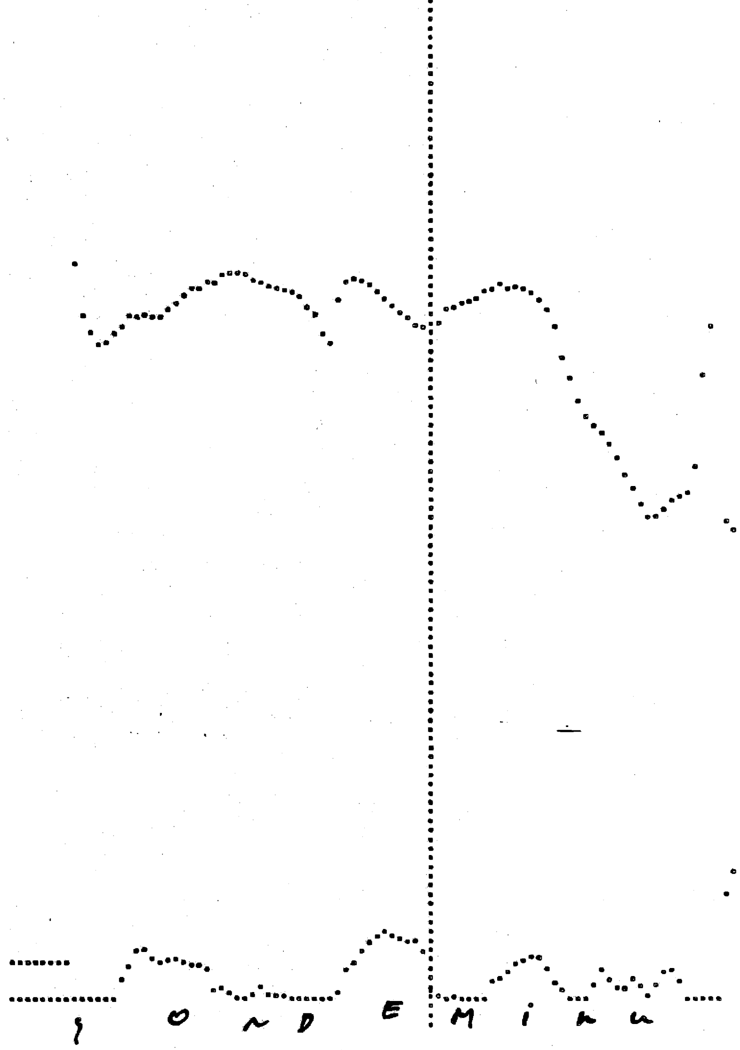
BIP4/m1/usr2/ym5/P3
yoNde mΓru (call and see)



yoNde mΓru (try calling)
BIP4/m1/usr2/ym5/P5

FIG. 4.10

BIP4/m1/usr2/ym2/P3
yoNde miru (call and see)



lPc coefficient one

FIG. 4.11

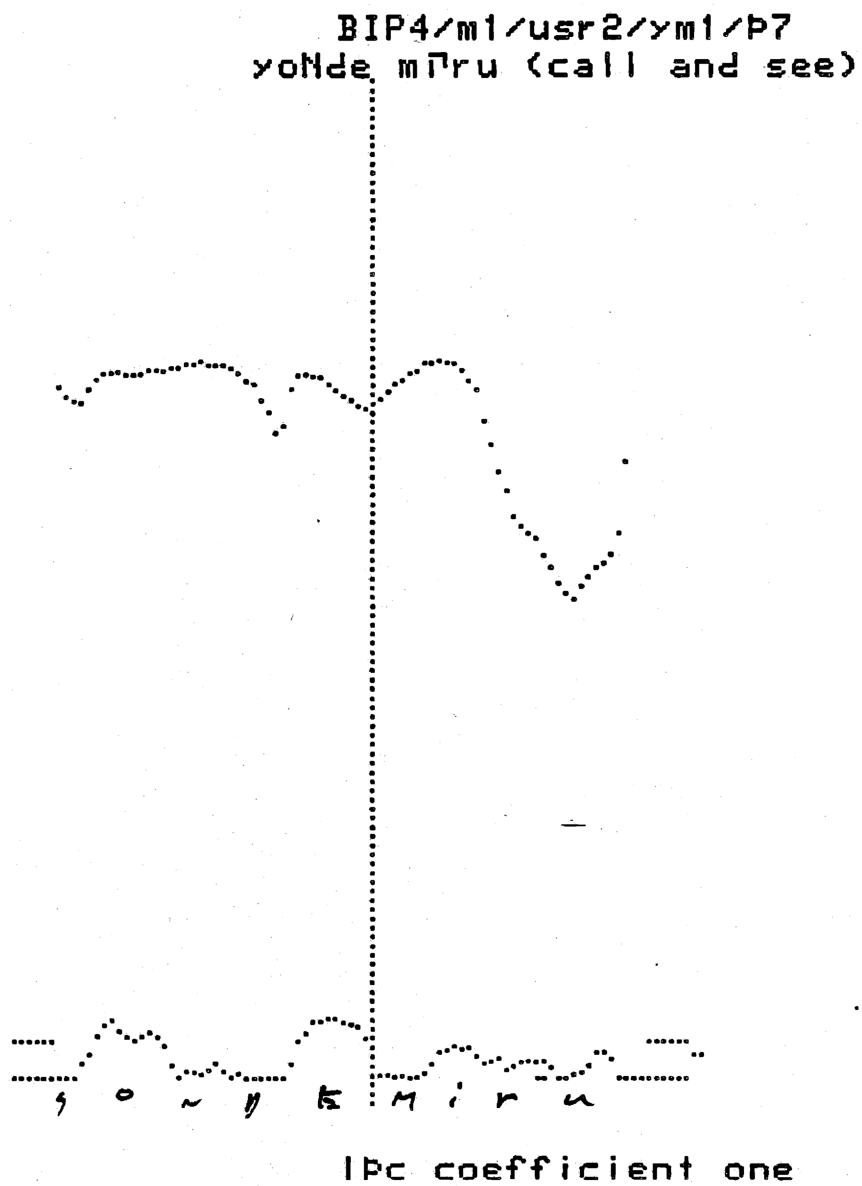
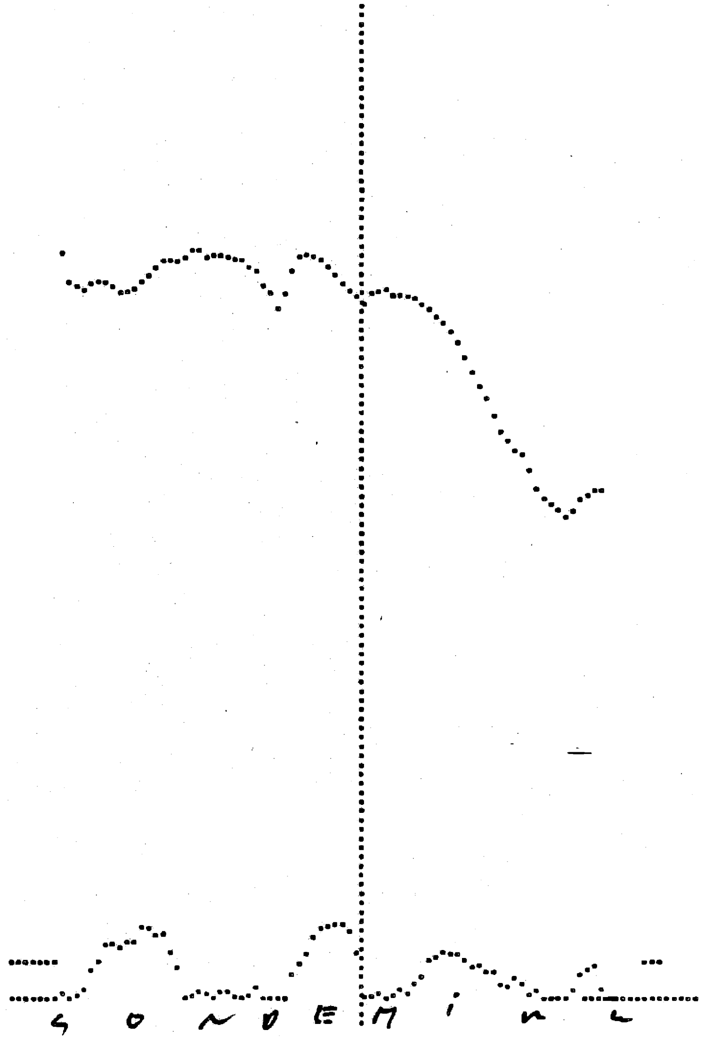

BIP4/m1/usr2/ym1/P7
yoNde mIru (call and see)
lpc coefficient one

FIG. 4.12

BIP4/m1/usr2/ym3/P3
yoNde mPru (try calling)



lPc coefficient one

FIG. 4.13

CHAPTER FIVE: PHRASAL TRENDS IN F0

1. Preliminary Considerations

1.1. Phrasal Downtrends in F0

It is a widespread and fairly uncontroversial observation that, *ceteris paribus*, in most languages the fundamental frequency falls as one proceeds from the beginning of an utterance to the end.[1] It is this phenomenon that I will refer to as F0 downdrift. Reports of downdrift based both on impressionistic observation and instrumental analysis of speech are too numerous to mention. Moreover, Pierrehumbert (1979) has reported that English speakers expect a gradual decline in F0, since they perceive the second of two tones as equal to the first when it is in fact somewhat lower. Shimizu & Dantsuji (1981) report the same finding for Japanese. All in all, it is widely believed that fundamental frequency gradually declines as the utterance progresses, and for at least some languages this belief is valid. In this chapter I will consider to what extent and in what circumstances F0 downdrift occurs in Japanese, with particular attention to facts that bear on the choice of models of F0 downdrift.

1.2. Possible Mechanisms & Models

Hypotheses about the mechanism of F0 downdrift fall into two general classes. The first, which I will refer to as declination, proposes that downdrift is a consequence of the tones (or other sorts of tonemic entity) riding on a gradually declining baseline. Declination is not controlled by linguistic variables, that is to say, neither the tonal string nor the accents have any influence on declination. Declination hypotheses predict that downdrift is a direct function of time, so that in the absence of any change in the tonological representation, a tone will be realized lower the farther it is from the beginning of the utterance.

[1] Umeda (1982) attacks this claim, but all that she shows is that in averaged data other factors may override this effect.

Declination models are extremely common in the phonetic literature. Proposals that assume some sort of declination include Ohman (1967) and Bruce (1977,1982) for Swedish, Kobayashi (1969), Fujisaki & Sudo (1971), Fujimura (1972), Fujisaki et al. (1979,1982) Fujisaki (1981), and Beckman, Hertz, & Fujimura (1983) for Japanese, Olive (1974), Maeda (1976), Breckenridge & Liberman (1977), Pierrehumbert (1979), Sternberg et al. (1980), and Sorensen & Cooper (1980) for English, Myers (1976) for Hausa, Vaissière (1971) for French, Hirvonen (1970) for Finnish, and Thorsen (1980) for Danish. In spite of this, little evidence has been advanced in favor of this model over other models.

The second class of hypotheses involves what I will refer to as Local Phonologically Conditioned F0 Modification. The various members of this class all share the property that they attribute F0 downdrift to to rules depending on local properties of the phonological representation. These hypotheses differ from declination hypotheses in that they predict that F0 downdrift will not be a direct function of time, but only of the phonological representation, so that if the tonological representation is unchanged the position of tone in the segmental string will have no effect on its realization. Moreover, downdrift is taken to depend explicitly on the phonological representation, so that we expect to find it in some environments and not in others.

Since the cover term Local Phonologically Condition F0 Modification is rather cumbersome, I will abbreviate it as LPCFM. Moreover, when claiming that in some environment it occurs, I will say that one word depresses another, which is both less cumbersome than saying that "LPCFM occurs", and emphasizes the fact that under this hypothesis downdrift is the result of the effect of one part of the phonological representation on the realization of another.

LPCFM mechanisms fall into two subclasses. The first consists of what I will call edge effects. It is sometimes claimed that special treatment is given to the beginning or the end of a phrase. The mechanisms responsible for such effects must produce their effect locally, triggered by some property associated with the boundary of the phrase. One particular mechanism for generating edge effects is the use of boundary tones, i.e. tones that are associated with the phrase boundary. For instance, the sharp fall that occurs at the end of declarative sentences in many languages might be attributed to the occurrence of a sentence final Low tone, rather than to any global properties of the intonation contour. Pierrehumbert (1980) and Liberman & Pierrehumbert (1983) argue that many of the phrase level F0 phenomena in English are best accounted for in terms of boundary tones, and I have suggested above that boundary tones might be used to acount for the major phrase final effects in Japanese.

In addition to edge effects there are mechanisms whereby one word or phrase affects the F0 of another word or phrase. Such mechanisms fall again into two classes. The first is what I will call *catathesis.*[2] Catathesis is triggered by particular sequences of tones. Most typically, a High tone is said to be depressed (i.e. lowered) when it follows a HL sequence. I will refer to all hypotheses in which the realization of a tone is governed by the neighboring tonal representation as versions of catathesis.

In the literature on African tone languages, where catathesis is frequently described, a distinction is often made between automatic and non-automatic catathesis. Automatic catathesis is catathesis that is triggered by the superficial tonal string. It is frequently also referred to as downdrift, a term that I have reserved for use as a cover term. It not infrequently happens that catathesis occurs in environments where the superficial tonal string does not meet the structural description of the rule. This is non-automatic catathesis. In some such cases, it is easy to show that the catathesis is triggered by tones that are not directly realized, typically by floating Low tones, so that it is readily conflated with automatic catathesis. (Clements 1979). In other cases, for example, in some cases in which it is syntactically triggered, it is less clear whether it can be treated as involving an abstract HLH sequence, although Clements & Ford (1979) have argued that this is the case. It is thus likely that automatic and

[2] As will be evident from the following paragraphs, what I call *catathesis* is what is usually referred to as *downstep* or *downdrift.* Unfortunately, different authors use these terms differently, so that it is impossible to use them without ambiguity. For example, some authors use the term *downdrift* to refer to the phenomenon of F0 downdrift, as I do here, others use it to refer to downdrift attributed specifically to declination, and still others use it to describe catathesis. The term *catathesis* was invented for Mark Liberman, Janet Pierrehumbert and the author by Michael Studdert-Kennedy.

non-automatic catathesis represent the same phenomenon, differing only in the abstractness of the trigger.

Accent reduction is a form of the stress reduction familiar from Chomsky & Halle (1968)'s analysis of English stress. Chomsky & Halle's account of English stress made use of a set of stress placement rules that had the effect of assigning primary stress to some vowel together with a stress reduction convention that applied every time primary stress was assigned to reduce by one level the rank of all stresses other than the one just assigned primary stress. I use the more general term accent reduction to refer to a system with the same formal properties as Chomsky & Halle's stress system but where the accent need not represent stress. In a pitch accent language like Japanese, accent reduction rules would have only F0 as their phonetic correlates, unlike English in which, in addition to F0, duration and vowel quality are affected by stress.

Accent reduction resembles catathesis in that it is governed by linguistic variables and in that it is not a direct function of time, but differs in the mechanism by which it is computed. It goes without saying that accent reduction is a possible mechanism of F0 downdrift only in accentual languages. Accent reduction has been proposed as a mechanism for F0 downdrift in Japanese by McCawley (1968,1977).

It is important to emphasize that the various mechanisms listed here, declination, boundary tones, catathesis, and accent reduction, are distinct mechanisms, but that a model of F0 downdrift may well incorporate more than one of them. In fact, there is no theoretical inconsistency to a model making use of all of them. So when we ask how best to describe F0 downdrift we must take care to consider the possibility of combinations of these various mechanisms.[3]

[3] A more detailed review of possible models of F0 downdrift may be found in Pierrehumbert, Liberman, & Poser (in preparation).

1.3. The Existing Data

It is rare to find any argument for choosing among these mechanisms, or even awareness that more than one possibility exists. In general, phonologists propose accounts based on catathesis, accent reduction, or boundary tones, while phoneticians assume that F0 downdrift is due to declination. Indeed, the existence of declination is presupposed to such an extent that, in spite of the complete absence of any data clearly supporting the existence of declination, Myers (1976:110) asserts that "This type of downdrift [declination-WJP] has a natural phonetic explanation and occurs in a majority of the languages of the world." The great majority of papers in this area simply present some model of the observed data, without any discussion of alternatives or argumentation for the model presented.

The only careful arguments of this type known to me are those due to Pierrehumbert and Liberman for English. They argue that the phrasal F0 contours of English should be attributed to a combination of catathesis and boundary tones. Other relevant data exists, though the studies are to various degrees flawed. In the remainder of this section I will review these studies, both in order to determine the current state of our knowledge and in order to point out some of the methodological flaws that I have tried to avoid in the present study.

Painter (1974,1979) presents data on downdrift and declination in Gwa which appear to bear on this question. He distinguishes between "terraced sequences" and "non-terraced sequences" of High tones, where "terraced sequences" are defined to be those that contain catathesis. One might therefore hope to determine (a) whether there is any descent in the non-terraced sequences i.e. whether there is any declination; and (b) whether the slope of the terraced sequences is different from that of the non-terraced sequences, i.e. whether there is a distinction between catathesis and declination.

Painter's data appear to support both hypotheses. Non-terraced sequences do descend, suggesting the existence of declination, but terraced sequences descend more rapidly, suggesting the existence of catathesis. Unfortunately, Painter's methods are badly flawed, to the extent that no conclusions whatever can be based on his data.

The first defect of Painter's study is that his data come from a corpus of recorded texts, with the result that there are no controls whatever for segmental effects. No restrictions were imposed on the segmental content of the materials studied, nor were any measures taken to average out such effects as might be present.[4]

Secondly, no statistical testing of significance of differences was performed either between positions, in order to demonstrate the reality of the decrease in F0 with position, or between different types of utterance, in order to demonstrate the difference between terraced and non-terraced spans.

Third, Painter's "non-terraced sequences" include sequences containing non-automatic catathesis. As Pierrehumbert (1980) has pointed out, this means that not all of the sequences in this category represent a pure declination environment. Any descent observed might be due entirely to the presence of the catathesis. Consequently, no conclusion as to the existence of declination can be drawn.

Finally, Painter's data are averaged over sequences of different lengths. That is to say, he aligned all of the utterances of a given class, regardless of their lengths, at the beginning, and then averaged the recorded F0 of all of the syllables in each position counting from the beginning of the utterance, so that, for example the last syllable of a two syllable utterance would be averaged with the second syllable of a five syllable utterance. This procedure has two undesirable effects.

First, as Pierrehumbert (1980) points out, due to the statistical fact that a given text tends to have more shorter sentences than longer sentences (Zipf's Law) the number of measurements per position decreases exponentially as the position number increases. This means that the rank ordering of the various positions with respect to F0 may not be preserved in the averaged data. Pierrehumbert points out that this situation actually arises in Painter's data, since the highest F0 level reported is for the 9th position which is represented by only a single

[4] Painter does average together many utterances, but segmental effects will only be averaged out if the corpus is balanced, of which we have no guarantee.

token.

Secondly, this procedure potentially confounds effects due to the overall shape of the F0 contour with local edge effects, which is undesirable if we wish to distinguish between the two. Suppose for example, that in some language we observe that F0 is perfectly flat until we reach the last syllable of the phrase, which is considerably lower than the penult. In this case we would probably want to say that there is no declination, but only a final lowering effect, perhaps due to the presence of a Low boundary tone.

But if data for several utterances of different lengths were averaged as in Painter's study, we would observe a globally falling contour that would appear to support the existence of declination. This is illustrated by Figures 5.1 and 5.2.

Figure 5.1 shows hypothetical F0 contours of four utterances of different lengths, all level at 150 hz. until the last syllable which drops to 100 hz. Figure 5.2 shows the result of aligning these utterances from the left and averaging them position by position. The top tracing shows the effect of averaging equal numbers of utterances of each length. This curve shows a gradual fall throughout the utterance, which we would attribute to declination, with a steeper fall at the end which one might attribute to final lowering.

The results of this procedure are even worse when the statistical properties of the text are taken into account. Suppose, as is approximately true in real texts, that the number of utterances of a given length decreases exponentially with the length of the utterance. The lower tracing in Figure 5.2 shows the effect of averaging the same four utterances as above, position by position, where the number of tokens of each length is distributed exponentially.[5] The averaged contour shows a global fall, as before, but now the final lowering effect is less clear. The effect of the statistics of utterance length is to make the contour look like a continuous exponential decline, which would lead us to posit declination but quite possibly to overlook final lowering as a mechanism. This is, of course, exactly the opposite of the correct

[5] That is, in the present example, one utterance of length five, two utterances of length four, four utterances of length three, and eight utterances of length two.

conclusion.

For these reasons, averaging of utterances of different lengths is potentially seriously misleading.

Myers (1976) discusses Hausa, a language previously claimed to exhibit phonological catathesis but not declination. She argues that Hausa has both catathesis and declination. As evidence for the existence of declination she cites the fact that F0 descends in sentences containing only like tones. She claims that catathesis is different, since the F0 curve is "chunkier", i.e. the pitch falls occur at HLH transitions, not uniformly along the utterance.

Insofar as Myers' claims about the F0 contours of sentences containing only like tones are valid, the data she presents constitute the only published data known to me that argue clearly for the existence of declination, as distinct from the other mechanisms of F0 downdrift. Unfortunately, Myers' methods and presentation make her claims less than fully convincing.

The actual data presented in the relevant portion of Myers' thesis consist of two pitch contours, one illustrating the case of an utterance with all High tones, the other illustrating an utterance containing an initial High tone followed by Nine Low tones. Both utterances fall, in the first case a total of 30 hz. from the first syllable to the last, and in the second case 40 hz. from the first Low toned syllable to the last. Thus, there appears to be some substance to Myers' claim that Hausa has declination.

Myers presents only one example of each type, nor does she present averaged data. Instead she says that she studied a total of 32 utterances in which the structural description of her declination rule was met 90 times, and says that in 75 cases out of 90 her rule applied correctly. She does not list the utterances or provide any other data. Since her declination rule lowers the F0 of the second tone in a sequence of two like tones, what it means for her rule to apply correctly is presumably for the measured F0 of the second tone in every sequence of two like tones to be lower than that of the first. Without controlling for segmental effects, such measurements are difficult to interpret, though to some extent the bias induced is against Myers' claim rather than for it. It could be the case that the 15 cases in which Myers' rule did not apply correctly were cases in which a consonant kicked up the F0 on the second syllable, overriding the declination. The total fall from beginning to end in the two sentences shown is sufficiently large that, insofar as these are representative, it is likely that there is some sort of downdrift even over like-tone sequences, but whether this effect is declination in the strict sense or, say, attributable to a final Low tone cannot be determined. Thus, in spite of the methodological flaws of her study, Myers is probably justified in claiming that declination exists in Hausa.

When we turn to the question of contrast between sentences containing alternating High and Low tones and sentences containing only like tones, Myers presents no data at all. We have only her assertion of the difference, and a few pitch tracks of sentences containing both High and Low tones in other parts of the thesis from which it is hard to draw any conclusion. In sum, although the data presented are consistent with Myers' claims, the amount of data presented is so skimpy as to require one to withold judgment as to the existence of both catathesis and declination in Hausa.

Mountford (1983) presents similar data for Bambara. He found that sentences containing both High and Low tones showed a steep fall in F0, while sentences containing only High tones showed very little fall in F0. These results are inconsistent with the declination approach, and support the hypothesis that catathesis is the principal mechanism of F0 downdrift in Bambara.

Although Mountford's study is much more careful than most of its predecessors, it is not without methodological flaws. First, there were no explicit controls for segmental effects. Mountford measured the F0 at the center of each vowel in order to minimize consonantally induced perturbations, but he admits that this is in some instances not effective, and indeed it appears that the perturbing effect of an adjacent consonant may extend throughout the entire vowel.[6] Moreover, there was no attempt to eliminate the effects of intrinsic pitch. Here again

[6] Mountford cites experimental results pertaining to the distance from the perturbing consonant at which the perturbation dies out. For example, after a voiceless obstruent F0

Mountford is cognizant of the problem, but does not balance his sentences carefully so as to eliminate intrinsic pitch effects. He hopes, instead, that by using several different sentences and averaging them these effects will be neutralized. But at most four sentences were studied, and in the case of the all High sequences, only three, so the odds do not favor neutralization of intrinsic pitch effects. Moreover, in some positions, all of the sentences of a given type contain the same syllable, so averaging them cannot possibly cancel out intrinsic pitch effects.

