Émerillon stress: a phonetic and phonological study[1]

Matthew Gordon* and Françoise Rose**
**University of California, Santa Barbara, mgordon@linguistics.ucsb.edu*
***Centre National de la Recherche Scientifique, rose@vjf.cnrs.fr*

Abstract. This paper explores phonetic and phonological features of the stress system in Émérillon, a Tupi-Guaraní language spoken by approximately 400 people in French Guiana. Stress placement in both elicited wordlist and natural discourse data is examined. Three potential acoustic correlates of stress (fundamental frequency, duration, and intensity) are examined in order to provide quantitative verification of the discovered stress patterns. Results indicate that the domain of stress is the phrase with the metrical parse involving the formation of moraic trochees counting from the right edge of the phrase. The acoustic correlates of stress differ depending on the speaker and whether the data consists of words uttered in isolation or in connected discourse. The results for Émérillon are discussed within a broader context of comparative Tupi-Guaraní stress.

1. Introduction

This paper examines the stress system of Émérillon (referred to as "Teko" by the speakers of the language), a Tupi-Guaraní language spoken by approximately 400 people in French Guiana. The Émérillon speaking population is divided between two areas in French Guiana; one situated in the eastern part of the country and the other located in the western portion. The Émérillon speaking area is depicted in the map of French Guiana in figure 1.

[1] We would like to express a deep debt of gratitude to our Émérillon speaking consultants (Ti'iwan Couchili, Colette Kelly, Eddy Monnerville, James Panapuy, Anne-Marie Petit-Pied, Auxilia Renaud, and Françoise Renaud) without whose generous participation this study would have been impossible. Thanks to two anonymous reviewers for many helpful comments on an earlier version of this paper and thanks to the numerous scholars who provided information on comparative Tupi-Guaraní stress.

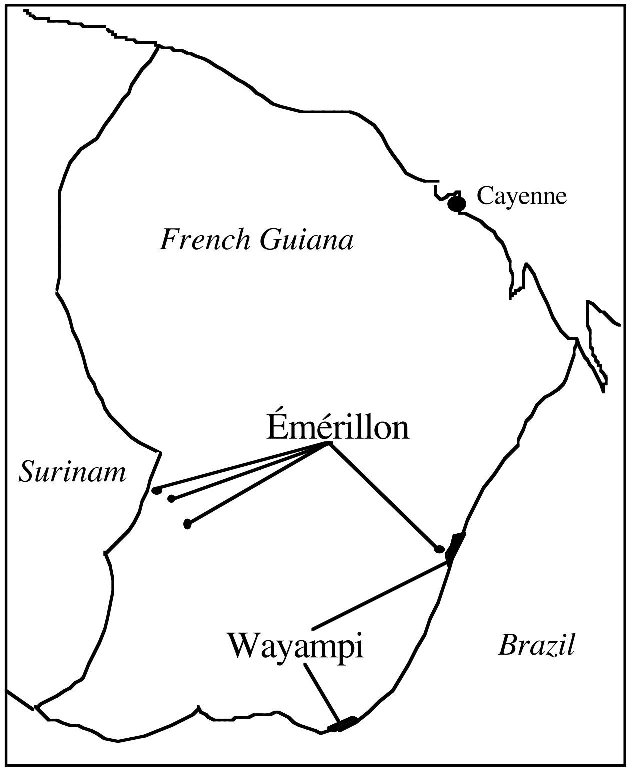

Figure 1. The Émérillon speaking areas within French Guiana (based on Goury 2002)

Émérillon belongs to the 8th branch of the Tupi-Guaraní family (Rodrigues 1984-5), which includes a number of languages spoken in Brazil as well as Wayampi, Émérillon's closest linguistic relative and geographic neighbor to the Émérillon speaking population in southeastern French Guiana (see section 7.3 for more on the Tupi-Guaraní family). Despite the small size of the Émérillon community and its close contact with several languages, including the socio-politically dominant French and French Guiana Creole, Émérillon is still actively being used and passed on to children as a native language.

There is very little published work on the phonology of Émérillon. Rose (2000) is a phonological sketch, Rose (2002) discusses the phonology of nasality in Émérillon, and Rose (2005) examines reduplication patterns in the language. None of these works explores prosodic properties such as stress. The current study thus provides the first description of stress and prominence in the language. Furthermore, this work is, to the best of our knowledge, the first acoustic analysis of stress in any Tupi-Guaraní language.

The primary goal of this paper is to expand our cross-linguistic database of stress systems, both from a phonological standpoint in terms of the principles governing the location of stress and also from a phonetic standpoint in terms of the acoustic correlates of stress. A further goal of the study is to compare stress in Émérillon with stress patterns found in other Tupi-Guaraní languages in order to hypothesize on the historical development of prominence within the language family.

2. Phonological background

2.1. Consonants

Émérillon possesses the 16 consonants in table 1.

Table 1. The consonant phonemes of Émérillon (after Rose 2000)

	Bilabial	Alveolar	Palatal	Velar	Glottal
Stops	p b	t d	tʃ dʒ	k kʷ g	ʔ
Fricatives		s z			h
Tap		ɾ			
Approximants	w		j		

Certain segments in table 1 have multiple surface realizations, which appear in some of the transcriptions used in this paper (the reader is referred to Rose 2000 for further discussion of the segmental inventory and alternations). The bilabial and alveolar voiced oral stops are often produced with prenasalization. In addition to the voiced oral stops in table 1, there are many instances of nasal stops in the language. Nasality, however, is not contrastive at the segmental level but is a feature of certain morphemes, typically roots, and rarely affixes. The strict domain of nasalization is the morpheme, although nasal harmony can propagate across the word to adjacent affixes compatible with nasalization.

2.2. Vowels

Émérillon possesses seven vowel phonemes, which are charted in table 2.

Table 2. The vowel phonemes of Émérillon (after Rose 2000)

	Front	Central	Back
High	i	ɨ	u
Mid	e	ə	o
Low		a	

Length is not contrastive, although sequences of vowels commonly arise across syllable boundaries. In addition, all vowels have nasalized variants in morphemes specified for nasality.

2.3. Syllable structure

Most syllables in Émérillon are open, although syllables closed by a single consonant (CVC) syllables are possible at the end of a word, and, in very rare instances, morpheme-finally in the middle of the word. Potential cases of word-internal clusters are typically eliminated through various lenition processes (see Rose 2000 for discussion). Many onsetless syllables occur in Émérillon, as sequences of vowels are separated by a syllable boundary. Evidence for the treatment of vowel sequences as heterosyllabic comes from native speaker intuitions and reduplication patterns. When asked to break words into syllables, speakers separate vocalic sequences but group together a coda consonant with the preceding vowel. Bisyllabic reduplication, which typically expresses event-external plurality, is discussed in Rose (2005). We summarize the relevant phonological patterns here. The final two syllables of a word minus a word-final consonant are copied and placed before the penultimate syllable. Some forms illustrating reduplication appear in (1) with the reduplicant in bold. Glosses are for the non-reduplicated forms.

(1)

o.dʒi.kaŋ	o.**dʒi.ka**.dʒi.kaŋ	'They killed (it).'
o.ka.ku.a	o.ka.**ku.a**.ku.a	'He is growing up.'
o.za.ug	o.**za.u**.za.ug	'He is bathing.'
o.bu.ʔu.a.i	o.bu.ʔu.**a.i**.a.i	'He is bothering him/her.'
o.ku.a.ku	o.ku.**a.ku**.a.ku	'He undergoes restrictions.'
o.ka.i.ɲum	o.ka.**i.ɲu**.i.ɲum	'He disappears'

As the second, third and fourth forms show, two vowels in a sequence spanning the penultimate and final syllable may be copied in keeping with their heterosyllabic status. The last three forms show that reduplication can copy one vowel to the exclusion of others in a heterosyllabic sequence. While it initially seems plausible to treat reduplication as a mora-based rather than a syllable-based process, the docking site of the reduplicant argues for a syllable-driven approach. If the reduplicant were situated before the final two moras of the word rather than the final two syllables, we would expect it to occur immediately to the left of a final closed syllable. Furthermore, if vowel sequences formed a diphthong belonging to the same syllable, we would not expect the reduplicant to intervene between the two halves of the diphthong in the final two examples.[2]

3. Methodology

The present study is based on acoustic data collected by the second author in French Guiana. Recordings were made using a high quality unidirectional tabletop Sony microphone in conjunction with a Sony minidisc recorder for the wordlist data and a DAT recorder for the text data. As a first step in the analysis, the authors transcribed stress patterns in the recordings independently of each other.[3] The recordings were then submitted to acoustic analysis using the Praat speech software (www.praat.org). Two types of data were examined. The primary phonetic and phonological analysis is based on a list of 111 words read in isolation by four speakers (two male and two female) from the Émérillon speaking area in the eastern part of French Guiana. Each word was repeated twice by each speaker. Results of this phase of the study are discussed in sections 4 and 5. Further acoustic and impressionistic analysis was performed on words occurring in natural discourse data produced by three speakers from western French Guiana and one from eastern French Guiana. The speaker from eastern French Guiana was one of the speakers from whom the wordlist was recorded. Results from the study of the discourse data are presented in section 6.

---

[2] Arguments based on the shape of the reduplicant are not as compelling since factors independent of syllabification could preclude coda consonants from being copied. For example, an independent ban on coda consonants in the language (violable in base forms) could block coda reduplication in certain cases, e.g. o.**dʒi.ka**.dʒi.kaŋ not *o.**dʒi.kaŋ**.dʒi.kaŋ, while a requirement that segments occupy the same syllable position in the base as in the reduplicant (in the sense of McCarthy and Prince's [1995] Optimality-theoretic constraints requiring base-reduplicant identity) could block reduplication in other cases, e.g. **o.ʔa**.o.ʔaɾ not ***o.ʔa.**ɾo.ʔaɾ.

[3] The first author transcribed stress for all the recordings, while the second author transcribed a subset of the data analyzed in this paper plus some additional text recordings not analyzed in this paper. Stress judgments were in agreement for the bulk of the data transcribed by both authors. In those few cases in which a consensus was not reached, the first author's transcriptions served as the basis for coding of the acoustic results.

4. Basic phonological generalizations

Both impressionistic and acoustic analysis of the elicited data indicates that words are parsed into moraic trochees from right-to-left (Hayes 1995). With few exceptions, primary stress falls on a final heavy syllable (CVC, since Émérillon lacks CVV), otherwise on the penult, and secondary stress falls on alternating syllables counting backward from the primary stress. Representative words in which the primary stress falls on the penultimate syllable appear in (2a) and words with primary stress on the final syllable are given in (2b). Metrical representations using Hayes' (1995) grid-based stress theory are given in addition to the stress transcriptions. In the representations, an 'x' grid mark indicates a stressed syllable, with each layer of grid marks corresponding to an additional level of prominence. Thus, the lower tier represents secondary stress and the upper tier corresponds to primary stress.

(2a)

```
(       x )
( x  )( x )
màna ni□to
'how'
```

```
(                 x   )
(x  )( x  )(x  )(x   )
tèpe d͡ʒàpɨ àka ȍwã
'you all must think a little'
```

```
(           x  )
(x  )( x  )( x  )
wȉɾa kàɾa kótɨ
'about God'
```

```
(       x  )
(x )( x  )
àʔɨ d͡ʒúa
'type of banana'
```

```
(        x   )
( x  )( x   )
kùd͡ʒa búɾu
'siren'
```

```
(      x  )
(x )( x   )
dàe pɨ□d͡ʒi
'it's not expensive'
```

```
(            x  )
(x  )( x  )( x  )
dèze kàsi wáha
'your tattoo'
```

(2b)

(x)
(x   )(x   )(x)
kèd͡ʒu kàsi wáɾ
'apron'

(x)
(x   )(x   )(x   )
kùɾa tàɾa pɨ□d͡ʒ
'manioc house'

(x)
(x   )(x)
èɾe zóɾ
'you come'

(x)
(x)(x)
o zàu góŋ
'they bathe'

One complication arises in words with stress on the second syllable. Such words have an optional secondary stress on the initial syllable (depending on the speaker and the particular token), even though this creates a stress clash between the first two syllables. Words demonstrating this optional stress clash word-initially appear in (3).

