INTRODUCTION

This book investigates certain tonal problems within the framework of lexical phonology. The results bear primarily on two types of issues: (1) issues concerning the theory of lexical morphology and phonology, and (2) issues concerning the theory of autosegmental phonology. Chapter 1 presents an overview of important aspects of the lexical and autosegmental theories. It will be shown that certain assumptions within these theories have direct consequences for the other theory. A summary will be given of the basic results of the present investigation. Finally, a number of issues will be raised which bear directly on the topic of this study but remain unresolved due to lack of evidence.

1. LEXICAL PHONOLOGY

In early generative treatments of phonology, such as that of Chomsky and Halle (1968) (henceforth SPE), the phonological component mapped surface syntactic structures onto a phonetic representation. This proposal was reached within a theory of syntax where word-formation rules were essentially a subset of the set of syntactic rules. That is, morphological operations could be performed by syntactic transformations and transformations (see for example, Chomsky 1957, Lees 1966). Since the morphological representation of a word was not determined until after the operation of the syntactic rules, the phonology could not have access to a well-formed morphological string until the post-syntactic level had been reached. So it was proposed in SPE that the entire set of phonological operations applied post-syntactically. With the (re-)emergence of a word-formation component (Chomsky 1970, Halle 1973, Aronoff 1976, et al.), it became necessary to re-evaluate the SPE position. One recent approach that has emerged from such a re-evaluation is the theory of lexical morphology and phonology proposed by Mohanan (1982) and Kiparsky (1982a).

The theory of lexical phonology holds that there are two distinct types of phonological rule applications. The first is when rules apply within the lexicon (the LEXICAL PHONOLOGY), while the second is when rules apply to the output of the syntactic component (the POST-LEXICAL, SENTENCE-LEVEL, or PHRASAL PHONOLOGY). The reason for this bifurcation rests with the claim that the two types of phonological operations systematically differ in a number of interesting ways. This is, rules applying in one component of the grammar will manifest different properties than rules applying in another component. Following Mohanan (1982), I assume that there is a single set of phonological rules, but that any given rule in the set may be defined as applying lexically, post-lexically, or both lexically and post-
In the diagram in (1), we see that a lexical item can undergo affixation at any of a finite number of ordered strata defined for any given language. After affixation, the derived form is scanned by the phonological component, and all phonological rules applicable at the appropriate stratum (and whose structural descriptions are met) will apply to the derived stra.
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The theory of phonology sketched above allows a marked reduction in the power of phonological rules as concerns their ability to refer to morphological bracketing. Pesetsky (1979) proposes that inner morphological brackets are erased at the end of every pass through the lexical phonology. Although this is essentially the same strategy assumed in SPE, its effect within lexical phonology is quite different. In SPE, morphology precedes phonology. Hence a convention of bracket erasure has a constraining effect only on the operation of phonological rules. Within lexical phonology, on the other hand, morphological processes at stratum n follow phonological processes at stratum n-1. Hence by erasing morphological brackets, we constrain not only the operation of phonological rules on subsequent strata, but also the operation of morphological rules. Following Mohanan (1982) and Kirpisky (1982a), I will assume in this study that bracket erasure applies at the end of every stratum. I accept the arguments for weakening Pesetsky's position that are discussed in those papers, and refer the reader to them for details.

Note that an important result of bracket erasure is that any rule that refers to word-internal bracketing — such as a rule referring to a notion like 'stem', 'affix' or 'compound' — must be a rule of the lexical phonology. Such bracketing will be unavailable to the post-lexical phonology, since bracket erasure will apply at the end of the last stratum of the lexicon.

Also with respect to bracketing, note that any rule that applies across word-boundaries must be a post-lexical rule, since words are only concatenated into phrases at the point where they are inserted post-lexically into syntactic phrases. This follows from a theory of grammar schematized as follows:

(5)

LEXICON

SYNTAX

POST-LEXICAL PHONOLOGY

By assuming that phonological rules apply in either of two locations — pre-syntax or post-syntax — one need not stipulate that rules applying lexically may apply only word-internally and that rules applying post-lexically may apply across word-boundaries: these conditions follow from the organization of the grammar. It also follows from such a model that in any given derivation, all lexical applications of rules must precede all
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lexically applications of rules. For example, a rule applying across j-boundaries could never apply earlier in the derivation than a rule applying to sub-word constituents. 5

1.4. The Model

could be stressed that the theory being summarized here does not inhibit a rule from applying both lexically and post-lexically. Rather, the aim is that when such cases arise, lexical applications of the rule will hit different properties than post-lexical applications of the same rule. Mohanan (1982) discusses a number of such cases. Hence a fuller view of the relation between phonology, syntax and the lexicon is as in

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1.6. Lexical Exceptions

It has been suggested by Mohanan (1982) that there is a correlation between a rule’s making reference to word-internal structure, and its ability to have lexical exceptions. He proposes therefore that as a further feature distinguishing between lexical and post-lexical rule operations, only lexical rules may have exceptions.

