PROSODY IN BRAZILIAN PORTUGUESE PHONOLOGY

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
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1979

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1979
To Elza and Sylvia
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CHAPTER I
INTRODUCTION

Prosody includes the features of prominence (syllabic and stress) and duration (quantity) which are characteristically perceived as occurring with temporal regularity in speech. These features, together with pitch, are often referred to as suprasegmental features: features whose domain includes more than one segment (Kemp 1957). However, this definition is inadequate since it would exclude quantity, pitch, and stress if the syllable happened to consist of a single segment, e.g., one vowel (Lehiste 1970). Furthermore, this definition could include such features as voicing, velarization, pharyngealization, nasalization, point of articulation, and vowel harmony, since their domain can be greater than one segment. This is apparent in the tendency of such features to be assimilated over strings of segments, as point of articulation may be assimilated through a series of stops, e.g., [\text{[\text{\text{\text{u\text{\text{d\text{\text{n\text{\text{\text{p\text{\text{b\text{\text{i}\text{\text{}}}}}}}}}}}}]]}}] {\text{shouldn't be}} (in casual speech).

A major difference between segmentals and suprasegmentals is that segmental features can be determined without comparison to other segments in a sequence while suprasegmental features can be determined only by comparison to other segments in the sequence: a vowel is long only if there are shorter vowels; a tone is high only if there are lower tones; a syllable is stressed only if there are unstressed syllables.
Although segmental features are frequently assimilated, supra-
segmental features are never assimilated, except for pitch
(Maddieson 1978:349-352). Pitch can have assimilatory influences
on adjacent syllables, e.g., in tone languages, a high tone can
cause a following low tone to become falling. In contrast, segments
do not assimilate the syllabicity, stress, or duration of adjacent
segments. Rather they tend to be dissimilated. A stressed syllable
or a syllable with a long duration does not cause an increase in
stress and duration in adjacent syllables. In fact, the effects
seem to be quite the opposite. Increased stress and duration tend
to decrease the stress and duration of adjacent syllables. For example,
in Brazilian Portuguese, unstressed syllables frequently become
devoiced and/or shorten (Chapters II and IV).

Although pitch may be distributed over prosodically defined
domains such as syllables and stress measures, it is not itself a
prosodic feature. Although Portuguese pitch is certainly a worthy
are of investigation, its effects are so different from stress and
duration that I have excluded pitch from this investigation.

Prosodic influences in phonology have been observed in a variety
of languages. Vowel reduction and deletion are often conditioned by
lack of stress. English examples are well known,
e.g., [ˈtuːdə] → [ˈtədə] today, [ˈprəbəlɪ] → [ˈprəblɪ] probably. In Grebo (Innes 1966) vowels syncopate in fast speech:
/foːdə/ → [fəo] 'emptiness'. In contrast to the lack of stress, the
presence of stress is often associated with lengthening and
strengthening processes such as diphthongization. For example, many
natives of Columbus, Ohio pronounce /o/ as [o] when the syllable is unstressed, e.g., meadow but when the syllable is stressed it becomes [ʌw], e.g., no!

Duration (for which the phonological term is quantity) also has important effects on segmental processes. It has been observed that universally long vowels tend to diphthongize and tense more readily than short vowels. (See Donegan 1978 for a detailed discussion on vowel processes.) Duration can also affect vowel reduction. Although vowel reduction is most frequently associated with lack of stress, Lindblom 1963, in his analysis of Swedish vowel reduction, concludes that timing is the principal variable for vowel reduction and that the articulatory imprecision due to lack of stress is negligible. He concludes that "Duration seems to be the main determinant of the reduction". (p.38). Since Lindblom's data involve carrier phrases with stress held constant while tempo was varied, his conclusion seems reasonable.

In addition to the individual effects of stress and duration, they combine to produce collective effects. It is generally well known that English is a stress-timed language, i.e., a language in which the length of syllables (ceteris paribus) is inversely proportional to the number of syllables in a stress measure or stress group. The stress measure (like a musical measure) runs from one stressed syllable up to (not including) the following stressed syllable. What is less well known is the extent to which these rhythmic characteristics influence pronunciation. For example, in English, the stressed syllable in a monosyllabic measure is
long (e.g., [rɑːd] ride), but in a polysyllabic measure it is relatively short([rɑːrɪŋ] riding). This shortening may prevent diphthongization, as in [dɔːri] Daddy beside [dɒd] Dad, Southern [dæd], Northern urban [dəd).

Syllabic shifts ($\text{VV} \rightarrow \text{WV}$) also correlate with changes in duration (Donegan 1978). In English, a stressed syllable in a disyllabic word is shorter than an monosyllabic. Professor Robert J. Jeffers, a native of New Jersey, pronounces /ɔ/ differently, depending on whether it occurs in a monosyllabic or disyllabic word:

[ˈkɑːf] cough but [ˈkɑːf] coffee. This illustrates that $\text{VV} \rightarrow \text{WV}$ is associated with shortening. In Frisian (Cohen et al. 1961:118-21 cited in Donegan 1978) a falling diphthong $\text{VV}$ in a monosyllabic word undergoes a shift in syllability to $\text{WV}$ when it occurs in a disyllabic word:

$\text{dɔs}/[\text{dɔske}]$
$\text{stoʃ}/[\text{stoʃə}]$
$\text{foʃ}/[\text{foʃə}]$

doas/doaske 'box, little box'
stien/stiennən 'store, stones'
foet/fuotten 'foot, feet'

In recent years it has become very common for phonologists to reanalyze old problems. The assumption is that the best analysis follows from the best theory; i.e., evaluating different solutions is a means of testing which theory is the most adequate. This approach is seen in several works on Portuguese phonology. Leite 1974 limited her study to an area where there have been many analyses, namely the assignment of stress. Her study evaluates the competing analyses, i.e., either Portuguese stress is totally unpredictable and thus marked in the lexicon, or stress is assigned
by rule and not marked in the lexicon, or stress is partially assigned by rule and partially marked in the lexicon. Redenbarger 1976 reanalyzed Portuguese height demonstrating that tongue root features offer a better explanation than previously used features.

Although this approach to phonology can have important contributions to theory, so does the investigation of new areas and new problems. The new problem which I have chosen to investigate is the interplay of stress and duration on Portuguese pronunciation. This investigation should be considered preliminary because there have been no previous studies on Portuguese dealing with these prosodic aspects. This area of research may offer new insights into how the intricate details of a language can be integrated into a well-motivated system. I hope that this beginning study will inspire others to join in the investigation of the role of prosody on the phonology of a language.

The data upon which my analysis is based comes from a variety of sources. In addition to sources from the literature, I have used data consisting of notes and recordings I made (1) during the period I was living in Brazil (1971-1974; 6 months in Londrina, Paraná and 3 years in Rio de Janeiro), (2) from a short trip to Brazil in 1977, and (3) from personal contact with Brazilians living in Columbus, Ohio.
CHAPTER II
A SURVEY OF BRAZILIAN PORTUGUESE PHONOLOGY

2.0. Introduction

Historically, Spanish and Portuguese are quite closely related yet the phonologies of the two languages, both synchronically and historically, are very different. Spanish phonology has been treated extensively in the literature (Navarro 1968, Harris 1969), while Portuguese has not enjoyed such a success, although there are over 100 million speakers in Brazil. The reader, therefore, may be relatively unfamiliar with the language. Because a good portion of this thesis will deal with the influences of prosody on segmentals, a general knowledge of the segmental phonology of the language is useful in order to understand the discussion on prosody. Rather than my referring the reader to other works concerning Portuguese phonology or presupposing that the reader is acquainted with the language, I am including an abbreviated treatment of Portuguese phonology, some of which can be found in the literature (Head 1964, Câmara 1970, Redenbarger 1976, Mateus 1977) while other aspects cannot.

2.1. The Phonemes of Portuguese

The following chart lists the underlying segments occurring in Brazilian Portuguese.
### Consonants

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### Vowels

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<th>[+hi]</th>
<th>[-hi]</th>
<th>[+tense]</th>
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### Diphthongs

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<td>əi</td>
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<td>əi</td>
<td>əu</td>
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<tr>
<td>ai</td>
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There are several controversial points that need to be mentioned with regard to this inventory of sounds.

The nasal vowels and nasal diphthongs have been treated differently by different authors. Some (Head 1964) treat them as underlying nasal vowels while others (Reed and Leite 1947, Saciuk 1970, Hensey 1968) treat them as underlying vowel plus nasal consonant. Still others treat them as a vowel plus a suprasegmental phoneme of nasalization (Hall 1943) or a vowel plus a nasal archiphoneme (Camara 1970). Thus the word sim [sɨ] 'yes' is underlyingly /sɨ/, /sin/, or /sin/, or /siN/, depending on the approach one prefers. There is no question that there are surface contrasts between oral and nasal vowels, e.g. [sɨ] sim yes and [si] se it, but how this difference should be represented underlyingly is controversial.

The diphthong [ɔy] occurs on the surface from orthographic ol. One might argue that [ɔy] is not underlying, but rather derived from /ɔl/ because of the existence of such pairs as [sɔu]/[solaradu] sol/ensolarado 'sun/sunny'. However, one must be quite careful when using arguments which involve derivational morphology to prove the existence of underlying representations. Arguments such as these have been criticized as not being conclusive proof for the existence of underlying representations (Hooper 1974). Showing that there is a relationship between two forms does not imply that deriving one form from the other involves a truly productive synchronic process. A further treatment of underlying representations will be presented in Chapter IV.
The underlying representations of diphthongs is also controversial (just as it is in English: Trager and Smith 1951, Lehiste & Peterson 1961, Ladefoged 1975). Should diphthongs be represented as VV sequences which on the surface become monosyllabic by glide formation, should they be treated as underlying VG, or V'? This will be discussed in 3.2, p.56.

2.2. Diachronic Phonology of Portuguese

The reader who is familiar with the vowel system of Latin may be interested in knowing how the vowel system of Portuguese developed so differently from that of Spanish. Since a great deal of the phonology of Portuguese which I will treat later deals with the vowels, and since some of the historical processes involving vowels are also synchronic processes, an acquaintance with the historical development of the vowel system is important. (For a more detailed treatment see Williams 1962.)

2.2.1. Simple Vowels

The seven vowels in Portuguese are the direct reflex of the seven vowels in Hispano-Romance:

| HR [a] | > | Ptg. [a] |
| HR [ɛ] | > | Ptg. [ɛ] |
| HR [e] | > | Ptg. [ɛ] |
| HR [i] | > | Ptg. [i] |
| HR [ɔ] | > | Ptg. [ɔ] |
| HR [ɔ] | > | Ptg. [ɔ] |
| HR [u] | > | Ptg. [u] |
2.2.2. Nasal Vowels

Portuguese nasal vowels arose from three sources: (1) word final m or n in monosyllabics, (2) n which became final through loss of final e or t, and (3) loss of intervocalic n.

In polysyllabic words final m deleted in Vulgar Latin and final n deleted in early Portuguese. Neither segment left its nasality. However, in monosyllabic words both m and n remained in Vulgar Latin. Later in Portuguese they deleted, leaving their nasality on the preceding vowel.

\[ \text{cum} \rightarrow \text{com} \ [k\text{õ}] \ 'with'; \ \text{non} \rightarrow \text{nom} \rightarrow \text{não} \ [n\text{ãõ}] \ 'no'; \]
\[ \text{quem} \rightarrow \text{quem} \ [k\text{ẽ}] \ (\text{Diphthongization of nasal vowels will be treated in 2.2.4}). \]

n becoming final through loss of final e or t deleted leaving its nasality on the preceding vowel.

\[ \text{vênit} \rightarrow \text{vem} \ [v\text{ẽ}] \ 'comes'; \ \text{fínem} \rightarrow \text{fíne} \rightarrow \text{fín} \rightarrow \text{fin} \ [f\text{ĩ}] \ 'end' \]

Loss of intervocalic n in the tenth century produced nasal vowels, nasal diphthongs, or oral vowels. Whether the result was an oral or nasal vowel depended on the vowel involved. Nasality persisted if the first vowel was equal in height or higher than the second vowel. In addition, if the two vowels were equal in height but not identical in frontness or backness, nasality was preserved if the sequence was back vowel plus front vowel but not front vowel plus back vowel.

\[ \text{lanã} \rightarrow \text{lã} \ [l\text{ã}] \ 'wool'; \ \text{ponĩs} \rightarrow \text{pões} \ [põ̞s] \ 'put'; \]
\[ \text{canĩs} \rightarrow \text{cães} \ [kã̞s] \ 'dogs'; \ \text{manõ} \rightarrow \text{mão} \ [mãõ] \ 'hand'; \]
\[ \text{bõnõ} \rightarrow \text{bom} \ [bõ̞m] \ 'good'; \]
\[ \text{bõnã} \rightarrow \text{bõa} \rightarrow \text{boa} \ 'good'; \ \text{frenõ} \rightarrow \text{frão} \rightarrow \text{frãõ} \ \text{freio} \ 'brake' \]
2.2.3. Portuguese Oral Diphthongs

Portuguese oral diphthongs originated from several different sources: (1) loss of an intervocalic consonant, (2) deconsonantalization, (3) metathesis, and (4) epenthesis of a vowel, undoing hiatus.

2.2.3.1. Loss of Intervocalic consonants

Intervocalic \( a \) (followed by \( e \) or \( i \)), \( i \), and \( l \) was lost.

\[ \text{cogitar} > \text{cuidar} \quad \text{'to take care of'} \]

\[ \text{mal} > \text{mau} \quad \text{'bad'} \]

2.2.3.2. Development of \([i]\) from a palatal consonant

\[ \text{gr} > \text{ir}; \quad \text{kt} > \text{it}; \]

\[ \text{fragrare} > \text{flagrare} > \text{cheirar} \quad \text{'to smell'}; \quad \text{factum} > \text{feito} \quad \text{'fact'} \]

\[ \text{nocte} > \text{noite} \quad \text{'night'}; \quad \text{conceptum} > \text{conceito} \quad \text{'concept'} \]

2.2.3.3. Metathesis

\[
\begin{align*}
\begin{array}{c}
\text{prim\textcolor{red}{\textit{a}}rium} \\
\text{prim\textcolor{red}{\textit{a}}rio} \\
\text{primeiro'first'}
\end{array}
\end{align*}
\]

\[ \text{bas} > \text{beijo} \quad \text{'kiss'} \]

2.2.3.4. Epenthesis

stressed \( e \) in hiatus with \( a, o, \) or \( u \) (through intervocalic loss)
developed an epenthetic \( i \) (\([i]\))

\[ \text{credo} > \text{creo} > \text{creio} \quad \text{'I believe'}; \quad \text{freu} > \text{freo} > \text{freio} \quad \text{'brake'} \]
2.2.4. Nasal Diphthongs

Intervocalic loss of ɐ resulted in /ɐi/, /ɐu/, /ɐɐ/

canis > cães 'dogs'; manã > mão 'hand; põens > pões 'put'

/ɐu/ also resulted from two other sources. The Latin words cane
and pane resulted in Ptg. cão 'dog' and pão(ane) > an > â > ão [ãũ]
while ratiōnem resulted in razão (one > on > õ > ão [ãũ]

Various reasons have been suggested to explain why the nasal
vowels a and o diphthongized to ão [ãũ]. Leveling has been suggested:
All singular forms in which the plural was ães or ões were
supposedly leveled to ão:

razom > razão (pl. razões) 'reason'; pã > paão (pl. paões)
'loaves of bread'

Leite de Vasconcelos 1926 offers an unlikely explanation by
suggesting that syllable final â and ō were "repugnant to the ear"
and that they received support from the vowel o. Later ō
supposedly developed into ão by either dissimilation, confusion, or
spontaneously.

Bueno 1967 points out the ridiculousness of this explanation
and offers an alternative which attempts to explain this diphthong-
ization as a result of emphatic accent: "From pã, by emphatic stress,
there resulted in a widening (enlargement) of the nasal vowel or the
diphthongization presently existing in pão." (Bueno 1967 p. 62, my
translation). However Bueno's 'explanation' i.e., "a widening of the
nasal vowel" is just another term for nasal diphthongization. Giving
a synonym for a term does not explain it.
There is another possible explanation. Stress and timing could have a factor which caused the diphthongization of ā > [ãã]. In a stressed-timed language a monosyllabic word is longer than a stressed syllable of a disyllabic word. (See chapter V). If at the time of the change ā > [ãã] Portuguese was in the process of changing over to stress-timing from syllable-timing, one would expect the monosyllable pã (pane > pan > pã > [pãã] pão 'bread') to be longer than pã in pã(n)es 'breads' (panes > pães). Since there is a universal tendency for long vowels to diphthongize more readily than short vowels, this suggests that the diphthongization of pã > [pãã] may have been due to the increased length of a stressed monosyllable. (Also cf. razon > razó > ra[zãã] razão 'reason' but razones > ra[zõõ]s 'razões 'reasons'). If the diphthongization was indeed due to the increased length of a monosyllable, then this is evidence that a change in timing (from syllable-timed to stress-timed) was a causal factor in these changes. Since diphthongization is only one piece of evidence, much further work in this area should be done in order to make any definite claims regarding rhythm and timing as a factor in the historical change of Portuguese. (See chapter V on synchronic rhythm and timing in Portuguese).

2.2.5. Contractions

In addition to the loss of consonants and subsequent desyllabification which gave rise to nasal vowels, and oral and nasal diphthongs (e.g., ianam > lã 'wool', manõ > mão 'hand', maiõ > mau 'bad'), many contractions occurred between words which have become part of Modern Standard Portuguese, as a result of [ẽ] deletion.
This tendency of Portuguese toward reductive phenomena can also be observed synchronically as we shall see in the following section.

2.3. Synchronic Phonology of Portuguese

2.3.1 Processes vs. Rules. Natural Phonology vs. Generative Phonology

Early generative phonology (Chomsky and Halle 1968) used the term 'rule' to include both rules which had phonetic motivation (e.g., plural voicing assimilation in English, cat[s] vs. dog[z]) as well as rules which lack any synchronic phonetic motivation (e.g., 'velar softening' i.e., k → s as in electric/electricity. Chomsky and Halle (1968).

Although historically this second type of rule may have had phonetic motivation, the synchronic phonetic motivation has been lost and now this type of rule is strictly governed by morphological considerations. For example 'velar softening' in English is governed by the derivational endings like -ic and -ity, rather than a productive
process which changes [k] to [s] in a phonetically specifiable context. The existence of words like *lickety-split*, and *persnickety* demonstrates that, synchronically, velar softening is strictly a morphological phenomenon rather than a phonetically motivated rule. One of the results of a reaction against this lumping together of both morphologically and phonetically motivated rules has resulted in an 'extended standard theory' (Anderson 1974) which recognizes a fundamental difference between these two types of rules.

Even before an 'extended standard theory' developed, the natural phonology of David Stampe (1969), had distinguished between phonetically motivated and non-phonetically motivated rules. (Also see Stampe 1979, Donegan & Stampe 1979.) The same type of distinction was made by Baudouin de Courtenay (1895 and Stankiewicz translation 1972) between neophonectic (anthropophonic) and paleophonectic (traditional) alternations. The (early) generative phonologists 'rules' in Stampe's terms are divided into the phonetically motivated 'processes' and the 'rules' which lack phonetic motivation. Thus, in Stampe's natural phonology 'velar softening' is treated as a 'rule' since k → s/ [I] is not a productive process in English, while 'palatalization' (e.g., *did you* → *[dɪdʒu]*) is a 'process'. Early generative phonologists thus use the term 'rule' to refer to what Stampe later called 'process' and 'rule'. In order to avoid confusion, I will henceforth use the term 'process' to refer to phonetically motivated phenomena and 'morpho-phonological rule' (hereafter MPR) to refer phenomena which are morphologically conditioned, and lack synchronic phonetic motivation. MPR's do not represent any
constraints on pronunciation, but rather they govern what is 'correct'.
The alternation between [ai] and [i] in divine and divinity is one of 'correctness'--a speaker would be able to say di[vai]lity but he has learned that div[ɪn]ity is correct. Although MPR's are obligatory--i.e., they govern the 'correct' pronunciation of a given word or morpheme--they may have exceptions, e.g., in serene/serenity [ɪ] alternates with [ɛ], while in obese/obesity [ɪ] occurs in both words.

Processes, however, may be obligatory or optional. Yet they are exceptionless in the sense that they limit or constrain pronunciation. In English, for many speakers, vowels are obligatorily nasalized before a tautosyllabic nasal, e.g., can [kæn], never *kæn]. This process is exceptionless--there are no non-nasalized vowels before tauto-syllabic nasals, and indeed it is impossible (or at least requires considerable phonetic effort) for, these speakers, to make a non-nasalized vowel before a tautosyllabic nasal, as in trying to pronounce French [bon] bonne 'good'.

Although processes may be optional, they are still exceptionless. In words which end with ˌ some English speakers (like myself) use both an apical velarized [ɹ] as well as a non-apical velarized variety, [ɾ] (a mid-back-unrounded-velarized vowel). The process which deapicalizes the ˌ is exceptionless in the sense that the process is able to apply in all words with final ˌ. The fact that it is optional does not mean it has lexical exceptions. There are no words in which the process never is permitted to operate. Likewise, since it is optional, there are no words in which the process always operates (i.e., show no fluctuation. Contrast this with serene/
serenity vs. obese/obesity, where in obesity the MPR /ɪ/ [i] never operates.

Some of the major differences between 'process' and 'morpho-phonological rules' can be summarized as follows:

<table>
<thead>
<tr>
<th>Process</th>
<th>MPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. phonetically motivated</td>
<td>1. may lack phonetic motivation</td>
</tr>
<tr>
<td>2. optional or obligatory</td>
<td>2. obligatory</td>
</tr>
<tr>
<td>3. exceptionless—i.e.,</td>
<td>3. may have exceptions—hence represents a limit or constraint do not represent constraints on pronunciation on pronunciation.</td>
</tr>
</tbody>
</table>

The major portion of this dissertation will involve 'process' rather than 'MPR'.

2.3.1.1. Obligatory vs. Optional

Although Stampe makes a basic distinction between 'process' and 'rule '(MPR), under 'process' he includes both optional and obligatory processes. Any given process then may be marked as optional or obligatory, but both are still considered to be fundamentally the same type of phenomenon. I think the distinction between optional and obligatory process is significant and deserves more discussion than it has been given by Stampe. An obligatory process which operates regardless of style, tempo, or attentiveness (e.g., English vowel nasalization before tautosyllabic nasals and l velarization syllable finally, Portuguese unstressed tensing (see 2.3.4.1.1. below), indeed does represent a categorical constraint or limit on pronunciation— it is impossible for a speaker of the language to violate the
process, or if, with considerable effort, he is able to stop (suppress) the process this it makes his pronunciation sound 'foreign'.

On the other hand if a process is optional within a given style (e.g., English [tʰ] → [θ], or Portuguese pretonic raising in fast or casual speech, i.e., /e,o/ → [ɨ,ɨ]: [me'ainu] → [mi'ninu] menino 'boy'), it does not represent an absolute constraint on pronunciation, rather the process produces just one of the acceptable alternates (or more if it operates iteratively or interacts with other processes). Thus, a speaker of Brazilian Portuguese in a casual speech situation may alternate between [po'lídu] and [pu'lídu] polido 'polite', because pretonic raising of [o] to [u] is optional in this style. Contrast this with the following case: Any unstressed non-low vowel is obligatorily [⁺tense] in all styles, 'ff[ɛ]sta 'party' but f[ɛ]'s'tivo 'festive'⇒[ɛ]'s'tivo. Thus, this obligatory teasing process represents a real constraint on pronunciation—the speaker cannot violate the process and still sound like a native speaker of Portuguese.

However, when one compares different styles the optional/obligatory distinction becomes more complex. A given process may be completely non-operative in one style, optional in another, yet obligatory in still another:

(1) In slow citation (as in reading a sentence or word list in a slow formal style) a speaker of English may never palatalize t and d before y (e.g., did you). In slow citation a speaker of Portuguese will never devoice vowels nor will he monophthongize word final [ɐũ] to [ã].
(2) In normal running speech an English speaker may optionally palatize ɪ and ʁ.

A Portuguese speaker may optionally devoice unstressed final vowels, e.g., ['gatu] ~ ['gatu] gato 'cat'; or he may monophthongize final unstressed [ẽũ] to [ũ] as in [ˈfxmlũ] ~ [ˈflexũ] falam 'they speak'.