(3)

(x   )   ~   (x   )
(x)(x   )   ~   (x   )
tà wáto   ~   ta wáto   'eagle'

(x)   ~   (x)
(x)(x)(x)   ~   (x)(x)
zà wàpɨ táŋ   ~   za wàpɨ táŋ   'puma'

(x)   ~   (x)
(x)(x   )(x)   ~   (x   )(x)
pà kùʔa si□ɾi   ~   pa kùʔa si□ɾi   'small yellow banana'

(x)   ~   (x)
(x)(x)   ~   (x)
mò kóɲ   ~   mo kóɲ   'two'

The Émérillon stress patterns falls into the class of stress systems that Gordon (2002) terms "binary plus clash". In these systems, stress falls on alternating syllables with an additional stress fixed at the opposite edge of the word from which the alternating count originates. Gordon (2002) cites Tauya (MacDonald 1990) and Southern Paiute (Sapir 1930) as two languages with binary plus clash stress systems.[4] Hintz (to appear) presents

[4] In Tauya, primary stress falls on the final syllable and secondary stress falls on odd-numbered syllables counting from the right edge plus the initial syllable. In Southern Paiute, stress falls on even-numbered

acoustic data from another language, South Conchucos Quechua, with a binary plus clash stress pattern that, like Émérillon, stresses even numbered syllables counting from the right plus the initial syllable.[5] In South Conchucos Quechua, as in Émérillon, stress clashes found at the beginning of longer words involve two secondary stresses rather than a secondary stress followed by the primary stress. A noteworthy feature of the initial stress clashes is that they involve the construction of a degenerate, i.e. subminimal, foot over the first syllable.

4.1. Destressing and deletion of high vowels

There are some deviations from the basic binary plus clash system described above. One departure from this pattern arises in the case of the high vowels /i, u, ɨ/ in onsetless syllables. Such vowels often reject stress. This resistance to stress manifests itself in two ways. First, the extra stress on a word-initial syllable preceding a stressed second syllable consistently fails to surface on an initial onsetless syllable containing a high vowel. For example, /ibaʔeɾaɨ/ 'It's heavy' is realized as [ibàʔeɾáɨ] and /idʒaikom/ 'the herbs' surfaces as [idʒàikóm]. A second manifestation of stress avoidance on onsetless syllables containing a high vowel arises word-internally, where a high vowel that is in a metrically strong open syllable consistently passes the stress leftward to an immediately preceding lower vowel. This is illustrated in a number of forms in the database. For example, /wãĩwi/ 'woman' is realized as [wã□ĩwi] rather than *[wãĩ□wi]. Similarly, /wɨwaupokaha/ 'sugar cane press' surfaces as [wɨ̀wàupokáha] rather than *[wɨ̏waùpokáha]. Yet another example of this phenomenon is found in the form /disidʒukuʔataɾaɨdʒi/ 'We no longer want to breathe' which is pronounced as [dȉsidʒùkuʔàtaɾáɨdʒi] and not as *[dȉsȉdʒukùʔatàɾaɨ□dʒi]. This last form is of interest, since it shows that the alternating stress count recommences two syllables before the vowel preceding the onsetless high vowel. This indicates that the metrical parse to the left of the onsetless high vowel transparently follows the general rule of secondary stress on alternating syllables. It also entails that the syllable following the onsetless syllable remains unparsed since the high vowel lacking an onset consonant is the weak syllable in

moras counting from the left edge of a word plus the penultimate mora. The leftmost stress is the strongest one.

[5] In South Conchucos Quechua, however, a final heavy syllable does not attract stress, unlike in Émérillon.

its foot. The metrical analysis of leftward stress shift from high vowels in onsetless syllables is depicted in (4).

(4)

Metrical parse from R to L	**(x)** disidʒukuʔataɾa ɨ̀dʒi	**(x)(x)** wɨwa ùpo kàha
Stress shift leftward	**(x)** disidʒukuʔataɾ àɨ dʒi	**(x)** (x) wɨ wàu po kàha
Metrical parse (continued)	**(x)(x)(x)**(x) dìsi dʒùku ʔàta ɾàɨ dʒi	**(x)**(x) (x) wɨ̀ wàu po káha
Primary stress	**(x)** (x)(x)(x)(x) dìsi dʒùkuʔàta ɾáɨ dʒi	**(x)** (x)(x) (x) wɨ̀ wàu po káha

In cases where a high vowel occurs in an onsetless syllable with a coda consonant, the limited data possessing the requisite shape suggests variation in whether the high vowel attracts stress or not. Thus, the word /ipoɨdʒ/ 'It's heavy' has a variant with stress on the final syllable, [ɨ̀poɨ□dʒ], and one with stress on the penult, [ipóɨdʒ]. This indicates that the weight contributed by a coda consonant to a syllable optionally offsets the reduced weight of a high vowel lacking an onset consonant. The variant with stress on the penult is interesting since it contains an uneven trochee in which the light stressed penult is followed by a heavy unstressed ultima. Instances of light-heavy trochees are relatively rare cross-linguistically, though Hayes (1995) cites their occurrence in some languages, such as Finnish and Hungarian.

It might initially seem tempting to attribute the leftward shifting of stress off of a high vowel to fusion of the two vowels into a tautosyllabic diphthong. However, this analysis loses its appeal when one considers that vocalic clusters pattern as heterosyllabic sequences according to both native speaker intuitions and reduplication patterns (see section 2.3). Furthermore, linking stress shift to diphthongization in word-medial sequences ending in a high vowel would not account for the rejection of stress by word-initial high vowels.

In keeping with their tendency to reject stress, high vowels in onsetless open syllables are prone to lenition and deletion. For example, one of the male speakers deleted the first vowel in the forms /ipuɾuʔao/ ‘She’s pregnant’ and /ibaʔeɾaɨ/ ‘It’s heavy’, yielding the surface forms [pùɾuʔáo] and [bàʔeɾáɨ], respectively. More generally, high vowels in open unstressed syllables, even those with an onset, are prone to weakening. Thus, the forms /zawap**ɨ**taŋ/ ‘puma’ and /aʔen**u**waso/ ‘Didn’t I say so?’ can be realized as [zàwàpɨtáŋ] and [àʔènuwáso], respectively, without deletion or as [zàwàptáŋ] and [àʔènwáso] with deletion. The spectrogram in figure 2 illustrates the variant of /zawapɨtaŋ/ ‘puma’ with the high vowel being reduced to little more than a release of the preceding stop.

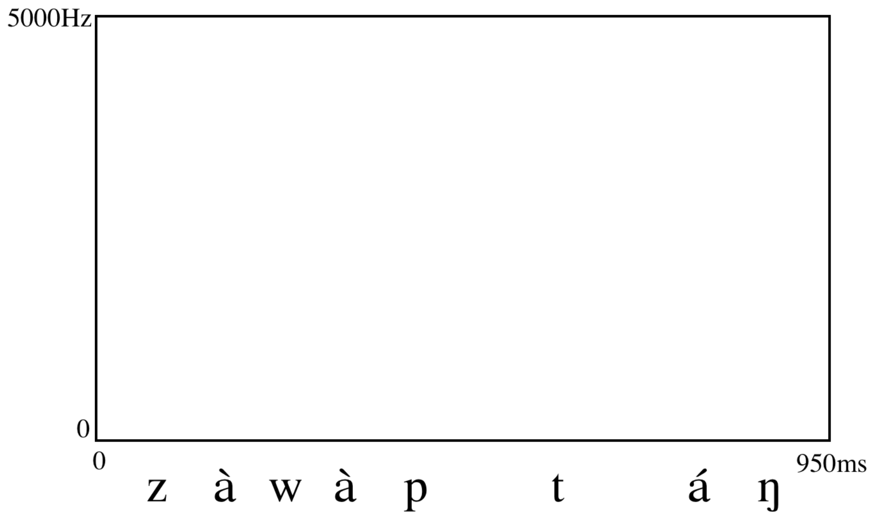

Figure 2. Deletion of an unstressed high vowel in an open syllable in the word [zàwàptáŋ] /zawapɨtaŋ/ ‘puma’ as produced by a male speaker.

We assume that the deletion of high vowels word-medially creates a closed syllable on the surface that is parsed into a bimoraic monosyllabic foot parallel to closed syllables in final position, e.g. [(zà)(wàp)(táŋ)].

The rejection of stress by high vowels in open syllables has an analog in the Pichis dialect of Asheninca, an Arawakan language of Peru. In Pichis Asheninca (Payne 1990), primary stress is sensitive to a hierarchy of weight, in which high vowels in open syllables are less likely to be stressed than non-high vowels in open syllables. Phonetically, high vowels are most likely to be dispreferred as carriers of stress, since they are shortest in duration and possess the least intensity relative to other vowels (Lehiste 1970; see also acoustic results in sections 5.1 and 5.2). Onsetless syllables also are less likely to carry stress than syllables with an onset consonant in several other languages of the world, e.g. Pirahã (Everett and Everett 1984, Everett 1988), Arrernte (Strehlow 1942), and Banawá (Buller et al. 1993, Ladefoged et al. 1997). In fact, another language related to Émérillon, Júma (Abrahamson and Abrahamson 1984), is reported to shift stress to the penultimate syllable of a word if the final syllable lacks an onset. More generally, onsetless syllables display a number of prosodically anomalous behaviors beyond the rejection of stress (Downing 1998).

4.2. Lexical stress

The generalizations about stress described thus far account for the majority of the examined data. There are, however, some stress patterns that are not predicted by the analysis provided thus far. One source of exceptions are morphemes that are inherently stressed. For example, the completive suffix –pa carries stress in final position, e.g. obòapá 'She finished sifting it', sɨ̀tuàmipá 'We finished wringing it'. Similarly, the future suffix –taɾ is also lexically stressed, as in the words dòzàu(k)patáɾiŋ 'They aren't going to finish bathing' and daòɾɨtáɾiŋ 'They won't be pleased'. The stress associated with –pa and –taɾ is plausibly attributed to their historical origin as lexical verbs, -pa from the verb pa 'to finish' and –taɾ from the verb potaɾ 'to want'. There are also certain monomorphemic words with irregular stress patterns; for example, ã̀tɨ□ 'here' (originally bimorphemic), kɨ̀tó 'frog' (a loan word from a Cariban language), dɨ́ɾɨg, an ideophone for the action of watching or looking, and sinã□, a discourse particle.

5. Acoustic realization of stress

In order to investigate the phonetic manifestation of stress, potential acoustic correlates of stress were measured for the wordlist data using Praat. Three properties commonly used to differentiate stress cross-linguistically (see for, example, Fry 1955, 1958, Beckman 1986 on English, Jassem et al. 1968 on Polish, Baitschura 1976 on Mari, Gonzalez 1970 on Tagalog, Gordon 2004 on Chickasaw) were targeted for measurement: duration, fundamental frequency, and intensity. Duration measurements were taken for vowels using the onset of the second formant as the beginning point and the offset of the second formant as the end point of the vowel. Fundamental frequency and intensity values were computed as averages over the duration of each vowel. Vowels in absolute final position were excluded from the analysis, as they were often characterized by a gradual shift into non-modal phonation (breathiness or creakiness) that made it difficult to determine their endpoints. In addition, vowels in hiatus contexts, i.e. vowels immediately adjacent to another vowel, were not included in the analysis, since the determination of segmental boundaries in such cases was deemed too arbitrary.

5.1. Duration

Overall averages for the four speakers indicated a tendency to differentiate multiple levels of stress durationally, although speakers varied in the levels they distinguished. Results for all of the data for individual speakers are shown graphically in figure 3. Primary stressed vowels are represented by darkly shaded bars, secondary stressed vowels by lightly shaded bars, and unstressed vowels by unshaded bars. Statistical results calculated over controlled subsets of the data are discussed below.