1.7. Structure Preservation

As a final important distinction between lexical and post-lexical rule operations, Kiparsky (1982a) has shown that rules applying in the lexicon are subject to structure-preservation constraints that do not necessarily hold of post-lexical rules. For example, if a given language’s lexical inventory of syllables does not include syllables with a branching rime, then a lexical rule in such a language will not be able to create a branching rime. On the other hand, post-lexical application of rules may create a variety of syllables unattested in lexical representations.

1.8. Summary

Below is a summary of the properties discussed above that distinguish between rules applying lexically and rules applying post-lexically:

(6) LEXICAL

a. may refer to word-internal structure
b. may not apply across words
c. may be cyclic
d. if cyclic, then subject to strict cycle
e. structure-preserving
f. may have lexical exceptions
g. must precede all post-lexical rule applications

POST-LEXICAL

a. cannot refer to word-internal structure
b. may apply across words
c. cannot be cyclic
d. non-cyclic, hence across-the-board
e. need not be structure-preserving
f. cannot have lexical exceptions
g. must follow all lexical rule applications

1.5. Stratum Domain Hypothesis

Lexical rules may not apply on an arbitrary set of strata (including the post-lexical) according to Mohanan. He argues for the following constraint:

7) The domain of a rule is specified as a set of continuous strata. Once a rule could, for example, apply on all strata on strata 1, 2, 3 and stratum 4; etc. A rule could not, however, apply on stratum 1 and stratum 5, but not stratum 2.

1.9. Phonetic Rules

A last point, before leaving this brief outline of lexical phonology, concerns the role of phonetic rules in the above model. There is increasing evidence that rules of a strictly phonetic nature may sometimes be language-particular (Pierrehumbert 1980, Liberman and Pierrehumbert 1982). For
impe, if we compare the use of aspiration in different languages, we serve systematic differences between such languages as to the degree of onetic aspiration present. Liberman and Pierrehumbert (1982) have gested that an adequate model of grammar must contain a phonetic component. Such a phonetic component will contain language-specific is that interpret the output of the phonology. They point out that many phonetic rules may actually belong in such a phonetic component in- of in the phonological component where they are generally located. Liberman (1983) suggested, for example, that aspiration in English can ifably be looked on as a phonetic — and not as a phonological — rule. Liberman (1983) even raises the possibility that such a phonetic com- ment is in fact the post-lexical component as discussed above. Hence phonology of a language would consist of a lexical phonological con- ment and a post-lexical phonetic component. Evidence will be presented this book suggesting that the pre-lexical = phonetic position is too. Nevertheless, the basic move of positing a phonetic component will adopted, and incorporated into the grammar along the following lines: words are derived in the lexicon, they are scanned by the phonology; r lexical insertion at the syntactic level, the syntactic phrase is scanned the phonology. The phonologically interpreted output of the syntax is on passed to the phonetic component.

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lexical levels have been discussed in work such as that of Mohanan (1982) and Kiparsky (1982a). Formal properties of the third level, the post-lexical level, will receive some preliminary investigation in sections of this book; its psychological importance is left for further research.

2. TIERED PHONOLOGY

Since Goldsmith’s (1976) thesis on autosegmental phonology, there has been a wide range of research on a variety of phonological problems, all assuming some form of tiered phonology. In this section, I will not review the autosegmental literature or attempt to motivate an autosegmental framework. I will, however, introduce certain issues that will be addressed in this book, and make clear certain assumptions about how a multi-tiered phonology is organized.

2.1. Association Conventions

The most basic and uncontroversial aspect of autosegmental phonology is that the phonological representation is broken up into a finite number of parallel tiers. Even though such tiers exhibit considerable independence for example, deletion on one tier does not entail deletion on another tier — one can nevertheless only obtain a well-formed phonological representa- tion once the various tiers are connected up. Hence a central issue in autosegmental theory concerns the principles (association conventions) used for linking tiers in non-rule-governed situations.

