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DICTIONARIES AND PHONOLOGISTS: ENGLISH ACCENTUATION AND STRESS

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1 Introduction

There is a long tradition—as exemplified in English language dictionaries and in the extensive work by phonologists—of developing notations for indicating the accentuation or stress levels of words. In Section 2, we compare and contrast two modes of representation: on the one hand, that exemplified by Chomsky and Halle (1968) and by Garde (1968), and on the other hand, that found in many English-language dictionaries. The principal difference between the two notational systems lies in the treatment of "full" (as opposed to "reduced") vowels. For Chomsky-Halle and for Garde, full vowels are always stressed. For the lexicographers, full vowels can be either accented or unaccented. We maintain that both notations are needed but they characterize very different aspects of the prosody of English words: The accent notation of the dictionaries corresponds to a surface representation of underlying metrical foot structure, whereas a Chomsky-Halle type of stress notation concentrates on degrees of prominence among syllables. The complexity of many previous analyses has resulted from an exclusive concern with degrees of stress. An analysis that incorporates accentuation provides a simpler and more elegant characterization of this particular prosodic aspect of English word phonology.

In Section 3, we cite data in support of unaccented full vowels. We look at the distribution of full and reduced vowels within similar accentual frames. Unaccented syllables can be defined are those where full and reduced vowels are in complementary distribution or in free variation.

In Section 4, we show that the dictionary-type representations, with their alternating accented and unaccented syllables, suggest a natural way of assigning foot structure to syllables. English words typically are composed of binary and ternary feet that are left-headed. Unary feet and unfooted syllables, when they occur, are restricted to the right and left edges of words, respectively. We conclude this section with a discussion of the properties exhibited by feet and the constraints affecting word accentuation.

In Sections 5 and 6, we present our analysis of English word accentuation. First, we consider morphologically simple (underived) words. We present the rules for creating the foot structures and associated accents for these kinds of words. Then we look at words whose accents do not occur in the expected positions. There are two broad classes of exceptions: words requiring that a right-edge binary or unary foot be lexically specified, and words whose final syllables must be extrametrical. Next, we turn to morphologically complex (derived) forms. We deal primarily with words whose suffixes are part of the accentual domain (e.g. *–ic, -ity*). We adopt a noncyclic approach where the rules for deriving foot structures apply simultaneously to each of the constituents of a derived

word. We discuss accent preservation, where the syllable that is accented in a contained word retains that accent in the derived word. Nonpreservation happens whenever there is overlap of syllables in the feet of two adjacent constituents.

In Section 7, we offer a nonderivational (OT-style) account of the some of the words analyzed in Sections 5 and 6. We present a set of ranked constraints, show how they accommodate the data previously treated, and compare the constraints to the derivational rules for deriving foot structures, noting the similarities and differences. In support of the noncyclic approach, we show how the constraints evaluate simultaneously the morphological constituents of a derived form.

In Section 8, we consider derived words that are irregular in some way. These are words whose lexical entries require particular morphological bracketings or some other kind of specification, without which the correct outputs cannot be obtained. We look at the accentual properties of three kinds of suffixes: internal, external, and extrametrical. From this perspective we analyze various problematic data that have been discussed extensively in the phonological literature (e.g. words with the suffixes *–ate, –ary/ory, -ize, -ive*). We conclude this section by suggesting that it may be necessary to recognize some unusual instances of word-initial syllables that are extrametrical and of word-internal syllables that are unfooted.

The preceding sections concentrate on the accentual aspect of word prosody. In Sections 9 and 10, we turn to stress. We present correspondence rules for converting the accentual representations of English words into notations with stress levels. We also consider the relation between these correspondences and further adjustments due to rhythm rules. We then extend this analysis of word stress to phrases, compounds, and sentences. Similar principles govern the stress levels of these constituent types. We reject the depth-of-embedding typical of many previous analyses, and instead argue for a flat phonological phrase, one composed of unary, binary, or ternary constituents.

2 Stress and Accentuation

2.1 The Stress Levels of Chomsky-Halle and of Garde

In 1968 two influential works appeared. In *The Sound Pattern of English*, Chomsky and Halle presented an extensive analysis of various aspects of English phonology including a long chapter (Chapter III) on word stress. In *L'Accent*, Paul Garde proposed a general theory of accentuation with several sections of his book devoted to English. In spite of their common interest the authors of these two works seem to have been unaware of each other's research, for neither cites the other in references or mentions having seen a preliminary version of the other's manuscript. Yet they employ remarkably similar notations for representing English word stress and are in agreement about the relationship between stress and vowel quality. Let us examine some of the properties of their representations.

The first property establishes a one-to-one correspondence between full or reduced vowel quality and the presence or absence of stress: Stressed syllables always contain full vowels and unstressed syllables have reduced vowels. Conversely, syllables with full vowels always bear some degree of stress whereas those with reduced vowels are never stressed. Garde notes that the reduced vowels of English include schwa (e.g. *sof<u>a</u>, del<u>e</u>gate, ed<u>i</u>t*), word-final *i* (usually represented orthographically by *y*) (e.g. *cit<u>y</u>*), medial

u (e.g. *educate*), and often word-final *o* (e.g. *window*, *tomato*). All other tense (long) vowels, lax (short) vowels, and diphthongs are full.

The second property concerns prominence relations among stressed syllables. For words in isolation, Chomsky and Halle recognize three degrees of stress: primary, tertiary, and quaternary. (Secondary stress is reserved for phrases.) Garde has only two levels: primary and secondary, the latter found on those syllables where Chomsky and Halle have tertiary or quaternary. This difference in representation is purely notational and the two systems are completely interconvertible. Consider the following examples. (We cite all forms in the standard orthography. A numeral above a vowel represents one of Chomsky and Halle's stress levels. A raised diacritic preceding a syllable denotes Garde's primary stress and a lowered diacritic indicates a secondary. Syllables not marked have reduced unstressed vowels.)

(1)

Chomsky & Halle	1 3 alcove	3 1 3 anticipate	4 3 1 anticipation	3 4 1 attestation	3 4 1 artificiality
Garde	'al,cove	,an'tici,pate	,an,tici'pation	,at,test'tation	,arti,fici'ality

Other researchers (Fudge 1984, Jones 1977, Halle & Vergnaud 1987, Hayes 1980, 1985, Kager 1989, Kiparsky 1982, Liberman & Prince 1977) also maintain that there is an exact correspondence between full vowel/stressed syllable and reduced vowel/unstressed syllable and that there are various degrees of prominence among the stressed vowels. These relationships have been adapted to other notational systems, such as metrical trees and grids. For example, here is how the preceding words would look in a grid notation (e.g. Halle and Vergnaud), where columns with asterisks (or X's) represent levels of stress and where a higher column denotes a greater degree of stress.

(2)

Halle & Vergnaud	x x x alcove	x x x x x x anticipate	x x x x x x anticipation	x x x x x x attestation	x x x x x x artificiality

2.2 Dictionary Accentuation

The notational conventions just described differ from the traditional representations found in many English language dictionaries (e.g. Kenyon and Knott, Webster's New World Dictionary of American English, American Heritage, Collins), where *full vowels can occur in both accented and unaccented positions*. Hence, these dictionaries depict fewer syllables that bear accents. They recognize only primary and secondary accents and their notations generally make use of the raised and lowered diacritics, respectively. We cite the preceding examples using the accentual notation found in Kenyon and Knott's *A Pronouncing Dictionary of American English*. Note those subsidiary stresses of Chomsky-Halle and of Garde that are no longer marked. Eliminated are precisely those that were contiguous to a stronger stress; in their place we find full vowels without stress

or accent.[1] (In all of the representations that follow, unaccented full vowels will appear in upper case. It is of course understood that accented vowels are always full and so they will not be cited in upper case.)

(3)

Kenyon & Knott	'alcOve	An'tici,pate	An,tici'pation	,attEs'tation	,arti,fici'ality

The *Longman Pronunciation Dictionary 2000,* Daniel Jones's *English Pronouncing Dictionary*, and the *OED*, 2nd edition go even a step further in noting unaccented vowels that are full. These dictionaries indicate secondary accents only when they occur to the left of the primary. What this means is that any secondary accent to the right of the primary in the other dictionary notations (e.g. the final accented syllable of *An'tici,pate*) becomes instead unaccented with, of course, a full vowel (i.e. *An'ticipAte*). This treatment is a radical departure from the other dictionaries and it will become an important feature of the accentual system that we shall propose.

(4)

Longman	'alcOve	An'ticipAte	An,tici'pation	,attEs'tation	,arti,fici'ality

The Longman-type representation has an interesting consequence. Since secondary accents now occur only to the left of the primary, the rightmost accent will perforce always be the primary one. This correlation suggests that there is no longer any need to mark explicitly secondary accents. In fact, this mode of representation is adopted by *The Oxford American Dictionary of Current English*. The accents appear in the same places as in *Longman's* but with a single diacritic. Hence, the notation for accent in the *Oxford* dictionary has become strictly binary: Syllables are either accented (indicated by the raised diacritic) or unaccented.

(5)

Oxford	'alcOve	An'ticipAte	An'tici'pation	'attEst'ation	'arti'fici'Ality

[1] Kenyon & Knott state that on occasion they employ a secondary accent next to an accented syllable to emphasize that the vowel is not reduced (e.g. *,Win'chester).* Vanderslice & Ladefoged (1972:821) propose a set of suprasegmental features, recognizing that full vowels may be either accented or unaccented. They state: "(a) The first syllable of *magnitude* as a citation form is ... [+ accent, + heavy]; ....(c) The first syllable of *magnanimous* for most speakers (other examples are *grotesque*, *citation*) is [- accent, + heavy]....(d) The first syllable of *maternal* is [- heavy]..." Their feature [+/- heavy] corresponds to the designation *full/reduced*. They state: "If a syllable is heavy, it will have its full vowel quality; if it is light, it will be completely unstressed and will often have a reduced, centralized vowel." Their term *heavy syllable* is not to be confused with the current usage where a heavy syllable is defined as a closed syllable or a syllable with a tense (long) vowel or diphthong. Burzio (1994) also recognizes that full vowels may be either accented or unaccented.

For the representations that we have examined—whether by linguists or by lexicographers—it is indeed the case that accented or stressed vowels are always full and that reduced vowels are always unaccented or unstressed. It is the treatment of full and/or unaccented that varies. Although the dictionaries indicate fewer degrees of accentuation, the perceptual salience of the various syllables in a word is in no way diminished. Chomsky and Halle have four levels of prominence: primary, tertiary, quaternary, and unstressed (reduced); Kenyon and Knott also have four: primary, secondary, unaccented full, and unaccented reduced. Hence, the notations make similar claims about perceptual prominence. Even in regard to the binary representation of the *Oxford* dictionary, the prominence relations are not compromised: The rightmost accent will always be the perceptually most prominent one; accented vowels to the left will be next in prominence, followed by full unaccented vowels, and finally by reduced vowels.

2.3 Stress versus Accent

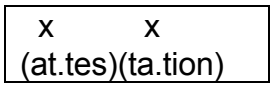
The reader may have noticed that we have used the term "stress" when referring to the Chomsky-Halle and Garde notations, but "accent" when discussing the dictionary representations. "Stress" refers to an explicit representation of the various degrees of prominence among syllables (in the sense that we have just discussed), whereas "accent," in our analysis, singles out only those prominences that determine how syllables are to be gathered into feet, for it is foot structure that is ultimately responsible for the rhythmic patterns of words. This terminological difference is reminiscent of the view expressed by Kenyon and Knott: "*Stress* is the general term for prominence of a sound or syllable, whether that prominence is produced by force of utterance, by pitch, by duration of sound, or (as usually) by some combination of these elements. *Accent* is the specific term for the prominence of one syllable over others in a plurisyllable…. Secondary accent is usually marked in words with a clear rhythmical alternation of accents…." (K&K, xxiv).

We do not see *accent* and *stress* as opposing, irreconcilable views concerning this particular prosodic phenomenon of English words. Rather, the prosodic system of English contains two discrete, but closely interrelated, components: "accent" and "stress", each of which accommodates different aspects of the prosody of prominence. It is the accentual component that organizes syllables into the higher-level constituents of feet and that recognizes the head of each foot as an accented syllable. Consequently, there will be as many accents in an English word as there are feet. Moreover, the category of *accent* is strictly binary—i.e. there are no degrees of accent—a syllable is either accented or unaccented. Once accents have been properly located the stress component takes over. It relegates degrees of prominence among the accented syllables and to syllables with full vowels. Accent is purely phonological; stress veers toward the phonetic. For example, the presence of stress may cause allophonic effects on segments within a syllable, such as the aspiration of voiceless stops in English. In this study we make no claims for the phonetic (acoustic or articulatory) correlates of "stress", other than its perceptual salience—that in words of sufficient length one of the syllables is perceived as most prominent, one or two others may be perceived as less prominent, and any remaining syllables are without prominence.

Using grid notation, let us illustrate how the analysis works. Consider the word *attestation*, which was cited previously in the various notations. This word has two accents (on its first and third syllables), but three stresses (corresponding to the full

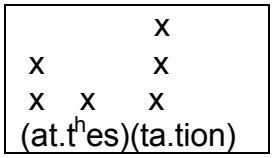
vowels of the initial three syllables). The accentual component applying to derived words (to be described in Section 6) will create two binary feet. Because English feet are left-headed, the first and third syllables will be assigned accents. (Feet are enclosed in parentheses and X's mark accented syllables.)

(6)



The stress component (to be described in Section 9) will then generate the requisite three degrees of prominence by providing additional grid marks (i.e. asterisks). The rightmost accent will be interpreted as the primary or most prominent stress (requiring a total of three grid marks), and the accent on the initial syllable will be next in prominence (with two grid marks). As for the unaccented syllables, the full vowel of the second syllable will have the least degree of stress (with a single grid mark), and the reduced vowel of the final syllable, being stressless, will have no grid marks. Note, incidentally, the fact that the second syllable of *attestation* begins allophonically with an aspirated stop is due to its stress and not to accent (as that syllable was initially unaccented).

(7)



The dual roles of accent and stress are reflected also in how rhythm gets manifested. Accentual rhythm is based on the binary opposition of accented/unaccented. In words of sufficient length, accented syllables are separated by one or more unaccented syllables, and as noted, it is accentual rhythm that is at the heart of many of the dictionary representations. Stress rhythm, on the other hand, seems less concerned with unstressed syllables and instead establishes alternation among the different levels of stressed syllables. It may be manifested as a weaker stress between two stronger ones, or as a stronger stress between two weaker ones. In the notation of Chomky and Halle, the words *anticipate* and *attestation*, which exemplify 3 1 3 and 3 4 1 stress configurations, respectively, exhibit this type of stress rhythm.

It is our claim that the dictionary accentuation, as embodied in the *Oxford* notation, in addition to being a representation of accentual rhythm, contains an implicit representation of the foot structures of English (in the sense that the syllables bearing dictionary accents will correspond precisely to heads of feet in our analysis). Before making explicit this latent property of dictionary accentuation, we need to provide some additional evidence for the principal trait that distinguishes accent from stress—the treatment of full vowels.

3 Unaccented Full Vowels

What evidence might we offer to show that the lexicographers are on the right track and that not all full vowels are accented? In general, it is easy to identify perceptually those full vowels that dictionaries count as unaccented: They are contiguous to a syllable with a

more strongly stressed vowel. For the *Longman* class of dictionaries there is an additional crucial proviso: a word-final full vowel in a trisyllable with primary accent on an antepenult will also be unaccented (e.g. *An'ticipAte, hY'potenUse, 'diffic*Ult). This procedure for identifying unaccented full vowels relies entirely on their stress levels. But are there any structural arguments that these full vowels are different from those that are considered accented? Interestingly enough, unaccented full vowels occur in those syllable positions where reduced vowels are also found. Here then is our strategy: We shall look at the occurrence of full and reduced vowels within various syllable positions of a word to see whether the two types of vowels are in complementary distribution or in free variation. If so, then the full vowels in that particular environment are unaccented. If not, they are accented.

3.1 Initial syllables

Let us begin with initial syllables preceding a more strongly stressed syllable. In this environment we find full and reduced vowels in complementary distribution: The full vowels occur in heavy syllables (i.e. in open syllables with a tense vowel or in closed syllables); the reduced vowels occur in light syllables (i.e. in open syllables with an underlying lax vowel).

(8)

dAy'tona	rO'tate	bAn'dana	bAc'terium	An'tici'pation
da'kota	po'lite	ba'nana	ba'cillus	e'labo'ration

The only difference for each pair of words is whether the syllable in question contains a full or a reduced vowel. All other relevant properties of the pair remain constant: Both members have the same number of syllables and identical stress configurations for the other syllables.

Moreover, for the initial syllable of many words a tense vowel and its reduced correlate may be in free variation. Depending on style or dialect, the vowels of the initial syllables of the following words may be realized as either full or reduced.

(9)

dE'troit	dE'ny	E'rase	psY'chiatry	E'nunciAte	fA'tality
de'troit	de'ny	e'rase	psy'chiatry	e'nunciAte	fa'tality

3.2 Medial syllables

A similar phenomenon in regard to the complementarity of full and reduced vowels occurs where the vowel is flanked on both sides by more strongly stressed syllables. And again for some of these words there will be free variation.

(10)

'att**e**s'tation	'dev**a**s'tation	'comp**e**n'sation	'fragm**e**n'tation	'cons**u**l'tation

It is reasonable, then, to suppose that where full and reduced vowels occur in the same accentual frame they contrast only in quality (as full versus reduced) and not in both quality and accentuation (as full accented versus reduced unaccented).

Recall that Chomksy and Halle's tertiary stresses are sometimes equivalent to the dictionaries' accented (e.g. *e'l<u>a</u>bo'ration*) and at other times to unaccented (e.g. *p<u>O</u>n'toon*, *<u>A</u>n'ticipAte*). It is only the latter that can be in complementary distribution with reduced vowels. Substituting a reduced vowel for the former (keeping all other aspects of the accentual structure of the word constant) would result in an unacceptable accentual pattern. Thus, it would not be possible in the second syllable of the word *elaboration* to substitute a reduced vowel for Chomsky and Halle's tertiary stressed vowel, for the result would be a word beginning with an unacceptable sequence of unaccented syllables (viz. **elabor'ation*). Hence, Chomksy and Halle's tertiary stress in this type of case can correspond only to the dictionary's accented syllable (viz. *e'l<u>a</u>bo'ration*).

3.3 Final syllable

The dictionary treatment of bisyllables is straight forward enough. Because the dictionaries eschew contiguous accented syllables, full vowels in the final syllables of bisyllabic words with initial accent can be only unaccented. Looking to complementary distribution, we find that these final full vowels indeed occur in the same environments as reduced ones. (Note the free variation of many words ending in *–ile*.)

(11)

'nomAd	'chlorIde	'commEnt	'permIt	'fragIle	'reptIle
'ballad	'acid	'tangent	'hermit	'fragile	'reptile

Now let us turn to words such as *compens<u>a</u>te*, *anal<u>y</u>ze*, *anecd<u>o</u>te*, words with main accent on the antepenult and with full vowels in their final syllables. In the Chomsky-Halle notation these final syllables carry tertiary stress, and in some of the dictionaries (e.g. *Webster's New World, Collins, Kenyon and Knott*) they have secondary accent. The latter accent is indicated whenever the final full vowel is preceded by an unaccented syllable. Yet, other dictionaries (e.g. *Longman's*, *OED 2nd ed.*, *Oxford American*) depict these final syllables as unaccented. It is this feature that permits the right-most accent always to be singled out as the primary one, and consequently, permits a binary representation of accentuation. What arguments are there in support of the claim that final syllables with full vowels in words with an antepenultimate main accent are to be analyzed as unaccented?

We have already established that final full vowels are unaccented in bisyllabic words. Now there are trisyllablic words having identical segmental content in their final syllables. We are suggesting that the parallelism is not restricted just to the segmental content, but that the parallelism extends as well to the accentuation.

(12)

'canIne	'icOn	'anthrAx	'rhombOId
'porcupIne	'marathOn	'parallAx	'humanOId

Consider now complementary distribution. The complementarity of full and reduced vowels that we noticed previously for initial and medial syllables is at work also for final syllables. Ross (1972) demonstrated that for nouns either kind of vowel is possible whenever the final consonant is a sonorant or a dental obstruent (as shown in the first two lines of the following table). Note, moreover, the two variants of *Oregon*, one with a

syllable-final full vowel and the other with a reduced vowel. However, only a full vowel occurs when the final consonant is a nondental obstruent (as shown in the third line). This difference in the behavior of dentals/sonorants and nondental obstruents lends further support to the complementary distribution of these syllable-final vowels.

(13)

'marathOn	'metaphOr	'alcohOl	'daffodIl	'sycophAnt	'oregOn
'cinnamon	'bachelor	'capitol	'codicil	'elephant	'oregon
'demigOg	'lollypOp	'succotAsh	'fisticUff	'handicAp	

Similar to *Oregon* are the many verb/noun pairs ending in *–ate* and *–ment*, where the verb exhibits a full vowel but the noun a reduced one. Here too we characterize this contrast as a difference in vowel quality and not as the presence versus absence of accent.

(14)

Verbs	'delegAte	'advocAte	'complimEnt	'documEnt
Nouns	'delegate	'advocate	'compliment	'document

An additional piece of evidence concerns some differences between American and British pronunciation. For the underlined vowels of words of the type *dictionary, category, realization*, American English has full vowels for the first two words and a reduced vowel for the third, whereas British English has the opposite. All other accentual properties of the pairs are the same for the two dialects.

(15)

American	'dictionAry	'categOry	'reali'zation
British	'dictionary	'category	'realI'zation

This pervasive variation between American and British pronunciation is indicative of a difference in vowel quality, rather than accentuation, and it is quite different in kind from the American '*corrolAry* versus the British *cor*'*rollary*, which is a difference in accentuation.

To summarize, only those subsidiary stressed vowels of Chomsky-Halle (and of Garde) that are in complementary distribution with reduced vowels are equivalent to the unaccented full vowels of the dictionary representations, whereas those subsidiaries not in complementary distribution will always correspond to the secondary accents of the dictionaries. This distinction is important for it shows that the dictionaries have not randomly assigned full vowels as either accented or unaccented; rather, the dictionary representations and the distributional properties complement each other. Moreover, the distributional facts are in accordance with the perceptual data: Full unaccented vowels generally are contiguous to syllables containing more prominent vowels.

3.4 Vowel reduction

It is a well-known fact about English that vowels that are accented in some words are unaccented and reduced in related forms, due to a shift in accentuation—e.g. *'cAnada, ca'nAdian*; *'tElegrAph, te'lEgraphy*. But not all unaccented vowels are reduced, the very trait which differentiates the dictionary representations from those of Chomsky-Halle and

of Garde. In what contexts, then, do unaccented vowels stay full? We have by no means conducted an exhaustive study of the conditions for the occurrence of unaccented full vowels. We note here some of the observed tendencies, most of which have been discussed elsewhere. In addition to the generalizations that emerge, there will be the inevitable exceptions requiring certain vowels to be lexically specified for nonreduction, such as the initial vowel of *rA'coon* and the medial vowel of *'chimpAn'zee*.