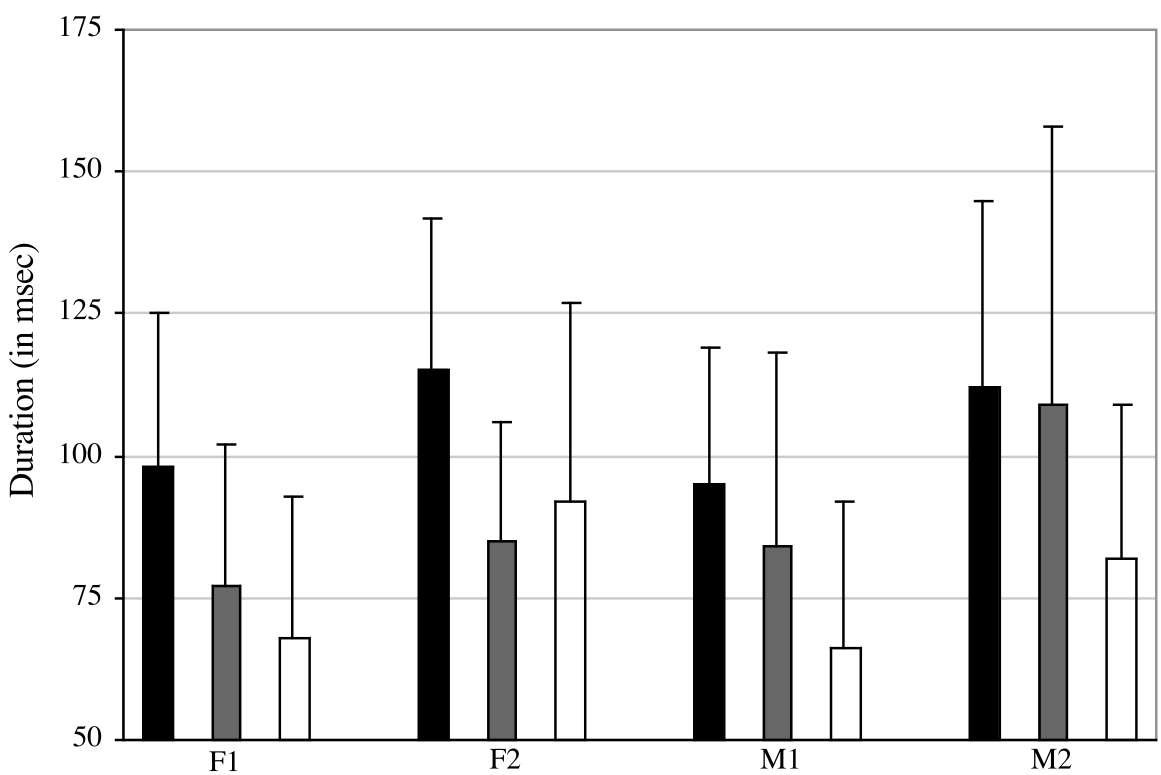

Figure 3. Average duration values (in milliseconds) for two female speakers (F1 and F2) and two male speakers (M1 and M2) of Émérillon (wordlist data). Primary stressed vowels are represented by darkly shaded bars, secondary stressed vowels by lightly shaded bars, and unstressed vowels by unshaded bars. Whiskers represent one standard deviation from the mean.

Analyses of variance (ANOVAs) using SPSS (www.spss.com) were conducted for individual speakers in order to determine the robustness of the duration differences between stress levels for each speaker. As a first step, the data were checked speaker by speaker using separate ANOVAs for possible effects of confounding factors such as vowel quality, the voicing of the following consonant, and whether the syllable containing the target vowel was open or closed.

For speaker F1, an ANOVA did not indicate any effect of syllable type (open vs. closed) on vowel duration. A separate ANOVA did indicate, however, a significant effect of vowel quality on duration: $F(5, 180) = 5.270$, $p=.000$, $\eta^2=.128$. Pairwise posthoc tests showed that the only robust difference was between /a/ and /i/, with /a/ being substantially longer than /i/: 89 vs. 69 milliseconds on average. Because the number of tokens of /i/ was much smaller than the number of tokens of /a/ (61 vs. 16), /i/ was excluded from the analysis of the effect of stress on duration. Furthermore, the following consonant also affected vowel duration ($F(1,181)=14.837$, $p=.000$, $\eta^2=.076$) with vowels being longer before voiced than before voiceless consonants: 84 vs. 69 milliseconds on average. Because there were many more tokens before voiced than before voiceless consonants (116 vs. 67 tokens), vowels before voiceless consonants were excluded from the analysis. The analysis of vowels (other than /i/) before voiced consonants showed a significant effect of stress on duration with a relatively large effect size: $F(2,103)=8.671$, $p=.000$, $\eta^2=.144$. Primary stressed vowels were longer (N=42, average duration =97milliseconds) than both secondary stressed (N=45, duration =76 milliseconds) and unstressed (N=19, duration = 81 milliseconds) vowels. Scheffe's posthoc tests showed, however, that only the difference between primary and secondary stressed vowels was significant ($p=.000$), although there was a trend toward significance for the difference between primary stressed and unstressed vowels ($p=.059$).

For speaker F2, vowel quality did not affect duration values. However, vowels differed significantly according to whether they occurred in open or closed syllables:

$F(1,165)=22.091$, $p=.000$, $\eta^2=.118$. Furthermore, vowel duration was also affected by the voicing of the following consonant: $F(1,160)=21.595$, $p=.000$, $\eta^2=.119$. Because open syllables outnumbered closed syllables (131 vs. 36 tokens) and vowels before voiced consonants were more numerous than those before voiceless consonants (100 vs. 62 tokens), vowels in open syllables followed by voiced consonants were included in the ANOVA looking at the effect of stress. In this analysis, stress level did not affect duration.

Turning to speaker M1, vowel quality had a significant effect on duration values: $F(5,114)=3.496$, $p=.006$, $\eta^2=.133$. None of the pairwise comparisons reached significance in posthoc tests, however. Furthermore, neither syllable type (open vs. closed) nor following consonant (voiced vs. voiceless) had a significant effect on vowel duration. An ANOVA revealed an effect of stress on duration of moderate size: $F(2,105)=5.365$, $p=.006$, $\eta^2=.093$. Vowels were longest in primary stressed syllables (N=33, average duration = 89 milliseconds), slightly shorter in secondary stressed syllable (N=37, duration = 83 milliseconds), and shortest in unstressed syllables (N=38, duration = 67 milliseconds). Posthoc tests indicated that the difference between primary stressed vowels and unstressed vowels was significant (p=.009), but neither of the other pairwise comparisons (secondary stressed vs. unstressed, primary stressed vs. secondary stressed) was statistically robust.

Speaker M2 did not show significant effects of vowel quality, syllable type, or voicing of the following consonant on duration values. There was a moderate effect of stress level on duration values, however: $F(2,165)=8.886$, $p=.000$, $\eta^2=.097$. Vowels were shorter in unstressed syllables (N=65, average duration = 81 milliseconds) than in either secondary stressed (N=62, duration = 108 milliseconds) or primary stressed syllables (N=51, duration = 105 milliseconds). Scheffe's pairwise posthocs indicated that primary stressed vowels and secondary stressed vowels were reliably longer than unstressed vowels: primary stressed vs. unstressed vowels, p=.005; secondary stressed vs. unstressed vowels, p=.001.

This speaker also displayed another interesting pattern. His initial secondary stresses in clash (N=25, duration = 147 milliseconds) were significantly longer than other secondary stresses according to a t-test (N=39, duration = 88 milliseconds): t(1, 62)=5.480, p=.000. These results do not argue against the status of secondary stresses in clash environments. However, the lengthening of vowels involved in a stress clash by speaker M2 may be viewed as a strategy for eliminating degenerate feet. By increasing the length of the vowel before another stress, the vowel becomes heavier, potentially on par with closed syllables, which are heavy due to their final consonant. Vowel lengthening is a common strategy for increasing the weight of stressed open syllables cross-linguistically (see Hayes 1995). In fact, Hayes (1995) cites languages, e.g. Bani-Hassan Arabic (Kenstowicz 1983, Irshied and Kenstowicz 1984) and Modern Greek (Malikouti-Drachmann and Drachmann 1981), that parallel speaker M2 in the present experiment in lengthening stressed short vowels before another stressed syllable as a strategy for eliminating degenerate feet.

A separate analysis of variance for speaker M2 excluding clashing initial stresses produced a significant durational difference between secondary stressed vowels and primary stressed vowels (p=.03) with the significant main effect still persisting: F(2,140)=9.19, p=.005, η^2=.124. However, the difference between secondary stressed vowels and unstressed vowels no longer reached significance.

In summary, for three of the four speakers (all except F2), duration was affected by stress level. Speaker F1 had significantly longer vowels in primary stressed than in secondary stressed syllables, while speakers M1 and M2 had significantly longer vowels in primary stressed than in unstressed syllables. Speaker M2 also had longer primary stressed vowels than secondary stressed vowels not clashing with another stress.

5.2. Intensity

Intensity levels also differed as a function of stress level, though these differences tended to be rather small. Results for all of the data for individual speakers are shown graphically in figure 4. Statistical results calculated over controlled subsets of the data are discussed below.

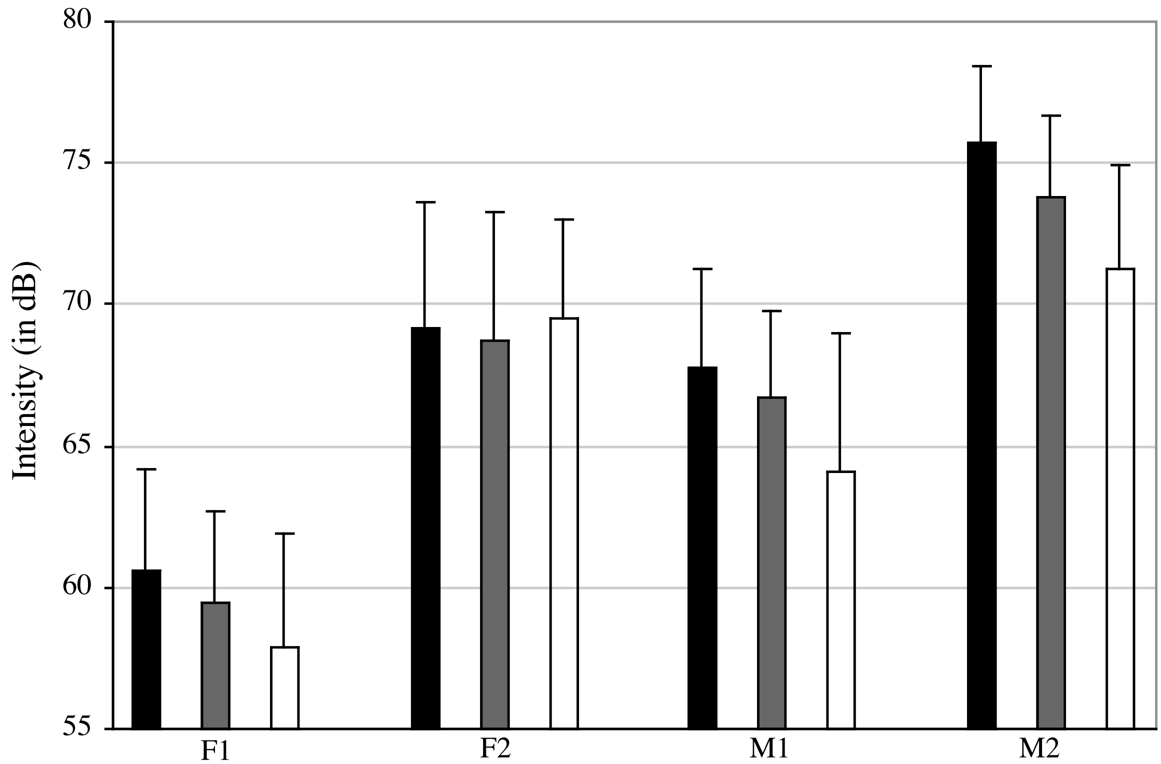

Figure 4. Average intensity values (in decibels) for two female speakers (F1 and F2) and two male speakers (M1 and M2) of Émerillon (wordlist data). Primary stressed vowels are represented by darkly shaded bars, secondary stressed vowels by lightly shaded bars, and unstressed vowels by unshaded bars. Whiskers represent one standard deviation from the mean.

Following the procedure for the duration statistics, separate analyses of variance were conducted for individual speakers. As a preliminary step to these analyses, the potential confounding factor of vowel quality was examined for its effect on intensity, since higher vowels cross-linguistically tend to have less intensity than lower vowels (Lehiste 1970). In fact, vowel quality did have a significant effect on intensity values for three of the four speakers (all expect M1): for speaker F1, $F(5,180)=6.270$, $p=.000$, $\eta^2=.113$; for speaker F2, $F(5,161)=4.334$, $p=.001$, $\eta^2=.119$; for speaker M2, $F(5,162)=7.97$, $p=.000$, $\eta^2=.197$. In all cases, the vowel /i/ had less intensity than at least one of the other vowel qualities. Consequently, /i/ was excluded from the ANOVAs looking at the effect of stress on intensity for speakers F1, F2, and M2.

Speaker F1 had a significant effect of stress on intensity though the size of the effect was relatively small: $F(2,167)=4.018$, $p=.020$, $\eta^2=.046$. Primary stressed vowels (N=47, average intensity = 61dB) had slightly greater intensity than secondary stressed vowels (N=77, 59dB) and unstressed vowels (N=46, 58dB). Posthoc tests showed that the difference between primary stressed and unstressed vowels was significant (p=.02). For speaker M1, there was a significant effect of stress level on intensity: $F(2,104)=6.381$, $p=.002$, $\eta^2=.109$. Scheffe's posthoc tests indicated that unstressed vowels (N=37, intensity = 64dB) had less intensity than both primary stressed vowels (N=33, intensity = 66dB; p=.005) and secondary stressed vowels (N=37, intensity = 66dB; p=.03). Speaker M2 also showed a significant effect of stress on intensity: $F(2,147)=13.7$, $p=.000$, $\eta^2=.157$. Posthoc tests indicated that unstressed vowels (N=39, intensity = 72dB) had less intensity than both primary stressed (N=51, intensity = 75dB; p=.000) and secondary stressed vowels (N=60, intensity = 74dB; p=.009). For speaker F2, there was not a reliable effect of stress on intensity.