In the case of the sentences containing both High and Low tones, the oberved drop in pitch is sufficiently large that in spite of the lack of control for segmental effects I am inclined to accept the data as compelling. The rate of fall is simply too large, an average of 63 hz. per sentence,[7] to be accounted for by segmental effects. At the very least, then, this study appears to support the claim that catathesis is the principal mechanism of F0 downdrift.

The situation is more problematic when we turn to the sentences containing only High tones. Here the observed fall is quite small (an average of 7 hz. per sentence) and this combined with the lack of control for segmental effects renders it impossible to be sure that there is, in fact any declination at all. Moreover, no statistical tests were performed on the position-by-position differences, so we cannot tell whether the differences in the means are significant.

One other point worthy of comment concerns the shape of the catathesis curve. Mountford goes to great lengths to argue that this curve is appropriately modeled by a straight line, and indeed he obtains very high correlation coefficients for a linear regression. This might seem to call into question the claim by Liberman & Pierrehumbert (1983) that catathesis involves an exponential decay due to multiplicative computation of one tone value on the basis of a preceding value.

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starts out very high, and falls sharply. The results cited by Mountford have to do with when the sharp fall ends, but the end of the sharp fall does not necessarily indicate the end of the influence of the consonant. Indeed, Myers (1976)'s data on consonantal effects on F0 in Hausa show that in many cases a small effect (on the order of 2 or 3 hz.) persists throughout the syllable. This seemingly small effect is not to be ignored in the study of declination since observed declination effects are of this order of magnitude or smaller.

[7] The normalization to hertz/sentence is Mountford's, not mine.

However, Mountford's conclusions about the shape of this curve should be taken with a grain of salt. First, the presence of a final lowering effect would, if not removed before computing the regression, improve the fit to a straight line. Whether or not such an effect is present is unclear, but many of Mountford's sentences with High tones near the end of the sentence do show a rather sharp drop. Second, the mere fact that a curve can be well modeled by a straight line does not mean that it cannot be modeled even better by some other curve, in this case an exponential. Since Mountford did not attempt to fit an exponential to his data we cannot tell which would be superior.

Indeed, there is some reason to believe that an exponential would fit the data even better. First, every one of Mountford's pitch contours shows the first High tone significantly above the second, so that the curve appears to consist of a sharply falling piece from the first High tone to the second, followed by a gradually declining piece thereafter. Such a shape is more compatible with an exponential decay than with a linear decay.[8] A second point favoring an exponential decay is that Mountford found that the average slope of the catathesis curve was greater in short sentences than in long ones. If the curve is indeed linear, then this requires preplanning, a question that is hotly debated in the literature, but for which, to my knowledge, no solid evidence has ever been advanced. On the other hand, if the curve is exponential, the average slope will decrease as the length of the sentence increases, without any preplanning. Consequently, although Mountford obtains good fits to a straight line this does not demonstrate that the exponential model is incorrect.

[8] Although Mountford did not attempt to fit an exponential, he did fit his data both with and without the first High tone. He indicates that he obtained a somewhat better fit with the first High tone than without. This might seem to indicate, as Mountford takes it to, that the first High tone, in spite of its deviant position, is an integral part of the linear declination curve, but this is not a necessary conclusion. Suppose, in fact that the curve is actually exponential, and that we try to fit a straight line to all but the first point. The regression line is, in this case, likely to undershoot the second point (the first point in the regression). If we then do the regression on all of the data, the effect of adding the first point will be to lift the lefthand edge of the regression line, perhaps, thereby bringing it closer to the second point. In such a case, we might obtain a better fit to a straight line fitted through all of the points than through all but the first, without in any way being justified in the conclusion that all the points actually lie along a straight line.

In sum, Mountford's data strongly suggest that in Bambara catathesis, not declination, plays the principal role in F0 downdrift. No firm conclusions can be drawn as to the existence of declination, or the shape of the catathesis curve.

The existing data seem generally to support a role for catathesis as a mechanism of F0 downdrift. Only Myers' data provide any support for declination, and these as presented are not entirely compelling. Moreover, only in Hausa is there reasonably clear evidence for the simultaneous existence of declination and catathesis, and in this case the existence of catathesis depends on Myers unsupported assertions together with the claims of impressionistic observers.

2. The Phrasal Phonetics of Tone in Japanese

2.1. The Facts

Since I will claim here that previous accounts of Japanese phrasal tonology are factually flawed in important ways, I will defer discussion of previous proposals until the facts have been established.

2.1.1. Simple Declarative Sentences

2.1.1.1. The Basic Claim

Even cursory inspection of pitchtracks of Japanese utterances reveals that it is true that there is some form of F0 downdrift in Japanese. The central claim that I will attempt to establish here is that F0 falls much more rapidly following an accented word than following an unaccented word. This can easily be seen in the five pairs of pitch tracks in Figures 5.3-5.7.

Figure 5.3 illustrates the form of verbal conjunction discussed in the section on phrasing. In both cases the second verb is *mi'ru* "see". In the first case the first verb is the gerund of *yo'mu* "read"; in the second case it is the gerund of *yobu* "call". The two gerunds are segmentally homophonous; they differ only in tat the first is accented on the syllable /yoN/, while the second is unaccented. As is evident from the figure, there is a substantial drop in F0 following the accented /yonde/, but no appreciable drop following the unaccented one. The actual measurements are given below.

Peaks and Falls in Fig. 5.3

	1	fall	2
ym1/p4:	170.9	29.5	141.4
ym2/p3:	159.7	3.0	156.7

The same pattern is illustrated by the Figure 5.4, which shows a noun phrase consisting of an adjective followed by the noun *nomi'mono* "beverage", in the frame *Sore wa* ___ *da.* "That's a __." Following the accented adjective *uma'i* "tasty" there is a steep drop in F0, while after the unaccented adjective *amai* "sweet", there is much less of a drop. The actual measurements are given below.

Peaks and Falls in Fig. 5.4

	1	fall	2
d1/p11:	174.2	39.1	135.1
d4/p10:	173.9	16.4	157.5

Figure 5.5 shows the same noun in the same environment, this time preceded by two adjectives. We notice that in both pitchtracks there is a steep drop from the accented adjective *nuru'i* onto the noun *nomi'mono*. In the lower pitchtrack there is a steep drop following the accented adjective *uma'i* onto the adjective *nuru'i*, while in the upper pitchtrack there is only a slight fall following the unaccented adjective *amai*. Figure 5.6 is almost identical, differing only in that the adjective *namanuru'i* has been substituted for its synonym *nuru'i*. Here again, the accented words are followed by sharp drops, while the unaccented *amai* is not. Notice that this is true even where *amai* is separated from the following adjective by a large dip due to Initial Lowering. This rules out the possibility that the absence of a steep drop is

due to cliticization of the adjective to the following word. The actual measurements for these two figures are given below.

Peaks and Falls in Figs. 5.5 & 5.6

	1	fall	2	fall	3
d1/p7:	174.2	3.6	170.6	28.4	142.2
d5/p9:	181.8	18.1	163.7	23.3	140.4
d2/p9:	151.3	1.1	150.2	28.5	121.7
d2/p13:	162.3	18.2	144.1	28.2	11.9

Figure 5.7 shows the same words in the same frame, only now the first adjective is *nuru'i* in both cases. In the lower pitchtrack there is a sharp fall following each of the accented adjectives. In the upper pitchtrack, there is a sharp fall from the accented *nuru'i* onto the unaccented *amai*, while there is no noticeable drop following *amai*. This shows that the difference in the amount of fall following accented and unaccentd words is not restricted to the initial position in the major phrase. The measurements are given in the following table.

Peaks and Falls in Fig. 5.7

	1	fall	2	fall	3
d2/p11:	171.2	39.4	131.8	1.3	130.5
d2/p6:	168.6	28.7	139.9	19.1	120.8

The pattern exhibited by these examples suggests two hypotheses about F0 downdrift in Japanese:

> Unaccented words are followed by little or no drop in F0.
>
> Accented words are followed by a substantial drop in F0, whether or not the following word is accented. This drop is additive, in that in a sequence of accented words, each is followed by a sharp drop.

Although these pictures are suggestive, they do not establish my claim unequivocally; more careful analysis of quantitative data is required. Nonetheless, for expository reasons I will assume this claim to be established for the time being, and turn to the analysis of sequences containing only unaccented words.

2.1.1.2. Sequences of Unaccented Words

In the examples in Figures 5.3- 5.7 it appears that there is little or no fall from an unaccented word onto a following accented word within the same major phrase, whereas there is a significant fall from an accented word onto an accented word. This suggests that accented words depress the following word, a suggestion that we will take up in considerable detail later. We consider here the question of whether sequences of unaccented words also fall. If they do, we will have some evidence for the existence of declination, while if they do not we will be able to conclude that there is no evidence for declination in Japanese.

Dataset II contains three sets of sentences of different lengths, each of which contains a sequence of unaccented words. Figure 5.8 shows the averaged peaks. Figure 5.9 shows the averaged means over the selected regions. for the various sequences.

Several conclusions can be drawn from the data obtained. First, the data clearly establish the existence of declination. This can be seen in two ways. First, if there were no declination, in sequences of unaccented words such as these we should expect the F0 contour to be flat, abstracting away from the effects of Initial Lowering, segmentally induced perturbations, and intrinsic pitch. The averaging across all permutations performed here eliminates the latter two effects, while the measurements made were on the High-toned regions unaffected by Initial Lowering. Moreover, with the exception of the mean pitch on the second /mo/ of *momo,* all of the data points were obtained in positions that were equally subject to any effects that Initial Lowering might have on the subsequent high-toned stretch. Consequently, the null hypothesis that there is no declination predicts that for each utterance length the mean value of the peak and the mean value of the mean on the diphthong of the high-toned stretch will not depend on the position of the point in the utterance. In order to reject the null hypothesis it suffices to show that there are significant differences between successive positions.

The following table summarizes the results obtained for average F0 over the diphthong for the lumped data. The last column represents the second /mo/ of the noun *momo*; the other columns represent averages across the permuted adjectives. In each case the first row gives the mean, the second row the variance.

Lumped Average F0 Statistics for Dataset II

Length I	165.8	156.5	152.0	133.1
	14.82	10.94	17.40	16.42
Length II	163.5	155.4	135.4	
	16.97	52.97	12.07	
Length III	163.9	141.4		
	7.00	7.53		

The following table summarizes the results obtained for peak F0 for the lumped data. The columns represent averages across the permuted adjectives. As above, the first row gives the mean, the second the variance.

Lumped Peak F0 Statistics for Dataset II

Length III	168.3	160.3	154.3
	19.67	10.90	16.92
Length II	166.1	159.2	
	16.10	18.60	
Length I	166.3		
	9.25		

It is evident that successive positions differ significantly in F0 value. In order to test for statistical significance of these differences, a T-test for difference from a mean of zero was performed on the utterance by utterance differences between successive positions. The T-test must be performed on the change from position to position within each utterance rather than on the means and variances of the lumped data since pitch range is presumably selected for each utterance and therefore the values measured at different points within a given utterance are not independent. The following tables give the mean difference between positions, the variance, the T-value, the number of degrees of freedom, and the significance level.

Length 3

Mean	9.3	4.6	18.8
Var	11.78	7.72	16.56
T	23.05	13.92	39.26
DF	71	71	71
P	<<.0005	<<.0005	<<.0005

Length 2

Mean	8.1	20.0
Var	41.47	40.89
T	10.67	26.55
DF	71	71
P	<<.0005	<<.0005

Length 1

Mean	22.5
Var	5.23
T	59.01
DF	35
P	<<.0005

Summary Statistics for Differences in Average F0

Length 3		
mean	8.0	6.0
var	18.56	8.25
T	15.66	17.70
DF	71	71
P	$<<.0005$	$<<.0005$

Length 2	
mean	6.9
var	18.49
T	13.57
DF	71
P	$<<.0005$

Summary Statistics for Differences in Peak F0

As these tables show, the fall from point to point, whether measured in terms of average or peak frequency, is in every case extremely significant.

A second test for the existence of declination is to compare pairs of utterances one of which is properly contained in the other and to ask whether the values in the shared material are affected by the presence or absence of the remainder. For example, we may compare the F0 levels of the adjective [amai] and the noun [momo] in the utterances

(1) Sore wa omoi amai momo da.
(2) Sore wa amai momo da.

If there is a left-to-right declination effect the height of [amai] should be lower in the first utterance than in the second, and similarly with [momo], since the presence of [omoi] in the first utterances pushes [amai] and [momo] further to the right and therefore, *ex hypothesi*, further down the declination curve.

I have conducted this test only on the peak measurements. The following tables show the comparisons made between the corresponding positions of the paired utterances, and the significance values obtained for each comparison. The comparisons are between peak values of identical adjectives in sentences with and without the first adjective in the longer sentence. In the first table Adj 1 refers to the first adjective in the length two sentence, which is the second adjective in the length three sentence. Similarly for Adj 2. The first two columns give the numbers, in terms of the list of sentences in section 2.2.2 of the Introduction, of the compared sentences. The second two columns give the value of Student's T and the corresponding significance level. The second table shows the comparisons between sentences of length two and sentences of length one. In this case, only one adjective was compared. Note that for every sentence of length one there are two sentences of length two whose second adjective is the same as in the sentence of length one. As a result, the t tests were based on the combined data for the two sentences of length two.

Length 3	Length 2	Adj1		Adj2	
1	5	-2.16	(p< .05)	-1.86	(p<.05)
2	6	-5.74	(p<<.0005)	-3.59	(p<.001)
3	1	-3.99	(p<.0005)	-4.35	(p<.001)
4	4	-6.20	(p<<.0005)	-3.11	(p<.01)
5	2	-4.36	(p<.0005)	-2.79	(p<.01)
6	3	-4.26	(p<.01)	-1.88	(p<.05)

Utterance by Utterance Comparisons: Length 3 with Length 2

(All 22 df)

Length 2	Length 1		
3&4	1	-5.43	(p<.0005)
2&6	2	-6.38	(p<.0005)
1&5	3	-4.53	(p<.0005)

Utterance by Utterance Comparisons: Length 2 with Length 1

(All 34 df)

Evidently, the F0 level of a form depends strongly upon the quantity of preceding material in the sentence, indicating the existence of a declination effect computed, at least in part, from the lefthand edge of the sentence.

In addition to the mere existence of a declination effect, the data obtained suggest some conclusions about the shape of the declination curve and the manner in which it is computed. One question concerns whether the anchor point is the lefthand edge or the righthand edge, or whether perhaps the total length of the utterance also enters into the computation. The fact just alluded to that the amount of preceding material strongly influences the F0 level of a form indicates that the lefthand edge serves as an anchor point. A similar conclusion is drawn if one compares the values obtained for sequences of different length. If declination is computed primarily from the lefthand edge, the declination curves for sequences of different length should line up best at the left, whereas computation from the righthand edge would imply a better lineup at the right. In spite of the fact that the values for position one in sequences of lengths two and three are marginally statistically significantly different, it is clear that the curves line up much better at the left than at the right, with the exception of the fall onto the second /mo/ of /momo/. This indicates that declination is computed primarily from the lefthand edge.

The difference in position one between lengths two and three, if not artifactual, may represent an effect of total utterance length, since the difference is due to a greater initial F0 value in the longer sentence.

If we ignore the data for the second [mo] of [momo], it is also clear that the slope of the declination curve is decreasing in absolute value. In particular, the curve could be approximated by a negative exponential. When we add in the data for the second [mo] of [momo], the curve becomes S-shaped, since a sharp fall occurs onto [momo]. It is possible that this fall is an intrinsic property of the declination curve, but it is tempting to speculate, as I have in Chapter IV, that the observed curve is to be resolved into two components, the declination curve proper, approximately a negative exponential, and phrase final lowering, producing the observed sharp fall.

2.1.1.3. Local Phonologically Conditioned F0 Modification

The basic claim made above without careful substantiation is that the fall following an accented word is considerably greater than the fall following an unaccented word. This section is devoted to careful substantiation of that claim.

Data showing the fall from an accented word to a following word to be greater than a comparable fall from an unaccented word to a following word do not necessarily establish the existence of catathesis. An alternative explanation would be that accented words are higher than unaccented words, and that the difference in the amount of the fall is due entirely to the difference in height of the first peak. In fact, as we have seen in section 3.2.2.1.2 of Chapter IV, accented words are indeed higher than unaccented words, so that we must take care to eliminate the possibility that the observed difference in falls is due to this alone, and does not reflect catathesis.

2.1.1.3.1. Catathesis of Accented High Tones

If the greater fall from an accented word to a following word than from an unaccented word to a following word were due entirely to the difference in height of the first word of the pair, the absolute height of the second word should be the same in both cases. On the other hand, if an accented word depresses the following word, then the second word should be lower following an accented word than following an unaccented word. Data from Dataset III establish that the latter is the case.

We will compare the height of the second word in a major phrase in utterances differing only in whether the first word in the major phrase is the accented adjective *uma'i* or the unaccented adjective *amai*. The relevant comparisons are listed in the following table. In each case, the sentence containing the unaccented adjective is listed first.

Comparable Sentences from Dataset III

(A)	/mi/ of /mi'ruku/	in sentences (1) and (2).
(B)	/i/ of /i'i/	in sentences (6) and (5).
(C)	/mi/ of /nomi'mono/	in sentences (8) and (7).
(D)	/ru/ of /nuru'i/	in sentences (10) and (11).

The following table gives summary statistics for each of these comparisons. In each case, the first line gives the mean, the second the variance.

Summary Statistics for Comparisons
(All 16 df)

Comparison	W1 Unaccented	W1 Accented	Difference	T	P
(A)	166.8	151.3	15.5	9.81	<.0001
	7.9	14.6			
(B)	180.4	168.1	12.3	7.90	<.0001
	8.2	13.6			
(C)	157.0	143.1	13.9	6.63	<.0001
	6.5	33.2			
(D)	174.7	164.6	10.1	6.10	<.0001
	10.1	14.5			

In each case the second minor phrase is significantly lower when the first minor phrase is accented than when it is unaccented. This demonstrates that the greater fall from an accented word is not attributable purely to the greater height of accented words.

The nonsense word data in Dataset IV also provide evidence for catathesis. Figures 5.10-5.13 illustrate representative examples of each accent pattern. Figures 5.14-5.17 show averaged F0 contours of the four accentual patterns studied. These generally resemble those that we have already seen: accented words are followed by relatively steep drops, while unaccented words are followed by lesser drops.

Dataset IV contains two subsets that are particularly useful to us, namely a seqence that is entirely accented, and a sequence that is entirely unaccented. By comparing the rate of fall in such sequences we can determine whether there is catathesis without worrying about the fact that accented highs are higher than unaccented highs. The following table shows the rate of fall from the first word to the second in the two cases, expressed as the difference between the peaks of the successive words.

Fall from First to Second Word		
	++++	----
mean	22.85	10.88
var	10.19	59.17

Evidently, the rate of fall from accented word to accented word is much greater (11.97 hz./phrase) than from unaccented word to unaccented word (p (T=7.041,df=46)<.0001). Indeed, the rate of fall is so much greater that in spite of the fact that the second word in the all accented sequence is accented and therefore, *ceteris paribus*, higher than an unaccented word, it is actually an average of 6.18 hz. lower than the unaccented second word in the all unaccented sequence (p (T=5.569,df=46)<.0001). The relevant data are summarized in the following table. This supports the claim that accented words trigger catathesis.

Relative Height of Second Words		
	++++	----
mean	144.86	151.04
var	11.46	18.09

2.1.1.3.2. Catathesis of Unaccented High Tones

We have so far concentrated on catathesis of accented words, but it is important to point out that unaccented words are equally subject to catathesis. This is easily seen when we compare sentence Nine of Dataset III with sentence Twelve of the same dataset. These sentences differ only in whether the second adjective is accented or unaccented, so we can factor out phrasing effects and declination. As we have previously observed, *amai* is 10 hz. below *uma'i*. If we say that both are depressed equally, and that the difference is due to the difference between accented and unaccented words observed in major phrase initial position, on our hypothesis, due to unaccented words being toneless, we very closely approximate the observed height of *amai*.

If we wanted to say that unaccented words were not subject to catathesis, we would have to say that accented Highs lie right on the reference line, except that when they are depressed they get lowered an appropriate amount. We would then have to say that the amount of lowering below the declination line for an unaccented High in second position is very much greater than in initial position (on the order of 35 hz. as opposed to 7 hz.). This would indeed be a curious scaling function, since the pitch range generally narrows with time. Moreover, it would be sheer coincidence that the amount of lowering in second position is almost exactly equal to the sum of the amount by which an accented word is depressed and the amount by which an unaccented word is lowered in initial position.

Moreover, this rule would have to be sensitive to the accentedness of the preceding word. If not, we would expect a very much greater rate of declination in utterances consisting just of unaccented words. And if we make the lowering rule sensitive to the accentedness of the preceding word, we have in effect duplicated the catathesis rule.

In sum, it is impossible to account for the contour of sentences like 9 unless unaccented words are subject to catathesis.

A more direct test of the hypothesis that unaccented words are subject to catathesis can be made by comparing sentences three and four of Dataset III, repeated below:

(3) Sore wa uma'i miriN da.
(4) Sore wa amai miriN da.

The word *miriN* is unaccented, so if unaccented words are not subject to catathesis we should expect to find no difference in the height of the syllable /riN/ depending on the accentedness of the preceding word.

This is not what we find. Figures 5.18 and 5.19 show typical pitch contours for these sentences. Figure 5.18 shows the curves separately, while in Figure 5.19 the two curves are superimposed to show the relationship between the them. Figure 5.19 provides a nice illustration of the difference in height between accented and unaccented words, which is readily seen in the peak region just after the initial low stretch. Following the unaccented adjective *amai* F0 remains high, declining only gradually, but after the sharp fall due to the accent on *uma'i*, F0 rises again, ensuring us that we have another phrase, but to a much lower level than when *amai* precedes.

In order to substantiate this conclusion statistically, I measured the peak F0 on the syllable /ma/ of the two adjectives and on the syllable /riN/ of *miriN*, in the Nine tokens of the two sentences. The raw measurements are given below, and the mean values are plotted in Figure 5.20. As we can see, the difference in the height of /riN/ in the two cases is large, a mean of 28.51 hz. This is extremely significant ($p(T=18.14, 16\ df) < .0001$). From this we conclude that unaccented words are significantly lower after accented words than after unaccented words, which indicates that they are subject to catathesis.

Peak F0 Measurements for Sentence Three

	/ma/	/riN/
	174.2	120.5
	174.2	121.4
	173.0	119.6
	175.7	122.7
	175.7	122.7
	173.0	122.4
	172.4	128.7
	173.6	124.4
	174.2	121.8
mean	174.0	122.7
var	1.33	7.00

Peak F0 Measurements for Sentence Four		
	/ma/	/riN/
	161.8	148.6
	163.4	149.5
	167.8	149.7
	163.9	148.6
	167.8	146.2
	169.8	158.7
	167.5	155.8
	166.7	152.0
	171.8	151.7
mean	166.7	151.2
var	10.18	15.25

2.1.1.3.3. Catathesis of Low Tones

This study concentrated on the behaviour of High tones, so that only limited data are available for Low tones. All of the low tone data is drawn from the nonsense word data in Dataset IV. Recall that there each of the first three nonsense words was followed by the conjunction *ya*. When the words are accented, this *ya* bears a Low tone. The minimum value of the F0 on *ya* was measured in the three subsets of the data that contain accented words.

It is quite clear that Low tones drift downward just as High tones do. This is easily seen in the averaged data for the ++++ sequence, which are plotted in Figure 5.21. The values are summarized below.

	1	2	3
mean	123.2	113.4	107.8
var	17.0	8.1	9.2

Summary Statistics for Low Tones in ++++ Sequence

The Lows clearly descend as we proceed from left to right. The second Low is 9.8 hz. lower than the first (p (T=9.62,df=46) <.0001), and the third Low is 5.6 hz. lower than the second ($p(T=6.59, df=46) < .0001$). Like High tones, the Lows descend at a decreasing rate.

Consider now the question of the mechanism of this downdrift. Because we have only Low tones due to accents available, we cannot test for catathesis by comparing the rate of fall in accented/accented sequences to that in unaccented/unaccented sequences. We can, however, ask whether a Low tone in the second minor phrase is lower when the first minor phrase is accented than when the first minor phrase is unaccented. This we can do by comparing the height of the Low tone on the second word in the ++++ sequence with that in the – +++ sequence. The relevant measurements are given in the table below.