3.4.1 Word-initial syllables

Both full and reduced vowels occur in initial syllables—e.g. *dAy'tona* versus *da'kota*. The underlying representations would contain a tense or a lax vowel, respectively. In 2.1, we noted that there are even words where full and reduced vowels are in free variation, due to style or rate of delivery—e.g. *dE'troit, de'troit; fA'tality, fa'tality.* We assume that the underlying representations of such pairs contain a tense vowel (viz. *'fAtal*) and that the vowel of the initial syllable is marked to undergo optionally vowel reduction. In regard to a lax vowel in a closed syllable, the other environment for a heavy syllable, the vowel will be full unless it belongs to a prefix. Hence, we find full vowels in words, such as *bAn'danna, mOn'tana,* but reduced vowels in *ad'mit, con'demm, ex'pect.*

3.4.2 Word-medial syllables

Underlying tense vowels in a syllable preceding an accented one tend to reduce—e.g. *adO'ration.* For medial lax vowels in a closed syllable there is much variation: *ostEn'tation, chimpAn'zee, HalicAr'nassus*, with full vowels, and *serEn'dipity, Pennsyl'vania, infor'mation*, with reduced vowels. Then there is the well-known pair *condEn'sation* versus *compen'sation*, cited by Chomsky and Halle, where the first member is supposed to have a full vowel and the second a reduced one. The difference here is attributed to the fact that the former word is derived from the verb *con'dense* and so the full quality of the vowel (due to its being stressed in the verb) is preserved in the derived form, whereas the latter word is derived from the verb *'compensate* and so the reduced medial vowel of the verb remains that way in the derived form. This distinction, though, is not consistently carried through. The words, *information*, *transportation, fragmentation, lamentation* have medial reduced vowels; yet the corresponding verbs have accented final syllables. Assuming that vowel reduction is the normal situation for medial syllables, in the lexicon we would need to mark with a diacritic those vowels not undergoing reduction.

3.4.3 Word-final syllables

In final syllables, tense vowels generally remain full when unaccented—e.g. *'aptitUde, 'cavalcAde, 'paradIse, 'telephOne,'diocEse, mol'luscOid, im'pregnAte, 'archIve, 'gangrEne, 'MoscOw, 'tirAde*.

With lax vowels followed by one or more closing consonants the situation is more complex. It depends on the type of final consonant.[2]

[2] Our examples of vowel reduction in final syllables (our sets 1-4) are adapted from Ross. The words in sets 2-3 exemplify the Arab-rule, attributed to Fidelholtz (1966).

1) Where the consonant of the final syllable is a nondental obstruent (or a cluster with a nondental obstruent) and the accent is on the antepenultimate syllable, the vowel of the final syllable is full. Notice the previously cited words, *'demigOg, 'lollypOp, 'succotAsh, 'fisticUff*, as well as *'asterIsk, 'parallAx, 'avalAnche, 'catarAct.*

2) Where the consonant of the final syllable is a nondental obstruent and the accent is on a preceding heavy syllable, the vowel of the final syllable is full—e.g. 'a:rAb, *'na:bOb, 'CantAb, 'pontIff, 'ko:pEck, 'humbUg*.

3) Where the consonant of the final syllable is a nondental obstruent (or a cluster with a nondental obstruent) and the accent is on a preceding light syllable, the vowel of the final syllable is reduced—e.g. *'ar<u>a</u>b, 'scall<u>o</u>p, 'spin<u>a</u>ch, 'ol<u>i</u>ve, 'hadd<u>o</u>ck, 'chall<u>e</u>nge, 'on<u>y</u>x, 'moll<u>u</u>sk*.

4) Where the consonant of the final syllable is a dental obstruent or a sonorant (or a cluster of dental consonants), both full and reduced vowels occur—e.g. *'boycOtt, 'gonAd, 'icOn, 'albatrOss, 'caravAn, 'metaphOr, 'daffodIl, 'sycophAnt*, with full vowels, and *'carp<u>e</u>t, 'serm<u>o</u>n, myri<u>a</u>d, 'anim<u>u</u>s, 'cinnam<u>o</u>n, 'vineg<u>a</u>r, 'eleph<u>a</u>nt*, with reduced vowels. Consequently, one cannot predict whether an unaccented vowel in this environment will be full or reduced. Because the vowels in question are lax (and lax vowels are more prone to reduction than tense ones), once again, those that remain full will need to be indicated with some kind of lexical marking.

An analysis based on accent recognizes that unaccented vowels may be either full or reduced. However it is not always possible to state the conditions governing the occurrence of each type of unaccented vowel, and consequently, some words will require a lexical specification for or against vowel reduction. The inability to state unequivocally the necessary conditions for the reduction or nonreduction of unaccented vowels is not to be construed as a weakness of this analysis. Exactly the same situation is confronted in analyses maintaining that full vowels are always stressed. In those analyses, the indeterminacy is shifted to the means for assigning stress to the particular vowels in question.[3] In any case, it will be necessary to indicate in the lexicon with a diacritic, whether certain vowels remain full or become reduced (as required in an "accent" analysis) or whether they fail to become stressed or unstressed (as required in a "stress" analysis).

4 Foot Structure and Constraints of Word Accentuation

We have proposed that the prosodic system of English contains two components: accent and stress. The former determines how syllables are to be organized into foot structure, and the latter how they acquire varying degrees of prominence. Moreover, these two components are interrelated: the category of *accented* always corresponds to some n-ary level of stress, whereas *unaccented* corresponds to either a lesser degree of stress or to unstressed. In Section 2 we argued that the notations of Chomsky-Halle and of Garde constitute fairly exact representations of stress levels, whereas the *Longman* and *Oxford*

[3] Ross (1972), who treats all full vowels as stressed and reduced vowels as unstressed, states conditions (and their exceptions) for assigning or removing stresses.

representations depict explicitly accent and implicitly foot structure. It is time to render the implicit as explicit and to show how we arrive at foot structure from dictionary accentuation. For many words, the following premise will derive feet from the location of accents.[4]

(16)

A foot is composed of an accented syllable and any following unaccented syllables.

Here are some examples of different types of feet with labels for describing them. (From here on for expository purposes, we shall indicate the primary accent of a word with an acute diacritic and any subsidiary accents with a grave, although it is to be recalled that both primary and subsidiary accents are manifestations of a single category, Accent. We enclose feet in parentheses, and initial unfooted syllables are not parenthesized.)

(17)

Ternary (Left-headed)	*Dactyl* ' ? ? (ánimal) (cánada) a(spáragus) a(mérica)
Binary (Left-headed)	*Trochee* ' ? (hábit) (téxas) a(génda) a(láska)
Unary (final syllable only)	(kànga)(róo) (kàlama)(zóo) de(vóte) ja(pán)

Looking at the kinds of feet exemplified by these English words, we can enumerate some of the properties of foot structure.

(18)

1) There are as many feet as there are accents.
2) An accented syllable will be the head of its foot.
3) Permitted foot structures are ternary, binary, and unary.
4) Binary and ternary feet are always left-headed; there are no ternary feet that are amphibrachs (i.e. unaccented-accented-unaccented) or binary feet that are iambic (i.e. unaccented-accented).
5) A unary foot is found only at the right edge of a word; this is the only position where an accented syllable has no unaccented one following it.
6) An unfooted syllable can occur only at the left edge of a word; being unaccented there is no preceding accented syllable with which it can form a foot
7) Except for initial unfooted syllables or extrametrical syllables (to be discussed in Section 5), every syllable of a word belongs to a foot.

[4] This premise is fairly uncontroversial. To my knowledge all previous studies dealing with the foot structure of English words have recognized left-headed feet.

Some words of four syllables and all words of five or more syllables have more than one foot. Here are some examples of multiple foot structures.

(19)

trochee + trochee	(àri)(zóna) mo(nònga)(héla)
trochee + dactyl	(càli)(fórnia) me(dìci)(nálity)
dactyl + trochee	(wìnnepe)(sáukee) phe(nòmeno)(lógic)
dactyl + dactyl	(mèmora)(bília) ex(pèrimen)(tálity)
trochee + trochee + trochee	(àpa)(làcha)(cóla) (rèha)(bìli)(tátion)
trochee + trochee + dactyl	(àrti)(fìci)(álity)
trochee + trochee + trochee + dactyl	(èxtra)(tèrri)(tòri)(álity)

The salient feature of accentuation is rhythm: Accented syllables are separated by one or more unaccented. What this means is that accented syllables may not be contiguous, which is a fundamental property of the dictionary representation of accentuation. By taking the proposed foot structures into account we can explain the absence of clash, i.e. of contiguous accented syllables. Words containing more than one foot have only binary or ternary feet to the left of the right-most foot. Consequently, there will always be at least one unaccented syllable following the head, and so two heads cannot abut. Clash could result only were a unary foot followed by a left-headed one. This state of affairs never happens in English because a unary foot is found only at the right edge of a word boundary.

Note also that English words begin with at most one unaccented syllable. In Section 5 we propose rules for building foot structures and for assigning accents. We shall see that feet are constructed from right to left (i.e. from the end of the word to its beginning). By means of this right-to-left parsing, syllables are gathered into feet and no syllable is skipped over. Should there be a stray syllable that cannot be footed, it will be found only at the beginning of a word. Hence, there can be at most one such syllable, for two contiguous stray syllables could always be gathered into a binary foot.

We shall refer to the distributional restrictions on unary feet and stray syllables as edge constraints since they affect the end and the beginning of words, respectively. These constraints will play a major role in Section 6, where we consider morphologically complex forms.

(20)

Edge constraints on foot structure
1. A unary foot is permitted only at the right edge of a word.
2. A single unfooted syllable is permitted only at the left edge of a word.

We have shown how it possible, starting from the dictionary representation of accent, to arrive at the foot structures of English words. There are as many feet as there are accented syllables, and every accented syllable becomes the head of its foot. This procedure revealed that feet are generally left-headed binary or ternary, and restrictedly unary. It is time to leave aside dictionaries and return to the realm of phonology. For a vast majority of English words, neither foot structure nor the location of accents is part of

the lexical representation, for it is precisely these attributes that we want to predict from the underlying segmental composition and syllable structure of a word. Consequently, there must be rules of metrification for generating feet, and then from those foot structures the locations of accents can be readily deduced. We turn now to this task.

5 Accentuation of Underived Words

In this section we present rules for metrification—rules for constructing feet and for assigning accents. In 4.1 we deal with binary and ternary feet, and in 4.2 with unary feet. Our concern here is exclusively with underived words. In section 5 we extend the analysis to morphologically complex or derived words.

5.1 Words with Binary or Ternary Feet

Here are the rules for deriving the foot structures and accents of simple (underived) words.

(21)

Rules for metrification	
From right to left, starting at the right edge of a word:	
Rule a.	Create a binary foot where there is a heavy syllable followed by a light one.
Rule b.	Otherwise, create optimal feet (ternary or binary).
Rule c.	Assign an accent to the syllable located at the left edge of a foot.

Metrification starts at the right edge of the word and proceeds leftward, gathering syllables into binary or ternary feet. If at the right word-edge there is a heavy syllable and following light one, a binary foot is created around the pair; otherwise, a ternary foot is formed if there are at least three syllables available; if not, then a binary foot. (Rule b, then, provides binary feet for bisyllabic words.) If there are two or more unfooted syllables to the left of the foot just created, the procedure continues leftward, skipping over no syllables, and additional binary or ternary feet are created as the case may be. Rule b mentions optimal foot construction, which has two different interpretations: one pertaining to foot span, the other to exhaustive metrification.

(22)

Foot span:	Ternary feet are optimal vis-à-vis binary.
Exhaustive metrification:	Avoid an unfooted syllable.

Consider, for example, the possible metrifications for a trisyllabic word.

(23) a) x (x x) b) (x x x)

The metrification in a), with its binary foot and unfooted initial syllable, violates both senses of optimal foot construction; hence, b) is the preferred metrification. There would be indeterminacy though with a four-syllable word. Which one is optimal—a ternary foot with an unfooted syllable, or two binary feet?

(24) a) x (x x x) b) (x x)(x x)

Each metrification satisfies one of the conditions of optimal foot construction but violates the other one. How is this dilemma resolved? For words sufficiently long, both conditions are at work but at different places. The principle of foot span, applying to words of three or more syllables, is relevant for the foot created at the right edge of the word. Thus, one finds *a(merica)*, exemplifying pattern (24a) (as opposed to **(amer)(rica)*, had there been exhaustive metrification). Exhaustive metrification, however, is applicable to any additional foot structure. Thus, one finds *(apa)(lachi)(co:la)*, illustrating pattern (24b) (as opposed to **a(pachali)(co:la)*, had there been foot span).

Let us see how metrification works for words of various length and syllable structure. (Throughout derivations we provide syllable divisions so that the number of syllables in a word is readily apparent. These divisions do not necessarily correspond to where syllable boundaries occur phonetically or even orthographically. Two conventions govern the placement of syllable breaks in our representations: 1) A single consonant between vowels is syllabified as the onset of a following syllable, and 2) for morphologically complex words, syllable divisions occur at morphological boundaries.)

(25)

	co.met	a.las.ka	ca.na.da	a.me.ri.ca
Rule a		a(las.ka)		
Rule b	(co.met)		(ca.na.da)	a(me.ri.ca)
Rule c	(có.met)	a(lás.ka)	(cá.na.da)	a(mé.ri.ca)

	a.ri.zo:na	ca.li.for.ni.a	se.ren.di.pi.ty
Rule a	a.ri(zo:na)		
Rule b		ca.li(for.ni.a)	se.ren(di.pi.ty)
Rule b	(a.ri)(zo:na)	(ca.li)(for.ni.a)	(se.ren)(di.pi.ty)
Rule c	(à.ri)(zó:na)	(cà.li)(fór.ni.a)	(sè.ren)(dí.pi.ty)

Notice why it is imperative that feet be created leftward from the right word-edge. The second syllable of *serendipity* is heavy and it is followed by a light syllable; yet it is not the head of a foot. The first place where rule a may apply is at the penultimate syllable. But because that syllable is light, rule a is not applicable and instead rule b creates a ternary foot. Once the antepenultimate syllable is within a ternary foot, that syllable is no longer available to enter into a binary foot with the preceding heavy syllable. Hence, rule b, through exhaustive metrification, must create a binary foot around the first and second syllables of *serendipity*.

Consider now the trio of words *Winnepesaukee, Apalachicola*, and *Monongahela*. All three have a binary foot at the right edge due to a heavy penult. Of interest here are the foot structures to the left. For *Winnepesaukee* there are three syllables preceding the rightmost foot, and for *Apalachicola* there are four. Hence, exhaustive metrification creates a ternary foot for the former and two binary feet for the latter. For *Monongahela*, there are also three syllables before the rightmost foot; however, its heavy second syllable

must be the head of a binary foot, and consequently, this word will have to begin with an unfooted syllable.

(26)

	win.ne.pe.sau:kee	a.pa.la.chi.co:la	mo.non.ga.he:la
Rule a	win.ne.pe(sau:kee)	a.pa.la.chi(co:la)	mo.non.ga(he:la)
Rule a			mo(non.ga)(he:la)
Rule b	(win.ne.pe)(sau:kee)	(a.pa)(la.chi)(co:la)	
Rule c	(wìn.ne.pe)(sáu:kee)	(à.pa)(là.chi)(có:la)	mo(nòn.ga)(hé:la)

Notice that there are two situations where an initial unfooted syllable can occur: with a following binary foot (e.g. *A(laska), Mo(nonga)(hela*), and in a four-syllable word with a ternary foot (e.g. *A(merica)*). It is evident then that in foot construction, rule a, which creates a binary foot for a heavy-light sequence, takes priority over both options of rule b for foot optimization (foot span and exhaustive metrification).[5]

Consider now words such as *compensate*, *anticipate*, *difficult, hypotenuse*. Chomsky-Halle and many dictionaries represent these kinds of words with a primary accent on the antepenult and a subsidiary accent on the full vowel of the final syllable. We have adopted the view, in conformity with the *Longman* and *Oxford* classes of dictionaries, that the final syllable is unaccented. The fact that these word-final full vowels are unaccented is what enables one to arrive at the generalization that the right-most accent will always be the primary one. Because these words will have only a single accent on the antepenult, their derivations will be analogous to words like *Canada* and *America* (i.e. they will have a rightmost ternary foot in conformity with rule b). Although a word like *compensate* has a heavy penult, that syllable will not become the head of a binary foot. Rule a fails to apply here precisely because the penultimate heavy syllable is followed by another heavy syllable, and not by a light one.[6] (In the following derivations, recall that the capitalized letters indicate unaccented full vowels.)

(27)

	com.pen.sAte	an.ti.ci.pAte	dif.fi.cUlt	hY:po.te.nUse
Rule b	(com.pen.sAte)	an(ti.ci.pAte)	(dif.fi.cult)	hY:(po.te.nUse)
Rule c	(cóm.pen.sAte)	An(tí.ci.pAte)	(díf.fi.cUlt)	hY:(pó.te.nUse)

[5] Words such as *àdiróndAck, penóbscOt* conform to rule a, and accordingly they will get binary feet enclosing their penultimate and final syllables. Word-final syllables containing a lax vowel and a single terminal consonant function as light; what is special here is the failure of the final vowels to undergo vowel reduction (see section 2.3.3).

[6] Liberman and Prince (1977) employ branching binary trees for the metrical structure of words: syllables are labeled S/W (equivalent to accented/unaccented) as well as [+/- stress] (equivalent to full/reduced). They represent a word like *compensate* as having a final syllable that is both W and [+ stress]—that is, as unaccented full. Burzio (1994) also advocates that there are word-final full vowels that are unaccented and that words like *anticipate* receive their accentuation by the regular rule for antepenultimate accentuation. It is not clear, though, how he would handle a word like *compensate*, with a heavy penult, which according to his formulation ought to get penultimate accentuation.

5.1.1 Accented Light Penultimate Syllables

The metrification rules yield binary and ternary left-headed feet. The binary feet arise either because there is a heavy penultimate syllable followed by a light one (rule a) or because the word is bisyllabic (rule b). But the metrification rules cannot create binary feet for polysyllabic words that are to be accented on a light penult. Yet there are many words with this accentual pattern. We need cite only a few examples.

(28)

Verbs	solícit endéavor devélop imágine delíver
Nouns	banána Kentúcky vanílla enámel cadáver

How are these words to be treated? The original Chomsky-Halle stress rules worked differently for nouns and verbs. For words terminating in two light syllables stress was placed on the antepenult for nouns (e.g. *Cánada*), but on the penult for verbs (e.g. *solícit*). For us, the situation exemplified by the nouns (i.e. antepenult accentuation unless there is a heavy penult) constitutes the default case, the one requiring no special restrictions or part-of-speech categorization. In order to handle the verbs, we propse a lexical rule that creates a binary foot at the right edge. Lexical rules, because they introduce metrical structure for special situations, will apply prior to the metrification rules, the latter being the default situation.

(29)

Lexical rule:	For verbs terminating in a light syllable create a binary foot at the right word edge.

Here are the derivations for two of the verbs.

(30)

	so.li.cit	i.ma.gine
Lexical rule	so(li.cit)	i(ma.gine)
Rules a, b		
Rule c	so(lícit)	i(má.gine)

The situation for verbs differs from that of nouns such as *banana*. How do we keep the latter from receiving antepenultimate accentuation, the default situation for nouns terminating in two light syllables? Chomsky and Halle suggested that such words, in their lexical entries, were to be represented with geminate consonants in the penultimate position (i.e. syllabically as *ba.nan.na*). Then these words would not end in two light syllables and so stress would be appropriately assigned to the heavy penult (exactly analogous to the assignment of stress to the heavy penult of *agenda*). But because such words do not have pronounced geminates in their output, a rule of degemination was required to undo this purported underlying gemination. Now we too could posit geminates in penultimate position and then our Rule a would see to it that the appropriate binary foot was created. However, we shall not adopt this solution, but instead we shall

enter the appropriate foot bracketing as part of the lexical entry for these kinds of nouns (e.g. *ba(nana)*).[7]

We accept the premise that, ideally, words should be entered in the lexicon without accents or stresses and that, whenever possible, their accentuation is to be assigned by rules or constraints. For a near minimal pair, such as *Canada* and *banana*, there is an identical syllable structure of three open syllables. Yet the former word must be accented on the antepenultimate syllable and the latter on the penultimate. Now no matter how the rules are formulated, they will assign the appropriate stress, accent, or foot structure to one member of the pair (call it the regular or default case), but they will not assign it automatically to the other member (call it the irregular case). We consider antepenultimate accentuation to constitute the default case (i.e. the one where the lexical representation requires no adjusting); therefore it is necessary to tinker in some way with those forms exhibiting penultimate accentuation in a light open syllable. Chomsky and Halle's original solution was to introduce a geminate in the lexical representation of *banana*, thereby giving it a closed penultimate syllable. But positing a consonant here (one that subsequently will have to be wiped out) is simply a way of marking this syllable for penultimate stress assignment and is equivalent to placing an accent on that syllable or providing the appropriate foot bracketing. For this reason, we have opted for the latter mode of specification.

Note, then, the various treatments for *Canada*, *agenda, solicit*, and *banana*. The forms *Canada* and *agenda* are not lexically marked for foot structure. They receive their foot structures and accents entirely from the operation of the metrification rules a, b, and c. A form like *solicit* has no foot bracketing as part of its lexical representation but gets its binary foot from the lexical rule that applies to verbs; it enters the accentual component so specified and receives its accent by rule c. Finally, *banana* has a lexically specified binary bracketing and it too enters the accentual component with its bracketing in place, and then receives its accent by rule c.

5.1.2 Word-final Extrametricality

We have just examined exceptional words that are accented on a light penult. There are also exceptions where a heavy penult, which should attract the accent, fails to do so; instead the primary accent falls on an antepenultimate syllable or even on a preantepenultimate syllable. Note the following contrasting forms.

(31)

Heavy accented penult (regular)	decémber	epóxy	coriánder	
Heavy unaccented penult (exceptional)	cháracter	gálaxy	sálamAnder	állegOry

We shall treat the exceptional forms in the manner that has become fairly standard for these kinds of words: The final syllables are deemed extrametrical (shown by angled brackets). We assume that the extrametrical bracketing constitutes part of the lexical

[7] Burzio (1994) argues for geminate consonants for words like *banana*. Halle and Vergnaud (1987) consider words of this type as having penultimate accentuation indicated as part of the lexical entry, the same solution that we have adopted.

entry for these kinds of words. An extrametrical syllable is excluded from the metrification process and so foot construction will begin with the syllable preceding the extrametrical element. In this way, a form such as *galax<y>* no longer is considered to have a heavy penult; without the metrification of its final syllable it becomes analogous to a word like *helix*, and accordingly, its first two syllables will form a binary foot. In a similar fashion, a form such as *salamand<er>* will have the same ternary footing as a word like *document*.