In fact, even before Goldsmith developed a formal theory of tiered phonology, research on tone languages was leading to the formulation of principles that would map tones onto tone-bearing units, even though the formal nature of the proposed mapping was often not made explicit. For example, an early proposal for assigning tones was the Tone Mapping Rule of Williams (1971). Williams proposed a left-to-right mapping rule which assigned tones to syllables. He assumed that if the mapping procedure ran out of tones before all syllables had been assigned, then the last tone would automatically be assigned to all remaining syllables in the relevant domain. On the other hand, if the procedure ran out of syllables before all tones had been assigned, Williams assumed that the multiple assignment of more than one tone to a single syllable could only result from a language-specific rule. Williams’ position is outlined below:

(10) a. The mapping procedure maps from left to right a sequence of tones onto a sequence of syllables.
b. It assigns one tone per syllable, until it runs out of tones,c. then, it assigns the last tone that was specified to the remaining untoned syllables on the right.
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10. d. until it encounters the next syllable to the right belonging to a morpheme with specified tone.
e. If the procedure above runs out of syllables, more than one tone may be assigned to the last vowel only if the grammar of the language includes a stipulation to that effect.

Goldschmidt (1976) developed earlier intuitions about the independence of tone into an explicit phonological theory, he proposed that the obvious Well-formedness Condition would govern the relation between segmental tiers at all stages of a phonological derivation:

11. a. All vowels are associated with at least one tone.
b. All tones are associated with at least one vowel.
c. Association lines do not cross.

c. Association lines do not cross.

11aconfiguration violated the Well-formedness Condition, then association lines would be deleted or added until the representation was well-formed.

A crucial difference between the pre-autosegmental proposal of liams and the Well-formedness Condition of Goldsmith concerned four-tone systems: Goldsmith (1976) would automatically link more than one tone to a single tone-bearing unit, while Williams (1971) would not. Both approaches assumed automatic spreading (one-to-many mapping) of tones onto toneless vowels.

In work based primarily on Kikuyu, Clements and Ford (1979) proposed a somewhat different set of Association Conventions, and argued for a theory similar in many respects to that of Williams (1971). They still used automatic spreading of a single tone onto more than one vowel, they returned to Williams' position that contour tones are only created by language-specific rules.

Bates and Vergnaud (1982), in yet a further development, proposed that the Association Conventions apply only to free (floating) tones. Hence configuration such as (12) will trigger the Association Conventions while (13) will not.

12. \[
\begin{array}{c|c}
\text{V} & \text{V} \\
\hline
\text{H} & \text{V}
\end{array}
\quad \begin{array}{c|c}
\text{V} & \text{V} \\
\hline
\text{H} & \text{H}
\end{array}
\]

13. \[
\begin{array}{c|c}
\text{V} & \text{V} \\
\hline
\text{H} & \text{H}
\end{array}
\]

In this book, I will argue that both the Tone Mapping Rule of Williams (1971) and the Well-formedness Condition of Goldsmith (1976) are too strong. Following Williams (1971), Clements and Ford (1979), and Halé and Vergnaud (1982), I will assume that multiple linkings of tones to a single tone-bearing unit come about only by language-specific rules. In addition, I will argue that multiple linkings of a single tone to more than one tone-bearing unit also occur only as the result of language-specific rules.

I propose, therefore, that the universal aspects of the Tone Mapping Rules and the Well-formedness Condition are as follows:

(14) Association Conventions:
Map a sequence of tones onto a sequence of tone-bearing units, (a) from left to right, (b) in a one-to-one relation.

(15) Well-formedness Condition:
Association lines do not cross.

Note that Halé and Vergnaud's (1982) proposal that the Association Conventions apply only to floating tones follows automatically from the proposal given in (14). Since tones are linked to tone-bearing units only in a strict one-to-one relation, a linked tone can never be subject to further linking by convention.

Detailed arguments for the strictly one-to-one Association Conventions proposed here will be given in a number of sections for a variety of languages; this set of conventions will, however, be assumed throughout the text, even where no specific arguments are presented for the revised position.