Preceding Word	Unaccented	Accented
mean	119.7	113.4
var	12.4	8.1

Low Tones Preceded By Accented and Unaccented Words

The Low is 6.3 hz. lower when the first minor phrase is accented than when it is unaccented ($p\ (T=6.85, df=46) < .0001$). This supports the claim that Low tones are subject to catathesis. Since the total fall when both minor phrases are accented is 9.8 hz., catathesis apparently does not entirely account for it, suggesting that Low tones may also be subject to declination. We have, unfortuntely, no data allowing us to test this hypothesis directly. We conclude that Low tones downdrift, and that this downdrift is attributable in part to catathesis.

2.1.1.3.4. Chaining of catathesis

2.1.1.3.4.1. High Tones

In the data thus far examined we have seen that an accented word in phrase-initial position depresses the following word. If the second word in the phrase is itself accented, it in turn depresses the following word. To see this, consider utterances Nine and Twelve of Dataset III. These are repeated below.

(9) Sore wa nuru'i amai nomi'mono da.
(12) Sore wa nuru'i uma'i nomi'mono da.

These two sentences differ only in that in sentence Nine the second minor phrase consists of the unaccented adjective *amai*, while in sentence Twelve, the second minor phrase consists of the accented adjective *uma'i*. If catathesis chains, we should find that the /mi/ of *nomi'mono* will be lower in sentence Twelve, where catathesis applies twice, than in sentence Nine, where catathesis applies only once. If there is no chaining of catathesis, we should find that the height of /mi/ is the same in the two cases.

The averaged F0 contours are shown in Figure 5.22, and the raw data for the F0 peaks are given in the following table. As the figure shows, the height of /mi/ is different in the two cases. Specifically, /mi/ is 5.24 hz. higher in (9) than in (12), which is significant ($p(T=2.38, 16df) < .02$). This suffices to prove that catathesis chains.

	Peak F0 on /mi/	
	9	12
	143.5	129.0
	141.2	140.6
	146.0	137.9
	146.8	141.8
	140.4	140.6
	139.3	142.0
	151.3	139.3
	147.9	145.8
	140.3	132.5
mean	144.1	138.8
var	25.21	26.44

High on /mi/ in Utterances 9 and 12

Additional evidence for the chaining of catathesis of High tones comes from the nonsense word data in Dataset IV. Here we may compare the height of the third word in the ++++ sequence, which is preceded by two accents, with the height of the third word in the

+– ++ sequence, which is preceded by only one accent. If catathesis chains, we expect to find that this word is lower in the former case than in the latter. On the null hypothesis, that catathesis does not chain, we expect to find no difference. The relevant data are summarized in the following table.

	++++	+– ++
mean	137.49	146.59
var	20.83	19.48

High on 3d Word in +– ++ Sequence and in ++++ Sequence

The High on the word preceded by two accents is 9.1 hz. lower than in the word preceded by one accent (p (T=6.94,df=45) <.0001). This supports the hypothesis that catathesis chains.

2.1.1.3.4.2. Low Tones

The data establishing that catathesis of Low tones chains is derived entirely from the nonsense word data in Dataset IV. Here we compare the values of the Low tone on the third minor phrase in the ++++ sequence with that in the +– ++ sequence. Since in the first sequence the third minor phrase is preceded by two accented words, while in the second sequence it is preceded by only one, we expect that if catathesis chains the Low in the former sequence will be lower than that in the latter. On the null hypothesis, that catathesis of Low tones does not chain, we expect to find no difference. The relevant measurements are given in the following table.

	++++	+– ++
mean	107.8	111.2
var	9.2	13.7

Low on Third Word in +– ++ Sequence and in ++++ Sequence

The Low preceded by two accents is 3.4 hz. lower than the Low preced by only one accent (p $(T=3.46, df=45) < .001$). This supports the hypothesis that catathesis of Low tones chains.

2.1.1.4. Summary of Factual Claims

With regard to F0 downdrift, we may summarize the the above observations as follows:

(1) The rate of F0 downdrift is significantly greater following accented words than following unaccented words.

(2) Nonetheless, sequences of unaccented words descend.

(3) An accented word exerts its depressing effect not only on accented words but on unaccented words.

(4) An accented word exerts its depressing effect both on the high region of a following word and on the low region of the following word.

(5) The depressing effect of accented words chains, in the sense that every accented word, regardless of its position in the phrase or of how many accented words there are, depresses the following word.

2.1.2. Interrogative Sentences

Dataset V contains data illustrating the F0 contours of interrogative sentences.

Figures 5.23-26 show pitchtracks representative of these data.

As can readily be seen from these pitch contours, the most salient characteristic of question intonation is that the sharp major-phrase final drop of declarative sentences is replaced by a sharp rise on the last syllable. The magnitude of the rise is difficult to quantify; as a reasonable estimate I measured the highest point reached while the pitch was monotonically increasing. In the case of the accented sequences this yields a mean of 240.7 hz. (var=710.5,n=10), and in the case of the unaccented sequences a mean of 258.9 hz. (var=343.1,n=36), for a rise in both cases of well over 100 hz.

Simple inspection of the pitch contours leaves the impression that the only effect of question intonation is this change in the very end of the contour from steeply falling to sharply rising, but it is possible that there are more global effects as well. According to Gårding, Svantesson, and Zhiang (1983) in Mandarin Chinese question intonation results in the complete suspension of phrasal downtrends in F0, while according to Hombert (1974) in Hausa phrasal downtrends are still present but that the rate of fall is smaller in questions than in statements. As is evident from the pitch contours exhibited, phrasal downtrends are certainly present in intonationally marked Japanese questions. In order to establish this rigorously, and in order to permit a quantitative investigation of the possibility that the rate of fall might be different in statements and questions, the data collected on the height of the peaks of the three minor phrases must be consulted. The raw data are given below.

Peak1	Peak2	Peak3
195.7	169.5	138.1
195.3	166.1	127.7
187.6	165.6	143.7
196.9	164.7	148.4

Peaks of Accented Statement #1

Peak1	Peak2	Peak3
195.7	181.2	135.7
182.8	161.0	132.1
177.6	173.9	147.3
182.8	171.5	148.1

Peaks of Accented Statement #2

Peak1	Peak2	Peak3
191.9	167.8	142.5
195.7	175.7	146.6
195.7	170.4	133.9
197.2	174.2	128.2
185.2	181.8	185.2

Peaks of Accented Question #1

Peak1	Peak2	Peak3
180.8	169.8	131.6
186.6	177.0	144.7
188.7	172.1	142.7
179.5	176.7	137.6
181.8	175.7	143.1

Peaks of Accented Question #2

Peak1	Peak2	Peak3
178.3	169.5	153.6
180.2	170.9	157.7
177.9	167.2	154.6
180.5	171.5	159.5

Peaks of Unaccented Statement #1

Peak1	Peak2	Peak3
185.2	169.5	163.7
178.9	170.4	150.8
179.5	167.2	153.6
179.9	171.2	159.2

Peaks of Unaccented Statement #4

Peak1	Peak2	Peak3
178.9	167.8	158.2
176.4	171.2	154.3
173.0	163.4	151.1
178.9	170.6	155.8

Peaks of Unaccented Statement #2

Peak1	Peak2	Peak3
182.8	165.3	155.5
184.2	167.8	157.0
179.5	162.3	147.1
190.1	168.4	164.2

Peaks of Unaccented Statement #5

Peak1	Peak2	Peak3
179.2	173.6	158.2
179.2	165.8	155.0
177.6	161.3	152.9
181.2	174.2	161.3

Peaks of Unaccented Statement #3

Peak1	Peak2	Peak3
185.9	169.2	156.7
182.8	172.7	152.4
180.8	166.7	156.0
187.6	170.4	159.7

Peaks of Unaccented Statement #6

Peak1	Peak2	Peak3
172.4	164.2	156.3
177.6	169.2	161.8
175.1	168.4	156.0
178.6	171.5	160.5
178.9	172.1	163.1
175.4	172.1	162.1

Peaks of Unaccented Question #1

Peak1	Peak2	Peak3
177.9	167.2	159.7
179.5	168.9	160.5
180.8	171.2	161.6
179.9	169.2	162.3
179.2	174.2	163.9
182.1	171.2	155.8

Peaks of Unaccented Question #4

Peak1	Peak2	Peak3
177.9	171.8	165.0
178.6	170.1	166.1
176.7	172.1	161.8
178.3	173.9	161.0
177.9	170.9	157.7
171.5	166.9	157.2

Peaks of Unaccented Question #2

Peak1	Peak2	Peak3
174.2	162.1	155.5
180.8	168.6	160.0
183.5	168.4	164.5
183.8	170.6	163.1
183.8	170.1	163.4
179.9	166.7	161.0

Peaks of Unaccented Question #5

Peak1	Peak2	Peak3
174.5	165.0	157.5
180.8	173.0	161.8
180.5	169.2	159.7
186.2	172.1	168.6
184.8	172.4	163.1
179.5	168.9	158.2

Peaks of Unaccented Question #3

Peak1	Peak2	Peak3
177.9	162.6	160.5
184.2	173.9	163.1
181.5	167.8	158.0
185.5	168.4	158.5
182.8	168.1	161.8
182.8	166.9	155.0

Peaks of Unaccented Question #6

For purposes of analysis, let us group the data into four categories, according as whether the utterance is a statement or a question and according as it consists of accented minor phrases or unaccented minor phrases. It is a simple matter to establish that an F0 downtrend is present in each of the four cases. The following table shows the result of computing, for each utterance, the fall from the first peak to the second peak, and from the second peak to the third peak, and averaging these values across all of the utterances in the category. The T value shown is for a test of the difference between the given mean and zero, the latter being the value expected if there is no downtrend. In every case, including the intonationally marked questions, the downtrend is present. All of the falls given are significant at at least the .001 level.

	Accented Statements		Unaccented Statements	
	Fall #1	Fall #1	Fall #1	Fall #2
Mean	20.11	29.05	12.10	12.50
Var	92.96	87.88	19.38	14.09
N	8	8	24	24
DF	7	7	23	23
T	5.899	8.765	13.465	16.314

	Accented Questions		Unaccented Questions	
	Fall #1	Fall #2	Fall #1	Fall #2
Mean	14.19	30.51	10.15	8.73
Var	75.74	177.40	13.46	8.33
N	10	10	36	36
DF	9	9	35	35
T	5.156	7.244	16.599	18.149

Summary of Peak-to-Peak Falls in Question Intonation Data

The question that remains is whether the rate of fall is different in questions and in statements, given that it is non-zero in both. To answer this question the peak-to-peak differences were computed for each utterance, these values averaged over all of the tokens of the same utterance, and the mean values for matched statements and questions compared. Two measures of the peak-to-peak difference were used. The first was simply the absolute differenc in hz. between the two peaks. The second was this difference as a percentage of the height of the first peak.

The following tables summarize the results of the comparisons of the peak-to-peak rates of fall in matched statements and questions. The first table shows absolute differences, the second table the percentage differences. The labels are to be interpreted as follows: "An" means "Accented utterance #n"; "Un" means "Unaccented Utterance #n". The number following the slash indicates whether the fall at hand is the first one, i.e. from the first peak to the second, or the second one, i.e. from the second peak to the third. In each case the mean, variance, and number of tokens are given for the statement and then the question, followed by the difference between the means, the number of degrees of freedom, and the value of the T statistic computed for a comparison of two sample means.

	Statement			Question					
Label	Mean	Var	N	Mean	Var	N	Meandif	DF	T
A1/1	27.40	18.96	4	19.16	81.48	5	8.24	7	1.661
A1/2	27.00	96.61	4	26.70	345.57	5	0.30	7	0.029
A2/1	12.83	56.32	4	9.22	27.18	5	3.61	7	0.854
A2/2	31.10	97.25	4	34.32	17.29	5	-3.22	7	-0.668
U1/1	9.45	0.74	4	6.75	3.37	6	2.70	8	2.709
U1/2	13.42	2.96	4	9.62	3.61	6	3.80	8	3.209
U2/1	8.55	6.30	4	5.87	2.73	6	2.68	8	2.058
U2/2	13.40	9.95	4	9.48	12.69	6	3.92	8	1.778
U3/1	10.57	26.10	4	10.95	4.86	6	-0.38	8	-0.164
U3/2	11.88	8.90	4	8.62	7.94	6	3.26	8	1.753
U4/1	11.30	11.65	4	9.58	5.25	6	1.72	8	0.963
U4/2	12.75	32.20	4	9.68	9.45	6	3.07	8	1.122
U5/1	18.20	5.66	4	13.25	1.21	6	4.95	8	4.520
U5/2	10.00	20.45	4	6.50	2.57	6	3.50	8	1.780
U6/1	14.53	10.55	4	14.50	5.54	6	0.03	8	0.017
U6/2	13.55	20.97	4	8.47	13.26	6	5.08	8	1.958

Statement/Question Comparisons

Absolute Differences

	Statement			Question					
Label	Mean	Var	N	Mean	Var	N	Meandif	DF	T
A1/1	14.10	3.98	4	9.84	21.12	5	4.26	7	1.711
A1/2	16.19	33.95	4	15.52	114.26	5	0.67	7	0.112
A2/1	6.90	16.41	4	4.99	7.54	5	1.91	7	0.845
A2/2	18.00	25.61	4	19.70	6.00	5	-1.70	7	-0.668
U1/1	5.27	0.25	4	3.83	1.10	6	1.44	8	2.524
U1/2	7.91	1.06	4	5.67	1.21	6	2.24	8	3.231
U2/1	4.84	2.00	4	3.31	0.82	6	1.53	8	2.110
U2/2	7.95	3.12	4	5.54	4.25	6	2.41	8	1.909
U3/1	5.91	8.36	4	6.03	1.24	6	-0.12	8	-0.094
U3/2	7.00	2.37	4	5.07	2.69	6	1.93	8	1.865
U4/1	6.23	3.19	4	5.33	1.61	6	0.90	8	0.939
U4/2	7.52	11.10	4	5.68	3.11	6	1.84	8	1.154
U5/1	9.87	1.16	4	7.32	0.27	6	2.55	8	5.084
U5/2	6.06	7.93	4	3.87	0.89	6	2.19	8	1.806
U6/1	7.87	2.81	4	7.95	1.66	6	-0.08	8	-0.086
U6/2	7.96	6.64	4	5.02	4.60	6	2.94	8	1.966

Statement/Question Comparisons

Percentage Differences

The following tables summarize the significance of the differences between declarative and interogative versions of the same sentence. I have also shown in each case the sign of the difference between the statements and questions. The sign is positive if the rate of fall is greater in the statements than in the matched questions. Here the abbreviations NS and NQS are used to indicate "not significant" and "not quite significant" (i.e. approaching but not quite reaching the .05 level) respectively.

	Fall #1		Fall #2	
Utterance	Significance	Sign of Difference	Significance	Sign of Difference
A1	NQS	+	NS	+
A2	NS	+	NS	-
U1	.025	+	.01	+
U2	.05	+	NQS	+
U3	NS	-	NQS	+
U4	NS	+	NS	+
U5	.001	+	.05	+
U6	NS	+	.05	+

Analysis of Absolute Falls by Utterance

	Fall #1		Fall #2	
Utterance	Significance	Sign of Difference	Significance	Sign of Difference
A1	NQS	+	NS	+
A2	NS	+	NS	-
U1	.025	+	.01	+
U2	.05	+	.05	+
U3	NS	-	.05	+
U4	NS	+	NS	+
U5	.001	+	NQS	+
U6	NS	+	.05	+

Analysis of Relative Falls by Utterance

As inspection of the above tables shows, it makes little difference whether the rate of fall is measured in absolute terms or relative to the peak from which the fall occurs. The only difference is that the second fall in utterances U2 and U3, which just fails to attain statistical significance when measured in absolute terms, becomes significant when measured in relative terms.

In only two of the 16 cases do questions fall faster than statements, suggesting that there is indeed a non-local effect of question intonation on the F0 contour. However, when we consider the statistical significance of the difference, the results are quite mixed, with some parts of some utterances exhibiting significant difference and the remainder none. No difference is found in the accented sentences except for the not quite significant difference in the first position in utterance A1. The unaccented utterances are quite variable.

These results do not yield a clear conclusion; we find neither a consistent effect nor a consistent lack of effect. As a result, only further investigation can determine whether or not the effect of question intonation is strictly local.[9]

2.1.3. Emphasis

The factors affecting F0 that we have discussed thus far all exert their influence indirectly, either by determining the distribution of accents and tones, or by interpreting them. There are, however, factors which appear to influence the F0 contour directly, by deforming it in some particular region.

One such factor is direct emphasis on some word or phrase, which has the effect of raising the high region of that word or phrase.[10]

Dataset VI contains data illustrating the effects of emphasis. The points measured were the peak F0 on each of the two averages and the trough in between. These measurements are given in the following tables. Figures 5.27-5.30 show representative examples of each of the four sentences.

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[9] One possibility is that there is actually no non-local effect of question intonation and that the difference that appears between questions and statements in some cases is due to the incompatability of question intonation with the pragmatics induced by the order of the adjectives.

[10] This is not to say that this is the only effect. I do not know of any data on effects of emphasis on features other than F0, nor have I studied the effect of emphasis on the height of Low tones.

Measurements of Sentence #1

	167.2	176.7	155.5
	167.8	172.4	156.0
	171.2	171.5	161.0
	165.8	161.8	153.6
	169.2	164.7	160.3
	174.2	168.1	161.3
	169.8	165.3	157.2
	177.9	170.6	165.6
	176.4	170.1	164.7
	173.6	168.1	162.6
mean	171.3	168.9	159.8
var	16.6	18.5	16.3

Measurements of Sentence #2

	166.1	196.5	147.3
	166.9	190.5	155.3
	171.2	191.6	153.6
	170.9	185.2	136.1
	166.9	185.9	155.8
	172.7	192.3	153.8
	169.2	182.5	153.4
	170.6	188.0	155.8
	165.6	182.8	152.2
	163.9	181.2	154.6
mean	168.4	187.7	151.8
var	8.4	25.0	36.53

Measurements of Sentence #3			
	172.4	161.6	135.1
	179.2	158.7	138.1
	177.9	162.6	133.7
	181.2	165.6	134.0
	172.7	163.1	133.9
	177.6	167.5	138.9
	176.1	163.1	136.2
	175.1	166.9	137.6
	176.1	163.7	137.0
	178.3	159.2	132.6
mean	176.7	163.2	135.7
var	7.7	8.6	4.6

Measurements of Sentence #4			
	173.9	174.8	129.5
	180.2	186.2	133.5
	172.4	180.2	134.8
	173.3	179.9	130.2
	173.9	186.9	137.7
	179.9	191.2	135.5
	174.8	182.1	130.5
	176.7	182.8	135.0
	176.4	181.8	132.3
	177.9	187.6	137.4
mean	175.9	183.4	133.6
var	7.5	22.2	8.7

As expected, the measurements show that emphasis has the effect of raising the peak of the emphasized word. This can be seen by comparing the peaks on *ao'i* in the sentences with emphasis (numbers 2 and 4) with those without emphasis (numbers 1 and 3). The following table gives the mean values of the peak on *ao'i* in both cases, both when preceded by *amai* and when preceded by *uma'i*.

Comparison of Emphasized and Unemphasized Adjectives		
First Adjective	Emphasized	Unemphasized
amai	187.7	168.9
uma'i	183.4	163.2

In both cases, the emphasized adjective is substantially higher, in the first case by 18.7 hz. (p (T=8.91,df=18)<.0001), in the second by 20.2 hz. (p (T=11.49,18df)<.0001). Since this effect is not readily attributable to any aspect of the phonogical representation, nor to the phonetic realization rules, I suppose that emphasis acts directly on the F0 contour.

We may also ask whether the raising due to emphasis blocks catathesis. Recall that catathesis occurs following an accented word, such as *uma'i*, and not following an unaccented word, such as *amai*. When *ao'i* is not emphasized, it is indeed depressed, as can be seen in the figures, as well as in the fact that the peak on *ao'i* is 5.7 hz. lower after *uma'i* than after *amai* (p (T=3.48,df=18)<.005). The question is whether this distinction is preserved when *ao'i* is emphasized. The answer appears to be yes, since in this case *ao'i* is 4.3 hz. lower after *uma'i* than after *amai*, but the difference is only marginally significant (p (T=1.98,df=18)=.03).

2.2. Accounting for the Facts

The observations described in the preceding section provide an outline for an account of F0 downdrift in Japanese. It is clear that we must introduce some form of LPCFM in order to account for the fact that F0 descends more rapidly after accented words than after unaccented words. And since sequences of unaccented words nonetheless decline we must provide some mechanism for this, presumably a form of declination. Many details remain to be established, some of which are not within the scope of this thesis. However, the data obtained here are sufficient to demonstrate, as I have implicitly assumed above by my references to catathesis when only some form of LPCFM had been established, that catathesis and not accent reduction is the form of LPCFM with which we must work. In the next section I review previous accounts of phrasal trends in F0 in Japanese, in the course of which this point will be established. In the following section I turn to a number of other details on which the existing data can be brought to bear.

2.2.1. Review of Previous Accounts

Accounts of phrasal trends in F0 in Japanese fall into two rough categories according as they are phonetically or phonologically oriented. The phonetically oriented accounts all provide numerical models of F0 contours, of varying degrees of explicitness, and all propose some form of declination. None of the authors of these accounts presents any data aimed at demonstrating the correctness of this class of models, nor is there any attention to the conditions under which F0 downtrends occur.

Three phonologically oriented accounts have appeared in the literature. These are due to McCawley, Shibatani, and Haraguchi. McCawley's account is cast in terms of accent reduction, while both Shibatani's and Haraguchi's accounts are based on the tonal string rather than on the accents. In this sense, both of them can be considered to involve catathesis, although only Haraguchi's account has the hallmarks of the typical catathesis account found in descriptions of African tone languages. Shibatani's account is of a character unparalleled in the literature on tone, since it does not require an HL transition for catathesis to occur,[11] nor does catathesis chain.

In view of the wide disparity of views on the treatment of downdrift in Japanese, it is striking that neither Shibatani nor Haraguchi offers any criticism of the empirical predictions of the previous analyses as motivation for his own, nor does either of them bother to discuss the different empirical predictions made by their theories, with the single exception of the question of whether catathesis is partial or total. Shibatani's motivation for his account was to disprove McCawley's claim that accent reduction was cyclic by providing an equivalent noncyclic account, yet he never discusses the fact that his account is not equivalent to

[11] In some African languages the presence of a triggering Low tone is debatable, but in such cases we are dealing with syntactically induced catathesis. The point here is that automatic catathesis always involves a HL transition.

McCawley's, not to speak of whether it is superior. Similarly, Haraguchi disputes McCawley's and Shibatani's claims as to whether catathesis is total or partial, but never provides any motivation for his revisions of the environment in which catathesis takes place.

In the following discussion, after a brief exposition of the theory in question, I will evaluate it in light of the factual claims about downdrift established above. I will show that accounts based on accent reduction (and tonal accounts like Shibatani's which share some of their properties) are incorrect for principled reasons, while Haraguchi's catathesis based account fails only as a result of its specific formulation.

2.2.1.1. Accounts Based on Declination

The earliest declination based account is that of Kobayashi (1969) who proposed that Japanese F0 could be modeled by step functions smoothed by a first order linear filter representing each minor phrase together with a declination curve of unspecified character. A similar account is that of Fujimura (1972) who proposed that each minor phrase is represented by an upstep and if there is an acvcent a downstep, smoothed by a filter of unspecified character, with the whole sequence of minor phrases then filtered again, in effect assuming some sort of declination curve.

In addition to these two accounts, there are two more detailed proposals. The first is due to Fujisaki and various collaborators (Fujisaki n.d., 1981, Fujisaki & Sudo 1971, Fujisaki, Hirose, & Ohta 1979, Fujisaki, Hirose, Takahashi, & Lehiste 1982 Fujisaki, Mitsui, & Sugitoo 1974), which is claimed to apply equally well to English and Estonian. The model treats each phrase as involving an upstep and a downstep smoothed by a second order linear filter. The string of minor phrase is then passed through another second order linear filter which provides the declination curve. The heights of the upsteps and downsteps, the times at which they occur, and the time constants of the various filters are all freely variable.