(3) Extremely rapid casual speech:

An English speaker will obligatorily palatalize ɪ and ʁ.

A Portuguese speaker will obligatorily devoice sentence or utterance final unstressed vowels as well as monophthongize [ẽũ] to [ũ].

Thus the processes above are completely suppressed in (1), optional in (2), and obligatory in (3). In (3) they are a real constraint on pronunciation—the speaker cannot help but let the processes operate in this extremely fast, casual style. Yet in (1) and (2) they are not constraints. In styles (1), (2), and (3) the processes of course are the same, but their status with regard to constraints on pronunciation is different. In (1) the speaker is able to suppress or stop the process from operating; in (2) he sometimes suppresses it and sometimes he does not; in (3) he is unsuccessful in suppressing the process.

One might be tempted to say that in cases where a given process is optional the alternation which exists is really an alternation between different styles rather than an alternation within a given style. Accordingly then, a speaker who sometimes palatalizes ɪ and ʁ and sometimes does not, in a given social situation, could
be said to be switching from one style to another. This is quite reasonable. However, if one does this, one might end up with an infinite number of styles, depending on a given process. Because of the difficulty in distinguishing between slight variations in style, I have limited my discussion to three styles, defined in 2.3.3.

2.3.2. Obligatory, Optional, Process, Rule and their Relationship to Synchronic and Diachronic Phonology

An optional process may first go unnoticed by the speakers of the language, i.e., they may not even realize that it sometimes operates and sometimes does not. Gradually over generations, the process can become obligatory, and thus, part of the obligatory constraint on pronunciation. Further changes in the language may cause the phonetic motivation to be obscured or cease to exist or it may operate only on words of a certain morphological class. In this way an optional process can become an obligatory process and later a morpho-phonological rule. Even further changes can result in a situation where forms are no longer related by a productive morpho-phonological rule but are better described by suppletion.

2.3.2.1. Optional > Obligatory

In the Portuguese spoken in Rio de Janeiro (Carioca dialect), the present generation of speakers obligatorily pronounce syllable final l as [y], e.g., mal 'badly' [may]. Thus, the process /l$\rightarrow [y]/ is obligatory. However, past generations of Cariocas used both [t] and [y] for syllable final l. (Margarida Basílio, a former student of the well-known Brazilian linguist Mattoso Câmara reported
that he used [+] p.c.). Thus, what was an optional process in a past
generation is obligatory today.

2.3.2.2. Obligatory Process $\Rightarrow$ Morpho-phonological Rule

   English 'velar softening' (k $\Rightarrow$ s, e.g., electric/electricity)
is synchronically a MPR. Although historically k $\Rightarrow$ s/____ i/I was
a synchronic phonetic process, today the rule is strictly morphologically
conditioned, since it applies only in the presence of certain deriva-
tional endings, e.g., -ic and -ity(2.3.1.).

2.3.2.3. MPR $\Rightarrow$ Suppletion

   In English the singular and plural of such pairs as mouse/mice,
goose/goose, foot/feet were related by a synchronic MPR of plural
formation(e.g. sg. mūs, pl. mūsi mouse/mice). However, with further
changes, the MPR ceased to be a synchronic process, e.g.,
mūs $\Rightarrow$ maws(Great Vowel Shift), mūsi $\Rightarrow$ müsi(umlaut) $\Rightarrow$ müs(final un-
stressed vowel deletion) $\Rightarrow$ mīs(unrounding of front vowels) $\Rightarrow$ majs
(Great Vowel Shift). This example illustrates that, historically,
the plural mice was derived from the singular mouse, by a MPR; but
since this MPR no longer operates today, forms such as these are best
treated by suppletion.

2.3.3. Style

   In 2.3.1.1. above I pointed out that style can be an important
factor in determining whether a process operates or not. For this
reason it is very important in any phonological analysis to specify
the particular style involved when describing a given process. The
classification of different styles is a difficult task. Many prefer to divide speech into formal and casual or slow and fast. Semiloff 1977 divided style into four categories: slow formal, fast formal, slow casual, and fast casual. Harris 1969, in his analysis of Spanish, also made a four-way cut primarily based on speed or tempo—largo, andante, allegretto, and presto. In the collection of any body of data it is often very difficult to control for style since the conditions which determine any particular style are so hard to control.

For the purpose of my analysis I shall divide style into three levels: 'Citation', 'Normal', and 'Casual'. Although the divisions between the different styles may at times be blurred or unclear, I believe for the purposes of my phonological description this categorization can be quite useful. I shall therefore establish an operational definition of these three styles.

'Citation' (or slow citation) is a very slow, careful, type of speech typical of reading a word list or list of sentences in a slow, deliberate manner. For some speakers the speech may be hyper-articulated or syllable boundaries may act as word boundaries. For example, water in this style might be pronounced as [ɔr'tɔr]. Thus, in the second syllable the t is aspirated even though it is unstressed—the second syllable acts as if it had a word boundary preceding it. In this way a word initial voiceless stop would be aspirated.

'Normal' (normal running speech) is the natural speech one might use on a formal, or semi-formal occasion such as delivering a lecture, a newscast, a business meeting, talking to one's colleagues
over professional matters. It is the style which the laymen considers 'good' or 'correct' pronunciation. The style is neither 'sloppy' nor extremely colloquial.

'Casual' (casual and/or rapid speech) refers to a colloquial style of speech used in a very informal, casual, or intimate setting, e.g., an informal conversation between two friends or lovers or a conversation among friends at a party. The layman often considers this type of speech to be 'incorrect' or 'sloppy'.

I have avoided using speed as a distinguishing characteristic between 'Normal' and 'Casual'. Although 'Casual' often tends to be faster than 'Normal' this is not always the case. Some newscasters are able to talk extremely fast yet can avoid using 'Casual' style. The speech of two of my professors at Ohio State illustrate that increase in speed is not necessarily correlated with increase in casual speech processes. Professor David L. Stampe generally talks much more slowly than Professor Arnold M. Zwicky, yet Stampe exhibits many more casual speech processes than Zwicky. (For more on casual speech see Zwicky 1972.)

2.3.1. Synchronic Processes of Brazilian Portuguese

The following is a survey of the most common processes in Brazilian Portuguese. Unless otherwise specified, these processes occur in the majority of dialects in Brazil.

2.3.4.1. Processes in 'Normal' and 'Citation'

2.3.4.1.1. Unstressed tensing

\[ \neg \in [\neg \text{tense}] \] \[ [-\text{lo}] \]
In stressed position all seven vowels occur, ([i e a o o u]), yet in unstressed position only five occur ([i e a o u]):

't[i]ro - t[i]l'rar  'shot'  'to shoot'
's[a]ca - s[e]l'car  'drought'  'to dry'
'f[el]sta - f[es]tivo  'party'  'festive'
'c[a]qa - c[a]l'car  'hunt'  'to hunt'
'f[ol]co - f[ol]l'car  'focus'  'to focus'
'j[o]go - f[o]l'car  'game'  'to play a game'
'f[u]ro - f[u]l'rar  'hole'  'to make a hole'

From the data one observes that the only alternation between vowels is between stressed [e] and unstressed [e], and between stressed [o] and unstressed [o]. In the forms with the alternations two processes are conceivable: either a process changing underlying lax vowels to tense vowels or a process changing underlying tense vowels into lax. In the case of these alternations either process would correctly generate the data. However Redenberger 1976 has given evidence that in sets such as these it is the lax variant, namely /æ/ and /o/ that is underlying rather than tense /e/ and /o/. However, the possible process [+tense] [-tense] would incorrectly generate the output for seca and jogo, namely, ['sɛka] → *[sɛka] and /f'ɛsto/ → *[f'ɛsto]. Thus, the most reasonable solution is to posit a process which tenses all unstressed non-low vowels., e.g.,

/'fɛsto/ → ['fɛsto] - /fɛs'tivo/ → [fɛs'tivo]
/'sɛka/ → ['sɛka] - /se'kar/ → [se'kar]
2.3.4.1.2. Word Final Unstressed Raising

\[ \gamma \quad [ + hi ] / _{(c) \neq} \] \\
\[ [ - i o ] \]

In word final position all seven oral vowels occur if they are stressed:

\[ [ v i ] \quad \rightarrow \quad vi 'I saw' \]
\[ [ v e ] \quad \rightarrow \quad vê 'he sees' \]
\[ [ k a ^ { ' e } ] \quad \rightarrow \quad kafê 'coffee' \]
\[ [ ' p o ] \quad \rightarrow \quad po 'dust' \]
\[ [ a ^ { ' i o } ] \quad \rightarrow \quad aîô 'hello' \]
\[ [ ' t u ] \quad \rightarrow \quad tu 'you(thou)' \]

However, only three unstressed vowels occur in this position in 'Normal' speech: \[ i i, u u, \] and \[ a a \].

\[ ' g a t [ u ] \quad (N o r m a l) \quad \rightarrow \quad ' g a t [ o ] \quad (C i t a t i o n) \quad \rightarrow \quad g a t o 'cat' \]
\[ ' m a t [ i i ] \quad (N o r m a l) \quad \rightarrow \quad ' m a t [ e ] \quad (C i t a t i o n) \quad \rightarrow \quad m a t e 'type of tea' \]
\[ ' p r a ç [ a l ] \quad (N o r m a l) \quad \rightarrow \quad ' p r a ç [ a ] \quad (C i t a t i o n) \quad \rightarrow \quad p r a ç a 'square' \]

This raising process is limited to the vowels \[ / e / \] and \[ / o / \] since \[ / a / \] does not participate in the process, and there is no evidence that \[ / e / \] and \[ / o / \] occur in this position (and if they did occur they would be phonetically [e] and [o] due to unstressed tensing—2.3.4.1 above).

These data show that the process is obligatory in 'Normal' but non-occurring in 'Citation'. However, for some speakers raising is obligatory even in 'Citation'. Two of the speakers I have consulted (from Bahia and Matto Grosso) always produced the raised versions.
even in 'citation' [i.e., [i] and [u]]; two other speakers (from Minas Gerais and Paraná) produced the non-raised [e] and [o] in 'citation'.

In light of this data, one might conclude that the first two speakers have underlying /i/ and /u/ rather than /e/ and /o/ because they show no alternation. The raising process for them would have become a synchronic lexical constraint rather than a synchronic alternation.

There is, however, some evidence that suggests that raising is a productive synchronic process, even for these first two speakers. Redenbarger 1976:150 points out that there is productive alternation between [i] and [e] in certain verbs. In the 1pl. present indicative the theme vowel appears:

\[
\begin{align*}
\text{fal\text{ar}} & \quad 'to speak' & \text{com\text{er}} & \quad 'to eat' \\
/\text{fal+e}+\text{mos}/ & & /\text{kom+e}+\text{mos}/ \\
[\text{fa}'+\text{memus}] & & [\text{ko}'+\text{memus}] \\
\text{falamos} & \quad 'we speak' & \text{comemos} & \quad 'we eat'
\end{align*}
\]

However, in the 3sg present indicative the theme vowel becomes final and unstressed, thus becoming subject to the raising process.

\[
\begin{align*}
/\text{fa}+\text{a}/ & & /\text{kom}+\text{e}/ \\
[\text{fa}'] & & [\text{kom}'] \\
\text{fala} & \quad 'he speaks' & \text{come} & \quad 'he eats'
\end{align*}
\]

2.3.4.1.3. Palatalization

\[
\begin{array}{l}
\text{C} \quad [+\text{deto} \text{re}]/\quad [+\text{hi}] \\
[+\text{ant}] & \quad [-\text{bk}]
\end{array}
\]
In a great number of dialects (including Rio de Janeiro, parts of Parana and Sao Paulo, Bahia, and Minas Gerais) /t/ and /d/ occurring before /l/ become palatalized (or more properly completely affricated).

['dʒa] dia 'day'
['tʃa] tia 'aunt'
['maʃi] mate 'type of tea'
[si'daʃi] cidade 'city'

The last two examples illustrate that raising can feed palatization, i.e., /mate/ → ['maʃi] → ['maʃi], /cidade/ → [si'daʃi] → [si'daʃi].

2.3.4.1.4. Glide Formation from /l/

[laʃ] → [-cons]/ + 3

In the majority of dialects syllable final /l/ is pronounced [y],

[bra'ziʃ] Brasil 'Brazil'
['faʃa] falta 'lack'

while in some dialects it is [t].

2.3.4.5. Carioca Palatal Gliding

\[
V - \begin{bmatrix} -sy \end{bmatrix} / V - \begin{bmatrix} +sib \end{bmatrix} \begin{bmatrix} +hi \end{bmatrix} \begin{bmatrix} -bk \end{bmatrix} \begin{bmatrix} \# \end{bmatrix}
\]

(Where by convention \( V_{i-1}V_{i}=V_{i} \))

In Carioca dialect (Rio de Janeiro) a final stressed syllable which ends in /s/ is pronounced [Vʃ]. (Note: syllable final /s/ is pronounced [ʃ]). This gliding process applies only to final stressed syllables; in non-final stressed or any unstressed positions
the process does not operate.

\[
\begin{align*}
[\text{'fej'}] & \quad \text{fer} & \quad \text{'did'} \\
[\text{'dɛj'}] & \quad \text{dez} & \quad \text{'ten'} \\
[\text{'pæj'}] & \quad \text{pas} & \quad \text{'peace'} \\
[\text{'nɔs'}] & \quad \text{nós} & \quad \text{'us'} \\
[\text{'pɔs'}] & \quad \text{pôs} & \quad \text{'put'} \\
[\text{'bɔs'}] & \quad \text{bons} & \quad \text{'good'} \\
[\text{'luːs'}] & \quad \text{luz} & \quad \text{'light'} \\
[\text{'pæʃtəs'}] & \quad \text{pastas} & \quad \text{'attaché cases'}
\end{align*}
\]

2.3.4.2. Processes in 'Casual' Speech

In casual speech all of the above processes in 2.3.4.1 operate in addition to the ones discussed below.

2.3.4.1. Carioca Schwa Gliding

\[
V \rightarrow \begin{cases} \\
[\text{-syl}] & / \hat{V} \quad \cancel{\$} [\text{-voc}] \\
[\text{-bk}] & / \quad [\text{-i}] \\
[\text{-front}] & / \\
[\text{-rn}] & / \\
\end{cases}
\]

(where $V_iV_i = V_i$)

In Carioca (Rio de Janeiro) speech, especially in the speech of the younger generation, a stressed vowel is pronounced $[V_\text{æ}]$, except when it is followed by a tautosyllabic glide, or a vowel in the next syllable. The actual phonetic value of the 'schwa' glide varies depending on the stressed vowel, e.g., the glide following $[i]$ is higher than the one following $[e]$ or $[ɛ]$. Since in all cases the offglide shows centralization, I have transcribed the glide as $[e]$. (Centralization means that for average male speakers the neutral position of the vocal tract is roughly $F_1=500, F_2=1500.$) In American English
the lax vowels often develop this offglide, e.g., *led [lɛd] but the
tense vowels do not, e.g., *led [lɛd] [lɛd]. However, in the
Portuguese of Rio de Janeiro, even the tense vowels develop this off-
glide. Only /a/ does not undergo this process. The process occurs
in all stressed positions although it is most pronounced word finally.

[['fiqta] fita 'tape'
[['a'loq] alo 'hello'
[['r'pegi] ipê 'species of tree'
[[''pegi] pé 'foot'
[[''bogta] bota 'boot'
[[''gruda] gruda 'sticks'

but [[fa'lej] *[fa'lej] falei 'I spoke'
[[mo'idu] *[mo'udu] moido 'ground'

In the figures below, the speakers are coded in the following
manner: The first letter represents the sex of the speaker (M = male,
F = female). The second and third letters represent the speaker's
native state. (These are standard Brazilian abbreviations). The
subscript, if any, is used to distinguish different speakers from the
same state. Thus, MRJ₁ = male speaker number one from Rio de Janeiro.
The states are abbreviated as follows: BA = Bahia, CE = Ceará,
MT = Mato Grosso, MG = Minas Gerais, PR = Paraná, RJ = Rio de Janeiro.
The additional abbreviation RP is used to stand for reporter or
'newscast dialect' (a kind of Brazilian 'Received Pronunciation').
Figures 4-1 and 4-2 contrast a speaker from Rio de Janeiro with one from Salvador, Bahia who does not show this process.

Although I have included this process under casual speech processes, according to my personal observation, for some speakers, particularly those under 30, the process is obligatory in all speech styles. Young children especially show this phenomenon, e.g., my daughter in her acquisition of English and Portuguese showed this schwa offgliding in her Portuguese utterances (all vowels) even though she was not exposed to this dialect (Major 1977). Her English vowels (tense) on the other hand did not undergo this process. Other speakers from Rio, particularly older speakers, may not show the process at all or if they undergo the process it occurs only in an extremely casual style.

2.3.4.2.2. Unstressed Raising

\[ \breve{\nu} \rightarrow [+hi]
[-lo] \]

In 2.3.4.1.2. above I discussed word final unstressed raising, which occurs in 'Normal'. Non-final unstressed vowels are not raised in 'Normal' but are often raised in 'Casual' speech (Houaiss 1958). Vowels may be raised either in pretonic or posttonic position. Since in Brazilian Portuguese the process applies only to unstressed vowels, they are already \[^{*}\text{tense}\] (except /a/ which does not participate in this process. See 2.3.4.1.1.). A vowel undergoing this process may start out underlyingly lax, e.g., /ɛ/, be (tensed) by the unstressed tensing process to [ɛ](2.3.4.1.1.) and be raised further to [i] by the unstressed raising process (2.3.4.2.2.).
Figure 2-1: Schwa Offgiding

1pê  'type of tree'
Speaker MRJ₁

1pê  'type of tree'
Speaker MBA₁
Figure 2-2: Schwa Offgliding
2.3.4.3. Voiceless Vowels

(A) /i/ → [-voi]/*#

(B) /u/ → [-voi]/[-voi]/*[-voi] [+hi]

All unstressed vowels ([i], [u], and [a]) in 'Casual' become voiceless word finally, especially sentence or utterance finally. Word internally, the high vowels ([i], [u]) become voiceless when adjacent to voiceless consonants. (Note: there are no voiceless *[e], *[o], *[e], *[o] because of unstressed tensing and raising, 2.3.4.1.2. and 2.3.4.2.2.).

| ['kapa']  | cena     | 'coat'   |
| ['sabi']  | sabe     | 'know'   |
| ['gatu']  | gato     | 'cat'    |
| ['pi:kenu] | pequeno | 'little' |

If a vowel devoices, it may devoice preceding segments as well:

| ['xapidu] | rapido   | 'rapid' |
| ['gadu]   | gado     | 'cattle'|
| ['levi]   | leve     | 'light' |
Brazilian students learning English also have a tendency to
devoice vowels in their English pronunciation as well. (I observed
this when I taught English in Rio de Janeiro 1971-1974). Because
English speakers are unaccustomed to hearing voiceless vowels they
hear them as an absence of a vowel; e.g. 'He invited her to coffee
after the movie' comes out like 'He invited her to cough after the
move'.

Figure 2-5, p.37, shows the pronunciation of a speaker
originally from Ceara (now living in Londrina, Parana) of Estados
Unidos 'United States'. (Note also that final s in Unidos has been
deleted.) Figure 2-5 clearly shows a voiceless [u] as well as
partial devoicing of the [d]. (The vocal fold vibrations stop
before the [d] is released.) The duration of the [d] is 90 milli-
seconds, the final 35 of which are voiceless. The spectrogram also
shows a deletion of [u] and [i] in [ils'tadGuls Unidos]. Vowel
deletion will be discussed in 2.3.4.2.4. below.

2.3.4.2.4. Unstressed Vowel Deletion

\[ \tilde{V} \rightarrow \emptyset / \text{ in certain conditions.} \]

Under certain conditions, which have not been adequately
specified, unstressed vowels delete.

\[ [a'bobora] \rightarrow [a'bobra] \quad \text{abóbora} \quad \text{pumpkin} \]
\[ ['arvori] \rightarrow ['arvri] \quad \text{árvore} \quad \text{tree} \]
\[ [prɛzidɛstʃi] \rightarrow [prɛzðɛstʃi] \quad \text{presidente} \quad \text{president} \]
viajante embrulhado numa capa 'to pass a traveller wrapped up in a coat'

Speaker MRJ₁

Figure 2-3: Voiceless Vowels
obrigar o viajante atirar a capa 'force the traveller to take off his coat'.

Speaker MRJ

Figure 2-4: Voiceless Vowels (here speaker does not devoice vowel. (Contrast 2-3)
de vocês lá nos Estados Unidos 'of yours there in the United States'

Speaker MCE

Figure 2-5: Voiceless Vowels
O rádio pequeno é muito caro 'the little radio is very expensive'

Speaker FPR Nor

Figure 2-6: Voiceless Vowels
In some cases the vowel may first become voiceless and then delete (e.g., prefeitos above), although in environments where both adjacent segments are voiced, e.g., prezidente, the vowel probably does not go through an intermediate stage of voicelessness. Since devoicing seems to be an assimilatory phenomenon, a devoicing in this environment would be unlikely—it would require changing a vowel from voiced to voiceless between two voiced segments.

Due to a deletion of [u] and [i], a surface contrast can result between [s] and [ʒ]. This is because when [u] deletes, it leaves itslabiality on the adjacent consonants. In Carioca dialect, where syllable final /s/ is pronounced [ʃ] these deletions can result in a surface contrast between [ʃ] and [ʃ].
Figures 2-7, 2-8, 2-9, 2-10, 2-11 (pp.41-45) are spectrograms of a recording I made of 'Jornal Nacional' on 14 December 1976. ('Jornal Nacional' is a national television newscast from 'Rede Globo', Rio de Janeiro). Because I recorded directly from a television, there is some extraneous noise, especially between 0 and 2000 Hz. Therefore, the reader is cautioned not to confuse this noise with the particular phenomenon under question. On the figures I have given a phonetic transcription of the actual speech. In order to aid the reader, beneath this transcription I have transcribed a 'Normal' pronunciation before deletions have taken place. In order to avoid confusion, this 'Normal' transcription is given in double square brackets, i.e., [[ ]].

Figures 2-7, 2-8, 2-9, 2-10, 2-11 were made from the speech of national television newscasters. Vowel deletion is usually a casual speech phenomenon, yet deletions sometimes occur even in the standard 'newscast dialect' used on national radio and television. (This 'newscast dialect' is fairly standard, i.e., newscasters from all parts of the country tend to sound the same (or try to sound the same)). It is noteworthy that the reporters that showed these vowel deletions were under 30 years of age, while the reporter who did not show the deletions was approximately 30 years older. It is also my informal observation that this older reporter shows less incidence of 'Casual' processes when compared to younger reporters. I suggest that 'Casual' processes, e.g., vowel deletions, have become 'Normal' processes for younger speakers. In fact they have become accepted as evidenced by the fact that they occur even in the speech of
segundo os prefeitos 'drought in the region, according to the mayors'

Speaker MRP

Figure 2-7: Vowel Deletions
quarenta e dois prefeitos e cidades "42 mayors and cities"

Speaker MRP_1

Figure 2-8: Vowel Deletions (Here no deletion, cf. 2-7)
Ernesto Geisel participou hoje de manhã 'Ernesto Geisel participated this morning'

Speaker MRP$_2$

Figure 2-9 Vowel Deletions
Speaker MRP\textsubscript{2}

Figure 2-10: Vowel Deletions
o carro dele é muito prático 'his car is very practical'

Speaker MBA  Nor

Figure 2-12: Vowel Deletions
national newscasters.

In preceding sections I have also given cases of language change in progress: schwa offgliding, i.e., \( \hat{\nu} \rightarrow \nu_{\text{a}} \) (2.3.4.1.) and vocalization of \( \lambda \), i.e., \( l\$ \rightarrow \{y\} \) (2.3.4.1.4.). It has been argued by some that language change takes place in the younger generation, i.e., the casual speech of the old becomes the normal speech of the young. However, the ultimate source of the change has been argued for decades. Some (Sweet 1900, Halle 1962) claim that sound change originates in adults while others claim that it is children who originate the change (Passy 1890, Stampe 1969, Major 1978). Here I shall not discuss the detailed arguments of either position (see references) but I would only like to point out that my Portuguese data suggest that sound change is taking place in the younger rather than in the older generation.

Figure 2-13 shows the surface contrast between \([f]\) and \([w]\).

Notice that passos was pronounced \([p\text{ass}\{\nu}\{\}]\). In the deletion of \([\text{ul}]\) the labiality was left on the \([\{\}]\). The acoustic effect of labialization is a lowering or attenuation of the higher frequencies. This is evident when comparing passos with passes.

