Topics in Syllable Geometry

Stuart Davis

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DEDICATION

To my parents and brothers.
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CHAPTER 1

OVERVIEW

1.0. Introduction

The goal of this chapter is to furnish background information on the role of the syllable in recent phonological theory, and, then, to put my thesis in proper perspective by presenting various views on the nature of syllable-internal constituency. In this dissertation, I argue that none of these various views provides an adequate representation of the syllable. I propose that the syllable universally consists of three (sister) components: an onset (optional), a nucleus, and a coda (optional).

1.1. Brief Background of the Syllable in Phonological Theory

Much recent work in phonology has focused on the study of the syllable. In the early years of generative phonology, though, the role of the syllable in phonological description was largely ignored. One reason for this was that the structuralists never succeeded in adequately defining the syllable as a physical reality. "Norton (1951:2), for example, attempted to define the syllable physically by associating it with a chest pulse.
induced by muscular activity. "Careful experimentation with all types of syllables and consonants makes it certain that every syllable has its chest pulse delimited by chest muscles (intercostals) or by the constriction (complete or partial) of the consonant or by both."

Contrary to Stetson's experiments, Ladefoged (1967) has shown that chest pulses are not always an accurate diagnostic for the syllable; some syllables are produced without a chest pulse, and some chest pulses do not correspond to syllables. Jespersen, as cited in Pulgram (1970) defined the syllable in terms of vocalic sonority; in other words, he believed that sounds grouped themselves into syllables by their sonority. However, this view has also been criticized (e.g., in Ladefoged 1975) since sonority can either increase or decrease before reaching the syllabic peak - e.g., in the word *cry* there is an increase in sonority between the /k/ and the /r/, but in the word *sky* there is a decrease in sonority between the /s/ and the /p/. Yet both words constitute a single syllable. Haugen (1956) and others defined the syllable in terms of distribution of phonemes. In other words, they viewed the syllable as a unit over which phonotactic constraints hold. This view, though, has been criticized by Bell (1976) for several reasons. One reason is that such a view is unable to handle languages in which modal consonant clusters do not break down into a combination of a possible word-final cluster followed by a word-initial cluster.¹

Even though the syllable cannot be defined physically, it can still function as a relevant phonological unit. And, in fact, significant phonological generalizations are missed when phonological rules are not allowed to refer to syllables. For example, it has been noted by Kahn (1976) and others that many rules that are written with the environment /C/ miss the generalization that the environment for the rules is actually a syllable boundary. Another case of a missed generalization, discussed both by Vennemann (1972) and Wheeler (1981) among others, relates to Chomsky and Halle's (1968) formulation of the main stress rule in English. Main stress for nouns and certain adjectives in English is usually assigned to a penultimate vowel if it is stressed or followed by at least two consonants;

¹ Not all structuralists, however, accepted the syllable. For example, Malmberg (1955) cites a number of linguists who view the syllable as not being significant since no physical correlate of it could be found. Similarly, Kohler (1966) concludes that the syllable is "impossible" and "harmful." He argues this on the basis of the claim that syllable division is often not discernible and is arbitrary. For further discussion of the differing views on the phonetic reality of the syllable see Pulgram (1970) and Vogel (1977).
otherwise, the antepenultimate vowel is stressed. The examples in (1) illustrate this:

(1) Ariz6na ag6nda vigilant

However, note the following exceptions:

(2) discipline l6dicious eloquent

Exceptions, like those in (2), led Chomsky and Halle to formulate the concept of "weak cluster" which is essentially defined as in (3):

(3) Weak cluster

\[ V C_0^1 [\text{voc}] [\text{cons}] \]

They then refer to the notion of weak cluster in their main stress rule (as well as in four other rules - Auxiliary Reduction, Pre-Cluster Laxing, u-Tensing, and Tensing before \( C_1 V \)). But by not recognizing the syllable Chomsky and Halle miss a generalization. Weak clusters are just those clusters that are possible syllable-initial clusters. That is, both their members are syllabified with the following (ultimate) vowel, so that the penultimate vowel is in an open syllable. Thus, in the data above, stress is on the antepenultimate vowel when the penultimate vowel is both lax and in an open syllable. This generalization was missed by Chomsky and Halle because they did not give any status to the syllable.

Another example of a generalization that is missed without reference to the syllable is found in Hooper's (1972) discussion of Harris' (1969) analysis of Spanish nasalization. Harris observes that nasals assimilate before adjacent obstruents in the same word or across word boundaries as is shown below (examples from Hooper 1972:525):

(4) un beso [umbeso] 'a kiss'
un charco [unčarko] 'a pool'
un gato [uŋgato] 'a cat'

Harris also observes that, before glides, nasal assimilation takes place only across word boundaries and not word internally, as the two examples in (5) illustrate:

(5) a. miel [myel] 'honey'
    b. un hielo [uŋyelo] 'an ice'

Hooper notes that in Harris' system the rules for the two cases of nasal assimilation (in (4) and (5b) above) cannot be collapsed, although they describe the same process. Hooper argues, however, that once the syllable is recognized (and it is formally recognized by syllable boundary insertion rules), an obvious generalization follows: Nasal assimilation occurs before a consonant or a glide if a syllable boundary intervenes.
Similarly, Hoard (1971) recognizes the syllable in his analysis of the different realizations of the intervocalic /t/ in the two words *veto* and *motto*. In the former the /t/ is aspirated (or tensed) but is not flapped; in the latter, it is flapped but not aspirated. Hoard (p.137) accounts for the different realizations of /t/ by first having a syllable boundary insertion rule (as in (6)) which has the affect of putting the boundary before the /t/ in *veto* but after the /t/ in *motto*, and afterwards, having a rule (as in (7)) which basically tenses a consonant before a stressed vowel (M=maximal initial cluster and [ . ]=syllable boundary).

(6) $ \rightarrow [ . ] / [+syll] C_0 \rightarrow \langle M \rangle \text{[+stress]}

(7) M \rightarrow [+tense] / [ . ] \rightarrow [+stress]

Though Vennemann, Hooper, and Hoard can capture significant generalizations by referring to the syllable, one disadvantage of their framework is that they cannot handle ambisyllability. This is because in their view syllables are marked off by syllable boundaries inserted into a string of segments by rules of the form $ \rightarrow S / X __ Y$ (where $S$=syllable boundary). This assumes that there are always clear divisions between syllables. However, many linguists have proposed that a single consonant can sometimes be part of two syllables (i.e., it can be ambisyllabic). Ambisyllability provides support for Kahn's (1976) proposal to treat the syllable autosegmentally. In the autosegmental treatment, the syllable constitutes a distinct tier onto which the elements from the segmental tier are mapped; it is then possible for a consonant to become ambisyllabic by having the consonant linking to more than one syllable as long as the anti-crossing lines constraint (Goldsmith 1976) is not violated. Specifically, Kahn (1976) has phonemes first linking to the syllable tier (by his rules I and II, p.22 and 24, respectively), and then, only under certain conditions (by rules III and IV, p.28), can some consonants (optionally) become ambisyllabic. Thus, the advantage of Kahn's theory is that it allows for significant generalizations to be expressed in terms of the syllable while adequately treating ambisyllability.

2. Selkirk (1982) proposes to do away with ambisyllability. However, in doing this, she has to propose a resyllabification rule (at least for English) that provides syllable divisions that are quite unintuitive.

3. One criticism of Kahn is that he cannot handle syllabic consonants (Lowenstamm 1979). However, they can be handled by allowing consonant clusters of syllables in underlying representations to differ from the consonant clusters of syllables in the phonetic representations, and then, a rule later applies changing the relevant consonant to [+syllabic].
1.2. Background on Syllable-Internal Constituency

While the importance of the syllable for phonological theory has become widely recognized, the issue of the type of constituent structure below the syllable (or, rather, the nature of syllable-internal constituents) has become controversial. Interestingly, not only has it become recently controversial, but it was also controversial in the structuralist period, as well.

Pike and Pike (1947) made one of the earliest (if not the earliest) proposals for dividing the syllable into various subsyllabic constituents. They divided the Mazatec syllable into a margin (syllable-initial consonant or consonants) and a nucleus (from one to three vowels in Mazatec). Pike and Pike proposed this division for two reasons: First, the pitch contours on vowels (i.e., in the nucleus) form contrasts in such a way as to differentiate meaning, while such is not the case with consonants; and second, phonotactic constraints hold within the elements of the nucleus and within elements of the margin. In later work, Pike (1967) further divided the margin into a pre-nuclear margin (containing syllable-initial consonants) and a postnuclear margin (containing syllable-final consonants).

Hockett has been credited (by Haugen 1956) with inventing the terms onset (syllable-initial consonantism), peak (vowel or syllabic consonant), and coda (syllable-final consonantism) to describe the subconstituents of the syllable. Hockett argued that the syllable could contain another element in addition to these three. This other element was called the interlude, which he defined as follows (1955:52): "An interlude is coda-like and onset-like at the same time, and structurally it belongs to the syllable that contains the preceding peak and to that which contains the following peak." Further, when there is an interlude, there is no syllable division between coda and onset. This is because Hockett proposed the interlude in order to handle ambisyllabicity. He cited such examples as 'nitrate', where the first /t/ can go with either syllable, and, thus, claimed (1955:64)

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4. Pike and Pike (1947) are sometimes mentioned as proposing a syllable in which the nucleus and the post-nuclear margin form one constituent and the pre-nuclear margin the other. However, this is not proposed in their article. What they do propose is that within the nucleus or within the margin there is a hierarchical structure. Thus, if a margin has three consonants, two of the consonants would have a tighter bond between them as against the third one.
that "syllable division in an interlude is structurally irrelevant." Essentially, the interlude would be the name of the constituent where coda and onset are simultaneous - since, because of ambisyllabicity, the division between coda and onset cannot be pinpointed.

Haugen (1956:218) criticized Hockett's proposal regarding the interlude for the following reason: "If we are to make use of the syllable as an IC [immediate constituent] of the macrosegment it does not make good sense to leave the syllables all attached to each other by indivisible segments." Haugen argued (p.220) that non-overlapping syllable division was important, for he saw, as mentioned above, "the syllable as a unit of phonotactic structure." Thus, the coda and the onset had to be kept separate. He also argued that one could always separate coda and onset, because the syllable division usually does not permit the formulation of a new coda or a new onset (Haugen 1956:218-219): "In 'nitrëte' a division /naytr. eyt/ would introduce a non-existent final cluster -tr; but the division /nay. treyt/ or /nayt. reyt/ would both fit with the existing positions and their members." Essentially, then, Haugen maintained that the syllable constituents consisted of just onset, peak (or nucleus) and coda, while Hockett further postulated the interlude as a constituent to which ambisyllabic consonants belonged.

In most of the structuralist work on sub-syllabic constituents, there are no claims about possible hierarchical relationships among these constituents. It is not usually discussed, for example, whether any two of the sub-syllabic constituents form a unit together, or whether all the subsyllabic constituents are independent of one another. Pike (1967:386), though, did suggest the possibility of the nucleus and the post-nuclear margin forming a constituent (e.g., in a tone language if the contrastive tone extends over these):

...there may be postulated a dichotomous break between the nucleus on the one hand and the two margins on the other (if the nucleus is somehow independent of the two margins), or a dichotomous break between the pre-nuclear margin versus the nucleus and the post-nuclear margin in a language in which the domain of significant pitch extends over the post-nuclear margin as well as the nucleus.

Pike's work on syllable structure had little influence at first on generative phonologists because of their belief that the syllable played no role in phonology. However, because of the evidence for the syllable in Kahn's (1976) dissertation, the importance of the syllable for phonological theory has largely been recognized. Kahn, though, viewed the syllable as having no internal structure; the syllable branched into
a string of segments, as in (8a). Kahn's view of syllable-internal structure is also held by Clements and Keyser (1983) with some modification. Clements and Keyser propose that a CV-tier intervene between the syllable tier and the segmental tier (as in (8b)).

(8) The Segmental Hypothesis

```
   syllable                        syllable
     \    \                        \    \                        \    \                        \    \                        \    \\
      p r i n t                    C C V C C                    C C V C C                    C C V C C                    C C V C C
```

Clements and Keyser recognize the nucleus as a constituent since elements in the nucleus can be displayed or projected. (Throughout the remainder of this dissertation the syllable structures in (8) will be referred to as the single-segment hypothesis or single-segment analysis.)

Another view of subsyllabic structure analyzes the syllable as consisting of an onset (the syllable-initial consonant or consonants), a nucleus (the peak of sonority within the syllable), and a coda (the syllable-final consonant or consonants). The nucleus and the coda, in turn, are obligatorily grouped together to form a subsyllabic constituent, the "rhyme" (or rime), as in (9a) (nuc.=nucleus).

(9) Rhyme-Structure Analysis

```
   syllable                        syllable
     \    \                        \    \                        \    \                        \    \\
      rhyme                       rhyme                       rhyme                       rhyme
        \                        \                        \                        \                        \\
       onset    nuc.   coda        onset    nuc.   coda        onset    nuc.   coda        onset    nuc.   coda
          p r i n t              p r i n t              p r i n t              p r i n t
```

Both Selkirk (1978) and Halle and Vergnaud (1980) among many others essentially claim that the rhyme is a universal in the strong sense; that is, all syllables in all languages contain them. Halle & Vergnaud's characterization of the rhyme, though, differs from that of Selkirk's in that they do not view the rhyme as possessing labelled constituents; for them, the syllable consists of just an onset and a rhyme, as in (9b).

Another view of subsyllabic constituency is that the syllable contains a body (a constituent that consists of an onset and a nucleus - after Vennemann 1984). A syllable containing body structure is illustrated in (10):

(10) Body-Structure Analysis

```
   syllable                        syllable
     \    \                        \    \                        \    \\
      body                         body                         body                         body
        \                        \                        \                        \                        \\
       onset    nuc.   coda        onset    nuc.   coda        onset    nuc.   coda        onset    nuc.   coda
          p r i n t              p r i n t              p r i n t              p r i n t
```

A number of linguists have suggested that the syllable could have the structure in (10). McCarthy (1976) viewed the syllable as either possessing the structure of (9)
or of (10). Specifically, he argued that both (9) and (10) are possible syllable types in Estonian. There, if the coda is an obstruent, syllable structure is as in (9) because the nucleus and the coda form a "tight phonetic unit." But, if the coda is a sonorant, syllable structure is as in (10) since there would be no tight phonetic relationship between nucleus and coda. Bach and Wheeler (1981) have argued that (10) reflects syllable structure in Korean because of the phonotactic constraints that exist in that language between the onset and the nucleus. More recently, Vennemann (1984) has argued that (10) is a possible syllable structure. He argues that syllables do not have any structure per se, but structure is imposed upon them by language specific phonological rules and processes. Thus, in his view, if a rule refers to elements within the onset and the nucleus then syllables involved in the rule (or process) would have the structure in (10).

In this dissertation, though, I will argue that none of the structures in (8-10) provide an adequate representation of the syllable. Instead, I argue that there is only a single syllable structure, and that is a (rhymeless) structure in which the syllable internal constituents are sisters (i.e., consisting of just the onset, the nucleus, and the coda), as in (11):

(11) Level Syllable Structure

```
syllable
  onset nucleus coda
```

In chapter two of this dissertation I argue in detail against the proposal of Selkirk (1978) and Halle & Vergnaud (1980) among others that the rhyme is an obligatory (universal) syllable constituent. In chapter three I discuss several stress rules in the metrical framework incorporating the different syllable structures in (9-11), and I show that it is only an analysis incorporating a level syllable structure that is compatible with all the different types of stress rules to be considered. Finally, in chapter four, I look at phonological "movement" phenomena and consider what type of syllable internal constituent structure it supports. Specifically, I argue that evidence from speech errors and language games

5. I do not consider other different proposals for syllable-internal structure. Among those not considered are the elaborated rhyme structure and onset structure proposals of Cairns and Feinstein (1982), the N-bar syllable structure proposal of Levin (1984) in which syllable structure parallels X-bar syntax, and the proposal of Hyman (1984) in which an essentially moraic analysis of the syllable is presented. There is also the view that at least for some languages the syllable is not relevant whatsoever. Higurashi (1983) has proposed this for Japanese and Hyman (1982) has argued thus for Gokana.
are most compatible with the syllable structure in (11) and thus provides additional evidence for syllable structure consisting of just an onset, a nucleus, and a coda.

CHAPTER 2
ON THE ARGUMENTS FOR THE RHYME AS A SUBSYLLABIC CONSTITUENT

2.0. Introduction

In this chapter, I challenge the widespread notion that the rhyme is an obligatory constituent in a theory of syllable structure. According to the most generally held view the nucleus and the coda are analyzed as forming a single constituent, the rhyme; nucleus and coda thus together have a privileged status. But here I review three major arguments that are often cited as indicating the universality of this privileged status between nucleus and coda, and, after summarizing each argument I show that it is invalid when a wider range of evidence is considered.

The first argument to be discussed is found in Asher (1978) and Vergnaud & Halle (1978). They argue for the rhyme constituent by appealing to the existence of phonotactic constraints holding between nucleus and coda. However, this argument for the rhyme, which is taken to establish it as a universal, makes an implicit prediction that can be shown to be false (namely, that phonotactic constraints occur between onset and nucleus...
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The first argument to be discussed is found in Selkirk (1978) and Vergnaud & Halle (1978). They argue for the rhyme constituent by appealing to the existence of phonotactic constraints holding between nucleus and coda. However, this argument for the rhyme, which is taken to establish it as a universal, makes an implicit prediction that can be shown to be false (namely, that no phonotactic constraints occur between onset and nucleus
or onset and coda). The second argument for the rhyme derives from the observation that certain rule types only make reference to elements in the nucleus and coda. An example of a rule type to be discussed here are stress assignment rules which are most commonly mentioned as supporting the constituency of the rhyme. Halle & Vergnaud (1980:93) argue for its constituency by claiming that "... in all languages known to us, stress assignment rules are sensitive to the structure of the syllable rime, but disregard completely the character of the onset." However, it can be shown that there are in fact languages where the structure of the onset is important for assigning stress. Thus, stress assignment rules do not provide evidence for the universality of the rhyme. A third argument which Selkirk (1978) gives to support the constituency of the rhyme is the claim that nucleus and coda form durational units. However, a closer reading of the phonetics literature, as well as my own investigations using spectrographic evidence, reveals that the durational relationship here is between a vowel and a following consonant (regardless of tautosyllabicity) and not between nucleus and coda. Thus the relative duration of segments offers no evidence for the rhyme. Hence, none of the major arguments adduced for the constituency of the rhyme actually supports it.¹

2.1. Phonotactics

2.1.0. Introduction

Selkirk argues for the universality of the rhyme on the basis of the existence of phonotactic restrictions between nucleus and coda. She argues (1978:5) that:

The grouping of peak and coda into a constituent is advocated as a universal of syllable composition... The claim made is that cooccurrence restrictions between peak and coda are always more likely to exist (and indeed are quite common) than restrictions between either peak or coda and the onset. The explanation offered is that the former two comprise a constituent.

Vergnaud & Halle (1978:41) employ a similar argument for justifying the constituency of the rhyme in English: "Whereas practically any onset can combine with any rime to form a proper English syllable, there are severe limitations on what peak can precede what coda." The

¹ Another often-mentioned argument for the subsyllabic constituent rhyme relates to the poetic notion "rhyme". It has been claimed that, in rhyming words, only the onset changes, but the rhyme remains the same. Clements & Keyser (1983:24) point out, however, that the poetic rhyme is actually sensitive to the stressed syllable plus everything to the right of it (e.g., sinister:minister). It is not equivalent to the subsyllabic constituent rhyme, and consequently, it does not constitute an argument for the rhyme constituent.
reason for this, so their argument goes, is that the nucleus and the coda form a constituent.

It would be predicted from the above arguments that any phonotactic restrictions existing between the onset, on the one hand, and nucleus or coda, on the other hand, must be highly irregular and infrequent; such constraints would not be considered to be systematic, but rather, only accidental gaps in the phonotactics. However, there is strong evidence that this prediction is incorrect, since there are systematic phonotactic constraints between other position slots than nucleus and coda. Recognition of such constraints eluded structuralist phonologists because they concentrated on constraints holding between adjacent slots, while neglecting to look for systematic constraints holding between nonadjacent slots. But I have shown previously (e.g., Davis 1984), that a number of such restrictions hold in English. In the following subsections I first present these phonotactic restrictions, and then show

2. Twaddell (1939, 1940), though, drew conclusions concerning the cooccurrence frequencies of pre- and post-vocalic consonants of stressed German syllables. He also cited a study by Jespersen of monosyllabic words for English in which Jespersen basically stated that any constraints holding between syllable-initial and syllable-final consonants in English are accidental.

that many other languages also possess phonotactic constraints holding between constituents other than nucleus and coda. Consequently, the existence of such constraints in many languages militates against the use of phonotactics to argue for the rhyme.

However, before presenting the phonotactic constraints holding between the onset and the other parts of the syllable, I must first make clear the view that I am adopting concerning the location of syllabification in the phonology. I am accepting the view of Selkirk (1981), McCarthy (1982a) and Clements and Keyser (1983) among others that syllabification is present in underlying representation. Probably the strongest case for the contrary view has been put forth by Broselow (1979). She proposes that syllabification occurs late in the phonological derivation. She argues for this view based on

3. The manner in which phonotactic constraints are expressed is somewhat controversial. The view adopted here is that of Stanley (1967) who essentially proposed that such restrictions are expressed either by positive conditions, negative conditions, or if-then statements. As for the question at what level such restrictions apply, the view of Shibatani (1973) is basically adopted here; that is, constraints apply at both the underlying level and the phonetic one. However, constraints at the two levels may differ in view of the fact that there are some well-motivated cases of positing abstract underlying representations, and there are cases of fast speech rules that produce surface outputs that do not occur underlingly.
evidence from Cairene Arabic where syllabification occurs across word boundaries (i.e., the domain of syllabification is the phrase, not the word). For example, the Cairene phrase míš ('not') ana ('I') is syllabified mi.ša.na (where the dot represents a syllable boundary), and the phrase bint ('girl') kibiira ('big') is realized as bi.n.tik. bii.ra, after an epenthesis and a deletion rule have applied. Consequently, syllabification takes place late in the derivation after rules of epenthesis and deletion. However, her proposal cannot handle data from the dialect of Palestinian Arabic described by Abu Salim (1980). In this dialect syllabification must precede epenthesis. This is because the stress rule (which must apply after syllabification since stress is sensitive to the makeup of a syllable) does not (normally) put stress on an epenthetic penultimate vowel that is part of a heavy syllable (other heavy penultimate syllables receive stress—unless the final syllable is superheavy). For example, the word [?fbin-ha] ('her son'), from the underlying form /?ibn-ha/, has stress on the initial syllable in spite of the fact that the epenthetic [i] has made the penultimate syllable heavy. Thus, stress here must apply prior to epenthesis, and, consequently, syllabification occurs at the underlying representation prior to the rule of epenthesis. Moreover, Selkirk (1981) has argued that syllabification does indeed occur at the underlying level in Cairene Arabic, contra Broselow. Selkirk shows how the epenthesis and deletion facts are elegantly handled by allowing an empty node to be incorporated in the underlying syllabification of Cairene words. On the phonetic level, then, either an epenthetic vowel fills the empty node, or (if the node is word-final) an initial vowel from an immediately following vowel-initial word fills the node. Thus, syllabification always occurs on the underlying representation, and, in cases like Cairene Arabic empty nodes are incorporated. In the remainder of this dissertation, then, I, too, will accept the view that syllabification occurs on underlying strings.