2.2. When do the Conventions Apply?

Another issue that relates to the Association Conventions is not how they apply, but when they apply. The basic approach that has been adopted with respect to this issue since Goldsmith (1976) is that the conventions apply whenever possible throughout the derivation. This means that rules of vowel or tone epenthesis, vowel or tone deletion, etc. will automatically be followed by reaplication of the Association Conventions. One alternative approach would be to assume that the Association Conventions apply only at the beginning of a derivation, but not automatically elsewhere. Hence linkings even of floating tones to free tone-bearing units would be solely by stipulation if the relevant configuration has been derived by rule. For example, given a derivation such as in (16), where a rule of vowel-deletion deletes \( V_1 \), a theory where the Association Conventions apply automatically would derive (17), while a theory where the conventions apply only at the beginning of the derivation would leave the output of (16) unaffected (unless by later rule).
The two approaches would have quite different results in a number of the choice between such alternatives will depend on empirical iterations. Evidence will be discussed in this book that supports the established view that the re-application of the Association Conventions is automatic. One class of counter-examples will be discussed, however: automatic re-applications of the Association Conventions are to be blocked. The class of cases being referred to involves rules peculiarity de-link tones, and it will be proposed in chapter 4 that they are not automatic. The idea that by developing a theory where spreading of autosegments is automatic, we allow configurations to arise in which certain tones units remain toneless even after the Association Conventions have applied. An example would be the configuration 0 (13) above. In fact, the same issue of how to deal with toneless rises even in a theory that posits automatic spreading of tones: happens to vowels if there is no tone available for association?

Possible discussing answers to this question, I will turn briefly to additional issues relating to a multi-tiered representation.

2.3. Linking of Tiers

were the only feature that was autosegmentalized, there would be two tiers — the tone tier and the phonemic tier. But such is not the case. Nasality may be represented on a separate tier, vowel harmony may be autosegmentalized, etc. This means that a language may have several independent (but parallel) tiers in its phonological representation. The question then is how to link tiers any given tier can talk. That is, are there limitations on the relating of tiers? Could a tier, for example, link directly to a nasality tier? Or could a tone tier directly to a vowel harmony tier?

The following problems:

\[
\begin{bmatrix}
V_1 & V_2 \\
H & H
\end{bmatrix}
\]
Concerning the issue of whether a tier can have internal structure, the reader is referred to Steriade (1982). The evidence of this investigation has no bearing on the issue. As for the representation of a feature on more than one tier — for example, tone in the phonemic tier and on an autosegmental tier — I will propose that such representations should be highly restricted.

The question of feature representations on more than one tier as explored in recent work involving redundant tone specifications has particular relevance for this study. Halle and Vergnaud (1982) propose that a feature may be represented both auto- and in the phonemic core (i.e. on a special phonemic tier). The autosegmental value takes precedence over the core value, so the core tonal value of V₁ will only surface if there is no tonal autosegment linked to V₁. Halle and Vergnaud assume that in Tonga all vowels are redundantly specified in the phonemic core as [ High tone]. Hence a word with no autosegmental form with I throughout.

(24) a. i - bá - ná \( [ +L ] [ +L ] [ +L ] \) flour

b. i - bá - sáiká \( [ +L ] [ +L ] [ +L ] [ +L ] \) men

A word that has certain vowels linked to tonal autosegments will surface with the core value on any unlinked vowels.

(25) a. i - ci - ñó ngá \( [ +L ] [ +L ] [ +L ] \) the Tonga language

b. bá - si ñá we \( [ +L ] [ +L ] [ +L ] \) leopards

An alternative approach, and the one that will be argued for in this book, is to assume that redundant tonal specifications are simply tonal autosegments supplied when a skeletal slot has not received any specification for tonal. This is, no special status would be assigned to a phonemic core; all tonal specifications in such an approach would be on a single tier.

In Kiparsky (1982a), it is proposed that lexical entries are underspecified and that unspecified values for features are filled in by rules that may be supplied either by Universal Grammar or by the grammar of the language in question. (Note also SPE.) Kiparsky proposes that all features are supplied minimally with a rule of the form \([ \_ ] \rightarrow \alpha F\) (where \(\alpha\) is either + or -), and that the set of such rules comprises a part of a theory of universal markedness.
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By assuming (1) that the skeleton is solely a sequence of slots, and (2) that the phonemic tier has no special status with respect to other tiers, we derive a theory where there is no formal difference in terms of tiers between segmental features and autosegmental features. Basically, segmental behaviour will result when each slot is linked to an autosegment prior to rule application:

\[
\begin{array}{c}
X ~ X ~ X ~ X \\
+ \! F ~ + \! F ~ - \! F ~ + \! F \\
- \! G ~ + \! G ~ - \! G ~ - \! G \\
\ldots ~ \ldots ~ \ldots ~ \ldots
\end{array}
\]

Autosegmental behaviour results when rules create multiple linkings, or when linkings are incomplete prior to application of rules or conventions:

\[
\begin{array}{c}
X ~ X ~ X ~ X \\
+ \! F ~ + \! F ~ - \! F ~ + \! F \\
- \! G ~ + \! G ~ - \! G ~ - \! G \\
\ldots ~ \ldots ~ \ldots ~ \ldots
\end{array}
\]

I emphasize that the positing of default rules as in (26) and (28) is not an enrichment of the theory of underspecification and default rules proposed by Kiparsky (1982a). It is an interpretation of Kiparsky’s proposal within a theory with a CV-skeleton whose function is to coordinate the various tiers.