2.3.4.2.5. Intervocalic /x/ Weakening and Deletion

\[
\begin{array}{c}
+\text{obs} \\
+\text{bk} \\
+\text{cnt} \\
\end{array} \rightarrow \emptyset \hat{\nu} \_\_ \_ \nu
\]

In a great number of dialects intervocalic \(rr\) is pronounced as a velar or uvular fricative \([x]\) or \([X]\). It may undergo successive weakening to \([h]\) or \([\text{fr}]\) and then delete, e.g.,
Figure 2-13: Labialization of /s/ and Vowel Deletion
Figure 2-14: /x/ Deletion
"kaxu" → "kahu" → "kah\u0111u" → "kau"

The process as stated above abbreviates this sequence of assimilations, as a deletion.

Figure 2-13 was made from a recording of 'Jornal Nacional' (10 December 1976) of a local resident's account of a robbery. (Same speaker as figure 2-5.) It contrasts [x] deletion with a 'Normal' [x].

2.3.4.2.6. Flap Deletion

\[\text{[+flap]} \rightarrow \emptyset /V_1 \rightarrow V \]

[a'gora] → [a'go\u00e7a]  
[\'para] → [\'pa(a)]

egora 'now'
pará 'stop'

2.3.4.2.7. Syllable Deletions Involving Consonants

In very common expressions in informal situations many unstressed syllables drop out:

[vo'sais.ta'bo\u00e7a] → [seta\u00e7a]  
['v\u00eemuzim'boa] → ['Tmbo\u00e7a]  
[n\u00e9\u00e7'e] → [n\u00e9\u00e7'e] → [n\u0111\u00e7'e] → [n\u00e9]

você está bom? 'How are you?'
vamos imborá 'Let's go'
\não é? 'isn't it?'

These examples should be analyzed as successive application of assimilatory processes, but the details can be forgone here.

2.4. A Brief Survey of Some Major Dialect Differences

There has been very little work on the major dialects of Brazil (Amaral 1955, Barbádio 1972, Michaele 1968, Rodrigues 1974, Rossi 1965). I do not intend to discuss dialect differences in any detail
but I shall merely point out some major differences which are common knowledge to most Brazilians and which I also observed when I lived in Brazil. These involve /s/, /r/, and /l/.

/s/

Syllable final /s/ in most regions is pronounced [s] or [z] (if the following segment is voiced). In Rio de Janeiro it is pronounced [ʃ] or [ʒ] under the same conditions.

[pais](most regions) [paiʃ] (Carioca) pais 'parents'
[es'ta] - [este'ta] está 'is'
[mezmu] - [mezmu] mesmo 'same'

/r/

/r/ varies considerably from region to region. In Rio de Janeiro and Bahia it is realized as a velar or uvular fricative [x] or [X] in all positions—syllable initially and finally. In the city of São Paulo, and in many southern regions, e.g., Rio Grande do Sul and southern Paraná, /r/ is pronounced as an alveolar trill [r]. In many other regions, e.g., northern Paraná, Minas Gerais, and in the interior of the state of São Paulo, /r/ is realized as [x] syllable initially, but syllable finally it is pronounced as a retroflex or rhotacized [ɾ]. /r/ is distinct from the flap /ɾ/ which occurs intervocally, and is pronounced as [ɾ] in all regions. (Orthographically, /r/ is represented by r initially, finally, and before a consonant; and by rr intervocally. The flap /ɾ/ is represented by intervocalic r).
<table>
<thead>
<tr>
<th>RJ, BA</th>
<th>SP, RS</th>
<th>MT, Int. SP, N. PR</th>
</tr>
</thead>
<tbody>
<tr>
<td>['xatu]</td>
<td>['ratu]</td>
<td>['xatu] rato 'rat'</td>
</tr>
<tr>
<td>['poxta]</td>
<td>['porta]</td>
<td>['pɔxta] porta 'door'</td>
</tr>
<tr>
<td>['kɔx]</td>
<td>['kɔr]</td>
<td>['kɔw] cor 'color'</td>
</tr>
<tr>
<td>['kaxu]</td>
<td>['karu]</td>
<td>['kaxu] carro 'car'</td>
</tr>
<tr>
<td>['karu]</td>
<td>[karu]</td>
<td>['karu] carro (expensive)</td>
</tr>
</tbody>
</table>

In most regions of Brazil syllable initial /l/ is [l] while syllable final it is [y] (See 2.3.4.1.4.). However, in certain southern regions, e.g., Rio Grande do Sul, it is pronounced [t]. In certain areas of Minas Gerais, especially in rural areas it is pronounced as [l].

<table>
<thead>
<tr>
<th>Most Areas</th>
<th>RS</th>
<th>MG</th>
</tr>
</thead>
<tbody>
<tr>
<td>['mɛu]</td>
<td>[mɛt]</td>
<td>['mɛw] mel 'honey'</td>
</tr>
</tbody>
</table>

2.5. Dialects of the Speakers Used in This Work

In this study I have used speakers from various dialect regions—Bahia, Ceará, Mato Grosso, Minas Gerais, Paraná, and Rio de Janeiro. The reader may think it is a shortcoming to use data from such a variety of dialects for a study which is not a dialect survey. However, what may at first appear to be a shortcoming can ultimately prove to an asset—for the type of phenomenon I am considering is characteristic of most dialects of Brazil (unless otherwise specified). Differences such as the pronunciation of /r/, /s/, and /l/ (2.4.) do not seem to alter the rhythmic influences (especially stress) on the phonology, e.g., raising, devoicing, syllable deletions (2.3.4.),
and syllabic shifts and monophthongization (4.2., 4.3., 4.4.). Thus, the processes which I have considered deal with the basic characteristics of almost Brazilian dialects—they are what makes Brazilian Portuguese sound like it does.

2.5. Summary

This brief summary of diachronic and synchronic processes has already shown the importance of stress in the history and structure of Portuguese. We have seen that diphthongization occurs only under stress, and that various shortening and assimilatory processes occur only in the absence of stress. The next chapter will discuss further effects of stress on Portuguese pronunciation.
CHAPTER III
THE INFLUENCE OF STRESS AND DURATION ON PHONOLOGICAL
PROCESSES AND SYLLABLE STRUCTURE

3.0 Introduction

Chapter 2 has demonstrated how stress influences segmental processes. The lack of stress causes or is correlated with a variety of shortening or weakening processes (lenition), such as /x/ and /r/ deletion (2.3.4.5., 2.3.4.2.6.) vowel and syllable deletions (2.3.4.2.4., 2.3.4.2.7.) raising (2.3.4.1.2., 2.3.4.2.2.), and tensing (2.3.4.1.1.). Tensing and raising (i.e., [ɛ, ɔ] → [e,o], [e,o] → [i,u]) may be considered shortening processes because the higher the vowel the less intrinsic duration and intensity it has (Lehiste 1970). In contrast, the presence of stress is correlated with lengthening or strengthening processes (fortition), e.g., Carioca palatal glide insertion (\[\tilde{\nu}\] → [\tilde{\nu}]), (2.3.4.5.) and schwa offgliding ([\tilde{\nu}] → [\tilde{\nu}], 2.3.4.2.1.)

The terms 'shortening' and 'weakening' are not synonymous. In some cases a weakening process may also be a shortening process but not necessarily. A stop which is pronounced as a fricative intervocalically is an example of weakening, since by becoming a fricative the stop is being partially assimilated to the adjacent vowels. This is assimilatory because in the production of a vowel the vocal tract is very open and relatively free from obstruction, while in the production of a stop there is a complete oral obstruction. A fricative, on the other hand requires only a partial obstruction.
Thus, a stop which becomes a fricative between vowels (e.g., [aba] → 
[aβa]), is a partial assimilation because the vocal tract has to undergo less movement than it would have to to produce a stop (i.e.,
VstopV → VfricativeV open-closed-open → open-partially closed-open).
Although this example is a weakening process, it may not be a shortening process because a fricative is not necessarily shorter than a
stop; it can depend on the language (Lehiste 1970:29-30). However,
some processes can be both shortening and weakening, e.g., flapping
of /t/ intervocalically in English (since [t] is voiceless and [r] is voiced as well as shorter than [t]).

3.1 Sandhi Shortening Processes

In addition to shortening processes which occur within individual words due to lack of stress, shortening processes occur across
word boundaries. Many of these shortening processes involve deletions as well as changes in syllable structure. Due to sentence
level stress, words lose primary stress. Associated with this loss
of stress are a variety of other changes.

['bɔa'sɔɾtʃi] → [bəa'sɔɾtʃ]  boa sorte 'good luck'
['fɔi't'bɔɾə] → [fɪt'boɾə]  foi imbora 'went away'
['fiudə'ʃtʃy] → [fiudə'tʃy]  Rio dental 'dental floss'
['xiu'ɡɾɐdizdu'suʃy] → [ξiugɾɐdizdu'suʃy]  Rio Grande do Sul (a state)
['xiudziʁe'nεɾu] → [ξiudʒiɾe'nεɾu]  Rio de Janeiro (a city and state)
['tiʃia'marʃiə] → [tiʃiə'marʃiə]  tia Marcia 'aunt Marcia'
['tiʃi'yamarʃi] → [tiʃi'u'marʃi]  tio Marcio 'uncle Marcio'
['eli'viɾε'marʃiə] → [aliviɾε'marʃiə]  ele viu a Marcia 'he saw Marcia'
The following examples which occur in casual speech show that there is a tendency to change unstressed diphthongs of the type [CVY] to [CVV], e.g., [{'xiu'} → {'xiu'}. The change from [CVY] to [CVV] (or from closed to open syllable) is associated with shortening in a variety of languages (Donegan 1968). In addition, standard baby talk words involving reduplication avoid unstressed [VV]:

\[
\begin{align*}
[\text{'dɔ'dɔi}] (\text{['dɔi]}) & \quad \text{dɔdɔi} \quad \text{'it hurts' (baby talk)} \\
[\text{'mɛ'mɛi}] (\text{['mɛi]}) & \quad \text{mamæ} \quad \text{'Mommy'} \\
[\text{pə'pajo}] (\text{['pajo]}) & \quad \text{papai} \quad \text{'Daddy'} \\
[\text{pju}'pju'pju}] & \quad \text{piu pju} \quad \text{'peep peep'} \\
& \quad \text{(sound of a chick)}
\end{align*}
\]

3.2. The Phonetic Transcription of Diphthongs

I have transcribed monosyllabic VV sequences either as [CVV] or [CVV]. This style of transcription deserves some discussion.

3.2.1. Various Systems of Transcription

The transcription of diphthongs, or syllabic nuclei of changing quality, varies from linguist to linguist. Daniel Jones, in his transcription of the vowels in English *bye*, *bow* (bend), *boy*, *bay*, and *bow* (knot) uses [ai], [au], [ɔi], [eɪ], and [ou] respectively; Trager and Smith 1951 use [ay], [aw], [ɔy], [eɪ], and [ow]; Ladefoged 1973 uses [ai], [aʊ], [ɔi], [eɪ], and [ou]. Lehiste and Peterson 1961 use a system to distinguish between a true 'diphthong' and a 'glide'. Their definition states that a true 'diphthong' consists of two steady states, while a 'glide' consists of only one steady state plus a
relatively long period of changing formant quality (i.e., a transition). In accordance with their instrumental data, the English vowel sounds mentioned above are transcribed as [ai], [au], [ɔɪ], [eɪ], and [oʊ] respectively. The vowels [eɪ] and [oʊ] are glides--i.e., they have only one steady state plus with a relatively long transition, while [ɔɪ], [au], [ɔɪ] are true diphthongs--i.e., they have two steady states. (Acoustically, a steady state consists of the period for which the formants are parallel to the time axis, e.g., would be a steady state while would not). However, what is a true diphthong in one phonetic environment may be realized as a glide in another. For example /ɔɪ/ in English is usually [ɔɪ] word finally, but due to rapid speed or a following voiceless consonant it may be realized as a glide [aɪ], e.g., night [naɪt](Lehiste, p.c.).

Naturally, any phonetic transcription is not a complete representation of the acoustic signal. Syllable nuclei of changing quality have no true 'segments' because of a changing formant pattern. Accordingly, the English vowel sounds in sight might be transcribed as [F₁ 700 → 300, F₂ 900 → 2300], or [ ai]. However, for linguistic purposes, phoneticians and phonologists take into account phonological criteria, and for better or worse they use segments to transcribe the non-segmental acoustic signals. This choice is not arbitrary, for there is evidence that 'segments' have psychological reality. For example, Portuguese /ai/ orthographically is ai even though acoustically the syllable nucleus changes its formant position from [a] to [i].
3.2.2. Diphthongs as [\text{\textit{ VW}}] or [\text{\textit{ WV}}]

In syllable nuclei of changing quality, I have used [\text{\textit{ V}}] to represent the most prominent portion of the syllable, i.e., the 'syllabic', and [\text{\textit{ W}}] to represent the less prominent portion or 'non-syllabic' or 'glide'. Thus, in this system English \textit{you} would be transcribed as [\text{\textit{ ju}}], while \textit{oh} would be [\text{\textit{ ow}}]. (A notational variant of this would be [\text{\textit{ ju}}] and [\text{\textit{ ow}}]).

The terms syllabic and non-syllabic, or more prominent versus less prominent have to do with the presence or absence of steady states as well as their relative durations. In accordance with these criteria I shall define [\text{\textit{ V}}] and [\text{\textit{ W}}] (i.e., the 'syllabic' and 'non-syllabic') in the following manner: In a monosyllabic \textit{VV} sequence (or a syllabic nucleus of changing quality), represented either by [\text{\textit{ VW}}] or [\text{\textit{ WV}}], [\text{\textit{ V}}] represents the more prominent portion of the syllable, i.e., the portion which has the longest steady state. [\text{\textit{ W}}] represents the less prominent portion; either it has no steady state or the steady state is considerably shorter than [\text{\textit{ V}}]. Thus, a process involving a syllabic shift of the type [\text{\textit{ V}}_1\text{\textit{ V}}_2] \rightarrow [\text{\textit{ W}}_1\text{\textit{ V}}_2] means \textit{V}_1 has shifted from being more prominent to less prominent, while \textit{V}_2 has shifted from being less prominent to more prominent.

Relative durations of the steady states are important in deciding which 'segment' is the syllabic and which is the non-syllabic (glide). When [\text{\textit{ W}}] has no steady state there is no question that it is non-syllabic. But when [\text{\textit{ W}}] has a steady state, in accordance with my definition it must be shorter than the syllabic [\text{\textit{ V}}]. Consider the following case:
In (1) \([Y_2]\) may have no steady state or it may have a steady state shorter than \([V_1]\). In (2) \([Y_1]\) either has no steady state or has a steady state shorter than \([V_2]\). However, when comparing (1) and (2) the actual duration of the steady state of \([V_2]\) in (2) may be equal to or even shorter than the steady state of non-syllabic \([Y_2]\) in (1)(if it has one). This is because in shifts of this type, the total duration of the syllable is often considerably shorter in (2). (See Figures 3-1 and 3-2 below). However, in (2) the steady state of \([V_2]\) is relatively longer than the steady state of \([Y_1]\)(if there is one), even though absolutely \([V_2]\) in (2) may be shorter than or equal to \([Y_2]\) in (1).

I have used \([Y]\) rather than \([G]\) as a notational convenience. Thus, \(iu\) sequences which undergo a shift in syllabic identity are represented as \([iy] \to [ju]\). I believe this notation is easier to follow than \([iw] \to [ju]\). A VV sequence for which no non-syllabic diacritic is used will be considered as disyllabic, as in \(Ri\) [xi\(\mu\)](= [xi\$u] or [xi\(\cdot\)u], as pronounced by Cariocas) vs. \(ri\) [xi\(y\)] 'he laughed'.

3.2.3. Acoustic Manifestations of \([VY]\) and \([YV]\)

Figure 3-1 contrasts \(cuido\) 'I take care of' with \(cuidamos\) 'we take care of'. In \(cuido\) [ku\(jdu\)] the steady state of the \([u]\) is approximately 130 msec, followed by a transition of 40 msec, and finally a semi-steady state for \([j]\) of 50 msec. The 'steady state' for \([j]\) is not really a steady state since the upper formants show a noticeable
Figure 3-1: Transcription of Diphthongs

k u l d é m u s

cuidamos 'we take care of'

Speaker MT Nor

'k u l d u

cuido 'I take care of'

Speaker MT Cit
downward slope. However, absolutely, a steady state is rarely observable. Clearly a formant which shows a angle of $0^\circ$ to the time axis is a steady state while one with an angle of $45^\circ$ is not. An angle of $5^\circ$ or $10^\circ$ might be considered a steady state and an angle of $1^\circ$ or $2^\circ$ certainly would. In the case of cuido, if one considers the second portion a steady state the vowel nucleus still would be transcribed as [uǐ] since the [u]/[i] ratio is about 2.6.

In contrast to cuido, cuidamos shows no steady state for the [u] portion of the syllable, while the [i] portion shows a semi-steady state of about only 25 msec. Thus, the syllable may be transcribed as [kui] or even [kǐ]. Notice that the absolute duration of the steady state of the syllabic [i] in cuidamos is less than the steady state of the non-syllabic [i] in cuido. But in keeping with the principle of relative durations, the transcriptions ['ku̯i̯d] and [kui̯demus] for cuido and cuidamos is consistent.

Figure 3-2 contrasts filmamos in Citation with filmamos in Casual. In filmamos(Citation) [=f̞u̯memus] the steady state of [i] has a duration of about 60 msec while the duration of the steady state of [u] is about 30 msec. However, in Casual filmamos [f̞u̯memus] there is no steady state for [i] while [u] has a steady state of about 30 msec.

Finally, figure 3-3 shows a speaker's rendition of calling the name Sylvia ['silyvia] from a distance(as a parents would call their children). Here the syllabic portion of the first syllable is [i] while the non-syllabic is [u]. The length of the steady-state of [i] is approximately 400 msec. while the steady state for [u] is only 50 msec. This is a ratio 8:1, clearly indicating that the [i] is the syllabic portion.
Figure 3-2: Transcription of Diphthongs
Figure 3-3  Sylvia 'Sylvia'

Speaker FPR Calling from a Distance
3.2.4. Notational Variants

I have justified the transcription of /V\ and /V\ in Portuguese over /V\ or some other system. In cases where there are two steady states the transcription /V\ is certainly reasonable. However, I have chosen to emphasize a different aspect of the same acoustic record—namely the relative durations of the steady states. In this way /V\ represents a shorter steady state than /V\. /V/ may be considered as a notational variant of either /V\ or /V/, where two steady states are involved. Of course, a formant pattern with no steady state necessarily has to be transcribed as /V/.

There are, however, languages where diphthongs consist of two steady states, roughly of equal length. Accordingly, in Estonian (Lehiste 1970) /æ/ is transcribed as [ae]. Furthermore, the fact that long diphthongs in Estonian consist of two long components roughly of equal length illustrate that neither member is more prominent (i.e., it would be unjust to say only one member is syllabic and that the other member is non-syllabic. Cf. the Portuguese case in 3-3 where one member is longer than the other). In the case of Estonian, the phonetic transcription of either [æ]\ or [æ] departs from the phonetic reality; [æ] better represents the facts. However, as argued above, in Portuguese, the transcriptions of diphthongs as /V\ or /V/ is justified.

3.3. Syllabic Durations in Trisyllabic Paroxytones

In trisyllabic paroxytones (words with three syllables and penultimate stress, e.g., batata 'potato' [ba'tata]) some processes
may apply to the posttonic syllable but not necessarily to the pretonic (e.g., Raising /e,o/ → [i,u] applies in 'Normal' posttonically but only in 'Casual' pretonically. More examples to follow). Since to my ears, the posttonic syllable is considerably shorter than the pretonic, this led me to consider the possibility that the durational differences of the pretonic and posttonic syllables might be motivating factors in the operation of certain shortening processes. This necessitated my doing instrumental work to determine the relative durations of the three syllables.

3.3.1. Methodology of Determining Syllable Durations

In order to measure the durations of syllables one might simply record speakers' productions of words and measure the durations using a spectrograph or mingograph. However, if the words are uttered in isolation (e.g., from a word list) there is the possibility of prepausal lengthening as there is in English (Klatt 1975, 1976).

Moreover, the intrinsic durational differences of the different segments would distort or obscure the data. For example, a voiceless stop has a longer duration than the corresponding voiced stop; fricatives may or not be longer than stops; low vowels are longer than high vowels (Lehiste 1970). Thus, in a word like *menina* [me'ni:na] 'girl' the stressed [n] may be shorter than the unstressed [n] or [n], because [n] is intrinsically shorter than either [e] or [a]. Therefore, the repetition of nonsense syllables seems to be the best method of controlling for intrinsic duration.

Liberman and Streeter 1978 employed a technique of using nonsense syllables as follows: Speakers uttered an English sentence and
immediately afterwards they attempted to imitate the sentence by using the nonsense syllable /ma/. The authors note that although /ma/ was used, any nonsense syllable would work. /ma/ is a good choice because the labial articulation of [m] does not interfere with the tongue position necessary for the production of the vowel. However, in Portuguese, the use of /ma/ would not be satisfactory for the following reason. Stressed /a/ before a nasal becomes [a] or [ã] (in unstressed position [a] alternates with [a], e.g., banana 'banana' is [ba'naa] - [ba'naã]). Thus, the use of mememem in Portuguese would not control for intrinsic duration since phonetically it would consist of different vowels, i.e. it would be pronounced [ma'memem]. There are only two other vowels which occur in unstressed final position, [i] and [u]. I asked one speaker to try to imitate words using /mi/ but he found it very unnatural and had considerable difficulty. Therefore, I decided to try some other nonsense syllable. /pa/ and /ba/ could not be used. Because /p/ is voiceless there would be no acoustic record of the onset of the /p/, and even though /b/ is voiced, there could be a slight delay in voicing onset (there is no experimental data on voicing onset time in Portuguese, to my knowledge). I tried /f/ and /v/ but discovered that the acoustic signals were often too weak to show up consistently on a spectrogram or mingogram. Therefore, by process of elimination, I chose /la/. Speakers found this syllable very easy to use for imitation, probably because they had all at some time or another used /la/ when singing a song for which they did not know the words. /la/ potentially has a drawback because /l/ could become velarized and perhaps veralize the
preceding vowel as well. However, in Portuguese, /l/ syllable initially is relatively 'clear' or unvelarized; the word *lalála* would be pronounced *[la$la$la]* (vs. English *[le$lat$la]*). Thus, the choice of the nonsense syllable /la/ for Portuguese is reasonable.

Using the frame sentence /Repita a palavra ____ de novo/ ('Repeat the word ____ again') I asked speakers to read the sentence in 'Normal' ('normalmente') substituting the words *batata* *[ba'tata]* 'potato' and *palito* *[pa'litul]* 'toothpick'. Immediately after each utterance of the frame sentence with the real word, the speakers uttered the frame sentence but imitated the key word by using /la/ syllables. For example, the speaker first uttered 'Repita a palavra batata de novo' and then 'Repita a palavra lalála de novo'. (I also tried having the speakers imitate the entire sentence using /la/ but no one was able to do this.) After several productions of the frame with the real word and the *lalála* imitation, the speaker was asked to continue repeating only 'Repita a palavra lalála de novo'. This was done in the interest of maintaining a good relationship with the speaker—most speakers could reasonably tolerate 30 productions but certainly not 60.

3.3.2. Results

Using a Mingograph 42B I measured the speakers' productions of *lalála*. For productions which were difficult to measure, I used a spectrograph (Voiceprint 700) as a means of cross-checking.

As one can observe from the table 3-1, the tonic syllable is the longest, while the pretonic is considerably longer than the
Table 3-1

Durations of Syllables of lalála (uttered in frame 'Repita a palavra lalála de novo' ('Repeat the word lalála again'))

<table>
<thead>
<tr>
<th></th>
<th>Average Durations (msec)</th>
<th>Durational Ratios</th>
<th>Standard Deviations (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S_1$</td>
<td>$S_2$</td>
<td>$S_3$</td>
</tr>
<tr>
<td>Speaker MBA₂</td>
<td>148</td>
<td>240</td>
<td>99</td>
</tr>
<tr>
<td>Speaker MMG</td>
<td>168</td>
<td>235</td>
<td>125</td>
</tr>
<tr>
<td>Speaker FPR</td>
<td>164</td>
<td>255</td>
<td>111</td>
</tr>
</tbody>
</table>

Levels of Significance: Mean durations between all syllables (for each speaker) are significant to $>0.01$. 
posttonic. In round figures the durational ratios of the syllables for lalála productions are 3:4:2 or 3:5:2. If these figures roughly represent the ideal or preferred durations of paroxytones, then one might expect the differences in length to be causal factors in the operation of certain processes. Specifically, one might expect shortening processes to be most likely favored in the posttonic syllable since it is the shortest and least likely favored in the tonic because it is the longest. I shall discuss this hypothesis in chapter IV.