(32)

Heavy accented penult	de(cém.ber)	e(póx.y)	(cò.ri)(án.der)	
Heavy unaccented penult	(chá.ract)<er>	(gá.lax)<y>	(sá.la.mAnd)<er>	(ál.le.gOr)<y>

Because the extrametrical element evades foot construction, it remains unfooted. We observed previously that a syllable that is left over at the beginning of a word is one source of unfootedness. Extrametricality then is a second way of obtaining unfooted elements, particularly in word final position.[8]

The following table shows that the same types of extrametrical syllables occur with the two classes of exceptions: words not accented on a heavy penult and words accented on the preantepenultimate syllable.

(33)

Heavy unaccented penult	(gálax)<y>	(cháract)<er>	(cárbunc)<le>	(ádject)<ive>
Preantepenul-timate accent	(állegOr)<y>	(sálamAnd)<er>	(végetab)<le>	(nóminat)<ive>

Thus far, we have made use of one of the following mechanisms for determining accent placement for exceptional forms:

(38)

1. assigning binary foot structure by means of a lexical rule (e.g. *so(licit)*
2. specifying binary foot structure as part of the lexical entry (e.g. *ba(nana)*
3. designating a terminal syllable as extrametrical (e.g. *galax<y>*).

5.2 Words with Unary Feet

The default accentuation on an antepenultimate syllable applies not just to nouns such as *Canada* and *America*, but to nouns, verbs, and adjectives such as *cavalcade*, *compensate*,

[8] A rare pattern is exemplified by a word like HáckensAck, whose lexical entry necessitates a final extrametrical syllable—i.e. hacken<sack>. Due to a following nondental consonant, the word-final vowel does not reduce (see section 3.3.3). In Section 7, we consider some unusual forms (e.g. *electricity, apotheosis*) that may necessitate extrametrical word-initial syllables.

and *difficult*, words with a full vowel in a final syllable that remains unaccented. Yet, there are many words where the primary accent does fall on the final syllable.

(39)

agrée ignóre abét domáin ballóon machíne canál kazóo políte chinése
èntertáin còmprehénd kàngaróo kàlamazóo chàndelíer jàpanése

Within our framework these words will have a final syllable that is parsed as a unary foot. For many of these words, the terminal accentuation is fairly predictable; for others, it is not. Thus, words ending in certain phonological sequences (e.g. *–oo, -ee*, *-eer*, *-ese*) tend to have the primary accent on their final syllables. We shall analyze such words analogously to our treatment of verbs requiring accented penults. A set of lexical rules will assign a unary foot to final syllables containing particular phonological sequences. But any word whose terminal accentuation is not predictable in this way (e.g. *abet, canal)* must have its final unary foot specified as part of its lexical entry.

There are a few other predictable patterns. Bisyllabic verbs composed of a prefix and a stem generally have final accents—e.g. *permít, compél, detér, devóte, repórt, expórt, convíct, survéy*.[9] The corresponding nouns have the accent on the final syllable when the initial syllable is light (e.g. *repórt*), but on the initial syllable when it is heavy (e.g. *pérmit, éxport, cónvict, súrvey*). For other nouns, too, the type of initial syllable seems to matter. Nouns where the final heavy syllable is preceded by a light one usually have final accentuation (e.g. *machíne*). Nouns (not related to verbs) where both syllables are heavy are unpredictable in their accentuation (e.g. *árchive* vs. *champágne*), and so unary feet will need to be lexically specified for those exhibiting final accents. We shall not go into further detail on the different classes of words as they have been extensively treated elsewhere (viz. Ross 1972). Our purpose has been to give the reader an idea of how we would handle the various classes.

Words of three or more syllables that are accented on their final syllables will always have a subsidiary accent on their initial syllables (e.g. *chàndelíer*, *Kàlamazóo*).[10] The syllables preceding the unary foot can be gathered into a binary or a ternary foot, in conformity with Exhaustive Metrification.

(40)

	chan.de(lier)	ka.la.ma.zoo
Lexical rule: Unary foot with -oo		ka.la.ma(zoo)
Rule b: Exhaustive Metrification	(chan.de)(lier)	(ka.la.ma)(zoo)
Rule c: Accentuation	(chàn.de)(líer)	(kà.la.ma)(zóo)

[9] Trisyllabic verbs composed of a prefix and monosyllabic stem also receive final accentuation (e.g. *còmprehénd, ùnderstánd, ìnterséct*).

[10] The word *càtamarán*, with main accent on the final syllable, has the same derivation as *Kalamzoo*. The more common pronunciation of *cátamarAn*, with main accent on the initial syllable, requires a final extrametrical syllable that is unusual in that it does not reduce. Both pronunciations then necessitate special bracketing of their final syllables: *catama(ran)* versus *catama<ran>*.

There are quite a few trisyllabic words where the accentuation is in free variation: The primary accent can be either on the final syllable or else on the initial. For those words with initial accentuation, the final syllable has an unaccented full vowel.

(41)

Final accent	màgazíne cìgarétte màyonnáise mìllionáire còckatóo gàberdíne
Initial accent	mágazIne cígarEtte máyonnAise míllionAire cóckatOo gáberdIne

How are these words with alternate accentual patterns represented in the lexicon? Consider the two variants of *magazine.* The form with a final primary accent has a unary foot specified in the lexicon. The variant with initial (primary) accentuation has no metrical specification at all as part of its lexical entry.

(42)

	ma.ga(zine)	ma.ga.zine
Rule b: Foot span		(ma.ga.zine)
Rule b: Exhaustive metrification	(ma.ga)(zine)	
Rule 3	(mà.ga)(zíne)	(má.ga.zIne)

The two variants indeed constitute a true minimal pair, differing only in accent placement. Once again there can be no set of rules or constraints that could predict the appropriate accentuation for both variants: One of them will have to be regular and the other irregular. We have chosen the terminally accented words to be the irregular forms, simply because we do not consider final accentuation to be the norm. A further bit of evidence in support of this choice comes from the historical evolution of these words having variants. The form with primary accent on the final syllable generally antedates the one with primary accent on the initial syllable. Within our analysis the shift is reflected as the elimination of the lexically specified unary foot. This change is in conformity with the tendency in English for the main accent to be shifted leftward—that is, for the default accentuation to be trochaic and dactylic.

Foot construction always proceeds leftward from either the right edge of a word boundary or the left edge of a previously assigned foot, in accordance with a single general principle: *Create maximal feet within the constraints of syllable type and word length.* The maximally permitted foot is ternary. This is the most common foot type at the right edge of words having three or more syllables. Although the occurrence of ternary feet is a cornerstone of our analysis of English, other researchers have eschewed them. Hayes (1985) and Halle &Vergnaud (1987) recognize only binary and unary feet. The presence of ternary feet is rare in their analyses. These researchers make extensive use of extrametricality in order to eliminate ternary feet at the right edges of words. Moreover, they permit unary feet word-internally because, for them, every heavy syllable must become a foot; consequently, at least in the early stages of their analyses heads of feet do abut. Burzio (1994) argues against unary feet for English, maintaining instead that all feet are either binary or ternary. Hence our characterization of feet agrees with much of

Burzio's analysis. However, a major difference is our recognition of unary feet under the special conditions noted: They are responsible for word-final accented syllables.

6 Accentuation of Derived Words

We are now ready to take up the accentuation of derived or morphologically complex words. These are words containing one or more suffixes. In this section we are concerned only with accent-affecting suffixes—what we call *external* suffixes, those that can be added to independent words and that play a role in the assignment of the rightmost accent in a derived form. [11]

6.1 Accentual properties of external suffixes

Recall that for underived words, the main accent always falls on one of the last three syllables of the word (excluding any extrametrical syllable). The default situation for words of three or more syllables requires that the accent land on a heavy penultimate syllable that is followed by a light one, otherwise on the antepenultimate—e.g. *agénda, América, cómpensAte*. Some of the exceptional cases included accentuation on a light penult and on any kind of final syllable. The relevant foot bracketing for those types of exceptions was introduced either by a lexical redundancy rule—e.g. *so(li.cit),* or else it was part of the lexical entry—e.g. *ba(na.na), chande(lier)*. The accentual properties of external suffixes fall into these same three general categories.

(1) The default situation for external suffixes is similar to what was encountered for underived words: The primary accent falls on the penultimate syllable when heavy (comprising the head of a binary foot), but on the antepenultimate whenever the penult is light (comprising the head of a ternary foot)—e.g. *pa(rén.tal), (pér.so.nal)*. Note that the suffix enters into the syllable count of the word. Some suffixes exhibiting this pattern are: *-al, -ant, -ent, -ide, -ile, -ine, -oid, -on, -ous*. This accentual pattern occurs even where the suffix contains a tense vowel—e.g. *mollúscoid, húmanoid*. The accentuation is different from the one that occurs in underived words containing a final tense vowel, where the primary accent is generally on the antepenultimate syllable regardless of the weight of the penult—e.g. *cómpensate, génerate.*[12]

(2) For some external suffixes, the accent always falls on the syllable immediately preceding the suffix, even when that syllable is light—e.g. *angélic, acídic*. Some

[11] In Section 8 we deal with two other kinds of suffixes in addition to the external ones: internal suffixes (e.g. the *–ate* of *compensate* and *generate*), which are added to stems that are not independent words, and extrametrical suffixes (e.g. the *–y* of *allegory* and *compensatory)*.

[12] In the phonological literature one finds reference to *strong* and *weak* retraction, so called because the analyses first assign stress to a word-final syllable; then the stress is retracted either unconditionally to the antepenultimate syllable (strong retraction) or else to a heavy penultimate syllable or otherwise to the antepenultimate (weak retraction), thus accounting for the distinction of e.g. *cómpensate* versus *mollúscoid, húmanoid*. We maintain that the normal situation is for a heavy penultimate syllable to remain unaccented when followed by a heavy final syllable or an internal suffix, but to become accented when followed by a light syllable or an external suffix. We deal with exceptions to these generalizations in section 7.

suffixes of this type are: *-ic, -id, -ion.* [13] These suffixes would be listed in the lexicon along with a lexical redundancy rule stating that the suffix forms a binary foot with a preceding syllable. A word containing this kind of suffix will then come into the accentual component so specified—e.g. *an(ge.lic)*.

(3) For still other external suffixes, it the suffix itself that bears the primary accent—e.g. *àbsentée*. Some suffixes of this type include: *-aire, -ee, -een, -elle, -ese, -esque, -ette, -ique, -oon*. These auto-accented suffixes too would be listed in the lexicon along with a lexical redundancy rule specifying that the suffix by itself forms a unary foot, and its word would then enter the accentual component with this unary bracketing—e.g. *ab.sent(ee)*.

The behavior of types (1) and (2) leads us to redefine the conditions under which penultimate footing takes place. Hence, we must amend rule a of the rules for metrification that were presented in Section 4.

(43)

Revised Rule a:	Create a binary foot:
	(i) where there is a heavy syllable followed by a light one;
	(ii) where there is a heavy syllable followed by an external suffix;
	(iii) with certain external suffixes (e.g. *–ic, -id, -ion)* and a preceding syllable.

The morphological constituent structure of a derived form is crucial for the assignment of accentuation to that form. In our representations there will be constituent boundaries (i.e. square brackets) around the innermost word as well as around each derived word. Consequently, every right-hand bracket of the morphological representation must correspond to the right edge of a contained word or of a suffix. Consider a derived word of the form: [[[A]B]C], which has the three constituents, [A], [A B], and [A B C], where A is an independent word and where B and C are suffixes. We shall refer to [A] as the "contained word," or "base word" and to [A B], and [A B C] as "derived words". The largest constituent, in this case [A B C], corresponds to the "final derived word" or "prosodic word".

6.2 Accent preservation: the rhythmic principle

One of the truly interesting aspects of English derivational morphology concerns the position of the accent of a word when external suffixes are added. For some words the primary accent of the contained word remains as primary in the derived word—e.g. *pérson, pérsonal.* For other forms, the preserved accent becomes secondary—e.g. *antícipAte; antìcipátion*. For still other forms, there is no preservation, and in the derived form the accent shifts onto a neighboring syllayble—e.g. *párent, paréntal; médicine,*

[13] We consider *–ion* to be a monosyllabic suffix. Note that a word like *nátional* requires two monosyllables following the initially accented vowel. Although words with the suffix *–ity* are accented on the syllable preceding the suffix, this suffix does not require lexical specification of this fact, as the normal accentual rules will always assign antepenultimate accentuation.

medícinal; cómpensAte, compénsatOry; adóre, àdorátion. It is these various accentual phenomena that make English derivational morphology so intriguing and challenging.

In pairs such as *antícipAte, antìcipátion* or *expériment, expèriméntal*, the shift from primary accent to secondary poses no particular problem in our analysis. Recall that a word like *anticipate* has its primary accent on the antepenult and an unaccented full vowel in the final syllable. Because the derived form *anticipation* has two accents, the rightmost one must be primary and the accent to its left secondary. We saw this same accentual distribution for underived words, such as *Winnepesáukee*. But there is an important difference between underived *Winnepesaukee* and derived *anticipation*. For the former word the secondary accent is on the initial syllable, whereas for the latter word it is on the second syllable. In our analysis of *Winnepesaukee* we noted that, in conformity with exhaustive metrification, the first three syllables must be gathered into a ternary foot—*(win.ne.pe)(sau.kee)*. But this is not what happens with *anticipation*, where instead we have an initial unfooted syllable followed by a binary foot—*an(ti.ci)(pa.tion)*, in spite of the fact that an optimal ternary foot ought to be preferable. What this means, of course, is that the accentuation of the morphologically simpler form *anticipate*, with its accent on the second syllable, influences the accentuation of the derived form *anticipation,* even in violation of exhaustive metrification.[14]

Why do some derivational forms preserve the accentual pattern of their contained word, whereas other forms do not? The answer is "rhythm." If the accent required by the external suffix for the derived word is not immediately contiguous to one of the accents of the contained word, then the place of the accent within the contained word will remain undisturbed in the derived form (i.e. there will be accent preservation). If, however, the two accents are contiguous (i.e. there is a clash), the accent due to the suffix has priority and the adjacent accent of the contained word is shifted one syllable to the left, or it is eliminated altogether if there is no syllable to its left (i.e. because the accent of the contained word is on the initial syllable).

Consider the words *solicitation* and *experimental*, both of which preserve the accents of their base words *solicit* and *experiment*. In the following table, we cite the morphological structure in row 1. In the first line of row 2, we show the accentuation of the contained word, and in the second line the accentuation of the derived form due to the suffix. Because there is an unaccented syllable intervening between the two accented ones, there is no clash of accents, and consequently, there will be accent preservation, as exemplified in row 3. (So as not to clutter the representations, we eliminate square brackets for all forms other than the input, which shows the morphological constituent structure.) It is for expository purposes only that in row 2 we use separate lines to show the accentual placement due to each constituent. In no way is this representation to be construed as cyclic rule application. The accent assignment applies simultaneously to all the constituents of a word. For example, for the word *experimental* there are two constituents: the contained word *experiment* and the derived word *experimental*. The former (as a word) requires antepenultimate accentuation, the latter penultimate. It is for this reason that there is overlap with the syllable *ment*. Where there is overlap, the rightmost constituent dominates; consequently, the syllable *ment* will bear the

[14] Kenyon and Knott cite for *anticipation* and similarly accented words an alternative pronunciation with a word-initial secondary accent (i.e. *àntícipátion*). We provide an analysis of these alternate forms in Section 9.3.

accentuation due to the suffix. But there is still an intervening unaccented syllable between the two accented ones, hence clash is avoided, and accent preservation holds between the contained word and the derived form.

(44)

[[solicit]at+ion]	[[experiment]al]
so.lí.cit át.ion	ex.pé.ri.ment mént.al
so.lì.ci.tá.tion	ex.pè.ri.mént.al

Consider now two derived forms where there is nonpreservation, the words *adoration* and *medicinal.* The contained word *adore* is accented on its final syllable, and *telegraph* on its antepenult. For *adoration,* the external suffix -*ion* assigns an accent to the preceding -*at,* and for *medicinal* the external suffix -*al* assigns an accent two syllables to its left. For both words, the accent due to the external suffix would be immediately adjacent to the accent assigned to the base word, instances of clash, a violation of rhythm. Because the accent due to the suffix must prevail, the rhythmic principle requires that the accent of the base form either shift one syllable to the left (i.e. *àdorátion*) or be eliminated if originally on the initial syllable (i.e. *medícinal*).

(45)

	[[ador]at+ion]	[[medicin]al]
Clash	a.dór át.ion	mé.di.cin dí.cin.al
Rhythm	à.dor.át.ion	me.dí.cin.al

6.3 Foot structures of derived words

We have discussed the rhythmic principle and its effect on accentuation. The preceding examples of accent preservation and nonpreservation did not make any reference at all to foot structure. The purpose for analyzing the forms in that way was to clarify the conditions where accent preservation is possible and where it is not.[15] How then do we accommodate the notion of rhythm (and of clash) within a framework that assigns foot structure to syllables and derives the requisite accents from the headedness of a foot?

The rules for metrification for derived forms are the same as what was required for underived words. We repeat the rules for metrication along with two well-formedness constraints; the latter are identical to the edge constraints that were presented in Section 4. Note that the foot creation process now refers to the right edge of a constituent (and not just the final word boundary), so that metrification will be able to apply to each of the constituents of a derived word. The rules for metrification are concerned with the assignment of syllables to the two major types of foot structures: binary and ternary. The constraints are concerned with the distribution of single syllables: as unary feet or as unfooted.

(46)

[15] This way of looking at accent preservation and nonpreservation was the basis for the analyses in Schane (1979a,b). However, in those early studies there was no notion of foot structure.

Rules for metrification	
Create feet from right to left, starting at the right edge of a constituent boundary:	
Rule a:	Create a binary foot:
	(i) where there is a heavy syllable followed by a light one;
	(ii) where there is a heavy syllable followed by an external suffix.
	(iii) with certain external suffixes (e.g. *–ic, -id, -ion)* and a preceding syllable.
Rule b:	Create optimal feet (ternary or binary).
Rule c:	Assign an accent to the syllable located at the left edge of a foot.

Well-formedness (edge) constraints on foot structure
1. A unary foot is permitted only at the right edge of a word.
2. A single unfooted syllable is permitted only at the left edge of a word.

The metrification rules are noncyclic: They apply simultaneously to all constituents, building a foot from the right edge of each constituent. (A contained word with multiple syllables is the only kind of constituent that could ever govern the creation of more than one foot.) However, the resulting foot structures may have feet that overlap—that is, the left edge of a foot and the right edge of a preceding foot may share one or more syllables. In cases of overlap, the foot governed by the suffix to the right prevails. The foot to the left always gives way, and its right edge must be realigned against the left edge of the following foot. If the resulting realigned foot does not violate well-formedness constraints on foot structure, no further adjustments are necessary and, accordingly, there will be accent preservation. On the other hand, if the resulting foot were to be ill-formed (i.e. it would become a word-internal unary foot), then the syllable from that impermissible foot, in order to satisfy well-formedness, must be reintegrated into a permissible structure.

Let us consider some examples of accent preservation and nonpreservation, and how these phenomena come about due to the interaction of the rules for metrification and the well-formedness constraints on foot structure. Row 1 of a table will contain the morphological bracketing of a complex word, row 2 the preliminary foot construction due to each constituent, row 3 the resulting foot structure after realignment of a right foot boundary, and row 4 adjustments due to well-formedness along with the assignment of accents. For ease of reading, each constituent appears on a separate line in row 2, although it is understood that the rules apply simultaneously to all constituents. We shall not indicate morphological bracketing in rows 2-4. We do show syllable divisions at constituent boundaries even though these divisions do not always correspond to where syllable boundaries would actually be phonetically.

Consider first forms with accent preservation. For *solicitation*, the contained word enters the accentual component (row 2) with a binary foot; recall there is a lexical redundancy rule creating binary feet for verbs with a light penult. By the same token, for the derived word, the lexical redundancy rule a(iii) forms a binary foot around the suffix *-ion* and a preceding syllable. There is no overlap of feet and so the final foot structure requires no adjustments (row 3). The result is accent preservation, because the left foot boundary of the contained word is intact in the derived word.

(47)

	[[solicit]at+ion]
Lexical rule Rule a(iii)	so(li.cit) (at+ion)
	so(li.ci)(ta.tion)
Accent	so(lì.ci)(tá.tion)

For *experimental*, Rule b creates a ternary foot for the contained word, and Rule a(iii) forms a binary foot around the penultimate syllable and the following suffix. There is overlap with the syllable *ment*. Where there is overlap, it is the foot to the right that always has priority. Consequently, the binary suffixal foot is retained, but the foot of the contained word cannot be maintained as a ternary foot. But that ternary foot can become a perfectly respectable binary one without the need to readjust the left edge of the resulting new foot. Since the original left edge of the contained word *experiment* has stayed intact, there is accent preservation within the derived word *experimental*.

(48)

	[[experiment]al]
Rule b Rule a(iii)	ex(pe.ri.ment) (ment.al)
Readjustment of right foot edge	ex(pe.ri)(ment.al)
Accent	ex(pè.ri)(mént.al)

Now let us contrast *experimental* with *medicinal*; the latter does not have accent preservation with the contained word. Both constituents of *medicinal* receive ternary feet according to Rule b. Once again there is overlap of syllables. For *experimental*, there were two syllables preceding the overlapping syllable and, consequently, they could constitute a new binary foot. As for *medicinal*, there is only one syllable preceding the overlap. After readjustment of the right foot boundary of the contained word, the result would be an impermissible unary foot, a violation of constraint 1. Being word initial, there is no preceding syllable with which it could form an acceptable foot; hence, the only way for that syllable to be well-formed is for it to become unfooted, in accordance with contstraint 2. Because the left foot boundary of the contained word no longer occurs at the same place in the derived word, there is nonpreservation of accent.

(49)

	[[medicin]al]
Rule b Rule b	(me.di.cin) (di.cin.al)
Readjustment of right foot edge	*(me)(di.cin.al)
Well-formedness	me(dí.cin.al)

The word *inhibition* has a contained word (i.e. *inhibit*) that enters the accentual component with a binary foot, due the lexical redundancy rule applying to verbs with a

light penult. There is overlap of one syllable and after readjustment of the right foot edge of the contained word, we would end up again with an impermissible word-internal unary foot (line 3). It could not become unfooted as a word may begin with at most one unfooted syllable, and only word initially. (viz. constraint 2). However, the syllable of the impermissible unary foot along with the original unfooted initial syllable can regroup as a binary foot, and that is exactly what happens.

(50)

	[[inhibit]ion]
Lexical rule Rule a(iii)	in(hi.bit) (bit.ion)
Readjustment of right foot edge	*in(hi)(bit.ion)
Well-formedness	(ìn.hi)(bít.ion)

For *adoration*, the contained word (i.e. the verb *adore*) enters the accentual component with a unary foot around its final syllable, due to a lexical redundancy rule applying to bisyllabic verbs with a heavy second syllable. Although there is no overlap between the unary foot and the foot due to the suffix, there would still be an impermissible unary foot to the left of another foot. What is permissible, of course, is for the syllable from the impermissible foot and the preceding unfooted syllable to be gathered into a binary foot.