It will be shown in this book that in a number of languages, default tonal specifications must be autosegmental in nature, supporting the suggestion that such fill-in rules are of the form given in (26). In the interest of a restrictive theory, it is therefore proposed that default tonal specifications must be autosegmental in general. To allow multiple possibilities for specifying redundant tonal values would create a needless enrichment of the theory. I propose the following constraint:

\[
\begin{array}{c}
X ~ \text{skeletal tiers} \\
[F.] ~ \text{tier n}
\end{array}
\]

This constraint rules out a representation where a skeletal slot is linked to the same feature on two different tiers. It rules out the supplying of re-
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Tonal features in the manner of Halle and Vergnaud (1982), since their constraint (33) was in fact required by McCarthy (1979, 1981) to account for examples such as the following, where association on the Arabic root must skip over the slot to which an affix I has been attached:

\[ \gamma \rightarrow (34) (\text{20c of McCarthy 1981}; \eta = \text{morpheme}) \]

McCarthy assumed that double linkings of the type in (33) were prohibited by the general form of autosegmental association conventions. Assuming that many-to-one linkings of the single-tier type shown in (35) are not the fault of the application of conventions, a multi-tier representation like that in (33) could not result by convention either.

(35) [F] \rightarrow [F] X

The implication of McCarthy's assumptions is that where a representation such as (35) is well-formed (as is the case in numerous tone languages), a representation like (33) should also be possible — at least by rule. As I have not encountered cases requiring the configuration in (33) even in languages allowing contours as in (35), I conclude that the two types of representations are of different theoretical status: (33) is universally excluded, while the possibility of (35) depends on language-specific provisions.

Note that the constraint in (33) is formulated in terms of linkings and not as an absolute prohibition against the representation of a feature on more than one tier. This is because in certain languages like Arabic (McCarthy 1979), it is necessary to allow phonemic specifications on more than one tier. Note, however, that such cases do not violate the constraint in (33), since the specifications on one tier link to one class of skeletal slots, and the specifications on another tier link to a different class of skeletal slots. The position would be consistent with views of the skeletal tier as either: (1) completely empty slots (X-slots), or (2) slots that are inherently

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\[ \text{\# syllabic (CV-slots). While the first possibility pushes further the idea that the skeletal tier has no internal feature structure, the second possibility is logically possible and uses the feature \text{\#syllabic} to define the otherwise unstructured nature of the skeleton. The CV nature of the skeleton (which was assumed in McCarthy 1979, Halle and Vergnaud 1982, etc.) has been interpreted in terms of featureless X's in Kaye and Lowenstamm (1981) and Levin (1983). For expositional reasons, we should assume a skeleton consisting of C's and V's in this book, but it should be kept in mind that if such labeling is derivative, this will not affect the issues discussed here.} \]

2.5 Extratonicity

The final issue that I wish to raise concerning autosegmental representations concerns extratonicity. There has been work on stress systems recently (e.g. Hayes 1980, 1982, Harris 1983) that has argued that certain constituents on the periphery of a stress domain should be excluded from consideration when applying stress rules. Such constituents have been labeled 'extratonical'. In this book, I will argue that basically the same notion is applicable in tone systems. Tonal constituents that are marked as extratonical lose their extratonicity if they cease to be on the periphery of the relevant domain. That is, extratonical constituents are shown to be subject to the same Peripherality Condition proposed for extratonical constituents by Harris.

2.6 Final Remarks

In closing this section, I want to make it clear that the topics concerning tonal representations that I discuss in this book are merely a subset of the important tonal issues. For example, there will be virtually no discussion of the relation between tone and syntax. There will be no investigation of the relation between tone and segmental features such as vowel height, voicing, glottalization, etc. And there will be virtually no discussion of what constitutes a tone-bearing unit.

