SOME ASPECTS OF THE THEORY OF TONE WITH SPECIAL REFERENCE TO HAUSA

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

JUDITH MARIE MAXWELL

1976

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ABSTRACT

SOME ASPECTS OF THE THEORY
OF TONE WITH SPECIAL
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By

Judith Marie Maxwell

This thesis is concerned with the theoretical systems describing tone languages that have been developed in modern phonology.

It begins with a discussion of the definition of "tone language" as given by various taxonomies of tonedness. A new taxonomy and corresponding definition of "tone language" is proposed.

Having identified the set of languages to be considered, acoustic and articulatory feature systems are examined. No complete feature system is found which allows unique designation of tones while describing the maximum known number of tonal distinctions. Two articulatory features, glottal stricture and voice onset timing, are identified as crucial to development of a comprehensive and physiologically accurate feature account of tone.

The problem of kinetic tones on single segments is then explored, and a mechanism of explicit ordering within segmental matrices is proposed.

Next, data from languages in which tonal phenomena are found to be independent of segments at some point in the derivation of lexical items or grammatical constructions are presented and shown to be most

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Four aspects of Hausa grammar (1) contraction of lexical items, (2) tonal unity of grammatical constructions, (3) verb classification, and (4) noun pluralization, are then detailed, illustrating significant generalizations about tonal patterning that are best portrayed by a suprasegmental representation of tone.

Finally, the language specific mechanisms developed for the Hausa data are shown to extend to other languages defined as tonal.

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By

Judith Marie Maxwell

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

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1976

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DEDICATION

To my mother, who typed an earlier draft of this thesis and still claims she wants to read in its final form, and to Benji Ishaku, who taught me all the Hausa I know and all I have forgotten.

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ACKNOWLEDGEMENTS

This thesis has had a long and sporadic history. I wish to express my deepest gratitude to Dr. Falk, chairman of my committee, and to Dr. Song for having struggled through four revisions with me, always encouraging me to do it over that one more time. I wish also to thank Dr. Dwyer, who, though slogging through only two drafts, had many insightful comments and is largely responsible for the final form of this version.

I am also literally and figuratively in debt to Linda Hansen, who wasted her week-ends typing the final copy.

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Chapter 1

What is a Tone Language? : A Gallery of Conflicting Views

This chapter reviews four linguists' answers to the question, "What is a tone language?" As these answers generally take the form of taxonomies for classification of languages according to their use of tone, each taxonomy will be evaluated using the criteria of descriptive and explanatory adequacy.

1.1 Criteria of adequacy

To be adequately descriptive a taxonomy must subsume all the available data, apply non-arbitrarily, and give a unique division. In the case of tone language typologies this means the taxonomy must apply to all languages, the criteria for "tonedness" must be testable and a single classification of the languages must result. This is the minimum requirement of adequacy; ideally a typology will go on to be explanatory.

To be explanatory the taxonomy should allow the statement of further generalizations about the languages' behavior based on the classes obtained and should insure that no significant generalizations of the language be overlooked or unstatable within the framework.

The four taxonomies presented here appear in order of increasing comprehensiveness. Once these taxonomies have been evaluated, a compromise classification system is proposed to achieve at least descriptive adequacy and a modicum of explanatory power.

1.2 Tone in language

By "tone language" we mean something more than a language with pitch accompanying utterances. No language is spoken on a single pitch without variation in amplitude or frequency, every language

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has some accent, or inflection, or modulation of the voice. Similarly, there are various styles or manners of speaking within any given language, so every language has various tones. Used thus the term "tone language" does not set off a group of languages as being distinct from those designated by the simple term "language". Linguists must further constrain the term "tone language" so that it serves a delimiting purpose.

1.3 Beach's definition

Beach (1924) requires of a tone language only that it modulate pitch and that some of the resulting differences in pitch signal a difference in meaning. By this definition English would be a tone language, because difference in the pitch modulation distinguishes questions from statements: 'coming?' from 'coming.' All languages could be brought into the tone fold by similar analyses. This definition then, is not descriptively adequate as it makes no unique demarcations and does not differ from the preceding definition of tone despite the addition of the stipulation that pitch modulation be contrastive.

1.4 Pike's definition

Pike (1948) offers another definition for tone languages. "A tone language may be defined as a language having lexically significant, contrastive, but relative pitch on each syllable." (Pike, 1948, p. 3) To be significant, pitch must distinguish the meanings of utterances, here lexical items. To be contrastive, pitch must operate within a functional system. To be lexical, pitch must be associated with dictionary entries. English pitch is both contrastive and significant, since in utterances like 'hot!', 'hot.', and 'hot?',

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the contrast of high, low and rising tones systematically distinguishes the meanings, exclamation, statement, and question, respectively. The crucial element in determining whether a language is tonal or not under Pike's definition is whether or not the language has lexical entries, but Pike's definition does not consider lexical tone to be a subset of some larger kind of tone. For Pike, then, if all Hausa worked like the verbal system, by a kind of tonal inflection with no tone inherent in the verb stem, either Hausa would not be a tone language or each tonal inflection of the verb would be treated as a separate lexical unit. Since the latter alternative would miss such generalizations as the contour L^nH, low tone on all but the final syllable and high tone finally, meaning Imperative, regardless of the verb so inflected, that alternative can hardly be deemed satisfactory.[1] And as the former alternative would move the verbal system of Hausa into the same class as English systems, neither does it appear to be a satisfactory solution. We do not want to say that the verbal system of Hausa is intonationally similar to English; yet it is not lexically tonal as Pike's tone definition would require. We may still call Hausa a tone language, since its noun system employs the prerequisite lexical tone. Pike rates descriptive adequacy. While not exhaustively cataloguing tone behavior, his taxonomy does exhaustively and uniquely classify languages as tonal or non-tonal. Again no predictive power is built into the system.

1.5 Dokė's definition

Doke presents a slightly more restricted definition. His description of tone itself differs little from Beach's. "Tone or

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intonation is the musical modulation of the voice in speech, and as such is an integral part of speech enunciation in every language." (Doke, 1931. p. 215) Consequently, he, too, calls all languages tone languages. However, he does sub-categorize languages into types of tone languages, only one of which bears the label 'tone language'. He defines 'tone languages' as those "in which the tone or tone sequence employed is significant of meaning--semantic." (Doke, 1931. p. 215) Tone in Doke's view may be of two types: characteristic or significant. Characteristic tone refers to "the method of grouping, or succession of musical pitches which characterizes a particular language, language groups, or language family." (Doke, 1931. p. 215)

1.5.1 Characteristic tone

English, he claims, has characteristic tone: a rise in pitch on emphasized or stressed syllables and a fall in pitch utterance-finally. Such characteristic tone, though, is defined to exclude uses "essential to the grammatical significance of any language." Tonal syntactic forms, such as those marking questions, show that some English tone usage is distinct from stress phenomena.

1.5 (a)

Six dollars. Six dollars?

Of course, tone cannot be said to be independent of stress. If, in the examples of 1.5 (a) above, six, rather than dollars, had been stressed, the contours would shift slightly.

1.5 (b)

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1.5 (b)

Six dollars. Six dollars?

Despite the medial variations, the statement still has a low pitched final syllable, while the question has a rising tone. Mood, declarative or interrogative, is grammatical information. English, then, has more than just "characteristic" tone.

1.5.2 Significant tone

In addition to characteristic tone, Doke recognizes "significant tone". Significant tone is that which "plays an active part in the grammatical significance of the language." It may serve to distinguish words of different meanings which would otherwise be phonetically alike, or it may convey varying emotional content. Doke subdivides significant tone into three classes: (a) semantic tone, found in Chinese; (b) grammatical tone, found in Sudanic languages; (c) emotional tone, found in all languages. Semantic tone behaves like a phoneme in providing minimal contrasts between morphemes. Grammatical tone operates as do inflections or other markers which show grammatical information. English stress-high tone would fall in this category. Emotional tone includes, in Doke's view, "all the emotions of interrogation, sarcasm, emphasis, surprise, doubt, irritation, exultation, command, anger." (Doke, 1931. p. 217) English question-statement intonation fits here. Of the three types of significant tone discussed by Doke, English has two. If we assume English to be at the non-tonal end of the tone language continuum, we can still only set it off from more tonal languages by the lack of semantic tone.

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1.5.3 Semantic tone

It is precisely the presence of semantic tone that Doke referred to, however, in labelling as tone languages proper just those languages "in which the tone or tone sequence employed is significant of meaning--semantic." (Doke, 1931. p. 220) This, of course, does not imply that languages with semantic tone lack grammatical or emotional tones.

Sango, a creole language of Central Africa, has two semantic tones.[2] In addition, definite "emotional tones" can be isolated. Statements are marked by a fall in pitch on the last tone-bearing unit of an utterance. Questions exhibit a long rise in pitch over the last morpheme. Sarcasm is shown be falling pitch. None of these contours destroys the underlying tonal configuration. The tonal sequence of tǒngàsó mà 'that way' will always consist of two low tones and a high on tòngàsó and a low tone on mà, regardless of the use of this phrase as a question or a statement. Nevertheless if it is used as a question, there will be a long rise in pitch after the syllabic in mà has begun on a low tone. If tòngàsó mà is used as a statement, mà will be low throughout, but it will be lower than the lows on the initial syllables of tòngàsó. This occurs independently of downstep.[3]

1.5 (c)

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'This is not good.'

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intonationally that the phrase is declarative rather than interrogative. Sango exhibits both emotional and semantic tone. However, since interrogatives, imperatives, exclamations and assertions are subsumed under the rubric "emotional" tone rather than as grammatical uses of tone, Sango is classed as without grammatical tone.

Hausa, however, exhibits all three sub-types of significant tone. Verb forms in Hausa have no inherent tone but pickup tones as inflections, "grammatical tone" in Doke's terminology.[4] Rising pitch indicates questions, "emotional tone." Hausa uses semantic tone in distinguishing sets such as jíbí, 'day after tomorrow', and jībì, 'a meal', or fító, 'come out', fítò, 'ferrying', and fìtó, 'guinea-corn beer'.[5] Thus, languages exist which have all three kinds of significant tone in addition to characteristic tone.

As suggested by Doke, any language might have any combination of significant tone types. However, these three types of significant tone differ in their pervasiveness. That all languages appear to use some kind of emotional tone. Even Chinese, the semantic tone language par excellence, is not devoid of tonal mechanisms for expressing ire, surprise, disbelief or interrogation. After emotional tone, semantic tone seems most common. Grammatical tone, inflecting words by tonal alterations, seems to be the most rare, if stress determined tone use like that of English is excluded. This line of argumentation suggests a pyramid of increasing "tone language-ness", typing according to the progressively more selective tone functions.

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Grammatical Tone — Hausa

Semantic Tone — Chinese

Emotional Tone — English, All languages

Characteristic Tone — All languages

Each language placed within a given level of this pyramid utilizes all the tone types at or below that level. All languages with grammatical tone also have semantic tone. Thus, Chinese has semantic and emotional tone, but not grammatical tone. English has emotional tone, but not semantic or grammatical tone.[6] According to this classification, Hausa would appear to be more of a tone language than Chinese. It may be that while Doke's classification can distinguish tone languages from non-tone languages, classifying as tone languages those with semantic tone and as non-tonal those without semantic tone. Doke's classificatory system takes in all languages and dictates their unique designation. It is descriptively adequate. It goes no further toward prediction, however, and ranks languages counter to traditional views of "toned-ness".

1.6 McCawley's definition

McCawley (1964 and 1970) saw a need for greater differentiation than allowed by Pike's or Doke's definition. However, it was not the category of "grammatical tone" which he saw as lacking, but a grouping of semi-tone or "accent" languages as opposed to true tone languages. In a true tone language with two tones, any syllable may be either high or low, regardless of the specification of any other syllable. There are two possible tone patterns for a one syllable word: high or low. As the word increases in length, tonal

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1.6 (a)

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1.6 (a)

Number of syllables	Tone possibilities:				number
2	HH	HL	LH	LL	4
3	HHH	HHL	HLH	LHH	
	HLL	LHL	LLH	LLL	8
4	HHHH	HHHL	HHLH	HLHH	
	LHHH	LLHH	LHHL	LHLH	16
	HHLL	LLLH	LLHL	LHLL	
	LLLL	HLLH	HLHL	HLLL	

The number of possible forms increases geometrically according to the formula T^n, where T = the number of tonal contrasts and n = the number of syllables in the word. In a two-toned language the formula T^n would be 2^2. A three syllable word would have $2^3 = 8$, possible tone patterns.

However, many languages which use pitch lexically and contrastively do not show this geometric proliferation of tone forms. Instead the number of possible tone patterns increases arithmetically as the number of syllables increases. Languages exhibiting such patterning comprise McCawley's class of accent languages. Japanese, Serbo-Croatian and Bambara fall in this class. For these languages the pitch contour of the entire word is predictable as soon as the location of the "accent" is determined. In Japanese, for example, "accent" is realized as a following fall in pitch. There is only one accent per word. The first syllable of a word is low unless the accent falls on that syllable, in which case it must be high in order to allow the pitch to fall afterwards. Thus, we get the possibilities shown in 1.6 (b).

1.6 (b)

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1.6 (b)

1. hasi da — it's chopsticks
2. hasi da — it's a bridge
3. hasi da — it's an edge

Hasi, 'chopsticks', has an accented first syllable. Hasi, 'bridge', has an accented second syllable. Hasi, 'edge', has no accented syllable. For these and other two syllable items, there are only three contour possibilities, (two in isolation, since without the da, 'it is', in 1.6 (b) 2. and 3. would be indistinguishable). Three syllable words have only four alternatives: accent on the first syllable, accent on the second syllable, accent on the third syllable or no accent. Thus, for accent languages, the number of tone contours of a word increases arithmetically as the number of syllables increases. For Japanese the formula n + 1 indicates the number of possible tone patterns for a word where n equals the number of syllables in the word. Accent may fall on any syllable (n possibilities) or on no syllable (+1 possibility).

In addition to accent languages with their arithmetic progression of tonal possibilities and tone languages with their geometric progression of tonal possibilities, there are languages with lexically significant tone which show no increase in the number of tonal possibilities as the number of syllables increases. Such a language would be one which distinguishes word as high toned throughout or low toned throughout and which allows no ditonic words. Margi as described by Williams (1976) appears to be such a language.

Another feasible grouping of language would be those which allow ditonic morphemes, but distinguish between only two possible contours.

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Kagoshima Japanese is one such language. In Kagoshima Japanese a lexical item may be either 'rising' or 'falling'. If it is 'rising', then the phrase which it heads will have high pitch on the final syllable. If the lexical item is 'falling', then the phrase it heads will have high pitch on the penultimate syllable. Hana, 'flower', is a 'rising' lexical item. When it alone comprises a phrase, the second syllable is high pitched: hana. When it heads the phrase 'to the flower', the last syllable of the phrase is high pitched: hana ni. When hana, 'flower', begins the phrase 'as for to the flower', the last syllable again is high pitched: hana ni wa. On the other hand, hana, 'nose', is a 'falling' lexical item. When it alone comprises a phrase, the first syllable is high pitched: hana. When hana, 'nose', comes first in the phonological phrase 'to the nose', the penultimate syllable is high: hana ni. When hana, 'nose', starts the utterance 'as for to the nose', the penultimate syllable is again high: hana ni wa. The number of contours possible does not increase geometrically for this type of language either; for any lexical item only one syllable will be high, the rest will be low.

McCawley sought a classification based on the type of entry required in the lexicon and on the types of phonological rules used in each system. Systems such as the last two discussed would require only a binary feature entry in the lexicon. For Kagoshima Japanese, a lexical item need only be specified ($\pm$ rising), where (- rising) equals 'falling'. For languages such as Margi, a lexical item need only be marked ($\pm$high tone). Thus, fixed contour languages and languages which disallow ditonic morphemes (a proper subset of the former) both are specified by binary features and so fall together

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as a class. McCawley calls such languages "partially free accent" languages. Languages with arithmetically progressive number of pitch determinants require a dictionary entry which specifies the location of the accent, from which tone specifications are predictable. Use of a location feature (+ syllable n) in a lexical entry would classify a language as a 'free accent' language. Geometrically progressive pitch determinant number languages, those commonly called tone languages, require dictionary entries which mark tone as features on the individual vowels, or tone-bearing units. Finally, languages such as English, in which tone is redundantly determined by grammatical markings such as QUES or EMP or by stress assignment based on grammatical bracketing, require no mention of pitch in the dictionary. Languages of this last type McCawley defines as "bound accent" languages.

Having classified languages as above, using dictionary entry form as a criterion, McCawley sought to establish consequences for these groupings elsewhere in the grammar. The only division into subgroupings which showed any consequences elsewhere in the grammar was the opposition of the tone languages versus free, partially free, and bound accent languages. His use of the term "accent" in the labels of these last three classes emphasizes their unity. This unity stems from their behavior with respect to tone rules.

Accent languages operate solely with rules of tone (or stress) reduction, rules that accent one syllable while weakening others. For example, Japanese, a free accent language, has a rule which deletes all but the first accent within a phonological word. A comparison of <u>miyako desu</u>, 'it's a city', a phonological word having only one

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underlying accent, atama desu, 'it's a head', having two underlying accents, and atama dattara, 'if it were a head', having three underlying accents, shows the erasure of accents through reduction. In the following derivations the underscoring indicates the location of the underlying accent. Notice that where more than one syllable in the phonological word is underscored only the first is realized as accent (phonetically pitch fall) on the surface. The other accents have been reduced.

1.6 (c)

	1 accent	2 accents	3 accents
	miyako desu	atama desu	atama dattara
reduction	no change	atama desu	atama dattara
accent spell-out	[miyako desu]	[atama] desu	[atama] dattara

Similarly English stress undergoes reduction. In compounds such as bluebird, both blue and bird receive primary stress on the first cycle. But on the second cycle the Compound Stress rule assigns a primary stress to blue as the first primary stressed element within the noun bracketing and the stress on bird then reduces to secondary stress, as shown in 1.6 (d).

1.6 (d)

	bluebird
first cycle	1 1
second cycle	1 2

The accenting of blue weakened bird in English just as the accenting of ma in atama weakens de in desu in Japanese. Accent languages employ such reduction rules. McCawley's claim is that the accent

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languages employ no other type of rules which affect accent, stress or tone, and that only accent languages have such rules. Tone languages, he claims, "are subject only to rules such as assimilations and dissimilations which are of exactly the same formal nature as the rules affecting purely segmental features such as voicing or nasality." (McCawley, 1964. p. 5) 1.6 (e) summarizes the system of classification proposed in McCawley (1964).