(51)

	[[ador]at+ion]
Lexical rule Rule a(iii)	a(dor) (at+ion)
	*a(dor)(at+ion)
Well-formedness	(à.dor)(át.ion)

However, I shall propose a different analysis for words like *adoration*. Whenever a suffix is added to a word terminating in a unary foot, that foot becomes word internal in the derived form, and it would immediately violate the well-formedness constraint 1. What this means is that a unary foot that is not in absolute word-final position cannot be part of the representation of the derived word. That is, the lexical redundancy rule that assigns a unary foot to a verb terminating in a heavy syllable is not applicable to a derived form. Instead, the contained word will receive its binary foot structure by rule b, the default situation for a two-syllable constituent. This treatment of words like *adoration* is essential for a constraint-based analysis, as we shall demonstrate in section 6.

(52)

	[[ador]at+ion]
Rule b Rule a(iii)	(a.dor) (at+ion)
	(a.dor)(at+ion)
Accent	(à.dor)(át.ion)

Let us look at a more complicated form. Consider the word *phenomenological*. This morphologically complex form is composed of the contained word *phenomena* and the complex suffixes *o+log+y* and *ic+al*. The weak final vowels (i.e. the *-a* of *phenomena* and the *-y* of *ology*) do not surface before a following vowel-initial suffix, although these final vowels are crucial for determining the correct placement of the accents in both the contained word and the derived word with the first suffix. Hence, as seen in row 2, all three constituents must start out with ternary feet. In row 2 we have also indicated the demise of the two virtual vowels by double strikes through them. In row 3, with these final vowels gone and with the right edges of the feet of the two contained constituents readjusted, we would end up once again with a word-internal unary foot on the syllable *–o-*. The recalcitrant syllable can remain neither as a unary foot nor as unfooted. Instead, it is incorporated into the preceding foot, the result being an acceptable ternary foot.

(53)

	[[[phenomena]o+log+y]ic+al]
Rule b(i) Rule b(i) Rule b(i)	phe(no.me.n~~a~~) (o.log.~~y~~) (log.ic.al)
Readjustment of right foot edge	*phe(no.men)(o)(log.ic.al)
Well-formedness	phe(nò.men.o)(lóg.ic.al)

If one examines all of the previous examples where accent preservation has failed to take place, in every case one will note that the following happens: Due to overlap, the constituent on the right has pre-empted some of the syllables from the constituent to its left, leaving the latter with an impermissible word-internal unary foot, in violation of the well-formedness constraint 1—e.g. *(me.di.cine) > **(me)(**di.cin.al*); *in(hi.bit) > in**(hi)**(bit.ion)*; *phe(no.men)(o.log.y) > phe(no.men)**(o)**(log.ic.al)*. A unary foot preceding another foot is what constitutes a clash. To produce a well-formed structure, the syllable from the impermissible unary foot either joins up with syllables to its left to form an acceptable binary or ternary foot—i.e. *in(hi)(bit.ion) > (in.hi)(bit.ion)*, *phe(no.men)(o)(log.ic.al) > phe(no.men.o)(log.ic.al)*; or, if word-initial, it becomes unfooted (in conformity with constraint 2)—i.e. *(me)(di.cin.al) > me(di.cin.al)*.

6.4 Alternate foot building

There is another way of creating feet for derived words. Assume that the rules for foot construction, still applying simultaneously to all of the constituents, put into place only the left edge of a foot. There will then be no overlapping syllables. The right edge of each foot can be readily determined. It occurs at the left edge of a following foot or at the word boundary for the rightmost foot. To see how this procedure works, consider the word *componentiality*, composed of three constituents, as shown in line 1. In line 2 we show the placement of the left foot boundaries: The contained word *component* would require a binary foot around its penultimate heavy syllable and following light one. (The constituent-final consonant cluster *-nt* does not count as heavy within its own constituent, but it is heavy when it falls within the footing domain of a following suffix (e.g. *párent,*

paréntal). We place then the left edge of the foot for the contained word before the syllable *po:*. Within their respective constituents the suffixes *-ial* and *-ity* form ternary feet with their preceding syllables. Hence, left foot boundaries are placed before *nent* and *al*, respectively. In line 3 we show the placement of the right edges of the feet. The result is a sequence composed of an unfooted syllable, a unary foot, a binary foot, and a ternary foot. The binary and ternary feet, being permissible, are retained. However, a unary foot is not allowed internal to a word and so it forms a binary foot with the preceding unfooted syllable.

(54)

	[[[compo:nent]i.al]i.ty]
Left foot boundaries	com(po:(nent.i(al.i.ty
Right foot boundaries	*com(po:)(nent.i)(al.i.ty)
Well-formedness and Accent	(còm.po)(nènt.i)(ál.i.ty)

Although it appears that the two-step procedure of creating first the left edges of feet and then their right edges is a variant of our origianl one-step process of creating whole feet, there is an important difference. In section 6, we present a nonderivational (or OT-type) analysis of derived words. There the constraints must make reference exclusively to the left edges of feet.

6.5 The phonological cycle and accent preservation

Any analysis of English word accentuation must account for the effect of suffixes on the accentuation of the stems or words to which they are attached, the assignment of multiple accents in derived words, and accent preservation or the lack of it between a derived form and its contained word. Chomksy and Halle (1968) make use of the phonological cycle for deriving the stress configurations of morphologically complex words. The cycle serves to account for the different degrees of stress within a derived word and it also has provided an explanation for accent preservation. However, it did not always accommodate well the generation of the correct stress patterns of derived words where accent preservation fails. Consider, for example, their cyclic derivations of *telegraphic* (with accent preservation to the base word *telegraph*) and *telegraphy* (without accent preservation).

In the derivation of *telegraphic*, [1 stress] is assigned first to the stem *graph*, then retracted to the initial syllable of the contained word *telegraph* with reduction of the word-final [1 stress] to [2 stress], in conformity with the convention for stress lowering. In the next cycle, where the rules apply to the derived word, [1 stress] is assigned to the syllable preceding the suffix *–ic*, and the previously assigned stress reduces to [2 stress]. It is this stress that is responsible for the accent preservation in the derived word. Finally, because [2 stress] is reserved for the phrase level, it is further reduced to [3 stress] by a rule of stress adjustment.

In the derivation of *telegraphy*, [1 stress] once again is assigned first to the stem *graph* and then retracted to the initial syllable of the contained word *telegraph*, with reduction of the word-final [1 stress] to [2 stress]. In the cycle applying to the full word,

the antepenultimate syllable becomes stressed, with all previously assigned stresses being reduced by one. The derived word must not have accent preservation, although it is attested at this stage of the derivation. Hence, rules are needed to wipe out the two stresses that were generated on either side of the main stress, types of clash.

(55)

	[[tele+graph] ic]]	[[tele+graph] y]
1st cycle	1 1 2	1 1 2
2nd cycle	2 1	2 1 3
Stress adjustments	3 1	3 1 4
Stress deletions		- 1 -

Our treatment of morphologically complex forms eschews the cycle. The metrification rules for building foot structure apply simultaneously to each of the morphological constituents. In this way, the entire derived word obtains foot structure. This manner of forming feet is not cyclic in accordance with the usual interpretation of that concept. We do not create foot structure first within the innermost constituent of a complex word and then make use of the same rules or other ones to create additional structure progressively outward. To be sure, we still need to know the constituent structure of a derived form, and the rules for assigning foot structure must be sensitive to where constituent boundaries lie, for it is knowledge about those boundaries that is essential for accent preservation and nonpreservation. If the resulting feet respect the constraints on well-formed foot structures, then there will be accent preservation between the accentuation of the contained word and that of the derived form. When there is nonpreservation it is due to a constitutent on the right having pre-empted one or two syllables from the constituent to its left, causing the latter to end up potentially with an impermissible word-internal unary foot. The syllable from that foot either joins with syllables to its left to yield a binary or a ternary foot, or it remains unfooted if word-initial.

But one may ask: do we not require the well-formedness constraints in order merely to fix up (what would otherwise be) impermissible internal unary feet within derived forms? Now we have explicitly referred to these constraints so that the reader would be aware of the raison d'être for the type of restructuring taking place in derived words. However, the constraints do not need to be stipulated as they are derivable directly from the rules for metrification, their mode of operation, and the nature of the lexicon.

The rules for metrification yield only binary and ternary feet, whereas the unary feet of underived words must be lexically specified and they occur only with a final syllable. From these two properties of foot structure—that binary and ternary feet occur freely throughout words, but that unary feet, when they occur, are restricted to final syllables—we can deduce that unary feet are impermissible internal to words.

Now what about derived words? Here too we find analogous restrictions on unary feet. Auto-accented suffixes (e.g. *–ee, -eer*) occur as lexically bracketed unary feet, and these suffixes too are always word-final. Moreover, we have suggested that a unary foot of an underived word never enters into the lexical representation of a derived form—e.g.

a(dore), but *(ador)+(ation*). Thus, derived words are governed by exactly the very same restrictions that pertain to underived words.

The metrification of words operates from the right edge of constituent boundaries advancing syllable by syllable. In this leftward scansion no syllable is skipped over, and pairs or triplets of syllables are gathered into binary or ternary feet, respectively. Hence, the beginning of a word is the only position where a single stray syllable—an unfooted syllable—may occur. From these two components—the lexicon and the rules for metrification along with their mode of operation, we can deduce the absence of unary feet word-internally and the presence of unfooted syllables only word-initially

This analysis, moreover, requires no independent notion of clash or no special rule for eliminating contiguous accents. In our analysis clash and its avoidance follow automatically from the distributional restriction of unary feet. Because all feet are left-headed, a clash could occur only if a unary foot were followed by another foot, and it is precisely this configuration of feet that is ruled out by restricting unary feet to word-final syllables. To be sure, there are potential clashes whenever syllables overlap in derived forms. When that happens the culprit syllables become restructured immediately—not by a special rule that fixes up clashes, but through the normal processes of metrification and the independently justified restrictedness of unary feet to final syllables. What does it mean then to say that there is avoidance of clash in English? The language abhors contiguous accents. Rather it strives for rhythm.

7 Excursus: A Nonderivational Analysis

In this section, we present an analysis of word accentuation within the framework of optimality theory. [16]

7.1 Ranked constraints

Following is an informal characterization of the required ranked constraints that will ultimately be needed to handle the various words.

(56)

(1) PRESERVE-LX	Preserve lexical metrification.
(2) *UNARY	No foot may be unary.
(3) HEAVY	A ternary foot (anywhere within a word) may not be composed of a medial heavy syllable followed by a light one.
(4) TERNARY	A ternary foot occurs at the right edge of a constituent.
(5) ALIGN	Align right edge of rightmost foot with right edge of prosodic word.
(6) ACCENT	Feet are left-headed.
(7) SYLL/FOOT	Every syllable is assigned to a foot.
(8) MAXFOOT	No foot may be larger than ternary.

Here is the rationale behind each of these constraints.

[16] Pater (1995), Benua (1997), and Hammond (1999) provide optimality analyses of English word stress. Our constraints and argumentation are very different from theirs, particularly because of our view on the nature of accentuation and of the cycle.

(1) PRESERVE-LX is a faithfulness constraint. It requires that any word with specified metrical structure (e.g. *ba(na.na), chan.de(lier)*, with metrical structure introduced by a lexical rule (e.g. *so(li.cit), kan.ga(roo)*, or with an extrametrical syllable (e.g. *ga.lax<y>*) conform to that metrification in the preferred candidate.

(2) The constraint *UNARY prohibits unary feet. Such feet never occur to the left of any other foot or else there would be a clash. Hence, this constraint performs that function and obviates the need for an additional constraint, *CLASH. When a unary foot occurs as the final syllable of a word, it is either directly specified in the lexical representation or it is introduced by a lexical redundancy rule. Consequently, although prohibited in general, unary feet will surface word-finally thanks to their conforming to the higher-ranked constraint PRESERVE-LX.

(3) The constraint HEAVY prohibits anywhere within a word a ternary foot whose medial and terminal syllables are heavy and light, respectively, as a binary foot is required in this environment.

(4) Recall that for words of three or more syllables foot span favors a ternary foot at the right edge of a constituent, unless this optimal foot is pre-empted by the requirement for a binary foot due to a heavy syllable and a following light one. The constraint TERNARY stipulates that the three terminal syllables at the right edge of a constituent should form a ternary foot. Any word accented on the preantepenultimate, the penultimate, or the final syllable will be in violation of this constraint. Even though a pre-empted binary foot violates TERNARY, it is the preferred footing because a sequence of heavy-light within a ternary syllable would always trigger a violation of the higher-ranked constraint HEAVY. [17]

(5) The constraint ALIGN requires that the right boundary of the rightmost foot be placed at the right edge of the prosodic word (i.e. at the right edge of an underived word or after the last suffix of a derived word).

(6) The constraint ACCENT ensures that binary and ternary feet are trochaic and dactylic, respectively, and that a unary foot has an accent on its only syllable. Any foot without an accent or with an accent on a syllable other than the leftmost one violates this constraint.

(7) SYLL/FOOT is the constraint that strives for exhaustive metrification. Any unfooted syllable, anywhere within a word, will trigger a violation of this constraint. It is a fairly low-level constraint, and words requiring initial unfooted syllables, although violating this constraint, will always respect higher-ranked HEAVY or TERNARY.

(8) The constraint MAX/FOOT rarely needs to be invoked, being required mostly for words with four (or more) syllables preceding the primary accent (e.g.

[17] The constraint TERNARY could be broken down into two conjoined constraints: one recognizing a ternary foot and the other requiring that the right edge of that foot coincide with the right constituent boundary.

Apalachacola, onomatopoeia). It prohibits those syllables from being gathered into one giant quaternary foot.

Constraints (1) - (4) are strictly ranked with respect to one another. Constraints (5) - (8) have no strict ranking among themselves, but as a group they must be ranked below (1) - (4), giving the ranking: PRESERVE-LX » UNARY »HEAVY » TERNARY »{ALIGN, ACCENT, SYLL/FOOT, MAX/FOOT}

7.2 Comparison of ranked constraints and metrical rules

In Section 5, we presented rules for creating foot structure. Those rules have exact correlates among the ranked constraints. We repeat the relevant derivational rules.

(57)

Rules for metrification	
Create feet from right to left, starting at the right edge of a ***constituent boundary:***	
Rule a.	Create a binary foot wherever there is a heavy syllable followed by a light one.
Rule b(i).	Create a ternary foot at the right edge of a constituent.
Rule b(ii).	Create optimal feet (ternary or binary) from right to left.
Rule c.	Assign an accent to the syllable located at the left edge of a foot.

The constraint HEAVY corresponds to Rule a and TERNARY to Rule b(i). In the derivational analysis, a ternary foot is created at the right edge of a constituent only if Rule a has not applied at the right edge. In the nonderivational analysis, the constraint HEAVY, by being ranked higher than TERNARY, accomplishes the same thing.

Rule b(ii) creates additional binary or ternary feet to the left of the rightmost foot, and in so doing, it strives for exhaustive metrification, unless a heavy syllable and following light prevents this optimization from happening (e.g. *mo(nònga)(héla)*). For the nonderivational analysis, several constraints contribute to exhaustive metrification. The output candidates can have any combination of binary and/or ternary feet. Among all the occurring possible combinations only two types are prohibited: any ternary foot with a medial heavy syllable and a following light one; and at the right edge of a constituent any foot that is not ternary. Furthermore, in striving for exhaustive metrification, the constraint *UNARY sees to it that no syllable will be parsed as a unary foot, SYLL/FOOT that no syllable remains unfooted, and MAXFOOT that no foot is larger than a ternary one.

Within the derivational analysis, Rule c establishes the syllable at the left edge of a foot as the head and, correspondingly, it will be the syllable that is accented. The constraint ACCENT performs this function in the nonderivational treatment.

Within the derivational analysis, feet are constructed starting at the right edge of each constituent boundary, which means that the rightmost foot will always be placed at the right edge of the prosodic word boundary (ignoring any extrametrical syllables). The constraint ALIGN is intended to perform this same function in the nonderivational analysis.

Finally, whenever there is a lexically-specified unary foot, binary foot, or extrametrical syllable, that bracketing will be preserved in a derivation. Within our

nonderivational treatment, the constraint PRESERVE-LX, being the highest ranked, guarantees the integrity of these various kinds of lexical bracketings.

7.3 Analysis of underived words

In this section we present a nonderivational analysis of several kinds of underived words. In Section 7.4. we look at derived words.

To see how these constraints interact with one another, let us begin with an evaluation of the word *Arizona.* We have not included the constraint PRESERVE-LX as it is not relevant to this word. Comparing the correct form 1 to form 2, we see that HEAVY must be ranked above TERNARY. Forms 3-5 all have violations of TERNARY. In addition, form 3, has an impermissible quaternary foot; form 4 has a misplaced accent; and form 5, although it has accents on the correct syllables, its improper foot structures create violations of most of the other constraints.

(58)

	[a.ri.zo:na]	*UNARY	HEAVY	TERNARY	ALIGN	ACCENT	SYLL/FOOT	MAX FOOT
1	(à.ri)(zó:na)☞			*				
2	a(rí.zo:na)		*!				*!	
3	(á.ri.zo:na)			*				*!
4	(à.ri)(zo:ná)			*		*!		
5	(à)(ri.zó:)na	*!		*	*!	*	*	

The following tableaux treat the trio of words, *Monongahela, Winnepesaukee*, and *Apalachacola*. We have omitted the constraints PRESERVE-LX,*UNARY, and ALIGN since the words in question have no lexically prespecified elements, a unary foot would always be fatal, and all forms cited respect ALIGN. The rightmost foot of all three words is binary because of the heavy penult, and so there is a violation of the constraint TERNARY. Form 1 of *Monongahela* has two binary feet, but only the rightmost one (i.e. being at the word edge) can be in violation of TERNARY. There is also an initial unfooted syllable, a violation of SYLL/FOOT. Forms 2 and 3 have improper ternary feet (because of the medial heavy syllable and following light one), leading to violations of the constraint HEAVY. In addition, form 3 has an accent that is not located on the head of a foot. Forms 4-6 treat *Winnepesaukee*. Form 4, the preferred candidate, has exhaustive metrification of the left foot, but its right-edge binary foot is in violation of TERNARY. Forms 5 and 6 exemplify different violations of SYLL/FOOT. Forms 7-9 concern *Apalachacola*. What is special about this word are its four syllables preceding the primary accent. Form 7 treats them as two binary feet, form 8 as a ternary foot preceded by an unfooted syllable, and form 9 as a single quaternary foot. The exhaustive metrification of form 7, with binary feet, is the optimal one. The initial unfooted syllable of form 8 triggers a violation of SYLL/FOOT and the impermissible quaternary foot of form 9 creates a violation of the constraint MAXFOOT.

(59)

	[mo.non.ga.he:la]	HEAVY	TERNARY	ACCENT	SYLL/FOOT	MAXFOOT
1	mo(nòn.ga)(hé:la) ☞		*		*	
2	(mò.non.ga)(hé:la)	*!	*			
3	(mo.nòn.ga)(hé:la)	*!	*	*		

	[win.ne.pe.sau.kee]	HEAVY	TERNARY	ACCENT	SYLL/ FOOT	MAXFOOT
4	(wìn.ne.pe)(sáu.kee) ☞		*			
5	win(nè.pe)(sáu.kee)		*		*!	
6	(wìn.ne)pe(sáu.kee)		*		*!	

	[a.pa.la.cha.co:la]	HEAVY	TERNARY	ACCENT	SYLL/ FOOT	MAXFOOT
7	(à.pa)(là.cha)(có:la) ☞		*			
8	a(pà.la.cha)(có:la)		*		*!	
9	(à.pa.la.cha)(có:la)		*			*!

7.4 Analysis of derived words

In the derivational analyses of section 5, in order to arrive at the appropriate foot structures for a derived form, we began by creating them from the right edge of each constituent. In certain cases of overlap a potential unary foot to the left of another foot had to be readjusted or even eliminated. Within an OT-type analysis, however, we do not have the luxury of adjusting structures arising from impermissible overlapping feet. Instead, we must evaluate different completed foot structures according to the ranked constraints. But because the input contains the relevant constituent structure for a derived word, we can still permit certain constraints to apply independently to each of the constituents.

From the derivational treatment there are two important insights that we can glean for our nonderivational analysis: (1) The rightmost foot of a derived word has priority and must be retained. (2) Where there is accent preservation of a nonrightmost foot, its left edge (but not necessarily its right edge) always stays intact. Consider, for example, the morphological constituent structure (the input), *[[experiment]al]*, and its associated desired metrical structure (the output), *ex(pe.ri)(ment.al)*. The latter retains the rightmost binary foot resulting from the suffix and preceding heavy syllable; it also preserves the left edge of what would have been a ternary foot of the inner word *ex(pe.ri.ment)*, but not the right edge. Consequently, the constraints on foot structure must evaluate only left edges for feet constructed at the right edge of a constituent boundary; otherwise there is no way to account for how the ternary foot of *experiment,* as an independent word, shows up instead as a binary foot when part of the contained word within the derived form *experimental*. That the left edge should have special treatment vis-à-vis the right edge should not be surprising. After all, the left edge corresponds to the site of the head of a foot.

For the moment let us concentrate on the constraints HEAVY and TERNARY that were presented as constraints 3 and 4 in Section 7.1. Both need to be revised to accommodate the appropriate placement of a left foot boundary for the constraint TERNARY and to

include the environments involving suffixes for HEAVY. The modified constraints now become:

(60)

(3') HEAVY (revised)	A ternary foot may not be composed of: (i) a medial heavy syllable and following light; (ii) a medial heavy syllable and following external suffix; or (iii) a medial syllable and certain lexically-specified suffixes.
(4') TERNARY (revised)	A left edge foot boundary occurs before the third syllable from the right edge of a constituent.

