MAMAINDÉ TONE:

AN ACCOUNT OF PLATEAUING IN AN AMAZONIAN LANGUAGE

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1. Introduction

An endangered amerindian language of west-central Brazil, Mamaindé is spoken by a single community of some 180 speakers. It belongs to the Nambiquara language family and has been further classified as part of the Northern Nambiquara sub-group of languages. One of the distinctives of Nambiquara languages is their wealth of prosodic features. In Mamaindé, tone, stress, nasality[1] and laryngealization are all prominent characteristics.

This paper will describe the Mamaindé tone system. First I will give evidence that Mamaindé is indeed a tone language. Secondly, I will use an OT framework to describe and account for the phenomenon of tone plateauing found in verb roots. Finally, the analysis here poses a challenge for OT in regards to positional faithfulness, and I willdemonstrate that the phonology must reference the morphological structure in a unique way in order to capture the generalizations found in the tone system of this language.

This research is built on more than 8 years of intermittent living and interacting in the speech community. The actual data for this paper was recorded in April, 2001, in the Mamaindé village of Capitão Pedro, state of Mato Grosso, Brazil. I used a Sharp 722 minidisk recorder to record three native Mamaindé male speakers. There were 250 utterances, duplicated by each speaker,

[1] A detailed analysis of Mamaindé nasality, in particular the behaviour of pre-stopped nasals, can be found in Eberhard, 2003.

creating a database of 750 utterances. Data was then input into Speech Analyzer software, where waveforms, spectrograms and pitch graphs were produced and analyzed.

The theoretical framework assumed here will be OT phonology, with the use of autosegmental diagrams for descriptive purposes.

2. Tone vs. Stress

One of the initial questions one must address when studying tone is whether or not the pitch patterns one is dealing with are the result of a tone system or a stress system.[2] In this section I will show acoustic evidence that tone and stress are distinct features of Mamaindé, and that stress is predictable while tone is not.[3] We will look first at the stress system.

In Eberhard (1995:53&69), I argue that Mamaindé is a quantity-sensitive language where heavy syllables attract stress. All the details of Mamaindé stress are too intricate to go into here, but the basic notion is that each heavy syllable has two moras, and foot stress is then assigned to each heavy syllable. Word level stress is right-headed, or assigned to the rightmost heavy syllable. However, word level stress can only occur within the domain of the stem. If there are no heavy syllables within the stem, which often is the case, then stress is assigned to the rightmost open syllable of the stem. Secondary foot level stress is allowed on heavy syllables outside the stem except for the final morphological category of verb suffixes (the person, tense and mood markers) which cannot carry any stress at all regardless of their weight. [4] Morphology thus

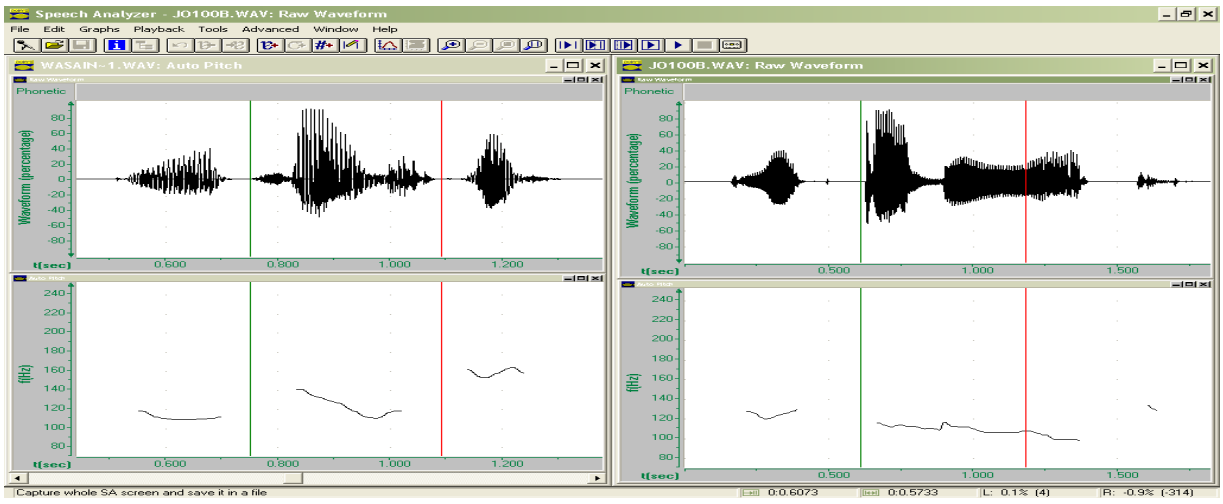
[2] Mamaindé is an exception to the common assumption that tone languages lack stress (Haraguchi, 1988:123). Yip (2002:256-257) gives further evidence of other tone languages which also employ stress.
[3] This is in keeping with Hyman's definition that a tone language is '…one in which an indication of pitch enters into the lexical realization of at least some morphemes' (Yip, 2002:4)
[4] Mamaindé stress requires different sets of metrical rules in different lexical strata (Eberhard, 1995:64).

clearly plays a significant role in Mamaindé stress, but the principle notion here is one of syllable hierarchy – only syllables with branching rhymes will receive stress.