1.6 (e)

language class	type	possible pattern progression	dictionary entry	rule type	example
accent	bound	arithmetic	none	reduction	English
accent	partially free	fixed	± feature	reduction	Margi
accent	free	arithmetic	location	reduction	Japanese
tone	tone	geometric	features on segments	assimilation and dissimilation	Chinese

Unfortunately both predictive claims of this classification are false.[7] Counter to McCawley's first prediction, that accent languages have only reduction rules, stands Margi. Recall that Margi has a binary feature, (± high), as its dictionary entry and therefore is properly a "partially free accent" language. However, in addition to reduction rules, Margi has tone rules which are clearly assimilatory.[8] The rule which maps the lexical tone of the verb onto the verbal inflections must be a rule of assimilation, since it takes a unit unspecified for tone and gives it the tone specification of the preceding unit. Examples of Margi tone rules are given in 4.3.1.

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Counter to the second claim, that tone languages have solely dissimilatory and assimilatory rules, stands Chinese. Taking verbs of motion in Chinese, their combinations into directional adverbs, and the combinations of these adverbs with other verbs in complex verb phrases and compound nouns (which we will discuss in more detail below), Nancy Woo (1969) shows that reduction rules also operate in Mandarin Chinese, the epitome of tone languages. She argues that 'neutral' tone in Chinese is a reduced tone comparable to the reduced vowel in English, schwa, in examples such as [dɛ́məkræt] and [əfɛ́ct]. Where tertiary stress appears, English vowels reduce to schwa, Mandarin tones reduce to neutral. But if there is a linguistic universal as McCawley claims which states that non-primary stresses are always derived by rules which stress one syllable and weaken the stresses on other syllables, the tertiary stress in Chinese (unstress) which triggers neutral tone must derive from one-stress via reduction rules. Using two rules and the reduction convention from Chomsky and Halle (1968), henceforth SPE, Woo formulated Chinese stress reduction.

First, she uses a compound noun rule, stressing the last stressed word in a compound noun. By SPE convention, stressing a position within a given bracketing automatically reduces other stresses within that bracketing by one. Finally a rule of the form of 1.6 (f), which reduces secondary stresses to tertiary stress on all non-initials followed by a stressed final, completes the Chinese stress reduction process.[9]

1.6 (f)

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These rules interact as in 1.6 (g), working cyclically outward from the innermost bracketing.

1.6 (g)

##pin##	#in#	#tzyh#	#muu##	'alphabet'
1	1	1	1	first cycle
2	2	2	1	second cycle with rule to assign 1-stress to last primary stress in compound
2	3	3	1	second cycle by rule reducing intermediate stresses

pinintzyhmuu
2 3 3 1

This and similar examples show that reduction rules appear in Mandarin, and, therefore, in at least one "tone language".

With counter-examples to both of McCawley's claims about possible interaction of the accent versus tone language distinction with rules of grammar, McCawley's basis for distinguishing tone languages reduces to discrimination in the forms of the dictionary entries for lexical items within the languages.[10]

Furthermore, the classification provided by McCawley does not supply a comfortable niche for phenomena like that of Hausa verbs, items which have no lexical pitch of their own, but become inflected for tone. Once again Doke's 'grammatical tone' would fill the gap. Another type of 'tonal inflection' which might fit under Doke's classification - 'grammatical tone' - but which has no place in McCawley's system is that which McCawley (1970) proposes for Tiv. For each tense of the Tiv verb, McCawley provides a tone pattern

which is to be distributed over the available sonorant segments of the verb forms. Each verb has a basic tone, high or low. This is B (for Basic) in McCawley's symbolization. Then General Past Tense is shown by a tone contour LBL_0, low first syllable, followed by a base tone syllable, followed by a second low if there are further syllables. The 0 subscript indicates optionality. There may be 0, zero, finallows in the case of General Past Tense. LHL is the tone pattern for General Past if the verb is a basically high-toned three syllable verb; LLL appears if the verb is a basically low-toned verb. The fourth Habitual Tense is marked H_0L, where the contour is HL, regardless of the underlying tone of the verb stem. The H is optional so that a one syllable verb would be uniformly low. This language then would appear to be 'partially free accent' in its verbal system in so far as the verbs are (± high tone); i.e. either basically low verbs or basically high verbs. However, the tonal frames must be characterized for an adequate description of the system, and these patterns abstracted from lexical items have no place in McCawley's system of dictionary entries. Hausa, also, has a system of such tone overlays which are grammatical signals but have no lexical counterpart and must be fitted over available segments of lexical items but are independent of them. The imperative contour, L^nH, is one such overlay. These tonal phenomena would never be localized in the accent-tone range.

While McCawley's system attempts to go beyond description explanation, predicting rule forms, it falls short as those predictions are not borne out. Furthermore, the system overlooks the languages which specify tone frames apart from segmental morphemes.

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This makes the classification non-exhaustive and the system falls short of descriptive adequacy as well.

1.7 Possible patches

Welmers (1959) recognized the presence of 'tonal morphemes' with no paired segments at the abstract level of the lexicon and likewise of segmental morphemes with no paired tones at this level, despite the physical impossibility of either of these elements at the surface where all articulations carry a tone quality and all tones are accompanied by some vocal configuration. Lexical entries bearing no tones have long been recognized, of course. All English morphemes are toneless in the lexicon. A tonal morpheme with no associated segments would be the associative marker in Efik, a non-segmentally paired high tone.[11] The tone frameworks discussed above in 1.6 for Tiv and Hausa would also be tones without inherent segmental relationships. Taking into account both types of tone-segment relationships, Welmers suggests a tentative definition of a tone language: "A tone language is a language in which both pitch phonemes and segmental phonemes enter into the composition of at least some morphemes." (Welmers, 1959. p. 9)

The lexicon of a tone language must then include specification for tone features and segmental features though these specifications need not be co-extensive. This allows the possibility of some purely tonal entries, some purely segmental entries, and some entries with both tonal and segmental specifications. Hausa utilizes all three of these possibilities, having purely tonal entries for verb classes, purely segmental entries for verb stems and mixed entries for nouns.

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Welmer's classification admits Hausa as a tone language. It would not necessarily readmit Standard Japanese or Kagoshima Japanese to the tone language circle as their morphemes would contain features of location and features of contour, respectively, but not pitch phonemes. This separation correctly predicts the different tonal possibilities of Hausa and Japanese strings and so is explanatorily adequate. However, Welmer's taxonomy runs into trouble with Margi-like languages. Margi would be deemed a tone language since each morpheme would carry a specification, ± high. However, we saw in 1.6 that Margi and Kagoshima Japanese are essentially similar in that entire word contours are dependent on a single binary feature specification on the morpheme, i.e. the dictionary entry for that morpheme. This generalization is missed if the taxonomy separates these languages. Missing a generalization impugns the explanatory adequacy of this account.

The system of classifying languages according to their lexical entry form can be modified, however, to include the anomalous cases, those of tone frameworks. The frameworks themselves could be listed in the dictionary as independent entries. Languages whose dictionary entries include instances of tonal frameworks could be called "tone frame languages". Tone frame languages would include such cases as the associative high tone of Efik since it would be a tone specification entered in the dictionary. This new category gives us a five-way classification: bound accent languages, partially free accent languages, free accent languages, tone languages, and tone frame languages.

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In addition to making a raw division between languages, an exercise in definition, this categorization makes one prediction: there will be two basic classes of lexical entries, those requiring no more than one specification, either binary or locational, for accent per lexical item, and those requiring more than one specification, either together with segmental features or independent of segmental features. The basic metric of categorization is lexical entry form. Lexical entry form predicts that free accent systems will not overlap with bound accent systems, nor with partially free accent systems, nor with tone or tone frame systems due to the different nature of their lexical entries. Free accent systems use a location feature; partially free accent systems use a binary feature; bound systems use no feature; tone and tone frame languages use tone values. Conversely, tone and tone frame systems may overlap, due to the similarity of their lexical specifications, the use of tone values. Thus, the taxonomy based on dictionary entry form predicts overlapping of tone and tone frame languages as both specify tone values, and of partially free and tone languages as both use binary features, but of neither with bound or free accent systems.

Indeed, these divisions are not necessarily discrete. Hausa may be seen to be a tone language given the geometric progression of the number of tonal possibilities on noun forms as the number of syllables in these forms increases. Hausa can also be classed as a tone frame language, given the overlay of tone frames on verb forms. BanguBangu also has a mixture of straight tone language phenomena and tone overlays.[12] Here the variation is not between different parts of the grammar, nouns versus verbs, but within the verbal system

itself. Verbs have lexical tone specified for each vowel in the dictionary entry, hence qualifying BanguBangu as a tone language. However, in the imperative and subjunctive moods (two different moods) this inherent verbal tone is overridden by a tonal framework: $H_1^2L_0$Det for imperatives, $H_1^3L_0$Det for subjunctive. These frameworks are to be read:--as many as two, but no less than one, high syllables followed by as many lows as there are syllables left before the final syllable, which must be a "determinant"-high syllable--for the 'imperative--as many as three, but not less than one, high syllables followed by as many low syllables as intervene before the final "determinant"-high--for the subjunctive.

Hausa and BanguBangu attest the overlap of language types using tone features as predicted by the taxonomy. Margi shows the overlap of partially free accent and tone language phenomena as predicted by the lexicon metric. Margi, which we had categorized as partially free accent on the basis of its verbal system, would be placed in the tone language grouping on the basis of its nouns.

Recall though that we would not expect to find overlapping of (1) free accent and (2) bound accent systems with each other, or with (3) tone, partially free accent, or tone frames. Free and bound accent systems don't refer to tone at all in their lexical specification because the relevant tone information is supplied by a redundancy rule in the phonology. In bound accent systems the rule would be of the form 1.7 (a).

1.7 (a)

$$1 \text{ stress} \longrightarrow +\text{high tone}$$

In free accent systems the rule would be of the form 1.7 (b),

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making initial syllables low, the syllables preceding the accented high, and the accented syllable as well as subsequent syllables low.

1.7 (b)

$$n \text{ syllable} \longrightarrow \text{low high}^{n-1} \text{ low}$$

But for partially free accent languages, tone languages and tone frame languages the dictionary must actually refer to tone values, though the distribution of these may be variously determined, by rule for partially free accent, by lexical specification for tone languages and by overlay for tone frames. The bound and free accent systems require rules to obtain tone values. The tone, partially free accent and tone frame systems start with some tone values given. These two sets do not interclassify and so the proposed taxonomy has some consequences beyond the form of dictionary entries.

This typology classifies strictly by lexical entry form. The differences in entry form entail different phonological rules to arrive at fully specified matrices and predict the possible cross-classifications of languages. This system classifies all language types discussed uniquely and goes beyond this descriptive adequacy to make one prediction, a step toward explanatory adequacy.

1.8 Summary

What, then, is a tone language? Shall we limit that term to those languages which mark tone on each vowel in their dictionary entries? What will we call a language like BanguBangu which mixes such tonal specifications with tone frames?...a semi-tone language? Suppose we use the division noted above in 1.7 and call all the following tone languages: partially free accent, tone, and tone frame languages. We can specify 'lexical' tone languages when we

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wish to refer only to the languages which rely solely on tone languages happily labels languages much as they have been traditionally discussed. English is classed as a non-tone language. Japanese is called non-tonal, too, in accord with the traditional Japanese analyses, which call it, rather, an accent language.[13] Chinese, of course, is a tone language, as are Hausa and many of its continental compatriots. This intuitively satisfying consequence lends credulity to the definition 1.8 (a).

1.8 (a)

A tone language is a language such that some dictionary entries will be labelled with tone features.

Notice that this definition requires only that some entries have tone specified. This gets around ticklish problems in languages like Margi which have derivational inflections presumably given some dictionary entry though inserted by transformation, which have no inherent tone and rely on assimilatory rules to supply tone markings.[14] Hausa similarly has some morphemes without inherent tone. Ne and ce, sentential stabilizing particles, must be listed in the dictionary without associated tones. Dissimilatory rules supply these markers with pitch specifications opposite that of the preceding syllable. On the other hand, the associative morpheme in Efik would be a dictionary entry in itself, as would General Past Tense in Tiv and the Hausa Imperative tone pattern. These would fall under the clause "some dictionary entries...labelled with tone."

We have ended by rejecting the tone function classification proposed by Ɔke since his groupings had languages like Hausa ranked more tonal than languages like Chinese. Instead we have substituted

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a system which classifies languages on the form of their grammars since this classification is congruent with traditional categorizations and allows one further statement on grammar form. Non-tone languages will require at least one rule before dictionary specifications contain matrices with tonal features.

In arriving at definition 1.8 (a), we have discussed three subsets of languages to be called tone languages under this definition. There are: (1) partially free accent languages which require only one binary tone feature marked per lexical entry, (2) lexical tone languages which require a tone specification on every unit capable of bearing tone and (3) tone frame languages which require a listing of tones as the dictionary entry itself. Non-tone languages were of two types: (1) free accent languages which require a location feature for accent from which tone contours may be predicted by rule and (2) bound accent languages which require no mention of tone since it will be redundantly specified from other features. The early definitions were in essence correct - a tone language is one which uses tone. The early definitions simply neglected to end this tautology with the phrase 'in the lexicon'. The succeeding chapters will only be concerned with tone as used in "tone languages": partially free accent languages, lexical tone languages, and tone frame languages.

Footnotes

Chapter 1

1. Superscript n requires iteration of the tone so marked as many times as there are syllables not taken by some other tone.

2. The data on Sango are taken from Samarin (1967).

3. Downstep, here, refers to successive lowering of non-adjacent pitches of the same value, i.e. high or low.

4. This is discussed in detail in section 5 of Chapter 5.

5. The macron over the vowel indicates length. This transcription is used here so that the tonal contrasts stand out more clearly; no theoretical importance is attached to it. This notation is taken as equivalent to writing the vowel as double, $\bar{i}$ = ii.

6. English may be excluded from the grammatical tone group if stress correlated tone is discounted as predictable and therefore non-contrastive.

7. He retracts these claims in the McCawley (1970), and presents further counter-evidence from Ganda and Kyoto Japanese and Ijo.

8. Final High Tone Lowering, a rule of the form H→ L/ ___#, may be better taken as a non-reduction rule. This rule is also part of the grammar of Margi.

9. This rule appears as example (8) in Woo's thesis, Chapter 1, page 23.

10. McCawley, in a lecture delivered at MSU on May 24, 1972 stated that he no longer had any hope for a classification along the lines of types of rules available within a grammar, but he was still holding out for lexical entry distinctions.

11. The Efik data are from John Ritter in personal communication.

12. BanguBangu, as discussed both by McCawley in "Global Rules and BanguBangu Tone," mimeo, and by Theresa Azzawi "Inherent and Superimposed Tone in BanguBangu" paper delivered before the Canadian Council of Learned Societies on May 30, 1972, has inherent tone in verbs for all forms except the imperative and the subjunctive, which require tone frame analysis.

13. Two excellent traditional analyses cited by McCawley in The Phonological Component of a Grammar of Japanese are Hirayama's Zenkoku Akusento Jiten and Kindaichi Haruhiko's Meikai Akusento Jiten. These works refer to Japanese, rather, as an accent language.

14. Not all derivational inflections in Margi are toneless. Inflections with tone would be listed in the lexicon with their tonal specifications.

Chapter 2

Tone Feature Systems

In this chapter I review four proposals for acoustic feature systems and two systems of articulatory tone feature specification. The acoustic feature systems are presented in the order of increasing adequacy, but one of the acoustic systems is found to allow unique and exhaustive description of all tone languages regardless of the number of tones contrasting distinctively. None of the articulatory systems describes the gestures of glottal articulators with sufficient precision to allow designation of a set of glottal gestures as necessary and sufficient to produce a given tone.

2.1 Gruber features

Gruber (1964) proposes two features for tone, [High] and [High 2]. [+High] is any pitch above a notational median. [-High] is any pitch below such a median. [High 2] splits the range of tone designated by the first feature, [High], into two parts and designates the higher pitched half of each of these parts. [+High, +High 2] is a high high; [+High, -High 2] is a low high; [-High, +High 2] is a high low; and [-High, -High 2] is a low low. 2.1 (a) displays this system's designation of features for a four tone language. Tone 1 is the lowest tone, tone 4 highest.

2.1 (a)

	1	2	3	4
High	-	-	+	+
High 2	-	+	-	+

This analysis suffers from three general weaknesses: first, two features can only give a four-way pitch distinction; second, the feature

[High 2] cannot be assigned universal articulatory or acoustic correlates; and third, no non-arbitrary three-way division of features is possible.

The first objection, a maximum four-way pitch division, becomes crucial when we seek to describe languages such as Trique (Longacre 1952) and Black Miao (Voegelin and Voegelin 1965) which have five distinctive pitch levels. If [High] and [High 2] were adequate for four tone levels, another feature, perhaps [High 3], would be needed for Trique and Black Miao.

However, there are theoretical problems with these features. First, the model of phonology developed in SPE requires that the features which appear in phonological matrices have articulatory or acoustic correlates, with the former being most highly valued.

> The phonetic features can be characterized as physical scales describing independently controlled aspects of the speech event...the features have a phonetic function and a classificatory function. In their phonetic function, they are scales that admit a fixed number of values and they relate to independently controllable aspects of the speech event or independent elements of perceptual representation. (Chomsky and Halle, 1968. pp. 247-248)

The feature [High 2] cannot be defined in these terms. It refers to the higher half of each of the initial binary divisions, [+High] and [-High]. So the highest of four tones is, [+High, +High 2]; the second lowest is [-High, +High 2]. No physical gesture--vocal fold tensing, glottal raising--can be associated with this feature. Nor is there a perceptual uniformity: one is a high high, the other a high low; but the lack of psychological validity for such grouping is demonstrated by the dearth of phonological rules applying to the class of segments sharing the specification [+High 2] or [-High 2].

Again according to SPE, the proposed features should be precisely those which capture most succinctly the natural classes, those which function together regularly within phonology. No language has been documented, to my knowledge, which pairs the highest of four tones with the second lowest excluding the lowest and second highest, or vice versa. No language uses rules that refer to the set of tones specified by the feature [High 2]. The feature [High 2] was chosen without regard to physiological or acoustic correlates and so, not surprisingly, fails to embody a natural class.