For the word *ex(pe.ri)(ment.al)*, constraint (3'ii) will sanction the binary foot at the word edge and Constraint (4') that of the foot to the left (i.e. of the contained word *experiment*). An important distinction between (3') and (4') is the following: Constraint (3') evaluates an entire foot, whereas constraint (4') is concerned only with a left edge. Although the latter constraint does not stipulate where the right edge of a foot lies, that position is readily deducible. For all well-formed foot structures, the right edge of a foot occurs either at the left edge of a following foot or at the right edge of the prosodic word (for the rightmost foot). (At the end of Section 6, we proposed for the derivational analysis a procedure for creating left foot boundaries and for deducing the placement of the right boundaries.) [18]

Let us look more closely at the word *experimental* to see exactly how we evaluate each constituent of this derived form. In form 1 below, the binary foot comprised of the suffix and preceding heavy syllable violates TERNARY. The contained word *experiment* has its left foot boundary where it should be in conformity with TERNARY, being located three syllables to the left of the right edge of the constituent boundary of its input. One must not be deceived by the binary foot of the output candidate. (We are concerned here only with the placement of the left foot boundary.) Finally, there is a violation of SYLL/FOOT, due to the unfooted initial syllable. In 2, even though there is exhaustive metrification (i.e. no violation of SYLL/FOOT), what might look like a perfectly acceptable ternary foot at the left edge of the word is in fact in violation of TERNARY, as it is located four syllables from the right edge of the constituent boundary of the contained word. Hence, in 2, each of the constituents contributes to a violation of TERNARY. In 3, we find a violation of TERNARY only for the contained word; however, the ternary foot at the right edge of the word, although satisfying the constraint TERNARY, is in violation of HEAVY because of the medial heavy syllable and following light one. Only the preferred candidate, form 1, demonstrates accent preservation, since where the left boundary would be for the contained word (i.e. *ex(pe.ri.ment)*) coincides with where it is found in the derived form.

[18] Should a candidate in accordance with 4' have the left edge of what should be a ternary foot properly placed, but not the right edge, it would be rejected as the optimal candidate because of other violations. For example, the candidate *(Ca.na)da*, in spite of the correctly located left edge of its foot, has an unfooted final syllable in violation of both ALIGN and SYLL/FOOT, and the candidate *(Ca)(nada)* violates *UNARY.

(61)

	[[experiment]al]	HEAVY	TERNARY	SYLL/FOOT
1.	ex(pè.ri)(mént.al) ☞		*	*
2.	(èx.pe.ri)(mént.al)		* *!	
3.	(èx.pe)(rí.ment.al)	*!	*	

The constraint TERNARY requires that where there are three or more terminal syllables within a constituent they be gathered into a ternary foot. Because it makes reference to a constituent boundary, this is the only constraint that can affect separately each of the constituents. All the other constraints apply to the fully derived word. Let us look at the word *componential*, which does not have accent preservation with its contained word *component*. The word-final suffix and the preceding two syllables of the derived word must be parsed as a ternary foot *(nent.i.al)*, as any other foot structure would be a violation of TERNARY. The contained word, if it were to occur as an independent word, would necessitate the binary foot *(po:nent)*, because of its heavy syllable and following light. (Recall that a lax vowel followed by a dental cluster frequently functions as a light syllable word finally (see section 2.3).) Yet, as seen in 1, these two metrifications are in conflict with each other due to overlapping in the syllable *nent*, the result being an impermissible unary foot as well as a violation of TERNARY for the contained word. Consequently, there cannot be accent preservation. In form 2, the preferred candidate, both constituents have the left edges of their feet three syllables back in conformity with TERNARY. There is no violation of HEAVY here because there is no ternary foot with a medial heavy syllable followed by a light one. In 3, the desired binary footing for the contained word has been preserved, entailing an automatic violation of TERNARY, and the loss of the suffixal ternary foot produces a second violation of that constraint.

(62)

	[[compo:nent]i+al]	*UNARY	HEAVY	TERNARY	SYLL/FOOT
1.	com(pò:)(nént.i.al)	*!		*	*
2.	(còm.po:)(nént.i.al) ☞				
3.	com(pò:nent)(í.al)			* *!	*

Consider now the more complex form *componentiality*. Form 1 shows that the left edges of the feet of the two suffixes satisfy TERNARY, whereas the contained word violates it. Moreover, the accentual pattern of the fully derived word has an impermissible unary foot. For form 2, the preferred candidate, all three feet have the left edges of their syllable boundaries three syllables to the left of their respective constituent boundaries. Hence, there are no violations of TERNARY. Nor are there any additional violations within the fully derived word. For form 3, there are two violations of TERNARY, one for the contained word and the other for the derived word due to the first suffix, and the fully derived word has a violation of HEAVY.[19] In 4, the feet of the two nonrightmost constituents do conform to TERNARY, but the rightmost foot does not.

[19] The reader should not be misled by the two ternary feet in form 3. Recall that the constraint TERNARY requires that the left edge of a ternary foot occur three syllables to the left of the constituent boundary,

(63)

	[[[compo:nent]i+al]i+ty]	*UNARY	HEAVY	TERNARY	SYLL/FOOT
1.	com(pò:)(nènt.i)(ál.i.ty)	*!		*	*
2.	(còm.po:)(nènt.i)(ál.i.ty) ☞				
3.	com(pò:nent.i)(ál.i.ty)		*!	* *	*
4.	(còm.po:)(nènt.i.al)(í.ty)			*!	

Let us look at the derived word *medicinal.* What is interesting about this form is that both the contained word *medicine*, as an independent word, and the suffixed word require ternary feet. In 4, the left edges of both ternary feet are preserved; however, the result is an impermissible unary foot for the fully derived word. In 5, only the ternary foot due to the suffix has been retained, whereas in 6 it is the ternary foot of the contained word that surfaces. Hence, each form has a violation of TERNARY and of SYLL/FOOT. Moreover, the rightmost foot of 6 violates ALIGN. Recall that this constraint requires that the right edge of the rightmost foot be aligned with the right edge of the prosodic word. Note that this is the only constraint that can differentiate between candidates (5) and (6).

(64)

	[[medicin]al]	*UNARY	HEAVY	TERNARY	SYLL/FOOT	ALIGN
4.	(me)(di.cin.al)	*!				
5.	me(dí.cin.al) ☞			*	*	
6.	(mé.di.cin)al			*	*	*!

7.5 The Constraint "PRESERVE-LX"

The high-ranked constraint PRESERVE-LX is a faithfulness constraint. It is concerned with lexically-specified metrical structure (e.g. *ba(na.na), chan.de(lier)*, with metrical structure introduced by means of a lexical rule (e.g. *so(li.cit), em(ploy)* or with an extrametrical syllable (e.g. *ga.lax<y>*). The purpose of this constraint is to retain the effects of these kinds of specified metrifications in the preferred candidates. Any candidate not retaining the bracketing of the input will have violated the constraint PRESERVE-LX.

First we shall examine the effects of this constraint with the underived words *banana, employ,* and *galaxy.* The word *banana* has a lexically-specified binary foot. Form 1, the preferred candidate, by preserving the binary foot is in violation of lower-ranked TERNARY. Form 2, although manifesting the preferred ternary structure (cf. *Canada*), violates the higher-ranked PRESERVE-LX. Form 3 respects PRESERVE-LX but has a *UNARY violation. As for *employ,* form 4, the preferred candidate, with the preservation of its lexical unary foot still violates *UNARY as well as the lowest-ranked SYLL/FOOT because of its unfooted initial syllable. In form 5, both syllables are footed and so there are two violations of *UNARY, making form 5 worse than unfooted form 4. Form 6, the candidate with a normal binary foot, is rejected for failing to preserve the lexically-

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yielding *(component, compo(nential*, and *componenti(ality*. Only the final ternary foot of form 3 satisfies this constraint. Because there is no left foot bracket before the syllables *com* and *nent*, there are two violations of TERNARY. There is also a violation of HEAVY, because the heavy syllable *nent* does not form a binary foot with the following light syllable.

specified unary foot. Let us look at *galaxy* with its final extrametrical syllable. When a candidate has an extrametrical syllable, the constraints apply to the syllables situated to the left of the extrametrical one. For candidates that do not exhibit extrametrical syllables, the constraints apply from the end of the word. Candidate 7 of *galaxy*, with its specified extrametrical syllable, behaves like a bisyllabic word; having only two syllables it cannot be in violation of either HEAVY or TERNARY. Because the extrametrical syllable is not footed the form violates low-level SYLL/FOOT. Forms 8 and 9, without the extrametrical bracketing, are treated as trisyllabic words. In addition to violations of PRESERVE-LX, they have violations of HEAVY or TERNARY, and form 8 also violates SYLL/FOOT.

(65)

	[ba(na.na)]	PRESERVE-LX	*UNARY	HEAVY	TERNARY	ACCENT	SYLL/FOOT
1.	ba(ná.na) ☞				*		*
2.	(bá.na.na)	*!					
3.	(bá)(ná.na)		*!		*		

	[em(ploy)]	PRESERVE-LX	*UNARY	HEAVY	TERNARY	ACCENT	SYLL/FOOT
4.	em(plóy) ☞		*				*
5.	(em)(plóy)		* *!			*	
6.	(ém.ploy)	*!					

	[ga.lax<y>]	PRESERVE-LX	*UNARY	HEAVY	TERNARY	ACCENT	SYLL/FOOT
7.	(gá.lax)<y> ☞						*
8.	(gá.lax)y	*			*!		*
9.	(gá.lax.y)	*		*!			

We conclude this analysis of the effect of PRESERVE-LX on underived words with a comparison of the two variants, *màgazíne* and *mágazIne*. The former, because it must have a syllable-final accent, requires a lexically-specified unary foot, whereas the latter needs no special specification. Forms 1 and 3 depict the correct candidates, respectively, whereas forms 2 and 4 show what happens when one attempts to obtain the other alternant.

(66)

	[ma.ga(zine)]	PRESERVE-LX	*UNARY	HEAVY	TERNARY
1.	(mà.ga)(zíne) ☞		*		*
2.	(má.ga.zIne)	*!			

	[ma.ga.zine]	PRESERVE-LX	*UNARY	HEAVY	TERNARY
3.	(má.ga.zIne) ☞				
4.	(mà.ga)(zíne)		*!		*

We are now ready to examine the effects of the constraint PRESERVE-LX on morphologically complex words. Let us look at *solicitation*. Recall that the contained word, as an independent word, does not get the expected ternary footing and so it enters the accentual component with a binary foot specified by a lexical redundancy rule applying to verbs with a light penult—i.e. *[so(licit)]*. The derived word *solicitation* has maintained accent preservation, which means that the constraint PRESERVE-LX must be operative here too. We see this preservation in form 1, where both constituents violate TERNARY and where there is also an unfooted initial syllable. Although the contained word of form 2 has an optimal ternary foot, the derived word no longer preserves the lexically-specified binary foot.

(67)

	[[so(licit)]at+ion]	PRESERVE-LX	*UNARY	HEAVY	TERNARY	SYLL/FOOT
1	so(lì.cit)(át.ion) ☞				* *	*
2	(sò.li.cit)(át.ion)	*!			*	

Let us consider the word *èmployée*, where the terminal suffix bears a primary stress. The word-final unary foot that is required for the suffix is lexically specified. The contained word also had a unary foot when it surfaced as an independent word (i.e. *em(ploy)*). The desired output, however, cannot be obtained if both of these unary feet are retained in the input form. For form 1, which should be the preferred candidate, there is a violation of PRESERVE-LX because the lexically-specified unary foot *ploy* of the input form has not been retained. Form 2 has preserved both lexically-specified unary feet, but the result would be an unacceptable clash. The solution is not a reordering of PRESERVE-LX and *UNARY, for recall from the previous tableau of the underived word *employ* that PRESERVE-LX has to be ranked higher than *UNARY.

(68)

	[[em(ploy)](ee)] ?	PRESERVE-LX	*UNARY	HEAVY	TERNARY	SYLL/FOOT
1	(èm.ploy)(ée) ?	*!	*			
2	em(plóy)(ée)		* *			*

Because unary feet are restricted exclusively to the right edge of a word, in Section 6.3 we suggested that a lexically specified unary foot not appearing in that position, and hence no longer the final constituent within the derived word, will not be part of the metrical structure within a derived form. Consequently, for the input of *employee* a unary foot occurs only with the suffix, as shown in the following tableau. For form 3, which respects PRESERVE-LX, there is the expected violation of *UNARY. Form 4 with its double violation of *UNARY is now worse. In form 5, there is no unary foot around the suffix, a violation of PRESERVE-LX.[20]

[20] The form *emplóyee* is an acceptable variant pronunciation, but it is related to a different input, one where *–ee* behaves as a normal external suffix that is not specificed as a lexical unary foot.

(69)

	[[em.ploy](ee)]	PRESERVE-LX	*UNARY	HEAVY	TERNARY	SYLL/FOOT
3	(èm.ploy)(ée) ☞		*			
4	em(plóy)(ée)		* *!			*
5	em(plóy.ee)	*!				*

The derived word *inhibition* does not have accent preservation of the contained word *inhibit.* The latter, as an independent word, has a lexically-specified binary foot—i.e. *[in(hi.bit)]*, but this lexically-specified foot must not be part of the input of the derived form. The first of the two following tableaux shows that an inappropriate form is selected if the lexically-specified binary foot were retained. The second tableau illustrates that the correct output will be selected provided the derived word no longer has a lexically-specifed foot in the input.

(70)

	[[in(hi.bit)]ion] ?	PRESERVE-LX	*UNARY	HEAVY	TERNARY	SYLL/FOOT
1	(ìn.hi)(bít.ion) ?	*!			*	
2	in(hì.bit)(ión)		*		* *	*

	[[in.hi.bit]ion]	PRESERVE-LX	*UNARY	HEAVY	TERNARY	SYLL/FOOT
3	(ìn.hi)(bít.ion) ☞				*	
4	in(hì.bit)(ión)		*!		* *	*

It is fairly clear when the input of a derived word must not retain a lexically-specified foot from a contained word. The foot structure is not carried over for any unary foot followed by a suffix (e.g. *[[em**(ploy)**](ee)]* > *[[em.ploy](ee)]*), or a binary foot followed by the type of suffix that assigns an accent to an immediately preceding syllable (e.g. *[[in(hi.bit)]**ion**]* > *[[in.hi.bit]ion]*). The latter condition accounts for the different behavior of *inhibition* vis-à-vis *solicitation*, which does have accent preservation with its base word *solicit*. For *[[so(li.cit)]at+ion]*, the contained word *so(li.cit)* is followed by the complex suffix *-at+ion* (and not directly by accent assigning *–ion*), and so the lexical footing will be preserved in the derived form.

7.6 Accent Preservation vs. Exhaustive Metrification

When evaluating the various candidates of a derived word, the constraint TERNARY considers each constituent separately. It is this unique characteristic of the constraint that accounts for certain instances of accent preservation. Consider, for example, the difference between derived *expèriméntal* and underived *Wìnnepesáukee.* Both words have five syllables and have primary accentuation on the penultimate syllable. However, for the former word the secondary accent is found two syllables back from the primary, whereas for the latter it is three syllables back. Compare their respective tableaux. (To conserve space we have eliminated constraints not relevant for these two forms.)

(71)

	[[experiment]al]	HEAVY	TERNARY	SYLL/FOOT
1.	ex(pè.ri)(mént.al) ☞		*	*
2.	(èx.pe.ri)(mént.al)		* *!	

	[winnepesaukee]	HEAVY	TERNARY	SYLL/FOOT
3.	(wìn.ne.pe)(sáu.kee) ☞		*	
4.	win(nè.pe)(sáu.kee)		*	*!

A primary accent on the penult always entails a violation of the constraint TERNARY; hence, all candidates in the preceding tableaux have this violation. Recall that the constraint TERNARY requires a left edge foot boundary on the third syllable from the right edge of a constituent. This constraint is satisfied for the contained word *experiment* in form 1 and so the derived word maintains accent preservation. The less desirable form 2 has an additional violation of TERNARY due to the misplaced left edge foot boundary for the contained word *experiment*. The candidates for the word *Winnepesaukee* each have only a single violation of TERNARY, the one for the primary accent. Because the word is composed of only one constituent, there cannot be any additional violations of this constraint. Exhaustive metrification is the desired outcome for the placement of the secondary accent, and so form 3, without an initial unfooted syllable (which would entail a violation of SYLL/FOOT) becomes the preferred candidate.

For the derivational analyses presented in section 5, we showed how the metrification rules applied simultaneously to each constituent of a complex derivational word, thereby obviating the phonological cycle. In the nonderivational analysis of this section, we continue to preserve this notion of simultaneity. The key element that makes this noncyclic analysis possible is the constraint TERNARY. It alone is sensitive to the right edge of each constituent, for it is at the right edge that the action takes place in English derivational morphology. The other constraints (with the exception of ALIGN) evaluate an output candidate without taking into account any of the constituent boundaries of the input form that are internal to the prosodic word. [21]

8 Irregularly Derived Words

We consider a word to be irregular in some way if its lexical entry requires a particular metrification or specification without which the correct output cannot be obtained. For underived words, forms accented on a light penult (e.g. *solícit¸ banána*) or on a final syllable (e.g. *devóte*, *chandelíer*) necessitate that a binary or unary foot, respectively, be specified in the lexical entry or be provided by means of a lexical redundancy rule. Forms with a heavy penult that is not accented have an extrametrical final syllable (e.g. *gálax<y>*, *sálamAnd<er>)*, thereby assuring that the heavy syllable no longer functions as penultimate. For derived words, certain suffixes require a similar treatment: There are

[21] Benua (1997), within the framework of optimality theory, proposes a transderivational analysis of the accentuation of some English words. The contained word within a derived form is compared to the preferred candidate of the contained word when it occurs as an underived form. There is a comparison then between two different output forms. Because the preferred underived candidate has to be determined before any of the derived candidates can be evaluated, Benua's transderivational analysis is basically cyclic. For further discussion of this point, see Bakovic 2002.

suffixes forming a binary foot with a preceding syllable (e.g. *-ic*¸ *-ion*), autoaccented suffixes constituting a unary foot (e.g. *-ee*), and extrametrical suffixes (e.g. *–y*). Another way that a derived word may show irregularity is in the behavior of its rightmost suffix. We recognize four kinds of suffixes.

8.1 Classification of Suffixes

We classify suffixes according to their interactions with stems or words and according to their individual accentual properties.

(72)

Type of suffix	**Example**	**Word with suffix**	**Representation**
(1) Internal	-ate	anticipate	[anticip+ate]
(2) External	-al	parental	[[parent]al]
(3) Extrametrical	-y	presidency	[[president]<y>]
(4) Neutral	-ness	naturalness	[[natural]#ness]

(1) An internal suffix is typically joined to a root or a stem that does not occur as an independent word. Words with internal suffixes are most similar to underived words and exhibit similar accentual patterns. In fact, some of the examples previously cited in our discussion of morphologically simple forms were actually words with internal suffixes. Those containing suffixes like *-ate*, with a tense vowel, have the primary accent on the antepenultimate syllable. Because words with internal suffixes work no differently from underived words, previously we ignored the + boundary in their representations.

(2) An external suffix is one that can be added to an independent word. In the assignment of accentuation external suffixes always comprise part of the syllable count. The behavior of these suffixes was amply illustrated in Section 6.

(3) An extrametrical suffix works exactly like an extrametrical syllable and is represented in the same way. The suffix is not part of the syllable count, and so the accentuation is determined uniquely from the string of syllables preceding the extrametrical element. Thus a word like *présidency* has the same accentual pattern as *président*. Although extrametrical suffixes are not within the accentual domain proper, they can still effect other changes within the word, such as the assibilation of *t-* to *s-* found in *president, presidency*.

(4) A neutral suffix, like an extrametrical one, does not enter into the syllable count in the computation of accent placement. The accentuation of a word with this kind of suffix mirrors that of the independent word to which it is adjoined. Thus, *náturalness* has the same accentual pattern as *nátural*. Unlike an extrametrical suffix, which can affect the nature of a preceding segment, a neutral suffix has no such effect.

Suffixes do not necessarily function uniformly in regard to how they interact with the stems or words to which they can be affixed. This situation especially obtains with the suffixes *–ate, -ary/ory, -atory, –ize* and *-ive*. These suffixes belong to more than one category. For example, *-ive* functions as an internal suffix in *génitive,* as external in *digéstive*, and as extrametrical in *génerative* (with accent on the preantepenultimate syllable and laxing of the vowel of the preceding internal suffix *–ate*). These examples with *–ive* suggest the following lexical entries: *[genit+ive]*, *[[digest]ive]*, *[[generat]<ive>]*. There are even more radical irregularities. For example, a bound stem may occur exceptionally with an external suffix (viz. *[[impregn]ate]*, requiring penultimate accentuation).

English derivational morphology is not productive in the same way as the inflectional. That is, derivational suffixes are highly restricted in regard to the kinds of stems and words with which they can be combined, and there are many idiosyncracies. For this reason, it is the practice of standard dictionaries to list the various derived forms of a stem or a word. We adopt an analogous view of the lexicon. Once one recognizes the necessity of listing the various derived forms, their lexical entries will include the appropriate bracketing of suffixes and of contained words. We can account for many of the irregularities of behavior if we recognize that the suffix of an irregular form must be categorized differently from what would be normally expected. The lexical entry of a derived form, therefore, will have to contain the type of bracketing that reflects the particular function of its suffix. Variation exits only among the internal, external, and extrametrical categories, which involve principally suffixes of Latin/Romance origin. We will not be concerned at all with neutral suffixes, many of which etymologically are of Germanic origin. [22]

8.2 The Suffix *–ate*

The suffix *–ate* is normally an internal suffix. Words with this suffix are almost always accented on the antepenultimate syllable, regardless of the weight of the penult (e.g. *antícipAte, erádicAte, cónfiscAte, cómpensAte, désignAte*). [23] There is a residue of words where the accent does fall on a heavy penult (e.g. *imprégnAte, erúctAte, elóngAte, incárnAte*). There are even a few words exemplifying both variants (e.g. *ádumbrAte, adúmbrAte*; *ínculcAte, incúlcAte*; *íllustrAte, illústrAte*). Those with penultimate stress are behaving as though *–ate* were an external suffix, the type that can be attached to independent words (cf. *mollúsc-oid*). We have established that the type of suffix with its associated bracketing is part of the lexical entry of a derived word. What is irregular, then, about words in *-ate* with penultimate accentuation is the treatment of the suffix as an external one, even though the stem preceding the suffix is not an independent word.

Here are the derivations for the two variants of *inculcate.* Rule a(ii) creates a binary foot around a heavy syllable and following external suffix, as shown for the form in the right-hand column . Recall that one of the other environments for a binary foot, Rule a(i),

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[22] The suffixes with which we deal in this section correspond to the Type 1 suffixes of lexical phonology (Kiparsky 1982). The Type 2 suffixes tend to be the neutral ones.

[23] We do not consider words like *álienate, améliorate*, and *ídiolect*, which appear to require preantepenultimate accentuation, to be exceptional. The sequence iV behaves often as a monosyllabic (cf. the suffix *ion*). If we allow the sequence to count as a single syllable, the accentuation will then conform to the regular pattern.

requires that the heavy penult be followed by a light syllable, a condition that is not met by an internal suffix with a tense vowel. For this reason, the form in the left-hand column receives ternary footing.

(73)

Rules	Internal suffix	External suffix
	[inculc+Ate]	[[inculc]Ate]
Rule a(ii) Binary		in(cúlc.Ate)
Rule b Ternary	(ín.culc.Ate)	

Notice, incidentally, that for words with an accented penult, the suffix *–ate* cannot be analyzed as extrametrical. Being external to the foot-creating process, an extrametrical suffix could never form a foot with the syllable preceding it. On the other hand, the words (*óxygen)<Ate>, (nítrogen)<Ate>*, and (*péregrin)<Ate>*, with preantepenultimate accentuation, do require that the suffix be analyzed as extrametrical so that rule b can appropriately assign a ternary foot to the residue (cf. *salamander*).