Given the above, the next question is to determine the major phonetic correlates of stress in Mamaindé. First of all, we find that most of the heavy syllables have greater amplitude than open syllables[5] (something we might expect from a quantity-sensitive language). Secondly, the rightmost heavy syllable in the stem will normally receive a bit more amplitude than any other heavy syllable (the result of word level stress). Figure (1) below shows how this use of amplitude marks the more prominent syllable in the word (notice that pitch is not helpful in these cases). Amplitude, then, becomes the first phonetic correlate of the Mamaindé stress system. *(The stressed syllables in the words below are indicated by bolding)*

(1)

wasai^{g}ŋʔ-du 'stuff-ART'	*yuʔkai^{g}ŋ-latwa* 'like-3pPRES'
wa ***sai^{g}ŋʔ*** *du*	*yuʔ* ***kai^{g}ŋ*** *la* *twa*



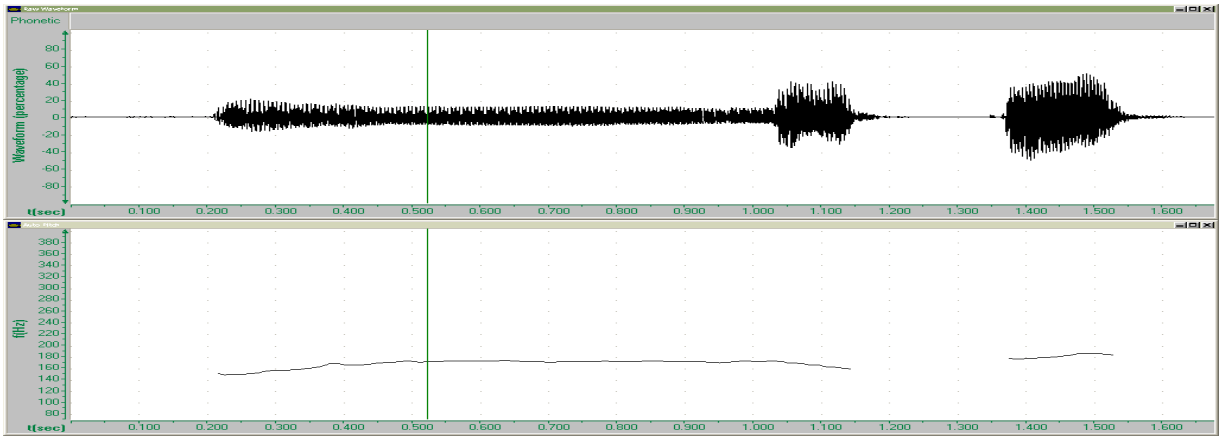
[5] This extra amplitude is not found, however, on those heavy syllables which are part of morphemes at the rightmost periphery of the word, such as articles, person/tense/mood markers, etc. (For more on the interaction between morphology and stress in Mamaindé, see Eberhard, 1995, chapter 8, "A Lexical Analysis…")

Another phonetic correlate of stress is length. We have already mentioned that when there are no heavy syllables in the stem, the rightmost open syllable will be stressed. Stress in these cases is realized by lengthening of the rightmost vowel in the stem, as the word below illustrates.

(2)

nĩ-latwa 'hurt-3pPRES'

nĩ *la* *twa*



Since this vowel lengthening is entirely predictable, it cannot be considered lexical, but simply one of the phonetic realizations of the stress system. Vowel lengthening, then, is another means by which the stress system marks the relative prominance of syllables within the Mamaindé word[6]. In form (2) above, as well as in figures 3-6 below, note that the stressed open syllables are consistently longer, often twice as long as any of the others (lengthened vowels in stressed open syllables range from .400-.700 seconds in duration while their unstressed counterparts have durations of .100-.300 seconds).

[6] Although originally I saw lengthening of vowels in open syllabels as a separate post-lexical procedure after the stress rules had applied (Eberhard, 1995:78-80), I no longer think that it is necessary to separate the two processes.

The final correlate of stress in Mamaindé is vowel quality. As in many languages, stressed vowels[7] in this language retain their distinctive place features while unstressed vowels (particularly the /a/ and the /o/) will usually suffer vowel weakening and a tendency to gravitate to a more centralized vowel [ə]. So the phonetic devices which signal stress in this language are three – amplitude[8], vowel lengthening, and vowel quality (Eberhard, 1995:27-28, 32-33).

Tone, on the other hand, *cannot* be used to predict stress.[9] Below we will see that the stressed syllables do not all carry the same tone. In fact, stressed syllables can display any of the four tone patterns in Mamaindé (see also Eberhard, 1995:27).

(Each example below is a verb with the same string of verbal suffixes, [-latwa], which is a contraction of /-lat^{h}a-Ø -wa/ '3p -present - noninterogative'.[10] This was done to insure that any changes in tone would not be due to intonation. The stressed syllable has been bolded for clarity. Long vowels are followed by a colon. I am also using a bracket to separate the root from the affix string, since this will be crucial in some forms. The waveform will highlight the stressed syllable unless otherwise indicated.)