In summary, three of the four speakers (F1, M1, M2) had greater intensity in primary stressed vowels than unstressed vowels. For two speakers (M1, M2), intensity was also greater for secondary stressed than for unstressed vowels.

5.3. Fundamental frequency

Fundamental frequency for individual speakers is shown graphically in figure 5. Statistical results calculated over controlled subsets of the data are discussed below.

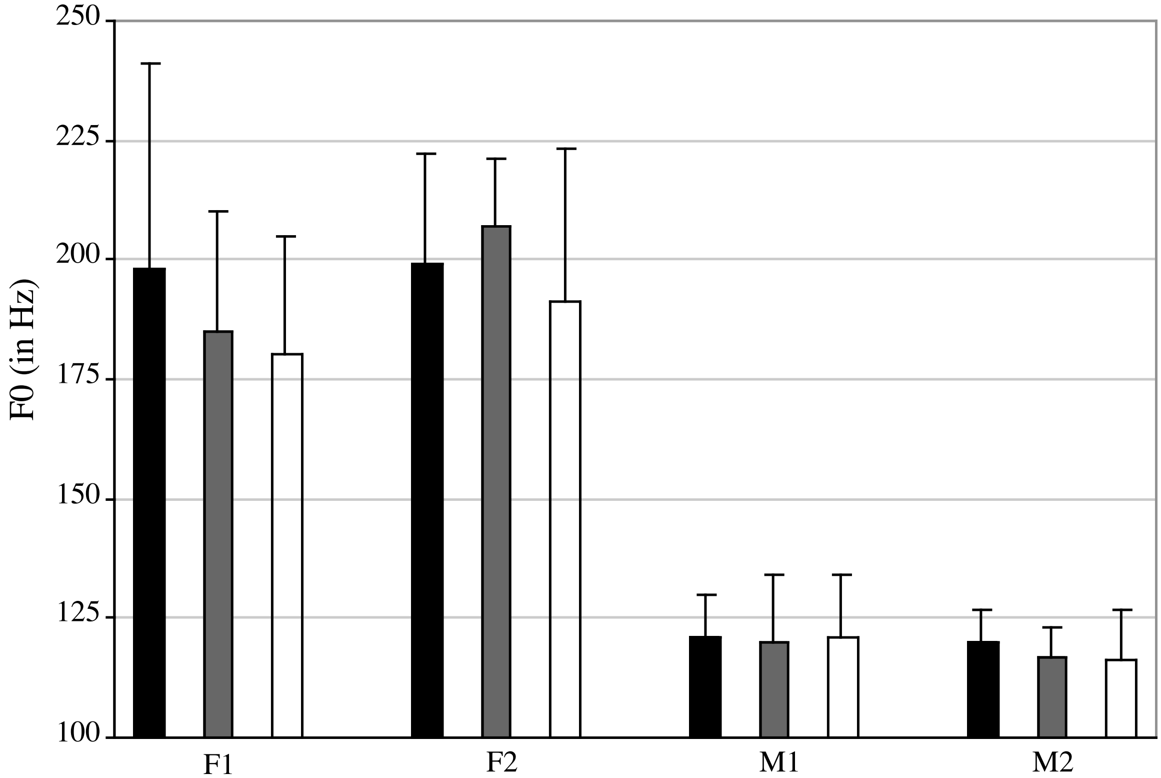

Figure 5. Average fundamental frequency values (in Hertz) for two female speakers (F1 and F2) and two male speakers (M1 and M2) of Émérillon (wordlist data). Primary stressed vowels are represented by darkly shaded bars, secondary stressed vowels by lightly shaded bars, and unstressed vowels by unshaded bars. Whiskers represent one standard deviation from the mean.

Before running analyses of variance looking at the effect of stress level on f0, an analysis of variance was conducted looking at vowel quality, which has been shown to influence f0 in many languages (Lehiste 1970). In the current study, none of the speakers showed a significant effect of vowel quality on f0 values. Values for all vowels were thus included in the ANOVAs examining the effect of stress on f0. For only two of the four speakers (the two female speakers) was there a significant effect of stress on f0. For speaker F1, there was a relatively minor effect: $F(2,181)=4.744$, $p=.01$, $\eta^2=.05$. Scheffe's posthoc tests showed that primary stressed vowels (N=48, average f0 = 198Hz) had higher f0 than secondary stressed vowels (N=80, f0 = 185Hz; p=.013), but comparisons of both primary and secondary stressed vowels with unstressed vowels (N=56, f0=180Hz) were insignificant. For speaker F2, the overall effect was slightly stronger: $F(2, 164) =6.295$, $p=.002$, $\eta^2=.071$. The only significant posthoc result, however, was that f0 was higher for secondary stressed vowels (N=67, f0 = 207Hz) than unstressed vowels (N=52, f0=191Hz; p=.002). Primary stressed vowels (N=48, f0=199Hz) had slightly lower (statistically insignificant) f0 than secondary stressed vowels.

In summary, one speaker (F1) had higher f0 in primary stressed vowels than in secondary stressed vowels, while another speaker (F2) had higher f0 in secondary stressed vowels than in unstressed vowels.

5.4. Summary of the acoustic results

The properties used by individual speakers to cue stress are summarized in table 3.

Table 3. Individual speaker use of phonetic properties to differentiate levels of stress

	Duration	Intensity	F0
Primary vs. Secondary	F1, (M2)		F1
Primary vs. Unstressed	M1, M2	F1, M1, M2	
Secondary vs. Unstressed	M2	M1, M2	F2

As the table shows, the most robust acoustic distinction was between primary stressed and unstressed vowels. For three speakers (F1, M1, M2), this distinction was conveyed through intensity, while two speakers relied on duration to signal the difference. Only speaker F2 did not distinguish primary stressed and unstressed vowels acoustically. Secondary stress and lack of stress were also distinguished for two speakers (M1, M2) using intensity, one speaker (M2) using duration, and a third speaker (F2) using f0. Interestingly, only one speaker (F1) made a clear distinction between primary and secondary stress in the wordlist data, but this distinction was made using both duration and f0 for this speaker. An additional speaker (M2) durationally distinguished primary stressed vowels from secondary stressed vowels, with the direction of this duration distinction depending on whether the secondary stress was in clash with another stress or not. Clashing secondary stressed syllables in initial position had longer vowels than primary stressed syllables, but non-clashing secondary stressed syllables had shorter vowels than primary stressed syllables. Two speakers (F1, M1) made at least two of the three possible pairwise distinctions in stress and one speaker (M2) distinguished all levels using duration. Of the different correlates of stress, intensity and duration were used most frequently to signal stress, while f0 was used least to cue stress.

6. Discourse data

Stress patterns were also examined for words in five unrehearsed monologues. Four of the monologues were recorded from three female speakers from western French Guiana, while the fifth one was recorded in eastern French Guiana by one of the male speakers (M2) providing wordlist data. The monologues varied in their content. One was a personal narrative, a second one was a traditional story, a third one was a sermon, a fourth one was a procedural description, and the fifth one was a description of the state of the local Émérillon community. The examined monologues contained 140, 189, 56, 294, and 196 words, respectively.

After stress was transcribed impressionistically following the same procedure used for the wordlist data, three of the five texts (the ones with 140, 189, and 196 words) were submitted to acoustic analysis. Two of these texts were produced by female speakers, while the third one was recorded from one of the male speakers (M2) providing wordlist data. Duration, average intensity, and average fundamental frequency were measured in the three texts following the procedures adopted for the wordlist data. Measurements were taken of all words, both affixed and unaffixed, as both types of words behaved similarly with respect to stress.

6.1. Stress patterns

The most salient pattern emerging in the discourse data was that stress in Émérillon has a prosodic domain larger than an individual word. In the examined data, the domain of stress often corresponds to the Intonation Unit (DuBois et al. 1992) or Intonational Phrase (Pierrehumbert 1980). An Intonation Unit (or Intonational Phrase) can be operationally defined as a string of words uttered under a coherent intonation contour and ending in a terminal pitch contour (often a rise but somtimes a fall in Émérillon). Note, however, that all of these properties are not always associated with the right edge of each stress domain, suggesting that the prosodic constituent defining stress in Émérillon may ultimately turn out to be smaller than the Intonation Unit or Phrase.

Within the phrase, stress patterns in the discourse data corresponded closely to those found in the elicited word data. Stress followed an alternating pattern starting at the right edge of the phrase with an additional stress on the initial syllable optionally present. Closed syllables attracted stress, thereby interrupting the alternating stress count. In addition, high vowels in open syllables repelled stress and were prone to deletion, just as in the wordlist data.

As a result of stress being phrasal, stress patterns of individual words fluctuate depending on their phrasal context. For example, a word followed by another word within the same prosodic phrase with stress on the second syllable carries stress on its final syllable, whereas the same word occurring phrase-finally or before a word with stress on the initial syllable has penultimate stress. Several instances of stress on a word-final light syllable were recorded in the discourse data preceding a word with peninitial stress. The penultimate stress pattern characteristic of isolation words reflects the fact that each word in isolation constitutes an entire prosodic phrase. Only when words are combined to form prosodic phrases does a clear picture of the phrasal nature of the stress domain emerge. Some examples of words with final stress and the phrasal context in which each word appears are given in (5). Word-final stressed vowels appear in bold.

(5) Words with final stress in the discourse data

wànèga**tù** nõdèɾe**kò** towáta ‘so that our life goes well’
pɨ**à** omàʔẽ**nè** nõdèɾehéo ‘in the night, he still sees us’
pànanàɾu**pɨ̀** omàʔẽ**nè** nõdèɾehéo ‘on the sea, he still sees us’
epèwaɾàm**té** idʒe ‘as far as I am concerned’

The last example epèwaɾàm**té** idʒe is of particular interest since it shows that stress can be passed leftward from an onsetless syllable containing a high vowel across a word boundary. The result of this stress shift is that the final word of the prosodic phrase lacks a stress. Another condition in which a lexical word may lack stress arises when a monosyllabic word appears in final position of a prosodic phrase, as in the noun phrase sikã□ɨ̀ ta ‘small village’.

6.1.1. Primary stress

Typically the final stress in the prosodic phrase is the primary stress unless there are semantic conditions placing focus on a stress to the left of the final stress. While the determination of the precise semantic and pragmatic conditions governing the leftward shift of the primary stress goes beyond the scope of this paper, we have identified examples in which focus on a non-final word attracts primary stress to the left of its canonical position. Some examples illustrating the more prototypical case in which the rightmost stress is promoted to primary stress appear in (6). A passage containing three intonational units in which primary stress falls on a syllable to the left of the final stress due to special focus circumstances is in (7).

(6) Prosodic phrases in which the rightmost stress is primary
nõdèɾaɾàdʒekódʒ ‘we have forgotten more’
□w□̀ɾupɨ̀ omàʔẽnè nõdèɾehéo ‘on earth, he sees us’
pòɾomɔ̃̀maʔám ‘to raise people’

(7) Passage in which the primary stresses are not the final stress in the prosodic phrase
kòb nẽ□ nõdèkuɾùo ‘There is still our manioc beer’
kòb nẽ□ tepɨ̀si ‘There is still our manioc press’
kòb nẽ□ uɾupẽ̀hem ‘There is still our sieve’

In the examples in (7), primary stress of each prosodic phrase falls on the discourse particle nẽ, which is used to signal contrast, in this case, contrast with items previously mentioned that were borrowed from foreigners.

The “default” positioning of primary stress within the rightmost word in an intonation unit corresponds to a pattern seen in most languages for which relevant data exists (mostly Indo-European languages). For example, in English, the most prominent syllable of an Intonation Unit coincides with the primary stress of the rightmost content word in the unmarked case (Pierrehumbert 1980). Thus, in the phrase *The woman saw an elephant*, the primary stressed syllable in *elephant* , the initial syllable, receives the greatest prominence in the entire phrase. As in Émérillon, however, the primary stress of a phrase can be moved leftward under certain focus conditions in English. Thus, if *the woman* is contrastively focused in *The woman saw an elephant* , the primary phrasal stress shifts to the first syllable in *woman*.

6.1.2. Lexical stress in the discourse data

Words and morphemes that behaved exceptionally with respect to stress assignment in the list data (see section 4.2) displayed the same exceptional patterns in the discourse data (8).