Moreover, the proposed system meets further difficulties when applied to a language such as Yoruba (Bamgbose 1966), having three distinct tones, high, mid and low. The mid pitch must be designated either as [+High, -High 2] or [-High, +High 2]. The choice seems fairly arbitrary; though given the unusual nature of the feature [High 2], we could posit a marking convention: [u High 2] → [-High 2]. With this marking convention, the system predicts that mid is more closely associated with high tone than with low. For Yoruba such a grouping fits in easily with the rule for emphasis: EMP → L/ $\begin{Bmatrix} H \\ M \end{Bmatrix}$. However, the system rates the opposite union, mid and low, as less natural, despite the fact that this set also operates within Yoruba phonology: third person singular object pronoun → H/ $\begin{Bmatrix} L \\ M \end{Bmatrix}$ ____. In addition, it seems to indicate that the phonological distance is greater from mid to low than from mid to high. Neither the greater distance nor the difference in set naturalness seems justified for Yoruba. Rather mid is precisely that--midway between high and low. The simple features of High and Low would more adequately describe

Yoruba's mids, [-Low, -High]. These features, also, would overcome the second objection to Gruber's classification: lack of physical correlates, High being perceptually high and Low perceptually low. However, these features are still inadequate to the task of characterizing five-toned systems.

2.2 Maddieson features

Maddieson (1970) attempts to handle five-toned systems by adding a third feature. He renames High "raised", Low "lowered", and adopts a new term "extreme". The terminology, "raised" and "lowered", is meant to avoid confusion of tone features with those features already in use for tongue height. Explicit physical relations are given for each of the features. The phonetic correlate of [+raised] is 'higher than a notational median pitch' and that of [-raised] is 'not higher than a notational median pitch'. The phonetic correlate of [+lowered] is 'lower than a notational median pitch' and that of [-lowered] is 'not lower than a notational median pitch'. [+extreme] connotes a greater distance away from the notational median pitch.

2.2 (a) displays a Maddiesonian analysis of a five-toned system with Tone 1 being lowest and Tone 5 highest.

2.2 (a)

Tone	1	2	3	4	5
Raised	-	-	-	+	+
Lowered	+	+	-	-	-
Extreme	+	-	-	-	+

A constraint must be added to the system to avoid plus values for raised and lowered simultaneously, and to rule out the combination [+extreme, -raised, -lowered].

However, this adjusted system still has some flaws: (1) definition of "notational median", (2) the oddity implicit in the feature [Extreme], (3) the problem of unique specification of tones in two, three, and four toned languages. First, the notion of 'notational median pitch' requires careful definition so that it does not represent a set level. Even with the rider, 'normal or median pitch for the speaker', no absolute range can be set up because in languages with downdrift a high appearing late in an utterance may be actualized at an acoustically lower pitch than an initial low, yet still need to be analyzed as high. 'Notational median', then, must build into its formalization a relativity to environment so that as Elugbe (1970) points out, "however low a high has descended it will still be distinguished from low by its immediate surroundings." (Elugbe, 1970. p. 75) Second, the notation [extreme] makes the explicit claim that "in a language with four or five levels a wider overall range of pitch is employed to keep items apart than in an optimal one with two or three levels." (Maddieson, 1970. p. 9) Pike (1967), however, does not find this to be the case. Rather he notes that the spread of an interval varies with stress and intonation and from language to language. Awobuluyi (1970), likewise, notes "the pitch range in all languages was the same and languages either expand or compress the intervals according to the number of tones that are present." Similarly, Ladefoged (1967), while recognizing six possibly distinctive tones, allows independence of tonal division and pitch range so that if 100 different pitches or degress of tone are available, a two-tone language may let High range from 100 to 75 and Low from 50 to 25; a five-tone language might have its highest tone at 80 and

its lowest at 30 with 10 degree intervals. Thus, the prediction inherent in positing a feature [extreme] is not borne out. The pitch range does not necessarily increase as the number of distinctive tones increases; the divisions simply become finer. A second drawback of the feature [extreme] is that in describing four-toned languages one of the four tones will be marked [+extreme]. As Maddieson says, "This amounts to a prediction that four-level languages commonly make least use of either their highest or lowest level." Pike (1967) does not cite any of the four level tones of Mazateco as more infrequent or even more subject to weakening during fusion. Each of the tones seems to carry the same weight in the operation of sandhi and glide formation so ascribing a special or extreme status to one seems a bit suspect. Thus neither prediction of the feature [extreme] is realized. Furthermore, [extreme] falls victim to the same objections leveled agains [High 2]. Finally, fixing a unique specification of tones for systems utilizing fewer than the maximum number, five, would be arbitrary. A two tone language might be given any of ten specifications for its two tones. Likewise, three- and four-toned languages would not have their tones uniquely determined by this system. The possibilities for two, three, and four tone feature matrices in Maddieson's system are shown in 2.2 (b).

2.2 (b)

Two tones:

	H	L	H	L	H	L	H	L	H	L
R	+	+	+	-	+	-	+	-	+	-
L	-	-	-	+	-	-	-	+	-	+
E	+	-	+	+	+	-	-	+	-	-
R	+	-	+	-	-	-	-	-	-	-
L	-	-	-	+	-	+	-	+	+	+
E	-	-	+	-	-	-	-	+	-	+

Three tones:

	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
R	+	+	-	+	+	-	+	+	-	+	-	-	+	-	-
L	-	-	+	-	-	+	-	-	-	-	-	+	-	-	+
E	+	-	-	+	-	+	+	-	-	+	-	-	+	-	+
R	+	-	-	+	-	-	+	-	-	-	-	-			
L	-	-	+	-	-	+	-	+	+	-	+	+			
E	-	-	-	-	-	+	-	-	+	-	-	+			

Four tones:

	1	2	3	4	1	2	3	4
R	-	-	-	+	-	-	+	+
L	+	+	-	-	+	-	-	-
E	+	-	-	-	-	-	-	+

Such indeterminacy can be reduced by a marking convention that makes [-extreme] unmarked or free of cost. Such a convention, however, would still not allow the Maddieson features to predict specification for languages with less than five tones.

While Maddieson's system of using three tone features allows

exhaustive cataloguing of tone, including the five-toned languages not encompassed by the Gruber model, it can not uniquely specify tone features. Furthermore, one of the features involved, [+extreme], makes erroneous predictions about the tone range in four-toned languages and about tone rules in three-toned systems.

2.3 Wang features

Wang (1967) proposes a three feature system, using [High], [Central], [Mid], as in 2.3 (a).

2.3 (a)

1	2	3	4	5
-High	-High	-High	+High	+High
-Central	+Central	+Central	+Central	-Central
-Mid	+Mid	-Mid	-Mid	-Mid

[+High] is defined as above an idealized pitch median; [-High], conversely, is below that idealized level. [+Central] specifies proximity to the median. And [+Mid] pinpoints it. The options shown in 2.3 (a) do not exhaust the logical combinations of these three features, but Wang establishes a redundancy rule to assure that [+Mid] occurs only with [-High, +Central]. He also proposes a convention whereby the negative value for any feature is unmarked, thus, the most natural value. A language with three tones will choose tones 1, 3, and 5 from the possibilities listed in 2.3 (a), as this choice allows the language to avoid tones with more than one marked feature.

Unfortunately, these constraints will not uniquely delimit the tone specifications for all languages. A two-toned language is not constrained to choose Tone 5, [+High, -Central, -Mid], as its

second tone. Tone 3, [-High, +Central, -Mid], would be equally valued by the marking conventions. The tones of a three-toned language would be uniquely determined by the marking conventions, but again ambiguity of specification creeps back in four-toned systems. A four-toned language might either have Tone 2, [-High, +Central, +Mid], or tone 4, [+High, +Central, -Mid], as its fourth tone. Either alternative has two marked features. A five-toned language would get its five tones uniquely specified by these features and the proposed redundancy rule and marking conventions.

The non-uniqueness of tone feature specification for two and four toned languages is not the only weakness in Wang's model. This system dictates that a three-toned language specify its tones as Tone 1, [-High, -Central, -Mid], Tone 3, [-High, +Central, -Mid], and Tone 5 [+High, -Central, -Mid]. Thus, tones 1 and 3, the low and mid tones of a low, mid, high system are described as more similar than the tones 3 and 5, mid and high. Within the SPE framework, the more natural a class of sounds is the fewer the features needed to specify it. To specify the class, low and mid, in Wang's format, only requires mention of [-High]. To specify the class mid and high requires the listing of the specifications for both High and Central; that is, [-High, +Central] and [+High, -Central]. The only feature shared by high and mid tones is [-Mid], a feature also shared by the low tone. Thus Wang's system predicts that for all languages mid tones will pattern with low tones and that no rule will join high and mid without also joining low. However, in section 2.1, Yoruba, a three-toned language was found to have both rules that pair mid and low tones and rules which pair

high and mid tones while not affecting lows.

Wang's feature system does not uniquely specify tone feature values for languages with an even number of tones, nor does it correctly predict the behavior of these tones in tone rules.

2.4 Sampson features

Sampson (1969) proposes another three- feature system using [High], [Low], and [Mid]. This system makes none of the special status predictions stemming from Maddieson's analysis with extreme and so is not liable to the same objections. It avoids one pitfall of Wang's proposal by not lumping mid tone together with low tone. Sampson's alternative is illustrated in 2.4 (a).

2.4 (a)

Tone	1	2	3	4	5
High	-	-	-	+	+
Mid	-	+	+	+	-
Low	+	+	-	-	-

Thus, a mid tone shares the value [-Low] with high tone and the value [-High] with low tone. The class high and mid is specifiable with a single feature, [-Low], and thus is shown to be as natural as the class low and mid, which is specifiable by the single feature [-High]. The Yoruba rule (given in section 2.1) of emphatic lowering can be restated simply as [-Low] $\rightarrow$ [+Low] / $\underline{\quad}_{\overline{EMP}}$. The raising of third person object pronouns may also be simply put: $[-High]_{\text{3rd singular pronoun}} \rightarrow$ [+High] / [-High]$\underline{\quad}$. Sampson manages to express the neutrality of mid with respect to the high - low opposition, which Wang's system misses.

However, Sampson's system is more liable to indeterminancy of feature assignment than in Wang's. Sampson establishes two conventions, that simultaneous plus values for [High] and [Low] be disallowed and that [-High, -Low] be always [+Mid]. These conditions, however, do not reduce the number of equally valued alternatives as well as do Wang's. For a four-toned system, rather than two equally valued alternatives given by Wang's system, Sampson's system offers five possibilities for tone feature combinations.

2.4 (b)

Tone	1	2	3	4	1	2	3	4
High	-	-	+	+	-	-	+	+
Mid	-	+	+	-	-	+	+	-
Low	+	+	-	-	+	-	-	-
High	-	-	-	+	-	-	+	+
Mid	-	+	+	-	+	+	+	-
Low	+	+	-	-	+	-	-	-
High	-	-	-	+				
Mid	-	+	+	+				
Low	+	+	-	-				

As in Wang's analysis, in Sampson's notation a three-toned system is uniquely designated by the features and the conventions. A three toned language would be given the feature combinations shown in 2.4 (c).

2.4 (c)

	high	mid	low
High	+	-	-
Mid	-	+	-
Low	-	-	+

A two-toned language again is more loosely constrained. The three possible designations of tone features for a bi-tonal system appear in 2.4 (d).

2.4 (d)

	high	low	high	low	high	low
High	+	-	+	-	-	-
Mid	-	+	-	-	+	-
Low	-	-	-	+	-	+

Sampson's system allows too much indeterminancy. It fails to offer a unique specification for a given tone, and so is not descriptively adequate.

2.5 Articulatory features

All of the systems so far discussed, when relating at all to a physical parameter, have been defined acoustically. Although allowing for acoustic definitions, the SPE model more highly values articulatory correlations. Not surprisingly then, Halle and Stevens (1971) developed a system of laryngeal features to accomodate tone. They propose four features: [spread glottis], [constricted glottis], [stiff vocal cords] and [slack vocal cords]. Minus values for each feature define mid tone or the tone used in non-tonal languages. This is to say that two-toned languages may not use high and low tones as such, given the articulatory correlates of these terms, but may, in

fact, use one of this pair and the mid tone. Low tone is specified by the features [-spread, -constricted, -stiff and +slack].

An immediate objection to this system is that it does not allow us to describe five-toned languages. We cannot simply attribute extra tonal correlates to other feature combinations. Two combination candidates must be disqualified due to physiological impossibility: [+spread, +constricted] and [+stiff, +slack]. Two other remaining combinations can apply only to consonantal articulations: [+spread, -constricted, +stiff, -slack] and [-spread, +constricted, -stiff, -slack] block spontaneous voicing, the defining characteristic of vowels. The last four possible feature configurations ascribe qualities other than tone to vowels: breathiness, voicelessness, creak and glottalization.

2.5 (a)

	mid	high	low	consonantal		voiceless	breathy
spread	-	-	-	-	+	+	+
constricted	-	-	-	+	-	-	-
stiff	-	+	-	-	+	-	-
slack	-	-	+	-	-	-	+

	creak	glottalization
spread	-	-
constricted	+	+
stiff	-	+
slack	+	-

The beauty of the Halle-Stevens model is that it cross-classifies consonants and vowels explicitly, thereby showing the relationship of voiceless consonants and high pitched vowels, a relationship

attested by the diachronic development of Burmese and by some synchronic data from dialects of Jingpho.[1] Voiceless consonants would be [+spread, -constricted, -slack, and +stiff] and high vowels would be [-spread, -constricted, -slack, +stiff]. Both share plus values for the feature [stiff] and minus for the inverse, [slack]. Other consonant vowel cross-classifications are possible. Glottalization and high tone are also [-slack, +stiff]. Ohala (1973) bears out this correlation. Breathy voice, [+spread, -constricted, +slack, -stiff], shares the features [+slack, -stiff] with low tone. Ohala (1973) checked this correlation in the laboratory and found it generally valid for Hindi. Likewise, creaky voice and low tone have equal values on the glottal stricture dimension, [+slack, -stiff]. Ladefoged (1973) reports that creak often accompanies low tone in those languages in which no other glottal mechanism compensates. Since the explanatory power of such a mechanism is so pleasing, we would do well to find some way to categorize two more tones within this framework in some non-ad hoc fashion.

A possible strategy for incorporation would be to coalesce the Halle-Stevens framework with that provided by Maran (1971). Rather than the features [stiff] and [slack], Maran uses [raised glottis] and [lowered glottis], in addition to [spread] and [constricted], the latter being closed in Maran's terms. Maran notes that during articulation of high pitches in Jingpho, the glottis is raised about two centimeters from rest position; during articulation of low pitches the glottis lowers about two centimeters. It seems plausible that when this system is meshed with that of Halle and Stevens all three parameters, height of glottis, width of glottis, and glottal tension,

will not be needed to characterized three-toned systems. Some combinations will redundantly or non-uniquely determine tone. Both

[	+raised	]	and	[	-raised	]	might project a
	-lowered				-lowered		
	+spread				-constricted		
	-constricted				-spread		
	-stiff				+stiff		
[	-slack	]		[	-slack	]	

surface high. In five-toned systems these configurations might still overlap to define mid, but a high tone in a five toned system would require both the gesture of glottal raising and that of stiffening. This, of course, can be speculation only at this point as the glottal articulations of five-toned languages have not to my knowledge been analyzed and published. However, it does seem that some kind of integration of the Halle-Stevens model and that of Maran will have to be effected: first, simply because glottal height is an independently controllable parameter which has been observed to influence phonological tone; second, because the added feature [raised] would be needed anyway to define ejectives, elements given no role in the Halle-Stevens framework. Phoneticians have long been aware of the correlation between larynx raising and ejective articulations. Maran's use of [+raised] as a glottal feature would make this relationship explicit, while also describing one individually controlled tone parameter. Halle and Stevens do not include ejectives in the list of consonants they cross-classify with vowels. As it is the laryngeal raising which specifies ejectives, it seems plausible that were they to include ejectives they would, likewise, posit a feature like [raised].

Considering the slightly differing segments of consonantal <u>corpi</u> encompassed by the Maran and Halle-Stevens frameworks and

the intersection of the two sets, a description of the union of these sets seems in order. We would then use the sextet of glottal features: (1) raised, (2) lowered, (3) constricted, (4) spread, (5) stiff, (6) slack. With the union of the two glottal articulation models, we achieve: (1) the ability to provide a feature analysis for five-toned systems, (2) cross-classification of vowels and consonants, (3) and more complete characterization to the consonantal elements available to a language.

Despite these advantages, Victoria A. Fromkin (1971) objects to such features. Her chief objection is that adoption of these features will leave some obviously assimilatory processes symbolized by hopelessly non-assimilatory rules. Thus, while intervocalic voicing could be salvaged in non-toned languages as (+stiff) $\longrightarrow$ (-stiff) / (-stiff) ___(-stiff), in tone languages, where stiffness is distinctive, the same process would be written as (+stiff) $\longrightarrow$ (-stiff) / (+stiff) _____(+stiff) between high-toned vowels and as (+stiff) $\longrightarrow$ (-stiff) / (-stiff) ___(-stiff) between low vowels. Counter-intuitively this claims that voicing of intervocalic consonants is dissimilation in the environment of high-toned vowels and assimilation in the environment of low-toned vowels. The situation waxes even more absurd when the surrounding vowels differ in pitch. Between a High vowel and a Low vowel the rule would be assimilation to the Low vowel alone, (+stiff) $\longrightarrow$ (-stiff) / (+stiff) ___(-stiff). Since the relevance of stiffness to the real generalization here seems minimal, we might seek refuge in some other feature, perhaps [syllabic] and be content to let the generalization lapse without the facade of pseudo-generalizations with the feature

[stiff]. Intervocalic voicing would then be symbolized as [+stiff] → [-stiff] / [+syll] ____ [+syll], with no trace of assimilation in the formalism. This awkward situation will arise only if the new glottal features replace the old feature [voiced]. Since it is the case that a given configuration of stiffness or of glottal width and height does not require voicing or voicelessness but only allows it, voicing may still be conceptualized as an independent feature and, indeed, would have to be. Even if the glottal features could be construed to replace the articulatory correlates of voicing, voice could still legitimately retain its status as a distinctive feature by appeal to its acoustic correlates. With this re-interpretation, voicing assimilation of a consonant between two vowels can be written as [-voice] → [+voice] / [+voice] ____ [+voice]. The correlation of voicing and tone derives from features other than [voice] shared by consonants and vowels, specifically [slack] and [stiff]. Compare a tone raising rule which refers to [stiff] and a devoicing rule which refers to voice as in 2.5 (b).