2.1.1. Constraints between Onset and Other Syllable Parts for English

English has a number of constraints that hold between onset and coda, as well as some that hold between onset and nucleus. The only mention of these in the literature (besides that in my own work) is by Fudge (1969) and Clements & Keyser (1983). Fudge (1969:279-181) observes that no syllable has an in the onset and an initial cluster in the coda. He also observes that the second slot of an onset cannot be the same as the first slot of the coda. (Actually, there are a
number of exceptions to this: state, stat, and stet. I state the relevant constraint later.) Moreover, he says that syllables do not both begin and end with an s + stop cluster (though, this is part of a broader generalization to be expressed by my constraint (2a)), and, finally, he mentions that no word has a nasal in both the second slot of the onset and the second slot in the coda. Further, Clements & Keyser (1983:20) have noticed the following two constraints for English that hold between onset and nucleus: "Voiced fricatives and /C1/ clusters are excluded before /U/... Stop plus /w/ clusters are excluded before /u:/, U, A, aw/: *kwu:t, etc." Interestingly, this last constraint partly follows from the fact that /w/ plus high back vowel sequences are rare in English. As I will mention again later, Kawasaki & Ohala (1980) point out that such a constraint is common in the world's languages, and can be understood acoustically, since the transition between a /w/ and a high back vowel is not distinct.

Probably the most extensive collection of onset coda constraints holding in English is given in my own previous work (Davis 1982, 1984). For example, I have noted the following exceptionless negative constraints holding within the syllable:

(1) Constraints Holding Within the Syllable

a. *s [-cont] [-cor] [+syl] [+ant] [+voice]
     [-cont] [-cor] [+ant] [+voice]

b. * [+cons] [+cons] [-syl] [-syl] [+syl] [+lat] [+lat]

By (1a), if a [-coronal] stop follows an /s/ in a syllable's onset, then that same consonant cannot be initial in the syllable's coda. Thus forms like *spin or *skak are not possible. By (1b), if /l/ is the second consonant of an onset cluster, then /l/ cannot be the initial consonant of a coda. Thus, a form like *slil is not possible. And, by (1c), if a nasal occurs in the second slot of an onset no nasal occurs in the coda. Thus forms like *snarm or *smin are impossible. The second constraint has also been noted independently by Clements & Keyser (1983:20). Besides these general conditions on syllable shapes, English also possesses at least two onset-coda constraints that only hold within a monomorphemic syllable. These are given below:

(2) Constraints Holding Within the Monomorphemic Syllable

a. *C_C VC_C
Constraint (2a) disallows monomorphemic syllables in which the initial consonant of an onset cluster is the same as the initial consonant of the coda cluster. Thus monomorphemic forms like *raft are impossible, but spaced (/speyst/) is possible since it is not monomorphemic. (Two exceptions to constraint (2a) are the words crux and klux unless the sound represented by orthographic x actually represents a single affricate [kˢ] and not the sequence [ks].) Constraint (2b) rules out coda clusters beginning with a liquid (/r/ or /l/) when that same liquid occupies the only slot of an onset. Thus, monomorphemic forms like *rop cannot occur, but a nonmonomorphemic form like roared (/rowrd/) is permitted. The only exception to constraint (2b) is the word lilt.

Contrary to what Selkirk (1978) and Vergnaud & Halle (1978) argue, constraints holding between positions other than nucleus and coda are not infrequent in English, nor are they irregular or arbitrary; they are systematic because they involve natural classes. Algeo (1978) cites an example involving the case of the nonoccurrence of final /g/ in English in order to illustrate an accidental gap in the phonotactics. Algeo notes the following pattern in final position (with the parenthesis meaning nonoccurring):

-lp- -lt- -lʲ- -lk-
-1b- -ld- -lʲ- (-1g-)

Moreover, in final position /r/ can occur with any stop consonant after it, including /g/ (e.g., in morgue). These facts suggest the lack of final /g/ is truly accidental; /l/ does not pattern like /r/ in this regard, and /g/ does not pattern like any of the other stop consonants. On the other hand, the constraints proposed in (1-5) do make reference to natural classes; hence, they are not arbitrary. Furthermore, systematic constraints holding between onset and nucleus and between onset and coda are also found in other languages. In the following sections, I list some of these.

2.1.2. Constraints Between Onset and Nucleus for Other Languages

Constraints holding between onset and nucleus are not uncommon. In fact, Kawasaki & Ohala (1980) have suggested that there is a universal tendency against initial *wu and *vi, due to the lack here of an acoustically clear transition between the glide and the corresponding high vowel. Besides this universal tendency, many languages display specific onset-nucleus constraints. I mention just a few here.
For Mazatec, Pike and Pike (1947:87) cite the following phonotactic restriction involving onset and nucleus: "The nasalized vowels may not be preceded by v, y, l, r, or their clusters, nor by m, n, ñ." More simply put: the class of sonorant consonants cannot occur before nasalized vowels. That it is a natural class which cannot occur before nasalized vowels suggests that the restriction is systematic (it is possible that /v/ is an underlying sonorant in Mazatec; if not, its non-occurrence before nasalized vowels is most likely an accidental gap).

For Piro, an Arawakan language of eastern Peru, Matteson (1965:29) describes the following constraint: "The consonants /tʃ/, /x/, /ts/, /š/, /tʃ/ and /y/ do not precede /u/." These consonants are all the alveopalatal, palatal, and velar consonants that occur in this language. Thus, to state the constraint more simply, high consonants do not precede /u/.

In Kagate, a Tibeto-Burman language of Nepal described by Hoehlig & Hari (1976), an onset cluster consisting of a consonant followed by /y/ cannot precede a front vowel. This constraint perhaps reflects an extension to all front vowels of the universal tendency noted by Kawasaki & Ohala against yi-sequences.

In Korean, according to Cho (1967), a number of constraints hold between onset and nucleus. Two of these are that fronted vowels do not occur after labial consonants and that the vowel /i/ does not occur after any of the alveolar stops.

Finally, according to the description of the Nigerian language Efik given in Dunstan (1969), the high vowels (which are /i/ and /u/ in this language) do not occur after syllable-initial clusters.

2.1.3. Constraints Between Onset and Coda for Other Languages

Constraints holding between onset and coda are also found in languages other than English. For German, Twaddell (1939, 1940) notes a tendency for the same consonant not to occur both pre- and post-vocalically in the same syllable (except for /p/ and /s/); the more sonorous the consonant, the more likely the restriction is to hold. Moreover, in Chinese, according to Fudge (1969:226-7), if a glide is the second member of an onset, then no glide can appear in the coda. And for Yindjibarndi, a language of Western Australia, Wordick (1982:14) notes that /r/ does not occur in both the onset and the coda of the same syllable. Similarly, in Njangumad, a language of Northern Australia, O'Grady (1957) observes that identical liquids do not occur in a CVC syllable,
and also that a nasal in the coda (except n) does not occur with a homorganic stop in the onset. 4

2.1.4. Conclusion

The above data on phonotactic constraints indicate—contra Selkirk (1978) and Vergnaud & Halle (1978)—that there do exist systematic dependencies between onsets and codas and between onsets and nuclei. Thus, the proposed limitation of phonotactic constraints to members of the syllable rhyme cannot be maintained, since this would make it impossible to state the restrictions discussed in this section. A theory of syllable structure which incorporates the rhyme as an obligatory universal constituent therefore cannot be based on an argument from phonotactic constraints, since such an argument — applied to English (which has onset-coda constraints, onset-nucleus constraints, and nucleus-coda constraints) — would yield the following syllable structure with "double motherhood".

\[
\begin{array}{c}
\text{onset} \\
\text{nucleus} \\
\text{coda}
\end{array}
\]

The implausibility of such a structure (e.g., it violates the anti-crossing lines constraint) leads one to conclude that, in fact, phonotactic constraints are not a test for constituency. Moreover, this conclusion is not surprising in light of the similar situation in syntax where cooccurrence restrictions are not a necessary indicator of constituency. For example, subject verb agreement in English (or subject-NP predicate-adjective agreement for number and gender in Spanish) fails to establish the constituency of subject-NP and verb (or subject-NP and predicate adjective). The existence of such restrictions, then, cannot be used to establish the constituency of the rhyme, or, for that matter, subsyllabic constituency in general.

2.2. Rule Types Referring to the Rhyme

The next argument for the rhyme to be considered here derives from the observation that some phonological rule types supposedly make reference to elements only
in the nucleus and coda. Rules of stress placement, as well as phonetic-spreading rules and compensatory lengthening rules, are often claimed to make reference to only these elements, and thus provide support for the rhyme as a single constituent. In the following subsections, I discuss these and show that the argument from rule types fails to establish the constituency of the rhyme because the onset (in addition to the nucleus and coda) can sometimes be mentioned in these rule types. Moreover, elements in neighboring syllables can also sometimes be mentioned in phonetic spreading rules and compensatory lengthening rules. Since these rule types can refer to elements other than nucleus and coda, they do not provide convincing evidence for nucleus and coda together forming a single constituent.

2.2.1. Stress Rules

Halle & Vergnaud argue that the rhyme is obligatory; every syllable in every language has one. They state (1980:93):

Our proposal is that skeleta in all languages are subdivided into subsequences to which the term syllable has traditionally been attached. Furthermore, we wish to argue that the syllables themselves possess internal constituent structure... The obligatory constituent, which we shall call rime, dominates at least one V slot in the skeleton.

They argue for the universality of the rhyme on the basis of the following claim (1980:93): "... in all languages known to us, stress assignment rules are sensitive to the structure of the syllable rime, but disregard completely the character of the onset." A possible consequence of this argument for the rhyme has been noted by McCarthy (1978:8):

"... if the rhyme is a structural unit then no language can assign stress by reference to the weight or any other property of C0V sequence."

In the remainder of this section, I will show that Halle & Vergnaud's claim is false on two accounts, and that it thus fails to establish the universality of the rhyme. First, stress assignment rules are not always sensitive to the structure of the syllable rhyme. And, second, there are languages where the character of the onset is not disregarded in stress placement. Consequently, the argument from stress assignment is not valid, and so obviously does not establish that the rhyme is an obligatory (universal) syllable constituent, as Halle & Vergnaud claim.

Halle & Vergnaud's statement that "... in all languages known to us stress assignment is sensitive to the structure of the syllable rime..." could imply that there are no languages where stress placement fails to be sensitive to the particular make-up of the rhyme.
However, the various surveys of stress rules in the literature do not support this claim. Only in a minority (albeit a sizable one) of languages are stress rules sensitive to the structure of the rhyme; in most languages stress rules operate irrespective of its make-up. Ohsiek (1978:35), who surveyed stress rules in 140 different languages, found that stress rules were sensitive to the rhyme in only thirty of these languages. Hyman (1977:59-66) lists only twenty-four languages (out of more than 300) in which the rhyme plays a role in stress placement, although Hayes (1981:55) notes that there are some mistakes in Hyman's survey. Many of these 300 languages have consistent initial, penultimate, or final stress. In these languages, where stress is always on the same syllable in a word, the particular structure of the rhyme is irrelevant for stress placement. Thus, if Halle & Vergnaud are interpreted as arguing for the obligatoriness of the rhyme on the grounds that stress rules are sensitive to its structure in all languages, then their claim is simply false, and hence constitutes no argument at all.

Moreover, Halle & Vergnaud's claim that "stress assignment rules...disregard completely the character of the onset" is likewise false, and so also does not support the constituency of the rhyme, either. There are languages in which stress is sensitive to the presence of an onset, such as in the Arandic and Paman languages of Australia. And there are languages in which stress is sensitive to a particular type of onset, as in Madimadi and Pirahã. In the following section, I discuss these languages, as well as others that have onset-sensitive stress rules.

2.2.1.1. Onset-Sensitive Stress Rules

In this section, I discuss several languages that have onset-sensitive stress rules. The existence of these rules constitutes clear counterexamples to Halle & Vergnaud's claim of the onset-ignoring nature of stress rules. I delay until chapter three, though, the (metrical) analysis of some of the stress rules presented here.

In a number of Australian languages, stress rules are found that are sensitive to the presence of an onset consonant. Such stress rules are found in the Arandic languages of Central Australia, in many of the Paman languages and the Lamalamic languages of the Cape York Peninsula, and in the isolate language Mbabaram.

In Western Aranda the onset is crucial for determining stress placement in words of more than two syllables. (Bisyllabic words always have initial stress.)
Strehlow (1942:299-301) gives the following stress rule for Western Aranda:

If a trisyllabic word begins with a consonant, the stress falls on the first syllable... If the trisyllabic word begins with a vowel, the stress falls on the second syllable... If a word of four syllables begins with a consonant, the main stress falls on the first syllable... If a word of four syllables begins with a vowel, the stress falls on the second syllable... If a word of five syllables begins with a consonant, the main stress falls on the first syllable, and a weak secondary stress is usually placed on the third syllable or on the fourth... If a word of five syllables begins with a vowel, the main stress normally falls on the second syllable, and a weak secondary stress is placed on the fourth syllable.

Thus, in Western Aranda, main stress is on the first syllable containing an onset. The following examples, taken from Strehlow (1942), illustrate the rule in question:

(3) Western Aranda Main Stress Exemplified
- tárama 'to laugh'
- ankáta 'lizard (sp.)'
- kútunjula 'ceremonial assistant'
- tó:turatura 'marsupial ulámbulamba 'fowl (sp.)'
- mole'

In another Arandic language, Alyawarra, a similar stress rule is found. According to Yallop (1977:43), main stress in a word falls on the first vowel following the first consonant (i.e., stress is on the first syllable containing an onset). This is even the case for two syllable words (unlike in Western Aranda) as the following examples show:

(4) Alyawarra Main Stress Exemplified
- ingwá 'night'
- kwátja 'water'
- iylpá 'ear'
- piynta 'spring'

Moreover, note the following words that begin with a glide (/y/ or /w/):

(5) Stress on Glide-Initial Words in Alyawarra
- walíymparra 'pelican'
- yukúntya 'ash'

In glide-initial words, stress falls on the second syllable. Thus, we see that Alyawarra stress is sensitive not only to the presence of an onset, but also to the nature of that onset - i.e., to whether it is [+consonantal] or [-consonantal]. Thus, the existence of such rules falsifies Halle & Vergnaud's claim about the onset-ignoring nature of stress assignment rules.

Onset-sensitive stress rules are also found in the Paman Languages of the Cape York Peninsula in the northeastern part of Australia. Many of these languages possess an onset-sensitive stress rule that resembles the Arandic one. For example, in Uradhi, according to Hale (1976:44), "... stress is assigned by means of a rule that is apparently shared by all the Northern Paman languages, namely: V--> V/#(V)C₁. That is, stress
the first post consonantal vowel in the word." Or, in terms of syllable structure, stress the first syllable with an onset. Some examples showing this are /utága/ 'dog' and /mínhitji/ 'bird'. Hale (1966) cites another Northern Paman language, Linngithig, as possessing the same stress rule. Some examples are given in (6):

(6) Linngithig Stress Exemplified

/kápan/ 'short' ayo') 'sky'
/ŋgáro/ 'black' alá 'crow'

And Rigsby (1976) cites two other Paman languages, Kuku-Thaypan and Umbindhamu, as having this same onset-sensitive stress rule.

Besides the Paman languages, other languages of the York Peninsula share the same stress rule. Laycock (1971) establishes as separate from Paman the Lamalamic family, which O'Grady, Voegelin, and Voegelin (1966) had classified as a subfamily of Paman. Laycock (1971:78) observes that, "... by far the most common stress placement is on the first syllable beginning with a consonant." In other words, stress falls on the first syllable containing an onset. Also, Dixon (1970) notes that Mbabaram, a language isolate spoken in the southeastern part of the Cape York Peninsula, has the identical stress rule.

In sum, we have noted that four separate Australian language families (Arandic, Paman, Lamalamic, and Mbabaram) have virtually the same onset-sensitive stress rule (i.e., stress the first syllable containing an onset), though the details differ, depending on the language. In Western Aranda, for example, the rule applies only in words that have more than two syllables, while, in Alyawarra, the onset must contain a [+consonantal] segment for the syllable to receive stress. Thus, it is evident that, in these languages, it is not the properties of the rhyme constituent that is being referred to, in the stress-assignment rules, but, rather, the properties of the onset. And, in this regard, they constitute evidence against Halle & Vergnaud's argument for the universality of the rhyme based on the claim that rules assigning stress are sensitive only to the properties of nucleus and coda, but not to those of the onset.

Before discussing other languages that have onset-sensitive stress rules, I want to consider the development of the almost identical stress rule found in Arandic, Paman, Lamalamic, and Mbabaram. I do this because supporters of the rhyme might argue that, since the stress rule common to these languages has a historical explanation, it cannot be considered a legitimate counterexample.
to Halle & Vergnaud's claim of the onset-ignoring nature of stress rules.

Like all stress rules, the synchronic stress rule shared by Arandic, Paman, Lamalamic, and Mbabaram (stress the first syllable containing an onset) has a diachronic account. Alpher (1976) relates the stress rule to a process termed "initial-dropping" which has occurred independently in these branches, according to Dixon (1970) and Capell (1979). Alpher (1976:85) notes that: "Most, but not all, of the ID [initial-dropping] languages assign the most prominent stress in the word according to the following principle: stress the first vowel that follows a consonant." Alpher then posits a development whereby an original initial-syllable stress in these languages shifted onto the second syllable, thereby causing the loss of an initial consonant and the following vowel if that vowel was short, and, if that vowel was long, then it was shortened. The result of this development, as Alpher (1976:85) observes, "... would have been the synchronic rule that the first vowel that follows a consonant is stressed." However, the fact that this synchronic stress rule has a diachronic account does not mean that it cannot be considered a valid counterexample to Halle & Vergnaud's claim about the onset-ignoring nature of stress rules. Most stress rules have some historical explanation (e.g., in early Latin, according to Allen (1965:82), stress was assigned from the beginning of the word, and it was only later that a rule assigning stress from the end of the word sensitive to syllable quantity developed), but this should not be considered in a synchronic analysis of those stress rules. This is because children learning a language (and the stress rules of that language) do not know the history of that language (nor of its stress rules); they construct stress rules solely based on the data that they are exposed to. Thus, in spite of its historical explanation, the Australian onset-sensitive stress rule still constitutes a valid counterexample to Halle & Vergnaud's claim. 5

Not only are there languages in which stress is sensitive to the presence of an onset, as we have just illustrated, but also, there are other languages (besides Alyawarra) in which stress is sensitive to the particular nature of the onset. For example, in Djapu, a language of North Central Australia described by Morphy (1983), main stress normally falls on the initial syllable. Morphy (p.25) notes the following exception:

5. See Janda (1984:102-103) for some relevant remarks on the invalidity of certain types of diachronic explanation for synchronic phenomenon.
"... exceptions to the general rule are predominately words in which the second syllable begins with /d/, for example budápthu-N 'go down and cross' and bandány 'dry, clean.' So, if the onset of the second syllable consists of /d/, then main stress is attracted to that syllable.

A second example in which stress is sensitive to the particular nature of an onset is provided by Madimadi, an Australian language spoken in New South Wales. According to Hercus's (1969) description, primary stress normally falls on the first syllable of a word. However, if the second syllable begins with an interdental, alveolar, retroflex, or palatal consonant (i.e., roughly, a coronal consonant), then primary stress is attracted onto that syllable, and a weak secondary stress is realized on the first syllable. The following data illustrate the Madimadi stress pattern:

(7) Madimadi Stress Exemplified

<table>
<thead>
<tr>
<th>Word</th>
<th>Stress Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>wirándu</td>
<td>bůŋaθ̣a 'to pull out'</td>
</tr>
<tr>
<td>bůtűŋaθ̣a</td>
<td>gůpaθ̣a 'to drink'</td>
</tr>
<tr>
<td>mänŋai</td>
<td>děmaθ̣a 'to hear'</td>
</tr>
<tr>
<td>bíŋai</td>
<td>wálwaθ̣a 'to burn'</td>
</tr>
</tbody>
</table>

In the words of the first column, in which the second syllable begins with a coronal consonant, primary stress falls on the second syllable. In the words of the second column, stress is on the initial syllable, since no coronal consonant appears in the onset of the second syllable. Madimadi, thus, provides a good example of a language that has a stress rule that is crucially dependent on the particular features of an onset consonant.

A somewhat different example of a language having an onset-sensitive stress rule is Pirahã, an Amazonian language discussed by Everett and Everett (1984). The location of main stress in Pirahã sometimes depends on the particular nature of the onset and the particular nature of the nucleus. Briefly, main stress normally falls on one of the last three syllables of the word, whichever one has a long vowel or a diphthong. However, if more than one of the last three syllables has a long vowel or a diphthong, then stress falls on the rightmost syllable that has a voiceless consonant in the onset; examples illustrating this are given in (8):

(8) Pirahã Stress Exemplified (stressed syllables are underlined; tones are not indicated)

<table>
<thead>
<tr>
<th>Word</th>
<th>Stress Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>bii sai</td>
<td>'red'</td>
</tr>
<tr>
<td>kai bai</td>
<td>'monkey'</td>
</tr>
<tr>
<td>?i bao sai</td>
<td>'her cloth'</td>
</tr>
</tbody>
</table>

Further, if there are no long vowels or diphthongs in the last three syllables of the word, then stress falls on the rightmost syllable (among the last three) that has...
a voiceless consonant in its onset; otherwise, it falls on the final syllable. Thus, the Pirahã stress rule provides another counterexample to Halle and Vergnaud's claim.

Before concluding this subsection, it is worth pointing out that there are other cases of onset-sensitive stress rules mentioned in the literature, but these either do not seem to be as productive as the previously discussed onset-sensitive stress rules. For example, Breen (1981:25) mentions that, in Ngawun (an Australian language spoken in Queensland), there is a tendency for stress in words having three or more syllables to shift from the first syllable to the second if the first syllable starts with a peripheral stop or nasal and if the second syllable begins with a lateral or rhotic. Dixon (1977:102) notes the opposite tendency in Yidin. There, if the second syllable is assigned stress, and if that syllable begins with a lateral or rhotic, and if the third syllable begins with a stop or /w/, then stress shifts to the third syllable. Thus, Dixon notes that, in Yidin: "The main preference seems to be for the stressed syllable to begin with a stop or /w/ and for it not to commence with a lateral or rhotic."

Another example of a language in which the particular nature of the onset plays a minor role in stress placement is Gadsup, a language of New Guinea. Frantz & Frantz (1966:9) report that among the many factors helping to determine stress placement in Gadsup is the make-up of the onset. They observe that "... syllables with a phonetic stop onset have more stress than those with nonstop onset." Finally, for English, Oehrle (1971:26) observes that bisyllabic nouns with the prefix dis have stress on the first syllable if the (onset in the) root part of the word begins with /k/ or /ʃ/. Some examples include, discard, discount, and discharge.