There are many nouns and adjectives where the suffix *–ate* has a reduced vowel—e.g. *delegate, candidate, celibate, intricate.* We assume that there are two allomorphs of the suffix *–ate*, one with a tense vowel, occurring primarily with verbs, and the other with a lax vowel, occurring with nouns and adjectives.

The word *alternate*, whether verb, noun, or adjective, has the accent on the antepenultimate syllable. This accentuation is correctly predicted for the verb where the suffix has a tense vowel—i.e. *[altern+Ate]* (cf. *compensate*). However, for the noun or adjective, where the suffixal vowel is lax, one would expect penultimate accentuation—i.e. *altérnate*, as there is now a heavy syllable followed by a light one, and in fact, this pronunciation can be found in some dictionaries (cf. also *altérnative* in section 7.4.). In order to derive the more common initially accented noun or adjective (i.e. *álternate*), the lexical entry must be *[altern<ate>]*, with an extrametrical suffix, so that there can be a binary foot for the residue (cf. *[charact<er>], [galax<y>]*.

8.3 The Suffix *–y*

Previously we noted that word-final *–y* functions regularly for words such as *epóxy* and *ecónomy* and that it can be extrametrical in words such as *gálax<y>, létharg<y>* and *álimOn<y>*. What happens with the complex suffixes *–ary*/*ory* and *–atory*?

8.3.1 The Suffixes *–ary/ory*

Final *–y* is always extrametrical as part of the complex suffixes *–ary*/*ory*, which behave either as internal or external, and there are even rare instances where the entire complex is extrametrical.

(74)

Regular Internal	[volunt+Ar<y>]	sedentary, monastery, repertory, inventory, desultory, necessary, ordinary, apothecary, territory, allegory
Regular External	[[element]Ar<y>]	documentary, advisory, honorary, imaginary, urinary, evolutionary; depository, prohibitory, contributory
Irregular Internal	[legend+Ar<y>]	secondary, commentary, momentary, fragmentary; salivary, antiquary, excretory
Irregular External	[[infirm]Ar<y>]	anniversary, quaternary, dispensary, exemplary compulsory, responsory; satisfactory, introductory
Extra-metrical	[[disciplin]<Ar+y>]	veterinary

The regular internal examples have *–ary/ory* combined with a stem that is not an independent word. Hence, we expect accentuation in all cases to be located two syllables before the suffix—that is, -*ary/ory* will have the same behavior as the internal suffix *–ate*.

When it is combined with an existing word the suffixes should function as external. As the second set of examples shows, the accentuation will be on a heavy penult, otherwise on an antepenultimate.

The third set contains independent words combined with the suffixes. Yet, the accent is on the antepenultimate syllable even though the penult is heavy. Hence, we must treat the suffix as internal. However, it has been suggested (Kiparsky (1982), Halle & Vergnaud (1987), Kager (1989), Burzio (1994)) that with *–ary/ory* and a few other suffixes, a preceding syllable terminating in a sonorant and another consonant functions instead as a light syllable. If so, then these words would be expected to have antepenultimate accentuation regardless of how the suffix is analyzed, and they could be assigned to the category of regular external. Yet this treatment of sonorant-consonant clusters works only for words of two syllables. For three-syllable words, like *elementary* and *documentary*, the sonorant-consonant cluster must be part of a heavy syllable as the accent is attracted to it. Moreover, the forms where the vowel of the contained word is tense (i.e. *saliva, antique, excrete*), could be regularized only if the vowel is treated as lax in the derived word. However, this laxing of a stem vowel does not always occur (cf. *advisory*).

The treatment of sonorant-consonant clusters as belonging to light syllables is not borne out by the fourth set of examples. The syllables in question are accented. In our analysis we need to treat the suffix as external even though it is not added to an independent word. However, for words like *satisfactory* and *introductory*, where the consonant cluster preceding the suffix does not contain a sonorant, it appears that that kind of syllable always counts as heavy and attracts the accent. Although it may be possible to come up with some generalizations about the distribution of some of these irregularities, there will always be a residue of recalcitrant forms evading any neat classification.

The last example, *disciplinary*, is unusual because its accented vowel occurs three syllables to the left of the suffix *–ary*. This accentuation requires treating the entire suffix as extrametrical. In this way the accent will fall on the same syllable as it does for the independent word *discipline*.

In American English, the suffixes *–ary/ory* are generally pronounced with a full unaccented vowel when an immediately preceding syllable is unaccented, and with a reduced vowel when it is accented. In British English the suffix vowel is reduced in many of the contexts where a full vowel is retained in American English. We assume that these vowel adjustments are late phenomena occurring after metrification and accent assignment have taken place.

8.3.1.1 The Complex Suffix *–atory*

The treatment of *–atory* depends on whether *–ate* is an internal suffix of the contained word (e.g. *anticipate, anticipatory; compensate, compensatory)*, whether it is external to the contained word (e.g. *explore, exploratory*), or whether it follows the allomorph *–fic* of the suffix *–fy* (e.g. *classificatory*). Where *–ate* is an internal or external suffix, *-ory* is extrametrical. After *–fic* the entire complex *–atory* is extrametrical . Moreover, the suffix *–ate*, whatever its source, always has the allomorph with a lax vowel before the suffix *–ory*, as its syllable functions as light in this context.

Here are the derivations of *anticipatory, compensatory,* and *exploratory*. The suffix *–ory*, being extrametrical, is not part of the accentual domain of these words. The word *anticipatory* then has its accent on the antepenultimate syllable preceding the extrametrical material, and the other two words on the heavy penult. The difference in the placement of the accent for the verb *cómpensAte* and for its derived partner *compénsatOry* is entirely due to the particular allomorph of the internal suffix *–ate*. The verb *compensate* has the allomorph with a tense vowel. Recall that the accent cannot be on a heavy penult when the vowel of a following internal suffix is tense. The word *compensatory* (as well as *exploratory*) has the allomorph with a lax vowel, and before a suffix with a lax vowel the accent will land on a preceding heavy syllable.

(75)

Rules	[[anticip+at]<Ory>]	[[compens+at]<Ory>]	[[explo:r]at<Ory>]
Binary/Ternary	an(ti.cip.at)<Or.y>	com(pens.at)<Or.y>	ex(plo:r.at)<Or.y>
Accent	an(tí.cip.at)<Or.y>	com(péns.at)<Or.y>	ex(pló:r.at)<Or.y>

Finally, let us consider the trio of words, *classify, classification*, and *classificatory*. The internal suffix *–fy* has the allomorph *–fic* before another suffix. In one case it is followed by the complex suffix *–ation*, which is external, and in the other by *–atory*, which is completely extrametrical in this environment. Here are the derivations.

(76)

Rules	[classify]	[[classific]at+ion]	[[classific]<at+Ory>]
Binary/Ternary	(class.i.fY)	(classific) (at+ion)	(class.i.fic)<at.Or.y>
Accent	(cláss.i.fY)	(clàss.i.fic)(át+ion)	(cláss.i.fic)<at.Or.y>

Note that *classificatory* terminates in five unaccented syllables, three of them due to an unusual string of extrametrical syllables. As bizarre as this string of syllables may seem, the extrametricality follows from a few fundmental assumptions of our analysis. First, the rightmost accent of a word is always the primary one, so that all syllables to the right of it must be unaccented. Moreover, a main accent can occur no further to the left than the third syllable from the right edge of its constituent; hence, there must be a constituent *[classific]*, and any following syllables have to be extrametrical. [24] In American English, one of the five unaccented syllables is nonreduced, for the reason noted previously. In British English, however, all five terminal syllables can remain reduced. This phenomenon lends additional support to the claim that extrametrical syllables have no foot structure.[25]

8.4 The Suffix *–ive*

The suffix *–ive* functions as internal, external, or extrametrical, and it is always extrametrical after *–ate.*

(77)

Internal	[genit+ive]	explosive, repulsive, deceptive, adhesive, persuasive; indicative, infinitive, consecutive, purposive
External	[[digest]ive]	inventive, subjective
Extra-metrical	[adject<ive>]	substantive
Extra-metrical with *-ate*	[[gener+at]<ive>]	compensative, alternative, significative; nominative, administrative, meditative, anticipative
	[[represent]at<ive>]	informative, figurative, affirmative, comparative
	[[justific]<at+ive>]	qualificative, multiplicative

The suffix *–ive* contains a lax vowel and, consequently, its syllable will count as light.[26] For that reason, whether the suffix is analyzed as internal or external, (as shown by the first two sets of forms) the result will be the same: Accent on the penultimate syllable if heavy, otherwise on the antepenult.

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[24] In the analysis by Chomsky and Halle (1968) of *classificatory*, the morphemes *fic+at* were parenthesized within their stress rule (a kind of extrametricality?), so that the stress could be retracted from the suffix *-ory* and be reassigned two syllables in front of the two parenthesized suffixes.

[25] Webster's Third gives two other accentual patterns—*classificatOry* and *clássficAtory*, noting that the latter is especially British. We would derive the former from *[classific+at]<ory>* and the latter from [classific]<At+ory>, with the suffix *–ate* exceptionally retaining a full vowel in this environment.

[26] The suffix *–ive* has an allomorph with a tense vowel when followed by the suffix *–al* (e.g. *infinitIval, adjectIval)*. Consequently, there will be penultimate accentuation.

The third set of forms requires that *–ive* be analyzed as extrametrical so that the accent can be placed on the syllable preceding a heavy penult (cf. *galaxy*).

The words with *–ative* are particularly interesting in two respects. First, the *–ive* part is always extrametrical, but *–ate* can be internal, external, or extrametrical: (1) The suffix *–ate* belonging to a contained word is an internal suffix. (2) After an independent word, *-ate* is external. (1) and (2) state the expected behaviors of *–ate* (cf. 7.2). (3) After the allomorph *–fic*, the complex *–ative* is extrametrical, exactly analogous to the behavior of the complex suffix *–atory* (cf. 7.3.1.1).

The second significant fact about these forms is that some of them show a full vowel for *–ate* while others have a reduced vowel—e.g. *méditAtive* versus *figurative*. (The form with a reduced vowel occurs exclusively whenever the preceding syllable is accented (e.g. *infórmative, rèpreséntative*).) Moreover, there are forms that sanction both pronunciations—e.g. *génerative, génerAtive; admínistrative, admínistrAtive; compénsative, cómpensAtive* (with a shift in accentuation). We attribute the difference in vowel quality to the choice of allomorph for the suffix *-ate*. For words with both alternants, the bracketing remains the same, the difference being whether *–ate* has the allomorph with a tense vowel or a lax one. This choice will cause a different placement of the accent whenever there is a heavy syllable preceding *–ate* (i.e. *compensative*). The accent will be attracted to the penultimate syllable when the internal suffix *–ate* manifests a lax vowel, but to the antepenultimate when *–ate* is tense. Note the following derivations. [27]

(78)

Rules	[[gener+at]<ive>]	[[gener+At]<ive>]
Ternary	(ge.ne.rat)<ive>	(ge.ne.rAt)<ive>
Accent	(gé.ne.rat)<ive>	(gé.ne.rAt)<ive>

Rules	[[compens+at]<ive>]	[[compens+At]<ive>]
Heavy	com(pens.at)<ive>	
Ternary		(com.pens.At)<ive>
Accent	com(péns.at)<ive>	(cóm.pens.At)<ive>

8.5 The Suffix *–ize*

The suffix *–ize* is internal after most stems (as expected) and for words ending in a *–y* that is deleted before *–ize*. It is irregularly external after only a few stems. It is extrametrical after independent words, and consequently, the accent will be located on the same syllable as that of the independent word to which the suffix is attached.

[27] We have no problem with *admínistrAtive* (from *[[administr+At]<ive>]*. However, the alternate form, where *–ate* has a lax vowel, comes out as the incorrect **adminístrative* (accented on the antepenult) if derived from *[[administr+at]<ive>]*, unless *str* does not create a heavy syllable here, in which case the accent would then be correctly assigned.

(79)

Internal	[recogn+Ize]	advertise, exercise, fraternize, energize, jeopardize; apologize, subsidize, organize, hypnotize
External	[[metamorph]Ize]	eternize, sycophantize
Extrametrical	[[general]<Ize>]	nationalize, modernize, diphthongize, satirize, standardize, materialize, commercialize

There are a few words having variant pronunciations—e.g. *ámortIze, amórtIze*; *ággrandIze, aggrándIze*. This variation is to be treated analogously to that of *ínculcAte, incúlcAte* discussed in Section 8.2. The suffix functions as internal for one of the variants and as external for the other one.

We have demonstrated the necessity for three types of suffixes, depending on whether they typically combine with stems or words (i.e. internal versus external) and whether they are part of the accentual domain or outside of it (i.e. internal and external versus extrametrical). We need to recognize at least these three types because each affects differently how the rightmost foot is constructed. We accommodate the differences by the type of bracketing that accompanies the suffix. But the typical situation is not always respected. For example, a stem might require that its suffix be analyzed as external—e.g. [[impregn]ate], even though the suffix has not been added to an independent word. Yet, in all such cases, we continue to respect where the constituent boundaries lie—i.e. the suffix is always maintained as a separate constituent. By recognizing the chameleon-like behavior of suffixes, we are able to account for many kinds of irregularities in the accentuation of derived words. Because idiosyncracies abound, the lexical entry of a derived form will have to contain the bracketing that reflects the particular function of its suffix.

8.6 Other Kinds of Irregularities

8.6.1 Initial Extrametrical Syllables

Some derived words beginning with a sequence of syllables of the form: *light – heavy – accented*, have variant pronunciations—for example, *èlEctrícity, elEctrícity*; *rèlAxátion, relAxátion*; *cònnEctívity, connEctívity*. The form with an initial accented syllable is the expected one according to regular metrification. The other variant is unusual in that it begins with two unaccented syllables, although its second syllable is always heavy and has a full vowel. In general, one does not find two unaccented syllables at the beginning of a word as they can always be parsed as a binary foot. One way of obtaining this unusual configuration is by treating the initial syllable as extrametrical.

Following are the two alternants of *electricity*. The form on the left is straightforward. Feet are assigned within each of its constituents. There is overlap of the syllable *ic*; hence the syllable preceding it cannot be retained as a unary foot and so it joins with the unfooted initial syllable into a binary foot. For the form on the right, the syllable *–lectr* cannot form a foot with the extrametrical syllable to its left and so it must become unfooted.

(80)

Rules	[[electr+ic]ity]	[[<e>lectr+ic]ity]
Binary/Ternary	e(lectr.ic) (ic.it.y)	<e>(lectr.ic) (ic.it.y)
Accent	(è.lEctr)(íc.it.y)	<e>lEctr(ic.it.y)

For words beginning with three light syllables preceding an accented syllable, the expected pattern is for the initial syllable to be accented due to exhaustive metrification—e.g. *Wìnnespesáukee*. However, there are a few rare words where, instead, the second syllable is accented—e.g. *apòtheó:sis*, *amànuénsis*. These too will be properly metrified if their initial syllables are treated as extrametrical: *<a>(po.the)(o:sis), <a>(man.u)(en.sis).*[28] Alternatively, one might maintain that these words instead are lexically specified with a binary foot encompassing their second and third syllables—e.g. *[a(pothe)o:sis]*. We reject this analysis. All previous lexical bracketings of syllables—whether binary feet, unary feet, or extrametrical syllables, are found only at the edge of a constituent boundary. A binary foot around the second and third syllables would be the only instance of a lexically-specified word-internal bracketing. For this reason, we prefer the analysis that we have proposed, even though a left-edge extrametrical syllable is highly unusual. However, like its right-edge counterpart it is still located at the word edge.

8.6.2 Word-Internal Footless Syllables

Syllables are gathered into feet. However, we have seen that there are two contexts where footless syllables may occur: as unfooted word-initial syllables or as extrametrical syllables. Both environments situate these kinds of syllables at the word edge. However, there are some derived forms where an unfooted syllable must occur internal to the word. These include words containing the complex suffix *–ization* and words preceded by certain kinds of prefixes.

We noted in 7.5. that the suffix *–ize* is extrametrical after an independent word. This suffix, in turn, can be followed by the complex suffix *–ation*—e.g. *generalization, modernization, commercialization*. [29] This sequence of suffixes is unusual for there would be an extrametrical suffix (i.e. *–ize*), one that is outside of the accentual domain of the word to which it is affixed (i.e. *general*), followed by an external suffix (i.e. *–ation*), one that has its own accentual domain. Now extrametrical elements occur only at the edge of a word and not within the interior of a derived word. (Recall the similar restriction on the occurrence of unary feet.) Consequently, when *–ize* is followed by *–ation*, it is no longer extrametrical; instead, it joins with the following suffix to form the complex suffix *–ization* (analogous to *–ate* joining with *–ory* to form the complex suffix *–atory*). Here then is the derivation of *generalization*. The contained word, as expected, will be accented on its antepenultimeate syllable, and the complex suffix *–ization* on its penultimate syllable. Why then must *–ize* remain unfooted? Since the maximum permitted foot is ternary it cannot be gathered into the preceding foot, and since all feet

[28] Kenyon and Knott cite *àpothéosis* as an alternate pronunciation, a form that can be derived regularly—i.e. *(à.po)(thé:o.sis)*, where the underlying vowel of the penultimate syllable is lax (instead of tense).

[29] The suffix *–ize* has an underlying tense vowel (viz. 7.5). Before *–ation*, it becomes lax and reduced in American English, but it remains tense in British.

are left-headed it cannot be incorporated into the following one. Note, though, that unfooted *–ize* nonetheless is still the initial syllable of its constituent *–ization*.

(81)

Rules	[[general]i:z+at+ion]
Binary/Ternary	(ge.ne.ral) iz(at.ion)
Accent	(gè.ne.ral)iz(át.ion)

8.6.3 Words with Greek prefixes

An internal unfooted syllable may occur with certain prefixes of Greek origin when combined with an independent word. Consider the forms *artèriosclerósis* and *hèterogenétic*, which, respectively, must have as their foot structures, *ar(te.ri.o)scle(ro:s.is)* and *(he.te.ro)ge(net.ic)*. Here too we have internal unfooted syllables that cannot be absorbed into either of the neighboring feet. Following is the derivation of *arteriosclerosis*. Note that the prefix and the independent word are parsed as coordinate constituents (see line 1). This parsing provides an explanation for the internal unfooted syllable: It coincides with its occurrence within the independent word.

(82)

Rules	[[arterio][sclero:s+is]]
Binary/Ternary	ar(te.ri.o) scle(ro:sis)
Accent	ar(tè.ri.o)scle(ró:sis)

Consider now words such as *stéreoscOpe* or *hélicogrAph*, composed of a prefix with a monosyllabic stem. When the prefix was combined with a polysyllabic independent word (e.g. *arteriosclerosis*) the main accent occurred within the independent word, but with a monosyllabic stem it occurs within the prefix. In order for the accent to fall on the initial syllable of a trisyllabic prefix, we must treat the monosyllabic stem as extrametrical—i.e. *[[stereo]<scOpe>]*, with a vowel not undergoing reduction. However, a stem does not remain extrametrical when it is followed by a suffix. In that environment it will join with the suffix to form a separate constituent—i.e. *[[stereo][scop+ic]],* analogous to the previous treatment of a prefix and an independent word. [30] Here are the derivations.

(83)

Rules	[[stereo]<sco:pe>]	[[stereo][scop+ic]]
Ternary Binary/Ternary	 (ste.re.o)<sco:pe>	(ste.re.o) (scop.ic)
Accent	(sté.re.o)<sco:pe>	(stè.re.o)(scóp.ic)

[30] A monosyllabic word and a following suffix will also constitute a single constituent—e.g. *[scen+ic], [ton+al]* . Hence, both types of monosyllables (i.e. stems and words) are parsed alike when combined with a suffix.

Our analysis of English word accentuation is based on a few basic premises in regard to foot structure: Feet are generally binary and ternary. A unary foot is restricted to the right edge of the prosodic word, and an unfooted syllable may occur at the left edge. Moreover, a heavy syllable and following light one form a binary foot. As a consequence of these premises, the rightmost accent must fall on one of the last three syllables of a word, and additional accents occur either two or three syllables from the accent to their right. If we consider these premises to be inviolable and we take them to their logical conclusion, then there is only a limited number of ways to accommodate exceptions.

For example, if a word has a preantepenultimate main accent, the additional syllables can only be extrametrical (as well as unfooted)—e.g. *(sálamAnd)<er>, (clássific)<atOry>*. This same solution accommodates a trisyllabic Greek prefix, such as *stereo-*, when followed by a monosyllabic stem. Or consider what happens when this same type of prefix is combined with an independent word that begins with an unfooted syllable, such as *genetic*. The unfooted syllable is retained in the combined form—i.e. *(hètero)ge(nétic)*, and although no longer word-initial, nonetheless it is still the initial syllable of its constituent.

9 From Accent to Stress

Accent and stress are both necessary for an adequate characterization of the kinds of prominence relations exhibited within English words. The former is a manifestation of underlying foot structure, the latter of degrees of prominence among syllables. In this section we present rules for relating these two components. In Section 10 we extend the analysis to phrases, compounds, and sentences. We shall see that similar principles govern the accentuation and corresponding stress levels of these higher-ordered constituents.

9.1 Conversion rules for word accentuation

From the linear distribution of accented and unaccented vowels, and of full and reduced vowels, one can deduce all of the degrees of prominence required by a representation based on stress. The conversions from our accent representation to a Chomsky-Halle numerical notation are straightforward. Note the correspondences in the first two columns of the following table. Although we have indicated foot structures for the accent representations, the conversion to stress does not necessitate reference to feet but is dependent only the linear ordering of the accents. (For comparison, in column 3 we show the grid notation where the heights of columns correlate to degrees of prominence.)

(84)

Accents	Degrees of stress	
	Integer notation	**Grid notation**
(cóm.pen)(sá.tion)	3 1 com.pen.sa.tion	x x x com.pen.sa.tion
(cón.fi)(dént.i)(ál.i.ty)	3 4 1 con.fi.den.ti.al.i.ty	x x x x x x con.fi.den.ti.al.i.ty
An(tí.ci.pAte)	3 1 3 an.ti.ci.pate	x x x x an.ti.ci.pate
An(tí.ci)(pá.tion)	4 3 1 an.ti.ci.pa.tion	x x x x x x an.ti.ci.pa.tion
(át.tEst)(á.tion)	3 4 1 at.test.a.tion	x x x x x x at.test.a.tion
(kán.ga)(róo)	3 1 kan.ga.roo	x x x kan.ga.roo

From the preceding examples we can ascertain some of the properties of stress prominence. The rightmost accent will always correspond to [1 stress]. However, there are restrictions on the distribution of subsidiary stresses. A word may have two occurrences of [3 stress] provided they are separated by the [1 stress] (e.g. *anticipate*). However, two subsidiary stresses of the same level never occur to the same side (i.e. to the left) of the [1 stress]. One of them will be [3 stress] and the other [4 stress]: When both correspond to accented syllables then the one further to the left will be [3 stress] and the one closer to the main stress will be [4 stress] (e.g. *confidentiality*). When only one of the stresses corresponds to an accented syllable and the other to an unaccented full vowel, then the former will be [3 stress] and the latter [4 stress] (e.g. *anticipation, attestation*). Consequently, unaccented full vowels are always weaker than adjacent accented vowels. These observations are summarized in the following table. [31]

[31] The conversion rules to integer values are similar to the detail rules in Schane (1975), which antedated grid notation. In that study a set of generative rules uniquely assigned [+ stress] to vowels . A separate set of "detail" rules then converted each occurrence of [+ stress] to an integer value.