When stress applies to roots with no closed syllables, the stress rule itself is what lengthens one of the vowels in that root.

[7] The Mamaindé phonemes: consonants /p,t,k,p^{h},t^{h},k^{h},m,n,l,s,w,j,h,ʔ/, vowels /a,i,e,o,u,a^{i},a^{u},e^{i},e^{u},i^{u}/. The vowels also have a corresponding set of nasal phonemes /ã,ẽ,ĩ,õ,ũ,ã^{i},ã^{u},ẽ^{i},ẽ^{u},ĩ^{u}/ and a creaky voice set /a̰,ḭ,ḛ,o̰,ṵ,a̰^{i},a̰^{u},ḛ^{i}, ḛ^{u}, ḭ^{u}/. 6 vowels have simultaneous nasal and creaky voice phonemes: /ã̰, ḭ̃, ṵ̃, ã̰^{i}, ã̰^{u}, ḭ̃^{u}/.

[8] In Eberhard, (1995:27-28), I argued that the phonetic correlate of stress in Mamaindé is intensity (or amplitude). I also mentioned that length is closely tied to stress (p.28, 32-33) This paper differs from Eberhard, 1995 in that I have come to the conclusion that both of these processes, lengthening and amplitude, as well as vowel quality, are used at different times by the stress system to mark the prominent MD syllable.

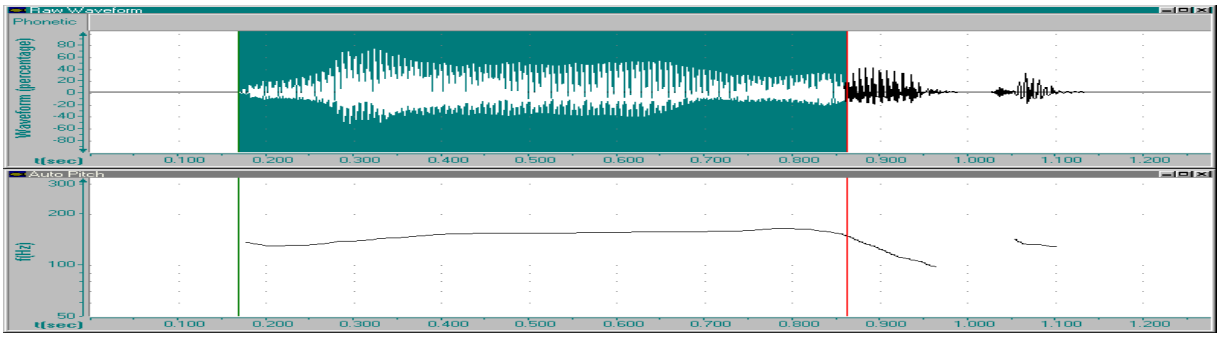
[9] The related Northern Nambiquara lects Latunde and Lakonde, on the other hand, have been analyzed as having quite different stress systems. Telles (2002:114) has posited a pitch-accent system for these languages and cites pitch as the only correlate of stress. As this section demonstrates, however, the Mamaindé data require an analysis where pitch is not connected to stress.

[10] 'Non-interogative ' is used here to indicate that this morpheme marks all moods except for the interogative.

(3) stressed syllable with H tone:

. H L H

wãn*]latwa* 'he is returning'



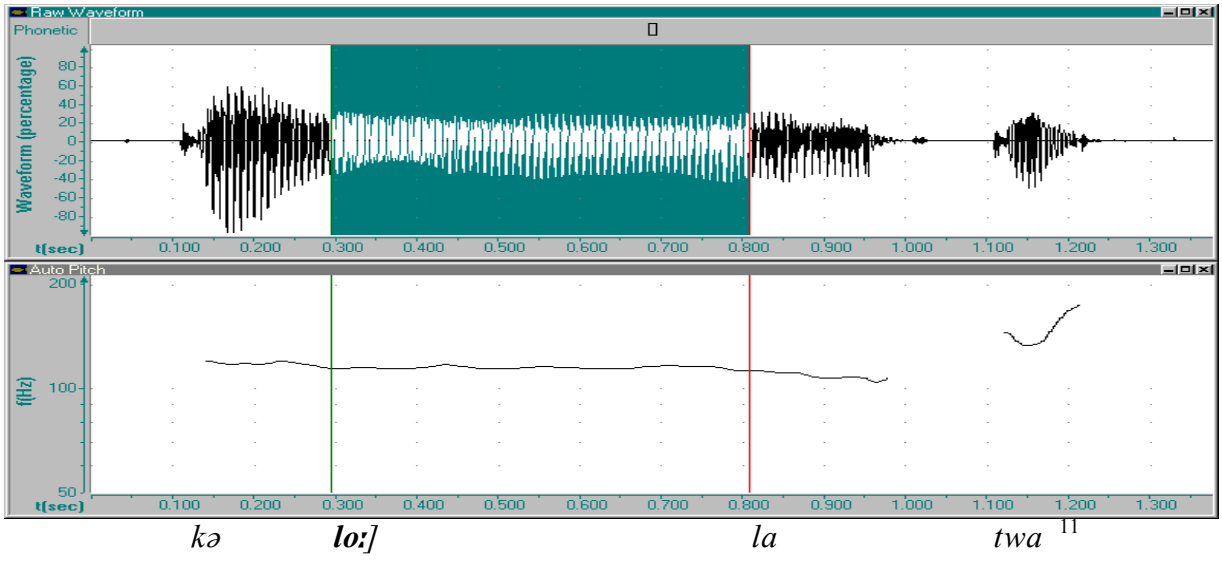
wãn*]* *la* *twa*

(4)

stressed syllable with L tone:

L L L H

*ka****lo:****]* *latwa* 'it's growing'



kə ***lo:****]* *la* *twa* [11]

[11] Notice the change in vowel quality here. Although the syllable */kə/* is pronounced with more amplitude, the vowel has weakened to a central position, indicating that this is *not* the stressed syllable. In multi-syllabic roots, the vowel quality must be taken into account. In this word, the effects of stress can be seen in the lengthening of the second

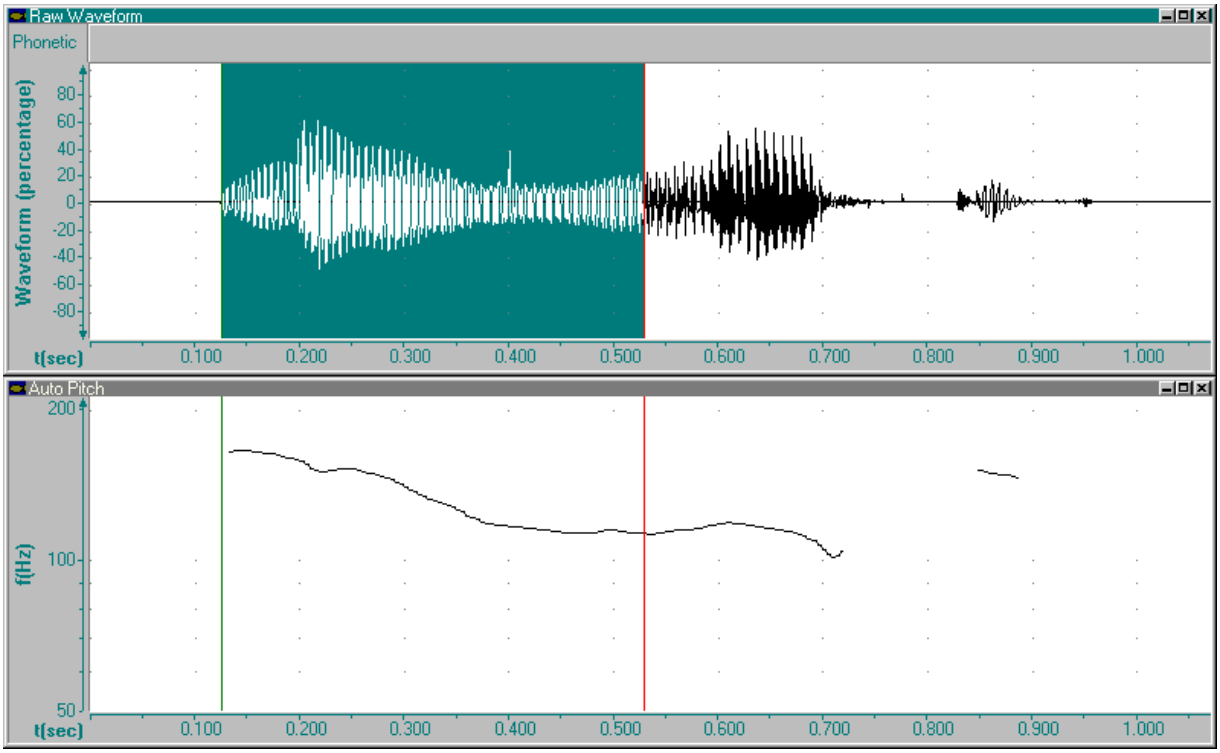
(5)

stressed syllable with HL tone:

H L L H

du:] *latwa* 'he's getting (something)'

ɗu:] *la* *twa* [12]



vowel. Although the stress system is too complex to explain fully here, the crucial point is that this is a quantity sensitive language where syllable weight is important. When there are no heavy syllables in the root, the stress system will lengthen the rightmost syllable in the root. This lengthening will be indicated throughout this paper.

[12] Notice the strongly imploded [ɗ]. This is the recording of an older speaker for the word /tulatwa/. The two imploded stops [ɗ,ɓ] were originally used word-initially in stressed syllables. These allophones of /t/ and /p/, however, are being abandoned by many of the younger speakers. Among the younger generation, /p,t,k/ are now being realized as voiced stops /b,d,g/ when in the onset of stressed syllables or between voiced segments. /t/ is realized as /ɾ/ in unstressed intervocalic positions.