The reader may be somewhat skeptical of the results obtained from nonsense syllables since lalála in 'Repita a palavra lalála de novo' does not constitute completely natural speech. However, these results are consistent with the data obtained from speech consisting of real words. In these data too, the posttonic is considerably shorter than the pretonic. (See Chapter V and Figure 3-5 which shows that the pretonic [pəl] in palavra 'word' is longer than the posttonic [vral]).

3.3.3. The Acoustic Correlates of Stress

In productions of nonsense lalála the stressed ['la] showed a higher pitch, intensity, and length than either of the unstressed syllables. Figure 3-4 show mingogram of a typical token of 'Repita a palavra lalála de novo' ('Repeat the word lalála again'). Here the tonic ['la] shows a greater length and intensity than either of the unstressed syllables. When comparing the two unstressed syllables, pretonic ['la] shows a greater length and intensity
Figure 3-4: The Acoustic Correlates of Stress
Figure 3-5: The Acoustic Correlates of Stress
Figure 3-6: The Acoustic Correlates of Stress
Figure 3-8: The Acoustic Correlates of Stress
than posttonic \[\text{[\text{posttonic}]}.\] The relative durations of the three syllables consistently show that the tonic is the longest, followed by the pre-tonic and the posttonic (Table 3-1, p.63). However, the relative intensities do not always directly correlate with the relative lengths.

Figure 3-5 shows a typical token of speaker FPR. Here the relative lengths directly correspond to the relative intensities, i.e., tonic > pretonic > posttonic, in intensity and length. This general pattern was the most common for all speakers. However, Figure 3-6 shows that the intensity of the pretonic is approximately equal to the intensity of the posttonic, although the duration of the posttonic is still less. In Figure 3-7 the intensity of the pretonic is approximately equal to the tonic although the pretonic is still shorter in duration. Figure 3-8 shows that for speaker MBA\textsubscript{2} the intensity of the posttonic is approximately equal to the tonic syllable, even though the posttonic has a shorter duration than either the pretonic or tonic syllable.

From these data I conclude that the absolutely consistent correlate of stress in Portuguese is length. The intensity of the stressed syllable is usually greater than the unstressed syllables, but this is not always the case. However, in all cases the duration of the stressed syllable is greater than either unstressed syllable. Therefore, length rather than intensity is the primary correlate of stress.

3.3.3.1. Emphatic Stress

Figures 3-9 and 3-10 contrast normal stress with emphatic stress.
Figure 3-10  O carro dele é linda. 'His car is beautiful'.

Speaker FPR Emphatic Stress
The narrow band spectrograms show that length as well as pitch increase under emphatic stress. The differences in length and pitch between normal and emphatic stress (for the tokens on figures 3-9 and 3-10) are shown below:

<table>
<thead>
<tr>
<th></th>
<th>Duration in msec</th>
<th>Fundamental Frequency in Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[lTn]</td>
<td>[du]</td>
</tr>
<tr>
<td>Normal Stress</td>
<td>330</td>
<td>100</td>
</tr>
<tr>
<td>Emphatic Stress</td>
<td>450</td>
<td>120</td>
</tr>
</tbody>
</table>

Notice that the duration and pitch of the stressed syllable ['lTn] vary considerably between normal and emphatic stress, but for unstressed ['du] there is very little difference between normal and emphatic. Since these measurements represent only two tokens, a greater sample size would be needed to make any statistical claims of significance. However, if the tokens from figures 3-9, and 3-10 are representative of a larger sample, it would indicate that the domain for emphatic stress on a word is the stressed syllable, rather than the whole word.

3.3.4. Summary

My data have shown that the most consistent correlate of stress in Portuguese is length. The following section will examine how the differences in length of the pretonic, tonic, and posttonic syllables correlate with the syllable structure of the language.
3.4. Syllable Structure

There are many differences in possible syllable structures between
the pretonic, tonic, and posttonic syllables—differences in possible
consonant and vowel combinations, possible diphthongs, as well as in
the occurrence or tolerance of closed vs. open syllables.

3.4.1. Consonant and Vowel Combinations

The possible consonant and vowel combinations in pretonic, tonic,
and posttonic syllables are indicated below:

\[(C)(C)V(C)(C)\]

(Note: The possible consonants depend on whether or not they occur
in prevocalic or postvocalic position and whether or not they occur in
a cluster. See Redenbarger 1979.)

Examples: \(\_ = \_\)

[\text{pres.'tʃi.zu}] \quad \text{prestígio 'prestige'}

[kɒ(n).tɾas.tʃi] \quad \text{contraste 'contrast'}

[tʃi.'a.tɾus] \quad \text{teatros 'theaters'}

[pers.pek.tʃi.va] \quad \text{perspectiva 'perspective'}

Although there are no differences in possible consonant and vowel
combinations (which exclude glides and vowel-vowel combinations) there
are differences when glides are involved.
Examples:

[kyay.'ker] qualeuer 'any'(sg.)
[kyais.'ker] quaisquer 'any'(pl.)
['kyay] qual 'which'(sg.)
['kyais] quais 'which'(pl.)
[i.'guay] igual 'equal'
['a.gyas] aquas 'waters'

Notice that although triphongs(GVG) occur in pretonic and tonic positions, they do not occur posttonically. When the syllable coda is /r/ there are still further differences:

Examples

[kyar.'tey] quartel 'headquarters'
['kyar.tu] quarto 'room'
Orthographic *qua* and *gua* are pronounced [kya] and [gya] respectively in all speech styles. The *u* is obligatorily pronounced as a glide [y] rather than a syllabic [u]. However, the pronunciation of *u* after other obstruents alternates between [u] and [y] depending on style (see chapter 4).

\[
[su'a'da](\text{Nor}) \sim [\text{su'a}d̠a] (\text{Cas}) \quad suada \quad '\text{sweaty}' \\
[sua'd̠i\text{na}](\text{Nor}) \sim [\text{syà}d̠i\text{na}](\text{Cas}) \quad suadinha \quad '\text{sweaty'}(\text{dimin.}) \\
[\text{ta'bua}d̠a](\text{Nor}) \sim [\text{ta'}bya\text{d̠a}](\text{Cas}) \quad tabuada \quad '\text{arithmetic table}'
\]

In these examples, the occurrence of [y] in casual speech can be considered as derived from /u/ since an [u]/[y] alternation exists. In contrast, *u* after [k] and [g] is obligatorily pronounced [y] in all speech styles, never *[u]*, e.g., *aqua* 'water' is *[a'gya]* *[a'gu.a]*.

On this basis, it is possible to argue for an underlying /u/ since no [u]/[y] alternation exists. However, to posit underlying /u/ when it only occurs after two segments seems unsatisfactory; there is another possible solution. Redenbarger (p.c.) has suggested that [kya] and might be represented as underlying labialized consonants, i.e., /k/ and [gya]. But both solutions potentially have their disadvantages.

To posit underlying /k/ and /g/ takes care of this problem but potentially raises another problem—Portuguese now would have underlying labialized consonants, but only two of them. From a classical phonemicist's point of view, the phonetic inventory is somewhat asymmetrical. However, this is not a valid criticism since lack of symmetry is found in many languages of the world, e.g., Arabic and
Old Irish have a /b/ but no /p/, yet they have other voiceless/voiced stops; English has labial, alveolar, and velar voiced and voiceless stops, yet only labial, alveolar, and palatal fricatives—it lacks velar fricatives.

There is still a third alternative, which is based on universal phonetic considerations and the presence of another synchronic process in Portuguese. All cases of obstruent plus u shall be assigned the status of /u/. Accordingly, the desyllabification process or glide formation (i.e., [u] → [y]) is obligatory when /u/ follows velars, but is limited to 'Casual' when /u/ follows non-velars. The operation of this process is asymmetrical/lopsided, but many, if not all, processes have favoring environments. That [u] → [y]/velar—is favoring environment is supported by data of the languages of the world. [k任何人] is far more common than, for example, [by]; labialized velar consonants are more common than any other labialized consonants. These facts involving labialization of velars are perhaps the result of a general principle involving assimilation: two segments which are more similar are more likely to assimilate than two segments which are less similar (Hutcheson 1973). The process

[u] → [y]/[+velar]— is in keeping with this principle. [u] has an oral approximation roughly in the velar region where [k] and [g] are also articulated. Thus, [u] is more similar to [k] and [g] than to any other consonant, and therefore is more likely to assimilate (either to [k] and [g] or [k] and [g]).

In Portuguese another synchronic process shows that [y] formation is favored after velars. [y] can arise from /o/ as well
as from /u/, and even when [u] is derived from /o/ its formation is favored after velar consonants over other consonants:

[k'ya'ɐ ada](Nor) - [ko'a'ɐ ada](Cit only) coalhada
[ʃ'a'kya'ɐ] (Nor) - [ʃa'ko'ɐ a](Cit only) chacoalha 'shakes'
but [voa'dor](Nor) - [vya'dor](Cas only) roador 'flyer'

These data support the claim that [u] formation is most likely after a velar since in Nor the glide is formed after a velar whereas it occurs only in Cas after non-velars.

One might expect that if velar vowels ([u] and [o]) are more likely to form a glide after velar consonants, then perhaps palatal vowels ([i] and [e]) would be more likely to form a palatal glide after palatal consonants. However, this does not seem to be the case. Although there are no palatal stops in Portuguese, /t/ and /d/ are assimilated to a following [i], i.e. /t, d/ → [tʃ, dʒ] → [i] (See 2.3.4.1.3.). However, palatal glide formation, [i], in these cases is not favored over other consonants.

[dʒia'meʃ][i](Nor) - [dʒia'meʃ][i](Cas) diamante 'diamond'
[vi'a'duʃ](Nor) - [vi'a'duʃ](Cas) viaduto 'viaduct'

Neither do preceding palatal fricatives favor [i] formation over other consonants:

[ʃi'adu](Nor) - ['ʃi'adu](Cas) chiado 'shrill'
[ʃi'adu](Nor) - ['ʃi'adu](Cas) fiado 'trustful'
3.4.2. Vowels

3.4.2.1. Oral Vowels

<table>
<thead>
<tr>
<th>Pretonic</th>
<th>Tonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>i</td>
<td>i</td>
</tr>
<tr>
<td>e</td>
<td>e</td>
<td>*e (except [er] in loans)</td>
</tr>
<tr>
<td>*ɛ</td>
<td>ɛ</td>
<td>*ɛ</td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>*ɔ</td>
<td>ɔ</td>
<td>*ɔ</td>
</tr>
<tr>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>u</td>
<td>u</td>
<td>u</td>
</tr>
</tbody>
</table>

The differences in occurrence between pretonic, tonic, and posttonic positions are a result of the raising and tensing processes (2.3.4.1.1. and 2.3.4.1.2., pp. 20-22). Posttonically in Nor only [I,a,u] occur (because of raising /e,o/ → [I,u]); but in Cit many speakers produce [e,a,o] because for them, the raising process does not operate in this style.

Examples:

**Pretonic**

[tʃiˈɾaɾ]  tıɾar  'to take off'

[meˈnɪnu]  menino  'boy'

[kaˈsar]  caɾar  'to hunt'

[poˈlidu]  polido  'polite'

[suˈliʃta]  sulista  'Southerner'

**Tonic**

['pi]  pi  'pi'

['pe]  p  'p'

['pe]  pé  'foot'
['pa']  
\text{pa}  
'spade'

['pó']  
\text{pó}  
'dust'

['po']  
\text{pô}  
(slang) 'heck, shucks, well'

[a'lo]  
\text{aiô}  
'hello'

['tu']  
\text{tu}  
'you'

Posttonic

['matʃi]  
\text{mate}  
'type of tea'

['mata]  
\text{mata}  
'dense vegetation'

['matʃu]  
\text{mato}  
'countryside'

[a'burger]  
\text{hamburger}  
'hamburger'

3.4.2.2. Nasal Vowels

<table>
<thead>
<tr>
<th>Pretonic</th>
<th>Tonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ɾ</td>
<td>ə</td>
<td>*ʔ̃</td>
</tr>
<tr>
<td>ɘ</td>
<td>ɘ</td>
<td>*ɘ</td>
</tr>
<tr>
<td>ɔ</td>
<td>ɔ</td>
<td>ɔ (or [ɔi], loans)</td>
</tr>
<tr>
<td>ü</td>
<td>ü</td>
<td>*ʊ</td>
</tr>
</tbody>
</table>

Examples:

Pretonic

[pit'ar]  
\text{pintar}  
'to paint'

[sæ'tar]  
\text{sentar}  
'to sit'

[kæ'tar]  
\text{cantar}  
'to sing'

[kə'tar]  
\text{contar}  
'to tell'

[ə'tar]  
\text{juntar}  
'to put together'

Tonic

['si']  
\text{si}  
'yes'

['sëte]  
\text{senta}  
'sits'
Posttonic vowels are diphthongized for many speakers due to a word final diphthongization process which also operates when the syllable is stressed. (See examples in tonic position.) However, posttonically this process only operates in Cit; in Nor the vowels are monophthongal [eI] and [oI]. (See chapter 4).

\[
V \cdot G / V
\]

\[
[ \text{ok} ] \begin{array}{c}
[\text{nas}] \\
[\text{ok}]
\end{array}
\]

(\text{where } V_i V_i^* = V_i)

3.4.3. Diphthongs

3.4.3.1. Oral Diphthongs

<table>
<thead>
<tr>
<th>Pretonic</th>
<th>Tonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ui</td>
<td>ui</td>
<td>ui</td>
</tr>
<tr>
<td>iu</td>
<td>iu</td>
<td>iu(from /il/)</td>
</tr>
<tr>
<td>ei</td>
<td>ei</td>
<td>ei(only /eis/)</td>
</tr>
<tr>
<td>eu</td>
<td>eu</td>
<td>eu(from /ei/)</td>
</tr>
<tr>
<td>*ei</td>
<td>*ei</td>
<td>*ei</td>
</tr>
<tr>
<td>*eu</td>
<td>*eu</td>
<td>*eu</td>
</tr>
<tr>
<td>ai</td>
<td>ai</td>
<td>*ai</td>
</tr>
<tr>
<td>au</td>
<td>au</td>
<td>*au</td>
</tr>
<tr>
<td>*oi</td>
<td>*oi</td>
<td>*oi</td>
</tr>
<tr>
<td>*ou</td>
<td>*ou</td>
<td>*ou</td>
</tr>
<tr>
<td>oi</td>
<td>oi</td>
<td>*oi</td>
</tr>
<tr>
<td>ou</td>
<td>ou</td>
<td>*ou</td>
</tr>
</tbody>
</table>
Post-tonically, [iu] (realized as [iy] in Cit and [ju] in Nor) is derived from /i1/; and [ey] is derived from /el/. Tonic [oy] is derived from /ol/. The question of underlying representation will be discussed in 4.5.

**Examples:**

**Pre-tonic**

The non-occurrence of [*ei, *eu, *ei, *ou] is due to the unstressed tensing process (2.3.4.1.1.).

| [fiy'mēmus] | filmamos | 'we film' |
| [suy'sid'w] | suicidio | 'suicide' |
| [dei'tēmus] | deitamos | 'we lie down' |
| [dey'gadu] | delgado | 'slim' |
| [paj'zagē] | paisagem | 'scenery' |
| [muy'risju] | Maurício | 'Mauricio' |
| [koj'tadu] | coitado | 'poor guy' |
| [doj'radu] | dourado | 'golden' |

[ky i'dēmus] (See 4.4. on assimilation) cuidamos 'we take care of'

**Tonic**

| ['xiy] | riu | 'he laughed' |
| ['xej] | rei | King' |
| ['dey] | deu | 'saw' |
| ['xejs] | réis (old monetary std.) |
| ['sey] | céu | 'heaven, sky' |
| ['paj] | pai | 'father' |
| ['pay] | pau | 'stick' |
| ['ōdi] | dōi | 'hurts' |
['sɔ́y']  sol.  'sun'
['bɔ́i']  boi  'steer'
[vɔ́y]  vou  'I go'
[fui]  fui  'I went'

**Posttonic**

[dzil'fisiu](Cit) → [dzil'fisiu](Nor) **dificil**  'difficult' (sg.)
[dzil'fiseis](Cit) → [dzil'fises](Nor) **dificéis**  'difficult' (pl)
[a'mavey](Nor) → [a'mavju](Cas) **amável**  'loveable'

Posttonic [ei] is a special case since it only occurs as the result of a morphological rule of plural formation for words ending in *il* and *el*, e.g., **dificil/dificéis** 'difficult', **amável/amáveis** 'loveable'. Posttonic [iu] is realized as [ju] in Nor, rather than *[iy]*, as it occurs in Nor Pretonically and Tonically. This example, as well as other shifts in syllabic value will be discussed in §4.4.

### 3.4.3.2. Nasal Diphthongs

<table>
<thead>
<tr>
<th>Pretonic</th>
<th>Tonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>əɪ</td>
<td>əɪ</td>
<td>*əɪ</td>
</tr>
</tbody>
</table>
| əʊ      | əʊ    | əʊ(from /am/)
| əɬ      | əɬ    | *əɬ      |

**Examples**

**Pretonic**

[pahi'ziụnas]

[pahy'ziụa]

[mihət'ziụnas]

**Tonic**

['pəʊ]  pão  'bread'

['pəɛs]  pães  'breads'

['pəɬ]  pəe  'puts'
Posttonic

[‘falːə] (Cit) → [‘falːə] (Nor) → [‘falː] (Cas)

falam 'they speak'

Posttonic [əŋ] is derived from am (cf. em* [eI], om* [oU] in 3.4.2.2. above). This is a completely different source than pretonic and tonic [əŋ] from ão (historically, ano > ão).

3.4.4. Summary

Although the differences in possible syllable structures between pretonic, tonic, and posttonic syllables are of course to some extent due to historical accident, it is quite striking that posttonically there is a noticeable simplicity in possible structures when compared to the pretonic and tonic positions. My data on durational differences suggest that the extremely short duration of the posttonic syllable may be a factor which has limited the possible structures in posttonic position.
CHAPTER IV

THE INFLUENCE OF STRESS AND DURATION ON PRETONIC AND POSTTONIC SHORTENING PROCESSES

4.0. Introduction

My experimental data in Chapter 3 have shown that the pretonic syllable is significantly longer than the posttonic (about 50 longer; see 3.3.2.). This difference is reflected in the possible syllable structures (the posttonic has less complex combinations, 3.4) as well as in the operations of certain processes discussed below.

4.1. Raising

4.1.1. Raising of Oral Vowels

\[ \text{[i]} + [+hi]/\text{____(s)}\]$  
\[\text{[-lo]}\]  
\[\text{/ɛ, ɔ/} \rightarrow \text{[i, u]}\]

As discussed in 2.3.4.1.2, p. 21 and 2.3.4.2.2., p. 26, raising of /e/ and /o/ to [i] and [u] is obligatory posttonically in Nor, but pretonically it occurs only in Cas. For many speakers non-raised [e,o] occur posttonically in Cit.

<table>
<thead>
<tr>
<th>Cit</th>
<th>Nor</th>
<th>Cas</th>
</tr>
</thead>
<tbody>
<tr>
<td>[po'li'do]</td>
<td>[po'li'du]</td>
<td>[pu'l'ido] *[pu'li'do]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>polido 'polite'</td>
</tr>
<tr>
<td>[me'nino]</td>
<td>[me'ninu]</td>
<td>[mi'ninj] *[mi'ni'nj]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>menino 'boy'</td>
</tr>
<tr>
<td>[se'le'ste]</td>
<td>[se'l'esti]</td>
<td>[si'l'estj] *[si'l'estj]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>celeste 'celestial'</td>
</tr>
</tbody>
</table>
The difference in the operation of this raising process is undoubtedly influenced by the differences in syllable durations of the pretonic and posttonic syllables. Since [i] and [u] are intrinsically shorter than [e] and [o] (Lehiste 1970), the raising process in the posttonic syllable reduces the length of the syllable where a short duration is required. In the pretonic position, which has a longer duration, the raising process does not occur in Nor but only in Cas. Since the tempo of Cas is generally faster than Nor, the operation of this process pretonically also has the effect of shortening.

In Cit some speakers produce non-raised posttonic [e] and [o] while others show [i] and [u]. For the speakers who produce [i] and [u], one might consider that the raising process is now a lexical constraint which is the result of an historical process. The motivation for this process seems to be shortening. In contrast, the other speakers produce [e] ~ [i] and [o] ~ [u] alternations. But since the posttonic is shorter than the pretonic, why would [e] and [o] occur in Cit, if shortening is the motivation for raising? The explanation lies in the difference between Cit and Nor. My data on syllable durations were based on Nor, where lalála occurred in the middle of a sentence. Therefore, the possibility of pre-pausal lengthening in Cit must be considered. (Prepausal lengthening occurs in English; Klatt 1975). In order to test this, I asked speaker FPR to produce in isolation betata 'potato' with lalála imitations. Table 4-1 shows the results and compares Cit (isolated productions) with Nor (uttered in a sentence).
The results clearly show that Portuguese has prepausal lengthening. In fact, the differences in duration between pretonic and posttonic syllables in Citation are not significantly different. This suggests that non-raised [e] and [o] are permitted posttonically in Cit precisely because in this style the posttonic syllable is much longer than it is in Nor. The Cit/Nor difference is also a factor in the operation of other processes, as I shall discuss below.

4.1.2. Raising of Nasal Vowels

\[ \hat{\eta} \rightarrow [+hi]/____(s)\$ \\
\left[ -lo \right] \\
\hat{\eta} \rightarrow [I, \ddot{u}] \\
/s, \ddot{u}/ \rightarrow [I, \ddot{u}] \\

The process, as stated, is the same as for the oral vowels.

However, since the conditions for which the process operates vary, depending on whether the vowel is oral or nasal, a separate discussion is warranted.

<table>
<thead>
<tr>
<th>Cit</th>
<th>Nor</th>
<th>Cas</th>
</tr>
</thead>
<tbody>
<tr>
<td>['õtg]</td>
<td>['õg]</td>
<td>['õg]</td>
</tr>
<tr>
<td>[sê'tar]</td>
<td>[sê'tar]</td>
<td>[sê'tar]</td>
</tr>
<tr>
<td>[kê'tar]</td>
<td>[kê'tar]</td>
<td>[kê'tar]</td>
</tr>
</tbody>
</table>

Posttonic [õ] represents a special case since it does not occur in any native Portuguese words but rather only in English loan words which are proper names (e.g., Emerson, Nelson, Edson, Wilson).
Table 4-1

Durations of Syllables of *lalala*. Citation vs. Normal

Speaker FPR

<table>
<thead>
<tr>
<th></th>
<th>Average Durations (msec)</th>
<th>Durational Ratios</th>
<th>Standard Deviations (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S_1$</td>
<td>$S_2$</td>
<td>$S_3$</td>
</tr>
<tr>
<td>Citation</td>
<td>168</td>
<td>276</td>
<td>169</td>
</tr>
<tr>
<td>Normal</td>
<td>164</td>
<td>255</td>
<td>111</td>
</tr>
</tbody>
</table>

Levels of Significance: Citation: Mean durations between $S_1$ and $S_2$, and $S_3$ and $S_2$ are significant to $>0.01$; $S_1$ and $S_2$ not significant.

Normal: Mean durations between all syllables significant to $>0.01$. 
The following chart summarizes raising:

<table>
<thead>
<tr>
<th></th>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral</td>
<td>Nasal</td>
<td>Oral</td>
</tr>
<tr>
<td>Cit</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Nor</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Cas</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Clearly, nasality is a factor in the raising process. There is a universal tendency among languages for nasal vowels to be lower than oral vowels (cf. French [i]/[ε] for fine/fin). In addition to this, Portuguese has a diphthongization process which changes word final [ε] and [o] to [ë] and [ə] for many speakers (both tonically and posttonically, 4.1.2.2.1.). Thus, this diphthongization process as well as the universal tendency for nasal vowels to lower can be considered factors which limit the operation of raising for the nasal vowels.