2.5 (b)

tone-raising: [-stiff] → [+stiff] / [+stiff] ___ [+stiff]

devoicing: [+voice] → [-voice] / [-voice] ___ [-voice]

While voicing is independent of stiffness, stiffness does, in the Halle-Stevens view, inhibit spontaneous voicing and it will generally be the case that [+stiff] segments are also [-voice] and [+voiced] segments will be [-stiff, +slack]. But as the parameter of voicing is maintained separately no generalization need be lost in the writing of voicing assimilation rules.

In theory, then, combining Halle-Stevens features with those of LaRaw Maran yields a satisfactory explanatory mechanism for denoting tone. Unfortunately, subsequent laboratory experiments have failed to document the physiological correlates of the features proposed. Each of the oppositions has been re-examined. Ohala (1973) and Ewan and Krones (1974) tested the features [raised] and [lowered]. While the general tendency was that described by Maran, high larynx position, [+raised] for high tones and voiceless consonants, and lower position, [-raised] for voiced stops and low tones, the degree of correlation varied with other articulatory gestures. The larynx rose more for dental stop articulations than for bilabials, regardless of voice. Rises also accompanied high front vowels, while mid vowels left the positioning unaltered, [-raised, -lowered], and back vowels lowered the larynx. Aspirated stops had slightly lower larynx mean positions than their unaspirated counterparts. They conclude that larynx height may not be an independently controllable variable for voicing and pitch, but rather is a passive correlate of other gestures. Such a feature may still be needed for implosives and ejectives, but a single binary feature [$\pm$ up], rather than the two features raised and lowered would suffice to distinguish these articulations.

Halle-Stevens (1971) in incorporating the feature [raised] into their system sought to use it as a cover feature which, while claiming to name the primary controllable articulator, includes aspects of (1) ejection vs. implosion, (2) voice onset timing, (3) glottal stricture, and hence, (4) pitch. While these four elements often pattern together, Ladefoged (1973) points out that

they need not do so. The feature [raised] and its correlated [lowered] then show neither the direct physical correlates predicted nor serve as a cover term for a group of covarying parameters and so fail to be more than an arbitrary label without physiological or acoustic reflexes.

The second dimension in the proposed feature system, glottal aperture, [constricted] and [spread], has been studied for Korean by Hirose, Lee and Ushijima (1974) and for English by Lisker and Abramson (1971), Hirose and Gay (1972), Ladefoged (1972) and (1973), and Ohala (1973). Again the physiology of tone production does not correspond to that predicted under the proposed system. The degree of glottal stricture may vary independently of pitch and does, Ladefoged (1972) reports, in many Nilotic languages. Thus pitch or tone features can not be subsumed without cost under glottal stricture uniquely determine voicing. Lisker and Abramson (1971) found that vocal cords may be placed in a position that allows voicing, but they can not by their degree of openness alone cause or block voicing. The feature [spread] or [constricted] may still be needed to determine types of phonation, such as glottalization, glottal stop, and creaky voice, but it is neither necessary nor suffient as an articulatory correlate of either pitch or voicing.

The final pair of features proposed by Halle-Stevens, [stiff] and [slack], has received the most serious objections from phoneticians. Ohala (1973) declares that there is no evidence for stiffness of the vocal cords, or laryngeal muscles generally, with high toned segments, nor for laxness of these muscles with low tones. He points out that while influence of consonants on following vowels

is common and runs along lines congruent with Halle-Stevens features, low tone with breathy voice (including [ɦ]) and voiced consonants and high tone with voiceless consonants, there is no consistent influence of following consonants as predicted by Halle-Stevens system and as explicitly stated in LaRaw Maran's tonogenesis theory for Burmese. Ladefoged (1973) takes direct issue with the Halle-Stevens claims, finding positive evidence that creaky voice is not [+slack, -stiff], nor is the tenseness of the vocal folds the same for high toned vowels and voiceless obstruents. Voiceless obstruents are not in fact [+stiff]. Lisker and Abramson (1971) found that there is no direct correlation between the tenseness of the laryngeal muscles and voicing; but rather the relationship of tenseness to voicing varies from language to language. So the tension dimension of the coalesced Halle-Stevens-Maran system fails to correlate to any physiological reality as well. The feature [stiff] and [slack] must be discarded or relegated to arbitrary status.

Ladefoged (1973) in discarding the Halle-Stevens proposal remarked:

> A correct feature system must make it possible for differences in phonation type, which are due to differences in glottal stricture, to be separated out from differences in pitch which depend on another mechanism. It must also be possible to show that voiced sounds, breathy voiced sounds, and creaky voiced sounds can all occur over a range of different pitches. (Ladefoged, 1973. p. 82)

The failure of the Halle-Stevens-Maran features to correlate closely to their predicted output may lie in their abstractness. They seek to apply to the laryngeal musculature as a whole, though stiff-slack values are attributed to the thyroarytenoid and cricothyroid muscles specifically. Hirose and Gay (1972) determined two

independently activated sets of muscles involved in positioning and tensing the vocal folds: (a) the posterior cricoarytenoid muscle and the interarytenoid muscle teamed, tensing and laxing reciprocally; (b) the vocalis and cricoarytenoid muscles and the lateral cricoarytenoid muscles acted together. Ohala (1973) isolates the physiological correlates of tone as specifically laryngeal muscles. Therefore, if we can determine how the two sets of laryngeal muscles isolated by Hirose and Gay correlate to tone, we may also be able to define tonal features in terms of their gestures. Their studies indicate that while there is definite tensing and laxing of the reciprocal sets of laryngeal muscles for voicing, these muscles do not directly correlate to pitch. The cricothyroid appeared to be the prime pitch raising muscle. But the cricothyroid also is crucially involved in stress. Hirose and Gay (1973), Winitz, LaRieviere, and Herriman (1975) and Lisker and Abramson (1971) conclude that pitch, as well as aspiration and voice, is the result of coordination of (1) the timing of voice onset, and (2) the glottal width at the moment of articulatory release.

The first factor, voice onset timing (VOT), can be finely differentiated. Nooteboom (1973) found that people can distinguish very fine adjustments in timing, down to 10 ms. However, the ranges used in language tend to be greater, between 50 and 200 ms. Ladefoged (1972) found that languages may use as many as three variations in VOT as contrastive. Languages such as Thai and Hindi make use of a three way contrast: (1) voicing preceding articulatory release, (2) voicing shortly after articulatory release, and (3) voicing long after articulatory release. Kagaya (1974)

corroborated a similar three way distinction, first noted by Kim (1970), in VOT for Korean stops.

However, he points out, as do Winitz, LaRiviere and Herriman (1975) that VOT alone will not determine either voicing state nor tone, but must be coordinated with specifications for glottal width at the time of release. The distance between the folds at release influences airflow, hence, pitch, as well as aspiration. It is the conjunct of VOT and glottal width specifications, then, which determines pitch. It would be logical to express tone features in terms, then, of these physiological correlates, as SPE tradition defines features on the basis of their articulatory gestures. Ladefoged (1972) and (1973) proposes that the two features Timing and Glottal Stricture jointly be used to determine tone. He suggests a three value scale for each feature. This would be interconvertible with two sets of binary features with one of the combination options ruled out by convention.

2.5 (c)

Timing	Early	Delayed	
1	+	-	
2	-	-	
3	-	+	
*	+	+	out by convention

Glottal Stricture	Open	Closed	
1	+	-	
2	-	-	
3	-	+	
*	+	+	out by convention

For both the parameters, timing and glottal stricture, the plus values for both oppositions, [+early, +delayed] and [+open, +closed], would be disallowed.

Ladefoged (1973) indicates, however, that these two dimensions are necessary for a description of pitch changes, as well as for types of phonation, murmur, creak, voicing, aspiration. He notes that while these gestures may cause a rise in pitch by themselves, other glottal mechanisms may compensate to nullify the rise or convert it to a fall. Height of larynx and stretching of the vocal cords along the horizontal are two such mechanisms which interact.

Hirose and Gay (1972) studied the interplay of laryngeal muscles by electromyography, but were unable to specify a set of muscular gestures as uniquely determining pitch. However, they concluded that the cricothyroid was the single most important muscle, and that the crucial factor in determining how the gestures of the musculature as a whole would be interpreted, whether as voicing, pitch, aspiration, creak, etc. was the relative timing of the muscle activity patterns.

While the primary factors involved in pitch determination have been isolated, their interplay is as yet too amorphous to allow a unique feature description. Though Ladefoged (1973) has indicated at least two parameters which must be included in an adequate feature system, the complementary features needed to uniquely determine pitch specifications along those parameters are as yet uncertain.

The proposed complete system, a combination of features used by Halle-Stevens (1971) and Maran (1971) has been rejected in the face of four objections:

(1) The physiological correlates ascribed to these features don't in fact pertain. Tenseness is not related to tone directly. (2) The interrelation of consonant types and tone can not be due solely to identical glottal states as the laryngeal muscles make different gestures for consonants and vowels. (3) Tone may vary over different phonation types and hence can not be wholly determined by those mechanisms defining phonation, voicing, creak, breathiness, etc. (4) The features make bi-directional predictions for tonal effects of consonants. The state of voicing of consonants should cause assimilation as readily in preceding as in following segments, whereas Ohala (1973) reports regressive assimilation of tone to preceding vowels only for [h] and [ʔ]. Other consonants affect only following segment's tones.

No complete feature system has been proposed to replace the Halle-Stevens-Maran model, but an outline of the form it would have to take has been presented in this section 2.5. A complete tone feature system would have to refer crucially to the laryngeal musculature as Ohala (1973), Ladefoged (1972), Lisker and Abramson (1971) discard respiratory mechanisms as crucial to tone, and oral gestures co-occur with all tonal values. In addition to simply citing a state of the relevant musculature, reference will have to be made to the timing of the gesture. Something along the lines of the features proposed by Ladefoged (1972) and (1973) must figure in the final formulation, either in the tertiary format he gives or in the binary form traditional in generative phonology.[2]

The inclusion of features of timing represents a modification in the theory as it refers not to a single gesture but to the

coordination of that gesture with other articulatory states. But that timing itself is crucially important is attested by Kagaya (1974), Hirose and Gay (1972), Ladefoged (1972b) and (1973), Lisker and Abramson (1971). Timing is crucial not only for tone description, but also for consonants. Three degrees of consonantal voicing have been found distinctive for languages such as Thai (Ladefoged 1972b and Lisker and Abramson 1973), Hindi (Ladefoged 1972b), and Korean (Kagaya 1974). Two degrees are contrastive for stop oppositions in English (Winitz, LaRiviere and Herriman 1975), French (Caramezza and Yeni-Komshian 1974), and Spanish (Lisker and Abramson 1973), though the specification for the onset of voice in voiceless stops differs for each of these languages.

Voicing, then, while specifiable by binary features, such as voice, is only crucial as it relates to time. Some mechanism must be built into the feature matrix model to accomodate change in feature value along a time continuum as the crucial factor in producing and identifying significant distinctions. Gandour (1974) identified four points in timing of vowel articulations that contrastively specify tone and consonant types in Siamese; pre-release, release, peak after release, and the point past which the preceding consonant has no effect on the contour. Ladefoged (1972a) and (1973) recognizes three possible timing contrasts, though many more variations. Nooteboom (1973) notes that people are capable of making and disinguishing more fine distinctions: the average duration of a stressed vowel is 100 ms; people can adjust easily down to 10 ms intervals, and possibly below that. How to specify the correlation of articulatory gestures over time in a unified model

of phonology is unclear, though it seems likely that more than a single binary feature will be needed; perhaps four features corresponding to Gandour's contrast points, or three as Ladefoged proposes, or spread over syllables as Lehiste (1970) posits.

While we can conclude that a descriptively adequate feature system correlated to articulatory fact will have to refer to glottal muscular states (in particular, to aperture width, controlled by the posterior cricoarytenoid and interarytenoid muscles), and that the timing of these coordinated gestures must be specified, we can not completely elaborate such a feature system as other muscles, such as the cricothyroid, the muscles raising the larynx, those moving the tongue root, etc., interact affecting tone, and their exact role has not yet been determined. Therefore, we must postpone the development of a definitive outline of tonal features.

In sections 2.1 through 2.4 we examined proposed binary features systems that sought to label acoustic attributes and found that none of these systems could encompass the maximum number of contrastive tones now known, five, and still uniquely designate tone feature values for less complex tone systems while maintaining the natural tone classes required by tone rules. In section 2.5 binary, and tertiary, feature systems based on articulatory parameters were examined, but no system was found that would provide a unique feature specification for tone, though two of the major parameters for future elaboration in such a system were designated. In lieu of an adequate feature system, we will designate tone in the following chapters simply by labels; high (H), mid (M), and low (L), always recalling that in a complete theory these labels will correlate to

specific sets of features naming articulatory gestures.

Footnotes

Chapter 2

1. The statement of this relationship and data supporting it are found in LaRaw Maran (1972) and (1973). Matisoff (1972) adduces some arguments against this position. These arguments are largely considered and countered in the 1973 Maran article. However, universal phonetic tendencies to progressively assimilate consonantal effects onto tone-bearing segments as stressed in Ohala (1973) and as pointed up in the Matisoff article are not considered.

2. The binary features convert to scalar values at a phonetic level by language specific rules in the Chomsky-Halle model. On page 298 of SPE they state, "The features have a phonetic function and a classificatory function. In their phonetic function, they are scales that admit a fixed number of values, and they relate to independently controllable aspects of the speech event or independent elements of perceptual representation. In their classificatory function they admit only two coefficients..."

Chapter 3

Kinetic Tones

The mechanisms discussed in the preceding chapter were designed to handle the specification of a given tone, high, low, or mid; 1, 2, 3, 4, or 5, within the feature matrix of a given vowel. While no unique feature specifications were determined in Chapter 2, two parameters for an adequate feature system were indicated, glottal stricture and timing. In this chapter I will look at proposals by Wang (1967), Woo (1969), Williamson (1970), Maddieson (1970), Fromkin (1971) and Dwyer (1973) for adjusting feature specifications to handle kinetic tones, tones which are not level throughout a segment.[1] I will suggest a way to describe these tones using the parameter of glottal timing.

3.1 Proposal by S-Y Wang

Wang (1967) proposed that, whenever a single segment carries a non-stationary tone (a rising tone, a falling tone, a rising-falling tone, or a falling-rising tone), the feature [+contour] appear in that segment's feature matrix. The direction of the movement of tone (up, down, or see-saw) would then be supplied by other features: [+rising] would indicate movement from a low pitch to a higher tone; [+falling] would describe movement from a high pitch to a lower tone. The degree of rise or fall may be indicated in Wang's system by the co-occurrence of features of height, [High], [Central], and [Mid].[2] A tone may be both rising and falling. A third feature is then needed to specify the ordering of the fall with respect to the rise, when a tone is [+rising, +falling]. Wang uses the feature [convex] to achieve this ordering.

A [+convex] tone rises before it falls. A [-convex] tone falls and then rises. Table 3.1 shows some sample kinetic tone specifications within this system.

Table 3.1

	high-rising	low-rising	high-falling	low-falling
contour	+	+	+	+
High	+	-	+	-
Central	-	-	-	-
Mid	-	-	-	-
rising	+	+	-	-
falling	-	-	+	+
convex	-	-	-	-

	high falling-rising	low falling-rising	high rising-falling	low rising-falling
contour	+	+	+	+
High	+	-	+	-
Central	-	-	-	-
Mid	-	-	-	-
rising	+	+	+	+
falling	+	+	+	+
convex	-	-	+	+

This feature system is sufficient to exhaustively describe known tone oscillations. For a given dynamic tone there is a way to desribe it. However, this system is too powerful as indicated in 2.3. Languages with fewer than five tones will not require distinctive use of all the height specifying features. For a language such as Hausa with only two distinctive tones the specification of a falling

tone in Wang's features might be any of those in 3.1 (a).

3.1 (a)

Contour	+	+	+	+
High	+	+	-	-
Central	-	+	+	+
Mid	-	-	-	+
rising	-	-	-	-
falling	+	+	+	+
convex	-	-	-	-

For kinetic tones as well as for level tones, then, Wang's system may yield non-distinct feature specifications.

In addition to this lack of uniqueness his system complicates the description of simple phonological assimilations. For example, Ngizim (Hyman and Schuh 1974) forms plurals by affixing -aC_2ín to the singular stem. The tone of the vowel is copied from the end point of the kinetic tone. Only the end tone is reduplicated not the entire tonal contour. Thus, wûrjí, scorpion, has a falling tone on the first syllable and a high tone on the final vowel. This final vowel is not taken as part of the stem. The plural form of scorpion is wúrjàjín with a high first syllable, low second syllable and high final syllable. The tone of the second syllable derives from the low toned end point of the singular stem wûrj-. The contour itself is simplified to a single high when followed by a low tone. Both this simplification rule and the tone copy rule must be viewed as unnatural and highly unlikely events in Wang's framework. Tone copy in this case would read as in 3.1 (b). The rule of tone simplification would

look like 3.1 (c).

3.1 (b)

$$V \rightarrow \begin{bmatrix} -\text{contour} \\ -\text{High} \\ -\text{Central} \\ -\text{Mid} \\ -\text{rising} \\ -\text{falling} \\ -\text{convex} \end{bmatrix} / \begin{bmatrix} +\text{contour} \\ +\text{High} \\ -\text{Central} \\ -\text{Mid} \\ -\text{rising} \\ +\text{falling} \\ -\text{convex} \end{bmatrix} \quad C_0^2 \_\_\_\_$$

3.1 (c)

$$\begin{bmatrix} +\text{contour} \\ +\text{High} \\ -\text{Central} \\ -\text{Mid} \\ -\text{rising} \\ +\text{falling} \\ -\text{convex} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{contour} \\ +\text{High} \\ -\text{Central} \\ -\text{Mid} \\ -\text{rising} \\ -\text{falling} \\ -\text{convex} \end{bmatrix} / \_\_\_ C_0^2 \begin{bmatrix} -\text{contour} \\ -\text{High} \\ -\text{Central} \\ -\text{Mid} \\ -\text{rising} \\ -\text{falling} \\ -\text{convex} \end{bmatrix}$$

Rules of simplification and tone copy are very common processes in West African languages, according to Hyman and Schuh (1973), among them Bamileke, Mende, Kikuyu, and Hausa, in addition to Ngizim. Taking these rules to indicate a natural phonological process, they should be more clearly assimilatory. Compare 3.1 (b) and 3.1 (c) with rules stated in terms of mnemonic labels, H and L, where $\frown$ indicates co-occurrence within a syllable.