(8)
àho**táɾ**aɾa èʔi ‘I am leaving, he says’
sinã sɨ̃dʒàpɨàkà àipo wɨ̃ɾakàɾakótɨ ‘let us think to God (positively and a little bit)’
wanèahà **sinã́□** ‘just good’

In the first example, the future suffix –taɾ, which regularly receives stress in the list data, attracts stress away from the following syllable even though this creates a stress lapse. In the last two examples, the discourse particle sinã has stress on its final syllable as is characteristic for this word. In the first case, this creates a stress clash with the following syllable. In the second example, the stress falls on the final syllable of the phrase even though it is light.

6.1.3. Syllable weight and the discourse data

Heavy syllables attract stress in the discourse data even if the stress clashes with a stress on an immediately following syllable, as the examples in (9) show.

(9)
owúɾa**nàm** wòo éʔi ‘When he (moon) goes up, he makes some light’
bàʔè i**ʔàɾ** zàmumùɲamáʔẽ ‘the stove [literally: the one people cook things on]’
bàʔesɨ̃po nào**nàn** òʔuɾ éʔi ‘Who does always come?, she asks’
òmu**mùɲ** báʔezaʔùwa ‘She cooks the food to eat’
kòɾ nàn dɨ̃sidʒudʒinàm nõdèɾaʔɨɾakòm ‘If we do like this, our children…’

In the first four examples, a word ends in a CVC syllable that attracts stress immediately preceding another stress. In these cases, stress does not retract leftward even though this would alleviate the stress clash. In the final example, the first two words are both CVC monosyllables that are stressed even though this creates a string of three consecutive stressed syllables.

We have, however, noted instances of heavy final syllables in the discourse texts that do not attract stress, instead passing stress to the penult. Examples of final syllables lacking stress appear in (10).

(10) Retraction of stress leftward from a phrase-final heavy syllable
okúaɾ zàdupà ok**ɨ̃ɾig** ‘She found genipa and grated it’
kòb nẽ□ uɾupẽ**hem** ‘There is still our sieve’
zà□ aʔè baʔè**kʷəɾ** ‘the story of the moon’

One possible interpretation of the rejection of stress by some heavy final syllables is related to intonational factors. Most instances in which a final CVC syllable rejects stress in the discourse data lack the final rise in fundamental frequency that predominates in Émérillon phrases. Although an understanding of the semantic and pragmatic conditions governing the choice of terminal intonational contours goes beyond the scope of this paper, it is not surprising that lowered fundamental frequency would be less compatible with stress even on heavy syllables. Sensitivity of stress to intonation would not be unique to Émérillon. Hixkaryana (Derbyshire 1985) positions primary stress on either the penultimate or the final syllable depending on the fundamental frequency pattern associated with the end of the phrase. The relevant generalization is that syllables associated with either raised fundamental frequency or a fall from high to low have primary stress. In Chickasaw (Gordon 2003), phrasal stress is also governed by intonational factors. Although the Chickasaw facts are more complicated than those in Émérillon, the relevant feature of Chickasaw for present purposes is that final CV and CVC syllables reject phrasal stress in questions, where there is a final low boundary tone, even though the same syllables attract phrasal stress in statements, where there is no low boundary tone.

6.1.4. Clash avoidance

A point of divergence between the word list data and the discourse data concerns the relative paucity of stress clashes between the first and second syllables in the discourse data. Recall from section 4 that such clashes arise when the alternating stress count places stress on the second syllable. The discourse data contained fewer instances of stress clash between the first and second syllables than the wordlist data. Typically, in the discourse data, potential stress clashes were avoided by not stressing the initial syllable of phrases in which stress also fell on the second syllable. This resolution strategy is also the one most commonly adopted in the wordlist data in cases where stress clashes are eliminated. The dispreference for stress clashes in the discourse data can be seen in table 4, which compares for speaker M2 the number of prosodic phrases containing stress clashes involving the initial and second syllable with the number of prosodic phrases that merely have the potential for a stress clash. The number of tokens in which clash is resolved in favor of the initial syllable and the number of instances in which the stress on the second syllable is preserved are also presented in the table. For purposes of comparison, the same figures are given for the elicited wordlist. Both the discourse data and the wordlist data are from the same speaker (M2).

Table 4. Comparison of potential stress clashes in the wordlist and discourse data for speaker M2

	Potential stress clash (total)	Stress clash	Only stressed initial	Only stressed peninitial
Word list	42	14 (33.3%)	3 (7.1%)	25 (59.5%)
Discourse	35	1 (2.9%)	6 (17.1%)	28 (80%)

In the discourse text, there was a single example of a stress clash between the first two syllables, whereas a third of the potential cases of clash actually displayed a clash in the list data. There was a slightly stronger tendency to resolve stress clash in favor of the initial syllable in the discourse data than in the list data, although both data sets showed a strong preference for adhering to the alternating stress count by preserving the stress on the second syllable rather than the first one. We speculate that the slightly greater likelihood of preserving the stress on the first syllable in the discourse data relative to the list data may be related to the demarcative use of stress as a signal for the initiation of a prosodic domain in connected speech. On the other hand, the greater tendency for stress clashes between the first and the second syllable in the list data could be a characteristic of the slower and more careful speech characteristic of words uttered in isolation.

6.2. Acoustic manifestations of stress in the discourse data

6.2.1. Duration

Figure 6 shows duration values averaged across all data within the three discourse texts submitted to acoustic analysis. Statistical results calculated over controlled subsets of the data are discussed below.

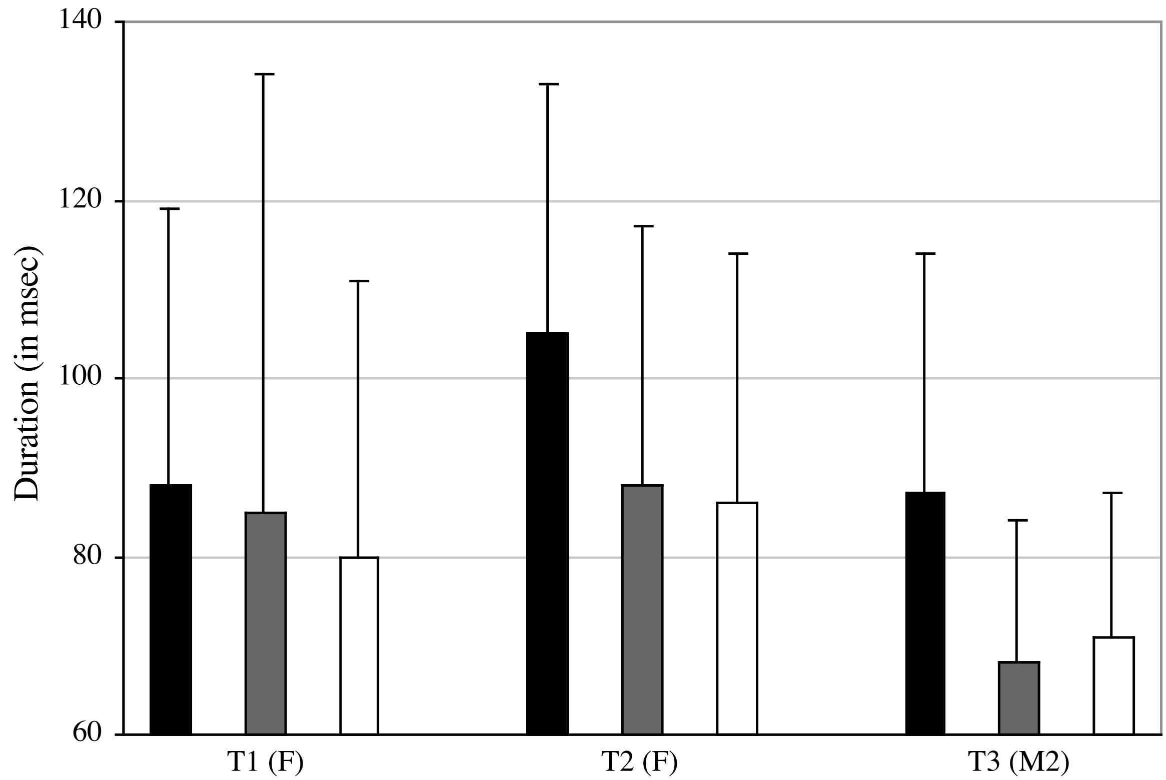

Figure 6. Average duration values (in milliseconds) for two discourse texts recorded from female speakers and one from a male speaker (M2 from the wordlist data). Primary stressed vowels are represented by darkly shaded bars, secondary stressed vowels by lightly shaded bars, and unstressed vowels by unshaded bars. Whiskers represent one standard deviation from the mean.

A procedure identical to the one followed for the measurements of duration in the list data was followed. Factors other than stress potentially influencing duration (i.e. vowel quality, syllable type, and following consonant) were examined for their effect on duration using analyses of variance. Those factors found to affect duration were then controlled for in the statistical examination of stress.

Looking at the first text, neither syllable type (open vs. closed) nor voicing of the following consonant affected duration values. However, vowel quality turned out to be a significant predictor of duration values: $F(5, 189) = 4.166$, $p<.001$, $\eta^2=.099$. Scheffe's posthoc tests showed that the main contributor to this overall effect was the shorter duration of /i/ relative to other vowels. Consequently, the analysis of variance for stress excluded this vowel. Stress was nevertheless not found to be a reliable predictor of duration values in this text.

In the second text, the voicing of the following consonant affected vowel duration values, though the size of this effect was rather small: $F(1, 470) = 17.805$, $\eta^2=.037$. Voicing triggered lengthening of the preceding vowel: 94 milliseconds on average for vowels before voiced consonants vs. 83 milliseconds for vowels before voiceless consonants. Thus, only vowels before voiced consonants, the statistically more common environment (306 vs. 166 tokens), were included in the stress analysis. Although syllable type did not affect duration, vowel quality did: $F(5,508)=11.833$, $p=.000$, $\eta^2=.104$. Scheffe's posthoc tests showed that there were many pairwise comparisons of vowel quality that yielded significant results. Consequently, only the vowel /a/, the statistically most common vowel quality in the text (188 tokens of 514 total) was included in the analysis of stress. In an analysis of variance looking at /a/ before voiced consonants, stress was found to have a large effect on duration: $F(2, 98) = 8.606$, $p=.000$, $\eta^2=.149$. The only significant pairwise difference, however, was between primary (N=29, average duration = 117 milliseconds) and secondary (N=36, 91 milliseconds) stressed vowels ($p=.000$).

Neither syllable type nor following consonant exerted an effect on duration in the third text, but vowel quality did: $F(5,123)=6.177$, $p=.000$, $\eta^2=.201$. Several pairs of vowels differed from each other in posthoc tests. Consequently, only the statistically most prevalent vowel /a/ (48 of 129 total cases) was included in the analysis of variance for stress. In this analysis, stress was shown to affect duration: $F(2,45)=7.933$, $p=.001$, $\eta^2=.261$. Primary stressed (N=12, duration = 100 milliseconds) vowels were much longer than both secondary stressed (N=15, duration = 77 milliseconds) and unstressed vowels (N=21, duration = 78 milliseconds): primary vs. secondary stressed, $p=.004$; primary vs. unstressed, $p=.003$.

In summary, primary stressed vowels were durationally distinguished from secondary stressed vowels in texts two and three, while primary stressed vowels were reliably longer than unstressed vowels in text three. Secondary stressed vowels were not distinguished from unstressed vowels durationally in any of the texts.

6.2.2. Intensity

Intensity differentiated stress levels in the discourse data, with the difference between secondary stressed and unstressed vowels tending to be relatively small compared to other differences, as is evident in figure 7, which contains results averaged across all data within each text. Statistical results calculated over controlled subsets of the data are discussed below.