This model has not been tested by systematically studying the F0 curves found in different environments. Instead, it is based upon observation of F0 contours of a small number of sentences (approximately ten) whose contents have not been varied in a systematic fashion.

The argument for the validity of the model is the fact that it is possible to obtain very good fits to this model for the sentences studied.

While it is certainly important that good fits be found, goodness of fit does not argue strongly in favor of a model. The number of parameters in this model is so large that virtually any reasonably smooth curve can be fit. Indeed, it is likely that given the same number of degrees of freedom, any of a number of other models, based on other sets of basis functions, could do as well. Fujisaki imposes no interesting constraints on the relative height of the different steps so that he makes no predictions whatever about declination, catathesis, accent reduction, or whatever. His model would be consistent with any of these, since the relevant parameters are freely and continuously variable.

In sum, the only mechanism for phrasal trends in F0 envisoned by Fujisaki is declination, but his model permits sufficient freedom as to account for almost any F0 pattern.

The other more detailed study is a proposal of a set of F0 synthesis rules by Beckman, Hertz, & Fujimura (1983) validated by informal listening to speech synthesized using the rules. The model is very much like Fujisaki's, except for the fact that the size of the steps is fixed and for the fact that separate declination curves are provided for declarative, interrogative, and continuative intonation. This model provides only the declination curve as a means of accounting for F0 downdrift.

What all of the above models have in common is the postulation of a declination curve in order to account for phrasal trends in F0, with no consideration of alternative mechanisms. Insofar as we have shown that pure declination is inadequate, these models are untenable.

2.2.1.2. Accounts Based on Accent Reduction

The first phonological account of downdrift in Japanese is that proposed by McCawley (1968). McCawley treats Japanese like a stress language, and proposes that the rules governing the relative height of minor phrases within the same major phrase are accent reduction rules.

McCawley's empirical claim is that within a major phrase the relatively high stretch of the first minor phrase is the highest, while the relatively high stretches of the subsequent minor phrases bear are lower than the first high stretch and equal to each other. He represents this by treating the first high stretch as bearing a High tone while the others bear Mid tones. He considers this to be the result of a an accent reduction rule, which renders all but the leftmost accent secondary, and of a set of pitch assignment rules which assign Mid tones to non-primary accents.

Accent reduction operates in a fashion that will be familiar from the account of English stress in Chomsky & Halle (1968). Accent reduction is not actually performed by any rule; rather, a rule assigns a primary accent to the leftmost primary accented syllable in the major phrase. This of course leaves the accentuation of the affected syllable unchanged. The desired reduction, which is the only superficial effect of the application of the rule, is effected by a convention that reduces the accentual rank of every syllable not assigned a primary accent by one level. Every accented minor phrase is assumed to bear a primary accent underlyingly, so the effect of applying the leftmost prominence rule for major phrases is to put a primary accent on the leftmost minor phrase and a secondary accent on every other minor phrase.

As we have seen, there are two other cases in which a similar leftmost prominence rule applies. One is internal to words where, other things being equal, the leftmost of two accents wins. The other is within a minor phrase that consists of more than one word, where only the leftmost of two accents is realized. I have suggested above that these two phenomena probably reflect the operation of a single rule.

McCawley takes note of the similarity between the word-level accent elimination rule and the major phrase level accent reduction rule and suggests that these are actually the same rule. Specifically, he proposes that both rules are actually accent reduction rules, applying cyclically, first to minor phrases, then to major phrases.

This means that non-leftmost accents within a word or phrase are not actually deleted; they are reduced, so that at the end of the word cycle they are secondary rather than primary. Then, since every minor phrase is part of a major phrase, albeit perhaps vacuously, leftmost prominence applies again, placing a primary accent on the leftmost accent and now reducing the secondary accent to tertiary. The tone assignment rules must then be formulated in such a way as to ignore tertiary accents.

McCawley therefore adopts the following set of pitch assignment rules, quoted verbatim (1968:174):

(1) Everything in a minor phrase becomes high or mid-pitched depending on whether the strongest accent in the phrase is primary or non-primary.
(2) Everything after the first mora of the strongest accented syllable becomes low-pitched.
(3) The first mora of the phrase becomes low-pitched if the second is not low-pitched.

McCawley gives the following illustrative derivation.

1	1 1	
[[kabu'r+te]	[mi'+ta'ra]]	underlying representation
1	1 2	
[[kabutte]	[mitara]]	accent reduction on first cycle
1	2 3	
[[kabutte]	[mitara]]	accent reduction on second cycle
H H H	M M M	
[[kabutte]	[mitara]]	first pitch assignment rule
H H L	M L L	
[[kabutte]	[mitara]]	second pitch assignment rule
L H L	M L L	
[[kabutte]	[mitara]]	third pitch assignment rule

Derivation Illustrating McCawley's Rules

Although one of McCawley's central claims is that the accent reduction rules are cyclic, it is important to note that his analysis is not entirely cyclic, as Shibatani (1972ab) has pointed out. Although the accent reduction rules apply cyclically, the pitch assignment rules do not. Rather, these rules apply postcyclically. Nonetheless, the pitch assignment rules make crucial reference to minor phrase boundaries. Such reference to internal structure by postcyclic rules is prohibited by strict cyclicity.

McCawley does not specify what happens to unaccented words. There seem to be two reasonable interpretations. One is that the reduction to Mid tone is intended to apply only to non-leftmost accented words, so that unaccented words will get High tones. Certainly the notion of accent reduction is one that is most consistent with there being no effect on unaccented words. That this is what he means is supported by the statement in McCawley (1977:272) that within a major phrase the minor phrases are pronounced "...with the accented syllable of the first phrase in the group higher in pitch than the accented syllables of the subsequent phrases." Since McCawley specifies that it is only the accented syllables of the non-leftmost phrases that are reduced, it seems that he intended no reduction of unaccented words. I will refer to this as alternative I.

The alternative would be to interpret McCawley's rules as saying that a High tone is assigned only to the strongest accent in a phrase, and that everything else, i.e. both unaccented and secondarily accented words, get Mid tones. I will refer to this as alternative II.

Let us consider now how McCawley's theory accounts for the data. Consider first a major phrase consisting exclusively of unaccented words. Depending on which interpretation of McCawley's analysis is correct, such a sequence should consist either entirely of Mid tones or entirely of High tones. Either way, the prediction is that such a sequence should be level. But as we have seen, such a sequence is not level at all; rather, it declines. This is the first failing of McCawley's analysis.

Notice that this is not an artifact of the details of McCawley's analysis: it is a necessary consequence of any analysis based on accent reduction, since no accent reduction rule can have any effect on unaccented words. At the very least, then, McCawley's accent reduction rule must be supplemented with a declination rule like that proposed above.

A second defect of the accent reduction analysis becomes apparent when we consider what will happen when a major phrase begins with an accented word and it is followed by an unaccented word. The accent reduction hypothesis predicts that the unaccented word will not be subject to catathesis. Whatever tone assignment rules we may choose, the tone assigned to an unaccented word is independent of the environment. Under Alternative I the prediction is that both words will be High, that is, that there will be no catathesis. Under Alternative II, the sequence will be realized as High Mid. One might think that this could be taken to represent catathesis adequately, but it will not. Notice that under Alternative II a sequence of two unaccented words will come out Mid Mid, so that the prediction is that the F0 of an unaccented word does not depend on the accentedness of the preceding word. But we have seen that this is false. An unaccented word is lower following an accented word than following an unaccented word. Thus, under both alternative interpretations, the accent reduction hypothesis incorrectly predicts that unaccented words will not be reduced.

Here again the defect is not an artifact of the particular analysis; there is no way that an accent reduction rule can affect an unaccented word.

There is yet a third problem for the accent reduction theory. The theory predicts, as McCawley explicitly claims, that in a sequence of accented minor phrases the first is higher than the others, and that the others are equal to each other. But as we have seen, they are not equal, even when declination is factored out; there is a continuous fall from position to position. This is captured by the catathesis theory, since it is natural for catathesis to chain, but the accent reduction theory cannot account for it.

This too is inherent in the accent reduction theory. Within a given domain, the accent reduction mechanism makes one element more prominent than all of the rest; the rest are necessarily equal.

Finally, on McCawley's account only High tones are subject to depression. But as we have seen this is incorrect, since Low tones too are subject to catathesis. This last defect is not inherent in the accent reduction proposal, since nothing would prevent a modification in which not only the type of [-Low] tone but also the type of [+Low] tone assigned depended on the accentual rank of the minor phrase.

To summarize, McCawley's analysis suffers from a number of defects. Some of these are inherent consequences of the accent reduction theory, while others are not.

Two of the problems are not inherent in the notion that what is involved is accent reduction. First, McCawley's theory does not provide any distinction between accented and unaccented High tones. This defect is not a consequence of the accent reduction theory, and could be remedied by introducing an additional tone or by means of a phonetic rule raising High before Low. Second, only the height of [-Low] tones depends upon the accentual rank of the minor phrase. This two could be remedied by modification of the pitch assignment rules.

In addition, the accent reduction theory has the following inherent defects:

(1) It falsely predicts that sequences of unaccented words will be level;
(2) It falsely predicts that unaccented words will not be subject to catathesis.
(3) It falsely predicts that catathesis will not chain;

These last are inherent consequences of the accent reduction theory. They argue against the claim that the relationship between minor phrases in a pitch accent language such as Japanese is comparable to the accent reduction observed in a stress language like English.

2.2.1.3. Accounts Based on Catathesis

The second phonological account of downdrift in Japanese is due to Shibatani (1972ab,1979). Shibatani proposes that there is no accent reduction and that accentuation is non-cyclic. Given a minor phrase with accents marked, he proposes that pitch is assigned by the convention below in accordance with the following Surface Phonetic Constraint (SPC) (Shibatani 1972a:593).

(1) Shibatani's Pitch Assignment Rules for Minor Phrases

Convention For Pitch Assignment

Assign pitches to minor phrases according to SPC 20 [below-WJP] on the condition that a pitch drop occurs [sic] only at the leftmost accent of a minor phrase.

SPC For Pitch Shapes of Minor Phrases:

$$\% \begin{matrix} M \\ Lo \end{matrix} \quad \begin{matrix} M \\ -Lo \end{matrix} \quad \begin{matrix} M \\ Lo \end{matrix} \%$$

Shibatani's SPC generates contours virtually identical to those generated by the pitch assignment rules of Hattori and McCawley and to those generated by Haraguchi's autosegmental description. It is to be interpreted as saying that morae following the accent are all Low, that the accented mora is High, as are any morae preceding it except for the first. The first mora is Low if the following mora is high; otherwise (which is to say, when it is the first mora that is accented) the first mora is high.

This rule is therefore more-or-less adequate. It suffers just two defects. First, it does not sufficiently constrain Initial Lowering; recall that the first syllable is entirely low only if the initial syllable is (a) unaccented (which Shibatani's SPC correctly states) and (b) contains only one sonorant mora. The SPC as stated does not contain the latter constraint, although in principle it could be modified to do so. Secondly, it fails to differentiate unaccented Highs from accented Highs. Here again, nothing in principle prevents such a modification.

Shibatani's proposal for downdrift is that a second Surface Phonetic Constraint applies to major phrases, with the effect of making the High tones of the the first minor phrase High, and the High tones of all subsequent minor phrases Mid. The SPC is formulated as follows.

(2) Shibatani's Rule for Tone Assignment to Major Phrases

SPC For Pitch Shapes of Major Phrases

@%(Lo) -Lo Lo % ((Lo) -Lo Lo %) @

Hi Mid

This SPC is to be interpreted as follows (Shibatani 1972a;593-4):

> ...a major phrase may contain one or more minor phrases;...if there is a [-Lo] mora, then that is necessarily [Hi] in the leftmost minor phrase and [Mid] in the other minor phrases.

Before discussing the implications of Shibatani's proposal I should note that although it is cast in terms of Surface Phonetic Constraints rather than rules, it appears to be safe to interpret it in terms of rules of the more familiar sort. I will do this both for the sake of simplifying the discussion and because Shibatani's theory of SPCs is nowhere described in detail, so it is unclear exactly how he intended his description to work. The reader interested in Shibatani's ideas about Surface Phonetic Constraints may consult Shibatani (1973).

In the case of his rule for minor phrases, the two types of description are virtually equivalent: in a rule-based system one assigns tones in a manner governed by the rule; in Shibatani's framework one assigns tones, apparently randomly, and filters the output with the SPC. The result is the same.

What is unclear is how Shibatani intends his second SPC to be interpreted. Since, on his own analysis, tones are assigned to minor phrases, it appears that this SPC must be interpreted as a rule of the traditional sort, changing the already assigned pitches into others. The alternative would be to conflate the two SPC's into a single SPC that applied to major phrases but had access to minor phrase boundaries, and to assign pitches randomly in such a way that this new SPC was satisfied.

Shibatani's SPC for major phrases makes the following predictions. First, it correctly predicts that both accented and unaccented words will be depressed, since it makes no distinction between accented and unaccented [-Lo] morae in non-initial minor phrases.

Second, Shibatani's SPC, Like McCawley's accent reduction rule, predicts that catathesis will not chain. The high stretch of the first minor phrase will be higher than the others; all subsequent minor phrases will be at the same height, namely Mid.[12] Since we know that catathesis chains, this is incorrect.

Third, Shibatani's SPC makes no distinction between accented and unaccented words as triggers. If we interpret it as referring to catathesis, it predicts that unaccented words will trigger catathesis just as accented words do. Since we know that unaccented words do not trigger catathesis, this is incorrect.

Of course, we could interpret Shibatani's SPC as describing the phenomenon that I refer to as declination, which does not depend upon the accentedness of the trigger. In that case, the problem with his analysis would be that he provides no description whatever of catathesis. The point is that accented and unaccented minor phrases have different effects on the height of subsequent minor phrases, and Shibatani's proposal does not account for this.

Finally, Shibatani's SPC predicts that only non-Low tones will be depressed. Low tones are unaffected.[13] This too is incorrect, since we have seen that Low tones are subject to catathesis.

In sum, Shibatani's proposal falsely predicts that catathesis will not chain, incorrectly fails to differentiate between the effects of accented and unaccented words, and falsely claims that only non-Low tones are subject to catathesis.

In addition to the proposals of McCawley and Shibatani, there are two other brief discussions of downdrift in the literature on Japanese phonology. These are to be found in

[12] Shibatani is quite explicit about this claim. He says (1972a;593): "...since there are three levels of pitch in a major phrase, we need to further specify the [-Lo] pitch in usch a way that the [-Lo] pitched moras are realized as [Hi] pitched moras in the leftmost minor phrase and, as [Mid] pitched moras in the other minor phrases of a major phrase."

[13] Shibatani (1979) does recognize that not all Lows are the same height, which he attributes to "...a detail rule stating that a sequence of H's or L's within a minor phrase involves a gradual lowering of pitch" (p.933). Since this statement is explicitly limited to single minor phrases, it cannot account for the observed catathesis of Lows. Moreover, it is not clear whether it is factually correct. It is true of Lows, but the High toned stretch of an accented word is typically higher at the end than at the beginning.

Haraguchi (1977) and Miyara (1981). Since Miyara bases his remarks on those of Haraguchi, I will confine my discussion to the latter.

Haraguchi's account of downdrift is informal and somewhat confusing. He gives no formal statement of his downdrift rule. The following passage is his most precise statement of the rule (Haraguchi 1977;30-31):

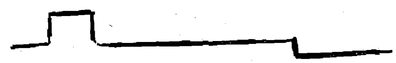
> ...Downdrift is regarded as a process (i) which makes the HL contour of the second phrase in (36) start with a H pitch equal to the preceding L pitch and go on to a lowered L pitch, if the preceding phrase has a L tone after a H tone as in (36a)... and (ii) which makes the LHL contour of the second phrase in (36b) into a L-lowered H(or M)-lowered L contour.

The representations to which Haraguchi refers as (36a) and (36b) are the following:

(3) Haraguchi's Sample Representations

(a) ## CV CV CV ## CV CV CV CV ##

L H L H L



(b) ## CV CV CV [+pause] CV CV CV CV ##
##

L H L L H L

Haraguchi treats downdrift as a relation among tones, and in particular as something that happens after a HL sequence. Although Haraguchi discusses none of the following cases, his analysis nonetheless makes a number of correct predictions that contrast with those of McCawley's and Shibatani's analyses. His analysis predicts that not only accented Highs but also unaccented Highs as well as Low tones in words of both types will undergo catathesis. It also correctly predicts that an initial-accented word preceded by an unaccented word will not be depressed. Moreover, although Haraguchi does not say anything about major phrases containing more than two minor phrases, his analysis is compatible with chaining of catathesis. In these respects Haraguchi's analysis is comparable to that presented here, and superior to its predecessors.

Nonetheless, Haraguchi's analysis suffers from a number of defects. First, Haraguchi claims that in some environments catathesis is total rather than partial, that is to say, that a depressed High tone is at the same level as a preceding Low. This is reflected in his discussion of his example (36a). It results from his claim that when a minor phrase begins with a High tone, that High is realized at the same level as the preceding Low.

This claim is incorrect. All of my data, including the cases in which the second minor phrase begins with a High tone, show partial catathesis, that is, the second High tone in a HLH sequence is higher than the preceding Low. Haraguchi's claim that catathesis is sometimes total is based on his belief that in the most natural pronunciation phrases like *kabutte mitara* have the F0 contour shown in (a) above. On this point he is partially correct. When such a sequence means "try V-ing", as it does in the intended reading of *kabutte mitara*, the F0 contour has approximately the contour in (a). The alternative, in which /mi/ rises above the Low of /te/, is characteristic of the conjoined reading. So in this respect the phrasing cited by McCawley is unnatural. But where Haraguchi errs, as Shibatani (1979) points out, is in believing that the contour in (a) represents catathesis. Rather, that contour is due to the fact that in the normal pronunciation, with the intended interpretation, phrases like *kabutte mitara* are pronounced as a single minor phrase. /mi/ is on the same level as /te/ because both bear Low tones. As for the alleged fall from /mi/ to /tara/, I can only say that in such cases[14] my data show no sharp fall indicative of the presence of an accent, although, as I have indicated, whether or not non-leftmost accents within words and minor phrases are completely unrealized remains an open question. I conclude that there is no reason to believe that under any circumstances total catathesis occurs in Japanese.

Haraguchi's analysis also has a rather curious property, in that there appears to be no uniform mechanism of catathesis. A High separated from a preceding Low by a minor phrase boundary is realized at the same level as the Low, but a High preceded by a Low within the same minor phrase is realized at a level above that of the Low, but is nonetheless lowered, by some mysterious mechanism, with respect to a preceding High.

A second problem of Haraguchi's analysis is that it makes no distinction between the sequences HL%(L)H and H%LH as to whether the second High will be depressed. The first sequence is that of an accented word followed by any other word; the second case is that of an unaccented word followed by a word that undergoes Initial Lowering. Haraguchi's account correctly predicts that when an unaccented word is followed by a word that does not undergo Initial Lowering, the latter will not be depressed. But in both of the above cases Haraguchi predicts that the second High will be depressed. However, as we have seen, an unaccented

[14] See the F0 contours for the comparable phrase *yo'Nde mi'ru* in Figures 3.1 and 3.2.

word never triggers catathesis, regardless of the tone pattern of what follows. Consequently, Haraguchi's statement of the environment for catathesis is incorrect.

Finally, Haraguchi presents no account at all of declination.

In sum, Haraguchi's account comes close to that presented here in treating downdrift in Japanese along the lines that have been proposed for African tone languages and for English. This success is apparently accidental, since he adduces as evidence none of the crucial cases that support his approach over those of McCawley and Shibatani. Indeed, when describing downdrift as something that happens to HLH sequences, he actually cites McCawley (1968) and Shibatani (1972a) as references, when in fact neither of the two state the rule in this fashion.

On the other hand, Haraguchi's statement of the environment for catathesis is incorrect, as is his claim that in certain circumstances it is total. Moreover, he presents no discussion of declination at all.

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2.2.2. A Model of F0 Trends in Japanese

We have thus far established several aspects of a model of F0 trends in Japanese. First, there must be some sort of declination curve. Second, in addition to declination there is some sort of LPCFM. Third, this LPCFM is a form of catathesis rather than accent reduction. Fourth, the catathesis applies to all tones, not just to High tones. It is possible to further narrow the class of models on the basis of the data available to us.

One question that has arisen in previous work on catathesis concerns what exactly it is that is lowered. The usual view is that there is a space within which tones are realized, High tones toward the top, Low tones toward the bottom, and that when catathesis occurs this space is lowered. In cases where only High tones are claimed to undergo catathesis, only the upper boundary of the space is lowered; if all tones undergo catathesis both the upper and the lower bounds are lowered. The point is that what is lowered is not a tone itself, but rather the region within which tones may be realized. Such theories of catathesis are known as register theories.

Pierrehumbert (1980) has pointed out that catathesis can be accounted for in another way, without recourse to such an inherently non-local device as registers. She observes that the values of tones might be computed from left to right, with the value of one tone based upon the value of a preceding tone. This model is more local and therefore to be preferred in the absence of evidenced in favor of register shift. Since Pierrehumbert is able to account quite nicely for catathesis in English without recourse to register, she proposes that register shift be abandoned. It appears, however, that Japanese provides some evidence in favor of a register shift account of catathesis. This arises from a consideration of exactly how to state the environment for catathesis.

The descriptive generalization is of course that accented words trigger catathesis and unaccented words do not. We consider here how this generalization ought to be stated formally.

One possibility is to make catathesis directly dependent on the presence of an accent.[15] This proposal is obviously observationally adequate, but there are a number of reasons for favoring the alternatives. First, it requires reference to diacritic accents, which, we have argued, is to be avoided if possible, and which on the best theory are not available. Second, it forces us to state the environment for catathesis in Japanese in a manner certainly different from that of other languages that exhibit catathesis. The majority of languages in which catathesis is described are true tone languages, not pitch accent languages, so there is no question of stating the environment for catathesis in terms of accents in these languages. If we hope to develop a universal theory of the occurence of catathesis, we must avoid recourse to accents.

The alternative is of course reference to the tonal string, and here we encounter again the problem of the representation of the high stretch of unaccented words. We will consider

[15] This possibility is not eliminated by the argument I have given against accent reduction. Catathesis could be triggered by diacritic accents but apply to tones or tonal registers. This may seem odd, but it is conceivable.

each of the three possible representations in turn.

Consider first the case where unaccented words are considered to have High tones. In this case, catathesis takes place following a HL sequence, and not following a lone H. This is reminiscent of the typical environment for catathesis in African languages, a HL transition. The interesting fact is that the Low tone inserted by Initial Lowering on the second word does not make any difference. That is to say, catathesis occurs in the environment HL%(L)X, but not in the environment H%(L)X.[16] This is not what we expect, if catathesis occurs at any HL transition, as it must on the accounts of the mechanism of catathesis that involve the more severe constraints on locality.

One way to account for the fact that a Low due to Initial Lowering has no effect is to make the environment for catathesis local in such a way as to prevent the rule from seeing the Low tone in the following minor phrase. This can be done in several ways. One way that is attractive is to make the domain (in terms of its structural description) of the catathesis rule the minor phrase, rather than the major phrase. In this case, an accented word will contain a visible HL sequence and so trigger catathesis, while an unaccented word will contain only a H tone, the L on the following word being invisible, and so will fail to trigger catathesis. In this case catathesis must involve some notion of register, since there must be something for the minor phrase level catathesis rule to lower that is propagated into the following minor phrase.

If we say that unaccented words have no tone, then unaccented words will fail to trigger catathesis because they do not initiate a HL sequence, so stating the environment is not problematic. On this account too some notion of register is essential, since unaccented words undergo catathesis. Insofar as unaccented words are toneless, but rather ride on the reference line (i.e. High register), there must be a register to be depressed.

Finally, consider the approach under which unaccented words are considered to bear Mid tones. As I have noted, this is the least plausible of the various accounts of the

[16] I use % to represent minor phrase boundary.

representation of unaccented words. On this account, unaccented words will fail to trigger catathesis because they contain no HL transition, but only an ML transition. On this account, no register is required, but a two-tone window is required to allow the catathesis rule to distinguish between HL and ML.

To summarize, no matter which account of the representation of unaccented words we choose, it is impossible to account for the different behaviour of accented and unaccented words within a strictly local model of catathesis that provides for the computation of the value of each tone only on the basis of the preceding tone. Moreover, on the two more plausible accounts of the representation of unaccented words, catathesis must involve register shift, rather than a strictly local tonal implementation rule.