In conclusion, the existence of such stress-assignment rules, which are sensitive to the presence of and sometimes also the character of the syllable's onset, constitutes evidence against Halle & Vergnaud's argument for the (universality of the) rhyme. For - to repeat - as McCarthy (1978:8) has observed, "... if the rhyme is a structural unit, then no language can assign stress by reference to the weight or any other properties of CV sequences." Since there are such languages, then, it appears that the rhyme cannot be an obligatory (universal) structural unit within the syllable. (Further, in chapter three, I will consider - and reject - (metrical) analyses of onset-sensitive stress rules that incorporate syllable structure possessing the rhyme.)
2.2.2. Phonetic-Spreading Rules

Another rule type said to have the rhyme as its domain is phonetic-spreading rules. For example, McCarthy (1979:454) argues for the rhyme on the basis of the following: "French vowels assimilate in nasality to the following tautosyllabic consonants. Therefore, the rhyme is the domain of the feature [+nasal]." Against this claim, one can mention that phonetic-spreading processes, such as nasalization, do not necessarily just have nucleus and coda as their domain - as McCarthy's French nasalization example would seem to imply. Rather nasalization, as well as labialization and palatalization, often apply over the onset and the nucleus. Examples of such languages include Lugisu, a Bantu language, and Nupe, a Kwa language.

In Lugisu, a nasal consonant nasalizes the following vowel, as the examples below from Brown (1970:13) illustrate:

(9) /ka + ju + fi/ → [kapuJli] 'bird'
/u + mu + kana/ → [umükanå] 'girl'

Also, in Lugisu, a rounded vowel causes the preceding onset consonant to become round, as is seen in (10):

(10) /i + N + goko/ → [i,gWOkw o] 'hen'
/Bu + Bu + eni/ → [BwuBwu:ni] 'forehead'

By McCarthy's reasoning, then, the Lugisu domain of the feature [+nasal] and [+round] is the onset plus the nucleus, and thus would constitute evidence for their comprising a subsyllabic constituent.

In Nupe, it is well known that front vowels condition palatalization of the preceding onset consonant, while back vowels condition rounding of the preceding onset consonant (Hyman 1970). Thus, the Nupe domain of the features [+round] and [+high] is also the onset plus the nucleus.

Finally, in English, the domain of the feature [+high] (when triggered by a high back vowel) is often just the onset and the nucleus, as is apparent from such words as cute [kYut], view [vYu], and mute [mYut]. By McCarthy's (1979) logic, then, that the domain of the feature [+high] is the onset and the nucleus constitutes evidence for them forming a single subsyllabic constituent. On the other hand, the English domain of nasalization is often the nucleus and the coda, as is exemplified by such words as can [kå:n], ten [tå:n], and sing [så:ⁿ]; McCarthy would interpret this as being evidence for the rhyme. Interestingly, sometimes, in the same word both nasalization and palatalization can occur; this is exemplified by such words as fume [fYum] and hewn [hYun]. By McCarthy's logic, such words would have a syllable structure in which there is "double
motherhood" for the nucleus: the onset and the nucleus form one constituent, and the nucleus and the coda comprise another. Consequently, phonetic-spreading rules do not support the rhyme as forming a subsyllabic constituent, unless onset and nucleus are also to be viewed as forming one.

In addition, it is relevant to point out that phonetic-spreading processes can sometimes affect elements in other syllables. For example, the /u/ in construe can cause the entire consonant cluster preceding it, including the /n/ in the coda of the preceding syllable, to become [+round]. Thus, the domain of phonetic-spreading rules does not seem to be a relevant indicator of subsyllabic constituency.

2.2.3. Compensatory Lengthening Rules

Another rule type said to make reference to the rhyme is compensatory lengthening. Ingria (1980) proposes a metrical analysis of compensatory lengthening in which the rhyme plays a crucial role. Essentially, he argues—using Latin and Greek data—that, when the coda deletes, it leaves behind an empty node, which a segment associated with the nucleus then fills. He refers to this as the "Empty Node Convention" (p.471): "Empty w nodes which are part of a syllabic coda are to be associated with the terminal element dominated by the immediately preceding syllabic nucleus. All other empty nodes are to be pruned." The convention is illustrated by the Latin example /sisdo/ 'sit (present)' which, after a rule deleting a coda consonant, is phonetically realized as [si:do]:

\[
\begin{array}{c}
\text{\textbackslash s} \\
\text{i} \\
\text{d} \\
\text{o}
\end{array}
\longrightarrow
\begin{array}{c}
\text{\textbackslash s} \\
\text{R} \\
\text{i} \\
\text{d} \\
\text{R}
\end{array}
\]

Ingría's rhyme-based analysis of compensatory lengthening predicts that whenever a coda consonant deletes the preceding vowel should fill the empty node. However, there are cases where the empty node of the deleted coda is filled by the following onset consonant. The following derivation, from Ingría (1980), of [emmi] 'I am' from underlying /esmi/ in the Lesbian dialect of Ancient Greek illustrates this:
Such a derivation suggests that compensatory lengthening really does not involve the rhyme constituent as much as a language (or dialect) specific preference for direction of spreading. In the Lesbian Greek example, the empty node is filled by leftward spreading, while, in the Latin example, the empty node is filled by rightward spreading.

Furthermore, in Tiberian Hebrew, compensatory lengthening that involves an $X_C_1V_C_2C_3Y$ sequence may be resolved by leftward spreading, rightward spreading, or no spreading, depending on the nature of $C_2$. Basically (omitting certain details not relevant here), if $C_2$ is a nasal that deletes, leftward spreading follows, as in (13) below. And, if $C_2$ is a deleted guttural (or pharyngeal) then, depending on the particular guttural, either there is rightward spreading, as in (14), or there is no spreading, as in (15):

(13) /hinbit/ [hibbit] 'he looked'

(14) /haRRo$\bar{\text{s}}$/ [haaRo$\bar{\text{s}}$] 'the head'

(15) /bi$\bar{\text{g}}$er/ [bi9er] 'he burned'

(Hebrew seems to have a preference for leftward spreading (as in (13)). Rightward spreading occurs only when leftward spreading is not possible (or, rather, when leftward spreading would produce the original input). Lowenstamm and Kaye (1984) suggest that leftward spreading is preferred in languages that have geminates (as in
Thus, also in Hebrew, compensatory lengthening does not involve mention of the rhyme constituent, but rather a preference for a specific direction of spreading.

Furthermore, there are cases of compensatory lengthening that are triggered by the deletion of an onset consonant, which Ingria (p. 471) predicts should not occur: "All other empty nodes [i.e., those that are not part of a syllabic coda] are pruned." That such cases do occur clearly illustrates that the rhyme is not the domain of compensatory lengthening. One example of this kind of compensatory lengthening involves k-deletion in Maasai, a Nilo-Saharan language. In Maasai, when intervocalic /k/ (which is an onset consonant) deletes, the following vowel is lengthened. Levergood (1984: 48) cites Wallace (1981) who gives the following rule of k-deletion:

(16) [-hi] K [+lo]  
1  2  3  
"delete k between a non-hi vowel and a, lengthen a."

6. Lowenstamm & Kaye (1984) also provide an analysis of the Hebrew compensatory lengthening in which, essentially, there is leftward spreading if the deleted consonant is part of the coda, and rightward spreading if it is part of the nucleus (and not the coda). They argue that syllable-final gutturals are not in codas, but are more vowel-like since they are resonants. They do not consider the interesting cases where there is no compensatory lengthening (which is not uncommon). They say that such examples are not counterexamples to their analysis, but only to the data.
Thus, also in Hebrew, compensatory lengthening does not involve mention of the rhyme constituent, but rather a preference for a specific direction of spreading.

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(16) [-hi] k [+lo]  
1 2 3 \rightarrow 1633

"delete k between a non-hi vowel and a, lengthen a."

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She gives the example /atɔ-1ɔk-a/ which has the derivation in (17):

(17) /atɔ-1ɔk-a/ [atɔ1Uaa]

The deletion of an onset consonant in Maasai causes the following vowel to fill its slot. Another language that has a similar compensatory lengthening process is the Modern Greek dialect of Samothraki, discussed in a footnote by de Chene and Anderson (1979: 508). In this dialect, the loss of prevocalic /r/ (an onset consonant) triggers lengthening of the following vowel, as is shown in (18):

(18) /rota/ [o:ta] 'ask'  
/prasinos/ [pa:nus] 'green'  
/antras/ [a:as] 'man'

The last example in (18) is most illuminating because it shows that, in Samothraki, a deleted coda consonant (/n/ in the last example) fails to trigger compensatory lengthening, but a deleted onset consonant does trigger it.
It is apparent, thus, that the rhyme is not always the domain of compensatory lengthening. While it is the case that, in some languages, like Latin, nucleus and coda are mentioned in the spreading involved in compensatory lengthening, still, in other languages, the onset and nucleus alone (as in Maasai) or the coda and the following onset alone (as in Lesbian Greek) are mentioned in the environment of compensatory lengthening. Thus, the domain of compensatory lengthening does not comprise a subsyllabic constituent. This is made clear especially by the Lesbian Greek example, where the node of the deleted coda is filled by the onset consonant of the following syllable. It certainly cannot be the case that the coda of one syllable and the onset of another form a subsyllabic constituent. Perhaps, ultimately, Clements (1982) is correct in suggesting that the syllable is the domain of compensatory lengthening. When compensatory lengthening occurs, it seems always to lengthen the syllable that contained the deleted segment. All the different cases of compensatory lengthening considered here are compatible with this suggestion. Whatever the correct analysis of compensatory lengthening may be, it is clear that it is not a rule type that just mentions elements within the nucleus and the coda. Consequently, it does not provide evidence for the constituency of the rhyme. 7

2.2.4. Conclusion

I have shown in this section that the argument for the rhyme, based on the observation that certain rule types (stress rules, phonetic-spreading rules, and compensatory lengthening rules) only make reference to elements in the nucleus and the coda, does not hold up under further scrutiny. Stress rules can refer to elements within the onset. Phonetic-spreading processes often involve onset elements and, less often, elements in neighboring syllables. Finally, compensatory lengthening rules do not have the rhyme as their domain since a deleted coda consonant can cause the following nonsyllabic consonant to spread leftward (as in Lesbian Greek), and a deleted onset consonant can cause the lengthening of the following vowel (as in Maasai). Such cases of compensatory lengthening are anomalous if the

7. A very different analysis of compensatory lengthening is proposed by de Chene and Anderson (1979). They argue that, when compensatory lengthening occurs, the first of two consecutive consonants (in a CVCSCV sequence, for example) becomes a glide, and then monophthongization occurs with the preceding vowel. Clements (1982) shows that there are cases which de Chene and Anderson cannot account for.
rhyme is its domain, rather, they support the syllable as the domain of compensatory lengthening. Hence, it seems clear that these different rule types do not provide evidence for the constituency of the rhyme.

2.3. The Rhyme as a Durational Unit

In this section I investigate the argument for the rhyme proposed by Selkirk (1978:8) namely, that nucleus and coda form a constituent because there can be a durational relationship (i.e., a negative correlation or "tradeoff") between them. She argues that:

Evidence such as that provided by Chen (1970), who claims that there is a constancy (approximate) in the length of the vowel plus stop combinations, could be taken as supporting the existence of the rhyme. According to Chen, a lengthening of the vowel (as before voiced stops) coincides with the shortening of the consonant. That is, one could say that within a constituent like the rhyme the duration of one element is adjusted in function of another.

For Selkirk's argument to be valid, it must be the case that a negative correlation exists only between a vowel and a following consonant in the same syllable (in a VCS sequence, where $S$ is a syllable boundary), and not across syllables (in a VSC sequence). The reason for this is that, if durational relationships are an argument for (rhyme) constituency, then such a correlation between V and C in a VSC sequence would lead to the absurd conclusion that members of separate syllables can form a constituent (rhyme). But obviously, a VSC sequence cannot be a subsyllabic constituent. However, I will demonstrate that a durational relationship does exist between a vowel and the following nontautosyllabic consonant. Hence, the relationship between nucleus and coda is an instance of a more general relationship between the vowel and the following consonant (regardless of their tautosyllabicity). Selkirk fails to look for this possible generalization because she focuses solely on the durational relationship in a V C sequence within syllables, and tries to relate thus to constituency.

In the following subsections, then, I will show that in the languages that Chen (1970) investigated (English, Korean, French, and Russian), which Selkirk cites as providing temporal evidence for the rhyme, there is a durational relationship between a vowel and a following nontautosyllabic consonant. Moreover, I will show that a similar relationship holds in Tamil, Swedish, and Japanese. This indicates that syllable division is not a factor in this durational relationship; therefore, durational relationships cannot reflect subsyllabic constituency. Before discussing the VSC sequences in these languages, though, I will present some background information on temporal relationships.
2.3.1. Background on Durational Experiments of VC-Sequences

One of the issues discussed by Lehiste (1970, 1971) is the pinpointing of a domain over which there can be a temporal compensation between two or more segments. This issue may bear directly on the matter of constituency if we accept Lehiste's (1971:162) assumption that a temporal relationship (or negative correlation) between two or more segments implies that they are programmed as a unit at some higher level. Lehiste (1970: 42) mentions a number of possible domains. One possibility is that there may be a relationship between adjacent segments: "For example in Icelandic, Norwegian, and Swedish (Elert, 1964) there exists an inverse relationship between the quantity of the vowel and that of the following consonant, so that a short vowel is followed by a long consonant, and a long vowel by a short consonant." Another possible domain is bisyllabic sequences. An example given by Lehiste (1970) is Slovak: two long syllables may not follow each other in this language. A third possible domain is the word. Estonian is an example of this, because the distribution of short, long, and overlong syllables must make reference to the word. Also, in Dutch (according to Lehiste (1980) who cites a study by Noteboom (1972)), the duration of vowels shorten as the number of syllables increase, thus supporting the word as a temporal domain.

Now, the temporal domain that I want to focus on, in this section, is that of a vowel with a following consonant, since Selkirk suggests that the existence of this temporal domain is evidence for it comprising a subsyllabic constituent. However, before discussing whether or not this temporal domain reflects rhyme constituency, I want briefly to discuss the history of VC durational experiments and the problems involved with them.

Much work has been done examining the temporal relationship between a vowel and a consonant in a VC-sequence. Probably the first researchers to record physically the temporal relationship between a vowel and a following consonant were Lehmann and Heffner (1943). In instrumental studies, they showed for English (p.212), "... that before a voiced stop one may expect a somewhat longer vowel duration than before the homorganic voiceless stop. This is true for every vowel, and our evidence on this point is unequivocal." Lehmann & Heffner's results have been verified by other researchers. Peterson & Lehiste (1960) examined over 1200 CVC-words in English and observed a negative correlation existing between the vowel and its following consonant. They
also concluded that the influence of the initial consonant on the following vowel in CVC-sequences follows no regular pattern. For example, vowels tend to be longer after /s/ and shorter after /z/, but they also tend to be longer after /\j/ than /\v/. Moreover, vowel length tends to be constant when followed by /v/ or /\l/. Thus, unlike the English VC-sequence, the CV-sequences seem to lack any consistent negative correlation (although this conclusion is disputed by Shockey and Gregorski (1972: 1196)).

The phenomenon of vowel-duration variation depending on the voicing of the following consonant occurs in many languages. Chen (1970) proposes it as a universal. He shows that this relationship occurs in Korean, French, and Russian, in addition to English. Balasubramanian (1981) demonstrates that the relationship exists for Tamil, and Elert (1964) for Swedish, while Zimmerman & Sapon (1958) show it for Spanish. However, the exact nature of the temporal compensation differs, depending on the language. For example, for English, Zimmerman & Sapon (1958) found that, in monosyllabic words, the vowel was, on the average, 83 milliseconds (ms.) longer before a voiced consonant than before a voiceless one. For Spanish, this difference is considerably less.

Moreover, there may be other domains of temporal compensation between adjacent segments besides the one between the vowel and the following consonant. For example, Lehiste (1971:160) reports Kozhevnikov & Chistovich's (1965) demonstration that, in Russian, there is a duration relationship between a consonant and a following vowel, while, to repeat, Chen (1970) shows that, in the same language, there is one between the vowel and the following consonant. Similar facts hold for Japanese, where Beckman (1982) notes that there is a durational relationship holding between the vowel and the following (nonautomoramic) consonant, while Homma (1981) shows that there is a relationship between the consonant and the following vowel (perhaps reflecting "morahood"). Thus, the existence of other domains of

---

8. The degree of compensation, though - as Peterson & Lehiste (1960) show - almost always is less before labial consonants than before alveolars and velars. One possibility for this is that there is a less and slower pressure build-up in the oral tract for bilabials than for other stops. Consequently, the muscular effort involved in other stops is greater, and so, the transitions to them must begin sooner.
These listed data, thus, argue against the theory that the second consonant in the case of the form park /park/ does not cause shortening otherwise in the rhyme.

Notice that the second consonant in the case of the form short /short/ causes shortening.

The data:

- The measurement for rhyme duration is counted from the open syllable.
- No measurements for these forms are given in (1970).
- Where one would expect that adding the consonant at the end of the form park /park/ and park /park/ would cause shortening, a contrast emerges from (1970). This shows that the second consonant does not cause shortening elsewise in the rhyme. Contrast, then, emerge from the open syllable.

The second consonant -- namely, the schwa -- is a hypochronically consonant. The following consonant is the rhyming consonant. The order between the vowel and consonant is significant for the consonant shortening.

Now the question I want to address is whether or not the consonant shortening is not by the complex root.

The transition to the next section:

Effort required in producing a vowelless consonant.

Consonant, that is, because of the greater muscular function of the vocal cords, the voice becomes higher pitched as a consequence of the vowelless consonant.

Contrasts:

(1970) Some investigators, though, such as House, state that voting no occurs in languages having vowel length.

(1970) It is shown that the pronunciation of vowel length.

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(1970) Some investigators, though, such as House, state that voting no occurs in languages having vowel length.
Word frequency work indicates that this is only true for shorter voiced consonant sequences and are shorter before unit. The data show that vowels are longer before can be interpreted as supporting the rhyme as a determinant.

2.3.2. English

To take an evidence for the following example:

consonant tokens were over in a random sample from temporal relationship between a vowel and a following

languages: English, Swedish, and Japanese. Since the

I will focus here on the rhyme of what the

I will focus on the rhyme of what the

a particular, though, such a pattern should be

the following example:

The following is a function of the volume characteristics of

intensities that in monosyllabic words, the direction of

represents (1971), ' vowels on these studies
depends on whether volume duration - namely, 'hustle' and 'speech'

This is true of the monorhythmic nuclei since we are concerned only with

shifts of -enences in English has been concerned only mono-

in each case, most of the work done on the temporal relationship

unit for English because the consonant just monosyllabic,
can be interpreted as supporting the rhyme as a determinant

(usually) voiced consonant, however, then data

59
of the consonants given followed the burst.

After the consonant burst, consonant-vowels, the duration
My analysis, I have assumed that vowel-quality effects the
in the classification of words, vowel acoustic qualities differ
the presence of an effect on vowel acoustic qualities. For
the production measurements, the production of words
were made of each word. All

words also extracted between a vowel and a consonant
between a vowel and a following consonant in monosyllabic
sentences which has been shown to exist in English.
The above data demonstrate that the temporal

\begin{tabular}{l|l|l|l|l|l|l}
  
  Word & Length of Vowel in Multisyllables & Length of C2 & Length of C1 & Length of C0 & Length of C1 & Length of C0
  
  
  Pithy & 112.5 & 72.5 & 5 & 95 & 179.5 & 147.5
  
  Pitchfork & 112.5 & 72.5 & 5 & 95 & 179.5 & 147.5
  
  Pink & 320 & 131 & 5 & 95 & 179.5 & 147.5
  
  Pink & 320 & 131 & 5 & 95 & 179.5 & 147.5
  
  Pink & 320 & 131 & 5 & 95 & 179.5 & 147.5
  
  Pink & 320 & 131 & 5 & 95 & 179.5 & 147.5
  
  Pink & 320 & 131 & 5 & 95 & 179.5 & 147.5

\end{tabular}

holds over the syllable boundary.

Extracted between the vowel and the following
consonant, the syllable affects the speech sound since the
tone is to the reality of the syllable... The consonant
measurements are not likely to estimate our guesses.

consonants (p. 146). From such data, that... duration
... nonconsonant-vowel consonant consonance. Licker
nonconsonant-vowel consonant consonance, and shorter

In the data, the vowels are longer before (shorter)

\begin{itemize}
  
  \item exact form given here.
  
  \item presents roughly the consonant decision (though not in the

whether or not the syllable is a durational unit), we
the focus of this study was actually on the issue of
the effect of the most consonant consonant (although
the extraction of a complex relationship between a vowel
study of English nonsense forms can be taken to indicate

\begin{itemize}
  
  \item needles, data from Liska (1981:129)

sequence.

a vowel and the following consonant in a nonconsonant-vowel

no studies on bunched consonants reveal study between
hold in a nonconsonant-vowel-sequence. However, virtually

\begin{itemize}
  
  \item needles, data from Liska (1981:129)

sequence.
consonant across a syllable boundary. Hence, the dura-
tional relationship between nucleus and coda in English
is not a reflection of the subsyllabic constituency of
the rhyme, for it would be absurd to argue that a subsyl-
labic constituent consists of some (but not all) segments
from two different syllable. Rather, what appears to be
a relationship between nucleus and coda is just an
instance of a more general relationship existing between
the vowel and the following consonant. 12

2.3.3. Korean

K.-O. Kim (1975:262), using Korean nonsense forms,
shows that a similar durational relationship between
vowel and following consonant also exists in that

12. Selkirk (1982) suggests that an intervocalic
consonant following a stressed vowel forms the coda
of the stressed syllable and not the onset of the following
one. Thus, according to her, the intervocalic consonants
of the words in (21) are codas. Consequently, since
there is no syllable boundary between these consonants
and the preceding stressed vowels, the words in (21)
are irrelevant for indicating a durational relationship
in a nonautosyllabic VC-sequence. Nonetheless, my
own further spectrographic investigations have shown
that the relationship between a vowel and a following
consonant occurs even when that vowel is unstressed (and
thus, even in Selkirk's view, would be heterosyllabic
with the following consonant). Durational measurements
of the first vowel and the second consonant were made
in such minimal pairs as regatta-ricotta and sadistic-
statistic (pronounced [stisDIK]). The (stressed)
vowel was consistently longer before the shorter voiced
consonant. Admittedly, though, the compensation is
not nearly as great as when a stressed vowel is involved.

language. He gives the following data:

(22) \[ C_1 \ a_1 \ s \ C_2 \ a_2 \ p' \]

Nonsense Form n a k a p'
Milliseconds 66 102 67 97
Nonsense Form n a p a p'
Milliseconds 65 92 85 84
Nonsense Form n a p h a p'
Milliseconds 65 71 154 61

According to Kim (p.263), the syllable is divided between
\( a_1 \) and \( C_2 \): "In the test words, the syllable boundary
occurs between the first vowel and the following
consonant."