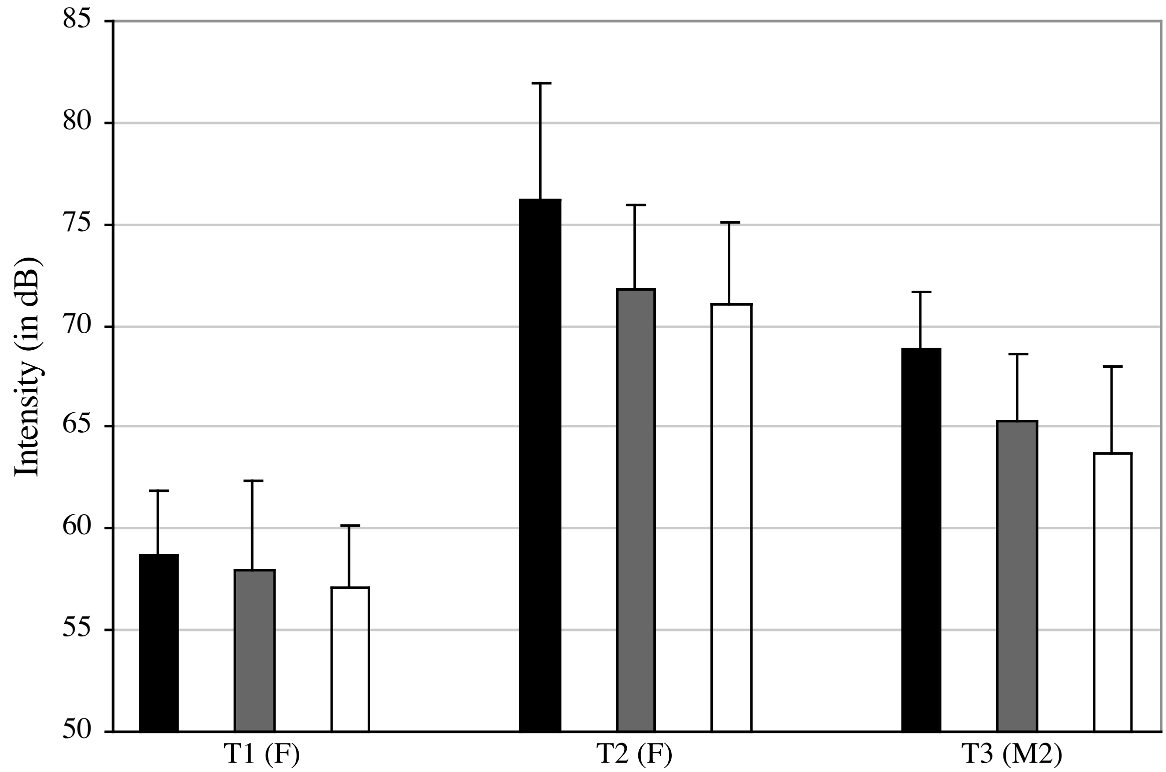

Figure 7. Average intensity values (in decibels) for two discourse texts recorded from female speakers and one from a male speaker (M2 from the wordlist data). Primary stressed vowels are represented by darkly shaded bars, secondary stressed vowels by lightly shaded bars, and unstressed vowels by unshaded bars. Whiskers represent one standard deviation from the mean.

Before analyzing the effect of stress on intensity, a separate analysis of variance was conducted to determine whether vowel quality affected stress. This test indicated that vowel quality affected intensity in only one of the texts, text one: $F(5,188)=3.334$, $p=.007$, $\eta^2=.081$. The only pairwise comparisons yielding differences in this text involved /i/, which was thus excluded from the analysis of stress. An analysis of variance looking at stress showed that stress level was a predictor of intensity values in the first text, though this effect was rather small: $F(2,165)=3.539$, $p=.031$, $\eta^2=.041$. None of the pairwise Scheffe's posthoc tests yielded significant results.

In the second text, stress exerted a stronger effect on intensity results: $F(2,514)=52.141$, $p=.000$, $\eta^2=.169$. Intensity was greater for primary stressed vowels (N=81, intensity = 76dB on average), smallest for unstressed vowels (N=280, intensity = 70dB) and intermediate for secondary stressed vowels (N=156, intensity = 72dB). All of the pairwise comparisons were statistically robust: primary vs. secondary stressed, p=.000; primary stressed vs. unstressed, p=.000; secondary stressed vs. unstressed, p=.001.

In the third text, stress also had a sizable effect on intensity values: $F(2,126)=15.442$, $p=.000$, $\eta^2=.197$. Primary stressed vowels had the greatest intensity (N=23, average intensity = 69dB) while secondary stressed (N=44, intensity = 65dB) and unstressed vowels (N=62, intensity = 63dB) had less intensity. Scheffe's posthoc tests showed that primary stressed vowels had significantly greater intensity than both secondary stressed (p=.003) and unstressed (p=.000) vowels. There was not a reliable difference between secondary stressed and unstressed vowels in intensity.

In summary, primary stressed vowels had greater intensity than both secondary stressed and unstressed vowels in two of the texts (texts two and three), while secondary stressed vowels had greater intensity than unstressed vowels in one text (text two). Intensity did not distinguish any of the stress levels in the first text.

6.2.3. Fundamental frequency

Turning to fundamental frequency, overall f0 values differed between certain stress levels in some of the texts, as is apparent in figure 8, which presents averages for all of the data in each text. Statistical results calculated over controlled subsets of the data are discussed below.

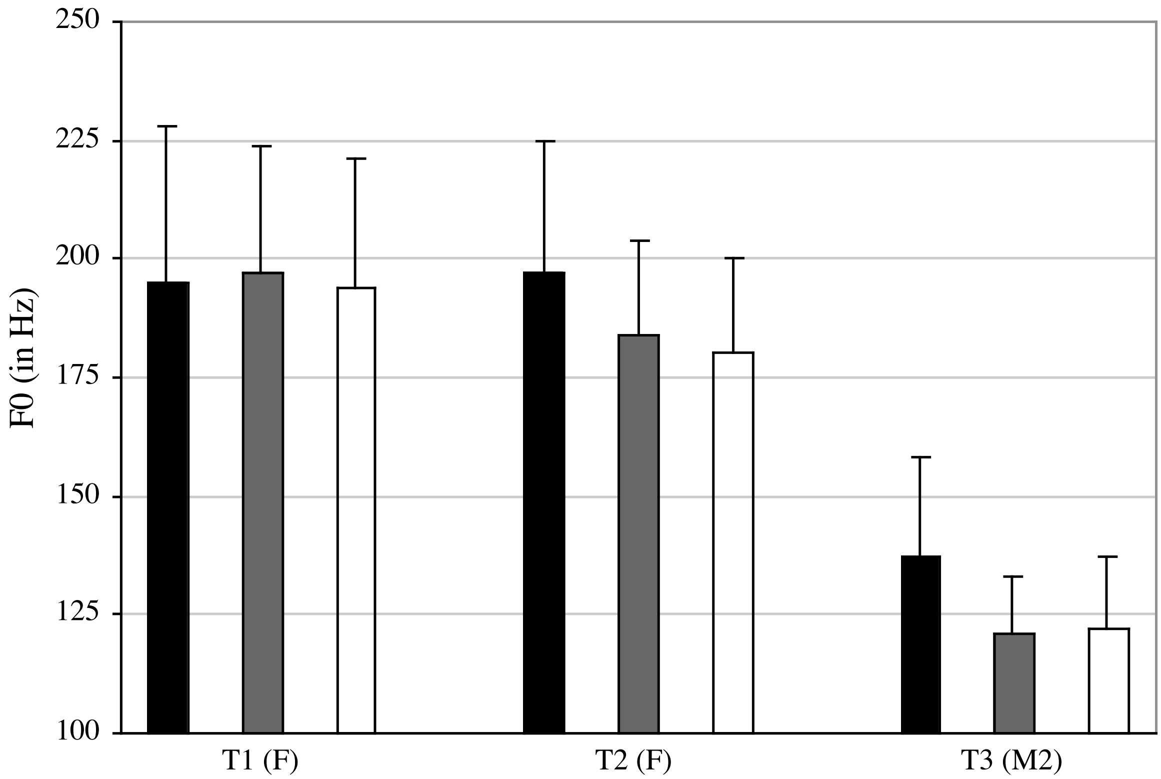

Figure 8. Average fundamental frequency values (in Hertz) for two discourse texts recorded from female speakers and one from a male speaker (M2 from the wordlist data). Primary stressed vowels are represented by darkly shaded bars, secondary stressed vowels by lightly shaded bars, and unstressed vowels by unshaded bars. Whiskers represent one standard deviation from the mean.

Before conducting analyses of stress, analyses of variance looking at the effect of vowel quality on f0 were performed for each speaker. Only in the second text did vowel quality have a significant effect on f0 values: $F(5,508)=7.632$, $p=.000$, $\eta^2=.07$. Posthoc tests indicated that this result was attributed primarily to a substantially higher f0 associated with the vowel /i/. This vowel was thus excluded from the stress analysis for the second text.

In text one, there was not a significant effect of stress level on f0 results. In text two, however, there was a relatively strong effect of stress on f0: $F(2, 467) = 27.617$, $p=.000$, $\eta^2=.106$. F0 was highest for primary stressed vowels (N=78, average f0 = 196 Hz), lowest for unstressed vowels (N=252, f0=175 Hz) and intermediate for secondary stressed vowels (N=140, f0=181Hz). All pairwise comparisons were significant in Scheffe's posthoc tests: primary vs. secondary stressed, p=.000; primary vs. unstressed, p=.000; secondary stressed vs. unstressed, p=.027. In text three, there was also a large main effect of stress on f0: $F(2, 122)=10.073$, $p=.000$, $\eta^2=.142$. Primary stressed vowels had highest f0 (N=23, average f0=137Hz), while secondary stressed (N=41, f0=122Hz) and unstressed vowels had identical values (N=61, f0=122Hz). Scheffe's posthoc tests revealed that primary stressed vowels had higher f0 than both secondary stressed (p=.001) and unstressed vowels (p=.000).

In summary, f0 distinguished primary stressed vowels from both secondary stressed and unstressed vowels in two of the texts (texts two and three), while secondary stressed and unstressed vowels were differentiated in one text (text two).

6.2.4. Summary of the acoustic results in the discourse data

The properties used to signal stress in the discourse data are summarized in table 5. As the table shows, intensity and f0 were the most robust cues to stress, being used in all the texts to distinguish stressed vowels (both primary and secondary stressed) from unstressed vowels and in two of the three texts to distinguish primary from secondary stress. Duration played an important role in differentiating stress levels in two of the three texts. Fundamental frequency was used in two of the three texts to differentiate primary stressed vowels from both secondary stressed and unstressed vowels. The three levels of stress were differentiated by at least two phonetic properties in two of the three texts. Only text one failed to differentiate any of the three degrees of stress.

Table 5. Use of different phonetic properties to differentiate levels of stress in the discourse data

	Duration	Intensity	F0
Primary vs. Secondary	T2, T3	T2, T3	T2, T3
Primary vs. Unstressed	T3	T2, T3	T2, T3
Secondary vs. Unstressed		T2	T2

7. Discussion

The data on Émérillon stress tie into a number of issues related to the typology of metrical stress patterns, the acoustic realization of stress, and the study of prosody within the Tupí-Guaraní language family. The relation between the present study and these topics is considered in sections 7.1-7.3.

7.1. Stress patterns

The Émérillon stress system mixes characteristics that are typologically common with other properties that are considerably less common. The alternating stress pattern of Émérillon is attested in many languages of the world. In his survey of 262 languages, Gordon (2002) finds 38 languages reported to have alternating stress. In fact, the Émérillon pattern in which the pattern initiates with the penult is the second most common (after left to right starting with the initial syllable) of the four possible binary patterns, found in 12 of the 38 languages with alternating stress in Gordon's survey.

Considerably rarer than the basic binary pattern is the additional optional stress found on the initial syllable in words with another stress on the second syllable. This type of stress pattern is reported for only 4 languages in Gordon's survey, to which we may add a fifth language, South Conchucos Quechua, described by Hintz (to appear).

Another interesting feature of Émérillon is the phrasal nature of stress. Unfortunately, most descriptions of stress found in grammars do not explicitly discuss the domain of stress though it may be assumed that most refer to stress patterns in words uttered in isolation. It is possible that future investigations of stress in other languages, including those with binary stress patterns, will reveal that stress is bound by domains larger than the word in some of these languages. In fact, in the few languages for which phrasal prosody has been extensively examined, the prosodic phrase has turned out to play an important role in determining prominence, e.g. Cayuga (Chafe 1977, Michelson 1988), Onondaga (Chafe 1970, 1977, Michelson 1988), certain varieties of Yupik (Leer 1985, Miyaoka 1985, Woodbury 1987), Chickasaw (Gordon 2003), Hixkaryana (Derbyshire 1985).

7.2. Acoustic realization of stress

Émérillon robustly distinguishes three degrees of stress in the acoustic domain. Intensity and duration proved to be the most reliable correlates of stress in both the wordlist and the discourse data, suggesting that Émérillon should be classified as a stress-based accent language in Beckman's (1986) classification. Émérillon appears to differ from many stress accent languages, however, in its relatively limited use of fundamental frequency (in comparison to intensity and duration) to mark stress. Only the female speakers used f0 to distinguish stress levels in the wordlist data and its efficacy at differentiating stress levels was inconsistent. Speaker F1 used f0 to distinguish primary and secondary stressed vowels, whereas speaker F2 used it to differentiate secondary stressed and unstressed vowels. Interestingly, though, fundamental frequency became a more reliable marker of stress in the discourse data in which the true phrasal character of stress became apparent In two of the three texts, one produced by a female speaker and one by a male speaker, f0 values set apart primary stressed vowels from both secondary stressed and unstressed vowels, while, in one of these texts, f0 also differentiated secondary stressed vowels from unstressed vowels. The greater reliance on f0 in the discourse data is evident if one compares the cues used to distinguish stress levels in the wordlist data with the acoustic markers of stress in the discourse data for a single speaker. This is done in table 6 for the male speaker who is M2 in the list data and T3 in the discourse data.