3.1 (d)

Tone copy $\quad \emptyset \rightarrow L / \widehat{HL}\ C_0^2 \_\_\_\_$

3.1 (e)

Tone simplification $\quad L \rightarrow \emptyset / H\_\_C_0^2\ L$

The rule in 3.1 (d) shows clearly that the tone specification of the new vowel is a function of the end point of the preceding glide. While 3.1 (b) leaves this relationship unstated. The rule formulated in Wang's system makes the fact that the new vowel

is low as opposed to mid or high seem purely fortuitous. The rule 3.1 (e) shows that a fall becomes a level high when its endpoint would be the same as the following tone. 3.1 (c) does not indicate that the change from [+contour, +fall] to [-contour, -fall] is to be expected before [-High, -Central, -Mid], low tone, any more than before [+High, -Central, -Mid], high tone, or [-High, +Central, +Mid], mid tone.

An adequate feature system should allow rules to be stated in ways which show assimilations to be such, adjustments of feature values to be more like those of neighboring matrices. Wang's features do not allow this for languages like Ngizim, using tone copy and tone simplification strategies like those suggested in 3.1 (d) and (e).

Furthermore, Woo (1969) has shown that the neutral tone of Chinese assimilates to surrounding tones by rules that appear as assimilations if the dynamic tones are analyzed as a series of level tones. Restrictions on syllable structure and tone correlations, also, are statable if the kinetic tones are not treated as single units, but are broken into level sections.

Arguing then that a proper feature system must enable us to uniquely describe tone, ie. assign one feature value to a given tone, and that with proper features the natural process of assimilation will be expressable in terms of changing unlike feature specifications in neighboring matrices to like specifications, and that Wang's system yields neither unique feature specifications nor clearly natural rules, we must conclude that the system as

proposed is "improper".

3.2 Woo's proposal

Woo (1969) after examining and rejecting Wang's feature system in favor of a system which allows kinetic features to be expressed as a series of level tones proposes the following features: [High], [Low], and [Modify]. [High] is a cover symbol used to indicate whatever glottal gestures are involved in producing a pitch higher than the "natural pitch" for a given speaker. This "natural" pitch is defined as that pitch around which the phonation of a given speaker habitually clusters. [Low] is the reciprocal cover feature, indicating whatever glottal gestures produce a pitch lower than the mean. [Modify] refers to any gesture used in addition to those which yield [High] and [Low] to change the normal waveform of the pitch produced.

Thus a five-toned language would have the features shown in 3.2 (a).

3.2 (a)

	1	2	3	4	5
High	-	-	-	+	+
Low	+	+	-	-	-
Modify	-	+	-	+	-

By convention no feature may be [+High] and [+Low] simultaneously, nor may a [-High, -Low] matrix be [+Modify]. A marking convention to the effect that [+Modify] be marked would be able to cull the candidates for non-unique tone specification in two and three toned languages, but the system would still yield a non-unique

specification for four toned languages.

3.2 (b)

	1	2	3	4
High	-	-	-	+
Low	+	+	-	-
Modify	-	+	-	-

	1	2	3	4
High	-	-	+	+
Low	+	-	-	-
Modify	-	-	+	-

This ambiguity is slight, however, compared to that of systems examined in 2.1-4.

Woo makes a further claim in presenting this system: that the features presented are to be assigned one set per segment. A given segment will have one set of specifications for the features [High], [Low], and [Modify] and no more. If all kinetic tones, as she argues, are series of level tones, each tone specified by a set of these glottal cover features, then all kinetic tones must be distributed over a series of segments. A tone series of rise from low to high and fall back to low would require three tone specifications and three segments to carry these specifications. To this end she analyzes all vowels which may carry rising or falling tone as a series of two vowels, and those vowels that carry rising-falling or falling-rising tones as a series of three vowels. She provides phonetic data to the effect that the vowels in Mandarin Chinese which must be taken as sequences of vowels

are phonetically longer than vowels which are only single vowels. This laboratory data sustained her argument that this segmentation of vowels was not merely notational. She predicts that all languages with dynamic tones will have longer vowels carrying these moving tones, indicating their true nature as vowel sequences.

However, not all languages have phonetically longer vowels under kinetic tones. They do not, as Woo predicts, exhibit a one-to-one correlation between vowel or sonorant matrices (those which will accept tone features) and feature matrices for tone to be plotted. Languages such as Trique (Longacre 1952), Maninka (Spears 1968), Mende (Dwyer 1973), Nupe (Smith 1967 and George 1970), Maasai (Tucker and Mpaayei 1955), and Hausa (Kraft and Kraft 1973) all have phonetically short vowels with dynamic tones. They have only one matrix to accept tone features and two matrices of tone features to be squeezed in. Somehow, then, contrary to Woo's claim, short vowels or single vowel matrices must be adapted to take two tone feature sets. The short vowels with double tone do in fact behave just as two vowels each carrying tone behave with respect to tone rules. 3.2 (c) states a tone dissimilation rule for Hausa predicate noun stabilizing particles. In terms of one tone per segment. 3.2 (d) states this same rule with one segment doubled up on tone.

3.2 (c)

$$V \rightarrow [\alpha\ \text{Tone}] \,/\, \left[\begin{matrix}+\text{son}\\ \alpha\ \text{Tone}\end{matrix}\right] \left[\begin{matrix}+\text{son}\\ \beta\ \text{Tone}\end{matrix}\right] \#\ [\underline{\quad}]\ \begin{matrix}\text{noun}\\ \text{stabilizer,}\end{matrix}$$

where α Tone and β Tone indicate given specification configurations for the glottal features determining tone.

3.2 (d)

$$V \rightarrow [\alpha\ \text{Tone}] \,/\, \left[\begin{matrix}+\text{son}\\ [\alpha\ \text{Tone}]\ [\beta\ \text{Tone}]\end{matrix}\right] \left\{\begin{matrix}-\text{son}\\ \#\end{matrix}\right\}\ [\underline{\quad}]\ \begin{matrix}\text{noun}\\ \text{stabilizer}\end{matrix}$$

The rules in 3.2 (c) and (d) represent a unitary process, the dissimilation of a tone from the preceding tone. We would like to be able to write this as a single rule regardless of the number of sonorant segments, those capable of bearing tone in Hausa, paired with the tones.

3.3 Williamson's proposal

Williamson (1970) seeks to avoid the issue by suggesting that the tone matrices be allowed to float next to the appropriate vowel matrices and bear the specification [-segment]. Thus, the rule 3.2 (c) would remain as given and 3.2 (d) would be reformulated so that both tone feature sets have independent matrices, one getting to join uniquely with the [+sonorant] matrix, the other with a [-segment] matrix. This proposal buys us nothing.

First, it gives no non-arbitrary description of any short vowel with a kinetic tone. The sequence bâ might be either b $\begin{bmatrix} a \\ high \end{bmatrix}\begin{bmatrix} -seg \\ low \end{bmatrix}$ or b $\begin{bmatrix} -seg \\ high \end{bmatrix}\begin{bmatrix} a \\ low \end{bmatrix}$.

Second, by the time the phonology grinds through to the phonetic spell out rules, the [-segment] matrix will have had to have been replaced or merged with another matrix. The tone features are inherently glottal gestures. They will, at least, specify states of glottal stricture and timing of voicing onset. Something that is a non-entity, a [-segment] can hardly be [-open, +closed], or [+early, -delayed].

While the [-segment] approach gives tone a temporary domain, tone must eventually move into real matrices, so no saving is made

at the phonetic level. Rather more problems are built into the system as the feature [-segment] must be eliminated before the phonetic rules and features under it shifted into another matrix. Furthermore, the use of [-segment] at the systematic phonemic level also weakens the model as the positioning of the [-segment] matrix with respect to the [+segment] matrices is arbitrary.

3.4 Dwyer's proposal

Dwyer (1973) suggested another way around the problem of getting two tone specifications in a single vowel matrix. His solution is to split the vowel matrix in two parts, each completely specified for all the vowel features and differing only in tone readings. Thus, â would be á à

+syllabic	+syllabic
+sonorant	+sonorant
+vocalic	+vocalic
-consonantal	-consonantal
-high	-high
+back	+back
+low	+low
-anterior	-anterior
-coronal	-coronal
-round	-round
+tense	+tense
high	low

.

An equivalence rule makes two of these half vowels equal to a single vowel. Tone rules may operate on the half vowels just as on full vowels. These half vowels appear only as needed, that is, whenever a single vowel carries two tone specifications which differ. á need only be represented as

$$\begin{bmatrix} \text{+syllabic} \\ \text{+sonorant} \\ \text{+vocalic} \\ \text{-consonantal} \\ \text{-high} \\ \text{+back} \\ \text{+low} \\ \text{-anterior} \\ \text{-coronal} \\ \text{-round} \\ \text{+tense} \\ \text{high} \end{bmatrix},$$

though this is notationally equivalent to twin matrices.

The number of fractional matrices within a two-toned syllable is not limited by this approach so long as the duration of the syllable remains constant.[3] In addition to the original equivalence of two half vowels per whole vowel, other non-distinct variations are allowed. v́vv, where the v's are thirds of vowels, must be defined as non-distinct from v́v under one interpretation of Second High Tone Copying in Loko. (Dwyer, 1973. p. 113, footnote 7) As nasals are possible tone carriers, a syllable with falling tone on the vowel-nasal coda may alternately be described as Cv́v̀ŋ or Cv́vŋ. (Dwyer, 1973. p. 113, footnote 2)

Besides this indeterminacy such a proposal for a universal treatment of vowels and tone would have to explain why only tone rules apply to these micro-vowels while segmental rules of phonology always apply to macro-vowels.[4]

3.5 Explicit ordering proposals

The Dwyer and Williamson proposals are attempts to introduce ordering implicitly by positioning a new sub-segment or non-segment carrying the wanted specifications for tone next to another tone-bearing entity. Maddieson (1970) simply states ordering along with

with his feature specifications. Thus, $\underline{\hat{a}}$ is represented as

$$\begin{bmatrix} +\text{vocalic} \\ X \\ +\text{High-initial} \\ +\text{Lowered-initial} \end{bmatrix},$$

where X indicates the other non-tonal features of $\underline{a}$.

Fromkin (1971) proposes a variation of this. $\underline{\hat{a}}$, in her system, would be $\begin{bmatrix} +\text{vocalic} \\ X \\ +\text{High followed by -High} \end{bmatrix}$. Maddieson's and Fromkin's systems are notationally interconvertible. Under the currently accepted matrix feature model, there is no way to interpret these systems, with ordering built into the matrix. The feature [+voice] is not seen as preceding [+abrupt release] for the articulation of [b], though voicing does precede release of the stop closure for the French [b]. A convention for reading off ordering with matrices could easily be established, however.

One such convention might be to write the features to be serially realized within ordered brackets inside the feature matrix and then constrain phonetic and phonological rules to apply from the innermost set of bracketing outward. Thus, $\underline{\hat{a}}$ would be represented as $\begin{bmatrix} +\text{vocalic} \\ X \\ [\text{high}][\text{low}] \end{bmatrix}$, a vocalic segment which has first a high tone then a low tone realized over it. The phonetic rules would by convention start reading out at the innermost set of bracketings spelling out, from left to right, high first and low second as it scans the matrix. Likewise tone copy rules would have to apply to the innermost bracketing first, copying high for regressive assimilations and low for progressive assimilations. While the addition of this ordering format within a matrix requires adding more

power to the system in the form of a new read-out convention for the phonological component, such power would be needed for other features now given within a "simultaneous" matrix, but which imply ordering. [Abrupt release] and [continuant] are two such features now commonly used. Furthermore, qualities such as aspiration and voicing are now being shown to be intimately linked to timing of glottal gestures within what is traditionally viewed as a segment. A more detailed view of the features which would reflect this internal timing is given in 3.6.

However, adding more power to the theoretical model weakens the model in that it becomes less constrained. Such weakening should be avoided if possible. But the model must be extended to include tonal features and to be able to specify more than one set of the tone features per tone-carrying segment matrix.

3.6 Linearity and segmentation

The problems met in attempting to extend the system without weakening it may derive from the dilemma of segmentation. Linguists have explicitly recognized that speech is a continuum but have proceeded to segment without compunction. Recent phonetics laboratory experiments have re-emphasized the two-edged nature of segmentation.

The primary cue for proper stop identification, voice onset timing, overlaps the actual stop articulation in few languages. Languages such as Korean distinguish three classes of stops by degree of voicing onset delay after stop release. Kagaya (1974) found 15 ms delay for the forced series of stops, 60 ms for the lax stops, and 160 ms for the aspirated stops. Linearity and

straight segmentation do not give an accurate picture of the articulatory facts even for traditional features.

Ladefoged (1972) has indicated that he believes there to be three distinctive degrees of timing possible for coordination of glottal gestures that relate to tone. It may be that the glottal timing feature to be set into a feature matrix to specify tone can also be used to modify those specifications before the articulatory gestures accompanying the glottal movements are changed. Gandour (1974) isolates four spots within vowel articulation which he feels may prove to be points for manipulation of tone articulators as these points correspond to sites of crucial acoustic cues to tonal distinctiveness.

Should they, in fact, check out, the timing feature could spell out orders in terms of gestures up to a set point. If these four points prove not definitive, the timing feature must report in other terms, perhaps the three valued system suggested by Ladefoged (1972). No language appears to specify more than three tones per vowel.

3.7 Summary

Without a definitive feature system for tone, we can not hope to spell out its articulatory correlates for kinetic tones. However, in the foregoing discussion of kinetic tones we have seen that (a) kinetic tones behave with respect to tone rules as do series of level tones, (b) the artifices of manufacturing units to carry tone for the use of rules that must then be deleted only add complexity to the system, (c) explicit ordering within a single feature matrix would capture kinetic tones though weakening the theoretical model

of matrix phonology. We have indicated, however, that some weakening of that model may be in order, especially as we have already established the need for a feature of timing for glottal gestures that relate to tone.

Footnotes

Chapter 3

1. These tones are also referred to in literature on tone languages as "dynamic" or "contour" tones.

2. But recall the problems with these features in isolation, as discussed in 2.3.

3. The equivalence condition which formalizes this indeterminary is given in Dwyer (1973, p. 19). "Any sequence of identical segments is non-distinct from any other sequence of the same segments as long as the duration of each sequence is the same."

4. This problem is accentuated by rules which claim to delete vowels but not their tones as does the Schacter and Fromkin (1968) Twi analysis.

Chapter 4

Tone as Suprasegmental

The preceding chapters have been concerned with the representation of tone features within the feature matrices of generative phonology. As tone is realized simultaneously with segments, such a representation must be part of the phonology of any language which uses tone. However, tone may not be a feature only of segments throughout the derivation of a word specified for tone. There appear to be languages in which the domain of tone is greater than the segment, just as in the preceding chapter we discussed languages in which the domain of tone is smaller than the segment. In this chapter I first outline the format for a non-segmental representation of tone and then data from languages in which tone appears to be suprasegmental.

4.1 Definition

I refer to tone designations in which the tonal domain is not the segment paired with a given tone or tones as suprasegmental tones.

The term "suprasegmental tone" as used by Williams (1976) and Leben (1971) refers to tone patterns which are paired with lexical items rather than segments. This usage is congruent with the definition given here, the tonal domain being a word rather than a segment. Likewise the tonal displays of verb tenses in Tiv would be classified as suprasegmental by this definition as the domain of tone is a grammatical construction, a tense, rather than a segment. Churma (1975) suggests that a more appropriate term for tone patterns that are displayed over constructions rather than over lexical items

would be "non-segmental" tone. Suprasegmental tone as defined here refers to tone paired with lexical entries as well as to tone paired with constructions. "Non-segmental" tone would be a proper subset of suprasegmental tone.[1]

Suprasegmental tones, not being paired directly with segments throughout their derivation, must be represented outside the segmental matrices at some point.

4.2 Suprasegmental representation

In specifying suprasegmental tone for lexical items, the tone will be entered in the dictionary apart from the segmental portion of the entry. Tone need not be spelled out in terms of glottal gestures as it is not at that point paired with other articulatory movements, but with a larger unit, the word, the phonological word, or the grammatical construction. I will continue to use the mnemonic labels of Chapter 2 to refer to these tones, abbreviating high as H, low as L and mid as M.

Matisoff (1973) suggests that tone in languages with supra-segmental displays carries a lower functional load than tone in languages where tone is paired with a segment throughout the derivation. He concludes that the number of tonal contrasts, both in terms of greater numbers of distinctive tone levels and in terms of greater numbers of contours, is directly proportional to the functional load of tone. So we might not expect four and five toned languages to employ suprasegmental tone. I know of no proposals for suprasegmental analyses of languages with more than three tones.

For those languages with such analyses a mechanism for representing the pairing of tone with units above the level of the segment

must be developed. I suggest that where the domain of tone is not a lexical item per se but a grammatical construction, as with verbs in Hausa, no tone specification accompanies a verb's dictionary entry, but the tone pattern is a distinct lexical entry in its own right, perhaps with other segmental information, spelling out the morpheme of verbal mood. Thus, the verb karant- 'read' is listed without any tone and a separate entry lists HL and a suffixal -e as the spelling of the completive mood. Where the domain of tone is the lexical item, as with nouns in Hausa, the dictionary entry for the word will have a matrix of segmental data and a specification of the tone display. A word like roozoo 'large, swift spider' is paired in the dictionary with the lexical tone specification H.

The mechanics for mapping the tones thus specified for lexical items or constructions onto the segments with which they are realized is discussed in detail in Chapter 5 for the Hausa language. At this point I wish only to demonstrate how tone may be marked not as a feature on segments but as associated with another domain, that of the lexical item or the construction. Should other domains be found to require tonal specification, pairing of tone patterns with those domains would be expected to follow along these lines.