3. TONE AND LEXICAL PHONOLOGY

In the above sections, we have seen that lexical phonology proposes an organization of the grammar where the phonology of a language interacts with its morphology and syntax in a particular set of ways; autosegmental phonology, on the other hand, proposes a particular type of organization for the phonological component itself. What then are the implications when autosegmental processes are examined within a lexical framework?

One can distinguish two ranges of implications. The first concerns the prediction that autosegmental rules should manifest properties comparable
indeed borne out. It will be shown that in languages like Margi and Tiv, tense association does indeed respect morphological bracketing in precisely the way predicted by cyclic association and role application. Moreover, it will be shown that cyclic tense association even plays a role in a language like Tonga which has traditionally been viewed as an accentual language.

But while most of this book argues for cyclic association, I want to stress that such cyclic behavior is the result of a cyclic morphology, and not a special property of tone per se. If tone was present in a language with a non-cyclic stratum, then tone association on such a stratum would be non-cyclic. Consider, for example, the case of Kikuyu, Clements and Ford (1979) propose that a morphological sequence such as (Xa) will be associated as in (34b).

\[
(36)\ \text{a. } mo + e + r \text{kr} + ag + e + i + e \\
\text{l H l H } \\
\text{b. } mo + r \text{kr} + \\
\text{l H H } \]

Their proposal is one of non-cyclic association, and what is particularly interesting about such a case is that the tone of morpheme \( n + 1 \) often ends up linked to morpheme \( n + 1 \). They propose that this shifting of tone to the right can be accounted for in the following way: (1) All morphemes (including their tones) are concatenated. (2) The first tone is linked to the second tone-bearing unit by an Initial Tone Association Rule. (3) Normal left-to-right one-to-one linking takes place. (4) Tones spread onto left-over vowels. Within Clements and Ford's theory, the linking of the first tone is done by an Initial Tone Association Rule specific to Kikuyu, while the rest of the linkings are carried out by clauses of their version of the Wolf-formedness Condition.

This non-cyclic account of tone in Kikuyu would be possible within a lexical framework only if the stratum on which the various morphemes in (36) were added was non-cyclic. This would mean, therefore, that all lexical rules applying to such a sequence would also be non-cyclic. In this light consider the application of Dalí's Law in Kikuyu. Dalí's Law changes a [k] into [l] when the next consonant sound is [k], [g], or [b] (Armstrong 1978). Consider the following examples:

\[
(37)\ \text{a. [ko [tel]] to throw away} \\
\text{b. [ko [iska] to come} \\
\text{c. [ko [baalka] to play} \\
\text{[yŏl̥] [yŏk̕ika] [yŏbaalka]} \\
\]
This rule must apply lexically for a number of reasons: (1) It applies stem-internally as a ‘morpheme structure constraint’:

(38) a. *γεκ- condemn
b. *γι - thatched a house
c. *γεκ- bend sharply
d. *γεκ- beer flask

(2) It applies to prefixes, when the triggering consonant is in another prefix (41 below) or in the stem (37 above). (3) Suffixes neither trigger nor undergo the rule.17

(37) a. [h] [ok] eet e → iŋkede I had come back
b. [ko [hiŋ] ok ek] a → koŋtikoŋe to be openable

The above facts mean that the rule must be sensitive to word-internal morphological structure. It could not apply across-the-board in the manner of a post-lexical rule. Supporting the rule’s lexical status, one observes sporadic exceptions, such as with ideophones and loan words (Myers 1974):

(40) a. kuku → yuku mocking interjection
b. mo + ktk̪e → Barberly (a plant)
c. koŋi → koŋi course of study (English)
d. keki → yeki cake (English)

Although by the criteria in (8), Dahl’s Law must be lexical, Myers argues that it cannot be cyclic, on the basis of examples such as the following case discussed by Barlow (1953):

(41) [ke [ke [ke [kok] a] → yeyeyeŋoŋa and thus it was spoiled

The multiple application of Dahl’s Law in a case like (41) can be explained by non-cyclic rule application. In (41), the structural description of the rule is met by all three proximal [k], and therefore all three [k]s undergo the rule.