Table 6. Use of different phonetic properties to differentiate stress levels in the list and discourse data for speaker M2

	Duration	Intensity	F0
Primary vs. Secondary	Discourse, (List)	Discourse	Discourse
Primary vs. Unstressed	List, Discourse	List, Discourse	Discourse
Secondary vs. Unstressed	List	List	

As table 6 shows, only in the discourse data is fundamental frequency used to signal stress and it is only relevant for differentiating primary stress from the other two levels of stress. It is not surprising that f0 emerges as a stronger cue to stress in the discourse data where macro-intonational patterns, which are conveyed by f0, play a more important role as markers of semantic and pragmatic properties, such as focus. This finding accords with the results of Sluijter (1995) and Sluijter and van Heuven (1996) showing that the primary role of fundamental frequency is to signal prominence at the phrase level. Sluijter and van Heuven (1996) term this type of higher level prominence “accentuation”, which they suggest is “used to focus and is determined by the communicative intentions of the speaker” (pg. 1471). The use of f0 to distinguish primary stress from both secondary stress and lack of stress in Émérillon is thus consistent with its reservation as a marker of phrasal prominence serving functions at levels larger than the word.

One possible interpretation of the discourse data for speakers like M2 is that raised f0 is a correlate of a pitch accent that docks on stressed syllables in a phrase. This analysis would be consistent with the standard analysis of phrase level prominence in stress languages such as English (Pierrehumbert 1980). Such an approach, however, does not really explain the difference between the wordlist and the discourse data in the role of f0, since each word in the list data is equivalent to a phrase and would thus be expected to carry at least one pitch accent. Rather, given that f0 is only used to signal prominence in the discourse data, f0 may be more accurately characterized as a marker of discourse level prominence than a marker of stress per se at least for some speakers of Émérillon. Nevertheless, the fact that the two female speakers used f0 to mark certain stress distinctions in the list data (primary vs. secondary stressed vowels for speaker F1 and secondary stressed vs. unstressed vowels in the case of speaker F2) suggests that f0 is not exclusively a discourse marker of prominence in Émérillon.

7.3. Comparative Tupí-Guaraní stress

The Tupi-Guaraní family extends throughout Brazil, Argentina, Paraguay, Bolivia and French Guiana. This family has been studied since the earliest times of colonization, but many languages of the family are still under-described, and most of them are endangered or already extinct. However, several classifications of its members have been proposed, among which the latest is Rodrigues & Cabral's (2002) classification, reproduced below as figure 9. The Tupi-Guaraní family is "noted for a high degree of lexical and morphological similarity among its member languages in spite of their extensive geographical separation" (Jensen, 1999: 128).

In conjunction with recent research on other languages[6], the results of the present study contribute to the relatively understudied field of comparative Tupi-Guaraní stress

[6] We thank the numerous colleagues who kindly contributed to this comparative section by making data available to us, namely Prof. W. Dietrich (Dietrich 1990: 16-17, 24 for Lingua Geral, Tupinambá, Guaraní Antigo, Kaiwá, Guaraní Paraguaio, Xetá, Tapiete, Izoceño, Parintintín, Asuriní do Xingu, Guajajára; Dietrich 1986: 54-60 for Chiriguano, Oguauíva; Hemmauer 2005: 55-56 for Siriono; Villafañe 2004: 26-29 for Yuki; Dobson 1988: 88 on Kayabí; Julião 1993:68 on Anambé do Cairari; Almeida et al 1983: 13-14 on Tapirapé, Eiró 2001: on Tembé), A.S. Cabral (Asurini do Tocantins, p.c; Jo'é, p. c.; Asurini do Xingu, p.c.; Guedes 1999: Mbyá-Guaraní), M. Borges (Borges 2006 on Avá-Canoeiro, p. c; Silva 1999 on Parakanã, Barbosa 1993:54-55 on Suruí), M. Crowhurst (Guarayú, p. c.), M. Magalhães (on Guajá, p.c.), W. Praça (on Tapirapé, p.c.), and C. Jensen (Jensen 1979 on Wayampi). The other sources for this section are as

(Dietrich 1990: 16-17, Jensen 1999: 133). Generalizations about comparative Tupi-Guaraní stress are characteristically based on a small number of available descriptions, all of which treat stress impressionistically with little attention to acoustic or discourse data. Stress in Tupi-Guaraní is traditionally described as a delimitative[7] stress on the final syllable, although Wayampi, Siriono and Chiriguano are presented as famous exceptions to this rule due to their penultimate stress patterns. These exceptions are presented as an historical deviation from the reconstructed final stress pattern.

As far as stress placement is concerned, results of our study clearly differ from what is the statistically predominant pattern of final stress within the Tupi-Guaraní family. Figure 9 illustrates the distribution of stress patterns in the various branches of the family[8]. Italicized names correspond to languages with final stress, underlined names to languages with penultimate stress, and non-underlined, non-italicized names to languages for which we did not have data on stress.

---

follows: Gregores & Suárez (1967: 63-65) on Paraguyan Guarani, Hoeller (1932) on Guarayo, Dooley (1982: 321) on Mbyá-Guaraní, Seki (2000: 419) on Kamayurá, Abrahamson (1984: 172-174) on Júma, and Kakumasu (1986: 401) on Urubu-Ka'apór.

[7] Barbosa (1993) gives some examples of quasi-minimal pairs of words in which stress is contrastive in Surui. In Surui, stress generally falls on the final syllable of the root. Therefore, words ending in the frequentive suffix –*a* surface with penultimate stress, which contrasts with monomorphemic homonyms with final stress.

[8] In the table, bullets indicate that the following names refer to dialects or closely related languages.

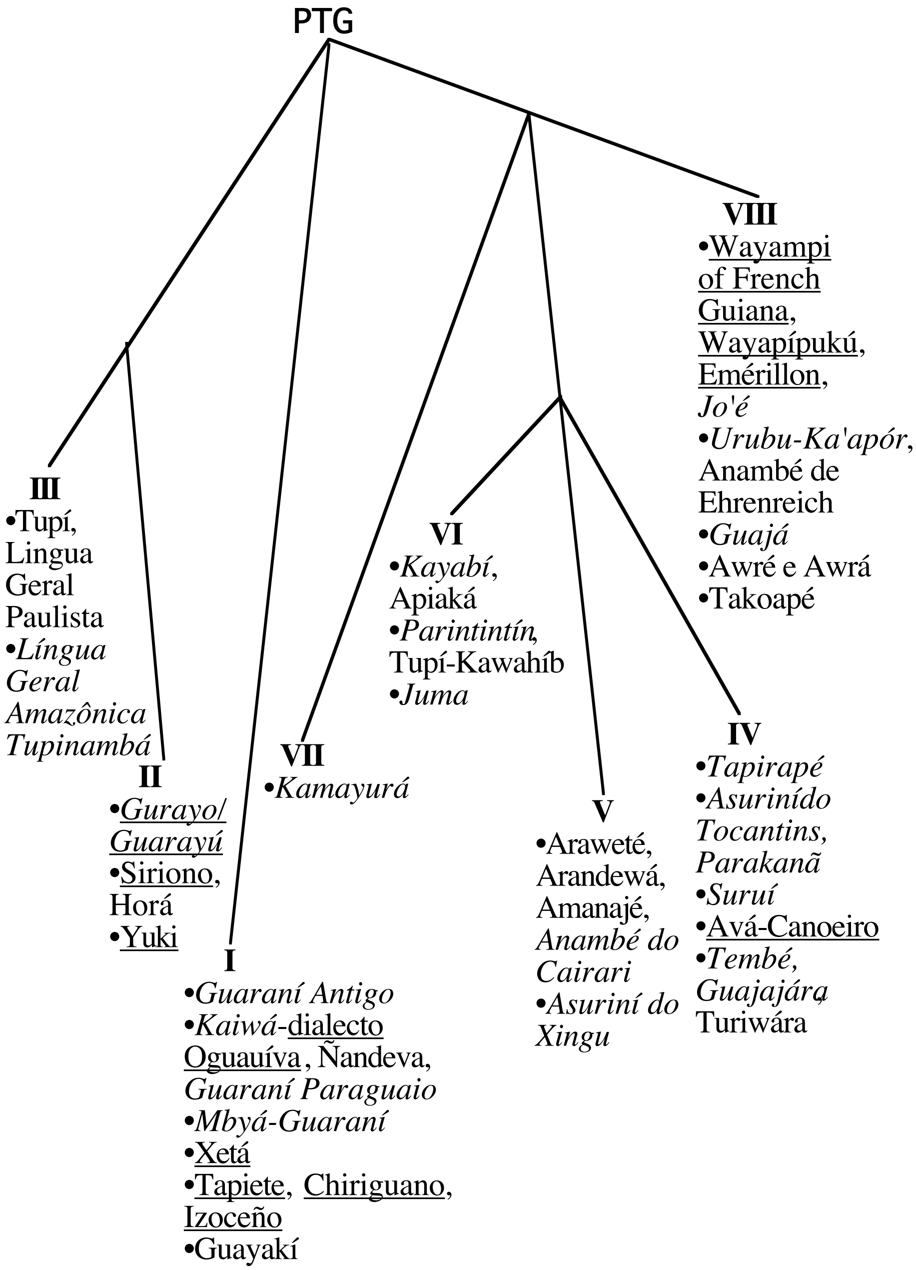

Figure 9. Tree of the Tupí-Guaraní language family (based on Rodrigues & Cabral 2002)

Final stress is indeed preponderant in the family being represented in all branches in a total of 21 languages. Even though the penultimate pattern is less widespread being restricted to 4 of the 8 branches, it is still, however, found in a significant minority of languages (11). Guarayú (underlined and italicized) represents a particularly interesting case in that the Urubicha dialect displays penultimate stress, the Ascension dialect final stress and the Yaguaru dialect initial stress, a pattern unknown elsewhere in the family (Crowhurst, p.c.).

The split between languages with final stress and those with penultimate stress in the Tupí-Guaraní family raises questions about how one pattern might develop from the other. If, as Dietrich (1990) and Jensen (1999) imply, final stress should be reconstructed for proto-Tupí-Guaraní, differences between languages in the domain of stress potentially provide insight into the shift from final to penultimate stress that took place in languages like Émérillon. In many languages, stress is bound by the word and may fall on suffixes (Urubu-Ka'apór, Anambé, Kayabí, Yuki, Guarayo, Avá-Canoeiro). In other languages (Parintintin, Tapirapé, Juma, Tembé, Parakanã), stress is fixed on the root even when followed by suffixes, indicating that the domain of stress is the root. Because suffixation is common throughout the family, the result would be many words with penultimate stress in languages with root-bound stress. We might speculate that reinterpretation of the morphological sensitivity of stress provided the impetus for the shift from final to penultimate stress. Perhaps stress originally fell on the final syllable of the root and then was subsequently reanalyzed by many languages in prosodic rather than morphological terms. This reanalysis took one of two forms depending on the language. In some languages, stress was reinterpreted as falling on the final syllable of the word (or some larger prosodic domain such as the phrase) rather than the final syllable of the root. In other languages, including Émérillon, stress was reanalyzed as occurring on the penultimate syllable of the word (or larger prosodic domain) due to the preponderance of unstressed suffixes. Although this account should be regarded as speculative, the results of the present study nevertheless underscore the importance of the supposedly "minor" pattern of penultimate stress in Tupi-Guaraní languages. The Émérillon findings may also force us in the future, pending the availability of stress data on other languages, to reevaluate possible paths of historical development for Tupi-Guaraní stress and perhaps ultimately to reconsider the widely accepted reconstruction of Proto-Tupi-Guaraní stress as final.

Aside from the general stress placement rule, some specific stress properties that have analogs in Émérillon are discussed in the literature on other Tupi-Guaraní languages. First, some cases of lexical stress are reported, for example, on the future suffix *–tá* in Yuki (Villafañe 2004:29). Second, phonological characteristics may complicate the stress pattern in certain languages: for instance, in Avá-Canoeiro, stress normally falls on the penultimate syllable but is attracted to a heavy final syllable ((C)VC), as we found for Émérillon. Another issue relevant to stress placement is the treatment of vowel sequences. Several descriptions (those of Juma, Yuki, Siriono, Chiriguano) indicate that vowel sequences, even though often analyzed as diphthongs, count as two syllables for stress, as in Émérillon. Furthermore, several languages mirror Émérillon in positioning secondary stress on alternating syllables counting backward from the primary stress, e.g. Urubu-Ka'apór, Kamayurá, Juma, Tembé and Avá-Canoeiro[9]. It is, in fact, conceivable that alternating stress is actually more widespread in the family than published descriptions might suggest, since secondary stresses are less likely to be noted than primary stresses due to their lesser perceptual salience.