4.3 Languages with suprasegmental tone

4.3.1 Margi

Williams (1976) proposes a suprasegmental analysis for Margi. The domain of tone in Margi is the morpheme. Each morpheme has a lexical entry, but not all are tonally specified. Verbs, for example, are tonally marked. Verbal affixes are not. Thus, the dictionary entry for the verb fǐ 'to swell' is paired with a LH tone pattern.

The causative verbal affix -ani has no paired pattern. The derivation of the verb form fyàní 'to make swell' in a suprasegmental analysis proceeds as in 4.3.1 (a).

4.3.1 (a)

lexicon	fi	LH
	-ani	0
lexical insertion	fiani	LH
P-rule: vowel glide formation	fyani	LH

tone-mapping

f	y	a	n	i
-syl	-syl	+syl	-syl	+syl
		L		H

A segmental derivation of this tone pattern would be more complicated as the lexical pairing of LH with fi alone is still necessary. 4.3.1 (b) shows a possible segmental derivation of fyani.[2]

4.3.1 (b)

lexicon	fi ˇ
	-ani
lexical insertion	fiani ˇ
tone copy	fiani ˇ ´
tone simplification	fiani ` ´ ´
P-rule: vowel glide formation	fyani ` ´ ´
tone shift	fyàní

The mechanisms of the lexicon, lexical insertion and tone mapping would be part of the universal grammar and would not count as

cost in the system. A suprasegmental assignment of tone to verbs in Margi allows verbal derivations to be stated with no tone rules, whereas a segmental assignment of tone requires three tone rules to juggle tone around as desired.

Compounds with vowel reduction in Margi again show the simplicity of a suprasegmental representation. The morphemes tlá 'to cut' and wà form tlwâ 'to cut in two'. In suprasegmental terms this may be represented as in 4.3.1 (c).

4.3.1 (c)

lexicon	tla	H
	wa	L
lexical insertion	tlawa	HL
V-deletion	tlwa	HL
tone mapping	tlwâ	

In segmental terms this would have to be stated as in 4.3.1 (d).

4.3.1 (d)

lexicon	tlá	
	wà	
lexical insertion		tláwà
tone spread[3]		tláwá̀
V deletion		tlwâ

Again a segmental analysis requires one more rule than a suprasegmental treatment. Furthermore, the rule needed is extremely powerful, having a global scope as in 4.3.1 (d). However, this power can be eliminated if vowels may delete while leaving their tone behind.

A similar rule shifting tone in the opposite direction is needed for other compounds, such as ngyîr 'to light', ngíí 'to burn' and

ri, under a segmental analysis. 4.3.1 (e) shows this segmental derivation.

4.3.1 (e)

lexicon	ngií rì
lexical insertion	ngiíri
reartone spread	ngiîrì
truncation	ngiîr
glide formation	ngyîr
tone shift	ngyîr

The tone rules needed for 4.3.1 (e) are rear tone spread, 4.3.1 (f), and tone shift, 4.3.1 (g).

4.3.1 (f)

$$\begin{bmatrix} +\text{syl} \\ \beta\ \text{Tone} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{syl} \\ \alpha\ \text{Tone} \end{bmatrix} \ / \ \underline{\quad} \ [-\text{syl}] \ \begin{bmatrix} +\text{syl} \\ \alpha\ \text{Tone} \\ +\ \text{Doom} \end{bmatrix}$$

4.3.1 (g)

$$\begin{bmatrix} -\text{syl} \\ \alpha\ \text{Tone} \end{bmatrix} \begin{bmatrix} +\text{syl} \\ \beta\ \text{Tone} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{syl} \\ \emptyset \end{bmatrix} \begin{bmatrix} +\text{syl} \\ [\alpha\ \text{Tone}]\ [\beta\ \text{Tone}] \end{bmatrix}$$

Again a suprasegmental analysis would handle this derivation with no tone rules.

4.3.1 (h)

lexicon	ngii	H
	ri	L
lexical insertion	ngiiri	HL
truncation	ngiir	HL
glide formation	ngyir	HL

tone mapping	n	g	y	i	r
	-syl	-syl	-syl	+syl	-syl
				HL	

Notice that what the rear tone spread rule of 4.3.1 (f) and the tone spread rule of 4.3.1 (d) accomplish is to move the tone of a delete-fated segment onto the nearest segment capable of bearing tone. Tone spread shifts tone to the right because a vowel on the left is to be deleted; rear tone spread shifts tone to the left as a vowel on the right is to be deleted. Though these rules represent a single process, there is no way to collapse them. A segmental treatment of tone in Margi must add at least three rules to the phonology; tone spread, rear tone spread, and tone shift. Two of these rules must be global in scope.[4] A suprasegmental treatment is simpler, needing no tone rules, only the phonological mechanism of mapping tone onto available tone carriers, [+syllabic] segments in the case of Margi. Tone in Margi is most simply described as suprasegmental. The tone domain, the unit carrying a tone specification in the lexicon, is the morpheme.

4.3.2 Tiv

McCawley (1970) describes tone in Tiv verbal conjugations. He finds that the sixty-six different tone patterns traditionally associated with tenses may be reduced to eighteen tonal tense morphemes using a suprasegmental analysis where the lexical pair of tone specification is tense. The association of tone and tense is not statable in a purely segmental theory except by rules which would change arbitrary values for tone on verbs to the desired ones in the proper grammatical environment, the proper tense.

4.3.3 Bolewa

Newman (1972) shows that in Bolewa the subjunctive construction is always LH regardless of segmental correlates. Thus, Bolewa uses

suprasegmental tone for the mood distinction, subjunctive. The domain of tone is the construction, not the segment.

4.3.4 Kikuyu

Pratt (1972) finds that the apparently anomalous behavior of some tense suffixes with respect to tone is due to their independence from tone. The suffixes are atonal. Tone patterns are the realization of tense morphemes. Again tone is suprasegmental. Its domain is the construction verb tense.

4.3.5 Igbo

In Igbo another advantage of suprasegmental representation of tone can be illustrated, simplification of rules. To form interrogatory tense in Igbo, verbs with all high tones are lowered to all low; verbs with LH tones also become low throughout. Verbs with HL tones remain unchanged, as do verbs with all low tones.

4.3.5 (a)

HH → LL HL → HL

LH → LL LL → LL

In a segmental system of representation a rule which would accomplish the desired lowering would be represented as 4.3.5 (b).

4.3.5 (b)

$$\text{high} \rightarrow \text{low} \; / \left[X \; \underline{\quad} \; \begin{matrix} +\text{syl} \\ \overline{+\text{syl}} \end{matrix} \; (C_0^2 \; \begin{matrix} +\text{syl} \\ \text{high} \end{matrix}) \; \# \right] \text{question}$$

where the rule must apply iteratively to its own output to obtain the correct result for HH verbs.

The verb cíá, 'carry' will be lowered to cìà 'carry?' through the stages shown in 4.3.5 (c).

4.3.5 (c)

lexicon	cía
interrogative lowering first application	cìa
interrogative lowering second application	cìa

However, with suprasegmental representation, the rule may be stated without reference to segments. Interrogative lowering would apply before tone mapping associates tone with segments. 4.3.5 (d) states the lowering rule in suprasegmental terms. 4.3.5 (e) shows the suprasegmental derivation of cia 'carry?'.

4.3.5 (d)

$$H \rightarrow L \; / \; \underline{\quad\quad}\#_{\text{question}}$$

4.3.5 (e)

lexicon	cia		H
interrogative lowering	cia		L
tone mapping	c	i	a
	-syl	+syl	+syl
		L	L

Again the suprasegmental framework yields a derivation with fewer stages; interrogative lowering need only apply once. Furthermore, the rule used here may be stated more simply than the segmental rule. The environment is simply word boundary within a question. There is no need to sketch out skeletal structures for possibly intervening syllables as is necessary in the segmental version. Finally the rule need not be taken as applying iteratively to its own output.

4.3.6 Efik

Efik has a rule similar to interrogative lowering in Igbo.[5] This rule lowers initial sequences of high tones in noun-noun and adjective-noun compounds. In a suprasegmental anaysis this rule would be stated as 4.3.6 (a).

4.3.6 (a)

$$H \rightarrow L \;/\; \#_n \left[\left[\begin{Bmatrix} n \\ a \end{Bmatrix} \_\_\_\_ \right.\right.$$

A segmental analysis would be forced to list the possible syllable structures through which the lowering would have to iterate. The suprasegmental analysis again allows the simpler statement of the tone rule.

4.3.7 Tangsic, a Wu dialect of Chinese

In Tangsic, tone is associated with the lexical item, but the tone mapping rule maps the tone of the first lexical items in a compound over the whole compound. The following examples are taken from Leben (1973).

4.3.7 (a)

syao	'small'	nyin	'man'	syao-nyin	'children'
HL		LH		H L	
pen	'ice'	sea	'water'	pen sea	'ice water'
M		HL		M M	

A segmental analysis of these facts would first have to erase all but the first or first two tones, depending on the structure of the first syllable within a compound noun and then move the needed tones over to the proper syllabic units, and erase the moved tones on the first morpheme syllabics. A suprasegmental analysis need only map the

initial morpheme tones over the compound in the first place.

4.3.8 Mende

Leben (1973) describes a morpheme structure constraint in Mende which prohibits a morpheme carrying the tonal sequence HLH. Tonal sequences of the form LHL are quite alright and occur on one, two, and three syllable words: mbâ 'companion', nyàhâ 'woman', and nìkílì 'groundnut'. But neither one, two, nor three syllable distributions of HLH are admissible. Words such as *mbǎ, *nyáhǎ, *nìkílì are impossible. The statement of this restriction in a segmental theory of tone would require spelling out the possible syllable forms for one, two, and three syllable words, whereas a suprasegmental statement need not refer to segments at all. The tone patterns are paired with morphemes.

Mende has another restriction which in suprasegmental terms may be stated as * #HHL#/ Thus both *nyáhâ and *níkílì are impossible words in Mende. A segmental theory would again have to spell out possible carrier syllable forms to state this restriction. Morpheme structure conditions in Mende are more simply stated without reference to segments.

4.4 Summary

In section 4.3 several languages were presented which are more simply described if a suprasegmental representation of tone is applied to them rather than a segmental representation. Simplifications have taken the form of (1) reducing the number of rules needed within a derivation, (2) simplifying the statement of a given tone rule within the derivations, (3) streamlining the statement of morpheme structure conditions. The descriptions of the languages discussed

in 4.3 are simplified under suprasegmental analysis. We must conclude that features of tone for these languages are suprasegmental rather than segmental. In these languages, tone is best seen as a feature correlated with morphemes or constructs, but not with segments.

Footnotes

Chapter 4

1. There is another sense of suprasegmental that is used by Lehiste (1970). She defines suprasegmental as those aspects of phonology which are (a) due to secondary articulatory gestures coordinated so as to overlap other primary gestures, (b) not determinable in isolation but only in comparison with other instances. By non-determination in isolation she refers to the relative nature of stress, tone, and length. A given phonetic reading may correlate to stress or unstress, high or low tone, long or short duration; the value is not determinable by absolute measurements but only by comparison with surrounding units. In these phonetic terms all tone is "suprasegmental." I will use the term exclusively in the sense given in 4.1, however.

2. The rules needed for the derivation in 4.3.1 (b) are tone copy, tone simplification, vowel glide formation and tone shift. Vowel glide formation is needed in the derivation of 4.3.1 (a) as well.

tone copy

$$V \rightarrow \alpha\,\text{Tone} \;/\; \underset{[\alpha\text{Tone}]}{V}\;(C)\;\_\_$$

This rule must apply iteratively to its own output to get high tone out to the final i of -ani.

tone simplification

$$[H \rightarrow L \;/\; \_\_\; H$$

vowel glide formation

$$[+\text{syl}] \rightarrow [-\text{syl}] \;/\; \_\_\; [+\text{syl}]$$

tone shift

$$\begin{bmatrix} -\text{syl} \\ \alpha\text{Tone} \end{bmatrix}\begin{bmatrix} +\text{syl} \\ \beta\text{Tone} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{syl} \\ \emptyset \end{bmatrix}\begin{bmatrix} +\text{syl} \\ \alpha\text{Tone} \end{bmatrix}$$

3. Some derivational constraint must trigger this spread if and only if the vowel is marked for deletion. Alternately we could be allowed to delete a vowel, but not its tone and then shift that tone. The rule of tone spread would look like:

$$\begin{bmatrix} +\text{syl} \\ \beta\ \text{Tone} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{syl} \\ [\alpha\text{Tone}]\,[\beta\text{Tone}] \end{bmatrix} \;/\; \begin{bmatrix} +\text{syl} \\ +\text{Doom} \\ \alpha\text{Tone} \end{bmatrix}\; -\text{syl}\; \_\_\_\_$$

4. If the rule schema avoiding global rules is used, three rules would still be needed: shift of the [-segment] tone to the left and shift of [-segment] tone to the right as well as shift of [-syllabic] tone. The [-syllabic] and [-segment] right shifts might be collapsed making only two shift rules necessary, left and right.

5. Efik data are from John Ritter in personal communication.

Chapter 5

Suprasegmental Tone in Hausa

Overview

This chapter will present evidence showing that Hausa is best described as having suprasegmental tone. The domain of tone in Hausa is either that of the lexical entries or of grammatical constructs. After presenting the case for a suprasegmental analysis of Hausa tone, I will outline the form of the tone mapping rule, the rule which eventually inserts tone specifications into the segmental matrices for phonetic read-out. For explication of rules and derivations given in sections 5.1 - 5.5, the reader is referred to 5.7, the mapping rule.

5.1 The case for suprasegmental tone in Hausa

The case for a suprasegmental tone analysis of Hausa rests on four points: (1) various morphemes in Hausa have alternating segmental forms but are always paired with the same tone pattern regardless of the number of segments available for carrying tone (section 5.2); (2) certain constructions (imperative mood, deixis, abstract nouns of sensory quality) are represented as a set tone pattern: the lexical entry for that construct is simply a tone play (section 5.3); (3) the verbal classes, another grammatical construct, each have a tone play coupled with a suffix as their representation and this tone pattern must be spread over the entire verb form (section 5.4); (4) noun plurals have determined tone forms predictable either from the plural affix or the singular noun tone; these tone forms again are to be spread over all available segments (section 5.5).

Tone in Hausa when paired with lexical items as in the words with alternating bases is independent of segments as tone patterns do not vary where segments do. Tone is further shown to be independent of segments by being the only realization of certain constructs and spreading over the entire string of segmental material encompassed by that construct. Finally where both segmental affixes and tone denote constructs, as in verbal grades and noun plurals, the tone is not solely attached to the affixes denoting the construct, but is mapped over the entire construction.

5.2 Morphemes which lose segments but maintain their tone

Consider the examples in 5.2 (a).

5.2 (a)

Citation form	Contracted variant	
àlgúshì	àlgûs	'fraud'
bànúshì	bànûs	'flannel'
kàftánì	kàftân	'captain'
mélè	mêl	'mail'
mìinéenèe	mìinéè	'what is it?' (Sokoto dialect)
múrrù	mûr	'myrrh'

In these words the tone of the deleted vowel (or syllable) has been shifted one place to the left.[1] Within the segmental tone framework we could formalize this process in a transformation as in 5.2 (b).

5.2 (b) left shift

$$\begin{bmatrix} V \\ \text{Tone } 1 \end{bmatrix} \quad C \quad \begin{bmatrix} V \\ \text{Tone } 2 \end{bmatrix} \quad \# \Rightarrow \begin{bmatrix} V \\ \text{Tone } 1 \quad \text{Tone } 2 \end{bmatrix} \quad C \quad \#$$

$$1 \qquad 2 \qquad 3 \qquad 4 \qquad\qquad 1 \qquad\qquad 2 \quad 4$$

There are parallel cases in which tone shifts to the right as in 5.2 (c).

5.2 (c)

Citation form	Contracted variant	
ìnjárí	ǹjárí	'stream'
ùngùlú	ǹgùlú	'vulture'
íngàntáa	ńgàntáa	'reinforced'
àlwálì	wàlíì	'saint or person giving a girl in marriage'

Trying to retain a segmental approach, we might formulate transformations as in 5.2 (d).

5.2 (d) right shift

S.D. # [V, Tone 1] [+nasal] [+cons, -nasal] ⇒
1 2 3 4

S.C. # Ø [3, Tone 1] 4

S.D. # [V, Tone 1] [-son, -syl] [V, Tone 2] ⇒
1 2 3 4

S.C. 1 Ø 3 [4, Tone 1 Tone 2]

These rules attempt to show that the tone of the deleted vowel has been shifted to the right one place. The right shift rule as stated will not quite take care of the data. In the contraction of àlwálì, 'saint', to wàlíì tone shifts on two syllables. Tone shifts from the initial a, which is lost to the second a, while the old tone of this second a shifts to i. This movement is not handled by the right shift rule as formulated, which only shifts the tone of the deleted segment. A more complicated rule might be formulable

which would work. But two things seem clear: (1) the shift rules will not conflate to a single rule under the segmental analysis, and (2) what is involved is a unitary process. The tone contour for the morphemes is being preserved, distributed over the segments available. Suprasegmental tone overlays easily handle such phenomena.

Within a suprasegmental framework no rules are needed at all. The vowel deletion rule applies before tone is ever associated with segments. 5.2 (e) illustrates a left shift, 5.2 (f) a right shift.

5.2 (e)

	Citation form	Contracted form
lexicon	kaftani LHL	kaftani LHL
vowel deletion	----	kaftan LHL
mapping	kàftánì	kàftân

5.2 (f)

	Citation form	Contracted form
lexicon	ingantaa HLH	ingantaa HLH
vowel deletion	----	ngantaa HLH
mapping	íngàntáa	ńgàntáa

The examples in 5.2 (a) and (c) show that tone is associated with lexical items in Hausa, not the segments composing these items. The tone patterns do not vary whereas segmental composition of the morphemes may.

5.3 Tone as the mark of a construction

5.3.1 Imperative

Verbs in Hausa have no determinable tone of their own. Their tones are determined by their "grade", semantic class, or by their mood. The subjunctive mood specifies a $L^{n}H$ pattern. The superscript n above L indicates that whenever there are more syllables

than tones in the pattern, two in this case, low spreads over all extra syllables. 5.3.1 (a) shows the distribution of the subjunctive tone pattern over three, two, and one-syllable words.