Another question cncerns where catathesis occurs. I have repeatedly indicated that it occurs at a HL transition, but it is necessary to specify whether it happens before, during, or after this sequence of tones. The first possibility may be dismissed without further ado, since it amounts to accented words depressing themselves, the result of which would be that accented words would be systematically lower than unaccented words when in fact the contrary is the case. The evidence available to us does not provide strong evidence for distinguishing between the two latter hypotheses, but there is a fact that bears on the issue. Although I have not presented sytematic data on this point, it is nonetheless true that a post-accentual Low tone is noticeably lower than the Low the begins the same minor phrase. This may be seen in the various F0 contours presented above, as well as in the measurements of the word *nomi'mono* presented in Chapter I. While there may well be other adequate accounts of this phenomenon, this is just what we would expect if catathesis took place at the transition between the High and the Low, so that the Low tone that plays a role in triggering catathesis would be the first tone to undergo it. Notice that if this proposal is correct we must make use of register shift, since computing the value of the Low on the basis of the preceding tone, the High, will not lower the Low.

The evidence available to us thus argues in favor of a model containing at least a declination curve and a form of catathesis. In addition to declination, it is suggested that there are major phrase final boundary tones which account for the three different shapes of the declination curve at the end of a major phrase. Catathesis applies repeatedly, from left to right, to all tones. Catathesis is best implemented as a register shift that occurs at the boundary between the triggering High and Low.

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Average values of F0 peaks on syllables [ru], [ma], and [mi] in utterances Nine and Twelve of Dataset III.

Fig. 5.23
A typical F0 contour of the sentence [sore wa nuru'i uma'i nomi'mono] produced with declarative intonation. The lower three traces are the first three log-area linear prediction coefficients.

Fig. 5.24
A typical F0 contour of the sentence [sore wa nuru'i uma'i nomi'mono] produced with interrogative intonation. The lower three traces are the first three log-area linear prediction coefficients.

Fig. 5.25
A typical F0 contour of the sentence [sore wa amai omoi marui momo] produced with declarative intonation. The lower three traces are the first three log-area linear prediction coefficients.

Fig. 5.26
A typical F0 contour of the sentence [sore wa amai omoi marui momo] produced withinterrogative intonation. The lower three traces are the first three log-area linear prediction coefficients.

Fig. 5.27
A typical F0 contour of the sentence [sore wa amai ao'i kudamono da] spoken without emphasis on [ao'i]. The lower trace is the first log-area linear prediction coefficient.

Fig. 5.28
A typical F0 contour of the sentence [sore wa amai ao'i kudamono da] spoken with emphasis on [ao'i]. The lower trace is the first log-area linear prediction coefficient.

Fig. 5.29
A typical F0 contour of the sentence [sore wa uma'i ao'i kudamono da] spoken without emphasis on [ao'i]. The lower trace is the first log-area linear prediction coefficient.

Fig. 5.30
A typical F0 contour of the sentence [sore wa uma'i ao'i kudamono da] spoken with emphasis on [ao'i]. The lower trace is the first log-area linear prediction coefficient.

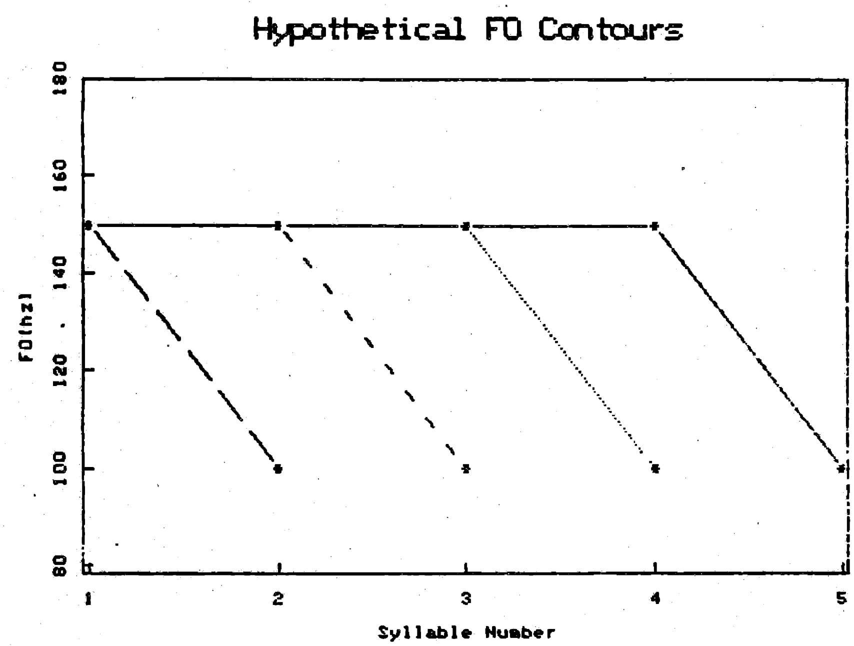

Hypothetical F0 Contours
F0(hz)
80
100
120
140
160
180
1
2
3
4
5
Syllable Number

FIG. 5.1

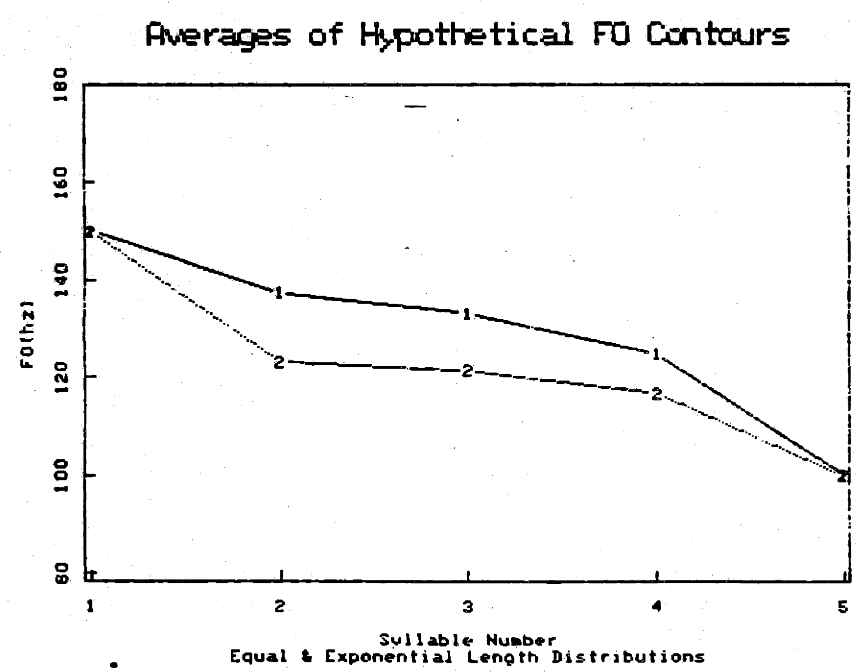
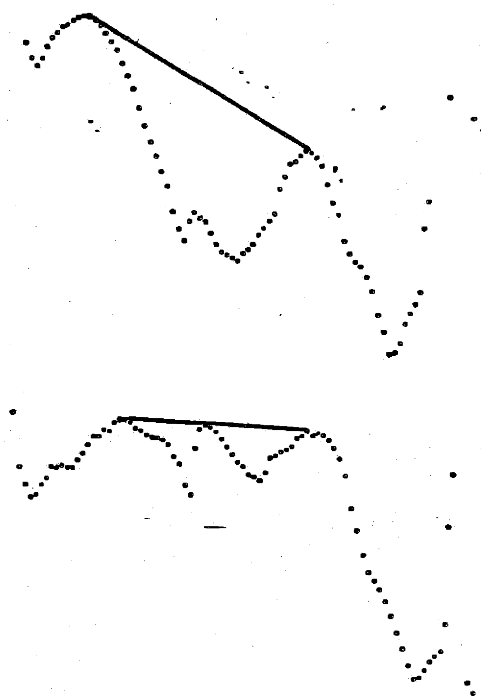

Averages of Hypothetical F0 Contours
F0(hz)
80
100
120
140
160
180
1
2
3
4
5
Syllable Number
Equal & Exponential Length Distributions

FIG. 5.2

BIP4/m1/usr2/ym1/P4
yonde mīru



yonde mīru
BIP4/m1/usr2/ym2/P3

FIG. 5.3

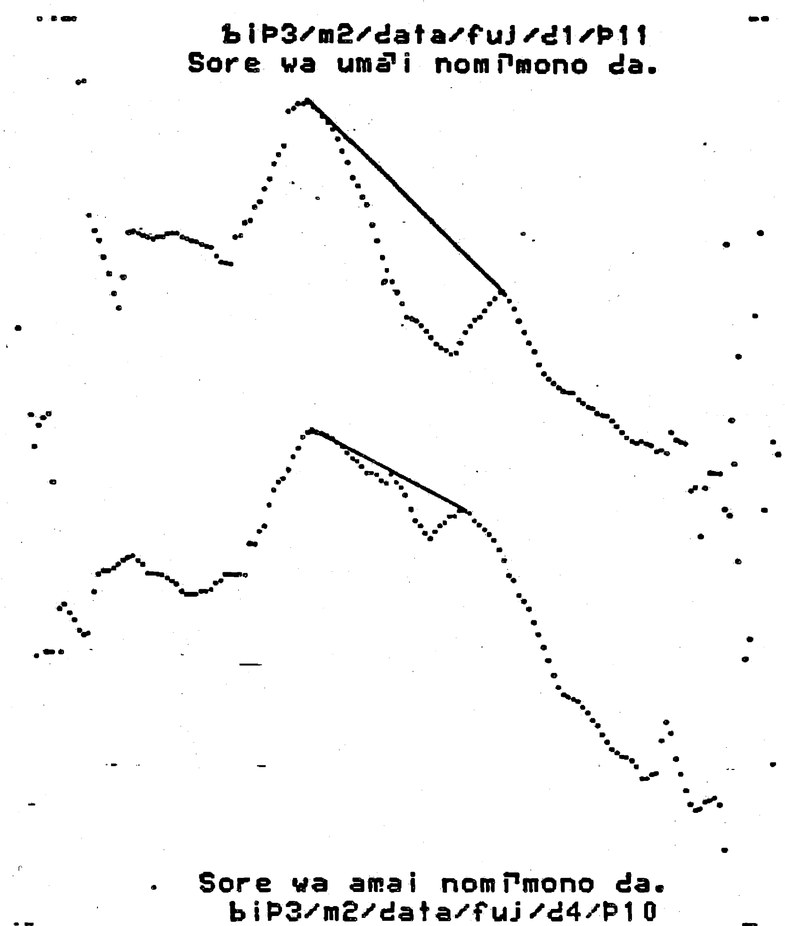

biP3/m2/data/fuj/d1/P11
Sore wa uma˥i nom˥mono da.
Sore wa amai nom˥mono da.
biP3/m2/data/fuj/d4/P10

FIG. 5.4

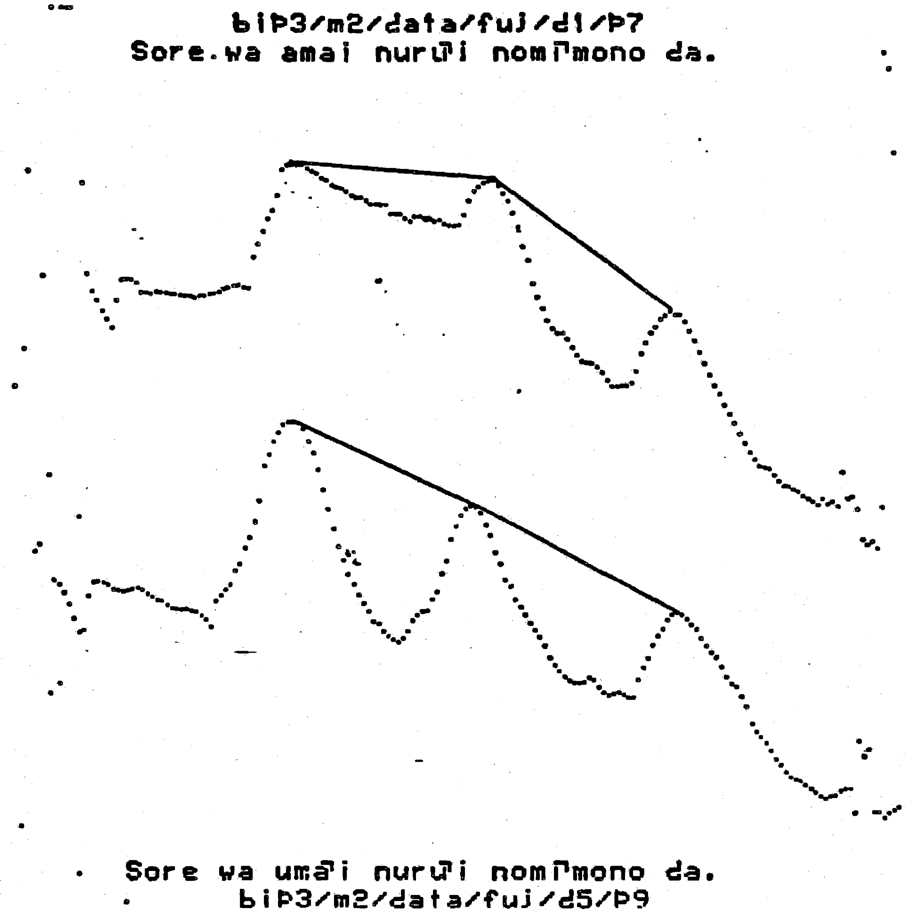

bip3/m2/data/fuj/d1/p7
Sore.wa amai nuru⌝i nom⌝mono da.
Sore wa uma⌝i nuru⌝i nom⌝mono da.
bip3/m2/data/fuj/d5/p9

FIG. 5.5

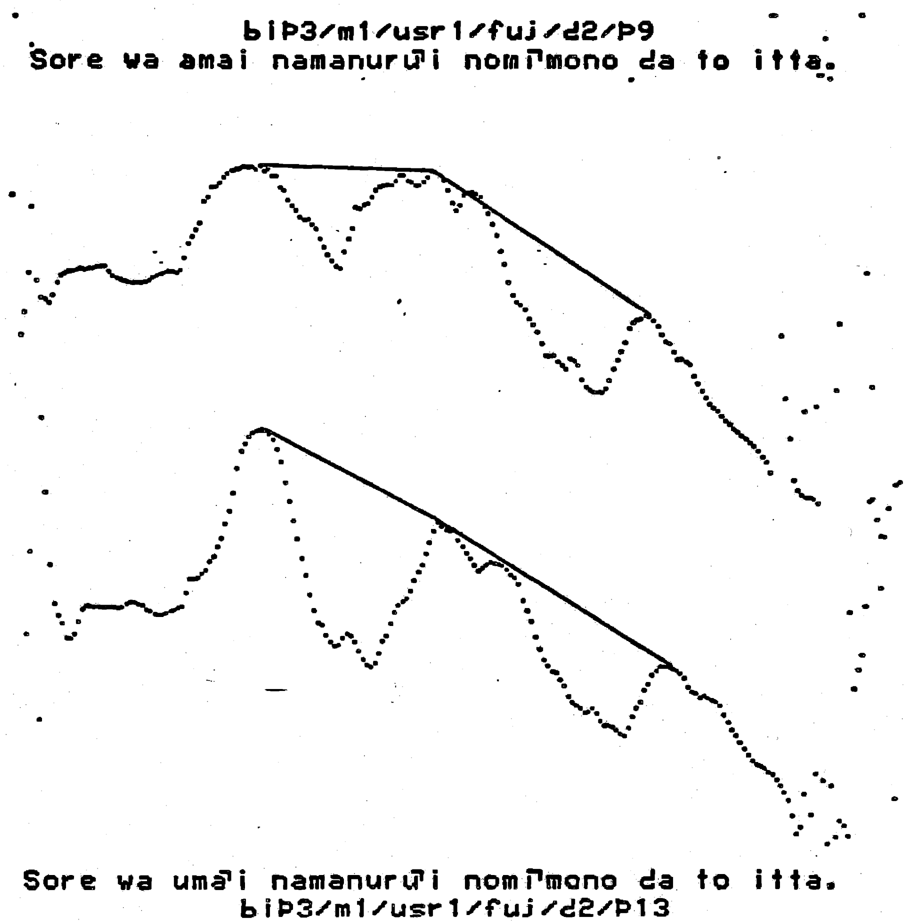

bip3/m1/usr1/fuj/d2/p9
Sore wa amai namanuru⁷i nomi⁷mono da to itta.
Sore wa uma⁷i namanuru⁷i nomi⁷mono da to itta.
bip3/m1/usr1/fuj/d2/p13

FIG. 5.6

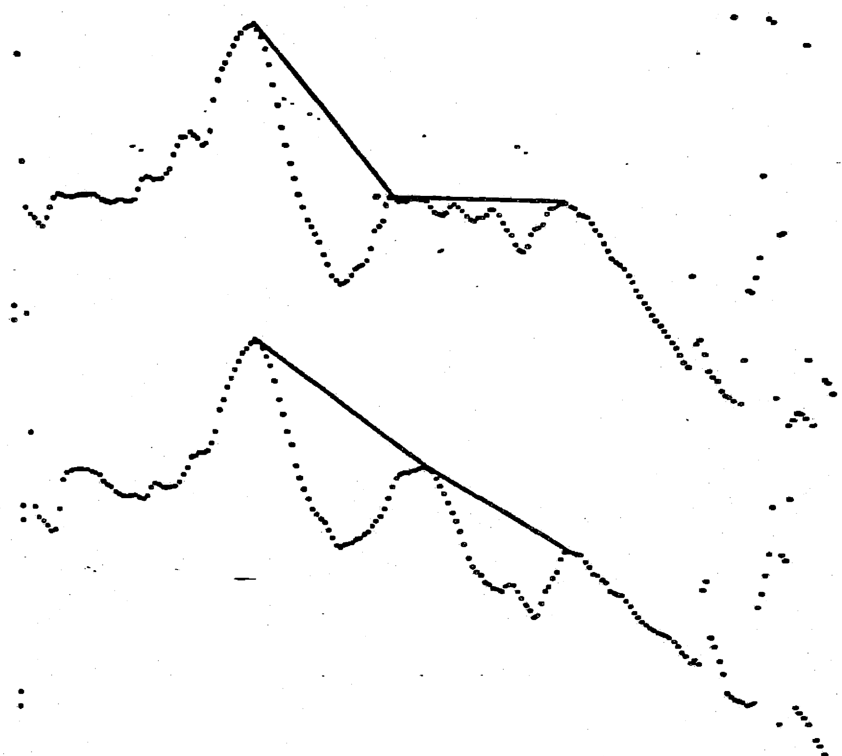

biP3/m1/usr1/fuj/d2/P11
Sore wa nuruʔi amai nomʔmono da to itta.
Sore wa nuruʔi umaʔi nomʔmono da to itta.
biP3/m1/usr1/fuj/d2/P6

FIG. 5.7

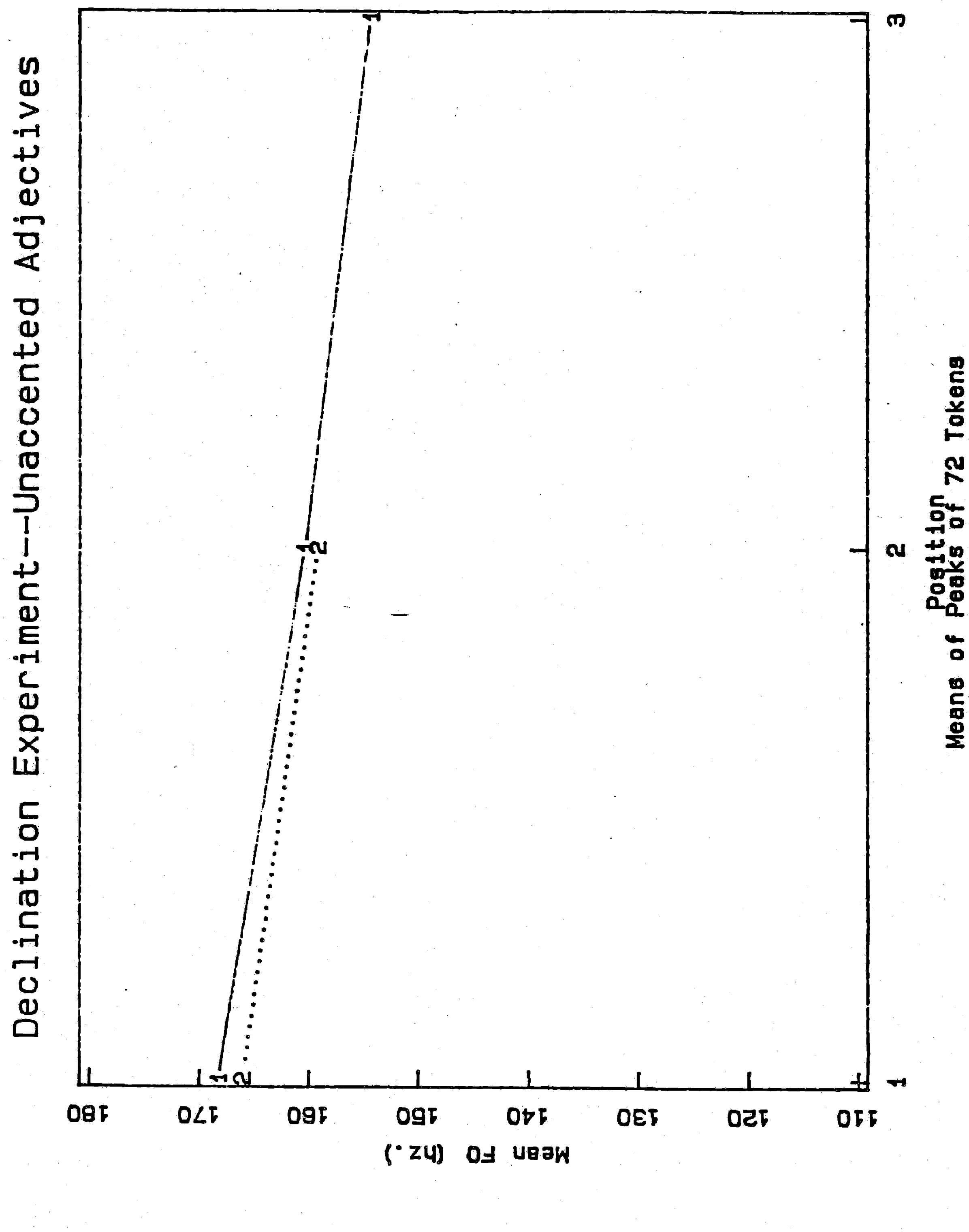
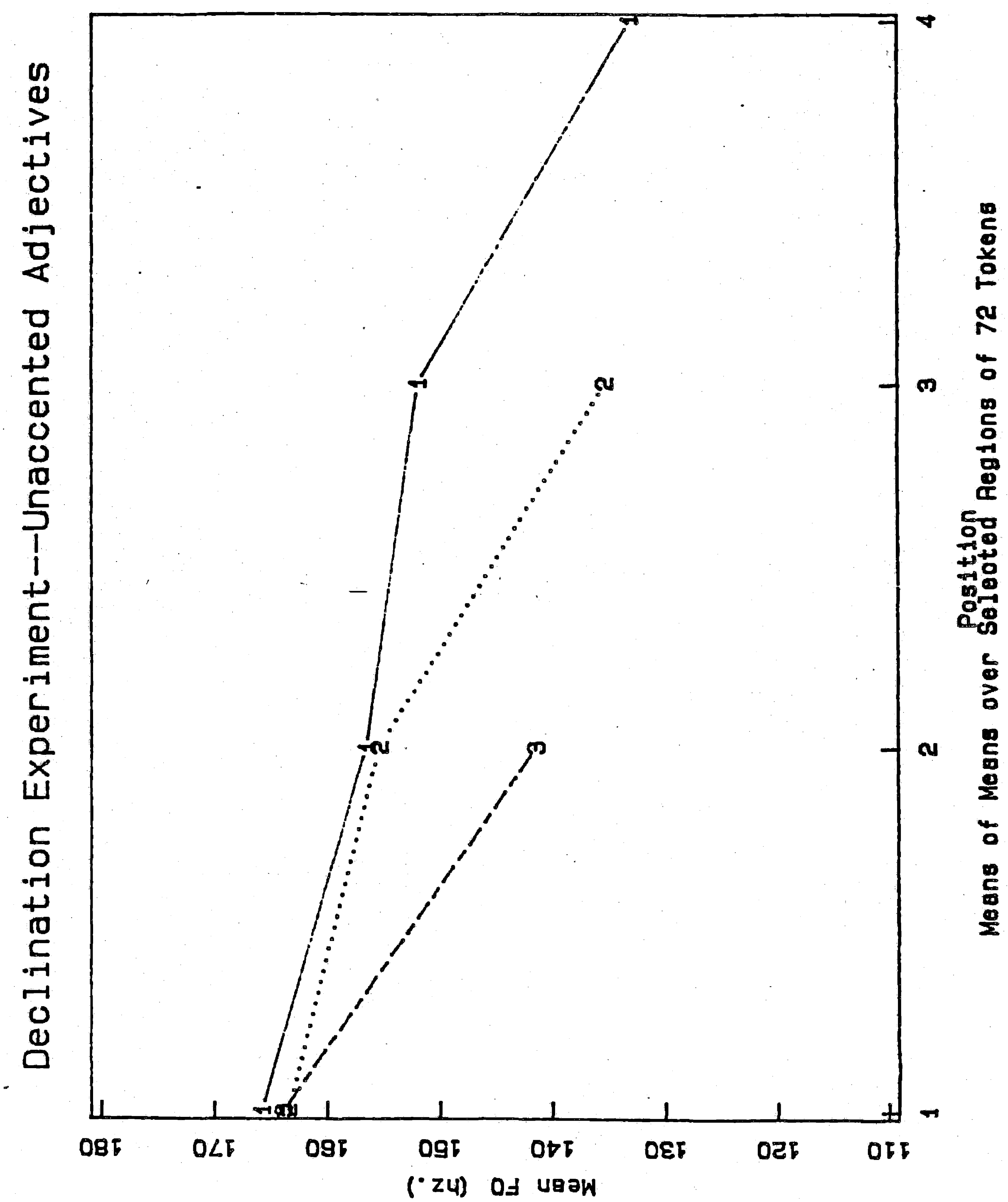