Regarding the acoustic correlates of stress within the family there are little data to which the results of the present study can be compared. Stress in Tupi-Guaraní languages has not been studied phonetically prior to the present work, but descriptions suggest that intensity is its primary correlate. Some also refer to pitch (Dooley 1982: 321 for Mbyá-Guaraní, Seki 2000: 419 for Kamayurá) or to duration of either the vowel in the stressed syllable or the pretonic syllable (Gregores & Suárez 1967: 64 for Colloquial Guarani, Jensen 1979: 2 for Wayampi, Dietrich 1986: 57 for Chiriguano, Eiró 2001 for Tembé and Dooley 1982 for Guarani). Gregores & Suárez (1967: 64) also mention that consonants are lenis in secondary stressed or unstressed syllables in Paraguayan Guarani.

It is only seldom that stress placement in discourse been examined. Some authors mention a phrasal accent (Dooley 1982: 321 for Mbyá-Guarani, Kakumasu 1986: 401 for Urubu-Ka'apór, Dietrich 1986 for Chiriguano, Wayampi, Parintintín and Asuriní, Cabral for Zo'é, p.c.) without really explaining its placement. Kakumasu and Dietrich analyze it as a type of emphatic and rhythmic accent distinct from word stress but superimposed on it in discourse, thereby resulting in either a shift in word-level stress or its suppression. Dietrich (1990: 58) puts forward the interesting diachronic hypothesis that this emphatic and rhythmic stress is the original accent and that fixed stress is a late innovation of the

[9] It should be noted, however, that in Avá-Canoeiro there is a minor pattern in which two consecutive unstressed syllables intervene between the primary stress and the rightmost secondary stress (Borges, p.c.).

Tupi-Guaraní group, after the separation of Amazonian Tupi from coastal and southern Tupi-Guaraní.

In summary, while we cannot be sure about the path of development of stress in Émérillon and other languages of the Tupí-Guaraní family, at the very least the present paper provides new empirical data that may contribute to future hypotheses about historical Tupi-Guaraní stress.

8. Conclusions

In summary, Émérillon stress displays a rhythmic pattern, whereby stress falls on even-numbered syllables counting from the right edge of a prosodic domain larger than the word. This basic binary stress alternation (also found in other related languages) is interrupted by heavy syllables, which attract stress even if adjacent to another stressed syllable. Acoustic analysis indicates that three degrees of stress (primary stress, secondary stress, and lack of stress) are distinguished through a combination of duration, intensity, and fundamental frequency differences. Duration and intensity are more reliable correlates of stress in the wordlist data, while the role of fundamental frequency as a cue to stress is primarily limited to discourse data. Many features of Émérillon stress have parallels in other Tupí-Guaraní languages, though the penultimate stress pattern documented for Émérillon appears to be statistically less common than final stress within the family.

References

Abrahamson, Arne & Joyce Abrahamson. (1984). Os fonemas da língua Júma. In Robert Dooley (ed.), *Estudos sobre línguas tupí do brasil* [*Série Lingüística* 11], 157-74. Brasília: Summer Institute of Linguistics.

Baitschura, Uzbek. (1976). Instrumental phonetische Beiträge zur Untersuchung der Sprachmelodie und des Wortakzentes im Tscheremissischen. *Études Finno-Ougriennes* XIII, 109-22.

Barbosa, J. N. (1993). *Contribuição à análise fonológica do Suruí do Tocantins*, Universidade de Brasília.

Borges, M. (2006). *Aspectos fonológicos e morfossintáticos do Avá-Canoeiro (Tupi-Guaraní)*, Unicamp, Brasil.

Beckman, M. (1986). *Stress and non-stress accent*. Dordrecht: Foris.

Buller, B., Buller, E. & D. Everett. (1993). Stress placement, syllable structure, and minimality in Banawá. *International Journal of American Linguistics* 59, 280-293.
Chafe, W. (1970). *A Semantically Based Sketch of Onondaga*. Baltimore: Waverly Press.
Chafe, W. (1977). Accent and related phenomena in the Five Nations Iroqouis languages. In Larry Hyman (ed.), *Studies in Stress and Accent* [*Southern California Occasional Papers in Linguistics* 4], 169-181.
Derbyshire, D. (1985). *Hixkaryana and linguistic typology*. Dallas: Summer Institute of Linguistics.
Dietrich, W. (1986). *El idioma chiriguano : gramática, textos, vocabulario*, ICI, Madrid.
Dietrich, W. (1990). More evidence for an internal classification of Tupi-Guaraní languages. *Indiana*, Supplement 12.
Dobson, R. (1988). Aspectos da Língua Kayabí, *Série Lingüística SIL,* Vol. 12.
Dooley, R. (1982). Options in the pragmatic structuring of Guaraní sentences. *Language* 58, 307-31.
Downing, L. (1998). On the prosodic misalignment of onsetless syllables. *Natural Language and Linguistic Theory* 16, 1-52.
Dubois, J., S. Cumming, S. Schuetze-Coburn, and D. Paolino (eds.). (1992). *Discourse Transcription (Santa Barbara Papers in Linguistics 4)*. Santa Barbara: Department of Linguistics.
Eiró, J. G. (2001). *Contribuição à Análise Fonológica da Língua Tembé*. Belém: Centro de Letras e Artes, Universidade Federal do Pará.
Everett, D. (1988). On metrical constituent structure in Pirahã phonology. *Natural Language and Linguistic Theory* 6, 207-246.
Everett, D. and K. Everett. (1984). Syllable onsets and stress placement in Pirahã. *Proceedings of the West Coast Conference on Formal Linguistics* 3, 105-16.
Fry, D. B. (1955). Duration and intensity as physical correlates of linguistic stress. *Journal of the Acoustical Society of America* 27, 765-8.
Fry, D. B. (1958). Experiments in the perception of stress. *Language and Speech* 1, 120-52.
Gonzales, A. (1970). Acoustic correlates of accent, rhythm, and intonation in Tagalog. *Phonetica* 22, 11-44.
Gordon, M. (2002). A factorial typology of quantity insensitive stress. *Natural Language and Linguistic Theory* 20, 491-552.
Gordon, M. (2003). The phonology of pitch accent placement in Chickasaw, *Phonology* 20, 173-218.
Gordon, M. (2004). A phonetic and phonological study of word-level stress in Chickasaw. *International Journal of American Linguistics* 70, 1-32.
Goury, L. (ed.) (2002). *Amerindia n°26-27, Numéro spécial langues de Guyane*.
Gregores, E. and J. Suárez. (1967). *A Description of Colloquial Guaraní*. The Hague: Mouton.
Guedes, M. (1999).*Subsídios para uma análise fonológica do Mbyá*. Campinas: Editora da UNICAMP.
Hayes, B. (1995). *Metrical stress theory: principles and case studies*. Chicago: University of Chicago Press.

Hemmauer, R. (2005) *Studien zur historischen Morphosyntax des Siriono*. München: Institut für Algemeine und Typologische Sprachwissenschaft, Ludwig-Maximilains-Universität.

Hintz, D. (to appear). A phonetic and phonological study of South Conchucos Quechua. *International Journal of American Linguistics*.

Hoeller, A. (1932) *Grammatik der Guarayo-Sprache*, Hall in Tirol.

Irshied, Omar and Michael Kenstowicz. (1984). Some phonological rules of Bani-Hassan Arabic: a Bedouin dialect. *Studies in the Linguistic Sciences* 14, 109-47.

Jassem, W., J. Morton, and M. Steffen-Batóg. (1968). The perception of stress in synthetic speech-like stimuli by Polish listeners. *Speech Analysis and Synthesis* I, 289-308.

Jensen, A. (1979). Análise preliminar do grupo de acentuação e do grupo rítmico em wajap. Ms.

Jensen, C. (1999). Tupí-Guaraní. In R. Dixon and A. Aikhenvald (eds), *The Amazonian languages*, vol. 5, 125-163. Cambridge University Press: Cambridge.

Julião, M. R. (1993). *A Língua dos Indios Cairari*. Belém: Centro de Letras e Artes, Universidade Federal do Pará.

Kakumasu, J. (1986). Urubu-Kaapor. In D. Derbyshire and G. Pullum (eds.), *Handbook of Amazonian languages*, *vol. 1,* 326-406. New York, Mouton.

Kenstowicz, Michael. (1983). Parametric variation and accent in the Arabic dialects. *Chicago Linguistic Society* 19, 205-13.

Ladefoged, P., Ladefoged. J. & D. Everett. (1997). Phonetic structures of Banawá, an endangered language. *Phonetica* 54, 94-111.

Leer, J. (1985). Prosody in Alutiiq. In Michael Krauss (ed.), *Yupik Eskimo prosodic systems: descriptive and comparative studies*, 77-134. Fairbanks: Alaska Native Language Center

Lehiste, I. (1970). *Suprasegmentals*. Cambridge, Mass.: MIT Press.

MacDonald, L. (1990) *A grammar of Tauya*. New York: Mouton de Gruyter.

McCarthy, John and Alan Prince. (1995). Faithfulness and reduplicative identity. *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory,* 249-384.

Malikouti-Drachmann, Angelika and Gaberell Drachmann. (1981). Slogan chanting and speech rhythm in Greek. In Wolfgang Dressler, Oskar Pfeiffer, and John Rennison (eds.), *Phonologica 1980*. Innsbruck: Institut für Sprachwissenschaft der Universität Innsbruck.

Michelson, K. (1988). *A Comparative study of Lake-Iroquoian accent*. Dordrecht: Kluwer.

Miyaoka, O. (1985). Accentuation in Central Alaskan Yupik. In M. Krauss (ed.), *Yupik Eskimo prosodic systems: descriptive and comparative studies*, 51-76. Fairbanks: Alaska Native Language Center.

Payne, J. (1990). Asheninca stress patterns. In D. Payne (ed.), *Amazonian Linguistics*, 185-212. Austin: University of Texas Press.

Pierrehumbert, J. (1980). *The phonology and phonetics of English intonation*. MIT Ph.D. dissertation. [Distributed by Indiana University Linguistics Club].

Ramstedt, G. J. (1902). *Bergtscheremissische Sprachstudien*. Helsingfors: Druckerei der Finnischen Literaturgesellschaft.

Rodrigues, A. (1984-5). Relações internas na família linguïstica Tupí-Guaraní? *Revista de Antropologia* 27-28, 33-53.
Rodrigues, A. (2000). Panorama das línguas indígenas da Amazônia. In F. Queixalós and O. Renault-Lescure (eds), *As línguas amazônicas hoje*, 15-28. São Paulo: IRD, ISA & MPEG.
Rodrigues, A. and A. Cabral. (2002). Revendo a classificação interna da família Tupí-Guaraní. In A. Cabral and A. Rodrigues (eds), *Línguas Indígenas Brasileiras. Fonologia, Gramática e História. Atas do I Encontro Internacional do GTLI da ANPOLL*. Belém: Editoria Universitária U.F.P.A.
Rose, F. (2000). *Eléments de phonétique, phonologie et morphophonologie de l'émérillon* (Teko), Mémoire de D.E.A. en Sciences du langage, Université Lyon 2
Rose, F. (2002). Le problème de la nasalité dans l'inventaire phonologique de l'émérillon. *Amerindia* 26/27 *(Langues de Guyane)*, 147-172.
Rose, F. (2005). Reduplication in Tupi-Guaraní languages: going into opposite directions. In B. Hurch (ed.), *Studies on Reduplication*, 351-368. Mouton: New York.
Sapir, E. (1930). *Southern Paiute: A Shoshonean language*. Cambridge, Mass.: American Academy of Arts and Sciences.
Seki, L. (2000). *Gramática do Kamaiurá: lingua Tupi-Guaraní do Alto Xingo*. Campinas, Brasil: Editora da Unicamp.
Silva, A. (1999). *Aspéctos da referência alternada em Parakanã*. Belém: UFPA.
Sluijter, A.M. C. (1995). *Phonetic correlates of stress and accent*. Dordrecht: ICG Printing.
Sluijter, A.M.C. & V.J. van Heuven. (1996). Spectral balance as an acoustic correlate of linguistic stress. *Journal of the Acoustical Society of America* 100, 2471-2485.
Strehlow, T. (1942). Aranda phonetics. *Oceania* 12, 255-302.
Villafañe, L. (2004). *Gramática Yuki. Lengua Tupí-Guaraní de Bolivia*. Tucumán, Argentina: Ediciones del Rectorado, Universidad Nacional de Tucumán.
Woodbury, A. (1987). Meaningful phonological processes: a consideration of Central Alaskan Yupik Eskimo prosody. *Language* 63, 685-740.