4.2. Raising and Monophthongization

\[
V \rightarrow V
\]

\[
\overset{\text{[æ] height}}{\text{[β] height}} / \overset{-lo}{+tense} \overset{\text{æ} bk}{\text{β} height} / (\text{/ei, cu/} \rightarrow \text{[e, o]}). \quad (\text{where } V_i V_i = V_i)
\]

The diphthongs /ei/ and /cu/ may undergo Monophthongization to [e] and [o] respectively, in all positions (pretonic, tonic, and posttonic. Note: there is no posttonic /ou/). This occurs in Cas, and for many speakers also in Nor. (Tonic /ei/ and /cu/ do not monophthongize and they do not occur in unstressed positions).
After Monophthongization has taken place, one might expect the vowels subsequently to undergo Raising to [il] and [u]. Although this

<table>
<thead>
<tr>
<th>Cit</th>
<th>Nor</th>
<th>Cas</th>
</tr>
</thead>
<tbody>
<tr>
<td>[dʒɪl'fɪsɪs]</td>
<td>[dʒɪl'fɪses]</td>
<td>[dʒɪl'fɪsɪs]</td>
</tr>
<tr>
<td>[deɪ'tɛmʊs]</td>
<td>[deɪ'tɛmus]</td>
<td>[deɪ'tɛmus]</td>
</tr>
<tr>
<td>[voʊ'tɛmʊs]</td>
<td>[voʊ'tɛmus]</td>
<td>[voʊ'tɛmus]</td>
</tr>
</tbody>
</table>

These data present a case of possible ordering. If pretonically one orders raising before Monophthongization, this would account for the non-occurrence of *[dʒɪl'+tɛmus] and *[voʊ'+tɛmus]. Posttonically, the correct output would result if both processes applied simultaneously and iteratively (or by ordering Monophthongization before Raising). However, Stampe and Donegan 1978 have pointed out that a counterfeeding order can be interpreted as a restriction on iteration rather than ordering. In this case, if Raising and Monophthongization both try to apply at the same time, only Monophthongization can apply (since Raising does not occur, as I have stated it, before a tautosyllabic vowel). If Raising can apply but once, the result would be a non-raised [e] and [o].
However, another solution is possible if the raising process is stated differently. Although I have implicitly stated that Monophthongization occurs as an intermediate stage to raising, i.e., \([e_i] \rightarrow [e] \rightarrow [i]\), it is conceivable that \([e_i]\) could go directly to \([i]\) (would thus be assimilated to the following \([i]\)). In this case the raising process would be stated as follows:

\[
\begin{array}{c}
\gamma^{-[+hi]} \\
[-lo]
\end{array}
\overset{[+hi]}{-[lo]} \overset{[+hi]}{-[lo]} \overset{[+hi]}{-[lo]}
\]

The process stated this way would be restricted to posttonic position. However, this solution still would not prevent pretonic \([e]\) and \([o]\) (which resulted from monophthongization of /ei/ and /ou/) from raising to *\([i]\) and *\([u]\). The only reasonable alternative is to order Raising before Monophthongization or restrict the iteration of the two processes.

4.3. Monophthongization of /ai/, /au/, and /öö/

In Cit and Nor /öö/ is pronounced /öö/ both in pretonic and posttonic positions. In Cus posttonic /öö/ monophthongizes to /ö/ and then may raise to /ö/ while in pretonic position Monophthongization occurs, but the resulting /ö/ does not raise. Because diphthongs are generally longer than monophthongs, this process can be considered a shortening process, and the subsequent posttonic Raising is a further shortening process.

\([fə'larö] \rightarrow [fə'larö] \rightarrow [fə'larö]\)  falaram 'they spoke'

\([pöö'zinu] \rightarrow [pöö'zinu] \rightarrow *[pöö'zinu]\)  pöözinho 'roll'

Monophthongization of /ai/ and /au/ to /a/ and /o/ respectively, occurs in extremely casual speech in pretonic position. The
resultant [o] (from /au/) does not raise to [u] (cf. above [ãĩ] → [ã] ≠ *[ã]).

\[\text{[mo'rišiu]} \rightarrow \text{[mu'rišiu]} \]
\[\text{[pa'zat̪i]} \rightarrow \text{[pa'zat̪i]}\]

These processes are not observable in variations in posttonic position because, quite significantly, these diphthongs do not occur posttonically. Loan words with posttonic [a] and [a] receive stress on the diphthong:

\[\text{[no'xou]} \quad \text{knowhow} \quad \text{'knowhow'}\]
\[\text{[ba'ka]} \quad \text{Buckeye} \quad \text{'Buckeye'}\]

(as pronounced by Brazilian residents of Columbus, OH)

These examples illustrate that rather than generating an unpronounceable representation in prosodic processing (i.e., stress assignment) and then repairing it by segmental processing (i.e., monophthongization), Portuguese assigns stress according to the normal stress rule, i.e., diphthongs are stressed. Thus, monophthongization of /ai/ and /au/ may be considered obligatory in the sense that there is a lexical constraint against these posttonic diphthongs.

A discussion of the alleged difference between a lexical constraint (variously called processes which govern underlying representations, redundancy or morpheme structure rules) and actual processes will be discussed in 4.5, which deals with underlying representation. This lexical constraint against posttonic diphthongs is seen in loan words with other posttonic diphthongs, where stress is placed on the posttonic diphthong.
[plei'boi] or [plei'boi]  playboy  'playboy'
[fuʃi'boy]  futebol  'football'
[kau'boi]  cowboy  'cowboy'
[koqui'teʃ]  coquetel  'cocktail'
[mai'tai]  mai tai  'mai tai'

If in borrowing a word Portuguese ignored stress altogether, a loan word with a posttonic diphthong would automatically become stressed by applying the normal stress rule. However, if stress were ignored in all cases, one would predict the stress rule to operate on non-diphthongal loans as well. However, this is not necessarily the case. Vila Sésamo (the Brazilian version of Sesame Street) is pronounced [ˈsɛzamu]. If the word had been borrowed as /səzamo/ and stress assigned by the normal stress rule (which assigns penultimate stress to non-diphthongal words and stresses diphthongs) the word would be pronounced *[səˈzamu]. Portuguese is able to borrow this antepenultimate stress, quite simply because it has native words with antepenultimate stress, e.g., ['prɔˈsimu] próximo 'next'. (Words which do not receive normal stress are orthographically marked with accent, e.g., rápi-do ['rapidu] 'rapid', al-o [aˈlo] 'hello').

However, for other loans which do not have posttonic diphthongs, stress is ignored and the word becomes stressed normally, e.g., hamburger is ['amburger]. The stress of loans can thus be summarized as follows: if the stress on the loan violates the constraints on pronounceability in Portuguese, the word is restressed normally; if the stress does not violate constraints on pronounceability, Portuguese may or not borrow the stress.
4.4. Syllabic Shifts

Underlying /VV/ sequences are potentially either disyllabic or monosyllabic on the surface, and some sequences which are disyllabic in one style may become monosyllabic in another style.

\[ \text{[pi\'e\'dad\'3\i](Nor)} \cdot \text{[pi\'e\'dad\'3](Cas)} \quad \text{piedade 'pity'} \]

A sequence of stressed vowel plus high vowel is monosyllabic on the surface in all styles and is pronounced \[VV\] not \[^{\text{V}}V\]. If the syllable becomes unstressed and both vowels are high, the syllability can shift, i.e., \[VV\] \rightarrow \[^{\text{V}}V\]. Syllabic shifts of this type (which change a syllable from closed to open) have been associated with shortening due to lack of stress. (See Chapter I.) Such a shift in Portuguese never occurs on a tonic syllable. (However, due to sentence level stress a whole word may become distressed, resulting in a syllabic shift for the normally tonic syllable.)

\[ \text{[t\'si\'e\'mars\'e]} \rightarrow \text{[t\'si\'e\'mars\'e]} \quad \text{tia M\'arcia 'aunt Marcia'} \]
\[ \text{[k\'ui\'du]} \quad \text{[k\'ui\'du]} \quad \text{cuido 'I take care of'} \]

\[ \text{but \ [k\'ui\'d\'em\'us]} \rightarrow \text{[k\'ui\'d\'em\'us]} \quad \text{cuidamos 'we take care of'} \]
\[ \text{[f\'i\'mi]} \quad \text{[f\'i\'mi]} \quad \text{filme 'film'} \]

\[ \text{but \ [f\'i\'m\'em\'us]} \rightarrow \text{[f\'i\'m\'em\'us]} \quad \text{filmamos 'we film'} \]

4.4.1. Syllabic Shifts involving /I/?

Syllable final \(I\) is pronounced \([y]\); \text{ma\^{i}} 'badly' and \text{mau} 'bad' are both pronounced \([m\text{a\^{i}}]\). The question of whether \(I\) is underlyingly \(1/\), \([y]\), or \([y]\) will be treated in 4.5 p.124. For \(I\) sequences which are unstressed the syllability can shift, i.e.,
[iʏ] → [iʊ]. The process has different conditions for application
protonically and posttonically.

[fiʏ'memacs](Cit and Nor) → [fiu'memacs](Cas)
filmamos 'we film'

['abiʏ](Cit) → ['abiu](Nor and Cäs) hábil 'skillfull'

Posttonically, the diphthong [aɪ](derived from el) may raise to
[iu] and then shift its syllabic to [iʊ]. Protonically, however,
this does not occur.

<table>
<thead>
<tr>
<th>Cit</th>
<th>Nor</th>
<th>Cas</th>
</tr>
</thead>
<tbody>
<tr>
<td>[a'maveʏ]</td>
<td>[a'maveʏ]</td>
<td>[a'maveʏ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>amável 'loveable'</td>
</tr>
<tr>
<td>[dey'gadu]</td>
<td>[dey'gadu]</td>
<td>[dey'gadu]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>delgado 'slim'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*[dɪgy'gadu]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*[dɪgy'gadu]</td>
</tr>
</tbody>
</table>

Since syllabic shifts involving il and el are favored
posttonically, it would appear that the short posttonic syllable
is a factor which influences the operation of these shortening processes.

4.4.2. VV Combinations

Since some VV combinations are disyllabic while others are mono-
syllabic, it is necessary to consider all possible combinations in order
to to extract the general principles governing syllabification of
unstressed vowels in hiatus([V$V] vs. [VV] vs. [YY]). VV combinations
in tonic position have already been discussed(3.4.3, p.86).
Since in unstressed position only the vowels [i,e,a,o,u] are possible
the following combinations are theoretically possible:
Possible VV Sequences in Unstressed Position

<table>
<thead>
<tr>
<th>i</th>
<th>e</th>
<th>a</th>
<th>o</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>ii</td>
<td>ai</td>
<td>ia</td>
<td>io</td>
</tr>
<tr>
<td>e</td>
<td>ei</td>
<td>ee</td>
<td>ea</td>
<td>eo</td>
</tr>
<tr>
<td>a</td>
<td>ai</td>
<td>ae</td>
<td>aa</td>
<td>ao</td>
</tr>
<tr>
<td>o</td>
<td>oi</td>
<td>oe</td>
<td>oa</td>
<td>oo</td>
</tr>
<tr>
<td>u</td>
<td>ui</td>
<td>ue</td>
<td>ua</td>
<td>uu</td>
</tr>
</tbody>
</table>

Word internally, to my knowledge, no identical [VV] combinations occur. However, most of the other combinations do occur. Classifying the combinations in terms of height, the following are possible:

<table>
<thead>
<tr>
<th>hi</th>
<th>mid</th>
<th>lo</th>
</tr>
</thead>
<tbody>
<tr>
<td>hi-hi:</td>
<td>iu</td>
<td>hi-mid: ie ie uo</td>
</tr>
<tr>
<td>mid-hi:</td>
<td>ei</td>
<td>mid-mid: eo eo</td>
</tr>
<tr>
<td>lo-hi:</td>
<td>ai</td>
<td>lo-mid: ae ao</td>
</tr>
</tbody>
</table>

4.4.2.1. Methodology

The syllabification of all possible unstressed VV combinations has not previously been worked out by anyone. Rather than relying on informal observation I decided to test systematically all possible VV combinations and their variations, if any, due to style. I constructed sentences with a key word containing a particular VV combination under question. A complete list of the sentences is found in the appendix. (I asked a native speaker if the sentences sounded natural; in some instances they had to be modified to make them sound more natural). Inasmuch as possible, I attempted to disguise the key word by placing it in a position where it would not receive special emphasis and in some cases there was more than one key word.
The key word was placed sentence internally in order to avoid the possible influence of sentence boundaries. For example, a sentence final [iu] might be lengthened which would make difficult the determination of the syllabic portion, based on durational differences.

As far as possible, the phonetic environment of the vowels in question was kept similar. (This was constrained by limits in the lexicon and perhaps my own limits.) For example, when comparing pretonic and posttonic io I used words with preceding bilabials, e.g. pioneiro 'pioneer' vs. lábio 'lip'. Because the hubs for various consonants are different, different consonants change the shape of the transitions for the same vowels, thereby making comparisons difficult. In some cases, however, I purposely varied the consonants in order to test the influence of the consonants on the vowel, e.g., rádio 'radio' vs. lábio 'lip'. Words with posttonic VV are also subject to the influence of the initial consonant of the following word. I controlled for this in the following way: VV sequences which are potentially identical on the surface precede a word with identical word initial consonants. For example, /el il io eo/ are all potentially [iu] or [iul]. Therefore, I used words with these combinations followed by a word which begins with [p] (Since [p] has a low hub and [u] has a low F₂ the influence of [p] on [u] is lessened). The following are examples of parts of sentences I used: 3...amável para...'loveable for', 6...inútil para...'useless for', 9...hável padeiro...'skillful baker', 11...gêmeo praticar...'twin practice', 13...labio pequeno...'little lip', 28...pátio pequeno...'little patio'. (See appendix for complete list.)
Because of real limits in the lexicon identical pretonic and posttonic environments for every VV sequence were impossible.

The sentences were arranged so similar words (or words for which identical phenomena potentially take place) did not occur back to back. e.g., 9. hábil 'skillful' 13. lábio 'lip'. This of course is a non-random order but since a random order could result in similar words occurring back to back (and thereby increasing the possibility that the speaker would become aware of the key word), I felt the best policy was to arrange them as I did.

I employed the following procedures and in the following order:

(1) 'Normal'

Native speakers were first asked to read each sentence in a normal style: "Eu gostaria que você lesse essas frases normalmente, nem muito devagar, nem muito depressa". ("I'd like you to read these sentences normally, not real fast, not real slow".) Speakers read the sentence list twice. In some instances speakers were asked to repeat a sentence because of stuttering or pauses or in order to elicit another token of an interesting phenomenon.

(2) 'Casual'

Speakers were asked to read the sentences in a casual style: "Imagine that you're talking to a close friend and you're in a hurry, and it's not important that he understand each word. You may 'cut off' words, as you wish").
Of course, reading sentences is not the most casual speech situation, but since these speakers were all my friends, the atmosphere was a very relaxed and friendly one. Therefore, I have no doubt that these recordings represent natural, casual speech.

(3) 'Citation'

Speakers read a list of isolated key words. The isolated word list was read after the sentences because reading the word list before the sentence list would familiarize the speaker with the key word, thereby increasing the possibility that the word in the sentence would receive special emphasis. Speakers were asked to read the word list twice "bem devar" ("very slowly") to give 'Citation', and twice "bem depressa" ("very fast") to give a semi-casual. My conclusions on 'Casual', however, were based on the words occurring in the sentences and not on these isolated readings.

4.4.2.2. Pronunciation of Unstressed VV

The possible syllable structures for VV combinations are listed below. Under examples I have only given the words orthographically, not phonetically or phonemically, because in most cases the vowels orthographically are identical to the underlying representation.

(See 4.5 p.124)

<table>
<thead>
<tr>
<th></th>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cit</td>
<td>Nor</td>
<td>Cas</td>
</tr>
<tr>
<td>[iu]</td>
<td>[iu]</td>
<td>[iy] - [iu]</td>
</tr>
<tr>
<td>[ui]</td>
<td>[ui]</td>
<td>[ui] - [yi]</td>
</tr>
</tbody>
</table>
Examples:

ciumento 'jealousy'  *
diurese 'diuresis'  *
suicídio 'suicide'  *

Mid-Mid: /ei eu oi ou/

<table>
<thead>
<tr>
<th>Cit</th>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ei]</td>
<td>[ei]</td>
<td>[e]</td>
</tr>
<tr>
<td>[ey]</td>
<td>[ey]</td>
<td>[e]</td>
</tr>
<tr>
<td>[oi]</td>
<td>[oi]</td>
<td>[o]</td>
</tr>
<tr>
<td>[ou]</td>
<td>[ou]</td>
<td>[o]</td>
</tr>
</tbody>
</table>

Examples

dheitamos 'we lie down'  iaúteis 'useless'
leucênico 'leukemic'  *
coitado 'poor guy'  *
dourado 'golden'  *

Lo-Mid: /ai au/

<table>
<thead>
<tr>
<th>Cit</th>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ai]</td>
<td>[ai]</td>
<td>[a]</td>
</tr>
<tr>
<td>[ou]</td>
<td>[ou]</td>
<td>[o]</td>
</tr>
</tbody>
</table>

Examples:

paisagem 'scenery'  *
Maurício (masc. name)  *

Hi-Mid: /ie io ue uo/

<table>
<thead>
<tr>
<th>Cit</th>
<th>Pretonic</th>
<th>Posttonic</th>
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</thead>
<tbody>
<tr>
<td>[ie]</td>
<td>[ie]</td>
<td>[i]</td>
</tr>
<tr>
<td>[io]</td>
<td>[io]</td>
<td>[i]</td>
</tr>
</tbody>
</table>
[ue]  [ue]  [ue]-[ye]  *  *  *
[uo]  [uo]  [uo]-[yo]  [uo]-[yo]  [y]  [u]

Examples:

piedade  'pity'
primeiro  'pioneer'
cárie  'cavity'
lábio  'lip'
duetista  'duettist'
continuo  'continuous'

Posttonic /ue/ does occur in agua [̋'ag̃e] (Cit) 'water'(imper.).

However, to my knowledge posttonic /ue/ only occurs after velars.

In 3.4.1, pp. 81-83 it was argued that because of assimilatory tendencies a velar plus [u] is a special case. Therefore the non-occurrence of *[g] is consistent with my discussion on assimilation. *[g] would be expected in Cit if /ue/ were parallel to /o/ → [i].

Also compare água 'water' [̋'ag̃a] *[̋'ag̃a] but continua 'continuous' [kõ[tʃ̃̃ña]~[kõ[tʃ̃̃ña]}

Mid-Mid : /o/  oe/

<table>
<thead>
<tr>
<th>Cit</th>
<th>Nor</th>
<th>Cas</th>
<th>Cit</th>
<th>Nor</th>
<th>Cas</th>
</tr>
</thead>
<tbody>
<tr>
<td>[eo]</td>
<td>[eo]</td>
<td>[i]~[i]</td>
<td>[i]~[i]</td>
<td>[u]</td>
<td>[u]</td>
</tr>
<tr>
<td>[oe]</td>
<td>[oe]</td>
<td>[ue]~[ye]</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Examples:

leopardo  'leopard'
poesia  'poetry'
gêmeo  'twin'
Lov–Mid: /æ eo/

<table>
<thead>
<tr>
<th>Pretonic</th>
<th>Posttonic</th>
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</thead>
<tbody>
<tr>
<td>Cit</td>
<td>Nor</td>
</tr>
<tr>
<td>[æ]</td>
<td>[æ]</td>
</tr>
<tr>
<td>[æ]?</td>
<td>[æ]?</td>
</tr>
</tbody>
</table>

Examples:

Caetano (masc. name) *

Hi–Lo: /ia ua/

<table>
<thead>
<tr>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cit</td>
<td>Nor</td>
</tr>
<tr>
<td>[iæ]</td>
<td>[iæ]</td>
</tr>
<tr>
<td>[ua]</td>
<td>[ua]</td>
</tr>
</tbody>
</table>

Examples:

viaduto 'viaduct'  sábia 'wise'
suadinha 'sweaty'  continua 'continuous'

Mid–Lo: /ea oa/

<table>
<thead>
<tr>
<th>Pretonic</th>
<th>Posttonic</th>
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</thead>
<tbody>
<tr>
<td>Cit</td>
<td>Nor</td>
</tr>
<tr>
<td>[ea]</td>
<td>[ea]</td>
</tr>
<tr>
<td>[oa]</td>
<td>[oa]</td>
</tr>
</tbody>
</table>

Examples:

reagimos 'we react'  gêmea 'twin'
voador 'flyer'  Páscoa 'Easter'

In a previous discussion(3.4) I noted that there is a greater tendency for [u] and [o] to become glides after velars than after other consonants. Because of this, /uV/ following
velars is pronounced [yV] in Cit but [u V] following other consonants. One further case must be mentioned. Tábua 'board' is ['tabya] in Cit. Apparently there is also a greater assimilatory tendency for back vowels following bilabials as well as velars. This is not unexpected since a rounded back vowel is both labial and velar. The following are examples of back vowels following bilabials and velars in Nor:

[kyi'dəmus] ruidamos 'we take care of'
[arpəa'dor] Arpoador (name of a beach)
[kya'ʃade] coalhada 'curdled milk'
[kye'ʃiŋ] coelhinho 'little rabbit'
['tabya](Cit and Nor) tábua 'plank'

4.4.2.1. [u] and [y] Derived from /1/

Pretonically, syllable final orthographic 1 is [y], e.g., delgado 'slim' [de'y'gad]. Pretonic 1 is [i y] never *[i3u], but iu → [i3u], ciumento 'jealousy' [si.u'mətu]. Therefore, 15 underlyingly must be non-syllabic and thus different from /u/. Whether 1 is /1/ or [y] will be discussed in 4.5. p.124. 1 can become syllabic but only through syllabicity shift, e.g., filmamos 'we film' [fi'y'məmus] → [fi3u'məmus].

Posttonically [y] can result from 15 as well as o5, e.g., hábil 'skillful', lâbio 'lip', and amável 'loveable' are pronounced ['abi3], [['abi3], and [a'mave3] in Nor. In Cás due to Syllabicity Shifts and Raising, the posttonic syllables of all three words can become identical, i.e., [3 u]
cuido 'I take care of'  

Speaker FMT Nor

Figure 4-1: Syllabic Shifts
cuidamos 'we take care of'

Speaker FMT Nor

Figure 4-2: Syllabicity Shifts
Figure 4-3: Syllabicity Shifts
Figure 4-5: Syllabic Shifts

gêmeo 'twin'
Speaker FPR Cit

gêmeo 'twin'
Speaker FPR Nor
sábia 'smart'
Speaker MBA2 Cit

sábia 'smart'
Speaker MBA2 Nor

Figure 4-6: Syllabicety Shifts
gêmea 'twin'

Speaker MBA₂ Cit

Speaker MBA₂ Nor

Figure 4-7: Syllabicity Shifts
Figure 4-9: Syllabic Shifts

coelhinho 'little rabbit'
Speaker FMT CIt

coeiho 'little rabbit'
Speaker FMT Nor
4.4.2.2.2. Instrumental Evidence for Syllabicity Shifts

Several spectrograms in Chapter 3 show syllabicity shifts. Figure 3-1 p.60 shows a pretonic [u̯]/[y̯] alternation. 3-2 p.62 demonstrates a pretonic shift in syllabicity [i̯u] → [iu].

In this chapter, Figures 4-1 and 4-2 show pretonic alternations in Nor for the same speaker for the words cuido/cuidamos 'I take care of we take care of'. (For the list of the words adjacent to the key words see appendix.)

Figures 4-3, 4-4, 4-5 show the posttonic shift in syllabicity [i̯u] → [iu] as the speaker goes from City to Nor in the words hábil 'skillful', lábio 'lip', and gêmeo 'twin'.

Figures 4-6 and 4-7 represent a desyllabification, [i̯a] → [ia], from Cit to Nor for sábia 'wise' and gêmea 'twin'.

Figures 4-8, 4-9, and 4-10 show the preference for labio-velar glide formation after velar consonants, for the words coelhada 'curdled milk', coelhinho 'little rabbit', água 'water' and Páscoa 'Easter'.