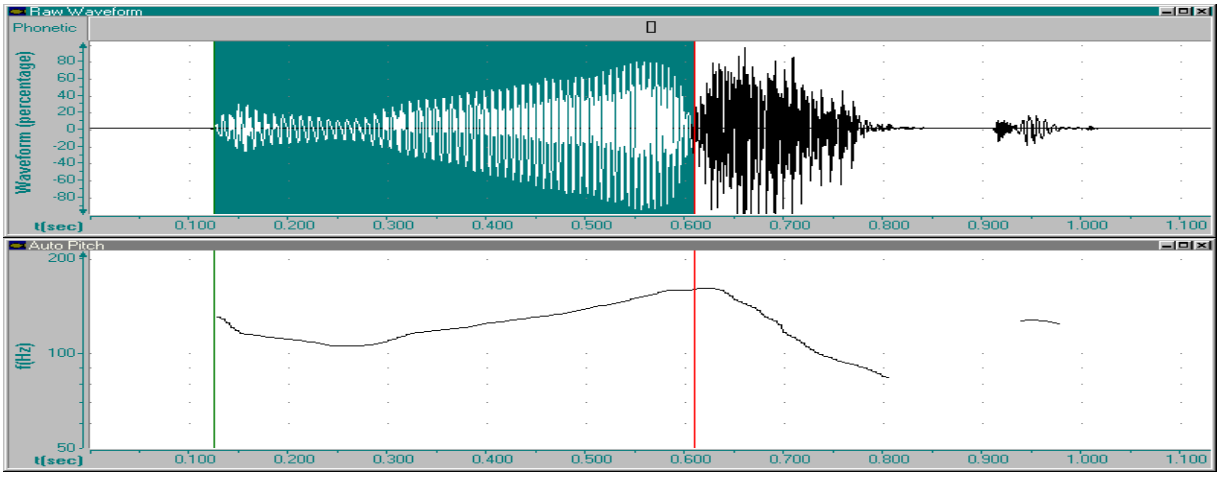
(6)

stressed syllable with LH tone:

L H L H

wɻ:]la twa 'he is eating (meat)'

wɻ:] *la* *twa* [13]



As these examples show, in Mamaindé any of the four pitch patterns can occur on stressed syllables, while in unstressed position one will only see H and L. This follows a predictable tendency in many languages to allow more contrasts on stressed syllables. The important point to note here, however, is that in Mamaindé pitch is independent of stress.

A final word about this independence is necessary. When one notices that the complex tone patterns (either HL or LH) occur only on stressed syllables, it is tempting to posit a direct relationship between pitch and stress, a relationship in which specific pitch patterns are based on the stress system. This is misleading, however. The only relationship between the tone system and the stress system is that they are both based on the notion of the mora. This simply means

[13] Underlined vowels are creaky voiced segments. In some examples, they can present erratic pitch graphs.

that syllable weight is what determines which tone patterns as well as which levels of stress are possible on any particular syllable. This will be discussed further in section 5.

3. Tone vs. Intonation

A second question we must address is whether or not the tones in Mamaindé are influenced in any way by intonational patterns[14]. There can only be three possibilities here: it could be that the changes in pitch we are noticing might be wholly attributed to intonation, partly influenced by intonation, or not influenced by intonational patterns at all. The four examples in section 2 above, where the stressed syllable of the verb root can carry one of four tonal patterns, show that intonation cannot be influencing the change in pitch on the root. Here they are again:

(7)

H L H
wãnlatwa 'he returns'

L L L H
kaloːlatwa 'it grows'

LH L H
wɻːlatwa 'he eats'

HL L H
duːlatwa 'he gets'

All of these verbs (as well as most of the examples in the paper) are intentionally shown with the same verb ending - the 3rd person present tense suffixes. This suffix string is as follows: */-lat^{h}a-/* '3rd person (this form is only used in the present tense)', followed by /-Ø-/ 'present tense', and finally */-wa/* 'non-interogative'. (Together this string is usually reduced to *[-lat^{h}wa]*, which is

[14] An issue not addressed in this paper is grammatical tone. An example in Mamaindé is the negative morpheme which is associated to a L. The L can remain floating after the segmental material has been deleted. This L then links to the verb material on its right, negating the verb. This is common in the imperative negative construction.

the way I will simplify it throughout the remainder of this paper.) Not only do these four examples have the same ending, but these utterances are all part of the same communicatory frame – an unmarked declarative sentence. There is no change in mood or attitude on the part of the speaker. Therefore, if there were any evidence of intonation on these utterances, it would be seen in that part of the utterance whose tone remains the same (the affixes), not in that part whose tone varies (the root).[15] We must deduce from this that the different tonal patterns found on the Mamaindé roots cannot be attributed to intonation. In section 2 we also argued that this variation in pitch was not due to stress. The logical conclusion is that the tone patterns on Mamaindé roots are lexical. These lexical tones, and the interesting sandhi which they sometimes exhibit, will be the major focus of this paper.

The affixes, on the other hand, may very well carry some intonation. Since Mamaindé is an SOV language, all of the verb examples in my data come sentence final. This would be a common locus for intonation to affect underlying tone. In Mamaindé, I believe that some intonation is evident on the tone of the final syllable of the verb affix string. A brief sketch of this final intonation would include the following tendencies: the final syllable of the last verb suffix is usually H when in unmarked declarative and imperative statements, it is H , HL or LH in different types of interrogatives, it is HL in a humorous statement, and L in a negative construction.