Declination Experiment--Unaccented Adjectives
Mean F0 (hz.)
110
120
130
140
150
160
170
180
1
2
3
Position
Means of Peaks of 72 Tokens

FIG. 5.8



Declination Experiment--Unaccented Adjectives
Mean F0 (hz.)
180
170
160
150
140
130
120
110
Position
Means of Means over Selected Regions of 72 Tokens
1
2
3
4

FIG. 5.9

BIP4/m1/usr1/nonsense/P2
awa⃓ ya ana⃓ ya ama⃓ ya ara⃓ ga aru

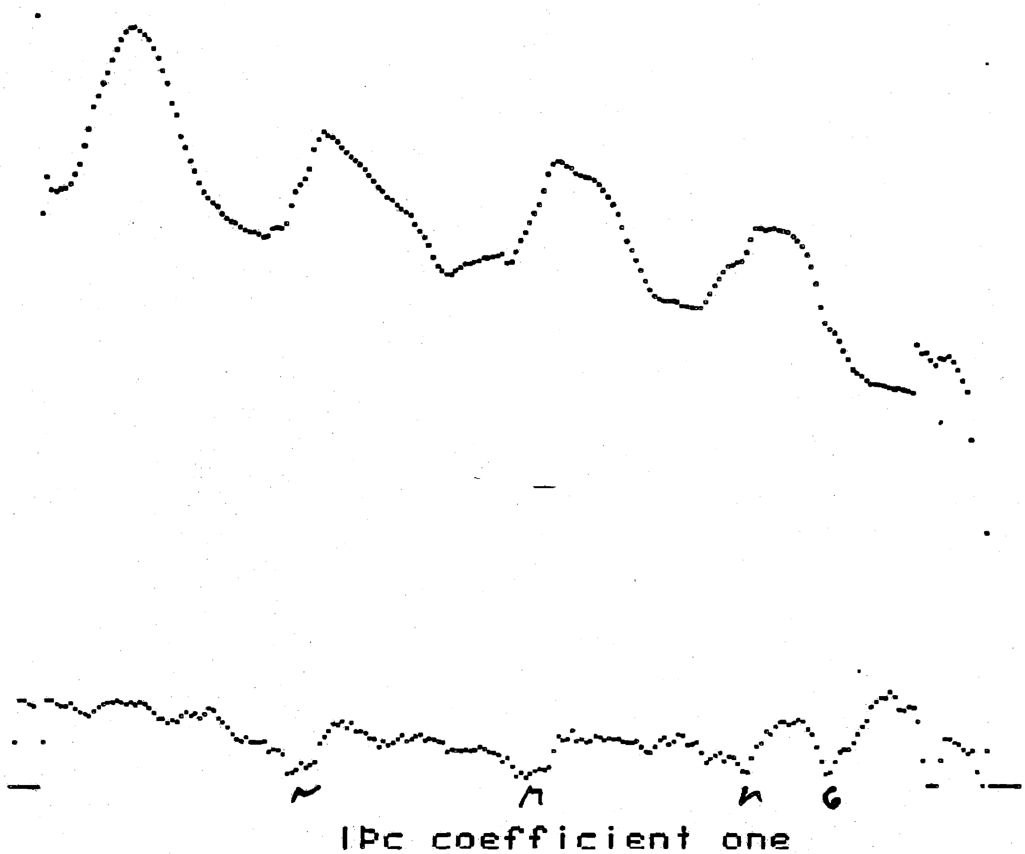
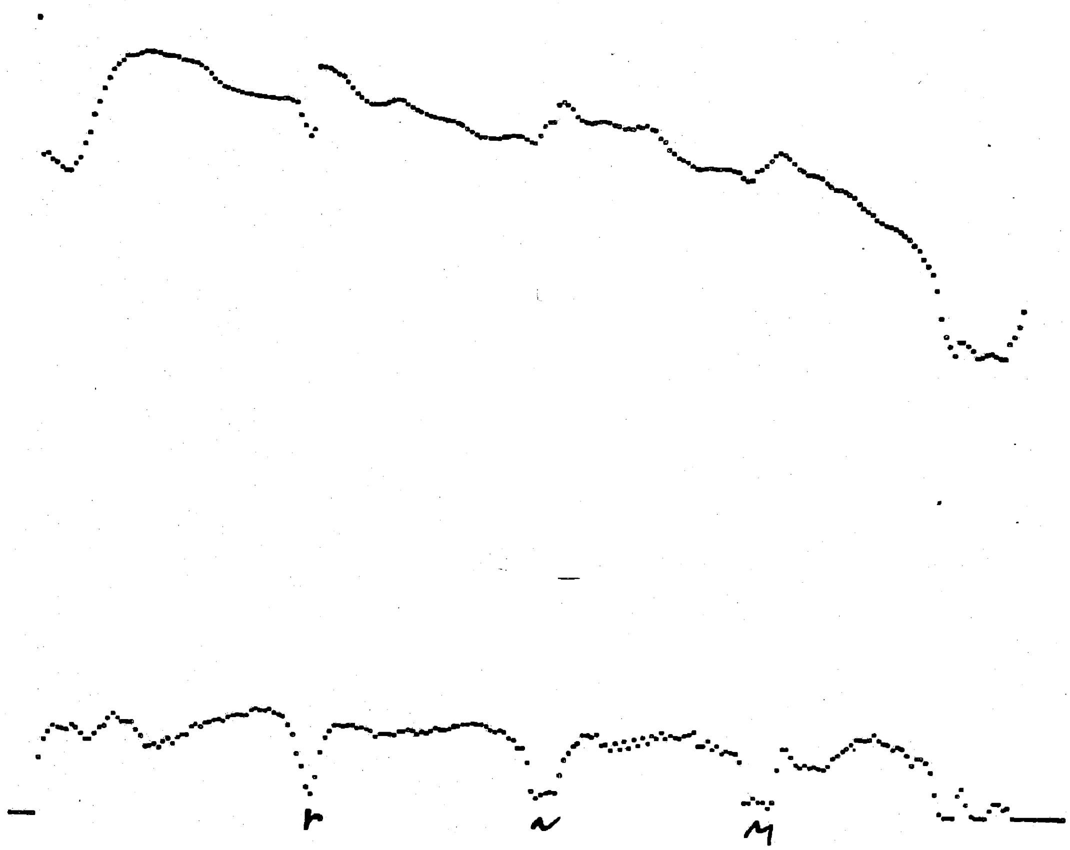


FIG. 5.10

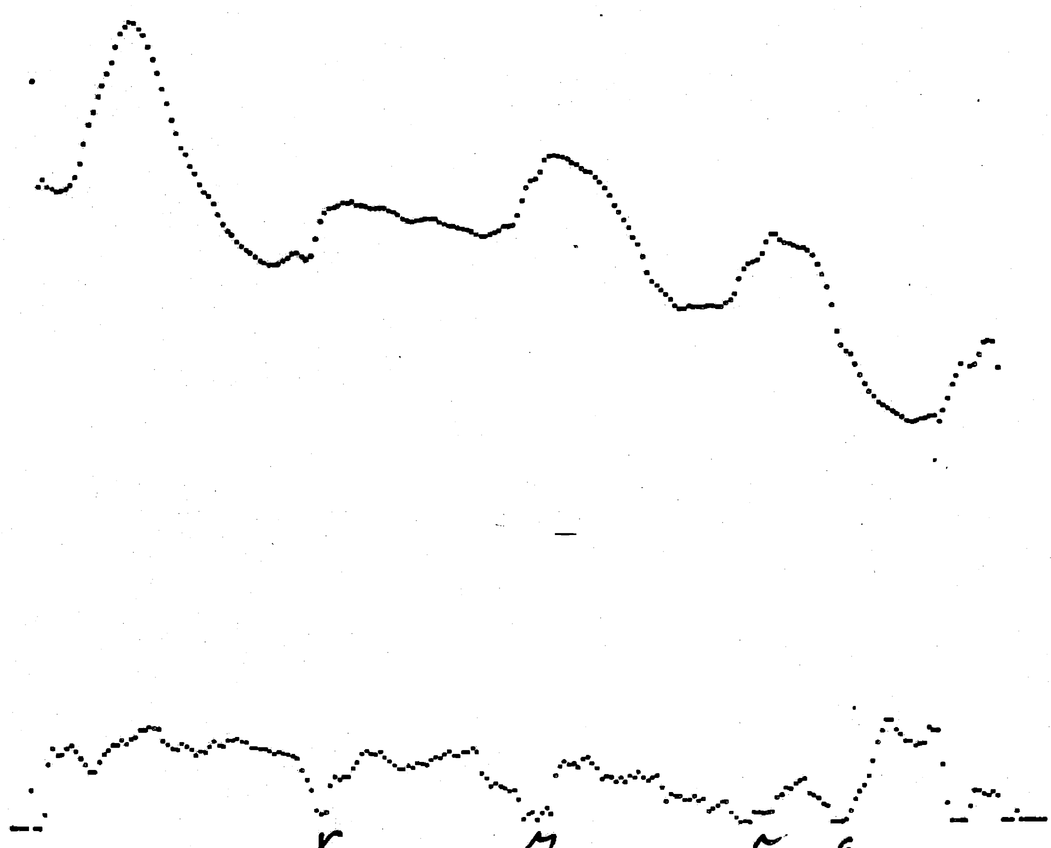
BIP4/m1/usr1/nonsense/p1
awa ya ara ya ana ya ama ga aru



lpc coefficient one

FIG. 5.11

BIP4/m1/usr1/nonsense/P3
awā ya ara ya amā ya anā ga aru



lpc coefficient one

FIG. 5.12

BIP4/m1/usr1/nonsense/P34
ara ya ama˥ ya awa˥ ya ana˥ ga aru

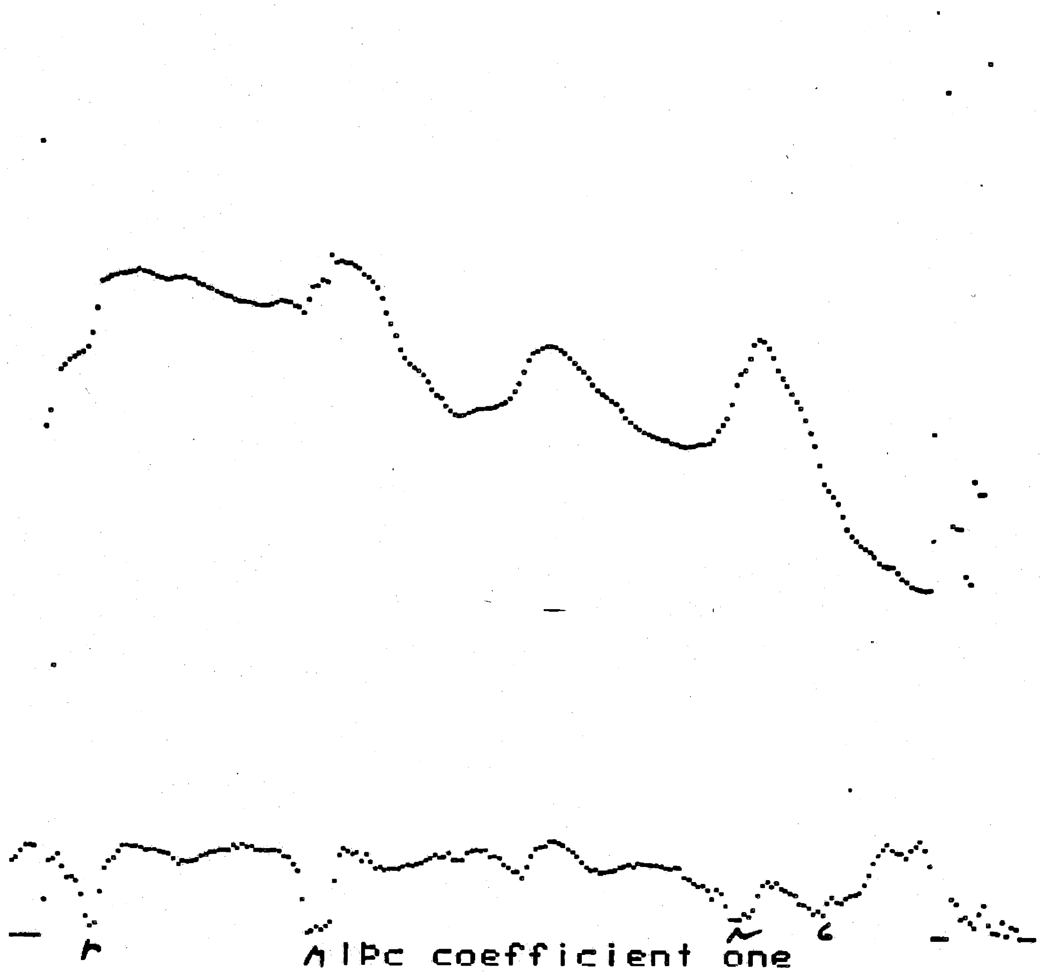
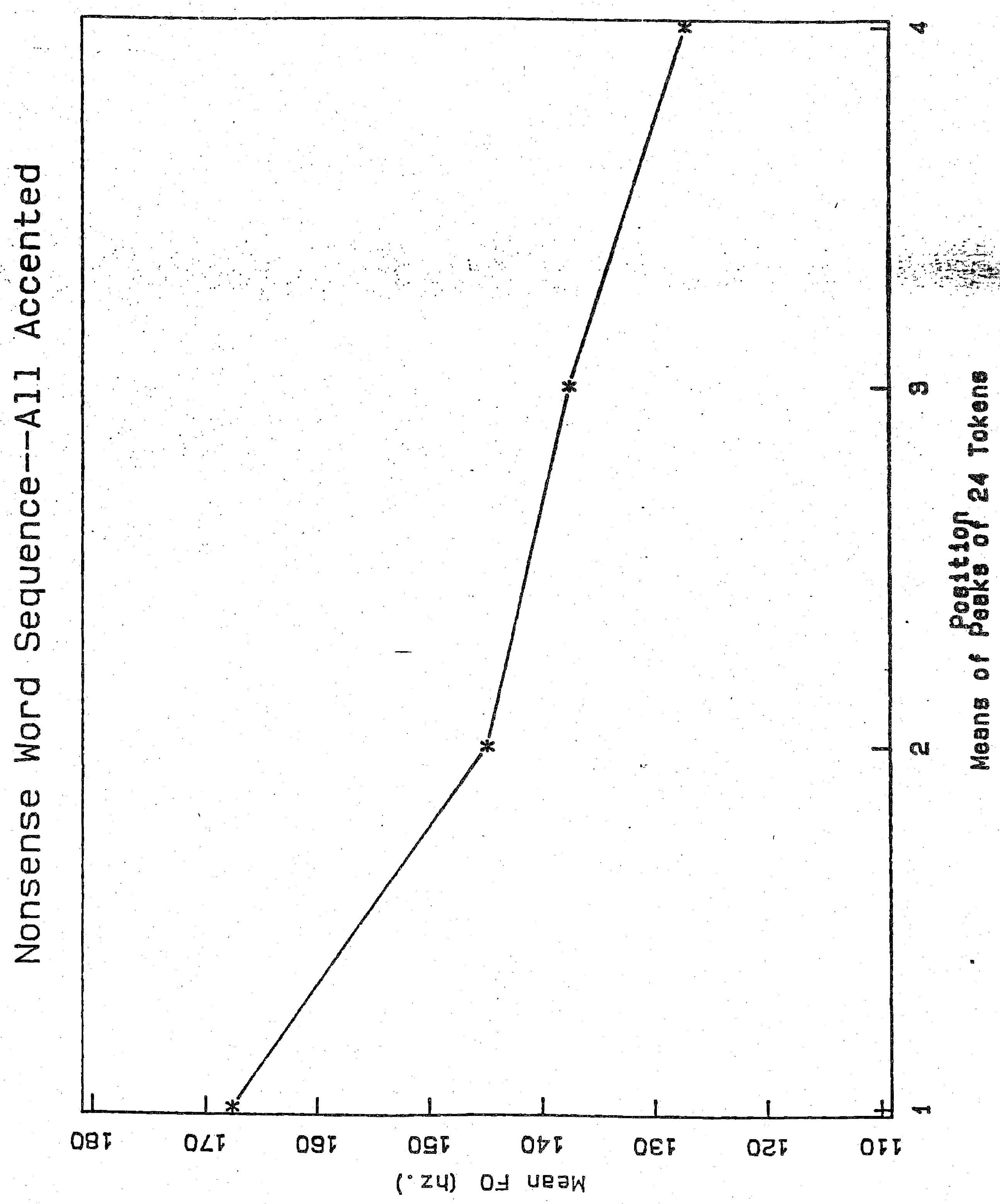
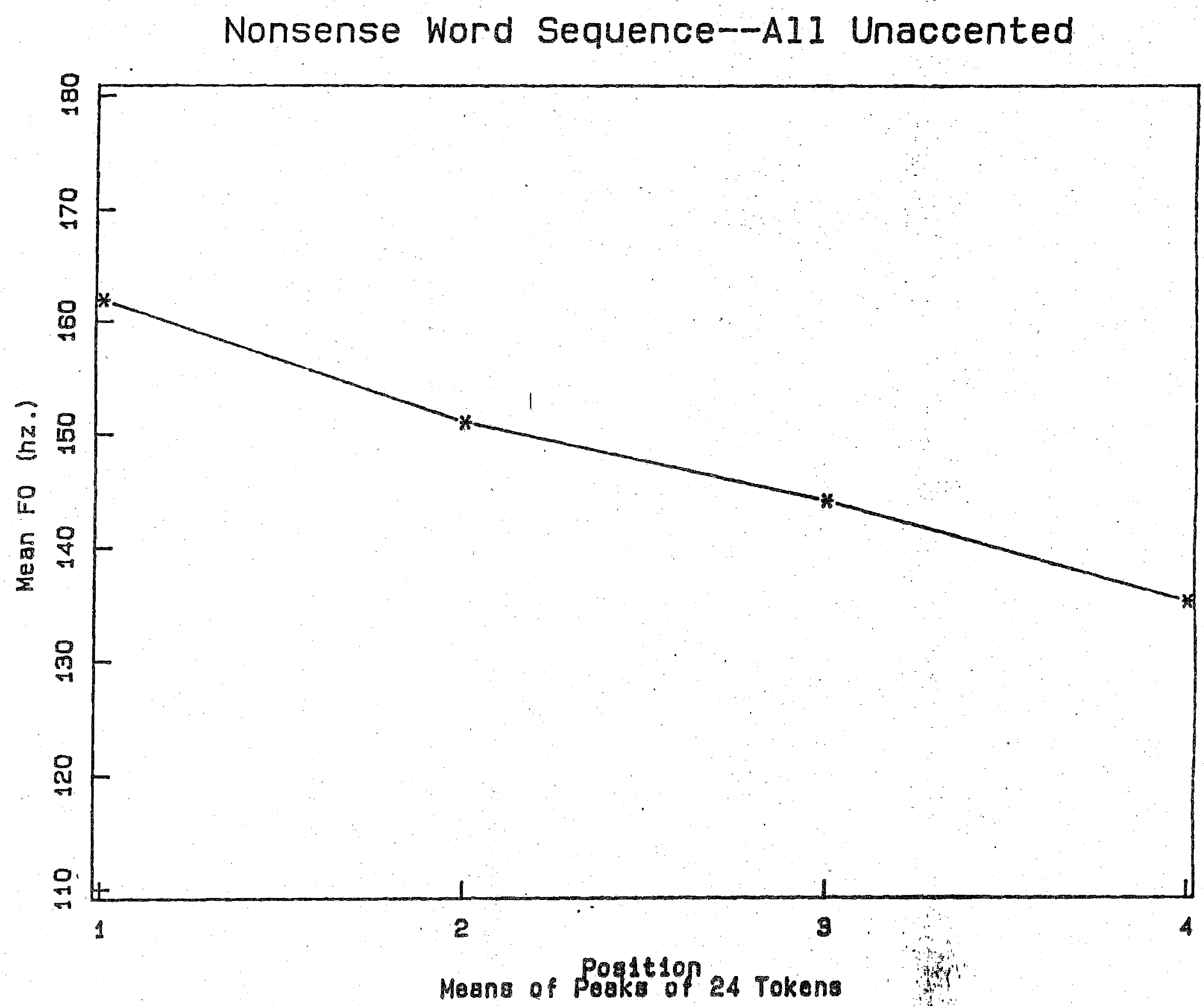