(85)

Conversion Rules to Integer Values
1. The rightmost accent always corresponds to [1 stress].
2. A single accent to the left of the main stress is [3 stress].
3. Where there are two accents to the left of the main stress, the leftmost one is [3 stress] and the middle one is [4 stress].
4. An unaccented full vowel is one degree weaker than any stress to either side of it.

9.2 Rules for stress assignment within a grid notation

The third column of the preceding table of examples utilizes a grid notation for stress levels, and it is this mode of representation that we shall use from here on. Whereas in the numerical notation a lower integer denotes a higher degree of stress, in the grid notation a higher column of asterisks correlates to greater stress. Now for words in isolation, all main stresses are considered to be equal. An advantage of the numerical notation is that all main stresses were depicted as [1 stress], irrespective of any other degrees of stress within a word; hence, all [1 stress] were equivalent. However, in the grid notation the number of asterisks in a column can vary, depending on the number of stress levels in a particular word. For example, a word with three asterisks for its main stress has two degrees of subsidiary stress, whereas a word with two asterisks for its main stress has only one degree of subsidiary stress. This difference is an artifact of the grid notation, and it has nothing to do with perceived main stress levels among different words.

The rules for accentuation (that were presented in sections 4 and 5) build feet and assign an accent to the syllable situated at the left edge (i.e. the head) of a foot. Within grid notation accent assignment is implemented as an asterisk (or X) above the relevant syllable of a bracketed foot. The result is a level playing field, where every accented syllable bears a single asterisk—what we shall call a *grid mark*, and every unaccented syllable is without such a mark. This output, but without the foot bracketing, becomes the input to the stress component. Because foot bracketing is no longer relevant, the derivation of stress levels takes place entirely within a pure grid framework. It is at this point that the stress rules will take over. Their purpose is to create columns by adding additional asterisks above some of the grid marks (depending on how many levels of stress need to be recognized) and to create a grid mark for any full vowel without one. A *column* is defined as a vertical alignment of one or more asterisks.

When a word enters the stress component it will have one or more columns of exactly one grid mark (i.e. one for each accented syllable). Where there is only one column and there are no unaccented full vowels (e.g. the initial accented syllable of *Canada*), then nothing further needs to be done. That single asterisk by itself will suffice to represent the main stress. But where there are two or more columns at the outset or there are syllables with reduced full vowels, then we will need a procedure for building columns of different heights in order to provide for the various degrees of prominence.

(86)

Rules for building columns of stress levels
1. **End Right:** Add an asterisk above the rightmost column (where there are at least two columns).
2. **End Left:** Add an asterisk above the leftmost column (where there are at least two columns to the left of the rightmost column).
3. **Full Vowel**: Add an asterisk above every unaccented full vowel.

The three rules are ordered: Where there are multiple accents (columns) in a word, End Right is responsible for the main stress, End Left for the next higher stress whenever there are at least two accents to the left of the main one, and Full Vowel for the lowest degree of stress (i.e. a single asterisk) for any unaccented full vowels. Moreover, whenever a later rule adds an asterisk, then one must be simultaneously added to any previously created column in order to ensure that the latter retains its relative position of prominence. This convention is an artifact of the grid notation (which requires that a higher column denote a greater degree of stress) and not the result of our particular view of accent or stress.

Let us look at some examples (shown in the following table). The first row represents the input to the stress component, which is an accentual representation without metrical bracketing, where each accented syllable bears a single grid mark. The second row shows the output from application of End Right. Because this rule applies only where there is more than one column, it will have no effect on the words *Canada* and *anticipate* because of their single grid marks. End Left applies only to *confidentiality* as it is the only word that, after application of End Right, still has two grid marks to the left of the taller grid mark. To resolve this situation an asterisk is added to the leftmost grid mark and, according to the convention, also to the column on the right edge, thereby preserving its main stress. End Left is responsible for the alternating stress configuration of *strong-weaker-strongest* so characteristic of words of this type. Finally, the rule Full Vowel supplies an asterisk to every unaccented full vowel, and by the convention an asterisk is added to each previously created column. Because *Canada* and *confidentiality* have no unaccented full vowels, this rule has no effect on these words.

(87)

Accent	x ca.na.da	x An.ti.ci.pAte	x x An.ti.ci.pa.tion	x x at.tEs.ta.tion	x x x con.fi.den.ti.al.i.ty
End Right	x ca.na.da	x An.ti.ci.pAte	x x x An.ti.ci.pa.tion	x x x at.tEs.ta.tion	x x x x con.fi.den.ti.al.i.ty
End Left	x ca.na.da	x An.ti.ci.pAte	x x x An.ti.ci.pa.tion	x x x at.tEs.ta.tion	x x x x x con.fi.den.ti.al.i.ty
Full Vowel	x ca.na.da	x x x x An.ti.ci.pAte	x x x x x x An.ti.ci.pa.tion	x x x x x x at.tEs.ta.tion	x x x x x con.fi.den.ti.al.i.ty

9.3 Rhythm

Halle and Vergnaud (1987), citing Kenyon and Knott, note that there are quite a few long words with two variants: either the first or the second syllable can bear the secondary accent (e.g. *ànticipátion, antìcipátion*). For many of these words the form with the accent on the second syllable (and consequently with an unfooted initial syllable) is due to accent preservation (cf. *antícipate*), whereas the form with the accent on the first syllable appears to be striving for exhaustive metrification. Some other words behaving this way are: *Ticonderoga, acceptability, articulation, asphyxiation, authentication, coagulation, decapitation, degeneration, depolarization, experimental, humiliation, impersonation, inferiority, irresolution*.[32]

Halle and Vergnaud treat each pair as absolute free variants (i.e. with no preference for one of the members). We agree with Burzio (1994) that the variant due to accent preservation is the more common one. In fact, it is often the only pronunciation indicated by many dictionaries, and it is this form that is uniquely accommodated by our metrical rules applying to derived words. How are we to account for the alternate stress pattern and why (if we are to accept the data from Kenyon and Knott) are there so many words permitting this variation? We believe that the answer is to be found in rhythm.

There is accentual rhythm and there is stress rhythm. Accentual rhythm is based on the binary opposition of accented/unaccented. In words of sufficient length, accented syllables are separated by one or more unaccented, and as we have argued, it is accentual rhythm that is at the heart of many of the dictionary representations. Stress rhythm, on the other hand, establishes alternation among the different levels of stressed syllables. It may be manifested as a weaker stress between two stronger ones, or as a stronger stress between two weaker ones. In the previous table, the words *anticipate, attestation,* and

[32] We cite just a few of the words found in footnote 12 of pages 245-6 of Halle & Vergnaud. The authors claim to have surveyed the first half of Kenyon and Knott's tome (letters *a-m*).

confidentiality exhibit this type of stress rhythm, but *anticipation* with its sequence of *weak-stronger-strongest* stresses does not. Yet, an interchange of the stress levels of the first two syllables would lead to a preferred stress rhythm of *strong-weaker-strongest*, thereby putting this word in the same league as *attestation* and *confidentiality*.

In the phonological literature the Rhythm Rule has been held responsible for the interchange of a weak and a stronger stress before a still stronger one. This rule is best known for its effects within phrases, such as *Ròmânce lánguage* > *Rômànce lánguage* and *Tènnesêe Williams* > *Tênnesée Williams*. (A circumflex accent denotes secondary stress, and a grave tertiary.) To accommodate these rhythmic shifts within a grid notation, we shall adopt the proposal of Hayes (1985) for a rule that moves the topmost asterisk of a column onto the column of a preceding syllable.

(88)

Rhythm Rule: Given a sequence of three columns of asterisks, *n-1, n, n+1* (where *n* is the number of asterisks), move the top asterisk(s) from column 2 onto column 1.

Notice the application of this rule at the phrasal level. The forms on the left meet the conditions of the rule. The arrows indicate the asterisks that are to be moved leftward, thereby yielding the forms on the right. Note furthermore that unstressed syllables may intervene between the columns of stressed syllables.

(89)

x ? x x x x x Romance language	Rhythm Rule >	x x x x x x Romance language

x ? x x x x x Tennesee Williams	Rhythm Rule >	x x x x x x Tennesee Williams

x ? x x x x x California wine	Rhythm Rule >	x x x x x x California wine

We claim that exactly the same conditions are at play for the shift in words such as *anticipation* or *Ticonderoga*, as shown below. The form on the left is derived by means of the rules End Right and Full Vowel, as illustrated previously. The resulting stress contour of *weak-stronger-strongest* is precisely the one needed for subsequent application of the Rhythm Rule.

(90)

x ? x x x x x an. ti. ci. pa. tion	Rhythm Rule >	x x x x x x an. ti. ci. pa. tion
Ti.con.de.ro.ga		Ti.con.de.ro.ga

The Rhythm Rule is optional, and because it affects stresses (and not accents) it must apply after stresses have been assigned. The words *Romance, anticipation* and *Ticonderoga* are not accented on their initial syllables. But because those syllables contain full vowels they ultimately receive the lowest degree of stress, thereby enabling them (along with *Tennesee* and *California* whose word-initial stresses do correspond to accented syllables) to undergo rhythmic adjustment. However, an initial unaccented syllable with a reduced vowel does not receive stress, and so it cannot be a candidate for retraction—e.g. *Madrîd díalect* > **Mâdrid díalect*. By the same token, although a word like *Ticonderoga*, with an initial full vowel, can have secondary stress on either its first or second syllable (thanks to the Rhythm Rule), a word like *Monongahela*, with an initial reduced vowel, can have secondary stress only on its second syllable (due to the inherent accent there).

Our analysis of treating the variants of words, such as *anticipation*, as a product of the Rhythm Rule entails that all such words must have initial syllables with full vowels. If we look at the many forms cited by Halle and Vergnaud, we find that the vast majority of them do in fact satisfy this condition or else begin with prefixes whose vowels can be optionally rendered as full.[33]

To summarize, our analysis of word stress contains the four rules—End Right, End Left, Full Vowel, and Rhythm. The first three rules build columns of different heights. The rules accomplish this goal with the help of a convention that adds an asterisk to any previously erected column whenever a new column has been created. The rules End Right and Full Vowel are responsible for the most prominent and the least prominent stress levels, respectively. The former renders the rightmost accent of a word as the most prominent stress, and the latter assigns the weakest stress level to unaccented full vowels. The rules End Left and Rhythm perform similar functions: Where there are two lesser stresses to the left of a more prominent one (i.e. the main stress), the one further to the left will become next in prominence. End Left applies where there are two subsidiary accents, whereas the Rhythm Rule interchanges the stress levels of the stressed vowel of

[33] There are other explanations for the occurrence of variation among the few words where one of the variants has an initial syllable with a reduced vowel. The two alternants of *academician* can be derived respectively from *academy* and *academic*, of *aristocratic* from *aristocrat* and *aristocracy*, and of *arithmetician* from the two variants of *arithmetic* (with accents on either the first or second syllable). For *canalization*, Kenyon and Knott cite both *cánalize* and *canálize* for the corresponding verbs. The pair *apòtheósis* and *àpothéosis* have their primary stresses on different syllables, which means that they must come from two variant underlying forms (see also note 28). Separate underlying forms account also for the odd pair *mìsericórd* (with a final primary stress) and *miséricord* (with primary stress on the second syllable), both pronunciations given by Kenyon and Knott. The variation exhibited by words like *electricity* has been analyzed in section 7.6.1. For all of the preceding words, although stress may occur on either the first or second syllable, the other syllable is without stress. On the other hand, for words like *anticipation* (as well as most of the other words in Halle and Vergnaud's list) both syllables always bear some degree of stress, and it is for this reason that the variation can be explained as a consequence of stress rhythm.

an initial syllable (from an originally unaccented vowel that became stressed due to the rule Full Vowel) and of the stressed vowel of the second syllable (from an originally accented vowel). Yet the effects from both rules are identical: an alternating rhythm of *strong-weaker-strongest* stress.

10 Phrase, Compound, and Sentence Stress

The three rules—End Right, End Left, and the Rhythm Rule—presented in Section 9 for word stresses, will accommodate as well the various stress patterns of phrases, compounds, and sentences. The Full Vowel rule, which assigns the lowest stress level to an unaccented full vowel, applies only at the word level, and so it will not play a role for the larger units. We discuss phrase stress in 10.1, compound stress in 10.2, and sentence stress in 10.3.

10.1 Phrase stress

When we arrive at the phrase level the stress rules will have already assigned one or more stress levels to the individual words. One of these stresses must then be elevated as the most prominent one of the phrase. For English, it is a stress within the rightmost constituent that becomes the strongest. Recall that at the word level, the rule End Right targeted the rightmost accent as the main stress. This same rule, at the phrase level, will elevate further the main stress of the rightmost word.

(91)

Word stresses	x x (French wine)
End Right (phrasal)	x x x (French wine)

At the outset the individual words of the phrase *French wine* have columns of equal height. However, if one of the words should have more stress levels (i.e. columns of different heights), neighboring words with fewer columns will have to be adjusted so that their columns for main stress are of the same height as the main stress of the word with the most columns. Consider, for example, the phrases *California wine* and *Ticonderoga wine*. The word *California* has two stress columns, *Ticonderoga* has three, but the word *wine* has only one. Yet the latter word at the phrase level must end up with the tallest column. Therefore, before applying End Right, we need to equalize the column on *wine* by adding one or more asterisks so that its column height becomes the same as the main stress column of the preceding word. Thus, after equalization, *wine* will have two asterisks when combined with *California*, but three with *Ticonderoga*. [34]

[34] Word equalization is similar to the Stress Equalization Convention of Halle and Vergnaud 1987:265: "When two or more constituents are conjoined into a single higher-level constituent, the asterisk columns of the heads of the constituents are equalized by adding asterisks to the lesser column(s)."

(92)

Word stresses	x x x x (California wine)	x x x x x x x (Ticonderoga wine)
Word equalization	x x x x x (California wine)	x x x x x x x x x (Ticonderoga wine)
End Right (phrasal)	x x x x x x (California wine)	x x x x x x x x x x (Ticonderoga wine)
Rhythm Rule optional	x x x x x x (California wine)	(not applied)

The last row shows the optional application of the Rhythm Rule to *California wine*. The rule applies to a sequence of *weak-stronger-strongest* stresses (line 3), and it interchanges the first two stress levels (line 4).

Recall from our discussion of word stress that *Ticonderoga* can have its second strongest stress on either the second syllable or the first one, the latter resulting from the optional application of the Rhythm Rule. This choice at the word level will affect the subsequent action of the Rhythm Rule at the phrase level. This means that there are four possible variants for *Ticonderoga wine*, depending on whether the Rhythm Rule has applied at the word level and/or at the phrase level. (In the following table we have indicated the four forms with smiley faces.) Of particular interest is the application of the Rhythm Rule to the form in row 4 of column 2, where the stresses to be interchanged belong to the first and fourth syllables. Note that the weak subsidiary stress on the second syllable does not interfere with this interchange. Nor can that weakest stress be the target for stress shift. Where there are two weak stresses followed by two stronger ones, the stronger of the two weaks becomes the target.

(93)

Word stresses	x x x x x x (Ticonderoga)(wine)	x x x x x x (Ticonderoga)(wine)
Rhythm Rule (word level) optional	(not applied)	x x x x x x (Ticonderoga)(wine)
Word equalization	x x x x x x x x x (Ticonderoga wine)	x x x x x x x x x (Ticonderoga)(wine)
End Right (phrasal)	? x x x x x x x x x x (Ticonderoga wine)	? x x x x x x x x x x (Ticonderoga)(wine)
Rhythm Rule (phrasal) optional	? x x x x x x x x x x (Ticonderoga wine)	? x x x x x x x x x x (Ticonderoga)(wine)

10.1.1 Types of phrasal constituents

What type of constituent structure do we require for phrases? Hayes (1985) has discussed problems associated with analyses that derive sentential, phrasal, and even compound stresses from cyclic application correlated to the depth of embedding provided by the syntax. The resulting configurations often are at odds with the desired rhythmic alternation of stresses. To remedy this deficiency we claim that the phonological phrase need be only a flat structure—that is, a linear sequence of unary, binary, or ternary constituents. (Recall that at the word level, feet also were unary, binary, or ternary.) These various constituents of a phonological phrase, by and large, will still correspond to those mandated by syntactic structure, but without the multiple levels of embedding. [35]

The majority of phrasal constituents are unary and binary, with ternary ones being rarer. The latter include certain numeral combinations, such as *one-twenty-four*; some proper name configurations, such as *New York-Maine*; and proper names joined with *street* or *avenue*, such as *Tom Paine Street*. A ternary constituent (to be enclosed in brackets) has an internal structure composed of a unary constituent and a binary one. Here are some examples of various constituent types.

[35] See Section 10.4 where we contrast depth-of-embedding analyses with those embracing rhythmic alternation.

(94)

binary	(red wine)
unary + binary	(French) (red wine)
binary + unary	(over-aged) (wine)
binary + binary	(over-aged) (red wine)
binary + unary + binary	(over-aged) (French) (red wine)
unary + unary + binary	(John's) (French) (red wine)
unary + binary + unary	(John's) (over-aged) (wine)
unary + binary + binary	(John's) (over-aged) (red wine)
binary + binary + unary	(John Smith's) (over-aged) (wine)
binary + unary + binary	(John Smith's) (French) (red wine)
binary + binary + binary	(John Smith's) (over-aged) (red wine)
binary + binary + unary + binary	(John Smith's) (over-aged) (French) (red wine)
ternary + unary	[(New York) (Maine)] (route)
ternary + binary	[(one) (twenty-four)] (Madison Avenue)

10.1.2 Binary and unary constituents

As a consequence of linear structure, there can be at most two levels of application of the rule End Right. Consider the following examples. On its first pass, End Right will add an asterisk to the rightmost column of every binary constituent and to the only column (which is rightmost by default) of every unary constituent. On its second pass to the full phrase, End Right will add an asterisk to the highest column on the rightmost word. (We shall continue to enclose binary constituents in parentheses but shall leave unary constituents unparenthesized.)

(95)

Word stresses	x x x French (red wine)	x x x (over-aged) wine	x x x x (over-aged) (red wine)
End Right (binary/unary)	x x x x x French (red wine)	x x x x x (over-aged) wine	x x x x x x (over-aged) (red wine)
End Right (phrasal)	x x x x x x French (red wine)	x x x x x x (over-aged) wine	x x x x x x x (over-aged) (red wine)
Rhythm Rule (optional)	(not applicable)	x x x x x x (over-aged) wine	x x x x x x x (over-aged) (red wine)

We find the effects of the Rhythm Rule more natural for *over-aged wine* than for *over-aged red wine*. The latter, though possible, leads to a less desirable rhythmic alternation (because of the contiguous weakest stresses) than that manifested prior to the rule's application. We consider the desirability of various types of rhythmic alternation in section 9.4.

Consider now the interaction of End Right and the Rhythm Rule along with Equalization. We contrast *Northern (California wine)*—i.e. a California wine from the

North—and *(Northern California) wine*—i.e. a wine from Northern California (Selkirk 1995). Notice the effect of the Rhythm Rule within both phrases. Stress gets shifted onto the leftmost column of the binary constituent.

(96)

Word stresses	x x x x Northern (California wine)	x x x x (Northern California) wine
Word equalization	x x x x x Northern (California wine)	x x x x x (Northern California) wine
End Right (binary/unary)	x x x x x x x x Northern (California wine)	x x x x x x x (Northern California) wine
End Right (phrasal)	x x x x x x x x x Northern (California wine)	x x x x x x x x (Northern California) wine
Rhythm Rule	x x x x x x x x Northern (California wine)	x x x x x x x x (Northern California) wine

Thus far we have seen how the rules End Right and the Rhythm Rule operate at the phrase level. What about the rule End Left? Recall that at the word level this rule was ordered after End Right and it applied whenever there were two accented vowels to the left of the rightmost accent. It rendered the accented vowel further to the left as the more prominent one (e.g. *cônfidèntiálity*). At the phrase level, End Left behaves similarly: It applies after phrasal End Right and it too resolve situations where there are two columns of the same height to the left of the highest column by adding an asterisk to the column further to the left. [36]

[36] The rule End Left is similar to the rule Phrase Edge Prominence in Selkirk 1995:565: "The most prominent syllable of an edge constituent is more prominent than that of a constituent not located at the edge."

(97)

Word stresses	x x x x x (over-aged) French (red wine)
End Right (binary/unary)	x x x x x x x x (over-aged) French (red wine)
End Right (phrasal)	x x x x x x x x x (over-aged) French (red wine)
End Left	x x x x x x x x x x x (over-aged) French (red wine)
Rhythm Rule (optional)	x x x x x x x x x x x (over-aged) French (red wine)

There are two observations in regard to the preceding derivation. The first concerns the convention governing the application of End Left. Recall that whenever that rule adds an asterisk to a column, one must also be added to any higher column so that the latter continues to retain its relative maximum prominence. For this reason, in line 4 an additional asterisk has been placed over *wine*.

The second observation concerns our version of the Rhythm Rule. This rule applies to a sequence of stresses: *weak-stronger-strongest*. However, one or more weaker stresses may intervene between the stronger stress and the strongest one. In line 4 (after application of End Left) there is a weak stress on *over*, a stronger one on *aged*, and the strongest one on *wine*. The two stresses between *aged* and *wine* (on the words *French* and *red*), because they are weaker than those to either side of them, do not block the Rhythm Rule. Moreover, we permit more than one asterisk to be moved from a column—note the constituent *over-aged*, where the two asterisks originally on *aged* have been shifted onto *over*. This multiple movement is necessary in order for the target syllable to end up with the same number of asterisks originally present on the site of removal.[37]

The next example illustrates where, at the same stage of the derivation, the Rhythm Rule applies simultaneously within two neighboring binary constituents.[38] In line 4, the sequences *John Smith's...wine* and *over-aged wine* both satisfy the Rhythm Rule. For the former, the intervening constituent *over-aged*, both of whose stresses are weaker than the stress on *Smith's*, once again does not block the rule.

[37] Hayes (1985) permits only the topmost asterisk to be moved leftward. We allow the removal of as many asterisks as necessary (but in reality probably no more than two) so long that the target ends up with the required number. This multiple movement does not violate Hayes's Continuous Column Constraint.