[15] There is some evidence that in certain genre, downstep may occur. If this proves to be true, it would obviously influence tones in the whole utterance. However, it could only affect the specific pitch of individual tones in relation to other syllables with the same tone. It still would not be able to account for the contrastive tone patterns found on Mamaindé roots.

Verb phrase final syllables which are not sentence final often carry a H tone as well. This is the locus of the verb connectives which are suffixed to the verb root, and are mandatory between two verb phrases in the same sentence. The final H tone on the majority of these verb connective markers could suggest an intonational influence.

(8)

L H
/-katoʔ/ 'then' (same subject) [16]

H
/-hɨ̃ʔ/ 'then' (different subject)

L H
/-tɑ̱ku/ 'and'

L L H
/-sihtɑ̱ku/ 'so that'

H
/-ĩ/ 'listing device' (sufixed to either verbs or nouns when they are being listed)

However, when some of these connectives are shortened, they do *not* end in a H tone. In their contracted forms:

(9)

H L H H L
/-sihtɑ̱ku/ becomes *[-siɕ̥^{h}ɑ̱ʔ]* [17]

L H L
/-tɑ̱ku/ becomes *[-ɾɑ̱ʔ]*

This behaviour has not been studied fully, but actually would seem to indicate that in the phrase final position, as in the root, tone appears to be lexical.

4. Tonal inventory

4.1 Underlying tones

This paper is based on a re-analysis of the Mamaindé tone system. The fundamental difference between my proposal here and the only other existing treatment of Mamaindé tone (Kingston) is in the number of underlying tones proposed. Here I posit a tone system for Mamaindé comprised of only 2 underlying tones, Hi & Lo.[18] These two tones can then be combined into a total of 4 surface patterns when spread over any bi-moraic syllable: Hi, Lo, Lo-Hi and Hi-Lo. This differs from Kingston's analysis where he posits 4 contrastive tones - two register tones, Hi and Lo, and two contour tones, Rising and Falling (Tonal Curves and Perturbation:6). As I will endeavor to show in the following pages, however, this tone system can be described quite readily without having to appeal to contour tones.

4.2 Tonal inventory of related languages

The tonal inventory of Mamaindé apparently differs from that of other languages within the Nambiquara family. Both Kroeker (2001:81), and Lowe (1997:269) describe the Southern Nambiquara tone system as being comprised of 3 underlying tones; one register (Lo), and two contour (Falling and Rising). For the Lakonde and Latunde lects of Northern Nambiquara, Telles (2002:125-126) cites the presence of Hi, Lo, Rising and Falling pitches in surface forms, but prefers to view only Hi as lexical, and refers to these as 'pitch accent' languages instead of tonal

[16] There are times however, when a speaker will change the H tone on the last syllable of the connective /katoɛ/ to a L tone. Since this always occurs phrase final, it is probably an intonational device, but its meaning is unclear.
[17] The /ɾ̥ʰ/ indicates a voiceless, aspirated alveolar flap.
[18] It is quite possible that we could posit just one underlying tone, Hi, and then fill in Lo by default at the end of the phonology. This analysis would reduce the complexity in the lexicon. However, there are 2 problems with such an approach. First of all, underspecifying tone is a way of constraining the input, something which is incompatible with an OT framework since all constraints are made with reference to the output. Secondly, the negative construction seems to require the presence of a L tone in the lexicon for the correct tone sandhi to occur.

languages.[19] Although I haven't conducted tonal research in the Negarote lect, my own personal interaction with Negarote speakers would lead me to infer that the Mamaindé and Negarote tonal systems are virtually identical, including the contrastive Hi. Apparently, then, all of the Northern Nambiquara languages present 4 possible pitch patterns in their surface forms, while the Southern Nambi languages only present three. The question remains whether the Hi tone of the Northern languages is a vestige of proto-Nambi or whether it was a more recent development.

In each of the Nambiquara languages tone seems to fill a slightly different role. In Southern Nambiquara, tone appears to carry a higher functional load than in Northern Nambiquara. Support for this is found in the orthography systems, where the Southern language requires tone to be written while Mamaindé readers do not require tonal diacritics but infer this information from the context. This could be taken as evidence that Mamaindé is less like a pure tone language than Southern Nambiquara. On the other hand, within the Northern language, Mamaindé appears to be closer to a pure tone language than Latunde/Lakonde. While Latunde (Telles:125) has been classified as a pitch accent language, where High tone is associated to lexical stress, and Low tones are filled in by default, Mamaindé tones are unpredictable, and no such correspondence to the stress system can be made.

It might be appropriate at this juncture to be reminded that a continuum exists between pure tone languages and pitch accent languages (Van der Hults, 1988:ix-xxii). Yip puts it in the following words:

> "There is no absolute division between accent languages and tone languages, just a continuum from accent to tone as the number and denseness of the tones increase and they become freer to move around." (Yip, 2002:4)

[19] We saw in section 2 that a pitch accent system will not account for Mamaindé since stress and tone are not linked.