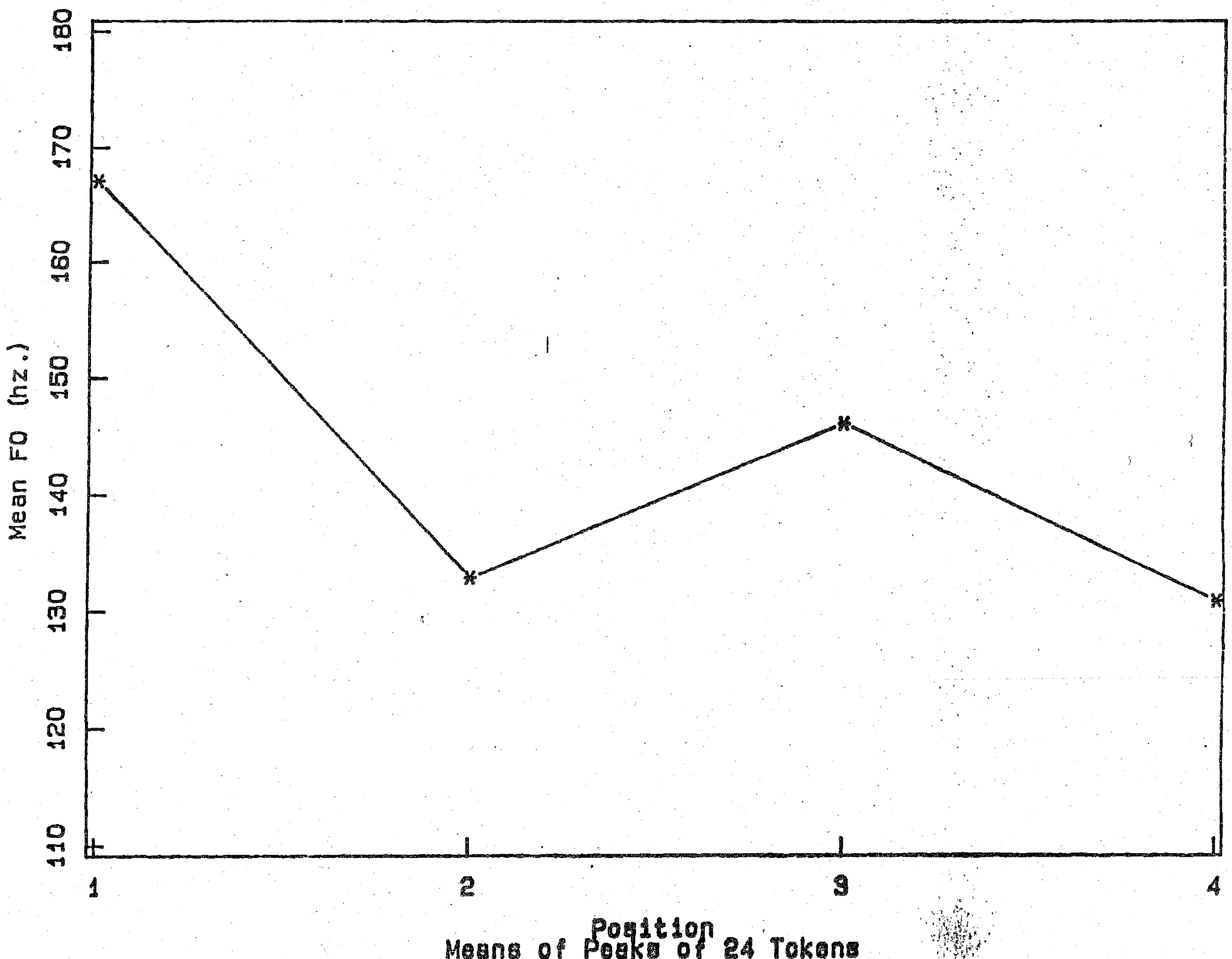
FIG. 5.13



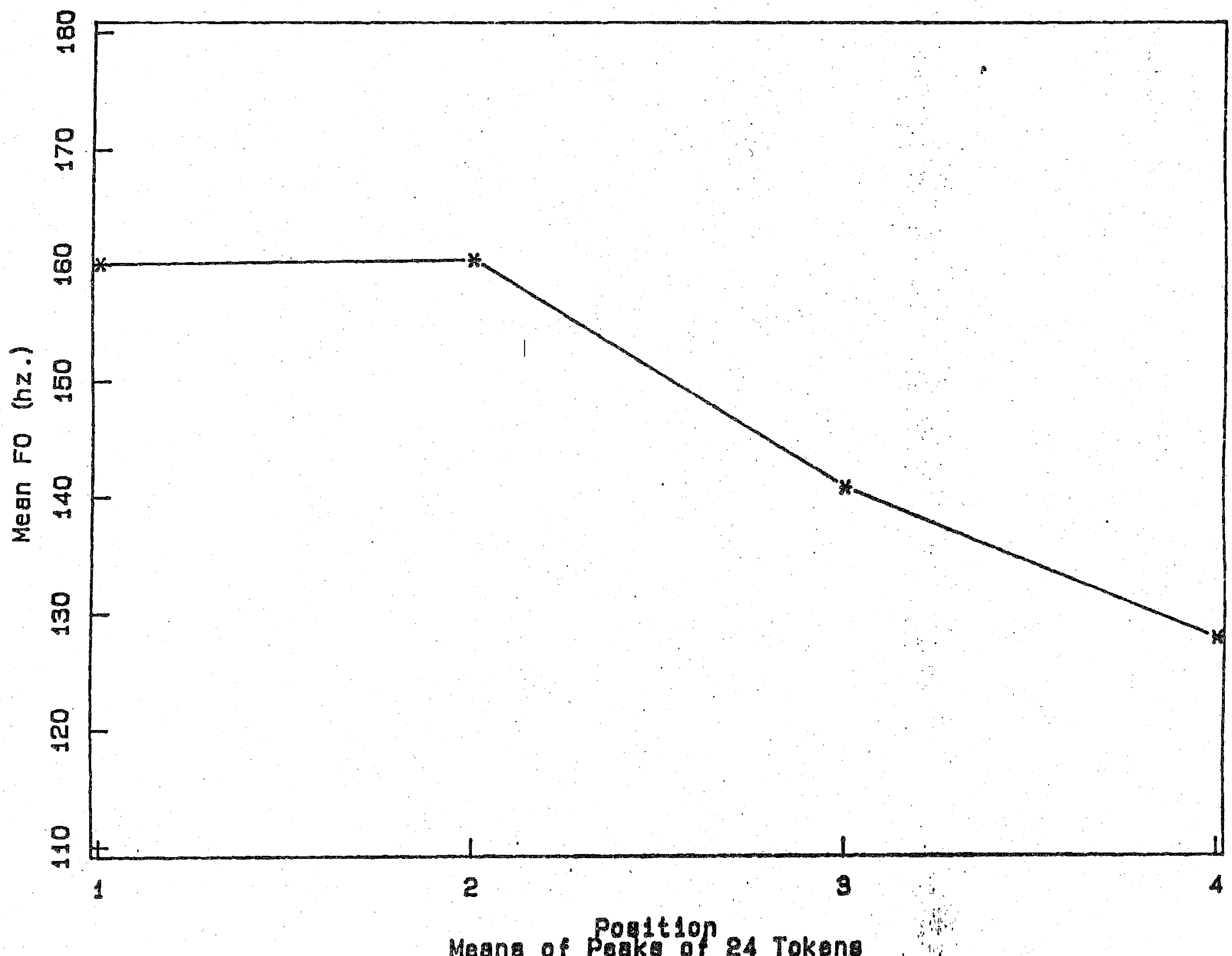
Nonsense Word Sequence--All Accented
Mean F0 (hz.)
180
170
160
150
140
130
120
110
1
2
3
4
Position
Means of Peaks of 24 Tokens


Nonsense Word Sequence--All Unaccented
Mean F0 (hz.)
180
170
160
150
140
130
120
110
1
2
3
4
Position
Means of Peaks of 24 Tokens

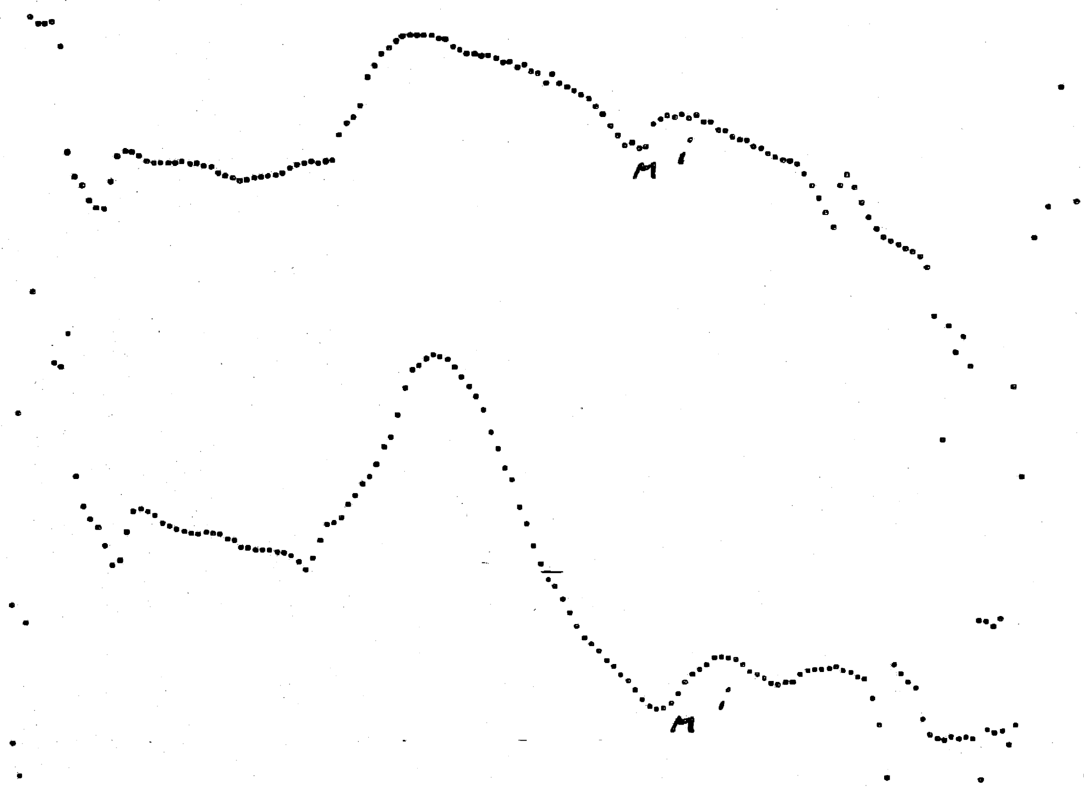
Nonsense Word Sequence--Second Unaccented



Nonsense Word Sequence--First Unaccented



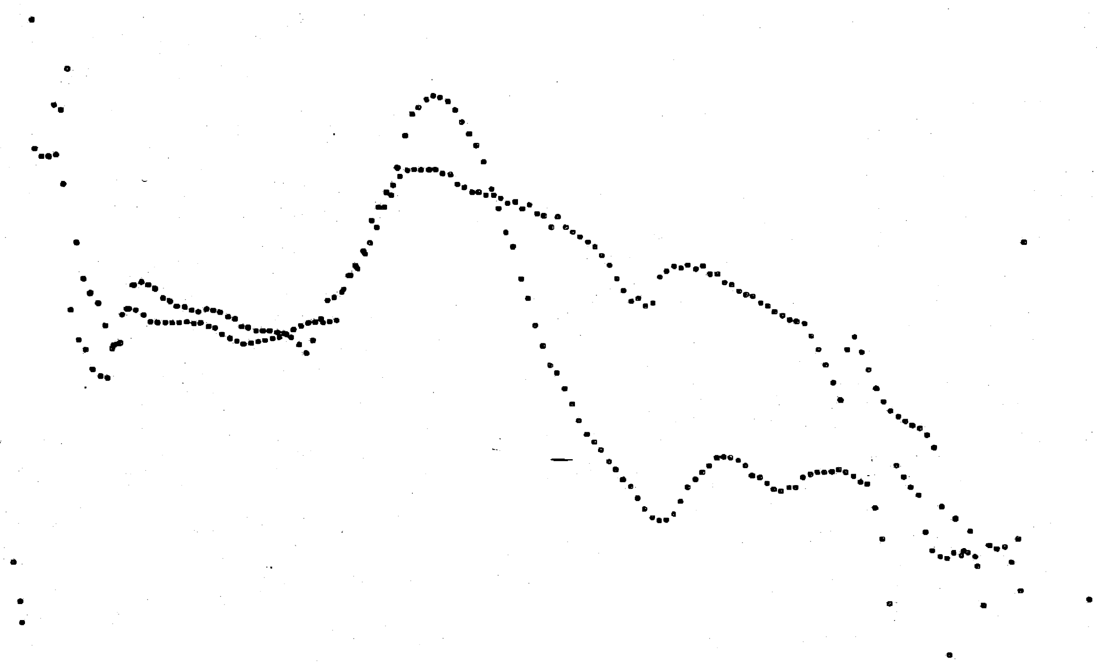
PdPdisc/11/usr3/bPmyl/d2/P9
Sore wa amai miriN da.



Sore wa uma⌝i miriN da.
PdPdisc/11/usr3/bPmyl/d2/P10

FIG. 5.18

PdPdisc/11/usr3/bPmyl/d2/P9
Sore wa amai miriN da.