5.3.1 (a)

karantaa	$L^nH \rightarrow$ kàràntáa
tafi	$L^nH \rightarrow$ tàfí
zo	$L^nH \rightarrow$ *zǒ → zó

Notice that in mono-syllables the predicted rising tone pattern does not appear. The tone is H not LH. However, no syllables in Hausa ever carry rising tone. Leben (1971) proposes a rule of rise simplification as in 5.3.1 (b).

5.3.1 (b)

$\widehat{LH} \rightarrow$ H

The superscript $\frown$ indicates the co-occurrence of two tones on a single syllable.

This rule is needed elsewhere in the grammar as other sequences of LH which would derive from contractions also surface as H. aniiya 'exertion' has LHL tone patterning. In its contracted form, niiya, mapping would assign LHL as *nìíyà. The surface form is níiyà. The LH sequence has been reduced to high. 5.3.1 (c) shows the derivation of níiyà using the LH rule.

5.3.1 (c)

lexicon	aniiya	LHL
vowel deletion	niiya	LHL
mapping	nìíyà	
LH rule	níiyà	

With the use of one tone rule, needed independently, a single tone

pattern L^nH, can be shown to accompany all verbs in the subjunctive mood. This abstraction of tone from segments may be naturally and easily described within a suprasegmental system.

5.3.2 deixis

In Hausa deictic pronouns have segmental forms: the morpheme can corresponds to 'this', nan corresponds to 'that'. But each of these pronouns is paired with either of two tone patterns depending on whether or not the thing being singled out is visible. If it is visible, the tone pattern is HL; if not, the pattern is LH. These patterns are spread over two syllables, so the LH pattern meaning 'invisible' is never reduced by rise simplification. The two syllables encompassed will be either those of the demonstrative pronouns as in 5.3.2 (a) or those of the noun and deictic tag as in 5.3.2 (b).

5.3.2 (a)

lexicon	wan+		wan+	
	nan	'this'	nan	'this'
	HL	'visible'	LH	'invisible'
lexical insertion				
	wannan	HL	wannan	LH
mapping	wánnàn		wànnán	
lexicon	wan+		wan+	
	can	'that'	can	'that'
	HL	'visible'	LH	'invisible'
lexical insertion				
	wancan	HL	wancan	LH
mapping	wáncàn		wàncán	

5.3.2 (b)

lexicon	dookin	H	dookin	H
	can	'that'	can	'that'
	HL	'visible'	LH	'invisible'
lexical insertion				
	dookin can HHL		dookin can HLH	
mapping	dóokín càn		dóokìn cán	

The tonal realization of the morphemes 'visible' and 'invisible' in the Hausa deictic system would be difficult to express within a segmental tonal framework, while a suprasegmental system has no trouble accepting a morpheme whose total realization is a tone pattern.

5.3.3 Abstract nouns of sensory quality

Parsons (1955) isolates another construction in Hausa with a characteristic tone pattern, abstract nouns of sensory quality. These nouns all have some abstract referent related to one of the senses, and all share a HH contour. Labɾii 'feeling', waarii 'smell', taushii 'softness', maskii 'pleasant taste', and nauyii 'heaviness' all have high tones throughout. Again, abstraction of tone from segments allows characterization of this uniformity.

5.4 Verbal grades

Another area in which use of a suprasegmental mechanism captures some useful generalizations is that of the verbal grades. In Hausa, tense-aspect is marked on the person pronouns rather than the verbs. Verbal inflection reflects some weak semantic correlates of the action expressed by the predicate. These inflections were to my knowledge first systematized into seven classes and labelled "grades"

by Parsons (1960). A dummy verb in each of the grades would appear as in 5.4 (a).

5.4 (a)

Grade one	CV́C-à	predicative
Grade two	CV̀C-é	object specified
Grade three	CV̀C-í	object unspecified
Grade four	CV́C-è	predicative, completeness
Grade five	CV́C-ár-dà	causative, indirect action
Grade six	CV́C-ó	reported
Grade seven	CV̀C-ú	be X-able

Karant- 'read' appears in all seven grades, as in 5.4 (b). The glosses given assume that the accompanying pronoun, which carries the tense marking, is a third person singular. The masculine pronoun ya- is assumed for grade 1-6, and the neuter a- for grade 7.

5.4 (b)

Grade	karant-	Gloss
1	káràntáa	'he read'
2	kàránte littáafii	'he read books'
3	kàrántii	'he read something'
4	káràntée	'he read it all'
5	karántár dà shí	'he had it read'
6	karántóo shì	'he is said to have read it'
7	kàrantúu	'it is readable'

The length of the grade theme vowel varies, being long in final and pre-pronominal position and short before nouns. Grades one and four may be characterized semantically as "predicative," with Grade four additionally entailing completeness, or thoroughness of action. Grades two and three are those grades which either require presence or require absence of an object. (Grades one and four may be used ambivalently with or without objects.) Grade five is generally characterized as a causative grade. Grade six is "indirect" in that it is used to report action done elsewhere. Grade seven coincides in meaning with 'to be X-able', where x is a verb root.

The typical Hausa verb is bisyllabic. Its segmental and tonal proto-types appears in 5.4 (a). However, in order to clearly grasp the complexity of the grade system's tonal correlates that the suprasegmental representation must describe, the trisyllabic and quadrisyllabic verbs should also be taken into account. The following table is taken from Parsons (1960).

5.4 (c)

Grade	bisyllabic	trisyllabic	quadrisyllabic
1, 4	HL / __Ø	HLH / __Ø	HHLH / __Ø
	HL / __N	HLL / __N	HHLL / ___N
	HL / ___Pn	HLH / ___Pn	HHLH / ___Pn
2	LH / ___Ø	LHL / __Ø	LLHL / ___Ø
	LH / ___N	LLH / ___N	LLLH / ___N
	LH / ___Pn	LLH / ___Pn	LLLH / ___Pn

5.4 (c) continued

Grade	bisyllabic	trisyllabic	quadrisyllabic
3	LH	LHL	LLHL
5	HH+ da	HHH + da	HHHH +da
6	HH / ___Ø	HHH/ ___Ø	HHHH/ ___Ø
	HH / ___N	HHH/ ___N	HHHH/ ___N
	HH / ___Pn	HHH/ ___Pn	HHHH/ ___Pn
7	LH	LLH	LLLH

The environments here should be read as / ___Ø "before nothing" or "finally"; / ___N "before a noun object"; / ___Pn "before a pronoun object".

5.4.1 The analysis of grades 1 and 4

That some of these grades are characterizable in a suprasegmental system has been noted previously. Leben (1970) has proposed HLL as the tone pattern for verbal grades one and four, those of the predicative verbs and verbs expressing action thoroughly done, respectively. Leben worked only with two and three syllable roots. The HLL pattern reads out directly for bisyllabic roots with the convention that LL=L. This can be seen for a dummy two syllable verb in 5.4.1 (a).

5.4.1 (a)

CVC-aa # HLL → CV́C\aa#

CVC-a N HLL → CV́C\a N

CVC-aa Pn HLL → CV́C\aa Pn

5.4.1 (b) shows kaam- 'catch' in grade one in final, pre-nominal and pre-pronominal environments.

5.4.1 (b)

kaamaa # HLL	káamàa#	'caught'
kaama HLL dookii HL	káamà dóokìi	'caught the horse'
kaamaa HLL shi[2]	káamàa shí	'caught it'

Trisyllabic verbs do not work out so nicely. 5.4.1 (c) shows how straight mapping would read out the tone for a mock trisyllabic verb.

5.4.1 (c)

CVCVC-aa # HLL	→	*CV́CV̀CàaV #
CVCVC-a N HLL	→	CV́CV̀Cà N
CVCVC-aa Pn HLL	→	*CV́CV̀CàaV Pn

5.4.1 (d) illustrates this with rubuut- 'write'.

5.4.1 (d)

rubuutaa #	HLL →	*rúbùutàa #	'wrote'
rubuuta HLL littaafii HHL	→	rúbùutà líttáafìi	'wrote a book'
rubuutaa HLL shi	→	*rúbùutàa shí	'wrote it'

Only the pre-nominal form is the correct surface reading. To rectify this Leben (1970) proposes a segmental tone rule of low tone raising, given here as 5.4.1 (e).

5.4.1 (e)

L L # → L H #
long long

A low tone on a final long, or heavy syllable (one having a long vowel, diphthong or closing consonant) will become high when preceded by a low tone. This rule must apply after mapping as it refers to segmental information. This rule is also needed to handle the alternations of polarized object pronoun tone with these verbal grades

and so is independently motivated in the grammar. A derivation of dummy trisyllabic verbs using the low raising rule and the proposed HLL tone pattern will now give proper surface tones.

5.4.1 (f)

underlying	CVCVCaa # HLL
mapping	CV́CV̀CàA #
low raising	CV́CV̀CáA #

---

underlying	CVCVCa N HLL
mapping	CV́CV̀Cà
low raising	———

---

underlying	CVCVCaa Pn HLL
mapping	CV́CV̀CàA Pn
low raising	CV́CV̀CáA Pn

5.4.1 (g) exemplifies this with rubuut- 'write'.

5.4.1 (g)

underlying	rubuutaa # HLL
mapping	rúbùutàa #
low raising	rúbùutáa #

---

underlying	rubuuta HLL littaafii HHL
mapping	rúbùutà líttáafìi
low raising	———

---

underlying	rubuutaa HLL shi
pronoun dissimilation	rubuutaa HLL shi H
mapping	rúbùutàa shí
low raising	rúbùutáa shí

The final low of the prenominal verb is not raised as the syllable is short. Leben's account then correctly predicts tone for grades one and four in all two and three syllable verbs. To include four syllable verbs we need only modify his proposed pattern adding an optional initial high tone. Verbal grades one and four correlate with the tone pattern H^nLL. An independently motivated rule, low tone raising, combines with this mapped pattern to give a verb in those grades its final surface form.

5.4.2 The analysis of grades two and three

No uniform pattern has been proposed in grades two and three. However, it is possible to abstract the pattern L^nH (L) for the phrase final verbs of grade two and the verbs of grade three. The non-final verbs in grade two take the pattern L^nH. The difference in these two patterns is that the non-final verbs of grade two do not have a final low tone.

The verbs in grade three are all intransitive syntactically, though having a specified object semantically. They allow no surface object. The verbs of grade two which are phrase final likewise have no object. We might posit then that the intransitivity of these forms is marked by a non-segmental morpheme, a low tone, fixed to the final syllable of the verb. The regular tone pattern for the grade is then retracted over the remaining available segments. 5.4.2 (a) shows how the L^nH pattern would be spread over nenneemaa 'to look in for repeatedly' in grades 2 and 3 if a low toned intransitive marker usurps the final syllable in verbs with no object. Usurpation entails the fixing of a tone to one syllable removing it from the domain one which the tone pattern may be

mapped. The normal tone pattern must then be realized only over the non-usurped portion of the word.

5.4.2 (a)

Grade 2	nenneemee #	L^nH	nenneeme	N	L^nH	nenneemee	Pn	L^nH
intr. low	nenneemèe #	L^nH	_____			_____		
mapping	nènnéemèe #		nènnèemé	N		nènnèemée	Pn	
Grade 3	nenneemii #	L^nH						
intr. low	nenneemìi #	L^nH						
mapping	nènnéemìi #							

The usurpation of the final syllable for the intransitive low-toned marker would be purely ad hoc, if it were unique within the Hausa grammar. However, similar usurpation of a final syllable for tonal specification of another morpheme is used elsewhere in Hausa. As seen in section 5.3.2, the final syllable of a noun followed by a deictic pronoun is reserved for the first tone of the deictic display, the H of HL for visible things, the L of LH for invisible things.

5.4.2 (b)

lexicon	tsuutsa	HL	'worm'	karee	LH	'dog'	
	can		'that'	can		'that'	
		HL	'visible'		LH	'invisible'	
lexical insertion	tsuutsa can	HL HL		karee can	LH LH		
usurpation	tsuutsá càn	HL		kareè cán	LH		
mapping	tsúutsá càn			kárèe cán			
LH rule	tsúutsá càn			kárèe cán			

Furthermore in the Sokoto dialect of Hausa, object pronouns may contract with preceding verbs. This contraction may be described as a vowel deletion rule.

5.4.2 (c) vowel deletion

S.D. verb root + $\begin{bmatrix} \text{pronoun} \\ C_0^1 \quad V \end{bmatrix}$

1 2 3 $\Rightarrow$

S.C. 1 2 Ø

The pronoun leaves a consonantal trace which cannot bear tone. Just as with the proposed intransitivity marker, the non-segmentally attached tone of the pronoun is assigned to the last sonorant of the preceding verb and tone mapping then assigns tone to what is left of the verb. 5.4.2 (d) shows the reduction of kashee ta 'kill her' in the Sokoto dialect. The high tone of ta is assigned to the final e, the LH rule simplifies the resulting LH contour to high, which surfaces.

5.4.2 (d)

	káshèe tá
vowel deletion	káshèe t
usurpation	káshèé t
LH rule	káshée t

kashee t then may undergo further rules of segmental phonology.[3]

Thus, in at least two other areas of Hausa grammar, the final syllable of one morpheme is absorbed by the tone of a following morpheme. We can then posit a L^nH tone pattern for grades two and three deriving the final low of the objectless forms from a low

toned intransitivity marker.[4]

5.4.3 The analysis of grades 5 and 6

Grades 5 and 6 are easily specified for tone, having H^n patterns. In grade five we find such forms as sáyár dà 'sell' and sássáyár dà 'sell repeatedly'. Da, like the noun stabilizing particle ne, takes the tone opposite that appearing last in the preceding morpheme.[5] Da, however, is optional in these "causative" constructions. As cited in 5.4 (b), grade five is HH + da for bisyllables, HHH + da for trisyllables, and HHHH + da for quadrisyllables. The tone pattern for the stem simplifies to H^n, but the polarizing tonal da may optionally accompany the grade five form bearing this tone overlay. In grade six appear forms like káamóo 'caught' and kákkáamóo 'caught repeatedly'. The tone pattern, like that of Grade 5, is H^n. Grade six, though, has no associated polarizing particle.

5.4.4 The analysis of grade 7

Grade seven carries L^nH as a contour. In other words, all but the last syllable will be low toned.

5.4.4 (a)

bùgú	'is malleable'
kàràntú	'is readable'
kàkkàràntú	'is readable repeatedly'

If the u of this form could be isolated as a separate morpheme (perhaps a counterpart of the English 'be able'), we could state the contour for grade seven simply as L.

5.4.5 Summary of the verbal grades

Interestingly, if the basic tone patterns of verbs are as postulated here, we have near mirror-image oppositions among the grades.

5.4.5 (a)

Grades 1, 4	(H)HLL
Grades 2, 3	(L)LLH
Grades 5, 6	H
Grade 7	L

These groupings correspond to the rough semantic classification given at the beginning of this discussion of the grade system: one and four - predicatives; two and three - verbs requiring presence or absence of object; five and six - indirect action (where causation is taken as being indirect); and seven - "ability". In the verbal grade system the suprasegmental approach permits the abstraction of generalities. The model proposed here makes possible the simplification of a linguistic description of Hausa, for it (1) allows the statement of uniform contours with the verbal grade system, and (2) makes possible coalescence of the seven grades into four groups in paired opposition.

5.5 Noun plurals

The formation of plurals in Hausa is not completely predictable. A given noun may have three or more plurals or only one. Which plurals a noun will take must be specified in the lexical entry for that noun. However, within this irregularity some regularities, such as tone placement, emerge. The tone of plural nouns is one of these regularities. Once the plural affix is known the tone of the plural noun as a whole can be predicted. The plural tone is spread over the whole noun, not simply associated with the segments of the plural affix. Thus its domain is larger than the segment. Plural tone is suprasegmental.

For some affixes this tonal predictability has been previously noted. Kraft and Kraft (1973) and Pilszczikowa-Chodak (1972) point out that plurals affixing {-oo...ii} are high toned throughout; those affixing {-u...aa} are high up to the last syllable; those affixing {-aa...ee, -aa...aa, or -aa...uu} are high low high; those affixing -ai are low up to the last syllable. These correlations are summarized in 5.5 (a). While the vowels of the plural suffix are specifiable the consonants are not; while reduplication of the final stem consonant is the primary strategy for specifying this plural consonant, it is not the only strategy.

5.5 (a)

affix	tone pattern	examples	
-oo...ii	H^n	téebùr, 'table'	téebúróorii 'tables'
-u...aa	H^nL	dáakìi, 'house'	dáakúunàa 'houses'
-aa...ee	HLH	wúríi, 'place' kárfèe 'metal' ídòo 'eye'	wúràarée 'places' káràafáa 'pieces of metal' ídàanúu 'eyes'
-ai i	L^nH	máalàm 'teacher' kàazáa 'chicken'	màalàmái 'teachers' kàajíi 'chickens'

In addition to the affixes and their accompanying patterns given in 5.5 (a), I have isolated two other plural suffixes with an accompanying tone pattern: $-C_2a$ with HLH and $\begin{Bmatrix} V \\ C \end{Bmatrix} C_3ani$ HLH^n. 5.5 (b) lists some nouns employing these plurals.

5.5 (b)

$-C_2a$	HLH	gábò	gúbbá	'teeth'
		gíibì	gîbbáa	'gaps from loss of teeth'
		káadò	kâddáa	'original inhabitant'
$-\begin{Bmatrix}V\\C\end{Bmatrix} C_3anii$	HLH^n	kádò	kádàndánii	'crocodile'
		kármáa	kárèemánii	'infantryman'
		gàrmáa	gárèemánii	'large hoe'

These affixes do not exhaust the pluralizing strategies of Hausa. Other affixes, whereas isolatable segmentally, do not have fixed accompanying tone patterns. A few such toneless affixes are -ajii, -anii, -uu. The tone of the plural noun, however, is still predictable, if one knows the singular noun's lexical plural. H^n nouns taking one of the non-tone paired affixes are always HLH^n in their plurals. HL nouns are HH in the plural when their affixes do not specify tone. L^nH nouns when non-tonally affixed remain L^nH in the plural. LL nouns apparently become H^nL. However, only one LL noun was found which used a non-tonal affix.[6] Example nouns with their plural tone predicted by the singular tone patterns are listed in 5.5 (c).