Although the exact definition of pitch accent seems to differ from one author to another, one of the general distinctions between pitch accent and tone languages that can be drawn from the literature revolves around degree of predictability. In some languages, very few tones are predictable and thus most tones are lexical (prototypical tone languages such as Mandarin), while in other languages, one tone per word is lexical and the rest are predictable (prototypical pitch-accent languages such as Japanese)(Mcawley, 1978:113-119). Between these two extremes are many languages displaying varying degrees of tonal phenomenon. In light of this, I would describe Mamaindé as falling somewhere on the tone side of the continuum, since it's tonal system is unpredictable and not linked to stress. On the other hand, Mamaindé tones are linked to moras, which means that the number of tone patterns per syllable is limited to the number of moras in that syllable, making this a rather simple tone language (in regards to number of tones). Mamaindé tone also seems to carry a lighter functional load than it does in some of the "purer" tone languages.

5. Associating tones and mora

Notice in the phonetic data below that complex pitch patterns (HL=falling, LH=rising) are possible on heavy syllables (those with a coda consonant or a lengthened vowel) but not on light syllables. *(Verb roots are within brackets, colons mark lengthened vowels, and periods mark syllable boundaries).*

(10)

HL L H
a) *[duː]la.twa* ‘he/she is getting’

L L L H
b) *[kə.loː.]la.twa* ‘it is growing’

LH H L H
c) *[on.gə.]la.twa* ‘he/she is doing …’

H L L H
d) *[də.nuː.]la.twa* ‘he/she is giving’

L HL L H
e) *[waʔ.nĩn.]la.twa* ‘he/she is performing magic’

H LH L H
f) *[wə.nũn.]la.twa* ‘it is good’

LH L H
g) *[dɑ̰ː.]la.twa* ‘he/she is laying down’

This pattern is consistent across the language, leading to the conclusion that the tone bearing unit in Mamaindé is the mora, not the syllable. Syllables with codas, in the form of a consonant or a lengthened vowel, are two moras long and are therefore allowed two tones[20]. So instead of rising and falling contour tones, what we get on bi-moraic syllables are combinations of Hi and Lo, each tone associating to a mora.

Our analysis of Mamaindé stress in section 2 (see also Eberhard, 1995:40,69) is also dependent on the notion of mora, and assigns importance to the number of mora in a syllable. The fact that

[20] Of course not all heavy syllables have two tones at the phonetic level. If the mora of the nucleus and the coda of a heavy syllable have the same tone, the two tones will naturally be reduced to one single tone in the output due to the OCP. The point here, though, is that **only** heavy syllables can have two tones.

both the stress system and the tone system are based on the same building blocks is a crucial insight that ties Mamaindé phonology together, giving more validity to the present analysis.

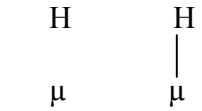
We can describe the mora as the tone bearing unit in the following constraint.

LINK[TONE]
Each tone is associated with a mora.

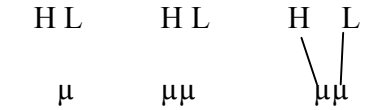
This constraint implies that all tones must link – they may not remain floating. It also means that tones only associate to segments which have been assigned a mora by the phonology. This effectively limits the tone bearing units to nucleus and coda segments only. Whether a syllable ends with a consonant or long vowel does not matter – both of these are considered coda segments and can attract an extra tone to the syllable. Below are some examples of tone to mora associations in Mamaindé.

(The intermediate lengthening in example 11b is due to the application of the stress rule on roots. This shorthand format, however, does not reflect the OT view, where both the constraints of the stress system and the tone system would be considered simultaneously to arrive at the surface form without any intermediate steps. Likewise, in 11c and d, the coalescing of two identical adjacent tones into one is simply the work of the OCP, and not an intermediate step in the phonology.)

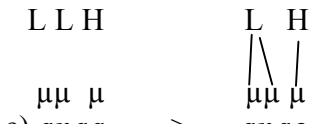
(11)



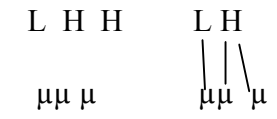
a) *ta* —> *da* 'my' (nominal prefix)



b) *tu* —> *du:* —> *d̥u:* 'to get'



c) *anga* —> *angə* 'to be costly'



d) *onga* —> *ongə* 'to do'

Conversely, all moras must be linked to one tone, and one tone only. A similar notion was proposed by Pulleyblank (1997:91,97) by way of two constraints, which I have taken the liberty to modify below:

INTERPRETABILITY
Each mora bears a tone.

This first constraint attempts to ensure that no mora will be toneless on the surface.

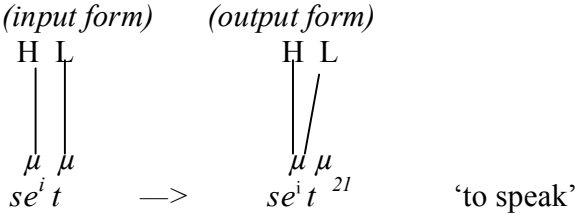
NOCONTOUR
No more than one tone is linked to a single mora.