In the above data, there is a negative correla-
tion between \( a_1 \) and \( C_2 \). This suggests that syllable
division is not a factor in the durational relationship
between a vowel and the following consonant. Thus,
Kim's overall conclusion is the following (p.263):

If the syllable boundary plays any role in the
temporal interaction between adjacent segments,
we would expect the adjacent segments across
the syllable boundary to show a less significant
negative correlation. However, there is no
such indication as the comparison of the co-
efficients of correlation in column \( a_1 \)...shows.

Kim's conclusion is actually corroborated by
Chen (1970:137), who gives the following data for actual
Korean words (recall that it was Chen's durational
evidence which Selkirk (1978) cited as supporting the
subsylabic constituency of the rhyme).
(23) **Korean Words**

<table>
<thead>
<tr>
<th>Word</th>
<th>length of first vowel in milliseconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kat'ha</td>
<td>81</td>
</tr>
<tr>
<td>Kada</td>
<td>95</td>
</tr>
<tr>
<td>Tsok'ong</td>
<td>127</td>
</tr>
<tr>
<td>Tsogog</td>
<td>160</td>
</tr>
</tbody>
</table>

Moreover, the sonagrams I have made of similar minimal pairs in spoken Korean from a native speaker also support Kim's contention that syllable division is irrelevant to the durational relationship between the vowel and the following consonant. The relevant average vowel and consonant duration in milliseconds for the minimal pairs ak'ha 'a while ago' vs. ak'a 'a baby' and kip'ong 'that bread' vs. kib'ang 'that room' are given below:

(24) **Word** | **length of V₁ in ms** | **length of following C in ms** |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ak'a</td>
<td>75</td>
<td>150</td>
</tr>
<tr>
<td>Aka</td>
<td>145</td>
<td>70</td>
</tr>
<tr>
<td>Kip'ang</td>
<td>57</td>
<td>172</td>
</tr>
<tr>
<td>Kib'ang</td>
<td>80</td>
<td>67</td>
</tr>
</tbody>
</table>

Thus, my further Korean data support Kim's contention that syllable division is not relevant for the relationship between a vowel and a following consonant.

2.3.4. **French and Russian**

A close look at Chen's (1970) French and Russian data reveals that the following consonant does not necessarily have to be tautosyllabic in order to influence the length of the preceding vowel. Chen (1970:136) gives the following examples from French:

(25) **French Phonetic Form** | **Length of First Vowel in ms** |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>La pær ('the fear')</td>
<td>117</td>
</tr>
<tr>
<td>La bær ('the butter')</td>
<td>140</td>
</tr>
<tr>
<td>Sa fwa ('her faith')</td>
<td>246</td>
</tr>
<tr>
<td>Sa vwa ('her voice')</td>
<td>310</td>
</tr>
</tbody>
</table>

In these examples, the vowel is longer before the (nontautosyllabic) voiced consonant than before the voiceless one. The Russian data are similar:

(26) **Russian Phonetic Form** | **Length of First Vowel in ms** |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Itu</td>
<td>79</td>
</tr>
<tr>
<td>Idu</td>
<td>98</td>
</tr>
<tr>
<td>Rasa</td>
<td>152</td>
</tr>
<tr>
<td>Raza</td>
<td>203</td>
</tr>
<tr>
<td>Luk</td>
<td>103</td>
</tr>
<tr>
<td>Lug</td>
<td>139</td>
</tr>
</tbody>
</table>

In the Russian minimal pairs in (26), the vowel is longer before the nontautosyllabic voiced consonant, and shorter before the (nontautosyllabic) voiceless one. Thus, this relationship again holds across syllable boundaries. The last example set shows that the same relationship also holds within the syllable (though the stop contrast is neutralized word-finally). It seems, therefore, that Chen's data do not provide evidence supporting the
contention that the rhyme is a durational unit. Rather, they just reflect a more general relationship holding between a vowel and a following consonant regardless of their syllable membership.

2.3.5. Other Languages

The result that emerges from the data in the preceding sections (that the temporal relationship between a vowel and a following consonant does not reflect subsyllabic constituency) also emerges from data on other languages. Balasubramanian (1981:160) reports a number of relevant observations on vowel length in Tamil based on seven hundred words elicited from four speakers. One of his observations is that: "In syllables of the structure V and CV, vowels are longer when followed by voiced consonants."

For Swedish, Lindblom, Lyberg, and Holmgren (1981) note that vowels are longer before voiced consonants than before voiceless ones. This relationship also holds between a vowel and a consonant in a heterosyllabic VC-sequence as can be seen from the spectrograms of

---

13. One exception to this durational relationship appears in the data of Elert (1964). In his data, the long vowel /i:/ averages 146 ms. before /p/, but only 135 ms. before /b/. However, short /i/ is longer before the voiced /b/ than before the voiceless /p/.

---

Swedish nonsense forms in Fant (1973:117).

Lindblom et al. also report that vowels tend to be shorter after a consonant cluster than after a single consonant. Such a fact suggests that, in Swedish, a vowel has a temporal relationship with both the preceding consonant(s) and the following one. And this relationship constitutes another problem for those advocating the use of durational evidence for subsyllabic constituency, since it entails that the vowel form one constituent with what precedes it and another one with what follows it.

Facts similar to Swedish hold for Japanese. Homma (1981:278) shows, based on nonsense words, that there is a negative correlation between a vowel and a following consonant, as well as one between the vowel and the preceding consonant. As for the relationship between vowel and following consonant, she notes that, for the nonsense words, the vowel is on the average, ten milliseconds greater before voiced stops than before voiceless ones. In a study of my own, done with a native speaker of Tokyo Japanese, I found that the average vowel duration was 23 milliseconds longer before voiced consonants than before voiceless ones. However, long vowels before voiced consonants were, on the average, 33 milliseconds longer than before voiceless ones.
As for the relationship between the vowel and the preceding consonant, Hamma observes that vowels, on the average, are 28 milliseconds longer after a voiced consonant than after a voiceless one. And, so she concludes that, "... in Japanese, the preceding consonant has a stronger effect on vowel duration."14 Once again, we note that the duration facts do not argue for rhyme constituency for two reasons. First, in Japanese, the stronger negative correlation is between the vowel and the preceding (onset) consonant. And second, the vowel and the following consonant also have a negative correlation, and they can be in different syllables; thus, then, temporal relationship cannot indicate subsyllabic constituency.

2.3.6. Summary

In this subsection, I have shown that - contra Selkirk - the length of the vowel plus following consonant cannot be taken as supporting the existence of the rhyme. This is because the durational relationship between a vowel and a following consonant holds in VSC sequences as well as in VCS ones. Unless one would want to argue that members of separate syllables could be part of the same subsyllabic constituent, it must be concluded that, in fact, the existence of a durational relationship between two elements is not an argument for their forming a subsyllabic constituent. Moreover the fact that, in some languages (e.g., Swedish and Japanese), there can be a negative correlation between the vowel and the preceding consonant, as well as one between the vowel and the following consonant, also suggests that such matters do not indicate constituency. Thus, what appeared to Selkirk (1978) to be a relationship between nucleus and coda is just an instance of a more general relationship between a vowel and a following consonant that occurs in many languages.

2.4. Conclusion

In this chapter, I have demonstrated that the arguments most often cited in favor of the subsyllabic constituency of the rhyme (arguments from phonotactics, certain rule types, and temporal compensation) actually fail to support such a constituent. One reason that these arguments fail is because the phenomena that involve both nucleus and coda can also involve either
nucleus or coda, on the one hand, and the onset, on the other hand. For example, I earlier noted that onset and nucleus can seemingly form a unit with regard to phonotactic constraints (e.g., recall the Mazatec constraint against sonorant consonants preceding nasalized vowels), be the domain of certain rule types (e.g., the domain of Lugiau rounding is a CV sequence), and have a temporal relationship (e.g., one domain of temporal compensation in Japanese was the CV-sequence). Also, I noted that onset and coda can act as a unit with regard to English phonotactic constraints. These facts, if taken as arguments for constituency, would thus lead to a syllable structure where there is "double motherhood" for each of onset, nucleus and coda, and hence would yield a syllable with the following implausible structure:

\[
\sigma \\
\text{onset} \quad \text{nucleus} \quad \text{coda}
\]

A second reason why these arguments fail to establish the subsyllabic constituency of the rhyme is that the same phenomena which are supposed to occur only between nucleus and coda can involve segments over a syllable boundary. For example, we noted that phonetic-spreading processes can involve heterosyllabic segments (as with the spreading of the feature [+round] in construe), and we also noted that the temporal relationship between a vowel and a following consonant exists regardless of their tautosyllabicinity. If these are taken to be arguments for subsyllabic constituency, then they would lead to the absurd conclusion that members of two different syllables can form one subsyllabic constituent.

The failure of these arguments to establish the subsyllabic constituency of the rhyme leads one to conclude that dependencies (e.g., phonotactic constraints and temporal dependencies) are not tests that establish subsyllabic constituency in phonology. This conclusion is not surprising in light of the similar situation in syntax, where subject-verb agreement (a dependency) does not establish the constituency of subject NP and verb. It is advisable to recall that, in syntax, movement rules (plus deletion and anaphora) provide the main evidence for constituency. Perhaps the same criteria establish constituency in phonology. However, before investigating this possibility (as I will in chapter four), I first reconsider stress rules. Earlier in this chapter, it was pointed out that not all stress rules refer to only elements in the nucleus and the coda; some rules refer to onsets, as well. In the following chapter, I analyze a number of different stress systems in order to determine if there is one syllable-internal structure
that is compatible with these different stress systems. If such is the case, strong evidence for a syllable-
internal constituent structure will be provided.

CHAPTER 3
SYLLABLE STRUCTURE AND STRESS RULES FROM DIFFERENT LANGUAGES

3.0. Introduction
In chapter two, I showed that the arguments most often cited in support of the constituency of the rhyme are not adequate to support such a constituent. In this chapter, I consider various metrical analyses of different stress systems in order to determine if there is one syllable-internal structure that is compatible with these different stress systems. I show that an analysis incorporating a level syllable structure (i.e., a syllable that consists of just an onset, a nucleus, and a coda) can handle all the stress systems discussed, but the other alternatives have shortcomings with some of the languages. The languages to be discussed here include a number in which the stress rule is onset-sensitive. The analysis of stress in these languages has never really been considered (other than in my own work - e.g., Davis 1985), and their occurrence does present problems for the onset-rhyme view of syllable structure. Before considering the onset-sensitive stress languages, I look at other more standard types of stress systems and
systems and show that it is only the analysis incorporating a level syllable structure that can account for them.  

3.1. Standard Stress Systems

3.1.0. Introduction

In this section, I demonstrate that a level syllable structure is compatible with the most common types of stress systems. I consider examples from four types of stress systems for which the onset-rhyme division appears to work adequately. These four types of stress systems are exemplified by languages in which stress falls on the same syllable (e.g., always initial stress), languages in which stress falls on a long vowel, languages in which stress falls on a closed syllable, and languages in which stress falls on a heavy syllable. Though an analysis incorporating the onset-rhyme division works adequately for these languages, it will be shown that the analysis incorporating a level

nyllable structure is preferable for at least the first two types. That a level syllable structure is compatible with these stress systems as well as with the onset-sensitive stress languages (to be discussed in section 3.2) constitutes support for the level syllable structure.

3.1.1. Same Syllable Stress

The most common type of stress system found in the world's languages, according to Hyman's (1977) survey, is one in which stress always falls on the same syllable. One language illustrating this is Maranungku spoken in Northern Australia. In Maranungku, according to Hayes (1981), main stress is always on the initial syllable with secondary stress occurring on every other syllable after. Some examples from Hayes (p.51) are given in (1).

1. Analyses in this chapter are presented in the framework of metrical phonology and illustrated by tree structures. I do not address the issue of whether stress is just represented by metrical trees or just by metrical grids. I refer the reader to Hayes (1984a) for a view that seems to be gaining popularity, that both metrical trees and metrical grids are needed.

(1) Maranungku Data

tíralk 'saliva'
mérepèt 'beard'
yängarmäta 'the Pleiades'

Hayes' metrical analysis of Maranungku stress is as follows:

(2) Metrical Analysis of Maranungku

a. Project nuclei (Hayes does not explicitly state this).
b. Construct binary, quantity-insensitive, left-dominant feet from the left edge of the word.
c. Construct a left-dominant word tree.
Two derivations are shown in (3) (F=foot, N=nucleus, s=strong, and w=weak).

(3) a. tıralık
   'saliva'

   b. yángarmata
   'The Pleiades'

Rules

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>tıralık</td>
<td>yangarmata</td>
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2a

<p>| | | |</p>
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<thead>
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<tbody>
<tr>
<td>i a</td>
<td>a a a a</td>
<td></td>
</tr>
<tr>
<td>N N</td>
<td>N N N N</td>
<td></td>
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2b

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<tbody>
<tr>
<td>i a</td>
<td>a a a a</td>
<td></td>
</tr>
<tr>
<td>N N w</td>
<td>N N N N</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
</tbody>
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2c

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<tbody>
<tr>
<td>----</td>
<td>a a a a</td>
<td></td>
</tr>
<tr>
<td>N s w N w</td>
<td>N s w N w</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
</tbody>
</table>

The analysis of Maranungku given in (2) would be the same whether the syllable structure is level or the onset-rhyme division is respected. However, in an analysis incorporating the onset-rhyme division, for languages like Maranungku, the rhyme properties are ignored, and simply the nucleus is projected. Thus, the advantage of an analysis incorporating a level syllable structure is that the nucleus would be projected directly without having to ignore the intermediate rhyme structure.

3.1.2. Long Vowel Stress

Similarly, in languages in which stress falls on a long vowel, it is just the nucleus that is projected; the rhyme is ignored. Consider some data from the Uralic language Eastern Cheremis in (4). Hayes (1981:57) gives the following description of its stress system. "Stress in Eastern Cheremis falls on the last full vowel of a word, and on the initial syllable if the word contains only reduced vowels." (I follow Hayes here in considering the full vowel-reduced vowel distinction as equivalent to a length distinction.)

(4) Eastern Cheremis Data

| šinčaám | 'I sit' |
| šlaapaágam | 'his hat (acc.)' |
| tálezam | 'moon's' |

Hayes provides a metrical analysis that is essentially as in (5).

(5) Metrical Analysis of Eastern Cheremis

a. Project nuclei (again, Hayes does not explicitly state this).
b. Construct a left-dominant, quantity-sensitive, unbounded foot at the right edge of the word.
c. Form a right dominant word tree.

Three derivations are illustrated in (6).
(6) a. šiinčaám  b. šlaapaázem  c. tělázem

Rules

\[
\begin{array}{c|c|c|c|c|c|c}
 & šiinčaám & šlaapaázem & tělázem \\
5a & ii & aa & aa & aa & ą & ą \\
   & V  & V  & V  & V  & ą & ą \\
   & N  & N  & N  & N  & N  & N  \\
5b & ii & aa & aa & a  & a  & a  \\
   & V  & V  & V  & F  & F  & F  \\
   & N  & N  & N  & S  & S  & S  \\
5c & ii & aa & aa & a  & a  & a  \\
   & V  & V  & V  & F  & F  & F  \\
   & N  & N  & N  & S  & S  & S  \\
\end{array}
\]

In the derivations above, the nuclei are projected. Then, by (5b), a left-dominant, quantity-sensitive, unbounded foot is constructed from the right edge of the word. In (6a), this set of rules ((5a) and (5b)) constructs a monosyllabic foot over the last nucleus since that nucleus branches. In (6b), a foot is constructed over the last two nuclei; the foot ends at the penultimate nucleus since that nucleus branches. In (6c), since not one of the nuclei branches, the foot forms over the whole word.

The analysis of Eastern Cheremis (and of other languages that stress long vowels) would essentially be identical whether the syllable has rhyme structure or flat structure. The advantage of an analysis incorporating a level syllable structure (over one that respects the onset-rhyme division) for these languages is that the branching properties of the rhyme do not have to be ignored (as would be the case in (6b) and (6c) where the final syllables have branching rhymes but would not receive stress); rather the nucleus would be projected directly.

3.1.3. Closed Syllable Stress

Another type of stress system that should be mentioned is one in which main stress is attracted onto closed syllables (i.e., syllables ending in a consonant) but not onto syllables with long vowels. Such stress systems are not common and, in fact, have been claimed not to exist (L. Hyman, lecture, 7/16/83). The only two languages that I have come across that are claimed to be of this type are Seneca and Tiberian Hebrew. The stress systems of both languages are quite complex and controversial. Here, I just briefly discuss Tiberian Hebrew.

In Tiberian Hebrew, main stress (at the earliest level) falls on a closed syllable (as in (7a)); otherwise, it falls on the penultimate one (as in (7b)).

(7) Examples of Stress in Tiberian Hebrew

a. katáb  "he wrote"
   yaquám  "he rises"
(9) a. katáb
    b. katábti

| Rules | 8a | N NC | N NC N |
|       | R R |     | R R R  |
|       |     |     |        |
| 8b    | N NC | N NC N |
|       | R R | R R R |
|       |     |        |
| 8c    | N NC | N NC N |
|       | R R | R R R |
|       |     |        |

In (9a), a monosyllabic foot is constructed over the final syllable (or, rather, rhyme) since that rhyme branches into a nucleus and a coda, and, in (9b), the last syllable (or rhyme) is the weak part of a left-dominant binary foot since the rhyme of the last syllable has one branch, into the nucleus. (Note that, from (9b), the internal branching within the nucleus is not relevant, and, if it were, it would be in violation of the principle of metrical locality.)

Briefly, by comparison, in an analysis of Tiberian Hebrew incorporating a level syllable structure, the nucleus and coda are projected, and a binary, left-dominant foot is constructed (from the right edge of the word) such that the final syllable would be labelled strong if it contains both a nucleus and a coda; otherwise, the penultimate syllable is strong.

I do not pursue the discussion of the analysis of Tiberian Hebrew any further since the correct characterization of its stress facts is not unequivocal – see Hammond (1984) for a recent discussion.

3.1.4. Heavy Syllable Stress

In languages like English, in which stress falls on a heavy syllable (i.e., a syllable with either a long vowel, a diphthong, or a final consonant), the metrical analysis would be different depending on whether the syllable has rhyme structure or a level structure. Consider the stress pattern on English nouns exemplified by the following words.
(10) Stress pattern of Some English Nouns

<table>
<thead>
<tr>
<th>Canada</th>
<th>agenda</th>
<th>Arizona</th>
</tr>
</thead>
<tbody>
<tr>
<td>América</td>
<td>apéndice</td>
<td>Dakota</td>
</tr>
<tr>
<td>Pánela</td>
<td>Torón</td>
<td>élítist</td>
</tr>
</tbody>
</table>

In the pattern above, main stress falls on the penultimate syllable if it is heavy (as in the words of the second and third column); otherwise, stress falls on the antepenultimate syllable (as in the words of the first column). A metrical analysis incorporating rhyme structure for the above data would be as in (11).

(11) Metrical Analysis of English Nouns

a. Project rhymes.
b. Mark final rhymes extrametrical.
c. Construct a binary, quantity-sensitive, left-dominant foot from the right edge of the word.
d. Other rules (not relevant here).

Some derivations are given in (12) (parentheses indicate extrametricality).

(12) a. Canada   b. agenda   c. Arizona

<table>
<thead>
<tr>
<th>Rules</th>
<th>Canada</th>
<th>agenda</th>
<th>Arizona</th>
</tr>
</thead>
<tbody>
<tr>
<td>11a</td>
<td>æ æ æ</td>
<td>æ æ æ</td>
<td>æ æ æ</td>
</tr>
<tr>
<td></td>
<td>R R R</td>
<td>R R R</td>
<td>R R R</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rules</th>
<th>Canada</th>
<th>agenda</th>
<th>Arizona</th>
</tr>
</thead>
<tbody>
<tr>
<td>11b</td>
<td>æ æ æ</td>
<td>æ æ æ</td>
<td>æ æ æ</td>
</tr>
<tr>
<td></td>
<td>R R(R)</td>
<td>R R(R)</td>
<td>R R(R)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rules</th>
<th>Canada</th>
<th>agenda</th>
<th>Arizona</th>
</tr>
</thead>
<tbody>
<tr>
<td>11c</td>
<td>æ æ æ</td>
<td>æ æ æ</td>
<td>æ æ æ</td>
</tr>
<tr>
<td></td>
<td>R R(R)</td>
<td>R R(R)</td>
<td>R R(R)</td>
</tr>
</tbody>
</table>

In the preceding derivations, rhymes are projected and final rhymes are marked extrametrical. Then, by (11c), a binary, left-dominant, quantity-sensitive foot is constructed from the end of the word (excluding the final extrametrical rhyme). In (12a), a bisyllabic foot is constructed over the last two (nonextrametrical) syllables since the penultimate syllable does not have a branching rhyme. In (12b) and (12c), a monosyllabic foot is constructed over the penultimate syllable since that syllable has a branching rhyme.

What is crucial about the analysis in (11)—and this point has been made by Piggott and Singh (1984)—is that the rhyme must not have the labelled constituents nucleus and coda; rather the syllable structure must be as in (13a).

(13) a. syllable  b. syllable

<table>
<thead>
<tr>
<th></th>
<th>onset rhyme</th>
<th>rhyme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>x₀ x₀ x₀</td>
<td>x₀ x₁ x₀</td>
</tr>
</tbody>
</table>

If the rhyme does have labelled constituents (as in (13b)), then in the word Arizona, for example, the penultimate syllable would not have a branching rhyme but a branching
would be for language in which a branching structure

...the surface is represented, as can be seen from Figure 11.2, which shows the branching structure and the structure of the underlying linguistic system. In the case of a long vowel, the stress is on the second syllable, and the stress is on the first syllable when the vowel is short. In the case of a short vowel, the stress is on the second syllable, and the stress is on the first syllable when the vowel is long. This is consistent with the branching structure shown in Figure 11.2, and it is consistent with the linguistic system.
In the preceding derivations, the nuclei and the codas are first projected. When these are projected the phonemes they dominate and the node that dominates them (the syllable node) are also "visible." The final syllable node is made extrametrical (anything visible on the projection can be made extrametrical as long as it is a peripheral element). By (14c), a binary, left-dominant foot is constructed from the right edge of the word (excluding the extrametrical syllable); the nature of the foot to be constructed depends on the projection. In (15a), a binary foot is constructed over the last two syllables. This is because the final nucleus (excluding what is extrametrical) has only one branch, so it is the weak part of the binary left-dominant foot. In (15b), a monosyllabic foot is formed over the penultimate syllable (by (14c)) since, on the nucleus and coda projection, there are two branches (one in the nucleus and one in the coda). Similarly, for (15c), a monosyllabic foot is formed over the penultimate syllable (by (14c)) since, on the nucleus and coda projection, there are two branches (both in the nucleus).