5.5 (c)

HH sing.	HLH^n Pl.	gloss
dáwá	dáawàwákii	guinea corn
fárcé	fáràutáa	finger-, or toenail
gáawáa	gáawàwwákii	corpse

HL sing.	H pl.	
dóoki	dáwáakii	horse
gábò	gábóobáa	tooth
yáatsa	yáatsúu	finger

5.5 (c) continued

L^nH sing.	L^nH pl.	gloss
fùréé	fùràànní	blossom
gèezáa	gèzànní	man
tsàakóo	tsìiyàakíi	chick

LL sing.	H^nL
àbù	ábúbbà

Tone in Hausa noun plurals is then specifiable by reference to the affix tone, or to the affix is non-tonally listed in the lexicon, by reference to the singular noun's tone. 5.5 (d) presents derivations of plural tones for the two plural forms of ráàmì 'hole in earthen constructions'. Ráàmì may form a plural either by suffixing {-u...a}, H^nL, or by suffixing -uu with no tonal correlate.

5.5 (d)

lexicon	raami	HL
	+u...a	H^nL
segment spell-out[7]	raamuna	H^nL
mapping	ráàmúnà	
lexicon	raami	HL
	+u...a	H^nL
segment spell-out	raamummuka	H^nL
mapping	ráàmúmmúkà	
lexicon	raami	HL
	+uu (tone predicted from sing. HH)	
segment spell-out	raamuu	HH
mapping	ráàmúu	

Plural noun tone in Hausa is predictable when tone is abstracted from segments.[8] The tone is associated with plural affixes, or, when these are atonal, is drawn from the singular noun's tone pattern. The domain of the tone is the plural construction, not a given segment. In fact, the segmental realization of plurals is not predictable.

5.6 Resume

In sections 5.2-5.5 we have examined various aspects of Hausa grammar and found that either rules are more simply stated, or generalizations are best abstracted using a suprasegmental analysis of tone. In 5.2 we found that suprasegmental tone plays obviate the need for two tone shift rules to account for tonal patterns of contracted morphemes. Section 5.3 showed several constructions with uniform tone displays, the linking of these constructs by tone being expressible directly in a system which does not require tone to be paired with segments. Section 5.4 argued that the entire verbal grade system shows such linking of grammatical constructs with tone. Section 5.5 extended the use of tone as independent of segments to predict the tone patterns of plural nouns. As a suprasegmental analysis allows us to state these significant generalizations of Hausa most simply, a suprasegmental tone model must be more highly valued than a segmental tone model for the phonology of Hausa.

5.7 The mapping rule

In this section I will formulate the tone mapping rule in Hausa, the mechanism which finally associates the tones of a tone pattern with a given segment. The system I propose here is very similar both to that used by McCawley (1970b) to describe Tiv conjugations and to that adopted by Williams (1972) in his treatment of Margi and Igbo

tonology. Under the proposed system a morpheme may have a tone pattern associated with it.[9] For example, dookii 'horse' and kyau 'goodness' are paired with a HL pattern, riigaa 'robe' and garii 'town' with LH, and mutum 'man' and laabaarii 'news' with LHL. As neither the segmental morpheme nor the tone pattern is pronounceable in isolation, some pairing of the two must be effected. The preferred strategy is to assign one tone to each syllable. In the simplest case, the leftmost tone is assigned to the leftmost syllable, the following tone to the following syllable, etc. Thus, suunaa 'name' coupled with HH is súúnáa; idoo 'eye' coupled with HL is ídòo; itaacee 'tree' with HLH is ítàacée. However, since tone is not inherent in the individual sonorant segments nor in the syllables, there is not always a one-to-one correspondence between the segments or the syllables of a word and its tone pattern.

When there are fewer tones than segments, some method for supplying extra tones must derive from the tone contour specified. Williams (1972) suggested that the tone specification for morphemes in Igbo and Margi be right-iterative. That is, the specification will be spread over whatever additional segments there are to the right of the last segment given a tone by the contour. We could adopt this as a tentative universal and extend its application to Hausa. Thus, if the tone pattern LH is to be coupled with shinkaafaa 'rice', we get shìnkáafáa, LHH. However, as we have already seen from examples like the imperative, it is sometimes necessary in Hausa to specify that it is the leftmost tone that iterates, as shown by L^nH, the imperative contour. We could still contend that Williams' principle of right-iteration holds, that the normal case

is that in which the rightmost tone is the one which copies onto unspecified syllables, and that instances like that of the imperative in Hausa are less usual and the use of the extra symbol, the superscript n, adequately represents this cost. That is, LH when spread over three syllables, as in our example shinkaafaa, will in the general case be realized as LHH, shìnkáafáa. It is only for special cases such as imperative that LH surfaces as LLH on trisyllabics. Thus kakkaamoo, 'catch several or catch repeatedly', in the imperative shares the regular imperative contour, LH, but here it materializes with a LLH structure, kàkkàamóo. Since this is not predicted by right-iteration, in fact runs counter to the prediction made by the righ-iteration schema, this divergence must be symbolized and will then add cost to the grammar. Such symbolization and cost could derive from the notation, L^nH.

However, it does not seem to be the case that the instances which require right-iteration in Hausa outnumber those which require left-iteration. Nor does the Tiv data examined by McCawley (1970b) favor one direction over the other for iteration. We might well note here that in the two languages examined by Williams tone is uniform throughout a morpheme. Any given morpheme will be either entirely high-pitched or entirely low-pitched. His decision then to assign the tone to the leftmost syllable and to iterate to the right is basically an arbitrary one. He might just as easily have decided to assign the specified tone to the rightmost syllable and iterate to the left. Or he could have avoided the issue of directionality altogether and simply have represented the tone as H^n or L^n. As this alternative avoids any arbitrary decision, it seems

preferrable on a priori grounds. Given that languages such as Tiv and Hausa which allow multi-tonal morphemes require both right- and left-iterative formulations, use of L^n and H^n will give more uniformity to the notation, and will avoid the seemingly false claim that right-iteration is more natural then its left counterpart. Hence, here we will settle on a notation which specifies the tone which will be copied should extra sonorant segments demand extension of the contour.

When there are more tones in the specified contour than syllables specified, some syllables will have to be paired with more than one tone. Those syllables in Hausa which may carry two tones are those which Newman (1972) refers to as 'heavy syllables'. These are the syllables ending in a vowel-vowel or a vowel-consonant sequence. As indicated in the preceding chapter, tonal specifications will have to be realized on the sonorant segments. So overflow tones will have to be sandwiched onto sonorants, as in the following examples:

kyau, 'goodness, beauty', HL kyáù

nan, 'near at hand', HL náǹ

mutum, 'man', LHL mùtúm̀

It will not be possible always to assign only one tone to a given sonorant, however. When the LHL tone contour is aligned with tattaf, 'a kind of small seed', the outcome is tàttâf, LHL. /f/ is not tone-bearing. The tone glide is entirely realized on the vowel, although the vowel is still phonetically short. Similarly in dâbdálà, 'long rope', the HLHL tone play is to be distributed over three syllables. As there are four tones, two must be assigned to one syllable. Only one long, or heavy, syllable is available for

the double tone specification, namely the initial syllable; so the HL sequence is realized as a falling tone on -dab-. Note, moreover, that only one sonorant is available, and so both tones are assigned to this single segment.

When there are fewer syllables than tones and more than one long syllable is available for two tones, the tones are assigned in such a way that the sequence LH does not occur within a single syllable. Thus, in distributing HLH over baujii, 'saddlegirth', we could conceivably get either bâùjíi or bâujìí. Instead, we get only bâùjíi, since this distribution of tones avoids a LH sequence on a single syllable. In fact, we have no cases of LH on a single syllable surfacing in Hausa. This tone assignment strategy eliminates the possibility of many such underlying forms, and the LH Rule proposed by Leben (1971) eliminates any which come about through operation of other phonological processes. Recall that this rule requires that whenever a single syllable carries the specification "low tone followed by high tone," only the high is realized: $\widehat{LH} \rightarrow H$. In a somewhat 'conspiratorial' sense, then, the tone assignment convention proposed here replicates an independently motivated rule of Hausa phonology.

In summary, tone mapping in Hausa consists in (1) assignment of one tone per syllable, where possible, copying the leftmost tone onto the leftmost syllable, etc.; (2) when too few tones are specified to cover the number of syllables, the tone superscripted by n iterates; (3) when too many tones are specified, they are realized on the available long syllables. 5.7 (a) shows three derivations using each of the steps of the tone mapping rule.

5.7 (a)

lexicon	koogii	LH	gidaa	H^n	malam	LHL
mapping	kòogíi		gídáa		màlám̀	

5.8 Summary

In this chapter we have examined various aspects of Hausa and found that a suprasegmental analysis of tone will allow us to state significant generalizations simply. In Chapter 4 we presented the representation of suprasegmental tone as tone sequence pairings for lexical items or constructions listed in the lexicon. In section 5.7 we have outlined a mechanism that will relate these suprasegmental tones to segments over which they are to be realized, finalizing a model of tone in Hausa which lists tone together with whole words or grammatical constructions in the dictionary but pronounces tone over sonorant segments. This chapter has shown that tone in Hausa should be suprasegmental and has developed a mapping rule which will allow the specifications of tone over domains larger than the segment.

Footnotes

Chapter 5

1. Tone in Hausa is essentially a feature of the syllable. Tone will optimally be assigned so that a syllable has a uniform tone throughout. Only if not enough syllables are available for the number of tones specified will contours appear within a syllable either over a long vowel or a vowel consonant coda. These syllables, CVV and CVC, are heavy syllables in the terminology of Newman (1972). When some syllable must carry a contour, it will be a heavy syllable whenever one is available. Falling contours are avoided, unless there is one syllable which may accept a kinetic tone.

2. Tone of object pronouns in Hausa is derived by a rule of tonal dissimilation. Pronouns are low toned after high tone final verbs, and high toned after low tone final verbs

$$[\text{Tone}]_{\text{pronoun}} \rightarrow [-\alpha\text{Tone}] \,/\, X \;\; \alpha\text{ Tone}]_{\text{verb}} \;\; \_\_\_$$

3. For a discussion of some of such succeeding rules, including a rule of heavy syllable lightening, see Leben (1970). Notice, too, that the actual lexical entry of ta is unspecified for tone. Pronouns receive their tone by a rule of tonal dissimilation. They are high toned after low tone final verbs and low after high tone final verbs. The pronoun dissimilation rule is not shown in the derivation of 5.4.2 (d); it would apply before the rule of pronoun reduction.

4. This marker may be incorporated into the pattern formula as an optional (L). Notice that it is realized only if there are sufficient syllables for the base pattern.

5. ne may be taken as a predicative particle. It is used whenever a noun would stand alone as a predicate or as a complete clause.

*Audu 'boy's name', but ok Audu ne 'it is Audu'.

6. LL nouns are very rare in the language. Parsons (1962) lists only eight LL nouns all told.

7. A strict rule for segment spell-out is not formulable. While the vowels of the affix are predictable, the consonants are not. The tone pattern, however, is unaffected by the idiosyncracies of the affix consonants.

8. Not all plurals have been taken into account in this discussion. Plurals of three and four syllable nouns have not been examined, nor have those nouns which undergo no change, segmentally or tonally, for pluralization.

9. Not all morphemes are marked for tone; polarizing particles, some plural affixes, and all verb stems are atonal. Also, morphemes like 'visible' and 'invisible' are purely tonal having no associated segments in the lexicon.

Chapter 6

Shi Ke Nan[1]

In closing the applicability of the tone theory elaborated should be quickly surveyed. The tone mapping rule developed in 5.6 applies within the framework outlined in chapters 1 - 5. It treats tone in those languages which use binary features for tone specifications in their dictionary entries. It would handle all tone systems with the same features, though these features are as yet unelaborated. Kinetic tones are represented within a single matrix with explicit ordering linked to glottal timing. Suprasegmental tone specifications are needed in Hausa and are mapped onto segments only after certain segmental rules like contraction and pronoun deletion occur. This same mechanism for tonal specification and mapping may be used in other languages as well.

6.1 Use in other languages

Hausa with its system of suprasegmental tone is not unique. The mapping procedure for distributing tone over underlying segments can be extended almost *en toto* to the Margi and Igbo data provided by Williams (1976). The particular advantages of this system for Hausa, uniform contour statements for verbal grades and some noun plurals and coalescence of verbal grades into paired class sets, have counterparts within the Margi system of verbal derivations. Similarly, the power of the suprasegmental tonal analysis to characterize such phenomena as the L^nH contour for Hausa imperatives could by extension characterize the tone frames of languages like Tiv, where all inflection for tense is marked by tonal alternations specifiable by set patterns.[2] (McCawley 1970)

6.1 (a)

General past	$\widehat{LB}\ L_0$
Recent past A	$\widehat{LB}\ H\ L_0$
Habitual 4	H_0L
Past habitual	$\widehat{LB}\ H\ H_0\ L$

The subscript zero of these tone frames indicates that the tone so marked may appear minimally zero times (i.e., it may be absent), but there is no upper bounds on its occurrence (i.e., it may be repeated as often as needed). This would be equivalent to the symbolization (H^n) or (L^n) in the notational system used for the Hausa data. The ligature above two tones indicates their appearance on the same syllable. The tone mapping rule would operate on these specifications exactly as it would on the Hausa (H)HLL (for grades one and four). As with Hausa, we would have the lexical form given; yevesen, 'run away', in Tiv. The Tiv dictionary would give the additional information that yevesen is basically a high-toned verb. Then the contour for the tense in question would be spread over the available sonorants, which includes n in the example. Taking the Past Habitual contour, LB H H_0 L, and combining it with the lexical form, we get the form in 6.1 (b).

6.1 (b)

ye ve se n
LH H H L

Then the Tiv counterpart of the LH Rule operates to give the surface string, 6.1 (c).

6.1 (c)

ye ve se n
H H H L

This final string has not only the combined phonological forms of the lexical verb and the tone pattern, but also the semantic features of both, run away + Past Habitual - 'used to run away'.

Once tones have been matched with segments, articulatory features must be added to the segmental matrices. At the point at which tone mapping applies, the symbols H and L have the same status as symbols such as /e/, /p/, /l/. They represent feature matrices. These matrices contain the glottal feature; [spread], [constricted], [stiff], [lax], [raised] and [lowered]. In the process of pairing these matrices with segmental matrices, the glottal features of the tone frame are superimposed over the specifications of the segments, taking precedence over the values given in the segmental listing. The segmental matrices would presumably already have some specification for these features, supplied by the lexical redundancy rules when the items are lifted from the lexicon. As the redundancy rules fill in unmarked values, they would mark all elements as mid-toned. In non-tone languages this is, in fact, the case at surface level, barring interaction with stress. The specification of a suprasegmental tone on these segments would have to be effected by some kind of matching rule, perhaps of the form 6.1 (d).

6.1 (d)

$$Z + \begin{bmatrix} +\text{segment} \\ +\text{sonorant} \\ R \\ E \end{bmatrix} \rightarrow \begin{bmatrix} +\text{segment} \\ +\text{sonorant} \\ Z \\ E \end{bmatrix}$$

In 6.1 (d), Z represents the phonological feature matrix of a supra-segmental tone, simply glottal features. R represents the glottal subset of the features of the segmental matrix. E stands for all

the other phonological feature specifications of the segment. The feature [+segment] and [+sonorant] are mentioned here only to show that the second element is a segmental unit capable of bearing tone. Only such elements will be paired with tones by the mapping rule. What 6.1 (d) schematizes, then, is that the glottal feature specifications of a tone bearing segment are those of the tone it bears, not those supplied by lexical redundancy rules.

Rule 6.1 (d) is specifically designed for tone frame languages like Tiv and Hausa. (Rules such as 6.1 (d) do not occur in the grammars of all languages.) Lexical tone languages have glottal features specified on each sonorant in their dictionary entry and so require no further rule. Bound accent languages have no Z elements, or suprasegmental tone elements, to collapse with segmental elements. They, in fact, carry no tone specifications in their dictionary entries. Hence, they are non-tone languages. Free accent languages, likewise, have no tone specifications per se in their dictionary entries, but at some point they will have a rule in the form of 6.1 (d). First, the free accent languages require a rule converting the location feature given in the lexical entry into a tone contour. For Japanese, such a conversion rule would read as 6.1 (e).

6.1 (e)

$$(\text{n syllable}) \longrightarrow \text{low high}^{\text{n-1}} \text{ low}$$

For the word, kokoro 'heart', the dictionary entry lists 2 syllable as the accent location feature. The conversion rule will specify an initial low, then n-1 (2-1=1) high, followed by a final low. This low high low specification must be paired with sonorants by a mapping rule to give 6.1 (f).

6.1 (f)

ko ko ro
L H L

Finally, this contour is converted to glottal feature specifications on the segments, just as with the independent tone contours from the lexicon paired with segments by suprasegmental mapping rules. Also, partially free accent languages with their single binary feature for tone in lexical entries require a rule like 6.1 (d). The binary feature cannot be strictly a phonological feature; it is a morpheme-sized feature, directly equatable with a contour H^n or L^n. Like the contours with which (± high) is interconvertible, the tone specification must be mapped on all tone-bearing elements and then converted by a rule such as 6.1 (d) to glottal specifications on segments. Thus, tone frame languages, partially free accent languages and free accent languages are similar in that they require some glottal feature superimposition rule like 6.1 (d). Lexical tone languages and bound accent (non-tone) languages require no such rule. A rule of the form 6.1 (d) then marks the middle ranges of the tone-non-tone continuum.

6.2 Summary

The essential elements of the system of suprasegmental tone as developed in Chapter 4 and elaborated in 5.7, the tone-mapping rule and the glottal feature conversion rule, are capable of characterizing more than the group of languages for which they were developed, tone frame languages. They, in fact, are necessary elements in any accentual system not fully specified lexically, either through direct marking (for lexical tone languages) or through redundancy rule

marking (for non-tone or bound accent languages). Despite possible inelegancies, or even errors, in the proposals given, this work, at least, sketches the general outline of the form such mechanisms must take.

Footnotes

Chapter 6

1. "That's all folks!"

2. Recall from Chapter One that B stands for Basic and is the basic tone of the verb, i.e. High or Low. This information would be entered in the lexicon for each verb.

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