Sore wa umai miriN da.
PdPdisc/11/usr3/bPmyl/d2/P10

Fig. 5.19

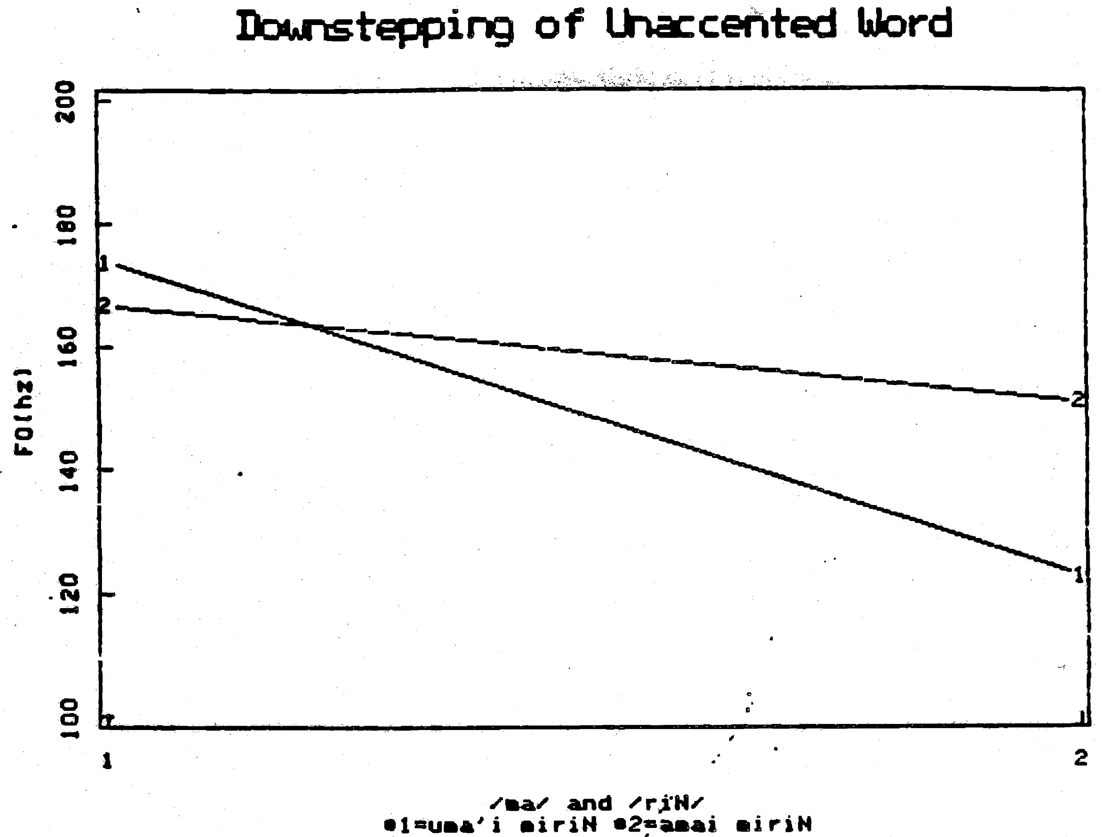


FIG 5.20

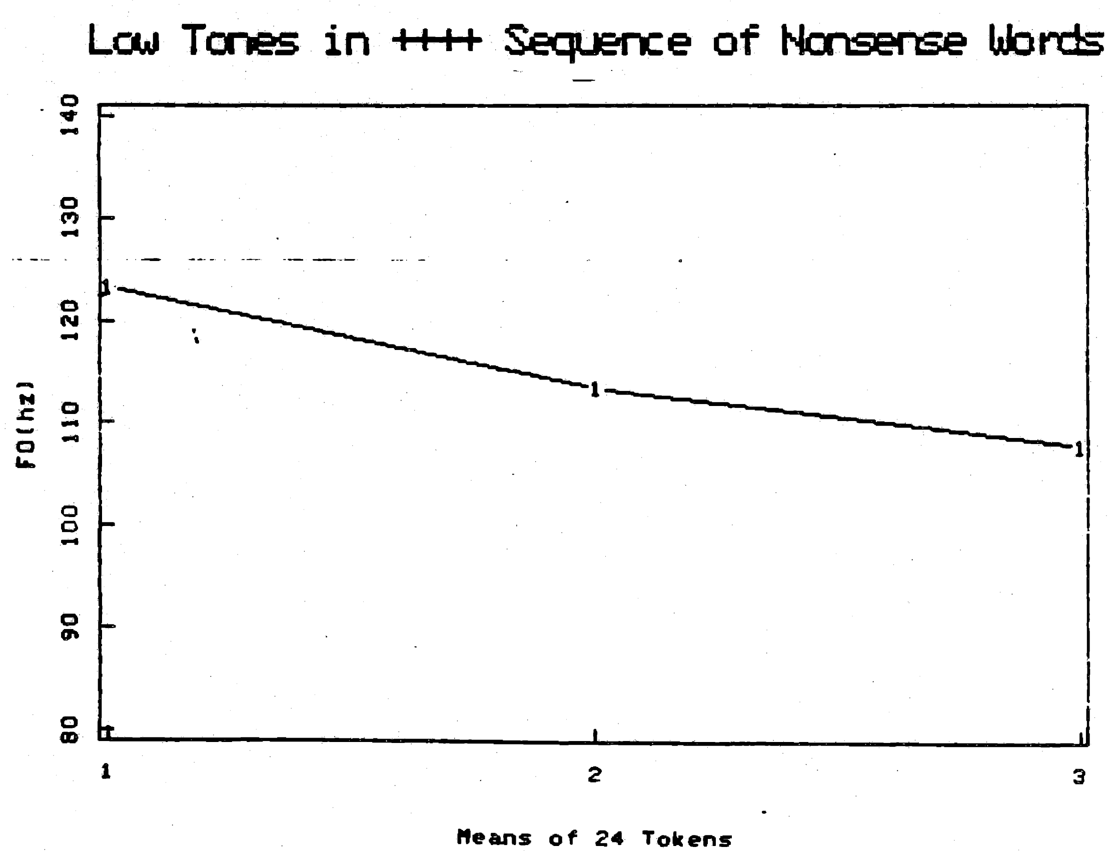


FIG. 5.21

Average F0 Contours of Utterances 9 and 12

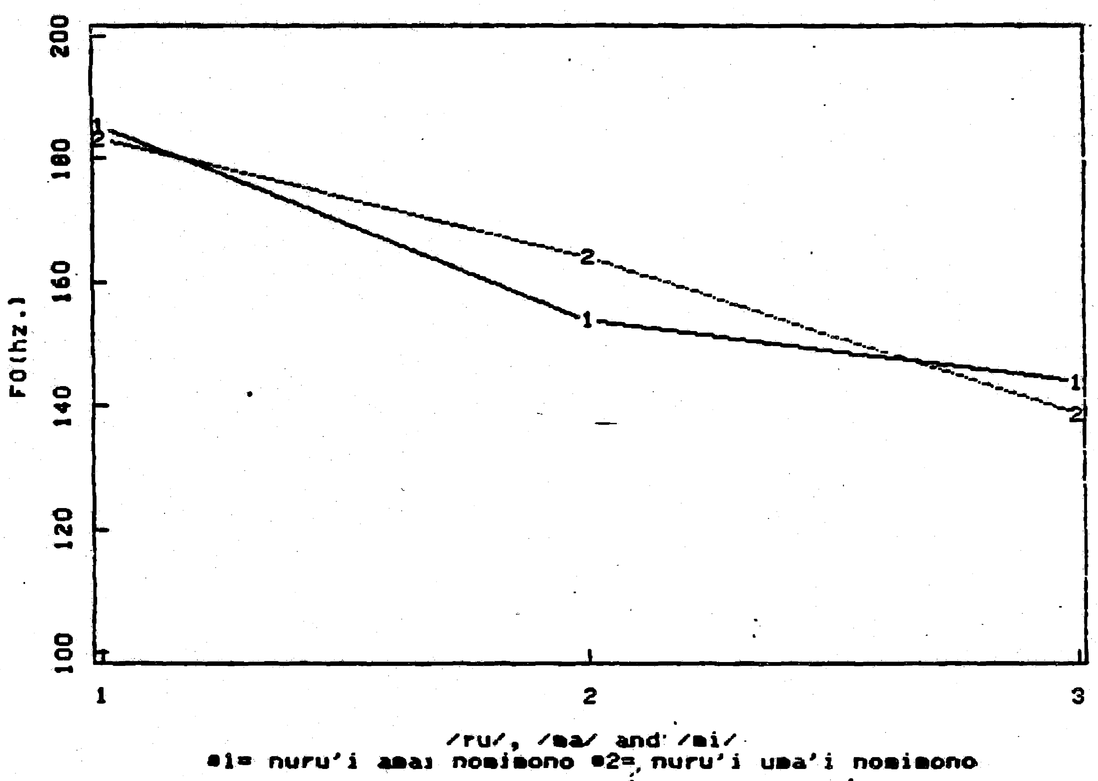


FIG. 5.22

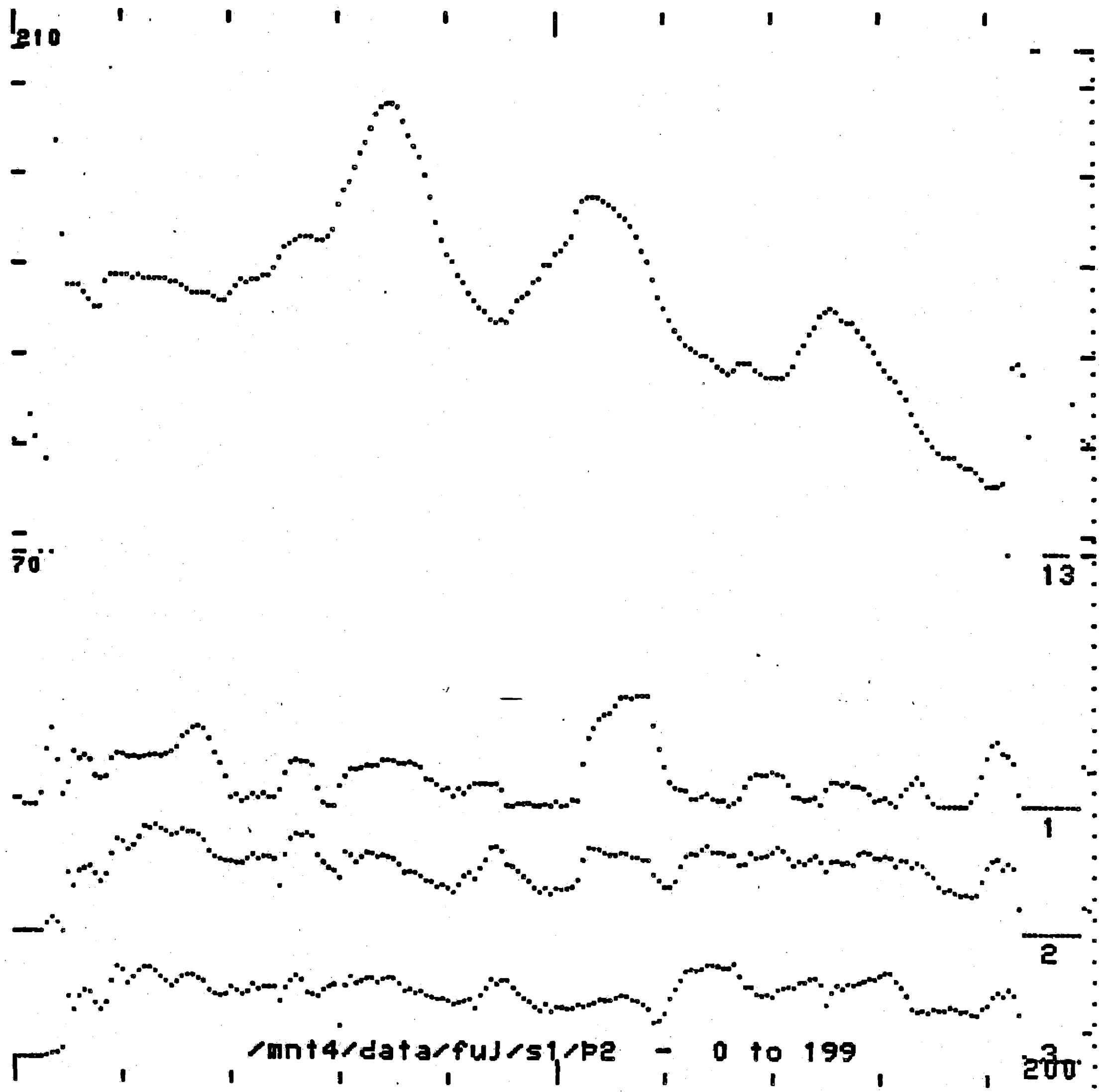


FIG. 5.23

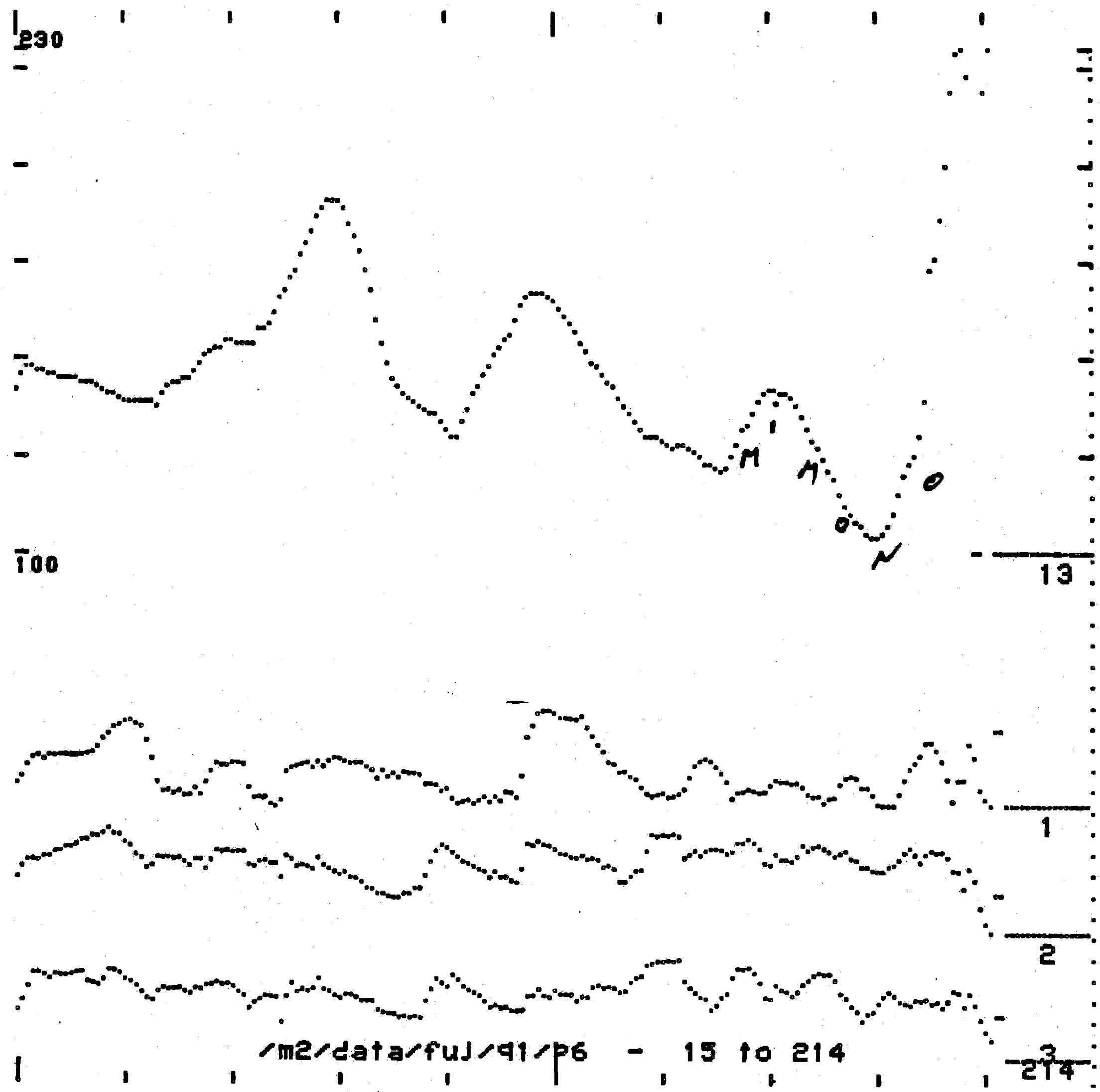


FIG. 5.24

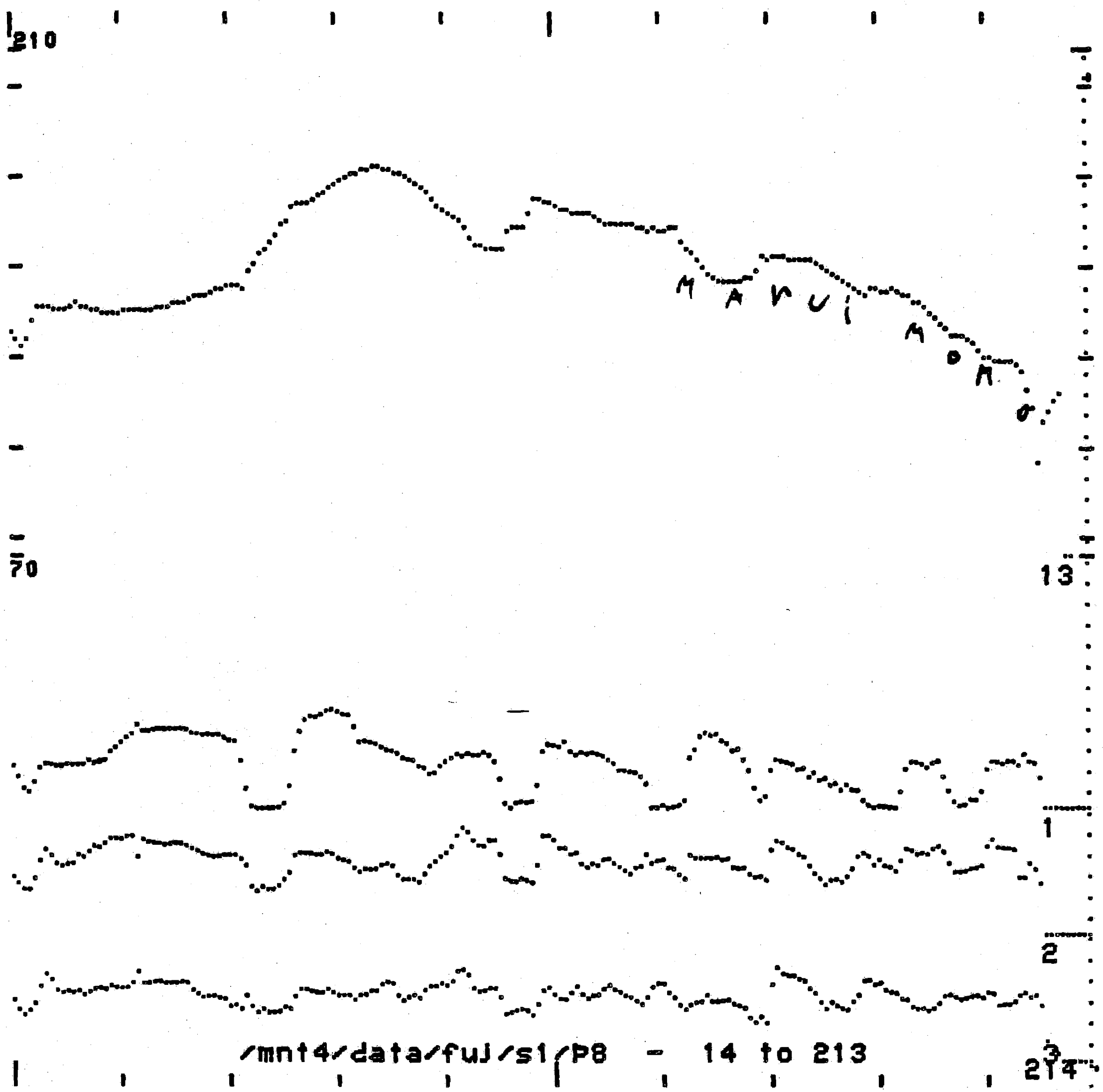


FIG 5.25

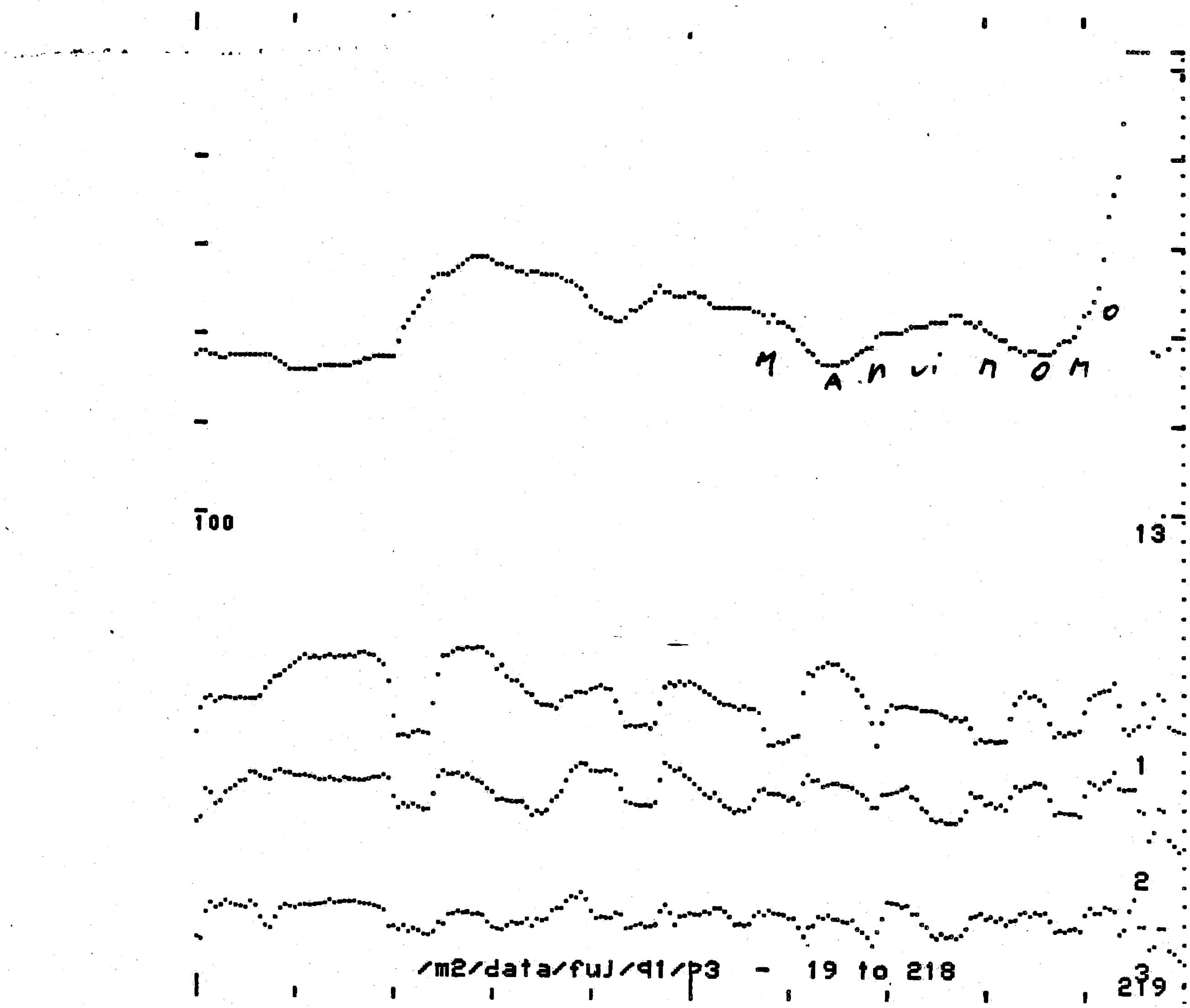
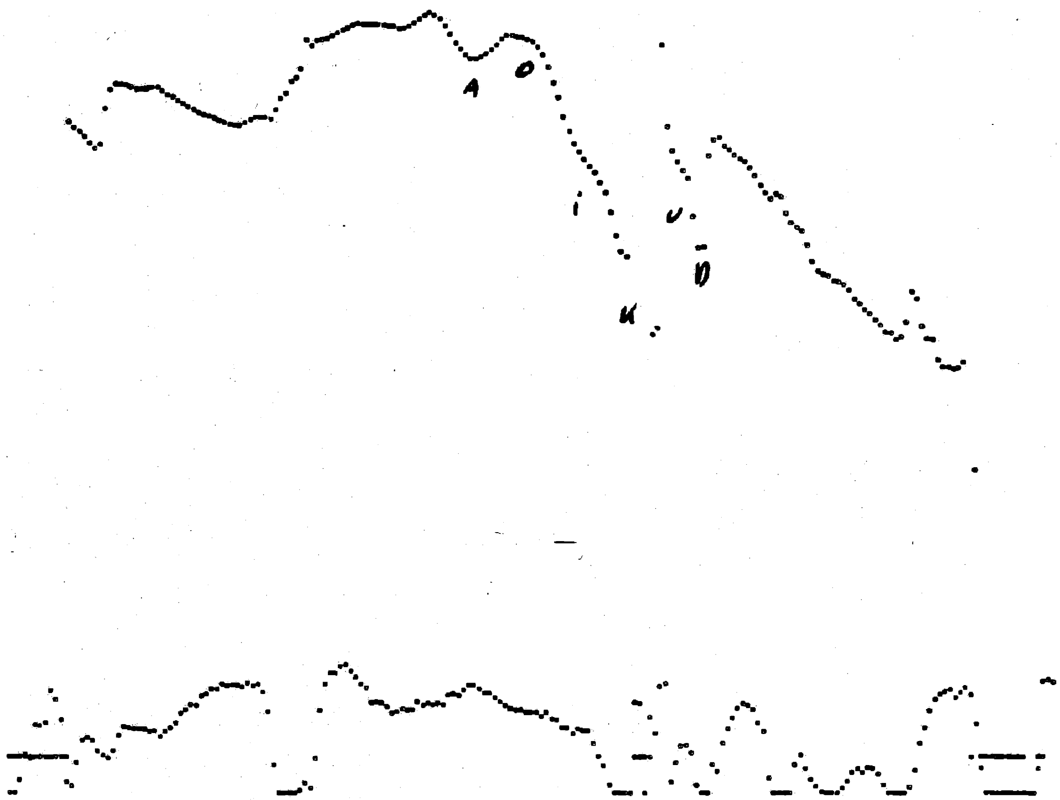


FIG. 5.26

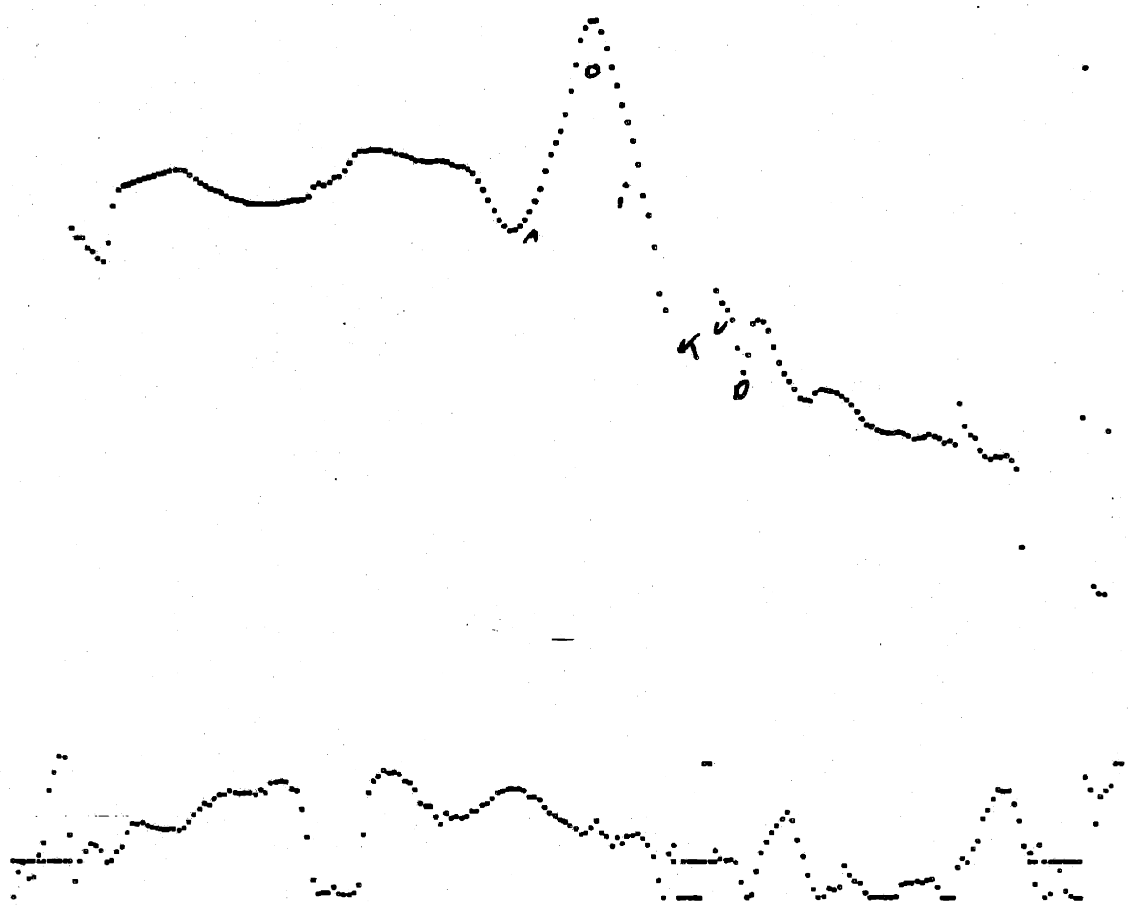
BIP4/m1/usr1/em10/P3
Sore wa amai ao⌉i kuda⌉mono da.



No emPhasis on ao⌉i.
lPc coefficient one

FIG. 5.27

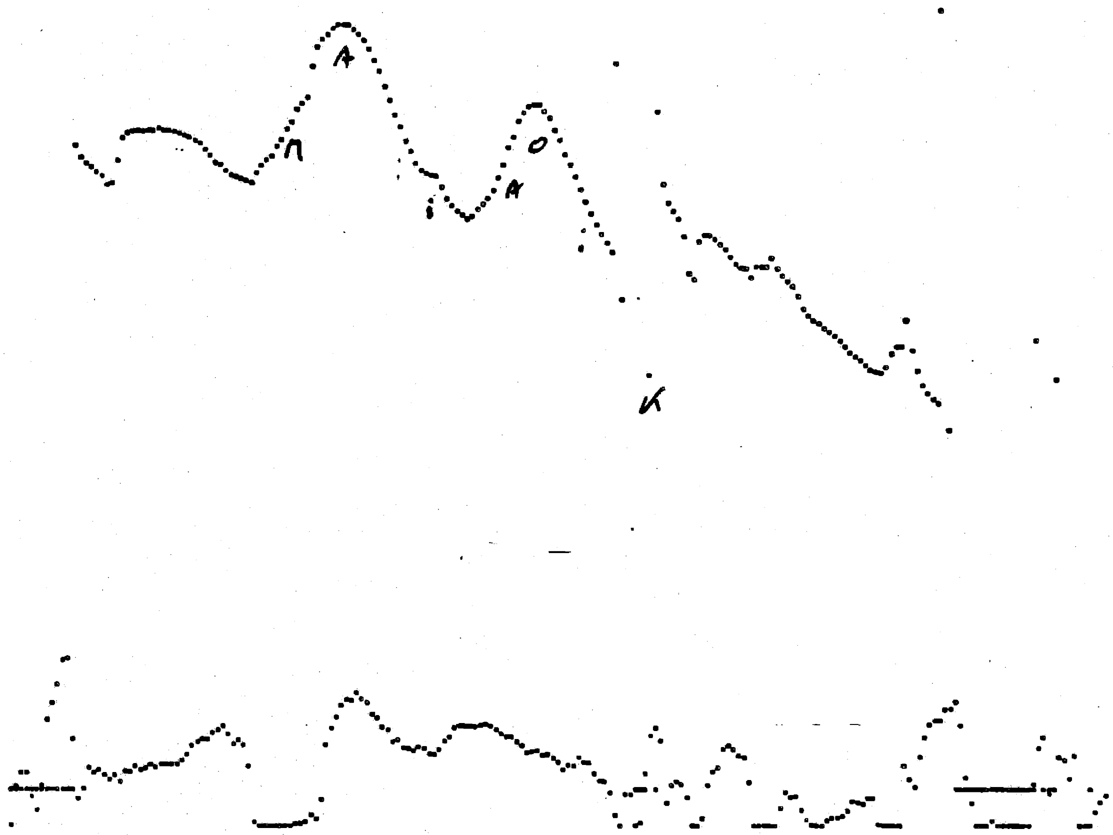
BIP4/m1/usr1/em1/P1
Sore wa amai aо̄i kudа̄mono da.



ao̅i emPhasized
lPc coefficient one

FIG. 5.28

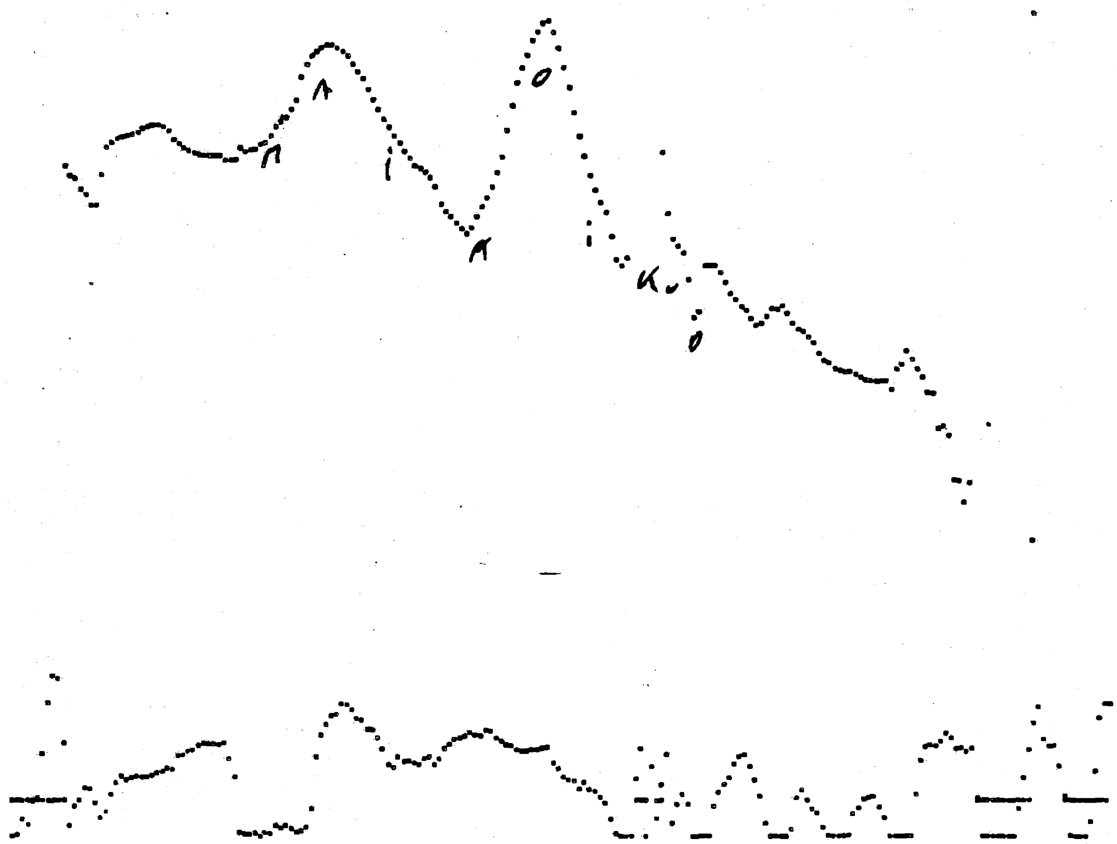
BIP4/m1/usr1/em10/p4
Sore wa umaꜜi aoꜜi kudaꜜmono da.



No emPhasis on aoꜜi.
lPc coefficient one

Fig 5.29

BIP4/m1/usr1/em9/P4
Sore wa umāi aōi kudāmono da.



aōi emphasized.
lpc coefficient one

Fig. 5.30

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ABBREVIATIONS:

ABRILP	Annual Bulletin of the Research Institute of Logopaedics and Phoniatrics, University of Tokyo.
GK	Gengo Kenkyuu
IJAL	International Journal of American Linguistics
JASA	Journal of the Acoustical Society of America
JASJ	Journal of the Acoustical Society of Japan
LI	Linguistic Inquiry
NELS	Proceedings of the North Eastern Linguistic Society
OGK	Onsei Gakkai Kaihoo
OK	Onsei no Kenkyuu
PIJL	Papers in Japanese Linguistics

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"On the Directionality of the Tone-Voice Correlation," *Linguistic Inquiry* 12.3.483-88. (1981)

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