3. That the two units nucleus and coda are being projected simultaneously might be objectionable. Alternatively, it may be the onset that is projected and the stress rules focus on the residue (i.e., the nucleus and the coda).
Thus, we see that the analysis incorporating a level syllable structure works for stress systems like English, in which stress is attracted onto a syllable with a long vowel or a final consonant. The advantage of the level structure analysis is that the labelled constituents of syllables are always the same regardless of the language’s stress system. On the other hand, with the onset-rhyme structure, the labelled constituents of the syllable differ (as Piggot and Singh (1984) point out) depending on whether stress is attracted onto just a branching nucleus (in which case there is a nucleus and a coda) or if it is attracted onto any heavy syllable (in which case the rhyme has no labelled constituents).

In sum, I have shown in this section that an analysis incorporating a level syllable structure is compatible with the common types of stress systems that are discussed by Hayes (1981). Moreover, for languages in which the same syllable is always stressed and languages in which stress is attracted onto a long vowel, the level structure analysis is preferable since the nucleus would be projected directly without having to ignore the intermediate rhyme structure. In the next section, I consider onset-sensitive stress languages and show that analyses incorporating a level syllable structure can account for them.

3.2. Onset-Sensitive Stress Languages

3.2.0. Introduction

In chapter two, I discussed a number of languages that have onset-sensitive stress rules and pointed out that these were counterexamples to the claim that stress rules never refer to the properties of syllable onsets. In this section I present metrical analyses incorporating a level syllable structure for some of these languages. The languages to be considered are Western Aranda, Alyawarra, Madimadi, and Pirahã. (For the reader’s convenience, some of the data in chapter two from these languages are repeated in this section.) Before each analysis incorporating a level structure, I consider alternatives incorporating other syllable structures. I will argue that only a level syllable structure can handle all the languages considered.

3.2.1. Western Aranda

In Western Aranda, an Arandic language of Central Australia, stress falls on the first syllable of consonant-initial words (as in (16a)) and on the second syllable of vowel-initial words (as in (16b)); however, all bisyllabic words have stress on the first syllable (as in (16c)).
Western Aranda Stress - Strehlow (1942)

a. Consonant-Initial Words
   túkura 'ulcer'
   wóratàra (place name)

b. Vowel-Initial Words
   ergúma 'to seize'
   utnádawàra (place name)

c. Bisyllabic Words
   káma 'to cut'
   ìlba 'ear'

In terms of syllable structure, primary stress falls on the first syllable containing an onset. Syllables that have branching rhymes do not attract stress. This is most clear from the two words in (16b), in which the first syllable would have a branching rhyme, but main stress does not fall on that syllable since it does not have an onset. Secondary stress falls on the second syllable after the one with primary stress, with no stress occurring on final syllables.

Now, a standard metrical analysis (along the lines of Hayes (1981)) of Western Aranda stress that incorporates a syllable structure that recognizes the onset-rhyme division (as in (17)) cannot handle the Western Aranda data in (16).

This is because in standard metrical theory only the rhyme and the nucleus can be projected for stress rules, but, in Western Aranda, the onset plays a role. Nonetheless, one can propose a standard metrical analysis of Western Aranda stress, as in (18):

Possible Standard Metrical Analysis of Western Aranda

a. Mark word-initial vowels extrametrical.
   
   b. Project nuclei.
   
   c. Form binary, left-dominant, quantity-insensitive feet from the left edge of the word.
   
   d. Form a left-dominant word tree.
   
Two examples are in (19).

(19)

a. utnádawàra (place name)
   
   Rules utnawara
   
   18a (u) a a a a o a a a
   
   18b (u) a a a a N N N N
   
   18c (u) a a a a N N N N

b. wóratàra (place name)
   
   Rules wóratara
   
   18a (u) a a a a o a a a
   
   18b (u) a a a a N N N N
   
   18c (u) a a a a N N N N
While the analysis in (18) handles the words in (19a) and (19b), it is unable to handle bisyllabic words that begin with a vowel. Consider the word ilba given in (16c). The analysis given in (18) would make the first syllable extrametrical, and, by default, stress would fall on the second syllable. However, stress falls on the first syllable of ilba, not on the second. This shows that it is not the word-initial vowel that is extrametrical, rather it is the final one that is always extrametrical in Western Aranda since it never receives stress of any kind. Consequently, the analysis in (18) cannot be maintained.

A metrical analysis of Western Aranda incorporating the onset-rhyme division can be saved if stress is allowed to be constructed on the syllable projection (in addition to the rhyme projection and the nucleus projection). The analysis in (20) is exemplified by the derivations in (21) (where O=onset).

**20** Metrical Analysis Incorporating Syllable Projections of Main Stress in Western Aranda

- a. Project syllables.
- b. Mark final syllables extrametrical.
- c. Construct a binary, quantity-sensitive, right-dominant foot from the left edge of the word.

(21) a. tukura 'ulcer'  b. erguma 'to seize'

<table>
<thead>
<tr>
<th>Rules</th>
<th>tukura</th>
<th>erguma</th>
</tr>
</thead>
<tbody>
<tr>
<td>20a</td>
<td>OROROR</td>
<td>R OROR</td>
</tr>
<tr>
<td></td>
<td>|||</td>
<td>|||</td>
</tr>
<tr>
<td></td>
<td>|||</td>
<td>|||</td>
</tr>
<tr>
<td>20b</td>
<td>OROROR</td>
<td>R OROR</td>
</tr>
<tr>
<td></td>
<td>|||</td>
<td>|||</td>
</tr>
<tr>
<td></td>
<td>|||</td>
<td>|||</td>
</tr>
<tr>
<td>20c</td>
<td>OROROR</td>
<td>R OROR</td>
</tr>
<tr>
<td></td>
<td>|||</td>
<td>|||</td>
</tr>
<tr>
<td></td>
<td>|||</td>
<td>|||</td>
</tr>
</tbody>
</table>

In each of (21a) and (21b) syllables are projected, and final syllables are marked extrametrical. By (20c), a right-dominant, quantity-sensitive, binary foot is constructed from the left edge of the word. In (21a) this puts a monosyllabic foot over the first syllable since that syllable has two branches (one into onset and one into rhyme). In (21b), on the other hand, the first syllable is the weak part of a bisyllabic foot since that syllable just has one branch (into the rhyme). To obtain the appropriate secondary stresses (in words of four or more syllables) a right-dominant, quantity-insensitive, binary foot would be constructed after main stress, and the word tree would be left dominant. (A rule such as stray syllable adjunction
would also be needed to attach any extra syllables to
the tree.) Thus, an analysis of Western Aranda stress
incorporating rhyme structure can be maintained if stress
can be constructed also on syllable projections.

A very different way of handling the Western
Aranda stress facts is by making reference to Vennemann's
that syllables do not have any structure per se, but
that structure is imposed upon them by phonological rules
and processes. An analysis of Western Aranda incorpo-
rating Vennemann's view could have syllables with the
structure in (22), and main stress would fall on the
first syllable with a branching body, as in (23a).

\[
(22) \quad \text{syllable}
\]
\[
\quad \text{body}
\]
\[
\quad \text{onset nuc. coda}
\]

(23) a. tükura 'ulcer'  b. ergúma 'to seize'

\[
\begin{array}{c|c}
V & \text{V}\, \text{V} \\
B & B & B
\end{array}
\]

B=body
C=coda

In (23a), tükura has initial stress since the initial
syllable contains a branching body. In (23b), the second
syllable has stress since it is that syllable that has
a branching body. One shortcoming of this analysis is
that, since secondary stress in Western Aranda does not
make reference to branching bodies, there is no motivation

for the later syllables (i.e., syllables after the main
stressed one) to have body structure in Western Arandic
words. Consequently, an analysis incorporating
Vennemann's view would have to maintain that different
syllables in the same word have different syllable
structure.

Another way of analyzing Western Aranda stress
is by incorporating a level syllable structure (as in
(24)).

\[
(24) \quad \text{syllable}
\]
\[
\quad \text{onset nuc. coda}
\]

On this view, stress rules can make reference to either
an onset or a coda projection in addition to a nucleus
projection. It is a language-specific characteristic
whether or not the onset or coda is projected. (Recall
from section 3.1 that codas are projected for stress
rules of Tiberian Hebrew and English.) A metrical
analysis of Western Aranda, then, would be as in (25).

\[
(25) \quad \text{Metrical Analysis of Western Aranda Stress}
\]
\[
\text{(level syllable version)}
\]
\[
\begin{array}{l}
a. \text{Project onsets and nuclei.} \\
b. \text{Mark final syllables extrametrical.} \\
c. \text{Construct a binary, quantity-sensitive, right-dominant foot from the beginning}
\quad \text{of the word.} \\
d. \text{Other rules (not relevant here).}
\end{array}
\]

As mentioned previously, I view projections as being
constrained by some principle of metrical locality,
like that proposed by Hammond (1982:215) who states, "... rules manipulating elements at one level refer to their immediate structural level, but not to structure beyond their domain." In other words, when something is projected, only what is immediately above it and what is immediately below it can be known. Let us consider the Western Arandic words wóratára (place name) and ergúma 'to seize'. They would have derivations as shown in (26).

(26) a. wóratára (place name) b. ergúma 'to seize'

By rule (25a), the onset and the nucleus are projected. When these are projected what is immediately above them and below them are also known. This is indicated in (26) where the projection of the onset and the nucleus (by (25a)) also displays the syllable node and the phonemes. (With the exception of (15) and (21), I have not previously incorporated the syllable node into the tree diagrams. I do so only when it is crucial.)

By (25b), final syllables (and syllable nodes) are visible
when the onset and the nucleus are projected) are marked extrametrical. Rule (25c) constructs a binary, quantity-sensitive, right-dominant foot on the onset-nucleus projection. In (26a), this constructs a monosyllabic foot over the first syllable since the onset and the nucleus of that syllable contain two branches between them (one in the onset and one in the nucleus). In (26b), though, the first syllable just has a single branch in the nucleus, so it is the weak part of the binary right-dominant foot formed with the following syllable. Other rules (not relevant here) apply to fill in the rest of the tree.

Thus, a metrical analysis incorporating a level syllable structure can handle the Western Aranda stress facts. However, a metrical analysis assuming rhyme structure and also incorporating the availability of syllable projections can also handle Western Aranda stress. The analysis involving syllable projections, though, is only a way around the fact that the onset is playing a role in stress placement without specifically mentioning it. The level structure analysis does not try to hide this. In the following subsections, data from other onset-sensitive stress languages will be shown to be compatible with a level structure analysis but not always with the onset-rhyme one.

3.2.2. Alyawarra

In Alyawarra, another Arandic language, stress falls on the initial syllable of words beginning with a [+consonantal] segment (as in (27a)) and on the second syllable of words beginning with a [-consonantal] segment (as in (27b) and (27c)). In other words, stress falls on the initial syllable unless the word begins with a vowel or glide, in which case it falls on the second. Moreover, unlike Western Aranda, main stress can fall on final syllables in bisyllabic words (as is seen be some examples in (27b) and (27c)).

(27) Alyawarra Stress Exemplified - Yallop (1977)

a. Words Beginning With a [+Consonantal] Phoneme

- mpula 'you'
- rinha 'him'
- kwíya 'girl'

5. The analysis here predicts that if Western Aranda has long vowels or diphthongs, they would be stressed in word-initial position, since, on a projection of the onset and the nucleus, there would be two branches (both in the nucleus). But Western Aranda does not have phonemic long vowels, although, in certain environments, some stressed vowels become long, phonetically. Also, diphthongs do not occur word-initially, judging from the data in Strehlow (1942).
b. Words Beginning With a Vowel

**iliipa** 'axe'
**iylpá** 'ear'
**inglyá** 'night'

c. Words Beginning With a Glide

**yukúntja** 'ash'
**walijymparra** 'pelican'
**waká** 'hut'

Different analyses assuming varying models of syllable structure can all handle the Alyawarra stress facts. First, consider the following standard metrical analysis of Alyawarra that respects the onset-rhyme division:

(28) Standard Metrical Analysis of Main Stress in Alyawarra

- Mark initial syllables beginning with a [-consonantal] segment extrametrical.
- Project nuclei.
- Construct a binary, quantity-insensitive, left-dominant foot from the left edge of the word.
- Other rules (irrelevant for the present discussion).

Three derivations are shown below:

(29) a. mpúla  
(29b) a. ilípa  
(29c) a. yukúntja

<table>
<thead>
<tr>
<th>Rules</th>
<th>mpúla</th>
<th>ilípa</th>
<th>yukúntja</th>
</tr>
</thead>
<tbody>
<tr>
<td>28a</td>
<td>Does not apply</td>
<td>(i)lipa</td>
<td>(yu)kuntja</td>
</tr>
<tr>
<td>28b</td>
<td>u a</td>
<td>(i)</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>28c</td>
<td>u a</td>
<td>(i)</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

In (29a), the first syllable is not extrametrical (since it begins with a [+consonantal] segment), so the left-dominant binary foot puts stress on the first syllable. In (29b) and (29c), the first syllable is extrametrical, hence, foot construction leaves stress on the second syllable. The only criticism of this analysis is that marking the first syllable extrametrical depending on the content of an onset means that the onset should somehow be projected, which is not permitted in standard metrical theory.

The above criticism suggests a different analysis of the Alyawarra data, but one still respecting the onset-rhyme division. Such an analysis incorporates syllable projections and is as follows:
(30) Metrical Analysis of Main Stress in Alyawarra
(on the syllable projection)

a. Project syllables.
b. Construct a binary, quantity-sensitive, right-dominant foot from the beginning of the word.
c. Other rules (not relevant here).

Three derivations follow:

(31) a. mpūla  b. ilípa  c. yukúntja

Rules

30a OR OR  R OR OR  R OR OR
\( V \sigma \)  \( \sigma V \sigma \)  \( \sigma \sigma V \sigma \)

30b OR OR  R OR OR  R OR OR
\( V \sigma \)  \( \sigma V \sigma \)  \( \sigma \sigma V \sigma \)

In (31a), (31b), and (31c), the words are illustrated with their syllable structure. First, syllables are projected (by (30a)). After syllables are projected, it can be known whether the syllable branches into an onset and a rhyme, as in the first syllable of (31a) for example, or, whether the syllable just branches into a rhyme (as in the first syllable of (31b) or the first syllable in (31c)). Note that the internal branching within the rhyme cannot be relevant, for this would violate the principle of metrical locality as proposed by Hammond (1982). Subsequently, (30b) applies, creating a binary, quantity-sensitive, right-dominant foot from the left edge of the word (on the syllable projection).

In (31a), this puts a binary foot over the first syllable since that syllable has two branches. In (31b) and (31c), though, the first syllable has only one branch, hence, it is the weak part of a binary right-dominant foot formed with the following syllable.

The only problem with the preceding analysis incorporating syllable projections (besides the general problem of using syllable projections to capture that onsets are playing a role in stress without specifically mentioning onsets) relates to glides. A word-initial glide must be considered part of the rhyme and not part of the onset, or else stress would be on the first syllable of glide-initial words. However, considering glides as part of the rhyme is not so unusual. It seems to be a language-specific issue. Harris (1983) argues for glides being part of the rhyme for Spanish. He points out that words like idíoma [ídyma] and aíento [aíyento] have the syllabification [i.dyo.ma] and [a.lyen.to], respectively, where the glide is not syllable-initial. Moreover, antepenultimate stress in Spanish is impossible when either the penultimate syllable
or the ultimate syllable has a branching rhyme. It turns out that antepenultimate stress is also impossible on words that have a glide in one of the last two syllables. This suggests that the glide is part of the branching rhyme at the point where stress applies. The situation in Alyawarra seems parallel to the Spanish with the glide being part of the rhyme (at least so at the point where stress applies). Hence, an analysis incorporating the onset-rhyme division can handle Alyawarra stress if stress is allowed to be constructed on the syllable projection, and if syllable-initial glides are considered as part of the rhyme.

An analysis of the Alyawarra stress facts incorporating Vennemann's (1984) theory of syllable structure would be almost identical to the analysis of Western Aranda incorporating his theory of syllable structure. Syllables in Alyawarra would have the structure in (22) (repeated here):

\[
\text{(22)} \quad \text{syllable} \\
\quad \text{body} \\
\quad \text{onset nuc. coda}
\]

Given the structure in (22), stress would fall on the initial syllable if it contains a branching body, or else, stress falls on the second syllable. Three examples are given below:

\[
(32) \quad \begin{array}{ccc}
\text{a. } \text{mpúla} & \text{b. } \text{ilípa} & \text{c. } \text{yukúntja} \\
\text{V} & \text{V} & \text{V} \\
\text{N} & \text{N} & \text{N} \\
\text{O} & \text{O} & \text{O} \\
\text{B} & \text{B} & \text{B} \end{array}
\]

In (32a), mpúla has initial stress since the initial syllable contains a branching body. In (32b) and (32c), the second syllable of each word has stress since the first syllable in these words does not contain a branching body. Again, glides must be considered part of the nucleus in the foregoing analysis and not part of the onset, or else, the initial syllable would be stressed in (32c).

One shortcoming of this type of analysis for Alyawarra is identical to the shortcoming that such an analysis has for Western Aranda. This has to do with the fact that in Alyawarra secondary stress is (usually) on the second syllable after the main stressed one, though none of the examples in (32) show this. That is, secondary stress does not make reference to branching bodies. Thus, on this view (in which syllable structure is imposed upon syllables by phonological processes or rules), there is no motivation for these later syllables (i.e., syllables after the main stressed one) having body structure. Consequently, a Vennemann type analysis would have to claim that different syllables in the same word could have different structures.
The stress facts of Alyawarra can also be analyzed with a level syllable structure (as in (24), repeated below).

(24) syllable
   onset nuc. coda

A metrical analysis of Alyawarra stress incorporating the syllable structure in (24) would be as follows:

(33) Metrical Analysis of Main Stress in Alyawarra (level structure)
   a. Project onsets and nuclei.
   b. Mark an initial onset extrametrical if it contains a glide.
   c. Construct a binary, quantity-sensitive, right-dominant foot on the onset and nucleus projection. In (34a), this builds a monosyllabic foot over the first syllable since that syllable has (at least) two branches in the onset and the nucleus together. In (34b) and (34c) the first syllable has just one branch in the nucleus (and none in the onset), so that syllable will be the first part (the weak part) of a binary right-dominant foot formed with the following syllable. One advantage of this analysis

Three derivations are given in (34).

(34) a. mpula b. ilipa c. yuwa

Rules

<table>
<thead>
<tr>
<th>33a</th>
<th>NON</th>
<th>NON</th>
<th>(O)</th>
<th>NON</th>
<th>(O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>33b</td>
<td>V</td>
<td>V</td>
<td>σ σ</td>
<td>σ σ</td>
<td>σ σ</td>
</tr>
<tr>
<td></td>
<td>(O)</td>
<td>(O)</td>
<td>(O)</td>
<td>(O)</td>
<td>(O)</td>
</tr>
<tr>
<td>33c</td>
<td>V</td>
<td>V</td>
<td>y</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td></td>
<td>(O)</td>
<td>(O)</td>
<td>(O)</td>
<td>(O)</td>
<td>(O)</td>
</tr>
</tbody>
</table>

In the above derivations, rule (33a) allows for the projection of the onset and the nucleus (when these are projected both what is immediately above them and below them are also visible), and rule (33b) marks a glide-initial onset extrametrical. Rule (33c) constructs a binary, quantity-sensitive, right-dominant foot on the onset and nucleus projection. In (34a), this builds a monosyllabic foot over the first syllable since that syllable has (at least) two branches in the onset and the nucleus together. In (34b) and (34c) the first syllable has just one branch in the nucleus (and none in the onset), so that syllable will be the first part (the weak part) of a binary right-dominant foot formed with the following syllable. One advantage of this analysis

6. The analysis here predicts that, word-initially, long vowels or diphthongs would be stressed in Alyawarra, since, on a projection of the onset and the nucleus, there would be two branches (both in the nucleus). Both /iy/ and /ay/ occur in Alyawarra, but as Yallop (1977:29) notes, "Initial iy and ay are limited in their distribution." Further, it is possible to argue (based on Yallop's discussion) that initial [iy] and [ay] are often allophones of /i/ and /a/, respectively. Nonetheless, minimal pairs like ilipa 'big' and yilipa 'ear' do occur (with stress on the second syllable in yilipa, even though the first syllable seems to have two branches in the nucleus). In order to handle such cases, I consider the off-glide part of iy and ay as belonging to the coda and not to the nucleus. And, in fact, one of the ways in which iy can be pronounced, according to Yallop (1977:27), is "... as a short i followed by the semivowel y." Thus, in my analysis of Alyawarra, glides are never part of the nucleus; they are either part of the onset (e.g., when they occur word-initially) or they are part of the coda (as in the first syllable of yilipa). Unlike Spanish, then, glides in Alyawarra do not make the nucleus branch.
is that it is not crucial for glides to be considered part of the nucleus.

In sum, then, different theories of syllable structure can be used in the analysis of stress in Alyawarra. The main weakness of an analysis with a theory recognizing the onset-rhyme division is that such an analysis only works on a syllable projection. Maintaining syllable projections, though, is tantamount to admitting that onsets can play a role in stress, which is not supposed to happen according to this view. Also, glides must be crucially considered as part of the nucleus, but there does not seem to be support for this.

The main weakness of a Vennemann type analysis of Alyawarra stress is that it would allow for different syllable types within the same word. This would be a case of needlessly multiplying entities (forbidden by Occam's razor) in view of the fact that (as shown) an analysis just incorporating a level structure of the syllable can handle adequately the Alyawarra data.

3.2.3. Madimadi

Further support for a level syllable structure comes from Madimadi, an Australian language of New South Wales. In Madimadi, stress normally falls on the initial syllable of a word. However, in words of three or more syllables, if the second syllable has a coronal consonant in its onset, stress falls on that syllable. (Coronal, here, includes the palatal glide /j/.) Secondary stress normally falls two syllables after the main stressed one, and final syllables are extrametrical (since they usually do not receive stress). Some examples are given in (35):

(35) Madimadi Stress Exemplified — Hercus (1969)

a. Words with [+coronal] onsets in the second syllable
   wiiswaθa 'to come back'
   guléeuwaθa 'to hate'

b. Words with [-coronal] onsets in the second syllable
   wiŋumimnin 'pupil' (of the eye)
   bokumanama 'kangaroo'

c. Bisyllabic words
   baθa 'to go out'
   baθir 'a swamp'

Analyses incorporating different theories of syllable structure can be proposed to handle the Madimadi data. I first consider a number of possible ways a standard metrical analysis, which respects the onset-rhyme

7. Hercus (1969) marks secondary stress on the initial syllables of words that have main stress on the second syllable (i.e., words with coronal consonants in the onset of second syllables). I assume that the initial secondary stress in such words is due to a low level (post-lexical) initial downbeat rule.
division, can handle the Madimadi stress pattern in (35). Subsequently, I consider a Vennemann type analysis, and also one incorporating a level syllable structure.

The analysis in (36) below, is a possible way (maintaining an onset-rhyme division) of handling Madimadi stress.

(36) Metrical Analysis of Madimadi Stress

a. Mark the first syllable extremmetrical if the second one begins with a [+coronal] consonant.
b. Project nuclei.
c. Construct binary, quantity-insensitive, left-dominant feet from the beginning of the word.
d. Build a left-dominant word tree.