If Dahl’s Law were to apply cyclically, on the other hand, we would derive incorrect results. As a first point, note that [ŋ] does not trigger Dahl’s Law:

(42) a. [ko [yék] a] → *yoreyka to condemn
b. [ko [yit] a] → *yoreyta to thatch a house

Consider therefore a cyclic derivation of (41). On the first prefix cycle, Dahl’s Law would apply, creating

(43) a. [ye [kok] a]

On the second prefix cycle, on the other hand, Dahl’s Law would be inapplicable since [ŋ] does not trigger the rule:

b. [ke [ye [kok] a]]

On the last prefix cycle, Dahl’s Law would again apply:

c. [ye [ke [ye [kok] a]]]

Hence cyclic application of Dahl’s Law would incorrectly predict an alternating pattern [ŋ]-[k]-[ŋ], as in *yeyeyeŋoŋa.

The above discussion of Dahl’s Law suggests that the stratum on which the relevant affixes have been added is non-cyclic. Hence facts concerning Dahl’s Law seem to support Clements and Ford’s non-cyclic analysis of tone. No stipulation would be required as to whether tone association was cyclic or non-cyclic — the morphological stratum would be cyclic or non-cyclic, and all phonological rules operating lexically would then apply in the appropriate fashion. Hence one could not have a language which was like Kikuyu in that tone association was non-cyclic, but unlike Kikuyu in that other lexical rules would apply cyclically.

3.3. Constraints on Linkings

A second major question concerning autosegmental representations in lexical theory involves the issue of constraints on autosegmental linkings. It has been observed (for example, in Halle and Vergnaud 1982) that languages differ as to the number of tones that can link to a single tone-bearing unit. It is proposed in this book that not only can only a single language vary in this respect, but the same language can vary lexically and post-lexically. It will be shown that whereas multiple linkings of tones are ruled out completely in the lexical component of languages like Tiv,
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Dschang and Yoruba, in some cases post-lexical rules may extensively or restrictively create contour tones.

3.4. Lexical vs. Post-lexical

Concerning autosegmental rule applications, it will be argued that the properties summarized in (8) above hold for the tonal rules examined. For example, cyclic rules apply before non-structure-preserving rules; rules sensitive to morpheme structure apply cyclically, while rules oblivious to morpheme structure apply non-cyclically, etc. While there are many predictions of lexical phonology that have not been tested in this book, those that have been examined generally bear out the predictions.

3.5. Underspecification

Finally, let us discuss the matter of underspecification of tonal entries with respect to the lexical model. It has been suggested that default rules of tone assignment can occur lexically, post-lexically and phonetically. Since the strongest hypothesis concerning such rules is that default tone-insertion rules are supplied by universal grammar, it will be suggested that the language-specific parameter concerning default insertion rules involves two aspects only: (A) A language may choose to implement the default values for one or both of the two tonal features supplied by Universal Grammar. (B) A language can select the component in which default tonal rules begin their application. It is also suggested that default rules cannot be extrinsically ordered with respect to phonological rules; where extrinsic orderings appear to exist, it is argued that such orderings can be derived by general principles.

The present investigation shows that the lexical framework forces us to choose certain types of analyses that turn out to be preferred for empirical reasons. A number of ad hoc devices, such as tonal variables, accentual diacritics and morphological boundary symbols are shown to be unnecessary within this framework. By restricting the types of analyses available to a tonal grammar, we take a step toward a more explanatory theory of tone. And it is in this respect that the lexical framework offers a particularly interesting approach to tonal phonology.

NOTES

1 This is not a new or recent observation. Rusin’s grammar of Sanskrit recognized such a division; the difference between primary and secondary derivation was discussed in work such as Whitley (1979) and Roolessen (1933). In this book, I will not be concerned with problems that arise in the theory of level-ordered morphemes since the crucial distinction that is needed is the tonal system. Chapter 3 examines the lexical/post-lexical context. For some problems with level-ordering—and proposed solutions—see Mohanan (1982) and Kiparsky (1982a).

2 This example is taken from Kiparsky (1982a), where such cases are discussed in detail. The formulation of Trivalent Shortening given there is:

\[ V - [\text{long}] \rightarrow CV; V \rightarrow V, \text{where } V \text{ is not miterically strong.} \]

3 But see section 5.3 of chapter 5.

4 In Mohanan’s work, an opacity condition instead of a miteric erasure. The choice of conventions is not important for the purposes of the present study.

5 Note that this ordering of rule applications is independent of the relative ordering of rules in a list. For example, if rule m is ordered prior to rule s in the list of phonological rules, but the domain of m is the post-lexical stratum and the domain of s is the lexical stratum, then application of s may precede application of m in a derivation.