4.4.2.2.3. Glide Formation

The data in 4.5.4.2.2. above dealing with syllabification of V̯ sequences can be summarized as follows. In V̯ sequences which become monosyllabic, the higher vowel will become the glide, or if the vowels are equal in height either vowel may become the glide. This is what would be expected from a universal sonority hierarchy which predicts a more sonorous element to become the syllabic. (Lower vowels are more sonorous). The exact conditions under which V̯ become mono-
syllabic or disyllabic and whether the syllabicity can shift
can be stated as follows:

4.4.2.2.3.1.

\[
\begin{array}{c|c|c}
V_1 & V_2 & G \\
\hline
+ & + & \text{Condition: height } V_2 > V_1
\end{array}
\]

<table>
<thead>
<tr>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
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<tbody>
<tr>
<td>Cit</td>
<td>+</td>
</tr>
<tr>
<td>Nor</td>
<td>+</td>
</tr>
<tr>
<td>Cas</td>
<td>+</td>
</tr>
</tbody>
</table>

**Examples:**

<table>
<thead>
<tr>
<th>Cit</th>
<th>Nor</th>
<th>Cas</th>
</tr>
</thead>
</table>
| [koj'tado]   | [koj'tadu]   | [koj'tadu]   | **coitado** 'poor guy'
| [ley'semiko] | [ley'semiku] | [ley'semiku] | **leucêmico** 'leukemic'
| [dei'temus]  | [dei'temus]  | [dei'temus]  | **deitamos** 'we lie down'
| [dou'rado]   | [dou'radu]   | [dou'radu]   | **dourado** 'golden'
| [dʒifu'seiʃ] | [dʒifu'fises] | [dʒifu'fisis] | **difficeis** 'difficult'

(See 4.2 on Monophthongization.)

As discussed in 4.2 above, glide formation (whether from /V/ or
/l/) prevents the syllabic from raising pretonically, but post-
tonically the syllabic may raise.

\[
\begin{array}{c|c|c}
\text{but } & \text{[dei'temus]} & \text{[dei'temus]} \\
\hline
\text{[dʒifu'seiʃ]} & \text{[dʒifu'fises]} & \text{[dʒifu'fisis]} \\
\text{[dey'gadu]} & \text{*[a'maviy]} & \text{*[a'maviy]} \\
\text{but } & \text{[a'mavey]} & \text{[a'maviy]} & \text{[a'maviy]} \\
\text{[dʒifu'seiʃ]} & \text{[dʒifu'fises]} & \text{[dʒifu'fisis]} \\
\text{[dey'gadu]} & \text{*[a'maviy]} & \text{*[a'maviy]} & \text{[a'maviy]} \\
\text{but } & \text{[a'mavey]} & \text{[a'maviy]} & \text{[a'maviy]} \\
\end{array}
\]

\[
\begin{array}{c|c|c}
\text{deitamos} & \text{'we take care of'} & \\
\text{difficeis} & \text{'difficult'} & \\
\text{delgado} & \text{'slim'} & \\
\text{amável} & \text{'loveable'} & \\
\end{array}
\]
\[ V_1 V_2 \]

\[ \uparrow \]

G \hspace{1cm} \text{Condition: height } V_1 > V_2 \\

\begin{array}{|c|c|c|}
\hline
\text{Cit} & \text{Pretonic} & \text{Posttonic} \\
\hline
\text{Nor} & - & + \\
\text{Cas} & + & + \\
\hline
\end{array}

\text{Condition: Post-Cit} + \leftrightarrow \begin{array}{c}
\text{[\text{\texttt{\textcolor{red}{\textbf{\texttt{g}}\texttt{\textcolor{red}{\texttt{b}}}}}}]} \\
\text{[\text{\texttt{\textcolor{red}{\texttt{a}}\texttt{b}}]} \\
\text{[\text{\texttt{\textcolor{red}{\texttt{-i}}\texttt{\textcolor{red}{\texttt{b}}}}]}
\end{array}

\begin{tabular}{|l|l|l|}
\hline
\text{Cit} & \text{Nor} & \text{Cas} \\
\hline
[kə'ʃi\text{\texttt{\textcolor{red}{\texttt{n}}\texttt{u}}\text{\texttt{a}}} & [kə'ʃi\text{\texttt{\textcolor{red}{\texttt{nu}}\text{\texttt{a}}} & [kə'ʃi\text{\texttt{\textcolor{red}{\texttt{n}}\texttt{u}}} & \text{continua} 'continuous'
\hline
[kə'ʃi\text{\texttt{n}}\text{\texttt{uo}} & [kə'ʃi\text{\texttt{\textcolor{red}{\texttt{nu}}\text{\texttt{u}}} & [kə'ʃi\text{\texttt{\textcolor{red}{\texttt{n}}\text{\texttt{u}}} & \text{continuo} 'continuous'
\hline
[\text{\texttt{\textcolor{red}{\texttt{z}}}\text{\texttt{e}}\text{\texttt{m}}\text{\texttt{i}}} & [\text{\texttt{\textcolor{red}{\texttt{z}}}\text{\texttt{e}}\text{\texttt{m}}\text{\texttt{i}} & [\text{\texttt{\textcolor{red}{\texttt{z}}}\text{\texttt{e}}\text{\texttt{m}}\text{\texttt{i}}} & \text{gêmea} 'twin'
\hline
[\text{\texttt{\textcolor{red}{\texttt{l}}}\text{\texttt{a}}\text{\texttt{b}}\text{\texttt{i}}} & [\text{\texttt{\textcolor{red}{\texttt{l}}}\text{\texttt{a}}\text{\texttt{b}}\text{\texttt{i}}} & [\text{\texttt{\textcolor{red}{\texttt{l}}}\text{\texttt{a}}\text{\texttt{b}}\text{\texttt{i}}} & \text{lábio} 'lip'
\hline
*['l\text{\texttt{a}}\text{\texttt{b}}\text{\texttt{i}}] & ['s\text{\texttt{a}}\text{\texttt{b}}\text{\texttt{a}}] & ['s\text{\texttt{a}}\text{\texttt{b}}\text{\texttt{a}}} & \text{sábia} 'wise'
\hline
[\text{\texttt{x}}\text{\texttt{e}}\text{\texttt{a}}\text{\texttt{\textcolor{red}{\texttt{\texttt{m}}}}} & [\text{\texttt{x}}\text{\texttt{e}}\text{\texttt{a}}\text{\texttt{\textcolor{red}{\texttt{\texttt{m}}}}} & [\text{\texttt{x}}\text{\texttt{a}}\text{\texttt{\textcolor{red}{\texttt{\texttt{m}}}}} & \text{rægmos} 'we react'
\hline
[\text{\texttt{p\texttt{i}}}\text{\texttt{e}}\text{\texttt{d\texttt{a}}}\text{\texttt{d\texttt{a}}} & [\text{\texttt{p\texttt{i}}}\text{\texttt{e}}\text{\texttt{d\texttt{a}}}\text{\texttt{d\texttt{a}}} & [\text{\texttt{p\texttt{i}}}\text{\texttt{e}}\text{\texttt{d\texttt{a}}}\text{\texttt{d\texttt{a}}} & \text{piedada} 'pity'
\hline
[\text{\texttt{s\texttt{u}}}\text{\texttt{a}}\text{\texttt{\textcolor{red}{\texttt{d\texttt{a}}}\text{\texttt{a}}} & [\text{\texttt{s\texttt{u}}}\text{\texttt{a}}\text{\texttt{\textcolor{red}{\texttt{d\texttt{a}}}\text{\texttt{a}}} & [\text{\texttt{s\texttt{u}}}\text{\texttt{a}}\text{\texttt{\textcolor{red}{\texttt{d\texttt{a}}}\text{\texttt{a}}} & \text{suadinhha} 'sweaty'
\hline
\end{tabular}

For those speakers who in Cit raise final unstressed vowels (4.1.1. p65) the following occurs: /\texttt{io}/ \rightarrow [\texttt{iy}] (in accordance with process in 4.4.2.2.3.3 and 4.4.2.2.3.4 below).

Glide formation prevents pretonic raising but not posttonic raising (similar to the constraint in 4.4.2.2.3.1. above)

\[ [\text{p\texttt{i}}\text{\texttt{e}}\text{\texttt{n}}\text{\texttt{e}}\text{\texttt{r}}\text{\texttt{u}}] \neq *[\text{p\texttt{i}}\text{\texttt{y}}\text{\texttt{e}}\text{\texttt{r}}\text{\texttt{i}}] \hspace{1cm} \text{pioneiro} 'pioneer'
\]

\text{but} \hspace{1cm} ['l\text{\texttt{a}}\text{\texttt{b}}\text{\texttt{i}}] \rightarrow ['l\text{\texttt{a}}\text{\texttt{b}}\text{\texttt{ju}}] \hspace{1cm} \text{lábio} 'lip'
4.4.2.2.3.3.

\[ V_1 V_2 \]

\[ + G \]

Condition: height \( V_1 = V_2 \)

<table>
<thead>
<tr>
<th>Pretonic</th>
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</thead>
<tbody>
<tr>
<td>Cit</td>
<td>-</td>
</tr>
<tr>
<td>Nor</td>
<td>-</td>
</tr>
<tr>
<td>Cas</td>
<td>+</td>
</tr>
</tbody>
</table>

Condition 1: For Pre-Cas 4.4.2.2.3.3. or 4.4.2.2.3.4. applies but not both

Condition 2: Post-Cit + \( \iff \) \( \tilde{V} \neq \) \( [+hi] \) \( [-lo] \) in Cit

4.4.2.2.3.4.

\[ V_1 V_2 \]

\[ + G \]

Condition: height \( V_1 = V_2 \)

<table>
<thead>
<tr>
<th>Pretonic</th>
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</thead>
<tbody>
<tr>
<td>Cit</td>
<td>-</td>
</tr>
<tr>
<td>Nor</td>
<td>-</td>
</tr>
<tr>
<td>Cas</td>
<td>+</td>
</tr>
</tbody>
</table>

Condition: Post-Cit + \( \iff \) \( \tilde{V} \neq \) \( [-hi] \) \( [-lo] \) in Cit

Cit Nor Cas

[ˈzamjo] [ˈzɛmju] [ˈzɛmju] zemio 'twin'
(some speakers)

[ˈzamju]

or [ˈzamjo]
(other speakers)

[leɔˈpardo] [leɔˈpardu] [leuˈpardu] ~[leuˈpardu] ~[leuˈpardu] ~[liuˈpardu] ~[liuˈpardu] ~[liuˈpardu] ~[liuˈpardu]

leopardo 'leopard'
These glide formations involving underlying vowels of equal height indicate that the posttonic has a decided preference for [UV]. Posttonically, [UV] occurs only in Cit and only for those speakers who obligatorily raise \( W \) in Cit. Otherwise [UV] occurs. In contrast, pretonic position shows [UV] only in Cas where it also alternates with [UV]. Either vowel may raise and subsequently form a glide. However, this prevents the other vowel from raising (similar to the other two glide formation processes discussed above).

_/OE_/ sequences potentially have eight possible surface realizations: [oe], [eu], [ey], [io], [io], [iu], [iy], [ju]. Pretonically, in Cit and Nor only [eo] is possible, while in Cas the following occur: [eu], [ey], [io], [io], but not *[iu], *[iy], *[ju]. Posttonically, [io] and [iy] occur in Cit but only [ju] occurs in Nor and Cas. (Since there is no posttonic /oe/, I have omitted this from the discussion.)

The non-occurrence of posttonic [eV] suggests a further stipulation on the raising process: \( \text{\( Y \)} \quad \text{\( Y \)} \quad \text{\( \text{-nas} \)} \) \quad \text{\( \uparrow \)} \quad \text{\( \text{\( +hi \)} \)}

Of course eV might be treated as underlying /IV/ in which case the sequence would not meet the condition of process 4.4.2.3.3. because the vowels would underlyingly have different heights. If eV is assigned the status /IV/ then process 4.4.2.2.3.2. would apply, which would give the same output as 4.4.2.3.3. if eV /eV/. Therefore, the status of eV in terms of underlying representation makes no difference in the correct prediction of the output. (See 4.5. on underlying representation).
Let us consider the data involving eo regarding syllable durations. Disyllabic VV sequences are longer than monosyllabic sequences (e.g., [eu] > [ey]); lower vowels are longer than higher vowels (e.g., [e] > [i]); closed syllables are longer than open syllables (e.g., [eY] > [iy]). When one considers my data in light of these universal phonetic characteristics regarding relative durations of syllables, it is quite clear that the posttonic syllable has a much greater tendency to undergo shortening processes than does the pretonic syllable: fewer restrictions on raising, desyllabification ([VSV] → [VV]), and syllabicity shifts ([Vy] → [YV]). Since my experimental data on syllable durations have shown that the posttonic syllable is considerably shorter than the pretonic, I suggest that this shorter duration is a causal factor in the operation of these shortening processes.

4.5. Underlying Representation

\[l\] as /l/ (vs. /y/ or /u/)

Orthographic \[l\] which occurs syllable finally is pronounced [y] (or [u] is there is a syllabicity shift). The question then is why should one represent the segment as /l/ rather than /y/ or /u/? /u/ is clearly ruled out since \[l\] on the surface is always monosyllabic, but \[lu\] can be disyllabic: [fy'memus] vs. [si.u'metu] filmemos 'we film', ciumento 'jealous'. If one posited /u/ for both \[l\] and \[u\], it would be difficult to justify why in one case the segment is always non-syllabic and in another case syllabic. Therefore, \[l\] underlyingly
must be a non-syllabic, either /u/ or /l/.

There are cases of [y]/[i] alternations, e.g., ['sɔju]/['sɔlərju] sal/saleiro 'salt/salt shaker', ['sɔl]/['sɔlaʃradu] sol/ensolardu 'sun/sunny', ['fasl]/['faslɪtar] facil/facilitar 'easy/to make easy'.

Because the meaning of the alternates is so closely related, it seems clear that the native speaker is aware of the relationship. Consequently, it would be justified to derive both [y] and [i] from /l/ rather than positing underlying /y/ for one member of the pair and /l/ for the other.

However, not all [y]/[i] pairs can be used as evidence. Although [me'ladu] melado 'moiasses' is derived from ['mɛlju] mel 'honey', the meanings of the two members of the pairs are so different it would be false to assume that the native speaker is aware that the two forms are related. I have presented this poor example to point out that arguments based on derivational morphology must be viewed with extreme caution. (See Hooper 1973.) However, even if one does not accept my arguments for underlying /l/ (but instead prefers to represent it as /u/) the pretonic/posttonic differences with regard to syllabic shifts still hold true. The process ['y] → [iu] occurs pretonically only in Cas but posttonically it occurs in Nor and Cas.

\[ e, i \] as /e, i/ (vs. /i, u/)

Speakers who show posttonic [e]-[i] and [o]-[u] alternations (in Cit vs. Nor) clearly have underlying /e/ and /o/; [i] and [u] can be derived by the raising process (2.3.1.2). In contrast, some speakers only show [i] and [u], even in Cit. 2.3.4.1.2.
discussed reasons for considering these vowels underlying /ə/ and /o/ and the argument holds true for these speakers. In addition, these speakers occasionally produce non-raised [e] and [o] in order to give special emphasis to a word. However, even if one still claims that these speakers have underlying /i/ and /u/ the phonetic motivation of the historical change, as it were, is shortening (since [il] and [u] are shorter than [e] and [o]). Raising, then, would not be a lexical constraint rather than a process which produces surface alternations.

Some phonological theories prefer to make a fundamental distinction between lexical constraints (phonotactics, redundancy rules or morpheme structure rules) and processes which govern surface forms and alternations. However, let us consider this alleged distinction in light of the Portuguese data for Raising. Although some speakers produce raised Ñ in all speech styles, while other speakers raise only in Nor and Cas, the phenomenon is the same for both sets of speakers. The differences between the two groups of speakers are the conditions for Raising, not the process itself. In one case (those who raise in all styles) Raising has had the historical effect of making word final posttonic [-lo] vowels obligatorily [ði]; i.e., it is an obligatory morpheme structure, or to use other terminology, there is a lexical constraint against word final posttonic mid vowels. In the other case (those who raise in Nor and Cas but not in Cit) Raising serves as a synchronic process which produces [e]-[i] and [o]-[u] alternations. To claim that Raising in these two sets of speakers is a fundamentally different phenomenon misses the generalization. Raising is a process for both groups—in one it
has become obligatory in all styles while in the other group it is limited to certain styles. (For a more extensive discussion on these issues, including how they relate to English h deletion, see Stampe 1973.)

\[ /\vbar / \] /as /\vbar / (vs. -/\vbar / or /\vbar /)

Some speakers show a [\vbar V] - [V] alternation post tonically, while other speakers show [V] (for certain vowels) in all styles. For example io for non-raisers is [\i o] in Cit and [\i u] in Nor and Cas. For the latter group, one might say that \i is underlyingly the glide /\i/ rather than /i/. If this solution is adopted then the motivation for this historical change, i.e., desyllabification (V + G), is shortening, since disyllabic [VV] sequences tend to be longer than monosyllabic [\vbar V]. However, the pronunciation of some \vbar V sequences, e.g., ia alternates between [VEV] and [V], for all speakers, in addition to the pre tonic alternation of [VEV] - [V] - [V], e.g. with io. Rather than specifying posttonic underlying /G/ for some \vbar V sequences and /V/ for others, and /V/ for all pretonic \vbar V sequences, I have chosen to write a glide formation process for which can be specified according to position, (pre or post), style, and specific vowels involved. Although the conditions vary, I view glide formation as a unitary process, i.e., it is the formation of a glide from an underlying vowel.

The native speakers' awareness that the conditions for glide formation vary is reflected in their responses to questions concerning number of syllables in a word. When Speaker FMT was asked the number
of syllables in lábio 'lip' she replied 'two', but for sábia 'wise' she said 'two or three' ("Pode ser duas ou três") ("it can have two or three"). I also re-asked the question for the same words several times to check consistency and I asked the number of syllables in unambiguous words such as ['falú] faló 'I speak' to check whether the speaker was able to count syllables). The responses of FMT reflects the fact the Yá is monosyllabic in all styles (whether [jo], [yu] or [iu]) while Yá is disyllabic in Cit but monosyllabic in Nor. Speaker FPR gave similar responses. To her, lábio had two syllables but for sábia she could not decide: "Não sei, duas ou três" ("I don't know, two or three"). These responses and others involving different WV combinations are in agreement with the conditions for glide formation in 4.4.2.2.3. The responses also indicate that the speakers are aware of different levels of representation (whether underlying or different levels of style). The different responses for sábia indicate that at one level (Cit) i is syllabic, yet at another level (Nor and Cas) i is non-syllabic.

4.6. Durations of SSÓ and ÓSS

In the discussion of unstressed WV sequences (4.4.2.2.) I have pointed out that there is a considerable preference for posttonic shortening over pretonic shortening. I suggested that the preference for a shorter posttonic syllable (based on instrumental data) was a motivation in the operation of these processes. However, the duration measurements I made were for trisyllabic paroxytones (SSS
words). My implicit argument is that if in $s_1 s_2 s_3$, $s_1 \geq s_3$, then in words of $s_1 s_2 s_3 s_4 s_5$ (or $s_1 s_2 s_3$, $s_1 s_2 s_3$, etc.) pretonic $s_1 s_2 >$ posttonic $s_4 s_5$. However, I have presented no experimental evidence to support this. To be thoroughly convincing that length is a factor governing the operation of processes, I would have to collect data from words of all types used in my examples, i.e., $s, ss, ss$, $sss, sss$, $ss$, etc. This would be quite a time-consuming task and would be beyond the scope of this study. However, I did make a very limited study of words of the type $ss$ and $sss$ in order to see if there were any differences between pretonic and posttonic disyllables. Using the same method as before (Chapter III) I obtained the following results from Speaker MMG:

<table>
<thead>
<tr>
<th>Table 4-2 Durations of Syllables of lalala and lalala (uttered in frame 'Repita a palavra ___ de novo')</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s_1$</td>
</tr>
<tr>
<td>Durations 210</td>
</tr>
<tr>
<td>(msec)</td>
</tr>
<tr>
<td>Pretonic $s_1 + s_2 = 385$ msec</td>
</tr>
<tr>
<td>($N=4$)</td>
</tr>
</tbody>
</table>

Since the sample size is extremely small, these results should be taken as tentative or suggestive. They do, however, support my hypothesis that pretonic and posttonic differences are factors governing W shortening processes since $ss$ sequences are longer than $ss$. |
4.7. Summary of Pretonic and Posttonic Shortening Processes

RAISING

(1) \( \forall \rightarrow [+hi]/ \rightarrow (s)\$\)
\[ [-lo, -nas] \]
\(/e, o/ \rightarrow [i, u] \)

<table>
<thead>
<tr>
<th></th>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cit</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Nor</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Cas</td>
<td>(\pm)</td>
<td>(\pm)</td>
</tr>
</tbody>
</table>

(2) \( \forall \rightarrow [+hi]/ \rightarrow (s)\$\)
\[ [-lo, -nas] \]
\(/\theta, \bar{o}/ \rightarrow [\bar{\theta}, \bar{\bar{o}}] \)

<table>
<thead>
<tr>
<th></th>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cit</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nor</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cas</td>
<td>(\pm)</td>
<td>(\pm)</td>
</tr>
</tbody>
</table>

Condition: PreCas \(\leftrightarrow\) [\(\bar{\theta}\)] is not derived from /\(\bar{o}\)/. See (5)

(3) \( \forall \rightarrow [+hi]/ \rightarrow G \)
\[ [-lo] \]

\([ei, eu, oi, ou, \bar{\theta}, \bar{\bar{o}}] \rightarrow [i, iu, ui, u, \bar{\theta}, \bar{\bar{o}}]\)

<table>
<thead>
<tr>
<th></th>
<th>Pretonic</th>
<th>Posttonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cit</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nor</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cas</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

MONOPHTHONGIZATION

(4) \( V \rightarrow V \)
\[ [-\text{bk}] \quad \text{[\text{\texttt{\$height}}} \quad \text{[\text{\texttt{\$height}}} \quad \text{[\text{\texttt{\$height}}}} \]
\( (\text{where } V_1 V_1 = V_1) \)
\(/e, o, ai/ \rightarrow [e, o, a], [\bar{\theta}, \bar{\bar{o}}] \rightarrow [\bar{\theta}, \bar{\bar{o}}]\)
\[ \begin{array}{c|c|c} \text{Cit} & \text{Pretonic} & \text{Posttonic} \\ \hline \text{Nor} & - & + \\ \text{Cas} & + & + \\ \end{array} \]

(5) \[ V \text{ [+] } G \text{ [+] bk} \rightarrow V \text{ [ ] hi} \text{ [ ] o} \text{ [+] bk] } \]

(/au, æu/ \rightarrow [o, ø] )

\[ \begin{array}{c|c|c} \text{Cit} & \text{Pretonic} & \text{Posttonic} \\ \hline \text{Nor} & - & + \\ \text{Cas} & + & + \\ \end{array} \]

(Note: There is a lexical constraint against posttonic */au/)

**SYLLABILITY SHIFTS**

(6) /iI/ \rightarrow [iy] \rightarrow [i u] 

\[ \begin{array}{c|c|c} \text{Cit} & \text{Pretonic} & \text{Posttonic} \\ \hline \text{Nor} & - & + \\ \text{Cas} & + & + \\ \end{array} \]

(7) /æl/ [æu] \rightarrow [iy] \rightarrow [i u] 

\[ \begin{array}{c|c|c} \text{Cit} & \text{Pretonic} & \text{Posttonic} \\ \hline \text{Nor} & - & - \\ \text{Cas} & - & + \\ \end{array} \]

(8) \[ V_1 V_2 \]

\[ G \quad \text{Condition: height } V_2 > V_1 \]

\[ \begin{array}{c|c|c} \text{Cit} & \text{Pretonic} & \text{Posttonic} \\ \hline \text{Nor} & + & + \\ \text{Cas} & + & + \\ \end{array} \]

(Note: \( V_2 \) can assimilate to \( V_1 \) as predicted in (4))
(9) $V_1 \downarrow V_2$

\[ + G \]

**Condition:** height $V_1 > V_2$

\begin{center}
\begin{tabular}{l|l|l}
 & Pretonic & Posttonic \\
\hline
Cit & $-$ & $-$ \\
Nor & $+$ & $+$ \\
Cas & $-$ & $+$
\end{tabular}
\end{center}

(Note: The condition on PostCit correctly predicts /io/ \* [JO], but all other /V/ \* [YSV])

(10) $V_1 \downarrow V_2$

\[ + G \]

**Condition:** height $V_1 = V_2$

\begin{center}
\begin{tabular}{l|l|l}
 & Pretonic & Posttonic \\
\hline
Cit & $-$ & $-$ \\
Nor & $-$ & $+$ \\
Cas & $-$ & $-$
\end{tabular}
\end{center}

(11) $V_1 \downarrow V_2$

\[ + G \]

**Condition:** height $V_1 = V_2$

\begin{center}
\begin{tabular}{l|l|l}
 & Pretonic & Posttonic \\
\hline
Cit & $-$ & $-$ \\
Nor & $+$ & $-$ \\
Cas & $-$ & $+$
\end{tabular}
\end{center}

(Note: Condition for $+$: either (10) or (11) may apply, but not both)
4.8. Summary

The operation of the shortening processes of Raising, Monophthongization, and Syllabic Shifts show a clear preference for posttonic position. In fact, the conditions for the processes may be summarized quite simply as pretonic ⇒ posttonic. In other words, if one of these processes has applied pretonically (in a given style) then one of these processes will necessarily apply posttonically as well, but not vice versa. Thus, a process that applies posttonically in Nor may pretonically only apply in Cas or not at all, e.g., (11) above /VV/ → /yV/, [ˈlabju] (Nor) lābio 'lip' but [ˈpjoˈneru](Cas only) pioneiro 'pioneer'. However, the converse does not hold true: No Nor or Cit pretonic shortening process only occurs posttonically in Cas.