Two examples are in (37):

(37) a. guléθuwaθa
'we hate'

b. wíŋumíŋí
'pupil'

Rules

<table>
<thead>
<tr>
<th>guleθuwaθa</th>
<th>wíŋumíŋí</th>
</tr>
</thead>
<tbody>
<tr>
<td>36a</td>
<td>36c</td>
</tr>
<tr>
<td>(gu) e u a A</td>
<td>i u i i</td>
</tr>
<tr>
<td>N N N</td>
<td>N N N</td>
</tr>
</tbody>
</table>

A second possible analysis preserving the onset-rhyme division could be based on different syllabification principles. An intervocalic noncoronal consonant syllabifies with the preceding vowel (i.e., it is a coda) while an intervocalic coronal consonant syllabifies with the following vowel (i.e., it is an onset). Then main stress would be determined by (38):

(38) Metrical Analysis of Madimadi Main Stress

a. Project rhymes.
b. Build a binary, quantity-sensitive, right-dominant foot at the left edge of the word.

Two examples are in (39) (=syllable boundary).
syllable projections. Such an analysis would be along
the lines of (40).

(40) Metrical Analysis of Madimadi Main Stress (on
the syllable projection)

a. Project syllables.
b. Construct a binary, left-dominant foot
over the first two syllables; however,
if the second syllable has a [coronal] onset construct a right-dominant foot.

Rule (40b) would put main stress on the second syllable
of words having a coronal consonant in the onset of that
syllable; otherwise, main stress would be put on the
first syllable. The problem with this analysis (besides
being rather forced) is that it violates the principle
of metrical locality. If syllables are projected, by
the locality principle it can only be known whether the
syllable branches into an onset and a rhyme or just into
a rhyme. The segments and features of segments below
the onset and rhyme nodes (such as [+coronal]) cannot
be known. Thus, we conclude that an analysis of Madimadi
stress incorporating the onset rhyme-division is very
difficult to maintain.

An analysis of Madimadi incorporating Vennemann's
(1984) view of syllable structure (that syllables do
not have any structure per se, but structure is imposed
upon them by rules and processes) also encounters
problems. One possible analysis of Madimadi in this
framework is that syllables with coronal onsets are
considered to have branching bodies (as in (41a)), but syllables with [−coronal] onsets have the structure in (41b).

(41) a. syllable
   \[\text{body} \rightarrow \text{onset nuc. coda} [−\text{cor}]\]

b. syllable

Stress, then, would somehow be attracted onto syllables with body structure. If there are no syllables with coronal onsets then main stress falls on the first syllable. The main problem with this type of analysis is that within the same word it is possible to have more than one type of syllable structure (i.e., both (41a) and (41b)). This would be a case of Occam's razor since it is possible to handle the Madimadi stress facts with just the level structure in (41b), to which I now turn.

Madimadi stress can be handled adequately given a level syllable structure (as in (41b)), and a view of projection that allows for the onset of the syllable in addition to the nucleus to be projected. I propose the following analysis for stress in Madimadi that first makes reference to nucleus projections:

(42) Metrical Analysis of Madimadi Stress (level syllable version)

a. Project nuclei.
b. Mark the final nucleus extrametrical.
c. Construct binary, left-dominant feet from the left edge of the word.

The application of (42) is shown in the first part of (45). A rule of stress readjustment that must make reference to the onset projection subsequently applies, after (42), reversing the sw order of the two syllables in a foot in which there is a coronal consonant in the onset of the weak syllable. The rule is formulated in (43).

(43) Stress Readjustment (onsets are projected)

\[
\sigma_s \sigma_w \Rightarrow \sigma_w \sigma_s
\]

\[
\begin{array}{c|c|c}
\text{On} & \text{On} & \text{On} \\
\sigma_s & \sigma_w & \sigma_s \\
\text{[+cor]} & & \\
\end{array}
\]

Rule (43) does not violate the locality principle since it is the onset that is projected; what is immediately above the onset (σ) and what is immediately below the onset ([+cor]) are also known. (Note that the rule in (43) could not be expressed with a syllable structure respecting the onset-rhyme division.)

Besides (42) and (43), the two rules in (44) also apply.

(44) Other Rules

b. Construct a left-dominant word tree.

Some derivations are given in (45).
(45) a. wigumjin b. bukumanama c. gulewua\^a

**Rules**

<table>
<thead>
<tr>
<th>Rule</th>
<th>Example</th>
<th>Example</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>42a</td>
<td>iuii</td>
<td>uuaaa</td>
<td>ueua^a</td>
</tr>
<tr>
<td>42b</td>
<td>NNNN(N)</td>
<td>NNNN(N)</td>
<td>NNNN(N)</td>
</tr>
<tr>
<td>42c</td>
<td>iuii</td>
<td>uuaaa</td>
<td>ueua^a</td>
</tr>
<tr>
<td></td>
<td>ONONON</td>
<td>ONONON</td>
<td>ONONON</td>
</tr>
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<td>VVVV</td>
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<td>FF</td>
<td>FF</td>
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<td>44</td>
<td>wigumini</td>
<td>bukumanama</td>
<td>gulewua^a</td>
</tr>
<tr>
<td></td>
<td>ONONON</td>
<td>ONONON</td>
<td>ONONON</td>
</tr>
<tr>
<td></td>
<td>VVVV</td>
<td>VVVV</td>
<td>VVVV</td>
</tr>
<tr>
<td></td>
<td>FF</td>
<td>FF</td>
<td>FF</td>
</tr>
</tbody>
</table>

First, in (45a), (45b), and (45c), the words are shown with the nuclei projected and with the final nuclei made extrametrical. (Again, when the nucleus is projected both what is immediately above it and below it are also known.) Next the words are shown with their foot structure after (42c) has applied. Subsequently, stress readjustment (43), which is triggered by a coronal onset in a weak syllable, applies. (The weak nodes that are to undergo stress readjustment are circled in (45b) and (45c). It switches the sw marking on these feet to ws. Finally, the other rules (in (44)) apply to produce the output shown at the bottom of (45).

Specifically, the examples in (45a) and (45b) show that the first foot is still labelled sw if there is no [+coronal] consonant in the onset of the second syllable after (43) has applied. The example in (45c) shows that the first foot is readjusted to ws (by (43)) if there is a [+coronal] consonant in the onset of the second syllable. In (45b), the second foot has been relabelled ws. The readjustment rule has applied since a [+coronal] onset appears in the originally weak syllable of that foot. Now the output for the derivation shown in (45c) would have main stress on the second syllable and secondary stress on the third syllable (gulewua\^a). Notice, though, that this output is incorrect. The correct form is gulewua\^a. However, the form in (45c) (gulewua\^a) contains a stress clash. The second and third syllables clash since they are both strong. This clash is resolved by the clash resolution rule in (46).
(46) Clash Resolution Rule
\[
\begin{align*}
\sigma_w \sigma_s & \quad \sigma_s \sigma_w \\
\check{F}_s & \quad \check{F}_w & \Rightarrow & \quad \check{F}_s & \quad \check{F}_w
\end{align*}
\]
Thus, after the clash resolution rule applies, (45c) is changed to the following tree structure:

(47) \[
\begin{align*}
gu & \quad le & \quad \theta u & \quad wa & \quad \theta^A \\
\check{V} & \quad \check{V} & \quad \check{V} & \quad \check{V} & \quad \check{V} \\
\check{\sigma}_s & \quad \check{\sigma}_w & \quad \check{\sigma}_s & \quad \check{\sigma}_w & \quad \check{\sigma}_s \\
\check{F}_s & \quad \check{F}_w & \quad \check{F}_s & \quad \check{F}_w \\
\check{S} & \quad \check{S} & \quad \check{S} & \quad \check{S} & \quad \check{S}
\end{align*}
\]

The rules given in (42-44) plus the clash resolution rule covers the bulk of the Madimadi data. Only a small percentage of the words from Hercus (1969) are exceptional, and most of these involve words that fail to undergo stress readjustment. These words would have to be marked as such in the lexicon.

In sum, it has been demonstrated that a metrical analysis incorporating a level syllable structure is compatible with the Madimadi stress facts, whereas other possible analyses incorporating different syllable structures were unable to account for the Madimadi data. This, then, provides additional supporting evidence for a level syllable structure.

3.2.4. Pirahã

One final onset-sensitive stress language to be considered here is the Amazonian language Pirahã. Everett & Everett (1984) report that Pirahã has a stress system in which stress is sensitive to both what is in the onset and what is in the nucleus. According to them, stress falls on one of the last three syllables of the Pirahã word, whichever one has a long vowel or a diphthong (i.e., a branching nucleus) as in (48a). However, if more than one of the last three syllables has a branching nucleus, then stress falls on the syllable that has a voiceless consonant in its onset, as in (48b). (If more than one of the last three syllables meets this requirement then stress falls on the rightmost one.)

(48) Pirahã data (Stress syllables are underlined; tones are not indicated, and =syllable boundary)

a. gii.so.gi 'turtle'
   ?a.pa.\underline{ba}.si 'square'
   ?o.gi.ai 'big'

b. bii.sai 'red'
   kai.bai 'monkey'
   ?i.b\underline{ao}.sai 'her cloth'

A metrical analysis of the Pirahã data is problematic given any theory of syllable structure. Nonetheless, I attempt to show that an analysis
incorporating a level syllable structure holds up better than either an analysis incorporating Vennemann's theory of syllable structure or one respecting the onset-rhyme division.

An analysis that incorporates the onset-rhyme division cannot handle the Pirahä data. Such an analysis has no way of accessing the onset since the onset (which is crucial for determining Pirahä stress) cannot be projected. Even if the object of projections were extended to include syllables, the analysis would have to violate the principle of metrical locality. The syllable projection would only be able to tell if the syllable branches into an onset and a rhyme or just a rhyme; it would be unable to consider the particular nature of the onset consonant (e.g., its voicing characteristics) and the particular nature of the nucleus (e.g., whether or not it is branching).

Similarly, an analysis incorporating Vennemann's (1984) theory of syllable structure would be hard-pressed to handle the Pirahä data. Perhaps onsets containing voiceless consonants would be considered part of the syllable body, as in (49a), and onsets containing a voiced consonant would just be dominated by the syllable node, as in (49b).

In the words in (48a), stress would be attracted onto the syllable with the most branches within the nucleus (the underlined syllables in (48a)), and, in (48b), stress would be attracted onto the syllable with the most branches within the body. The shortcoming of this approach, besides having to claim that there are two radically different syllable types in Pirahä, is that there does not seem to be any outside motivation for positing the two structures in (49).

It is possible, however, to give an analysis of the Pirahä data incorporating a level syllable structure, though the analysis may not be very elegant. The following is a possible analysis:
Metrical Analysis of Pirahä Main Stress (level syllable version)

a. Project nuclei.
b. Construct a left-dominant, quantity-sensitive, ternary foot from the right edge of the word.²

The analysis in (50) takes care of main stress for the words in (48a). Two examples are in (51).

(51) a. gi:s0:gi b. ?a:pa:baa:si
    'turtle' 'square'

Rules

<table>
<thead>
<tr>
<th>giisogi</th>
<th>?apabaasi</th>
</tr>
</thead>
<tbody>
<tr>
<td>50a</td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>l</td>
</tr>
<tr>
<td>o</td>
<td>i</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>N N N</td>
<td>N N N N</td>
</tr>
<tr>
<td>50b</td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>l</td>
</tr>
<tr>
<td>o</td>
<td>i</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>N N W</td>
<td>N N N N</td>
</tr>
<tr>
<td></td>
<td>F</td>
</tr>
</tbody>
</table>

In (51), the nuclei are first projected. Then, by (50b), a ternary, quantity-sensitive, left dominant foot is constructed from the right. The left s-node of the foot must dominate a branching nucleus. The analysis in (50)

² While Hayes (1981) proposes to restrict the inventory of possible feet by eliminating ternary feet through the use of extrametricality, there still seem to be cases that call for ternary feet. In Mancjiltjara, according to Odden (1979), main stress is on the first syllable, and secondary stress is either on every other syllable or every third syllable. The metrical analysis would be construct binary or ternary left-dominant feet from the beginning of the word.

does not handle all the words in (48b), and it fails to handle words that do not have a branching nucleus (in one of the last three syllables). Two provisions must be added to (50) in order to handle these words. First, if more than one of the last three syllables has a branching nucleus (or if none of the last three syllables has a branching nucleus) then the onsets of those syllables would be projected, and the rightmost one with a voiceless onset would form the strong part of the left-dominant foot (constructed from the right). Second, if each of the last three syllables lacks a branching nucleus and a voiceless consonant in the onset, then the final syllable receives stress (this would either be done by assigning a foot to the last syllable, or by claiming such words have no feet, but the last syllable receives stress because the word tree is right dominant). The foregoing analysis is obviously not very elegant, but this just reflects the complexity of the stress rule. Nevertheless, the Pirahä data do find some expression in terms of the level syllable structure.

In this section I have considered the analyses of a number of languages that have onset-sensitive stress rules. For the most part, the analysis of the stress systems of these languages has been neglected in studies done within the framework of metrical phonology. I
have demonstrated here that these languages are often incompatible with a syllable structure that respects the onset-rhyme division. They are also largely incompatible with analyses incorporating Vennemann's (1984) theory of syllable structure. These languages, though, can be analyzed within the metrical framework by incorporating a level syllable structure. Consequently, they provide further support for the level syllable structure.

3.3. Conclusion

In this chapter, I have shown that a level syllable structure is compatible with the various types of stress systems found in the world’s languages. These include languages that always stress the same syllable, languages in which stress is attracted onto a branching nucleus, languages in which stress is attracted onto a closed syllable, languages in which stress is attracted onto a heavy syllable, and languages in which there are onset-sensitive stress rules. A level syllable structure has a number of advantages over other possible syllable structure analyses. First, for languages where stress falls on the same syllable or on a long vowel, the nucleus can be projected directly (in rules of stress construction) without having to ignore the rhyme. Second, there is only one type of syllable structure (i.e., the level one). This is contrary to the view of both Vennemann (1984) and Pigott and Singh (1984). Vennemann proposes that phonological processes determine syllable structure; consequently, as previously discussed, there can be two (or maybe more) different syllable structures within the same word (and even within the same syllable). Pigott and Singh (1984) propose that languages where long vowels are stressed have internal labelled constituents within the rhyme (i.e., a nucleus and a coda), while languages in which any heavy syllable is stressed have no labelled constituent structure within the rhyme. A single level syllable structure, though, obviates the need for a multitude of syllable types. Third, the use of projections for stress rules can be limited to only structural units. This is contrary to Hayes (1981) who has proposed that, for stress, either [+syll] or the rhyme can be projected. But these are very different types of projections, the former being a segmental feature and the latter being a structural unit. By having a level syllable structure, stress construction projections can be limited to just structural units. In the more common case, only the nucleus is projected. This accounts for the great majority of languages, according to Hyman’s (1977) survey, in which stress falls on the same syllable or one with a branching nucleus. In the less common case, either one of the two other constituents can be
projected (in addition to the nucleus). Thus, for English, the coda is projected, and, in Western Aranda, the onset is projected. And fourth, as previously discussed, it is only an analysis incorporating a level syllable structure that can account for the different onset-sensitive stress languages considered in section 3.2. These four advantages, then, constitute support for the level syllable structure analysis.

It should be emphasized, though, that just because syllable structure seems to be level does not rule out the possibility that rules can refer to only the elements within the nucleus and the coda. Under the view taken here, such rules would not be evidence for the constituency of the rhyme, but are just rules that make reference to elements within the nucleus and the coda. (Of course, there is always the possibility—discussed in chapter two concerning phonetic spreading rules—of describing a rule or process as sensitive to syllable structure when, in fact, it is not.) For example, many instances of rules stated in terms of rhyme structure but probably better expressed (without any loss of generalization) in terms of a level structure can be found in Halle & Mohanan (1985). I consider here two examples. Halle & Mohanan give the following rule for English that lengthens nonhigh vowels (p.78):

\[
\begin{array}{c}
\text{Nucleus} \\
\phantom{x}
\end{array}
\begin{array}{c}
\text{Nucleus} \\
\phantom{x}
\end{array}
\begin{array}{c}
\text{Rime} \\
\phantom{x}
\end{array}
\begin{array}{c}
\text{Rime} \\
\phantom{x}
\end{array}
\begin{array}{c}
\text{[-high]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-high]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-cons]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-cons]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-stress]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-back]} \\
\phantom{xx}
\end{array}
\end{array}
\]

This rule lengthens a nonhigh vowel (before vowel shift) in such pairs as felony-felonly and Caucas-Caucasian (where the underlined vowel is the vowel affected by the rule). The level syllable structure version of this rule would just make reference to the nucleus, and the feature [-cons] would not have to be specified in the structural change, as below:

\[
\begin{array}{c}
\text{Nucleus} \\
\phantom{x}
\end{array}
\begin{array}{c}
\text{Nucleus} \\
\phantom{x}
\end{array}
\begin{array}{c}
\text{Rime} \\
\phantom{x}
\end{array}
\begin{array}{c}
\phantom{x}
\end{array}
\begin{array}{c}
\text{[-high]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-cons]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-stress]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-back]} \\
\phantom{xx}
\end{array}
\end{array}
\]

Halle & Mohanan (1985:73) also give the rule in (54) that tenses any long vowel or diphthong.

\[
\begin{array}{c}
\text{[-cons]} \\
\phantom{x}
\end{array}
\begin{array}{c}
\phantom{x}
\end{array}
\begin{array}{c}
\text{[+tense]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\phantom{x}
\end{array}
\begin{array}{c}
\phantom{x}
\end{array}
\begin{array}{c}
\phantom{x}
\end{array}
\begin{array}{c}
\text{[-cons]} \\
\phantom{xx}
\end{array}
\end{array}
\]

Their rule can be more simply stated in terms of a level syllable structure, as follows:

\[
\begin{array}{c}
\text{Nucleus} \\
\phantom{x}
\end{array}
\begin{array}{c}
\text{Nucleus} \\
\phantom{x}
\end{array}
\begin{array}{c}
\text{Rime} \\
\phantom{x}
\end{array}
\begin{array}{c}
\phantom{x}
\end{array}
\begin{array}{c}
\phantom{x}
\end{array}
\begin{array}{c}
\text{[-high]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-cons]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-stress]} \\
\phantom{xx}
\end{array}
\begin{array}{c}
\text{[-back]} \\
\phantom{xx}
\end{array}
\end{array}
\]

Moreover, Halle & Mohanan's version of the rule violates Hayes' (1984b:25) proposed linking constraint, whereas
the formulation in (55) does not. The linking constraint states, "Association lines in structural descriptions are interpreted as exhaustive." This means that Halle & Mohanan's rule in (54) only applies if the rhyme just contains two [-consonantal] elements. However, the rule, in actuality, also applies if the rhyme has more elements in it - i.e., hate [hæyt], paint [peɪnt]. By just specifying that it is only the elements within the nucleus that are important in this rule (as in (55)), the linking constraint is not violated; Halle & Mohanan are unable to do this since they do not view the rhyme as having labelled constituents.

In fact, many of the other English rules in Halle and Mohanan (1985) violate Hayes' (1984b) linking constraint or are more simply stated in terms of the level syllable structure. Moreover, the two rules in Halle & Mohanan in which the rhyme crucially contains a consonant in the structural description can also be stated just as easily with a level syllable structure (though one wonders if they should refer to syllable structure at all). Consider just the one rule of m-tensing (p.75) given below:

\[
(56) \quad \overset{\text{[+tense]}}{\text{\text{\$}}} \quad \overset{T}{\text{X}} \quad \overset{C}{\text{\text{\$}}} \quad \overset{R}{\text{X}}
\]

where \(C=[\text{+[voice, -son, -cont]}\)

This rule captures the apparent phonetic fact that for some dialects of English [æ] is lax before word final voiceless stops and tensed before other word-final consonants. In terms of a level syllable structure, the rule could be stated as in (57):

\[
(57) \quad \overset{\text{[+tense]}}{\text{\text{\$}}} \quad \overset{T}{\text{X}} \quad \overset{C}{\text{\text{\$}}} \quad \overset{R}{\text{X}}
\]

Nucleus Coda

From this example, then, it is seen that it is possible for a rule to refer to the nucleus and coda. Such examples are not deviant under the level syllable structure analysis.

In conclusion, the level syllable structure is the only syllable structure type that is compatible with all the different stress systems discussed. In addition, a level syllable structure does not prohibit rules like (57), above. In the following chapter, I consider external evidence for subsyllabic constituency from phonological movement processes and show that the data from these provide further support for a level syllable structure.

---

9. Perhaps this rule is better stated linearly \(\overset{\text{[+tense]} C}{\text{\text{\$}}}\), where the consonant is specified as being a voiced, oral stop (since this rule is a quality rule and not a quantity rule (at least for Halle & Mohanan who eliminate the feature [+-tense] from underlying representations--p.76). Hayes (1984b) has argued that rules that refer just to quality (and not to quantity) should be stated on the segmental tier.
4.0. Introduction

In chapter three, I argued that the evidence from the various types of stress systems supports a level syllable structure in which the onset, the nucleus, and the coda are the only constituents. In this chapter, I argue that the level syllable structure finds additional support from phonological "movement" or displacement phenomena. Specifically, I show that the data from the transposition processes involved in speech errors and language games are more compatible with a level syllable structure than they are with other possible subsyllabic structures. Consequently, movement phenomena provide strong external evidence in support of the proposed level syllable structure.

4.1. Speech Errors

4.1.0. Introduction

Speech errors often involve the switching of (a sequence of) segments. If it is assumed that a segment or a sequence of segments involved in such speech errors comprises a single constituent, then, speech errors would provide evidence for the reality of phonological constituents. There are a number of different types of movement errors that occur. The three main types are interchange or exchange errors, anticipation errors, and

---

1. One other possible movement (or, rather, copying) phenomenon is the morphophonological process of reduplication. Recent work on reduplication by Moravcsik (1978) and Marantz (1982) have shown that languages usually do not copy a subsyllabic constituent (though syllables are reduplicated in some languages). Instead, reduplication normally refers only to the consonantality and vowelhood of a linear string of segments, and therefore, does not provide evidence for subsyllabic constituency. Consider, for example, a language like Squamish (Kuipers 1967), in which plurals can be formed by reduplicating an initial CVC-sequence. Such a sequence cannot reflect upon subsyllabic constituency since the second consonant may be originally in the initial syllable (as in lam? 'house' whose plural is lamlam?) or in the second syllable (as in k'axa 'box' whose plural is k'ax k'ax a). Thus, reduplication is best understood as copying a specified string of consonants and vowels and not a subsyllabic constituent.
perseveration errors. Interchange errors involve the exchange of a phoneme (or phonemes) between two words (or between phonemes in the same word, but this is not common). These are exemplified in (1a) (where the underlined phonemes are involved in the error). Anticipation errors occur when a phoneme in a later word is anticipated in a preceding word, as in (1b). And perseveration errors occur when a phoneme in the first word is repeated in a following word, as in (1c). (Unless otherwise indicated, all speech errors cited are from the appendix of Fromkin (1973), the MIT corpus as reported by Shattuck-Hufnagel (1982, 1983), or from Stemberger (1983).)