7 But note Kiparsky (1982b).

8 Halé and Vennard (1982) make clause (10e) explicit.

9 The possible advantage of such an approach have been pointed out to me by Moris Halé with regard to Bamiloko-Dutch and by Akhnab Akinlabi with respect to Yoruba. Their arguments will be considered (although ultimately rejected) in sections of this book that discuss Dschang and Yoruba.

10 This possibility was pointed out to me by Paul Kiparsky.

11 Throughout this book, boundary symbols, dashes, etc. are employed as expository devices only—they are held to have no theoretical status. Where morphological constituency is relevant to the process under discussion, brackets will be employed.

12 Apparent counterexamples to (3) appear in certain examples of reduplication such as those in Marantz (1982). Marantz allows representations like the following for a type of Yoruba reduplication:

\[ \begin{array}{c}
\text{C} & \text{V} & \text{C} & \text{V} \\
\text{stot go}
\end{array} \]

Here, the V slot of the prefix is prefixed to the vowel [i], while the [i] is linked to the same slot by convention subsequent to reduplication. As Marantz himself points out, however, he has no examples that require such double linking. His examples could be reformulated so as not to violate the convention in (3) by simply assuming that prefixing blocks subsequent conventional linking:

\[ \begin{array}{c}
\text{C} & \text{V} & \text{C} & \text{V} \\
\text{stot}
\end{array} \]

13 It is suggested here that pitch accent languages fall into two categories: (1) those with lexical pre-linking of tones (see chapter 3) and (2) those with post-lexical or phonetic assignment of tones.

14 It has been shown by Mohanan and Mohanan (1984) that there are problems with the strongest version of structure pre-venon, where it is assumed that any segment that is not present underlyingly cannot be introduced in six lexicon. It is conceivable therefore that a weaker version of structure preservation would allow a recast class of cases where tones could be introduced into the lexicon even though they were not present underlyingly. This whole area requires detailed examination.

CHAPTER ONE

In the following discussion of Dahl's Law, I ignore questions about the precise formulation of the rule since it is not crucial to the point being discussed. Myers (1974), for example, suggests that [0] is a rule which is never applied, allowing a simplification of the environment for the rule to voiceless segments. Similarly, Myers suggests that the rule itself simply moves the velar stop and a general rule leaves velar stops. For a detailed discussion of Dahl's Law in Kikuyu and a number of related languages, see Davy and Nurse (5). These points are discussed in Myers (1974). In the following Kikuyu cases, I leave open the question of whether pronouns precede or follow suffixed since it does not usually affect the point under discussion.

CHAPTER TWO

THE RELEVANCE OF DOWNSPTE FOR A PHONETIC COMPONENT

1. INTRODUCTION

In this chapter, it will be shown that the study of downstep systems can shed light on the distinction between phonetic and phonological components. Downstep is particularly relevant in this respect because it involves the phonetic interpretation of phonological strings. Consider the following examples from Tiv, in which the phonetic pitch level of ga 'not' depends on the preceding tone:

(1) a. \( \ddash ve\) ga b. a dza ga
\[
\begin{array}{cccc}
\ddash & \ddash & \ddash & \ddash \\
H & H & L & H \\
\end{array}
\]

In (1a), ga is on the same pitch-level as \( \ddash \) (also H-toned), while in (1b), ga is phonetically lower than \( \ddash \) because of the intervening L-toned verb dza.

Although phonologically ga is the same in both examples — linked to a H-tone — its phonetic realization is different. In (1a), ga is on the same pitch-level as \( \ddash \) (also H-toned), while in (1b), ga is phonetically lower than \( \ddash \) because of the intervening L-toned verb dza.

Following suggestions made by Clements (1981), Huang (1980) and Odden (1983), I will account for the phonetic lowering of ga in (1b) by assuming that in Tiv tones are organised into constituents which will be referred to as FEET and that a H-tone begins a new constituent when it immediately follows a L-tone. In the phonetic component, (1a) and (1b) will therefore receive the following representations, where F stands for FOOT:

(2) a. \( \ddash ve\) ga b. a dza ga
\[
\begin{array}{cccc}
\ddash & \ddash & \ddash & \ddash \\
H & H & L & H \\
\end{array}
\]

In (2a), all H-tones will be assigned the same pitch since they belong to a single foot; in (2b), the second H is phonetically interpreted as lower than the first H since the two H-tones belong to different feet.

Putting aside details of the interpretation mechanism until later, it is nevertheless clear in an example like (1b) that phonetic interpretation is essentially a two step process: (a) a correct phonological representation is assigned (as in 1b), (b) this phonological representation is interpreted phonetically (as in 2).