[38] The phrase *John Smith's over-aged wine* is similar to Hayes's phrase *almost hard-boiled egg*.

(98)

Word stresses	x x x x x (John Smith's)(over-aged) wine
End Right (binary/unary)	x x x x x x x x (John Smith's)(over-aged) wine
End Right (phrasal)	x x x x x x x x x (John Smith's)(over-aged) wine
End Left	x x x x x x x x x x x (John Smith's)(over-aged) wine
Rhythm Rule (optional)	x x x x x x x x x x x (John Smith's)(over-aged) wine

The following example shows what happens when there are three subsidiary stresses to the left of the main stress. The rule End Left will apply twice: first, to the constituent furthest to the left (i.e. *John Smith's*), then to the next further one (i.e. *over-aged*). We have also shown an optional double application of the Rhythm Rule.

(99)

Word stresses	x x x x x x x (John Smith's)(over-aged) French (red wine)
End Right (binary/unary)	x x x x x x x x x x x x x x (John Smith's)(over-aged) French (red wine)
End Right (phrasal)	x x x x x x x x x x x x x x x (John Smith's)(over-aged) French (red wine)
End Left (first pass)	x x x x x x x x x x x x x x x x (John Smith's)(over-aged) French (red wine)
End left (second pass)	x x x x x x x x x x x x x x x (John Smith's)(over-aged) French (red wine)
Rhythm Rule (optional)	x x x x x x x x x x x x x x (John Smith's)(over-aged) French (red wine)

10.1.3 Ternary constituents

Let us look at some phrases containing ternary constituents. They have an internal structure composed of a binary constituent and a unary one. The rule End Right will still apply to each of the inner constituents, but not subsequently to the entire ternary unit. This is because End Right makes at most two passes within a phrase: first to the individual binary or unary constituents, and then to the entire phrase. However, the ternary bracketing may affect a subsequent application of the Rhythm Rule. Consider the following examples taken from Halle & Vergnaud 1987.

(100)

Word stresses	x x x x [(New York) Maine] route	x x x x [Maine (New York)] route
End Right (binary/unary)	x x x x x x x [(New York) Maine] route	x x x x x x x [Maine (New York)] route
End Right (phrasal)	x x x x x x x x [(New York) Maine] route	x x x x x x x x [Maine (New York)] route
End Left	x x x x x x x x x x [(New York) Maine] route	x x x x x x x x x x [Maine (New York)] route
Rhythm Rule	x x x x x x x x x x [(New York) Maine] route	(blocked)

In line 4, the sequence *New York...route* (whether or not *Maine* intervenes) has the necessary stress configuration of *weak-stronger-strongest* for the Rhythm Rule. The rule may optionally apply to *New York - Maine route*, but apparently does not apply to *Maine-New York route*. We explain this difference by appealing to the internal structure of ternary constituents. The two stresses to be interchanged by the Rhythm Rule always belong to the same constituent, and moreover, the target word that is to receive the shifted asterisk must be at the left edge of that constituent. For a ternary constituent this would have to be the leftmost word. Thus, for the preceding examples, the stress on *York* can be shifted onto *New* so long as the latter word occurs at the left edge of the ternary construction (i.e. *New York - Maine*), but the Rhythm Rule will be blocked whenever *New* is internal to the ternary constituent (i.e. *Maine - New York*). Now compare *Maine - New York route* to *main New York route*, where *main* (an adjective) functions as an independent unary constituent and where the Rhythm Rule may indeed apply to the leftmost word of the binary constituent *New York*.

(101)

Word stresses	x x x x main (New York) route
End Right (binary/unary)	x x x x x x main (New York) route
End Right (phrasal)	x x x x x x x main (New York) route
End Left	x x x x x x x x x x main (New York) route
Rhythm Rule (optional)	x x x x x x x x x x main (New York) route

One can observe a similar effect of the Rhythm Rule with compound numerals. Stress can be shifted onto *twenty* in the phrase *twenty-four Madison (Street)*, but not in the phrase *one twenty-four Madison (Street)*, where *one twenty-four* is a ternary constituent.

(102)

Word stresses	x x x (twenty-four) Madison	x x x x [one (twenty-four)] Madison
End Right (binary/unary)	x x x x x (twenty-four) Madison	x x x x x x x [one (twenty-four)] Madison
End Right (phrasal)	x x x x x x (twenty-four) Madison	x x x x x x x x [one (twenty-four)] Madison
End Left	(not applicable)	x x x x x x x x x x [one (twenty-four)] Madison
Rhythm Rule (optional)	x x x x x x (twenty-four) Madison	(blocked)

Note that names of persons composed of a binary constituent and a unary one do not combine into a ternary construction. The phrase *Farah Faucett-Majors' cats* will have a derivation analogous to that of *main New York route*, and hence the Rhythm Rule will be able to apply within the binary construction *Fawcett-Majors* (Hayes 1985).

(103)

Word stresses	x x x x Farah (Fawcett-Majors) cats
End Right (binary/unary)	x x x x x x Farah (Fawcett-Majors) cats
End Right (phrasal)	x x x x x x x Farah (Fawcett-Majors) cats
End Left	x x x x x x x x x x Farah (Fawcett-Majors) cats
Rhythm Rule (optional)	x x x x x x x x x x Farah (Fawcett-Majors) cats

10.2 Compound stress

Whereas for phrases the most prominent stress typically falls within the rightmost constituent, for compounds it occurs to the left—for example, *Mâdison Ávenue* (phrase), but *Mádison Strêet* (compound); *blâck bóard* (phrase), but *blâckbôard* (compound). There is much idiosyncracy in categorization (cf. *avenue* versus *street*), and we have nothing to contribute to this problem. We will assume that it is a lexical fact that the word *avenue* when combined with a name functions as a phrase, whereas *street* in similar circumstances behaves as a compound. In the derivations that follow, constituents that function as compounds will be identified by a subscripted *c*. What role will this categorization play within our set of phrasal rules? It will affect primarily the rule End Right, for that rule must not assign an asterisk to the final word of a compound constituent. Instead, the asterisk has to land on a preceding word. Hence, a word followed by a subscripted *c* (i.e. *Street* in the following table) behaves as though it were an extrametrical element, and so End Right will assign an asterisk to the preceding word (i.e. *Madison*), so long as it too is not so labeled (cf. the complex compound *blackboard eraser*, discussed below, where both *board* and *eraser* bear the subscripted *c*).

(104)

Word stresses	x x x eleven (Madison Avenue)	x x x eleven (Madison Street) $_c$
End Right (binary/unary)	x x x x x eleven (Madison Avenue)	x x x x x eleven (Madison Street) $_c$
End Right (phrasal)	x x x x x x eleven (Madison Avenue)	x x x x x x eleven (Madison Street) $_c$

Consider the effect of the rule End Right on compound forms containing an internal phrase. For example, *Tom Paine Street* is a ternary compound composed of the binary phrase *Tom Paine* and the unary constituent S*treet*. In line 2 of the following derivation, End Right cannot apply to the lone word S*treet* because of the following subscripted *c*, and the rule will have application only to the final word of the phrase *Tom Paine*. Because the two subsidiary stresses on *Tom* and *Street* are separated by the stronger stress on *Paine*, no further adjustment of stress is required.

(105)

Word stresses	x x x [(Tom Paine) Street] $_c$
End Right (binary/unary)	x x x x [(Tom Paine) Street] $_c$

Consider now compounds composed of compounds. The complex constituent *law school language exam* contains two binary compounds. At the binary level, the rule End Right will supply an asterisk to the first word of each compound. At the phrasal level, the rightmost word *exam* again is exempt from the effects of End Right, and so the rightmost site for application of that rule will be the immediately preceding word *language*.

(106)

Word stresses	x x x x (law school) $_c$ (language exam) $_c$
End Right (binary/unary)	x x x x x x (law school) $_c$ (language exam) $_c$
End Right (phrasal)	x x x x x x x (law school) $_c$ (language exam) $_c$

The ternary constituent *blackboard eraser* is composed of a binary and a unary constituent, both of which are labeled as compounds. In the first pass of End Right, an asterisk is assigned only to *black*. The words *board* and *eraser*, both being labeled *c*, fail to undergo the rule. As a result there are now two subsidiary stresses of the same level to the same side of the main stress. However, the stress on *eraser* should be the stronger of

the two. For phrases, whenever two subsidiary stresses of the same level occurred to the left of the main stress, the rule End Left resolved this dilemma. The compound case, where the subsidiaries are to the right of the main stress, looks like a mirror-image situation. We propose then to handle this case by a rule analogous to End Left, called End Compound Right, which will render the rightmost subsidiary stress as the stronger one.

(107)

Word stresses	x x x [(black board) $_c$ eraser] $_c$
End Right	x x x x [(black board) $_c$ eraser] $_c$
End Compound Right	x x x x x x [(black board) $_c$ eraser] $_c$

The constituent label *c* affects also the Rhythm Rule. Let us compare the phrases *Tom Paine Street blues* and *Tom Paine Avenue blues.*[39] The former phrase contains within it a ternary compound, whereas the latter contains within it a ternary phrase. The constituents *Avenue* and *blues* and the second member of the binary construction *Tom Paine* receive asterisks during the first pass of End Right, but the constituent *Street*, located at the right edge of a compound constituent (i.e. one labeled *c*), does not get an asterisk. At the phrasal level (line 3) an asterisk is assigned to *blues*, the rightmost constituent of the entire phrase. At this stage of the derivation, there are contiguous subsidiary stresses on *Paine* and *Avenue*, and so End Left resolves this situation by elevating the stress on *Paine* (line 4). For both constructions, the sequence *Tom Paine...blues* has the stress configuration of *weak-stronger-strongest.* However, whereas *Tôm Paine Àvenue blúes* is a possible outcome of the Rhythm Rule (line 5), **Tôm Paine Street blúes* is not, even though the stress on *Street* is lower than those on either side of it. The Rhythm Rule cannot apply within a constituent labeled *c*. That is, the Rhythm Rule is blocked within compounds, an observation which seems to us to be essentially correct.[40]

[39] The phrase *Tom Paine Street blues* is taken from Hayes (1985) and is also analyzed in Halle & Vergnaud (1987).

[40] Contrast *[(Tom Paine) Street]c blues* with (*Tom Paine*) (*High School*)c, where the phrase *Tom Paine* is followed by the compound *High School*. Because *Tom Paine* is not within the compound, the Rhythm Rule can apply to the phrase and stress can be shifted onto *Tom.* The restriction on the Rhythm Rule within compounds has the same effect as the Strong Domain Principle of Hayes 1985:386: "No prosodic transformation may apply to the head of a strong domain."

(108)

Word stresses	x x x x [(Tom Paine) Street] $_c$ blues	x x x x [(Tom Paine) Avenue] blues
End Right (binary/unary)	x x x x x x [(Tom Paine) Street] $_c$ blues	x x x x x x x [(Tom Paine) Avenue] blues
End Right (phrasal)	x x x x x x x [(Tom Paine) Street] $_c$ blues	x x x x x x x x [(Tom Paine) Avenue] blues
End Left	(not applicable)	x x x x x x x x x x [(Tom Paine) Avenue] blues
Rhythm Rule	(not applicable)	x x x x x x x x x x [(Tom Paine) Avenue] blues

The phrase *blackboard eraser ledge* contains within it a ternary compound. This example illustrates further the nonapplicability, within a compound, of both End Left and the Rhythm Rule. After application of End Right at the phrasal level, there are two columns of equal height to the left of the main stress column (i.e. the single asterisks over *board* and *eraser*). Because they are within a compound they will undergo End Compound Right (instead of End Left, which applies within phrasal constituents). The Rhythm Rule fails to apply for two reasons: the purported target *board* is not at the left edge of its constituent, but more importantly, the rule does not apply within a compound.

(109)

Word stresses	x x x x [(black board) $_c$ eraser] $_c$ ledge
End Right (unary/binary)	x x x x x x [(black board) $_c$ eraser] $_c$ ledge
End Right (phrasal)	x x x x x x x [(black board) $_c$ eraser] $_c$ ledge
End Left	(not applicable)
End Compound Right	x x x x x x x x x x [(black board) $_c$ eraser] $_c$ ledge
Rhythm Rule	(not applicable)

10.3 Sentential stress

We have gotten much mileage from the rule End Right. At the word level, it was responsible for the main stress corresponding to the rightmost accent. For phrases, the rule applied first to every unary and binary constituent, and then to the full phrase. Let us consider now the applicability of this rule at the sentence level. (We consider only simple sentences—i.e. those containing a single clause.) Here we make a normal syntactic division between the subject noun phrase and the predicate verb phrase. After the set of rules has applied independently to each of these phrases, End Right will then consider the entire sentence and it will render the most prominent stress of the rightmost phrase of the predicate as the most prominent stress of the sentence. To illustrate how this works, we contrast *Farah Fawcett Majors' black cats* (a phrase) with *Farah Fawcett Majors bought cats* (a sentence). Here is the derivation of the phrase.

(110)

Word stresses	x x x x x Farah (Fawcett Majors') (black cats)
End Right (unary/binary)	x x x x x x x x Farah (Fawcett Majors') (black cats)
End Right (phrasal)	x x x x x x x x x Farah (Fawcett Majors') (black cats)
End Left	x x x x x x x x x x x Farah (Fawcett Majors') (black cats)
Rhythm Rule (optional)	x x x x x x x x x x x Farah (Fawcett Majors') (black cats)

The derivation of the sentence follows. (A vertical spike separates the subject from the predicate.) We assume that whenever End Right applies to one of the phrases it must apply also to the other one, so that their respective highest columns will end up at the same height (line 3).[41] At the sentential level, End Right will then add an asterisk to the highest column of the rightmost phrase (line 4).

[41] Alternatively, we could have equalized the highest columns of both phrases by means of the rule Equalization (section 9.1).

(111)

Word stresses	x x x x x Farah (Fawcett Majors) | (bought cats)
End Right (unary/binary)	x x x x x x x x Farah (Fawcett Majors) | (bought cats)
End Right (phrasal)	x x x x x x x x x x Farah (Fawcett Majors) | (bought cats)
End Left	(not applicable)
End Right (sentential)	x x x x x x x x x x x Farah (Fawcett Majors) | (bought cats)

Note some of the differences between the phrase *Fârah Fawcett-Màjors' black cáts* (before application of the optional Rhythm Rule) and the sentence *Fàrah Fawcett-Mâjors bought cáts*. For the former construction, secondary stress falls on *Farah*, due to the rule End Left, whereas for the latter, it falls on *Majors*, as there is no relevant context for End Left. Moreover, the Rhythm Rule is not an option for the full sentence. Although it has the required configuration of a weak stress (on *Farah*), a stronger stress (on *Majors*), and the strongest stress (on *cats*), the three stresses are not within the same phrasal unit.

10.4 Rhythm and constituent types

For words, phrases, and sentences, the rule End Right is responsible for the heaviest stress within the type of constituent where it applies. End Left and the Rhythm Rule account for subsidiary stresses to the left of the main stress and provide for the rhythmic alternation characteristic of stress patterns. Rhythm is manifested either as a weaker stress between two stronger ones or as a stronger stress between two weaker ones. For example, the configuration 3 2 4 (of *strong–weaker-strongest*) is better than 2 3 4 (of *weak–stronger-strongest*), where the numbers now refer to column heights.

Within phrases one can encounter long sequences of stresses and here too, ideally, weaker stresses should intervene between stronger ones. Thus, the pattern 3 1 2 4 is more rhythmic than 3 2 1 4, because for the former the weakest column with only 1 asterisk is situated between stronger subsidiary stresses, while the column with 2 asterisks is contiguous to the strongest 4 column and not to the less strong 3 column. By the same token, a configuration of 1 3 1 2 1 4 is more rhythmic than either 3 1 1 2 1 4 or 3 1 2 1 1 4, where there are contiguous stresses, albeit the weakest, of the same level.

Sometimes optimal rhythm will result directly from End Left and at other times only after application of the Rhythm Rule. Ironically, there are also situations where application of the Rhythm Rule would lead to a less optimal rhythm. It is the sequencing of unary and binary constituents within phrases that determines the efficacy of each rule. Let us look at some of the examples previously treated. The numbers above syllables continue to represent column heights.

The Rhythm Rule is most effective where there is a binary constituent (or a sequence of binary constituents) followed by a unary constituent. Because a binary phrasal constituent starts out with a stronger stress on its second element, the preceding weaker stress is then a prime target for the Rhythm Rule. Moreover, where there is a sequence of binary constituents preceding a unary, the rhythmic pattern is optimal when the Rhythm Rule applies to each of the binaries. (Note the fourth and fifth examples in the following table).

(112)

Binary + Unary	
Less rhythmic (nonapplication of Rhythm Rule)	More rhythmic (application of Rhythm Rule)
1 2 3 (California wine)	2 1 3 (California wine)
1 2 3 (over-aged) wine	2 1 3 (over-aged) wine
1 3 2 1 4 (over-aged) French (red wine)	3 1 2 1 4 (over-aged) French (red wine)
1 3 1 2 4 (John Smith's) (over-aged) wine	3 1 2 1 4 (John Smith's) (over-aged) wine
1 4 1 3 2 1 5 (John Smith's) (over-aged) French (red wine)	4 1 3 1 2 1 5 (John Smith's) (over-aged) French (red wine)
1 3 2 4 [(New York) Maine] route	3 1 2 4 [(New York) Maine] route
1 3 2 4 [(Tom Paine) Avenue] blues	3 1 2 4 [(Tom Paine) Avenue] blues

Although the purpose of the Rhythm Rule is to yield a more rhythmic alternation of stresses, nonetheless its application can lead to a less rhythmic configuration. This situation arises when a unary constituent is followed by a binary, or when a binary is followed by another binary but with no following unary.

(113)

Unary + Binary	
More rhythmic (nonapplication of Rhythm Rule)	Less rhythmic (application of Rhythm Rule)
2 1 3 French (red wine)	(rhythm rule not applicable)
3 1 2 4 main (New York) route	3 2 1 4 main (New York) route
3 1 2 4 Farah (Fawcett-Majors') cats	3 2 1 4 Farah (Fawcett-Majors') cats
3 1 2 1 4 Farah (Fawcett-Majors') (black cats)	3 2 1 1 4 Farah (Fawcett-Majors') (black cats)
4 1 3 2 1 5 Farah (Fawcett-Majors') five (black cats)	4 3 1 2 1 5 Farah (Fawcett-Majors') five (black cats)

(114)

Binary + Binary (and no following unary)	
More rhythmic (nonapplication of Rhythm Rule)	Less rhythmic (application of Rhythm Rule)
1 2 1 3 (over-aged) (red wine)	2 1 1 3 (over-aged) (red wine)
1 3 1 2 1 4 (John Smith's) (over-aged) (red wine)	3 1 2 1 1 4 (John Smith's) (over-aged) (red wine)

From the last set of examples we can see that a sequence of binary constituents by itself is sufficient to guarantee optimal rhythm. Consider now the situation where there are two unary constituents followed by a binary (as shown in the left column of the following table). The resulting 3 2 1 4 pattern is not optimal. Because of the descending stress levels preceding the main stress, the environment for application of the Rhythm Rule is simply not met, and consequently, one cannot invoke that rule for improving the rhythm. Yet (as shown in the right column) there is a more rhythmic alternative that can be actualized, provided the original sequence of unary constituents is reanalyzed as binary, even though this revision flies in face of the syntactic constituent structure (i.e. *John's French* does not qualify as a syntactic constituent). An optional restructuring of contiguous unary constituents into a single binary constituent then becomes another means—in addition to the rules End Left and the Rhythm Rule—for ensuring optimal rhythm. (Recall the analogous phenomenon for words, where two adjacent unfooted syllables combine into a binary foot.)

(115)

Word stresses	x x x x (John's) (French) (red wine)	x x x x (John's French) (red wine)
End Right (unary/binary)	x x x x x x (John's) (French) (red wine)	x x x x x x (John's French) (red wine)
End Right (phrasal)	x x x x x x x x (John's) (French) (red wine)	x x x x x x x (John's French) (red wine)
End Left	x x x x x x x x x x (John's) (French) (red wine)	(not applicable)

Previously we remarked that there were problems with analyses that derive higher-level stresses from cyclic application correlated to the depth of syntactic embedding. The resulting configurations often fail to yield a rhythmic alternation of stresses. Let us pursue further the idea that as a way of ensuring rhythmic alternation there is a tendency to eschew contiguous unary constituents and instead for them to be grouped as binary ones that are not necessarily related to a syntactic parsing. Consider the following examples from Hayes (1985), where we contrast a depth-of-embedding analysis with one embracing rhythmic alternation. Note (in the second column of following examples) the

binary groupings *bought five* and *three chunks*, neither of which corresponds to a syntactic constituent required by a depth-of-embedding analysis.

(116)

Depth-of-embedding	Rhythmic alternation
x x x x x x x x x x (John (bought (five (black cats))))	x x x x x x x x x x John | (bought five) (black cats)

Depth-of-embedding	Rhythmic alternation
x x x x x x x x x - x (John's (three (chunks of banana)))	x x x x x x x x x - x John's (three chunks) (of banana)

A preference for binary constituents is observable for compounds too. Hayes (1985) notes that a word-initial main stress that would be generated from a long left-branching compound, such as *whale oil lamp stand dealer*, is quite unnatural (as shown in the left column). In the column on the right, *lamp* and *stand* have been gathered into a binary constituent. We find the rhythmic alternation resulting from this restructuring to be quite natural: The main stress now falls on the first element of the second binary constituent (analogous to the compound expression *(law school) (language exam)* cited previously).

(117)

Depth-of-embedding	Rhythmic alternation
x x x x x x x x x x x x x x x ((((whale oil) lamp) stand) dealer)	x x x x x x x x x x x x x x x (whale oil) $_c$ (lamp stand) $_c$ dealer $_c$

From our examination of individual words and of various types of phrases, we have seen that rhythm is the guiding principle for the sequencing of accents and stresses. Phonological rhythm is manifested as an alternation in prominence within entities of the same type. For polysyllabic words, foot structure yields the relevant entities. The constraints on foot structure—that syllables are gathered primarily into left-headed ternary or binary feet and that unary feet are restricted to word-final position—guarantee that accented syllables will always be separated by one or more unaccented. For compounds and phrases, syntactic structure furnishes the relevant entities—unary, binary, and tertiary constituents, and here rhythm finds realization in alternating degrees of stress.

The arrangement of stress levels is remarkably similar for the various constituent types. An entity at the right edge of its constituent acquires main stress, one located

toward the left edge has secondary stress, and remaining entities take on lower degrees of stress. The preferred rhythmic outcome is a stronger stress between weaker ones or else a weaker stress between stronger ones. When this desired pattern fails to transpire a rhythm rule may come into play to rearrange stress levels. The occurrence of contiguous unary constituents also may be responsible for nonrhythmic stress configurations, but a restructuring into binary constituents, albeit in defiance of syntactic parsing, will re-establish rhythm.

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