Processes (10) and (11) deserve comment. (10) optionally occurs in PreCas but it does not occur in PostCas. Because (10) is a shortening process (desyllabification) it would appear that this is a counter example to my claim pretonic ⇒ posttonic. However, this turns out not to be a true counter example if one considers process (11) as well. (11) applies in PostCas and PostNor but pretonically it operates only in Cas. (10) produces [yV] while (11) produces [yV]. Although (10) and (11) are both shortening processes (11) produces a shorter (open) syllable than (10) (which produces a closed syllable). Therefore, the preference for (11) over (10) posttonically demonstrates the posttonic susceptibility to shortening.

If the underlying form of a word fits the structural description of a shortening process, both pretonically and posttonically, in a given
style a shortening process will necessarily apply posttonically if a process applies pretonically, but not vice versa. The hierarchy of application, i.e., pretonic → posttonic, is illustrated in the following examples where more than one process can apply to a given word. The numbers in parentheses refer to the processes in 4.7. above.

<table>
<thead>
<tr>
<th>Cit</th>
<th>Nor</th>
<th>Cas</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>[me' nin</td>
<td>[me' ninu]</td>
<td>[mi' ninu]</td>
<td>*[mi' nino]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) menino 'boy'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[pa' zarin]</td>
<td>[pa' zar]</td>
<td>[pa' zar]</td>
<td>*[pa' zar]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[pa' zar]</td>
</tr>
<tr>
<td>(2,4) paisagem 'scenery'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[fiu'mino]</td>
<td>[fiu'minu]</td>
<td>[fiu'minu]</td>
<td>*[fiu'mino]</td>
</tr>
<tr>
<td>(1,6) filminho 'little film'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[se'nario]</td>
<td>[se'nariu]</td>
<td>[si'nariu]</td>
<td>*[si'nario]</td>
</tr>
<tr>
<td>or [se'nariu]</td>
<td></td>
<td></td>
<td>*[si'nariu]</td>
</tr>
<tr>
<td>(1,9,10) cenário 'scene'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[siu'meto]</td>
<td>[siu'metu]</td>
<td>[siu'metu]</td>
<td>*[siu'meto]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[siu'metu]</td>
</tr>
<tr>
<td>(1,9,10) ciumento 'jealous'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[mauri'sio]</td>
<td>[mauri'siu]</td>
<td>[mauri'siu]</td>
<td>*[mauri'sio]</td>
</tr>
<tr>
<td>or [mauri'siu]</td>
<td></td>
<td></td>
<td>*[mauri'siu]</td>
</tr>
<tr>
<td>(1,4,9,10) Maurício (masc. name)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[plau'zivey]</td>
<td>[plau'zivey]</td>
<td>[plau'ziviu]</td>
<td>*[plau'zivey]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[plau'ziviu]</td>
</tr>
<tr>
<td>(3,4,7) plausível 'plausible'</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cit          Nor          Cas          *
[leõ'pardo]  [leõ'pardu]  [leu'pardu]  *[leu'pardo]
[õ'pardu]    *[õ'pardo]

(1,10,11) leopardo  'leopard'  
(Note: [i] → [õ])

[kõ'тарăg]  [kõ'тарă]  [kõ'тарă]  *[kõ'тарăg]

(2,5) contaram  'they tell'

[põ'ziɲo]  [põ'ziɲu]  [põ'ziɲu]  *[põ'ziɲu]

(1,5) pãozinho  'roll'

The starred forms emphasize the pretonic ⇒ posttonic relationship.

These forms are tantamount to the mixing of styles, e.g., *[mi'niɲo]
would be equivalent to PreCas + PostCit, something non-existent in
natural speech. However, in some cases a hypothetical mixing of
PreCas and PostCit can produce utterable words (of course when
PostCit=PostCas), e.g., [fiu'miɲu](processes (1,6)). What these examples
show is that shortening processes are favored as one goes from
Cit → Nor → Cas and that they are favored in posttonic over pretonic position.

This chapter has demonstrated how the rhythmic structure at the
word level governs the segmental processes of a language. Since the
posttonic syllable is considerably shorter than the pretonic, and since
a shortening process will necessarily operate posttonically before it
will operate pretonically, I conclude that the shorter duration of the
posttonic syllable is a causal factor in the operation of these processes.
CHAPTER V

RHYTHM AND TIMING

5.0. Introduction

Typologically, the languages have frequently been divided up into three categories according to their rhythm and timing: mora-timing (e.g., Japanese), syllable-timing (e.g., Spanish), and stress-timing (e.g., English, Pike 1945).

In a mora-timed language, such as Japanese, the moras are approximately equal in duration; e.g., CV and CCV both have one mora and would be half as long as a two-mora syllable, e.g., CVV or CVC. (A mora is the number of segments starting from the end of the syllable up to and including the first vowel of the syllable.) There are, however, physical discrepancies due to differences in intrinsic durations of the segments as well as stress and position of the syllable in an utterance. For example, Wang 1971, 292-294 found that in the same word, Japanese /sya/ (one mora) was more than twice as long as /ya/ (also one mora). In spite of these differences the mora apparently has psychological reality to a Japanese speaker since it is used for counting purposes in singing and poetry.

A syllable-timed language is characterized by syllables which have approximately equal durations, regardless of stress or position. Thus, the duration of an utterance would be directly proportional to the number of syllables, and accordingly, the durations between major stresses would directly depend on the number of intervening unstressed syllables.
This contrasts with a stress-timed language in which durations between major stresses are approximately equal. Impressionistically, syllable-timed languages show a rapid-fire or machine gun type of production since the syllables follow one another in quick succession and at approximately equal intervals. Because Spanish is said to be syllable-timed, many textbooks and teachers of Spanish as a foreign language encourage the students to produce syllables of equal duration. (cf. Catellis and Lionetti 1974 p. 6). To my knowledge, there are no instrumental studies on Spanish which include data on interstress durations. If one uses such measurements as the only criterion for judging whether a language is syllable-timed or stress-timed, a decision about Spanish based on present data would be impossible.

However, there are studies dealing with the duration of individual syllables of Spanish. Navarro 1968 (pp. 50-53) states that a characteristic feature of Spanish is the brevity of its vowels regardless of stress or position. He does, though, point out that there are differences in syllable durations depending on stress and position; e.g., the shortest durations occur in penultimate vowels of proparoxytones. Yet "No vowel is shortened so much, besides the modifications caused by the hiatus reduction in some cases, as to become muffled or silenced", p.51. (Cf. Portuguese vowel devoicing, deletions, etc. Chapter 2). Navarro's measurements taken from a kymograph show that the syllables frequently differ in duration by as much as 2:1. However, his data must be viewed with caution since he does not mention his methodology, sample size, means or range of variation, nor any other statistical analysis. In addition, his differences could be the result of differences in intrinsic duration. Therefore, Navarro's
syllables vary considerably in duration does not necessitate rejecting the notion that Spanish is syllable-timed. It is still possible that a speaker intends to produce syllables of equal length, but because of stress and intrinsic duration differences the syllables result in unequal durations.

The data of Delattre 1966 are more enlightening. In his analysis of five minutes of extemporaneous speech of four languages (English, German, Spanish, and French), he found the overall ratio of the length of stressed to unstressed syllables in Spanish to be 1.3 (and 1.6 in English). These data hardly support the notion that Spanish is syllable-timed, since 30% difference in length is not negligible. However, his data reveal that many syllables in Spanish have approximately equal durations regardless of stress or position. For example, the ratio of final, unstressed open to non-final unstressed open syllables is 1.02 (1.77 in English): stressed non-final open to non-final open is 1.11 (1.59 in English); stressed non-final open to unstressed final open is 1.09 (2-2.5 in Portuguese; see Chapter III); stressed final open to unstressed final open is 1.0 (2-2.5 in Portuguese). In addition, the "maximal range of syllable length variation (combined effect of weight, position, and type)" is 3.39 for English but only 1.77 for Spanish (p. 188). In light of Delattre's data it might be argued that Spanish is a syllable-timed language since the overall variations in duration in part can be attributed to intrinsic durations and syllable structure differences in the various positions (closed vs. open, number of prevocalic consonants, etc.).
A stress-timed language is characterized by stress isochrony, i.e., the durations between major stresses are approximately equal regardless of the number (within limits) of intervening unstressed syllables. English is said to be stress-timed. It has been claimed that stress-timed languages tend to show reductive and shortening processes which often result in the loss of oppositions in unstressed syllables. Both English and Portuguese show this tendency. On this basis one might suspect that Portuguese has a tendency toward stress-timing. Further evidence will be considered in 5.1.-5.3.

Although there has been considerable instrumental work on English, the conclusions of the investigators vary remarkably. Some reject the notion of isochrony (Shen and Peterson 1962, O'Connor 1965, Lea 1974), while others admit a 'tendency' toward isochrony in production and perception (Classe 1931, Uldall 1971, 1972, Barnwell 1971, Lehiste 1977). The latter group claim there is a tendency to speak in isochronous units and a tendency for speech to be perceived as isochronous. However, because of such factors as intrinsic duration and human limits on speed of production, actual speech is frequently not isochronous. To illustrate, it is physically impossible to utter a tetra-syllabic foot as quickly as a di-syllabic foot. Yet the tetra-syllabic foot has a tendency to be reduced in duration, i.e., it is altered in the proper direction to become isochronous with the disyllabic foot (although complete isochrony is not achieved). This tendency for isochrony is described by Barnwell 1971 who claims speech attempts to be rhythmic and is heard as such but the actual physical production
is not completely rhythmic due to durational constraints. (For a more complete review of the studies cited above and others, see Lehiste 1977).

Lehiste 1977 treats isochrony with reference to human constraints on production and perception. The relevance of this in obvious: If a speaker can produce identical utterances with an accuracy of $x\%$, (in terms of producing identical durations) and he can perceive duration differences with $x\%$ accuracy, then two utterances which differ in durations by less than $x\%$ must be considered isochronous from the standpoint of perception and production, since he cannot perceive the difference and is unable to produce two utterances which differ in duration by less than $x\%$. When one further considers durational constraints (due to intrinsic duration and number of segments and syllables) it is quite clear why perfect isochrony can never be achieved. For example, an English speaker who is asked to utter the words sky and do with an attempt to make them equal in duration will inevitably produce sky with the longer duration, yet they will be perceived as equal.

Allen 1975 found that variability in speech production is about $1\%$ for long utterances and about $10\%$ for short segments. Perception thresholds are even greater. Using non-speech stimuli with reference durations of 300, 400, and 500 ms, Lehiste 1977 found that the just noticeable differences ranged from 30 to 100 ms (about 10-30\%). Since listeners do better at identifying durational differences for non-speech stimuli than for real speech (Lehiste 1970, 1977, Fujisaki,
Nakamura, and Imoto 1973) one might argue that the just noticeable differences for real speech are larger than these figures. The duration differences of interstress intervals in actual speech production are often within this range. Uldall 1971 reports the average durations of monosyllabic, disyllabic, and trisyllabic feet to be 440 ms, 510 ms, and 540 ms. (For other measurements, see O'Connor 1965, Lehiste 1977.) It is therefore quite probable that many utterances which are not absolutely isochronous are still perceived as isochronous because the actual differences are below the perceptual threshold. On this basis one can argue that English is a stress-timed language—the speaker attempts to produce interstress durations of equal length yet falls short of his goal. However, the durations are still perceived as equal.

The determination of whether a language is stress-timed or syllable-timed (or intermediate) is thus very difficult; one has to take into account human production and perception abilities as well as the distribution of segments and possible syllable structures in the various positions. There has been a good deal of study on English timing, but unfortunately, there are no comparable studies on Portuguese. My research therefore must be judged as preliminary since there are no other studies with which to compare.

5.1. Data Involving Real Words

5.1.1. Instress Durations

Using the frame sentence 'Repita a palavra ___ de novo' ('Repeat the word ___ again'), I asked speakers to read the sentence
in a 'Normal' style, substituting various monosyllabic, disyllabic, and trisyllabic words. Inasmuch as possible, I chose pairs and triplets with identical consonants and vowels in order to control for intrinsic durations, e.g., ['ba] (interjection), ['ba'bal 'nurse maid', ['babal 'drools'. (See appendix for complete list.) I recorded the sentences and took measurements from the tracings made by a Mingograph 42B. The frame sentence consists of four major stresses, or three interstress intervals: [xe'pitapa'lavra dʒi'novu] (Note: [xe'pita] - [xe'pita] a normal speech). The first interval has three syllables and is constant throughout ([xe'pitapa]). This serves as a basis for judging variability in production for a given speaker. The number of syllables in intervals 2 and 3 varies according to the number of syllables in the key word and stress placement. The following shows the variation in number of syllables of the intervals depending on the key word.

(1) ĺ: [xe'pitapa'lavra'sdʒi'novu]

\[
\begin{array}{ccc}
3 & 2 & 2
\end{array}
\]

(2) ļś: [xe'pitapa'lavra'ssdʒi'novu]

\[
\begin{array}{ccc}
3 & 2 & 3
\end{array}
\]

(3) ļśś: [xe'pitapa'lavra'ssdʒi'novu]

\[
\begin{array}{ccc}
3 & 3 & 2
\end{array}
\]

(4) ļśśś: [xe'pitapa'lavra'sssdʒi'novu]

\[
\begin{array}{ccc}
3 & 3 & 2
\end{array}
\]
Table 5-1 summarizes the results for speaker FPR. For notational convenience I have used numbers to represent the various intervals (e.g., 1 = first interval) and subscripts to represent the number of syllables in the interval (e.g., $2_3$ = interval 2 with 3 syllables).

The differences in duration in a given interval (e.g., $2_2$ vs. $2_3$ vs. $2_4$) are all statistically significant to 0.01. However, this is not necessarily a relevant consideration here because if the differences are not perceptible to the human ear, then it makes no difference whether they are statistically significant or not. If a listener cannot tell the difference between two utterances, they must be perceived as equal. Previously, I cited the work of Lehiste 1977 in which she found just noticeable differences in the perception of durations to be approximately 10-30 % for non-speech stimuli. With speech stimuli, the jnd’s are even greater (Klatt 1976). My data shows that $2_3$ is 23 *% longer than $2_2$ (or $2_2$ is 19 *% shorter than $2_3$); $3_3$ is 18 *% longer than $3_2$ ($3_2$ is 15 *% shorter than $3_3$). These differences are within the range of perceptibility for non-speech stimuli, but whether these differences are perceptible or not in
Table 5-1
Interstress Durations for Real Words

<table>
<thead>
<tr>
<th>Interval:</th>
<th>$\frac{1}{3}$</th>
<th>$\frac{2}{2}$</th>
<th>$\frac{3}{2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{x}$</td>
<td>455</td>
<td>396</td>
<td>416</td>
</tr>
<tr>
<td>(means in ms)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$s$</td>
<td>36</td>
<td>52</td>
<td>50</td>
</tr>
<tr>
<td>(standard deviation in ms)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$N$</td>
<td>92</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>(number of tokens)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interval:</th>
<th>$\frac{2}{3}$</th>
<th>$\frac{3}{3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{x}$</td>
<td>487</td>
<td>490</td>
</tr>
<tr>
<td>$s$</td>
<td>57</td>
<td>50</td>
</tr>
<tr>
<td>$N$</td>
<td>25</td>
<td>34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interval:</th>
<th>$\frac{2}{4}$</th>
<th>$\frac{3}{4}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{x}$</td>
<td>625</td>
<td>608</td>
</tr>
<tr>
<td>$s$</td>
<td>66</td>
<td>30</td>
</tr>
<tr>
<td>$N$</td>
<td>14</td>
<td>5</td>
</tr>
</tbody>
</table>
real speech is questionable. Therefore, I believe these data weakly suggest there is isochrony. However, for intervals which differ in number of syllables by two (e.g., $3_2$ and $3_1$) it is physically difficult for a speaker to make the durations equal. Do listeners unconsciously take this into account, and if they do, does this cause them to perceive isochrony even though it is physically absent? It is certainly a possibility, since in perception listeners unconsciously adjust to intrinsic durations of segments, (Lehiste 1976). For example, in natural speech [skai] sky is longer than [du] do; yet, they are perceived as equal. Furthermore, if the two words are made equal in duration (e.g., in synthesized speech) sky is perceived as shorter because the speaker 'expects' sky to be longer than do.

Because of this, an analogous question can be asked: Does a speaker of a stress-timed language 'expect' a trisyllabic word to be longer than a monosyllabic word even though he hears them as equal? To my knowledge, at present there has not been any research done in this area to answer these questions, yet it is a field of investigation which could prove fruitful.

5.1.2. Durations of Syllables

Another important consideration in timing is syllable duration. If a language is stress-timed, the length of the individual syllables in a word should be inversely proportional to the number of syllables in that word. For example when comparing (1) ŠSŠSŠ with (2) ŠS # ŠSŠ # Š the syllables in the first interval of (2) would necessarily have to be shortened in order to make the first interval isochronous with the second. Therefore, the stressed syllables in
(1) will be longer than the stressed syllables in (2). My data support this to some extent. Although my total sample size was 92, for speaker FPR there were only 5-10 tokens of each word. Therefore, I shall present no statistical analysis. However, these data do indicate moderate progressive shortening of syllables with increasing number of syllables in a word. For example, the stressed mono-syllable ['ba] bâ (interjection) had an average duration of about 300 ms but the phonetically identical syllable in a disyllabic word, ['ba]babá 'dribbles' and [ba]babá 'nursemaid', had a duration of about 250 ms. Speaker MMG also showed this tendency in his utterances of real words and nonsense syllables, on the same order of magnitude as for speaker FPR. (Section 5.2.2. p.150 which deals with nonsense syllables, has a greater number of tokens for each word type to warrant a statistical analysis.)

5.2. Data Involving Nonsense Syllables

Using a technique similar to the one described in 5.2.1. and 3.3.1., I recorded speakers pronunciation of real words and /la/ imitations.

5.2.1. Interstress Durations

Table 5-2 summarizes the results of speaker MBA, according to individual words. Table 5-3 combines the results of all nonsense words according to number of syllables in the word.

Some of the data obtained for nonsense syllables provide stronger support for the presence of isochrony than the data from real words (Table 5-1). Table 5-3 indicates interval $3_2$ differs from
<table>
<thead>
<tr>
<th></th>
<th>Speaker MBA₂</th>
<th></th>
<th></th>
<th></th>
<th>Speaker MBA₂</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lál</td>
<td>lálala</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>¹ₓ</td>
<td>³ₓ</td>
<td>¹s</td>
<td>³s</td>
<td>¹ₓ</td>
<td>³ₓ</td>
<td>¹s</td>
<td>³s</td>
</tr>
<tr>
<td></td>
<td>391</td>
<td>382</td>
<td>26</td>
<td>34</td>
<td>338</td>
<td>338</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>429</td>
<td>40</td>
<td>40</td>
<td>41</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>lálala</td>
<td>lálala</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>¹ₓ</td>
<td>³ₓ</td>
<td>¹s</td>
<td>³s</td>
<td>¹ₓ</td>
<td>³ₓ</td>
<td>¹s</td>
<td>³s</td>
</tr>
<tr>
<td></td>
<td>399</td>
<td>382</td>
<td>42</td>
<td>34</td>
<td>345</td>
<td>461</td>
<td>50</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>545</td>
<td>452</td>
<td>39</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>lalá</td>
<td>lalá</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>¹ₓ</td>
<td>³ₓ</td>
<td>¹s</td>
<td>³s</td>
<td>¹ₓ</td>
<td>³ₓ</td>
<td>¹s</td>
<td>³s</td>
</tr>
<tr>
<td></td>
<td>383</td>
<td>409</td>
<td>39</td>
<td>20</td>
<td>494</td>
<td>607</td>
<td>43</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>488</td>
<td>475</td>
<td>30</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>13</td>
<td>22</td>
<td>32</td>
<td>24</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-------</td>
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<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>387</td>
<td>341</td>
<td>464</td>
<td>607</td>
<td>617</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>st</td>
<td>51</td>
<td>51</td>
<td>42</td>
<td>66</td>
<td>41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>73</td>
<td>36</td>
<td>34</td>
<td>13</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>23</th>
<th>33</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>475</td>
<td>500</td>
</tr>
<tr>
<td>st</td>
<td>50</td>
<td>63</td>
</tr>
<tr>
<td>N</td>
<td>23</td>
<td>27</td>
</tr>
</tbody>
</table>
3 by only 36 ms (statistically significant to only 0.05), or approximately 1/2 or 3/4 of a standard deviation. This means a large portion of populations overlap. When the means of two normal curves differ by one standard deviation the area of overlap is roughly like the following: This is approximately 60-70 ".

In the case of 3 and 3 the overlap is even greater since the difference of the means is less than one standard deviation. This indicates a large portion of the population of the two intervals showed no differences in duration. However, even more important is that the actual difference in means is only about 7 ". This is perhaps within the range of an individual's control of production, but it is very probable that the difference is not perceptible. If the difference in durations is not perceptible then it follows that the two durations are perceived as equal.

Some of the data for individual words (Table 5-2) speak even more strongly for isochrony. Interval 3 for lajala had a duration of 452 ms, which was actually less than 3 for lalalá (475 ms) and 3 for lajla (488 ms). (The overall means of all intervals 3 on Table 5-3 is 500, due to the fact that 3 for lala is, for some unknown reason, nearly 100 ms longer than 3 for lalala). Interval 3a, however, is significantly larger than overall 3 and 3. The lack of observable isochrony for 3a compared to 3 and 3 is perhaps due to physical constraints on production; i.e., it takes longer to produce four syllables than two or three.
The differences in intervals 2 speak less strongly for isochrony. 

2_2 differs from 2_3 by 28°/₀, and 2_3 differs from 2_4 by 22°/₀. The nonsense words which occur in these various intervals are the following: 2_2 involves no pretonic syllable(lá), 2_3 has one pretonic syllable (lalá, lalála), and 2_4 has two pretonic syllables(lalalá).

The small differences between 3_2 and 3_3 provide the strongest support for isochrony. It is noteworthy that 3_2 involves words with a final stressed syllable(lá, lalá, lalalá), while 3_3 includes words with a single posttonic syllable(lála, lalála). It seems that isochrony is favored when an additional unstressed syllable is added posttonically(3_2 vs. 3_3) rather than pretonically(2_2 vs. 2_3). This means that the posttonic syllables can be shortened more readily to accommodate isochrony. This correlates directly with the other data on shortening which have indicated shortening processes are favored in posttonic position over pretonic position (Chapter IV).

What the present findings suggest is that a stress-timed language can have certain environments where the addition of unstressed syllables tends to disrupt isochrony, while at the same it has other environments where unstressed syllables do not seem to disrupt isochrony. Although this paints a somewhat lopsided picture of Portuguese rhythm, it does demonstrate how the details of the environment for shortening processes can affect the overall timing of the language. I shall discuss the implications of this in the conclusion of this chapter.