(1) a. taught courses → caught torses
   stiff neck → stick neff
   bed bugs → bud begs
   b. reading list → leading list
   group three → grep three
   with a brush → wish a brush
   c. phonological rule → phonological fool
   king, queen → king queeng
   beef noodle → beef needle

Fromkin (1971) argues that speech errors provide evidence for the reality of the phoneme, the syllable, and distinctive features (in addition to abstract phonological representations and morpheme structure conditions). For example, according to Fromkin, the fact that the great majority of speech errors (be they interchange errors, anticipation errors, or perseveration errors) involve the movement of units the size of the segment (as in (2)) supports the reality of the phoneme (or, at least, at some level of the production process utterances are represented as strings of phonemes).

(2) a. keep a tape      teep a cape
    b. dad hmp            odd hack
    c. also share         alsho share
    d. gave the boy       gave the goy

The fact that in the majority of speech errors a syllable-initial segment exchanges with a syllable-initial segment, the vowel exchanges with a vowel, and the syllable-final consonant exchanges with a syllable-final consonant provides evidence for the reality of the syllable (see (1a)). And the fact that phonological features can interchange in speech errors (as in (3)) provides evidence for the reality of distinctive features.

(3) a. (cedars of) Lebanon → Lemadon
    b. clear blue sky → clear blue sky
(In (3a) the nasality feature interchanges, and, in (3b), the voicing feature interchanges.)
Moreover, Stemberger (1983) argues that speech error data provide evidence that English truly has ambi-
syllabic consonants. It has previously been mentioned
that syllable-initial consonants interact with each
other (in speech errors) and syllable-final consonants
interact with each other. Stemberger shows that ambi-
syllabic consonants interact with both. (Consonants
that Stemberger considers ambi syllabic are intervocalic
consonants between a stressed vowel and an unstressed
one.) In 180 speech errors involving such consonants,
102 involved interchanges between the ambi syllabic conso-
nant in one word and the syllable-initial consonant in
another, while the remainder involved an interchange
between the ambi syllabic consonant of one word and the
syllable-final consonant of the other. Such data seems
to provide evidence for the existence of ambi syllabic
consonants for English.

Thus we see that speech errors have been used
to support different phonological hypotheses. In the
rest of the section on speech errors, I consider to
what extent speech errors support the constituency of
the rhyme in particular, and subsyllabic constituency in
general. But before discussing the relationship be-
tween speech errors and constituency. I first discuss
general problems in the use of speech errors as
evidence. ²

4.1.1. Some Problems With the Use of Speech Errors as Evidence

Linguists who work on speech errors have used
them in arguing for or against various hypotheses. The
speech error data, though, often has more than one
interpretation. One such case involves Stemberger’s
evidence for ambi syllabic consonants just discussed. A
second interpretation of his data is possible that does
not support ambi syllabic ity. The 102 cases where an
(alleged) ambi syllabic consonant in one word interchanges
with an onset consonant in another word may in fact just
involve onset consonants (the so-called ambi syllabic
consonant in these words is really just an onset con-
sont). Likewise, for the 78 errors that involve the
coda consonant of one word and the (alleged) ambi-
syllabic consonant of another, such errors may just
involve coda consonants (the so-called ambi syllabic
consonant in these words is just a coda consonant). Both
the interpretation suggested here and Stemberger’s are

² The discussion of speech errors in this chap-
ter involves English errors. This is mainly due to the
availability of a large literature on English speech
errors. I am assuming that the conclusions derived from
this section on English speech errors apply also to
other languages.
quite possible. (Stemberger’s case for ambisyllabic consonants can be made stronger if he can show that the same "ambisyllabic" consonant sometimes interchanges with onsets and sometimes interchanges with codas.)

Besides problems in interpreting the speech error data, there are also perceptual problems in recording speech errors. One of these relates to the high frequency of speech errors in stressed syllables. Cutler (1982) warns against perceiving significance in this, and suggests that, in all likelihood, this is because sounds in stressless syllables are difficult to detect. Cutler also mentions that certain errors are more readily detectable than others. Most prominent among these are feature errors (as opposed to anticipation or perseveration errors). All of these perceptual problems which Cutler discusses may bias the listener who is gathering the speech error data, and consequently, may lead to wrong interpretations.

In addition to perceptual problems which can bias the recording of speech errors, there are also factors that may influence the production of speech errors. For example, Cutler (1982:22) mentions the possible role of rhythm in speech error production when she suggests that "... syllable omission errors ... invoke a tendency towards underlying rhythmicity in

English utterance." Speech errors involving insertion may also be due to rhythmic factors, as the error in (4), recorded by the author, shows:

(4) Persian origin ---→ Persian origin
[pəɾiʃın əɾiʃın] [pəɾiʃın əɾiʃın]

The vowel insertion in the first word in (4) makes that word much more like the second word rhythmically.

Besides possible rhythmic influences affecting speech error output, Dell and Reich (1981) have demonstrated convincingly that there is also a strong lexical bias influencing speech error output. That is, the output of speech errors tends to be already existing words. Dell and Reich compared real speech errors to those that could have been produced (given the same target utterance) but were not. They found that the anticipation errors and the perseveration errors made consisted of actual words by greater than chance frequency. As for interchange errors (which normally involve at least two words) the error of the first word created an actual word by greater than chance frequency, while the error of the other word (or words) often produced a nonsense form. In other words, the first part of an interchange error usually is an already occurring word, while the second part often is not.

Thus, Dell and Reich show that there is a strong lexical
bias in speech errors. They also prove that Fromkin's observation (concerning her own data) that about 60% of the forms in her speech error data are nonsense utterances, is not contrary to their conclusion. First, they note that many of the nonsense utterances in her corpus are part of interchange errors (and, as noted, it is only the first part of the interchange that, by greater than chance, is an actual word), and second that the perseveration errors and anticipation errors in Fromkin's corpus form already existing words by greater than chance frequency. That speech errors tend to create already existing words is often not taken into account in speech error studies. However, it is unclear what influence this should have on studies that relate speech error evidence to the existence of phonological units. Nonetheless, all of these factors affecting the production and recording of speech errors should be considered when examining (or collecting) a speech error corpus.

4.1.2. Speech Error Evidence And the Rhyme

In the preceding section I mentioned some problems in the use of speech errors as evidence. Nevertheless, speech errors have been used as evidence for the reality of phonemes, phonological features, syllables, and ambisyllability. Let us now turn to the question of syllable-internal constituency; we first consider the speech error evidence claimed to support the rhyme. Afterwards, I discuss speech error evidence for subsyllabic constituency, in general.

A number of linguists working on speech errors explicitly state that such errors support the existence of the rhyme as a subsyllabic constituent. However, in actuality, the speech error data is equivocal on the constituency of the rhyme. Sussman (1984:100) alludes to this when he observes that, "Exchange errors involving the rhyme component of the syllable are comparatively rare in speech errors." Most exchange errors involve interchanges of onsets, of nuclei, or of codas. In spite of this, arguments have been put forward from speech error evidence to support the rhyme. For example, Stemberger (1983) argues that the fact that more speech errors involve the exchange of VC-sequences (as in (5)) than the exchange of CV-sequences (as in (6)) constitutes evidence for the rhyme as a subsyllabic constituent.

\((5)\) a. heap of junk \(\rightarrow\) hunk of jeep
b. my sock has a hole \(\rightarrow\) my sole has a hock

\((6)\) a. pitch and stress \(\rightarrow\) stretch and piss
b. edge of his wit \(\rightarrow\) widge of his et

But the data in (5) have at least two other possible interpretations. The first is that the rhyme is not being referred to, but rather, the rest of the word
(after the onset). Shattuck-Hufnagel (1983:120) points to errors like "Hairc and Cloward" for "Howard and Claire" that involve interchanges of everything after the onset and implies that errors involving rhyme interchanges (and nearly all of these involve monosyllabic words) are possibly errors like the one just cited involving the rest of the word. The second possible interpretation (of the errors in (5)) is that two interchange errors are happening at the same time. The nuclei of the two words interchange, and the codas of the two words interchange. This is parallel to (7) (recorded by the author) where two different perseveration errors occur in the same phrase.

(7) stress clash → stress cress

The fact that both [ɔ] and [s] have moved in this perseveration error would not necessarily reflect on their comprising a constituent; rather, there are simply two perseveration errors involving two different phonemes. In much the same way it is quite possible that the speech errors in (5) each involve interchanges of two different sets of phonemes (and not of one subsyllabic constituent). That speech errors like those in (5) are comparatively rare (according to Shattuck-Hufnagel (1983)) is not surprising under the interpretation that two different sets of phonemes are being interchanged. If a single subsyllabic unit (i.e., the rhyme) was being interchanged one would expect more of such errors. The lack of such errors does not actually argue against the existence of the rhyme, but it makes a second interpretation (i.e., that two different sets of segments interchange) a strong possibility.

Another argument for the rhyme put forth by Stemberger is taken from the observation that most speech errors involve syllable onsets. He suggests that this is because speech errors tend not to break up higher units (like the rhyme). Thus speech errors are less likely to involve the nucleus alone or the coda alone since such errors would break up the rhyme constituent. The same observation has been noted previously by MacKay (1972:219) who essentially proposed a division of the syllable into two groups, onset and rhyme (though he did not label them as such) based on such speech error evidence.

The [initial] consonant cluster must represent one of these groups since breaks separated consonant clusters less often than would be expected by chance. Final consonant(s) must form another group with the vowel since breaks rarely fell between final consonant(s) and the vowel.

However, that onsets are prominent in speech errors may be due to their being word-initial. In addition, the high frequency of errors involving the interchange of onsets
only supports the onset as a constituent. It is not the nucleus and the coda alone that are unaffected by onset errors, rather it is the rest of the word. This is most apparent in speech errors where onsets from two words interchange, and at least one of the words is not monosyllabic. Thus, examples like 'damage claim' being erroneously pronounced as 'clamage Dame' and 'finger spell' as 'spinger fell' indeed show that it is the whole rest of the word that remains the same and not just nucleus and coda.

Crompton (1982) gives two arguments for the rhyme constituent. First, he notes that no reported errors involve the interchange of the nucleus and the coda (in the same syllable), such as the target utterance "field" [fiyl] being realized as [fldly]; consequently, the nucleus and the coda are not independent units. But note, however, the same would hold for onset and nucleus. To my knowledge, no such interchanges between onset and nucleus (in the same syllable) are recorded in the various corpuses. There are no errors in which a target utterance like "pick" [pIk] is realized as [Ipk]. Probably no errors involving an interchange of a tautosyllabic onset and nucleus or a tautosyllabic nucleus and coda occur because they would usually involve violations of phonotactic constraints. And, as Fromkin (1971) and others have observed, speech errors do not normally result in phonotactically deviant utterances. Crompton's second argument for rhyme constituency (similar to one of Stemberger's) is that in exchange errors the rhymes can be interchanged. He cites examples from Fromkin (1973) to demonstrate such interchanges. He fails, however, to discuss the errors involving the interchange of CV-sequences (between two syllables) that are mentioned by Fromkin.

In sum, the main argument that emerges from the speech error evidence for the rhyme constituent is that in some exchange errors VC-sequences from two different syllables are transposed. The other arguments adduced (i.e., the frequency of onset errors and the lack of interchange errors between the nucleus and the coda in the same syllable) have shortcomings that I have already pointed out.

4.1.3. Speech Error Evidence and Subsyllabic Constituency

In this section, I argue that the speech error evidence provides support for a level syllable structure. First I show that the occurrence of interchange errors involving VC-sequences (as in (5)) does not constitute evidence for the rhyme. Rather, I argue that interchange errors, in general, provide strong support for a level syllable structure. Further evidence for this
view comes from elicited speech error experiments; these speech errors almost never involve rhyme interchanges. Finally, I briefly discuss other types of speech errors besides interchanges (such as blends and deletions) and show that they do not bear on subsyllabic constituency.

While it is the case that some speech errors involve the interchange of tautosyllabic VC-sequences (as in (5)), in all the corpora on English speech errors, there are errors involving CV-sequences (as in (6)). Fromkin (1971:33) observes this when he states "... a CV or VC sequence which is part of a syllable can be involved in speech errors." Hence, it seems that if the existence of transpositions of VC sequences argue for their comprising a constituent, then transpositions of CV sequences would argue for the onset and the nucleus forming a constituent (ignoring the problems of ambiguous interpretations discussed in 4.1.1). But, then, this would constitute a situation of double motherhood for the nucleus (i.e., the nucleus would form one constituent with the onset and another one with the coda).

A stronger case against the use of VC interchanges as evidence for the rhyme comes from the work of Shattuck-Hufnagel (1980, 1982, and 1983). Based on the MIT speech error corpus, she notes that errors involving the interchanges of VC-sequences or CV-sequences are rare by making the observation that (1980:32), "... spontaneous speech errors often involve individual phoneme-like segments, but seldom larger syllabic components containing both consonants and vowels." She relates thus to subsyllabic constituency (1982:140), "The predominance of single segment units among sublexical errors suggest that syllable constituents made up of either Cs or Vs are the normal unit of sublexical ordering" (emphasis is added). Interchanges of VC-sequences or CV-sequences are indeed quite rare. Shattuck-Hufnagel gives the following figures based on the 1981 speech error corpus:

- 68% of the errors involved exchanges of single segments—and most of these involved onset segments (Cutler (1982) notes that speech errors involving onsets are easiest to perceive).
- 16% of the exchange errors involved consonant clusters.
- 3% of the exchange errors involved syllables.
- 8% of the exchange errors involved CV-sequences or VC-sequences (6% the latter and 2% the former).

The remainder of the exchange errors involved other combinations.

Thus, it is only a small percentage of exchange errors that would make reference to the rhyme.

The above figures, as Shattuck-Hufnagel (1983: 117) notes, can be taken to support a rhymeless representation of the syllable that has an onset, a nucleus, and a coda as its constituents: "... the hypothesis
that the syllable onset, nucleus, and coda are the primary units of sublexical serial misordering accounts for a higher proportion of sublexical exchange errors than does the single-segment hypothesis or the onset and rhyme hypothesis." Specifically, the onset-rhyme hypothesis is unable to handle the occurrence of errors between CV-sequences. Further, if the rhyme has no labelled constituents (as Hayes (1981) assumes), then interchange errors between nuclei and interchange errors between codas and unexpected. And also, the relative scarcity of rhyme interchange errors in the speech error data would be difficult to account for assuming the onset-rhyme hypothesis.

The "single-segment hypothesis" (i.e., the hypothesis that the syllable just consists of a linear string of segments with no internal structure) faces problems when more than single segments are involved in interchange errors. Particularly problematic for this hypothesis is the interchange errors involving consonant clusters since all of these involve interchanges of onset clusters or interchanges of coda clusters. The single-segment hypothesis would predict randomness. For example, possible errors in which heterosyllabic clusters are involved (like in the fabricated Cholky and Hansy for Chomsky and Halle) should be as common as exchange errors involving onset clusters or coda clusters; but exchange errors involving heterosyllabic clusters never seem to occur.

The level syllable structure hypothesis, though, can account for most of the exchange errors. In particular, it nicely accounts for the fact that consonant cluster exchanges involve onsets or codas but not heterosyllabic clusters. Further, errors involving a CV-sequence or a VC-sequence can be interpreted as errors in which two constituents are involved (the onset and the nucleus in the former and the nucleus and the coda in the latter). That these errors are rare is not surprising since it would be expected that errors involving two different constituents would be much less frequent than errors involving single constituents. The only type of exchange error that the level syllable structure hypothesis fails to predict are the errors that split up an onset cluster or a coda cluster. Nonetheless, a representation of the syllable that recognizes the onset, the nucleus, and the coda as the only subsyllabic constituents can account for more of the speech error data than one that divides the syllable into onset and rhyme (or one that recognizes the single-segment hypothesis). Thus, this constitutes strong support for a level syllable structure over other possible structures.
Most of the work on speech errors has focused on errors occurring in the normal flow of discourse; some recent work by Shattuck-Hufnagel, though, has focused on speech errors elicited through tape recorded experiments. These experiments involve having subjects read tongue-twisters consisting of English nonsense forms into a tape, and, subsequently, having the subjects recite the tongue-twisters from memory. This method has the apparent advantage of controlling for possible semantic (or even psychological) interference. Thus, all errors elicited in such experiments are, presumably, phonologically caused.

The main result that can be drawn from Shattuck-Hufnagel's (1980, 1983) speech error elicitation experiments is that the rhyme plays no role in such speech errors. In the 1980 elicitation experiment, in which subjects were asked to repeat the made up tongue-twister "pan fill fun poll," 95% of the elicited speech errors involved single segments, while the remainder of the errors involved CV-sequences, VC-sequences, or syllables. In another experiment, Shattuck-Hufnagel (1983) made up twenty four-syllable tongue-twisters designed to produce speech errors. Subjects read each tongue twister three times and then repeated it from memory. Shattuck-Hufnagel found that 99% of all interchange errors elicited involved single segments and not strings of segments. (There were no onset clusters or coda clusters in her made up tongue-twisters.) In noninterchange errors single segments were involved over 95% of the time, and other sequences were involved less than 5% of the time. She concludes that (1983:122), "... the error units CV and VC are clearly not functional here." Thus, Shattuck-Hufnagel's data does not support a rhyme constituent. Her data, though, taken together with the natural occurring interchange errors, provide support for a level syllable structure.¹

Besides interchange errors, other less-common types of speech errors do not seem to bear on the issue of subsyllabic constituency. Anticipatory errors and perseveration errors almost always involve just a single segment, and hence, cannot reflect on the constituency of a linear string of segments.

Another (not so common) speech error type involves blends. These occur when the speaker has in mind two words that express the same concept, and thus produces

³ Withgott's (1982) elicitation experiments do not bear on subsyllabic constituency. Because of the nature of her nonsense tongue-twisters, almost all of her elicited errors were perseveration or anticipatory errors (there was only one interchange error). These errors always involved single consonants and single vowels, and thus do not seem to reflect upon constituency.
them as a single combined form. Two examples from Fromkin (1973) are given in (8):

(8) a. states [stɛːz] \(\rightarrow\) [stɛz]
says [sɛz]
b. switched [swɪtʃ] \(\rightarrow\) [swɪnd]
changed [čenʃd]

The first example in (8) illustrates that the onset of the first word combines with the nucleus and the coda of the second word, while the second example illustrates that the onset and the nucleus of the first word combine with the coda of the second word. Both these types of blends are common. If, though, we focus on blends involving polysyllabic words, it becomes quite evident that subsyllabic constituency actually has no role in the formation of blends. As the examples in (9) illustrate, blends can combine the first part of one word with the latter part of the second word. However, the exact division point varies. It could be after an onset consonant as in (9a), after a nucleus as in (9b) or (9b), or after a syllable boundary as in (9a). In fact, the division may occur after any segment. The examples in (9) should make clear, though, that the parts of the blends do not by themselves necessarily form a (subsyllabic) constituent.

(9) a. adjoining [ˈʃoːjəniŋ] \(\rightarrow\) [ʃoːjənt]
    adjacent [əˈʃeɪnt]

b. recognize [rɛkəˈnɛz] \(\rightarrow\) [rɛkɑɬiŋkt]
    reflect [rɪˈfiːkt]

Thus blends do not seem to have any bearing on the issue of subsyllabic constituency.4

Another type of speech error involves deletion (sometimes referred to as haploglosses). If in syntax deleted units comprise constituents, perhaps the same holds for phonology. In fact, Fromkin (1971:40) argues for the syllable as a significant unit in phonology on the basis of speech errors as in (10):

(10) a. revealed the generalization \(\rightarrow\) reeled the generalization

b. tremendously \(\rightarrow\) tremenly

In these errors entire syllables are deleted. As for the rhyme, there do not appear to be any reported cases of speech errors that involve its deletion. However, it is unclear to what extent speech errors in which segments are deleted bear on the question of constituency, because

4. Janda (1965) proposes an autosegmental analysis of blends in which the two target words are on different autosegmental tiers, and part of each word is linked to the CV-skeleton. This analysis predicts possible blends. All the speech error blends (except one) I have seen cited are possible by his analysis. His analysis does not crucially make reference to syllable structure.
when such speech errors do occur they never seem to complicate the sound structure. If a rhyme (or nucleus) were deleted, the result would be at least two consonants coming together creating a cluster, and it is quite possible that such a cluster would be phonotactically deviant. Speech errors, though, rarely violate phonotactic constraints. Hence, even though speech errors involving omission sometimes delete whole syllables, it is unclear, what, if anything, the handful of errors of this type tell us about subsyllabic constituency.

Another way of looking at deletion errors is not to consider what has been omitted, but rather, to consider what has combined after the omission has taken place. Consider the additional data in (11):

(11) a. shrimp and egg (souffle) $\rightarrow$ shigg (souffle)

b. Herb Alpert $\rightarrow$ Halpert

In (11a), the form "shigg" consists of the onset and the nucleus from shrimp combined with the coda from egg, while the form "Halpert" (in (11b)) consists of the onset from the name Herb combined with Alpert. These are similar to blends in that segments that combine do not have to form subsyllabic constituents (as in the example "Halpert" in which the second part is bisyllabic, or in the example (10b), in which a bisyllabic sequence comes together with a monosyllable after deletion has occurred). Consequently, speech errors involving deletions fail to provide evidence for subsyllabic constituency.

4.1.4. Conclusion

In this section, I have argued that the evidence from speech errors (specifically interchange errors, since, as discussed, other types of speech errors do not seem to reflect upon subsyllabic constituency) does not support an onset-rhyme syllable structure, but rather, provide support for a syllable structure consisting of just the onset, the nucleus, and the coda. This is because exchange errors, whether naturally-occurring or elicited, rarely involve the nucleus and the coda together, and when they do, they have other possible interpretations besides the one in which they are interpreted as comprising a constituent (as was discussed in section 4.1.2 and 4.1.3). Moreover, as Shattuck-Hufnagel (1983) has pointed out, it is only a syllable incorporating an onset, a nucleus, and a coda as subsyllabic constituents that captures the highest percentage of speech error data, "...the hypothesis that the syllable onset, nucleus, and coda are the primary units of sublexical serial misordering accounts for a higher proportion of sublexical exchange errors than does the
single-segment hypothesis or the onset and rhyme hypothesis." (p.117) Thus, exchange errors tend to support a level syllable structure over other possible subsyllabic structures.

In the following section, I consider the movement phenomena involved in language games and argue that they, too, provide support for a level syllable structure.

4.2. Language Games

4.2.0. Introduction

Another phenomenon in which the systematic movement or displacement of a string of phonemes often takes place are language games, sometimes referred to as play-languages, secret languages, or ludlings. In this section I investigate the issue of whether or not the types of segmental movement or displacement in language games provide evidence for subsyllabic constituency. I first present a brief typology of language games, and, subsequently, argue that language games provide evidence for a syllable structure containing only the onset, the nucleus, and the coda as subsyllabic constituents.

5. I ignore language games that do not play on the phonological form of the word. These include Tjiliviri the ritual language of Walbiri described by Hale (1971) in which Walbiri words have their opposite meanings, and the Hindi argots of various subclasses described by Mehrorta (1977).