5.2.2. Syllable Durations

Table 5-4 shows the measurements of the durations of the syllables for the nonsense words for speaker MBₐ₂.
<table>
<thead>
<tr>
<th></th>
<th>$S_1$</th>
<th>$S_2$</th>
<th>$S_3$</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>lā</strong></td>
<td></td>
<td>257</td>
<td>–</td>
<td>257</td>
</tr>
<tr>
<td></td>
<td>$\bar{x}$ 257</td>
<td>–</td>
<td>–</td>
<td>257</td>
</tr>
<tr>
<td></td>
<td>$s$ 21</td>
<td>–</td>
<td>–</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>(N=11)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>lālālā</strong></td>
<td></td>
<td>208</td>
<td>122</td>
<td>429</td>
</tr>
<tr>
<td></td>
<td>$\bar{x}$ 208</td>
<td>122</td>
<td>99</td>
<td>429</td>
</tr>
<tr>
<td></td>
<td>$s$ 21</td>
<td>13</td>
<td>19</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>(N=11)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>lāla</strong></td>
<td></td>
<td>217</td>
<td>114</td>
<td>330</td>
</tr>
<tr>
<td></td>
<td>$\bar{x}$ 217</td>
<td>114</td>
<td>–</td>
<td>330</td>
</tr>
<tr>
<td></td>
<td>$s$ 19</td>
<td>–</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>(N=14)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>lalālā</strong></td>
<td></td>
<td>138</td>
<td>202</td>
<td>448</td>
</tr>
<tr>
<td></td>
<td>$\bar{x}$ 138</td>
<td>202</td>
<td>108</td>
<td>448</td>
</tr>
<tr>
<td></td>
<td>$s$ 13</td>
<td>15</td>
<td>15</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>(N=13)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>lalā</strong></td>
<td></td>
<td>151</td>
<td>222</td>
<td>373</td>
</tr>
<tr>
<td></td>
<td>$\bar{x}$ 151</td>
<td>222</td>
<td>–</td>
<td>373</td>
</tr>
<tr>
<td></td>
<td>$s$ 12</td>
<td>–</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>(N=10)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>lalalā</strong></td>
<td></td>
<td>140</td>
<td>133</td>
<td>481</td>
</tr>
<tr>
<td></td>
<td>$\bar{x}$ 140</td>
<td>133</td>
<td>208</td>
<td>481</td>
</tr>
<tr>
<td></td>
<td>$s$ 14</td>
<td>20</td>
<td>24</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>(N=13)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>
The durations of the words increase as the number of syllables increases. However, total word length is conditioned not only by number of syllables but by stress placement. Specifically, pretonic unstressed syllables increase word length more than posttonic syllables; e.g., lalá vs. lála (373 ms to 330 ms), lalalá vs. lálalá (431 to 448).

This is in perfect agreement with my other data on pretonic and posttonic duration differences (Chapter III).

Although the durations of the words increase as the number of syllables increases, there is progressive decrease in the length of individual syllables (stressed and unstressed) as the number of syllables in the word increases. Some of the differences are quite small but they are all in the direction which minimize differences in the total duration of words. For example, the pretonic syllable in lalá is longer than the pretonic syllables in lalalá (151 ms vs. 140 ms and 133 ms); the stressed syllable in lá (257 ms) is longer than the stressed syllables both in lalá (222 ms) and lalalá (208 ms); the final posttonic syllable in lálalá is longer than the posttonic in lála (114 ms vs. 99 ms).

Table 5-5 summarizes the effect of the number of syllables in a word on the duration of the stressed syllable.

| Table 5-5 |
|---|---|---|
| Durations of Stressed Syllables According to the Number of Syllables in the Word |
| Speaker MBA₂ |
| Monosyllabic | Disyllabic | Trisyllabic |
| m | 257 | 219 | 206 |
| s | 21 | 19 | 21 |
| N | 11 | 24 | 37 |
The differences are all significant to 0.01. This progressive shortening of a stressed syllable as the number of unstressed syllables increases provides additional support for the claim that Portuguese is stress-timed.

5.3. Casual Speech

The data in the previous sections of this chapter involved 'Normal' speech. Many shortening processes which occur in 'Normal' posttonically only occur in 'Casual' pretonically (cf. Chapter IV). Because shortening processes potentially have the effect of aiding isochrony, it is conceivable that in casual speech the increase in the occurrence of pretonic shortening could aid isochrony. Perhaps the differential tendency of intervals to be isochronous, depending on whether the unstressed syllables are pretonic or posttonic (5.2.2.), would be minimized in casual speech.

I chose to work with speaker MBA₂ since his normal speech is very progressive and shows a greater incidence of shortening processes than most speakers. In addition, he characteristically articulates very rapidly. I asked him to repeat various sentences rapidly. The three sentences I shall consider here are the following: (1) 'Esta é a melhor universidade do Brasil.' (2) 'Esta é uma grande universidade no Brasil.' (3) 'Esta é uma péssima universidade no Brasil.' ('This is [the best, a great, a terrible] Brazilian university'). In normal speech the number of syllables per foot is indicated below:
(1) Esta é a melhor universidade do Brasil.

(2) Esta é uma grande universidade no Brasil.

(3) Esta é uma péssima universidade no Brasil.

As one can observe, the number of syllables in the intervals varies only in interval 2.

Table 5-6 indicates the interstress durations.

$2_5$ and $2_6$ differ by only 3% which certainly not a perceptible difference, nor is it within the range of production control. $2_7$ differs from $2_6$ by 16% and $2_7$ differs from $2_5$ by 19%. These latter two differences are not conclusively perceptible either.

The differences of the fixed intervals also vary (interval 1 and 3.) Although the differences in some cases are quite small, intervals 1 and 3 show a progressive lengthening as the number of syllables in interval 2 increases. If this small sample size is representative, what these data suggest is that in the production of interval 1 the speaker adjusts the length of the interval depending on the number of syllables in the next interval. It also suggests, at least in these cases, that the speaker has pre-programmed the entire sentence before speaking since the durations of first and last interval depend
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<td>355</td>
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<tr>
<td>$s$</td>
<td>16</td>
<td>18</td>
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<td>-</td>
</tr>
<tr>
<td>($N=13$)</td>
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<td>1026</td>
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<tr>
<td>$s$</td>
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<td>42</td>
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<td>-</td>
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<tr>
<td>($N=11$)</td>
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<td>$\bar{x}$</td>
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<tr>
<td>$s$</td>
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</table>
on the number of syllables in the second. I hasten to point out, however, that with such a small sample size this account is very speculative.

The data on casual/rapid speech provide two types of evidence in support of isochrony. First, the differences of the variable intervals are probably not perceptible. Second, in a given sentence, the durations of the fixed intervals (constant in a number of syllables) vary in proportion to the number of syllables in the variable interval.

The reader may wonder how this speaker succeeded in uttering 7 syllables in 291 ms (interval $2_r$). In fact, he did not. His speech was so rapid that it is difficult to give an accurate phonetic transcription. (See Figure 5-1.) The reduction of sentence (3) is roughly as follows:

```
['estacumalpesimauuniversidadziunubraziy']
+ ['esamepezmevezanubraziy']
```

The number of syllables in the intervals was reduced approximately in this manner: $1_s \ 2_6 \ 3_4 \ 1_3 \ 2_3 \ 3_3$. Sentence (2) was also reduced:

```
['estameyovuniversidadziunubraziy']
+ ['estameyounvestanubraziy']
```

Thus, the reduction in number of syllables is $1_s \ 2_5 \ 3_4 \ 1_3 \ 2_3 \ 3_3$.

In order to achieve isochrony, the speaker used the shortening process par excellence—deletion. My data on 'Normal' speech (5.2.1. and 5.2.2.) indicate isochrony is favored by reduction in duration of syllables; here, isochrony is aided by reduction in number of syllables. These rapid/casual data also demonstrate that pretonic shortening
'Esta é uma péssima universidade no Brasil!
('This is a terrible Brazilian university')

Figure 5-1: Casual Speech
occurs as an aid to isochrony (i.e., [universi\'dadʒi]). Cf. in 'Normal' where there was a lesser degree of pretonic shortening).

These data also correlate with my previous findings that many pretonic shortening processes only occur in 'Casual'.

5.4. Conclusion

I believe for the following reasons to have shown that Portuguese has a tendency toward stress-timing: (1) The increase in interstress durations due to an increase in number of syllables is less than what would be expected if total duration were directly proportional to the number of syllables. (2) Many interstress duration differences are not perceptible. (3) Syllable duration decreases as the number of syllables in a word increases. (4) In very rapid/casual speech unstressed syllables delete in a manner which tends to equalize the number of syllables in each interval.

My experimental data suggest that there is a greater tendency for intervals to be isochronous if they differ in number of syllables posttonically rather than pretonically; i.e., the addition of posttonic syllables disrupts isochrony less than pretonic syllables. I have suggested that this is perhaps due to the propensity for posttonic shortening over pretonic shortening. I would predict that a sentence such as $\ddot{s} \ # \ \dddot{s} \ # \ \ddot{s} \ # \ \dddot{s} \ # \ \dddot{s}$ would show more isochrony than $\ddot{s} \ # \ \dddot{s} \ # \ \ddot{s} \ # \ \dddot{s} \ # \ \ddot{s}$. I have also presented evidence that suggests in rapid/casual speech the differences may be lessened because of the increased tendency toward pretonic shortening (when compared to 'Normal').
These claims have far-reaching implications in terms of typological change. It is generally believed that 'Citation' (or an extremely formal style) represents the most conservative style of speech; 'Normal' is intermediate, while 'Casual' is the most progressive. Historical change often occurs in the direction of casual speech; i.e., today what is considered a very progressive, casual style may become the normal speech for some future generation; the normal style of today may in the future be considered extremely formal or archaic.

Consider these characteristics concerning style as they relate to timing. In Portuguese, 'Citation' shows very few shortening processes. This suggests that a sentence read in this style would tend to be somewhat syllable-timed since there would be only a limited occurrence of shortening processes which would be available to aid isochrony. If 'Citation' represents an 'Archaic Normal' style, it would appear that at one time Portuguese was a syllable-timed language just as Spanish is today. (In fact, Portuguese spoken in an extremely slow and deliberate 'Citation' style has a very Spanish sounding accent to it.) 'Normal' speech shows a high incidence of posttonic shortening, which can have the effect of aiding isochrony, while pretonic shortening is less frequent. Since natural speech contains a mixture of both pretonic and posttonic syllables, the overall result is that 'Normal' Portuguese is perhaps at an intermediate stage between a truly stress-timed and syllable-timed language. Casual speech, however, shows a greater incidence of pretonic shortening, which suggests this style would show a greater
tendency toward stress-timing.

If my data are representative, the implication is quite clear: Portuguese is in the process of changing from a syllable-timed language to a stress-timed language.
CHAPTER VI

CONCLUSION

This investigation has revealed that stress and duration have profound effects on the phonology of Portuguese. Stressed syllables frequently undergo lengthening and strengthening processes, e.g., the development of glides: \([\tilde{v}] \rightarrow [\tilde{v}_g], [\tilde{v}_d](2.3.4.2.1.\) and 2.3.4.5), while unstressed syllables undergo a variety of shortening or weakening processes, such as raising (2.3.4.1.2, 2.3.4.2.2.), vowel and syllable deletion (2.3.4.2.4., 2.3.4.2.7.), and /\(x/\) and /\(r/\) deletion (2.3.4.5., 2.3.4.2.6.) and syllabicity shifts (4.4). The experimental data have shown that greater duration is the primary correlate of stress. In trisyllabic paraoxytones (words of the type SSS) the durational ratios are approximately 3:4:2 or 3:5:2 (table 3-1, p. 68). The relatively long duration of the tonic syllable is associated with a greater number of possible segments and a greater complexity in syllable structure when compared to the unstressed syllables, which have shorter durations (especially the posttonic). For example, there are 15 tonic diphthongs; 11 occur pretonically while only 4 occur posttonically. My data concerning duration suggest that the short duration of a posttonic syllable is a factor which has limited the possible number of structures in this position.
The influence of duration is very striking when one compares the operation of shortening processes in pretonic vs. posttonic position. Raising, Monophthongization, and Syllabic Shifts ($\text{V}V \rightarrow \text{V}V$, $\text{V}SV \rightarrow \text{V}V \rightarrow \text{V}V$) show a greater occurrence in posttonic position. The posttonic preference for shortening is reflected in the hierarchy pretonic $\supset$ posttonic. This means that in a given style if a process applies pretonically it necessarily applies posttonically but not vice versa. Furthermore, the operation of shortening processes relative to style can be expressed as follows: Citation $\supset$ Normal $\supset$ Casual, i.e., if a shortening process applies in Citation it will necessarily apply in Normal and Casual, and if a process applies in Normal it has to apply in Casual but not necessarily in Citation. For these implicational relationships concerning position and style, it follows that some NorPost processes are only CasPre processes, but no NorPre processes will only be CasPost processes because according to the hierarchy a NorPre $\supset$ NorPost. Since the posttonic syllable is shorter than the Pretonic (a ratio of about 2:3) I propose that the short posttonic duration is a factor which favors the operation of shortening processes.

The absence of stress and the concomitant short duration thus have noticeable effects at the word level. This important role of stress (and the effects from its absence) is observable not only at the word level but also at the sentence or utterance level. The exaggeration of stress at the expense of unstressed syllables is correlated with the change from syllable-timing to stress-timing. Using instrumental data I have given evidence that Portuguese has
a tendency toward stress-timing (stress isochrony): (1) interstress durations are not directly proportional to the number of syllables; (2) many differences in interstress durations are not perceptible; (3) syllable duration is inversely proportional to the number of syllables in a word; and (4) in casual speech unstressed syllables delete, which has the effect of equalizing the number of syllables in each stress group.

My data suggest that posttonic syllables disrupt stress isochrony less than pretonic syllables. Considering the propensity for posttonic shortening over pretonic shortening, this is not surprising since the addition of syllables which can be readily reduced in duration will not disturb the rhythm as much as the addition of syllables which are more resistant to reduction.

Style also influences the operation of shortening processes, which in turn has repercussions on the rhythm. In 'Citation' very few of these processes operate; in 'Normal' shortening processes show a clear preference for posttonic position; in 'Casual' many of the posttonic 'Normal' processes also operate pretonically. Since these shortening processes have the effect of reducing duration which can aid stress isochrony, while the resistance to a reduction in durations disrupts stress isochrony, I have suggested that 'Casual' has the greatest tendency toward stress-timing while 'Citation' tends toward syllable-timing. If 'Casual' represents the most progressive style and is indicative of the trend or direction of language change, then my data suggest that Portuguese is changing from syllable-timing to stress-timing.
Shortening processes, which can have the effect of facilitating stress-timing, are favored in posttonic position over pretonic position. Since there are no obvious reasons why this should be true, I can only offer some speculations which are based on other characteristics of Portuguese. The prosodic structure of a syllable has similarities to the prosodic structure of a poly-syllabic word. Both a syllable and a word have a peak or area of greatest prominence. At the syllable level the peak is the syllable nucleus (syllabic or intensity peak); at the word level the peak is the stressed syllable. Temporally, a peak can be reached very quickly or relatively slowly; the peak can fade rapidly or very slowly. I hypothesize that the pattern which characterizes the development of the syllable peak also describes the whole word.

On the syllable level there is evidence that in Portuguese the syllabic peak or target position is reached very soon. (For an earlier version of this view see Major 1977). Consider the potential effects of the vowels on preceding consonants. If the vowel target position is reached quickly, one would expect that the vowel would affect or 'color' the preceding consonant to a greater extent than if the target position were reached relatively late in the production of the syllable. Portuguese consonants do show striking secondary articulations due to the following vowel, i.e., palatalization and labialization, e.g. /diː/ $\rightarrow$ [ˈdʒiː] diə 'day', /labio/ $\rightarrow$ [lɐ̃bʊ] lábio 'lip', /tabua/ $\rightarrow$ [ˈtɐ̃buw] tábuə 'plank'. This demonstrates that the consonants are anticipating a salient feature of the following vowel (i.e., its palatality or labiality), perhaps due to the fact that
this peak is temporally located very close to the preceding consonant.

Let us further consider aspiration, which phonetically is a delay of voice onset. This means that for a voiceless aspirated stop the period of voicelessness following the release of the stop delays the attainment of the target position of the following vowel. The observation that Portuguese has unaspirated voiceless stops (unlike English) suggests that the target position is reached quickly, or at least it is possible for a speaker to reach the target soon after the release of the consonant. Portuguese seems to contrast with English with respect to the temporal considerations of vowel target position. Consider the pronunciation of /tu/ both in English and Portuguese (to and tu 'you'). In English all speakers aspirate the /t/ and many speakers delay in reaching the target position of the vowel via diphthongation, i.e., /tu/ → [tʰu](Columbus, OH).

These speakers in a sense work into the target position. This contrasts with a Portuguese speaker who releases the /t/ without aspiration (or very little) and quickly reaches the target position, i.e., /tu/ → [tu]. Impressionistically, Portuguese is similar to the situation in music where a note is characterized by a sharp attack. In contrast, English vowel production seems to be similar to a crooner singing—he gradually works his way into the note.

I suggest that this pattern of the development of the syllable peak carries over to the whole word. Therefore, my hypothesis as to why Portuguese posttonic syllables shorten more readily than pretonic syllables is as follows: The syllable peak is reached very quickly and soon after it starts to fade. By the time the syllable is
terminated the intensity or articulatory force has become very weak.
This weakness carries over to the posttonic syllable and it is mani-
ifested as low intensity and short duration. This lack of intensity
often causes sentence final devoicing of the posttonic syllable (e.g.,
\[\text{gado} \rightarrow [\text{\text{'gado}}] \text{gado} \ 'cattle', \text{ see Chapter II}). Sentence medially
a posttonic syllable is frequently reduced to such an extent that the
vowel of the syllable deletes and in doing so transfer its informa-
tion to the preceding stressed syllable, e.g., \[\text{[\text{gatus}} \rightarrow [\text{\text{'gato}}]\text]{\text{gatos} \ 'cats' (especially in casual speech).

The underlying theme of this dissertation has been that prosody
is a unifying force of Portuguese; the specifics of the phonological
processes are not just coincidental, but rather they are the direct
consequence of the prosodic characteristics. The rhythm and timing
of the language affect stress and duration, which in turn affect
segmental processes. These interrelationships demonstrate how the
intricate details of a language are tightly woven into a larger
integrated whole.
Sentence List. Key word(s) underlined. (Note: in actual list given to speakers, key word(s) was not underlined).

1. Eu **cuido** da casa todo dia. 'I take care of the house every day'.

2. A **paisagem** que nós **filmamos** foi muito bonita. 'The scenery that we filmed was very pretty'.

3. Ser **amável** para ela é muito importante. 'Being loveable for her is very important'.

4. A **radiografia** não mostrou nada definido. 'The X-ray did not show anything definite'.

5. Essa **violeta** é importada da África. 'this violet is imported from Africa'.

6. A máquina foi **inútil** para isso. 'The machine was useless for this'.

7. Eu acho que a tia **Márcia** é **sábia** demais. 'I think that aunt Marcia is very wise'.

8. O **viaduto** é muito perigoso. 'The viaduct is very dangerous'.

9. Ele é um **hábil** padeiro. 'He is a skillful baker'.

10. Ela recebeu um **coelho** de presente. 'She received a rabbit as a present'.

11. Só tem que dar quatro **passos**. 'You only have to take four steps'.

12. É **difícil** para um gêmeo praticar um esporte sôzinho. 'It's difficult for a twin to practice a sport alone'.

13. Eu gosto da **Beatriz** da Silva. 'I like Beatriz da Silva'.

14. Ele tem um **lábio** pequeno. 'He has a little lip'.

15. Ela recebeu um **coelhinho** de presente. 'She received a little rabbit as a present'.

16. É **difícil** para uma gêmea praticar um esporte sôzinha. 'It's difficult for a twin to practice a sport alone'.

17. Eu acho que **Maurício** pratica yoga. 'I think Mauricio practices Yoga'.

18. Os **pioneiros** levam uma vida muito **difícil**. 'The pioneers led a very difficult life'.
19. O rádio pequeno é muito caro. 'The little radio is very expensive'.

20. O filme que eu mais gostei foi "Dona Flor e Seus Dois Maridos". 'The film I liked the best was "Dona Flor and Her Two Husbands"'.

21. Nós cuidamos da casa todo dia. 'We take care of the house every day'.

22. Esta escola tem um pátio pequeno. 'This school has a small patio'.

23. Água mineral é muito saudável para qualquer pessoa. 'Mineral water is very healthful for anyone'.

24. Eu acho que piedade é uma emoção normal. 'I think pity is a normal emotion'.

25. O duodeno fica no abdômen. 'The duodenum is located in the abdomen'.

26. Ele tem muitas cáries nos dentes. 'He has a lot of cavities in his teeth'.

27. Eu acho que casa de tábuas não é bonita. 'I think that a house of timber isn't pretty'.

28. O gerente me deu quatro passes. 'The manager gave me four passes'.

29. Eu acho que o leopardo da América do Sul é mais perigoso do que o leopardo da África. 'I think that the South American leopard is more dangerous than the African leopard'.

30. Ele disse que a área de serviço é muito pequena. 'He says the service area is very small'.

31. Ela é miudinha demais. 'She is very tiny'.

32. Ela é uma duetista excelente. 'She is an excellent duettist'.

33. Criança fica suadinha quando brinca. 'Children get sweaty when they play'.

34. Nós comemos coalhada todo dia. 'We eat curdled milk every day'.

35. Natal e Páscoa são feriados. 'Christmas and Easter are holidays'.

36. Ele pensa que poesia antiga é muito difícil de entender. 'He thinks old poetry is very difficult to understand'.

37. Gilberto Gil não é frágil de jeito nenhum. 'Gilberto Gil(a popular singer) isn't fragile in any way'.

38. Eu acho que fio dental é importante. 'I think dental floss is important'.

39. **Brasil p'ra frente! 'Success to Brazil!**'

40. A fazenda tem quatro **pócos**. 'The farm has four wells'.

41. Eu acho que **agora** Roberto está em São Paulo. 'I think Roberto is now in Sao Paulo'.

42. O **carro** dele é muito **prático**. 'His car is very practical'.

43. O **trem** é **rápido** e **barato**. 'The train is fast and cheap'.

44. Ele vive de acordo com suas **posses**. 'He lives within his means'.

45. O **gato** comeu o **rato**. 'The cat ate the mouse'.

46. O **capitão** não gosta de brincadeira. 'The captain doesn't like joking around'.

47. O **carro** dele é **lindo**. 'His car is beautiful'.

48. Ele é um ótimo **cirurgião**. 'He is an excellent surgeon'.
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<td>1. fio</td>
<td>'wire'</td>
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<tr>
<td>2. cuido</td>
<td>'I take care of'</td>
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<td>3. amável</td>
<td>'loveable'</td>
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<td>4. radiografia</td>
<td>'X-ray'</td>
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<td>5. violeta</td>
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<td>6. inútil</td>
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<td>7. Maria</td>
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<td>8. viaduto</td>
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<td>9. hábil</td>
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<td>10. coelho</td>
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<td>11. passos</td>
<td>'steps'</td>
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<td>13. Beatriz</td>
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<td>14. lábio</td>
<td>'lip'</td>
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<td>16. gêmeo</td>
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<td>32. miúda</td>
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<tr>
<td>53. posses</td>
<td>'possessions'</td>
</tr>
<tr>
<td>54. capitão</td>
<td>'captain'</td>
</tr>
<tr>
<td>55. cirurgião</td>
<td>'surgeon'</td>
</tr>
</tbody>
</table>
APPENDIX B

Word List from Chapter 5, Speaker FPR

1. de 'of' 18. Dudu (fem name)
2. Du (fem name) 19. siri 'crab'
3. pá 'spade' 20. Pará (a state)
4. tu 'you' 21. tutu 'money'
5. tá ''s' 22. páliado 'palid'
6. cá 'here' 23. máquina 'machine'
7. dá 'gives' 24. batata 'potato'
8. pi 'pi' 25. palavra 'word'
9. bá (interjection) 26. arara 'macaw'
10. casa 'dirt' 27. palito 'toothpick'
11. pára 'stop' 28. urubu 'vulture'
12. tudo 'all' 29. sarará (a racial type)
13. Sara 'Sara' 30. Piquiri (a river)
14. Tata (fem name) 31. Vatapá (a dish)
15. papa 'pope' 32. paletó 'coat'
16. dada 'datum' 33. Macapá (a city)
17. baba 'dribbles'
LIST OF REFERENCES


Donegan, Patricia J. 1978. On the natural phonology of vowels. The Ohio State University working papers in linguistics 23.