4.2.1. Typology of Language Games

Laycock (1972) suggests that language games can be described in terms of one or more of the four following mechanisms: expansion, contraction, substitution, and rearrangement. In this section I categorize language games from over twenty different languages (based on a variety of sources) in terms of these mechanisms. In section 4.2.2 I discuss their relevance for subsyllabic constituency.

4.2.1.1. Expansion

Language games that make use of expansion derive words from the actual language by affixing a (language-specific) group of phonemes to some part (or parts) of a word. For example, some language games form their words (from the real language) by inserting the specified phonemes before or after one or all syllables. Mohanan (1982) reports that Malayalam has a language game in which pa- is prefixed before each syllable of a Malayalam word in order to produce the language game word. Thus, the name "Moohan" has the realization "pamoopahanan" (where the inserted sequence is underlined). In other language games a string of segments is suffixed to each syllable of the actual word. This occurs in the Bantu language Luvale in which, according to White (1955), the sequence -ti is inserted after every syllable to derive
the forms in the language game. Thus, the Luval expression ‘ami ngunakuzangi’ (I like you) has the language game form ‘atimici ngutinicatorizatingiri’. Another instance of a language game where the syllable is important is the game Burling (1970) mentions for Egyptian Arabic. In Egyptian Arabic, the language game word is derived by inserting the sequence -tinV- before the last syllable of the word (where V of the tinV sequence is filled by the preceding vowel of the Egyptian word). Thus, 'huwa yedihali' (he gives me) is realized as 'hutinuwa yedihatinali' in the language game. And, finally, in one of the Finnish language games described by Campbell (1980), the sequence -tä- is inserted after the first syllable. Hence 'jonglööri' (juggler) is realized as jongtälööri.

Besides insertion before or after syllables many language games insert a sequence of segments before or after a part of the syllable. In a Tagalog language game, Laycock (1972:70) reports that -pi- is inserted after every CV sequence (not after every syllable) of actual Tagalog words in order to produce the language game words. Thus, the Tagalog word ‘tubig’ is realized as ‘tupibig’ in the language game. Similarly, for Spanish, Sherzer (1982:187) reports a language game in which -fu- is inserted after every CV sequence in the Spanish word in order to obtain the language game word (where V in -fu- stands for the preceding vowel of the Spanish word). For example, the Spanish word 'grande' is realized as 'grafandefe'. While Tagalog and Spanish have language games that insert a consonant-vowel sequence after a vowel, Chinese has a language game that inserts a vowel-consonant sequence before a vowel. In one of the Chinese language games described by Yip (1982) -ayk- is inserted after the onset (i.e., before the vowel). Thus, the Chinese word 'pey' is realized as 'paykey' in the language game.

A different possibility for the location of the inserted segment is found in the Japanese-based "babibu" language game, described by Haraguchi (1982). To form a babibu word, the sequence -by- is inserted after each mora of the Japanese word (where V is filled by the vowel of the preceding mora--if the preceding mora has no vowel then the vowel /u/ fills the V-slot). Thus, the babibu counterpart of the Japanese words 'asita' (tomorrow) and 'minna' (everyone) are 'abasibitaba' and 'mibinbunaba', respectively.

So far we have seen that in creating language game forms, a sequence of segments can be inserted before syllables (as in Malayalam), after syllables (as in Luval), before vowels (as in Spanish), or after vowels
(as in Chinese); and in mora-sensitive languages, insertion may occur after each mora (as in Japanese). English is recorded as having a number of language games that reflect some of these possibilities. One such game is the ap-insertion game as reported by Burling (1970) in which -ap- is inserted before the vowel (i.e., after the onset) of each syllable. Thus, in the ap-game, the phrase 'He will give it to me' is rendered as [hapiy wapi1 gapi4 apIt taguw mapiy]. Laycock (1972:74) reports another language game for English in which the sequence -gv- is inserted after every vowel. Hence, the phrase 'Shall we go away' is realized as "Shagall wego gogo agawaygay". Another English language game mentioned by Laycock is the 'alfalfa' game. To form a word in this game one inserts al after the first syllable, fal after the second syllable, and fa after the third syllable. Thus, in this game the expression 'better late than never' is realized as 'betalterfal latefa thanal nefalverfa'.

In sum, language games that make use of the mechanism of expansion may insert a specified sequence of segments before or after syllables, after onsets, after vowels, or after moras (in languages that are sensitive to them); no language games to my knowledge insert segments between consonants in a tautosyllabic consonant cluster. However, the type of sequence inserted seems to vary depending on the place of insertion. In the language games of Tagalog and Spanish, where insertion occurs after a vowel, the inserted element begins with a consonant (-pi- and -fu-, respectively). On the other hand, when the inserted sequence begins after an onset the sequence begins with a vowel, as in the English -ap-game and the Chinese -ayk-insertion game. The obvious generalization that follows from this is that, in language games in which words are formed by insertion, the syllable structure basically tends to remain CV and not become more complex.

4.2.1.2. Contraction

A second mechanism that is employed in forming language game words is contraction (or deletion). It is rare, though, for the forms in a language game to be systematically derived from the real language by the contraction (of parts) or words. Language games in which contraction is productively used are found in Murut and Javanese. The forms in the Murut language game, according to Laycock (1972:78), are derived by deleting all or part of final syllables of Murut words. For example, the Murut phrase 'mapanday kow kia ra ragu nu Murut' (Laycock does not provide a translation) is realized as 'mapan ko ki ra rag nu Mur' in the language game. It appears that the entire last syllable deletes
if what is left is a closed syllable (judging from the word 'mapanday'), if it is not, all but the onset of the last syllable deletes (as in 'ragu' and 'Murut')—monosyllabic words are problematic.

Javanese has two language games that involve deletion. In the game mentioned by Laycock (1972:78), the first syllable of the word deletes as seen in the following (obscene) Javanese expression: silit ku kepet dilaten → lit ku pet laten. In addition to this game, Sherzer (1982:184-185) mentions another Javanese language game which resembles the Murut game. In it, final syllables seem to delete if what is left is a closed syllable; otherwise, the onset of the final syllable is retained (i.e., the final rhyme deletes). Sherzer provides the following example of the Javanese expression for "I am going to go": aku arep lugo → ak ar luj.

4.2.1.3. Substitution

Another mechanism that language games sometimes make use of is substitution. However, like contraction, the productive use of substitution as the sole means of creating the forms in a language game is rare. Three cases where substitution is employed are in a Hanunoo language game, an Amharic language game, and a Maracaibo Spanish language game. Conklin (1959) describes a Hanunoo language game in which [ŋ] substitutes for the word-final consonant(s). If there is no word-final consonant, [ŋ] is added. Thus, the Hanunoo phrase 'kanta kantagbug' is realized as 'kantą́ kantagbug' in the language game. A second language game that utilizes this mechanism is found in Amharic. In this language game, as reported by Laycock (1972:79), an initial consonant is substituted by [m]. Thus, the Amharic words, günźáb and kəfu, are realized in the language game as mínźáb and məfu, respectively. Sherzer (1982:188) describes a language game of Maracaibo Spanish in which words are formed from Spanish words by the replacement of vowels with nonsense words. The replacements for the different Spanish vowels are as follows: [a] is replaced by 'agwara', [e] is replaced by 'emugér', [i] is replaced by 'isimil', [o] is replaced by 'ofo', and [u] is replaced by 'ugacher'. Thus, the Spanish word 'rosa' is realized as 'rofosaagwara' in the language game.

4.2.1.4. Rearrangement

One of the most common mechanisms that language games make use of is rearrangement. Units involved in rearrangements are usually syllables, parts of syllables, or phonemes. For example, in a number of language games, syllables of words (from the actual language) are rearranged to create the language game forms. However, language games differ as to exactly how this rearrangement
takes place. I consider here the language games in Bakwiri, Cuna, Luchazi, Zande, and Tagalog. In the language game of the Bantu language Bakwiri, as described by Hombert (1973), the last syllable of the Bakwiri word is moved to before the first syllable in order to create the language game word. For example, the Bakwiri word 'llyé' (stone) is realized as 'yálí' in the language game. On the other hand, in a Cuna language game, described by Sherzer (1982), the first syllable is moved to the end of the word. Thus, the Cuna word 'uwaya' (eat) is realized as 'wayau' in the language game.

Besides syllables moving to the end or the beginning of words, language game forms are often produced by syllable interchanges. In the Bantu language Luchazi, the last two syllables of a word interchange in order to create the language game form. White (1955) gives the example of the Luchazi expression 'tuye kundzivo' (Let's go to the house) which is realized as 'yetu kuvondzi'. The exact same language game is also found in another Bantu language, Sanga, according to Kenstowicz and Kisserberth (1979:168). Examples are the words múkwë:tù and bá:kolwë which are realized as mú:kwë and bá:lwëkë in the language game. In the language game of the Sudanese language Zande, on the other hand, it is the first and the second syllables of the Zande words that interchange to produce the language game forms, according to the description of Evans-Pritchard (1954). For example, 'degude' (girl) and 'baramu' (European) are realized as 'gude' (gude) and 'rabamu', respectively. Finally, in one of the language games of Tagalog described by Conklin (1956), the first and last syllables interchange to produce the language game forms. As an example, the Tagalog word 'kapatid' (sibling) is realized as 'tidpaka' in the language game. Thus we see that language games often move or rearrange syllables, but exactly how this rearrangement takes place is language-specific.

In addition to movement and interchange of syllables, the interchange of parts of syllables is sometimes the basis for the creation of forms in a language game. Three such language games are found in Thai, Hanunoo, and Finnish. Thai is reported by Churma (1979) as having a language game in which forms are created by the interchange of VC-sequences (i.e., rhymes). For example, the Thai words 'ténran' (dance) and 'wansug' (Tuesday) have the language game forms 'tamrén' and 'wàgsan', respectively. In a Hanunoo language game, described by Conklin (1959), the language game words are created by interchanging the first and last CV-sequence of actual Hanunoo words. For example, the Hanunoo words
'rignuk' (tame) and 'balayun' (domesticated) have the language game forms 'nugrik' and 'nulayban', respectively. And in a Finnish language game described by Campbell (1980), the language game words are created by exchanging the initial CV-sequences of two consecutive words. Thus tule siisan (come in) is realized as 'sile tusaan'.

Another type of rearrangement that is the basis for creating forms of a language game is the rearrangement of root consonants. These are reported as occurring in two Semitic languages: Amharic and Hijazi Arabic. For Amharic, Laycock (1972:82) gives the examples of 'wëddăqä' and 'nëbbärä' which are realized as 'dëwëqä' and 'nërräbä', respectively. In Hijazi Arabic, McCarthy (1982b) specifically notes that it is only the root consonants that interchange in forming the language game. Thus, a form like 'maktab' (office) which consists of the root consonants /k/, /t/, and /b/ and the prefix /m/ has the following five possible language game forms in which only the root consonants interchange: matkab, mabtak, mabkat, makbat, and matbak.

A final type of rearrangement by which words of a language game are created is the complete reversal of phonemes in words of the actual language. Such language games based on total reversals of phonemes are recorded as occurring in Tagalog, Czech, New Guinea Pidgin, and Javanese. For example, in the Tagalog language game that is based on total reversal, 'sala:mät' (thanks) is realized as tama:las; Conklin (1956) notes, though, that vowel length and stress remain in the same position. Laycock (1972:80) reports the same language games for Czech and New Guinea Pidgin. In Czech, the phrase 'dobrou noc' is realized as 'uorbod con', while the New Guinea Pidgin expression 'tësa i tok tok tumora nogat sukul' is realized as 'asit i kotok aromt tagon lukus'. Finally, Sherzer (1982:185) records the same phoneme reversal phenomenon for a Javanese language game. For example, the Javanese word 'dolanan' is realized as 'nanalod'.

Thus we see that language games based on movement or rearrangement, move or rearrange syllables, parts of syllables, or phonemes, but exactly how such movement or rearrangement occurs differs depending on the language game.

4.2.1.5. Combinations

A number of language games employ two or more of the mechanisms discussed. In Pig Latin, for example, the words are created by both expansion and rearrangement of English words. The initial consonant (cluster) is moved to the end of the word and the vowel /e/ is then suffixed. Similarly, one of the Chinese language games described by Yip (1982) utilizes both expansion and
rearrangement. The game is somewhat similar to Pig Latin. To form the
language game word from the real word move the onset to the end
and suffix the vowel /i/. However, the Chinese game differs from Pig
Latin in that /i/ is inserted initially. Thus the Chinese word 't'aw'
is realized in this game as 'lawtì'. Yip also describes a somewhat
more complicated language game from Cantonese. Likewise, to form
the language game words from actual words move the onset to the end
and insert the vowel /i/.

After this, copy the coda from the actual word (but change it to
an alveolar if it is labial) and add /1/ to the beginning of the word. Two
examples are 'kat' and 't'im' which are realized in the language game
as 'latkit' and 'limcìn'. One other language in which expansion and
rearrangement are employed is found in Finnish. According to
Campbell (1980), Finnish has a language game in which the initial
CV-sequence is moved to the end of the word, then ko- is prefixed and
-ntti is suffixed. Thus, the word 'pyrstö' (tail) is realized as 'korstypntti'
(after vowel harmony has applied).

Another language game that utilizes two mechanisms in creating its
words is one of the games Conklin (1959) attributes to Hanunoo. Language
game forms are derived from real Hanunoo words by prefixing gay- and
deleting all or part of the last syllable. Thus, the Hanunoo

words 'baraq' and 'kanta' are realized as 'gaybar' and 'gaykan' in the
language game.

Finally, a language game of German (mentioned to me by C. Dechert)
derives its forms from the corresponding German words by
reduplication, substitution, and expansion. In this language game a
word like 'Buch' is realized as 'Buchhuchlefuch' and 'ist' is realized as
'isthistlefist'. To acquire the language game form the following
three steps must apply:

1. Reduplicate the word replacing the onset with /h/.
   (If there is no onset insert /h/).
2. Add le after the reduplicated part.
3. Reduplicate the original word again replacing the onset with /f/.
   (If there is no onset add /f/). Place this after le.

The derivations of the language game forms of 'Buch' and 'ist' are given in (12b):

1. Buch \( \rightarrow \) Buchhuch \( \rightarrow \) Buchhuchlefuch
2. Ist \( \rightarrow \) isthistle \( \rightarrow \) isthistlefist

This German language game as well as the other language
games mentioned in this subsection indicate how difficult
language games can become when more than one mechanism
is utilized. Nonetheless, this does not prevent the
mastery of these games.
4.2.2. Language Games and Subsyllabic Constituency

In the previous section I categorized language games in terms of the types of mechanisms they employ in deriving their words from words of the real language. In this section I look at some of these mechanisms and consider how they reflect upon subsyllabic constituency.

One of the most common mechanism used in forming language game words is expansion (or affixing). Normally, in expansion, a language-specific CV-sequence (or VC-sequence) is prefixed, suffixed, or infixed to syllables. In language games like the Malayalam one, in which pa- is prefixed to syllables, or like the Luvale one, in which -ti is suffixed to syllables, there is no apparent evidence that bears on subsyllabic constituency. However, in language games in which a CV-sequence or a VC-sequence is infixed in a syllable it is reasonable to consider the part of the syllable to the left of the infixed sequence and the part of the syllable to the right of the infixed sequence as forming subsyllabic constituents. On this view, then, the English ap-insertion game and the Chinese ayk-insertion game would provide evidence for the onset-rhyme division in these languages, since the sequence -ap- or -ayk- is inserted after onsets (and before rhymes) of every syllable. Based on such evidence these languages would have the syllable structure of (13):

(13)

\[
\begin{array}{c}
\text{syll} \\
\text{On} \\
\text{Rh} \\
\text{nuc} \\
\text{coda}
\end{array}
\]

On the other hand, the language games of Tagalog and Spanish provide evidence for a syllable-internal structure in which the onset and the nucleus together form one constituent (referred to as the body) and the coda forms another, since in these two languages the sequence -pi- or -fi- is infixed before the coda (and after the body). Thus, based on such evidence, Tagalog and Spanish would have the syllable structure in (14):

(14)

\[
\begin{array}{c}
\text{syll} \\
\text{body} \\
\text{coda} \\
\text{on} \\
\text{nuc}
\end{array}
\]

Other evidence, though, has been used to argue that a syllable structure for Spanish recognizes the onset-rhyme division (as in (13)) and not the body-coda distinction (as in (14)). Most notably, Harris (1983) argues for such a division based on the Spanish stress facts. Spanish words ending in a vowel have penultimate stress and words ending in a consonant have final stress. Thus, in Harris' analysis, stress is constructed on a rhyme projection and falls on the syllable containing the second branch of the rhyme starting from the end of the word. (Extrametricality is incorporated to account for
vowel-final words with antepenultimate stress and consonant-final words with penultimate stress.) Hence, stress facts have been used to suggest one possible syllable-internal structure (i.e., (13)), but the language game facts seem to motivate a different one (i.e., (14)).

A situation similar to that in Spanish (in which different phenomena seem to motivate different syllable structures) pertains also to English. While Hayes (1981) and others have argued for the rhyme in English largely based on stress facts, the different language games of English motivate different syllable structures. For example, the ap–game provides evidence for the onset-rhyme division within the syllable, since in this game -ap- is inserted after the onset and before the rhyme. However, the English -sv- insertion game, cited in Laycock (1972), provides evidence for a syllable-internal structure that recognizes the body-coda division (as in (14)), since -sv- is inserted before the coda (and after the body). Thus different language games in English motivate different hierarchical syllable structures, and the situation resembles the Spanish case in which the facts of the sv-insertion game motivated a hierarchical structure different than what seem to be motivated by the stress facts.

English and Spanish are not unique in appearing to have language games that motivate a particular internal-syllable structure that is not motivated by other facts of the language (e.g., stress facts). For example, Thai has a language game in which the words are formed by interchanging the rhymes of normal Thai words, and Hanunoo has a language game in which the words are formed by interchanging the bodies of the first and last syllables of normal Hanunoo words (as discussed in section 4.2.1.4). However, there does not appear to be any other evidence for such hierarchical structure in these languages. Moreover, Javanese, as mentioned, has a language game which forms its words by deleting either the last rhyme or the last syllable of the normal Javanese word (depending on conditions mentioned in section 4.2.1.2). This might suggest a syllable-internal structure that recognizes the rhyme. On the other hand, Javanese has another language game (mentioned in Sherzer (1982)) identical to the Spanish one (and probably borrowed from it). To derive the words in this language game, an -fv-sequence is infixed before each coda (and after each body) of normal Javanese words. Thus, this language game provides evidence for the hierarchical structure in (14). Once again it appears that different
language games from the same language provide evidence for different hierarchical structures.

From the above examples it seems that language games provide contradictory evidence for hierarchical syllable structure. The language game evidence, though, can be better understood not as providing evidence for the rhyme or the body, but rather, as providing evidence for each of onset, nucleus, and coda. While, as illustrated, language games often do not respect possible rhyme (or body) constituents, they always respect the onset, nucleus, and coda. Of all the language games I have investigated not one splits up onsets, nuclei, or codas. For example, infixation occurs between onsets and nuclei (as in the English ap-insertion and the Chinese ayk-insertion), or between nuclei and codas (as in the English gV-insertion or the Spanish fv-insertion), or at syllable boundaries (as in the Luvale ri-insertion). What seems to be crucial in the location of a (language game) infix within a syllable, is not the possible hierarchical structure of the syllable, but the nature of the infix. If the infix begins with a vowel, it is inserted after the onset (as in the English ap-game and the Chinese ayk-insertion game) so as to create a single CV-sequence. If the infix begins with a consonant it is inserted after the nucleus (as in the Spanish fv-insertion or the English gV-insertion) so as to create a simple VC-sequence with no clusters. Thus, what motivates the location of syllable-internal insertion is not the hierarchical syllable structure, but rather, the nature of the infix to be inserted (i.e., whether the infix is consonant-initial or vowel-initial).

Moreover, in language games that make use of substitution, either the coda is substituted for (as in the Hanunoo game in which /ŋ/ replaces codas), the nucleus is substituted for (as in the Maracaibo Spanish game), or the onset is substituted for (as in the part of the German language game in which /h/ replaces the onset). Rhymes (or bodies) never seem to be referred to in language games making use of substitution.

In language games that involve rearrangement, the most common unit that rearranges (or interchanges) is the syllable. In the Thai language game, though, it was mentioned that the rhymes in two different syllables interchange. However, the other possible interpretation is that the two nuclei interchange and the two codas interchange simultaneously. Such an interpretation is not unlikely since rhymes do not seem to be otherwise motivated in Thai; and even if they seem to be motivated (e.g., by stress facts), language games would not necessarily respect them, as is apparent from the Spanish
fV-insertion game and the English gV-insertion game. Similarly, the Hanunoo interchange game previously mentioned (in which the first and the last CV-sequence of a word interchange) does not necessarily provide evidence for the body constituent, rather a possible interpretation is that there is an interchange between the onset of the initial syllable and the onset of the final syllable while at the same time there is an interchange between nuclei in the initial and final syllables.

Finally, consider the case of the English Pig Latin game which McCarthy (1979) cites as evidence for the rhyme in English. Pig Latin seems to display evidence for the rhyme because of such examples as pig-igpay and street-eetstrey in which the onset moves and the rhyme does not. However, this is not the correct generalization; the correct generalization is that the first onset moves and the rest of the word does not. This is obvious when polysyllabic words are considered (e.g., Latin-atinley, criminal-iminalcrey). Hence, the only subsyllabic constituent that Pig Latin provides evidence for is the onset.

In conclusion, language game data do not really provide support for a rhyme constituent (or for a body constituent). In language games where syllable internal infixes are inserted, the location of the insertion is not based on possible onset-rhyme structure, but rather, on whether or not the inserted infix begins with a consonant (in which case it is inserted after the nucleus) or a vowel (in which case it is inserted after an onset). Moreover, language games in which two VC-sequences interchange also fail to provide conclusive evidence for the rhyme because an interpretation in which there is a simultaneous interchange of two nuclei and two codas cannot be ruled out. (For the same reason, language games in which two CV-sequences interchange cannot provide conclusive evidence for the body constituent.) Finally, the syllable-internal structure that the language game data support is one that contains only onset, nucleus, and coda as constituents. In none of the language games investigated do these constituents split up. For example, none of the language game words are formed by inserting a phoneme sequence between onset consonants, or by moving one part of the onset only. Thus, to reiterate, the conclusion that emerges from the data on language games is that it is a theory of syllable structure that recognizes only the onset, the nucleus, and the coda that is compatible with all of the data considered.
4.3. Conclusion

In this chapter I investigated the question of how phonological movement phenomena reflect upon subsyllabic constituency. I concluded that the speech error data and the language game data furnish evidence for a subsyllabic structure that recognizes only the onset, the nucleus, and the coda as subsyllabic constituents. This conclusion taken together with that of chapter three (that only a level syllable structure is compatible with the different types of stress systems) and that of chapter two (that the arguments most often cited in support of the rhyme do not really support it) provide a strong case for a rheymeless syllable structure consisting of only the onset, the nucleus, and the coda.

LIST OF REFERENCES


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Elert, C. (1964) "Phonological Studies of Quantity in Swedish, Almquist and Wiksell, Uppsala."


*Language* 43:393-436.