The second does not allow double associations to a single mora. Contour tones, then, are not allowed. However, when the nucleus of a heavy syllable is assigned one tone and the coda is assigned a different tone, the result appears on the surface to be a contour pitch pattern, such as in examples 11b & d above.

Not all codas, however, can carry tone on the surface. What actually happens in Mamaindé speech, and it would seem plausible for most tone languages, is that only sonorants have this

privilege on the phonetic level. This means that if the coda is an obstruent, the second tone of a heavy syllable naturally falls back on the nucleus position.

(12)



So we could add the following informal constraint at the phonetic level:

***LINK[OBSTRUENT]**
Tones do not link with obstruents

However, for the remainder of this paper, such phonetic detail will not be necessary. My main concern regarding the linking of tone and mora will be to indicate which syllables can carry two tones and which may not. This is most clearly shown by linking the tones with the mora which license them. Although coda obstruents do not carry tone on the surface, their presence, in the form of an extra mora, is what allows a second tone to be linked to the syllable in which they are found. So throughout this paper I will be associating each mora with a tone, regardless of whether or not that mora is an obstruent. [22]

---

[21] In this form and throughout this paper, I will be viewing dipthongs as single vowel segments (with two place nodes) which fill a single nucleus position.

[22] Notice that tones are not prohibited from linking with nasal consonants, since nasals are not obstruents. This linking with nasals can occur either in the coda position, or in the nucleus position with a syllabic /n̩/, since in both of these instances the nasal is linked to a mora. The syllabic /n̩/, shown below, is found in forms where contraction has occurred and as a result of a vowel ellision, an original nasal onset has become the sole nucleus of a syllable. The syllabic nasal in the contracted form is allowed to retain the original tone of the syllable.

L H L	L H L	
μ μ μ μμ	μμ μ μμ	
de^i?.na.dạ?	de^i?.n̩.dạ?	"in order to"

We have now considered the three constraints which have to do with the linking of tone with mora; LINK, INTERPRETABILITY, and NOCONTOUR. In the Mamaindé tone system, these individual constraints can usually be grouped together and be referred to as a single family; the LINK constraints. Through the rest of this paper, I will simply assume that the LINK constraints are the highest ranking of all the constraints which deal with tone, even though they will not appear on individual tableaus.

6. Plateauing in Mamaindé verbs

As we have already mentioned, in Mamaindé, each mora of each syllable is lexically defined for tone. Typically, this means that no matter where a morpheme might occur it will usually have the same tone pattern. This can be illustrated below:[23]

(13)

Verb root	**followed by L**		**followed by H**	
H	H L H		H H H	
wan	*wan - la.twa*	'he is returning'	*wa: - naʔ.wa*	'I am returning'
L	L L H		L H H	
da	*da: - la.twa*	'he is falling'	*da: - aʔ.wa*	'I am falling'
L H	L H L H		L H H H	
wɨ	*wɨ: - la.twa*	'he is eating'	*wɨ: - aʔ.wa*	'I am eating'

[23] Here, as with most of the examples in this paper, I have selected a small number of frames to use with each verb stem in order to minimize the influence from different intonation patterns. The constant repetition of the 3rd person present tense forms is intentional.

There are, however, environments where tone sandhi is evident. This can be seen in forms such as the one below.

(14)

Verb root	**suffix**	**linking tone and mora**	**surface form**	***gloss***
L HL	L H	L HL L H	L HL L H	
sanĩn	*-la.twa*	*sənĩn - la.twa*	*sənĩn - la.twa*	*'he is happy'*
L HL	H H	L H L H H	L H H H	
sanĩn	*-naʔ.wa*	*sənĩː -naʔ.wa*	*sənĩː -naʔ.wa*	*'I am happy'*

As in the example above, the locus of most Mamaindé tone sandhi is within the verb stem.[24] This occurs when a verb root with a HL on its last syllable is followed by a high tone on the next syllable. (Kingston mentions this tone sandhi in Tone Curves and Perturbation, p 11). Let's take a closer look at the verb */sanĩn/*, which ends with a HL pattern on the last syllable. First we will show the root followed by a low tone, the 3rd person present tense ending */-latwa/*. Notice that the pitch graph shows a definite L tone on the last syllable of the root.[25]

[24] Nouns and other word classes also have lexical tone, but do not display much evidence of tone alternations.

[25] The reader may at first object to my interpretation of this tone graph, in particular the HL pattern with which I have analyzed the highlighted syllable /nĩn/. Although this may look more like both a rise and a fall in tone, or a LHL, we must remember that the actual tone bearing units in this language are only the segments of the rhyme, i.e., the nucleus and the coda. Therefore we must be careful not to assign tone to every change in pitch, but only to those changes in pitch which are distinctive in this language. Since the rising portion of this syllable corresponds to a non-tone bearing unit, or the articulation of the onset, we will disregard it as simply a phonetic process by which the speech organs are preparing themselves for the high tone on the following vowel. My analysis of other tone graphs throughout this paper will also disregard the tone of the onset.

(15)

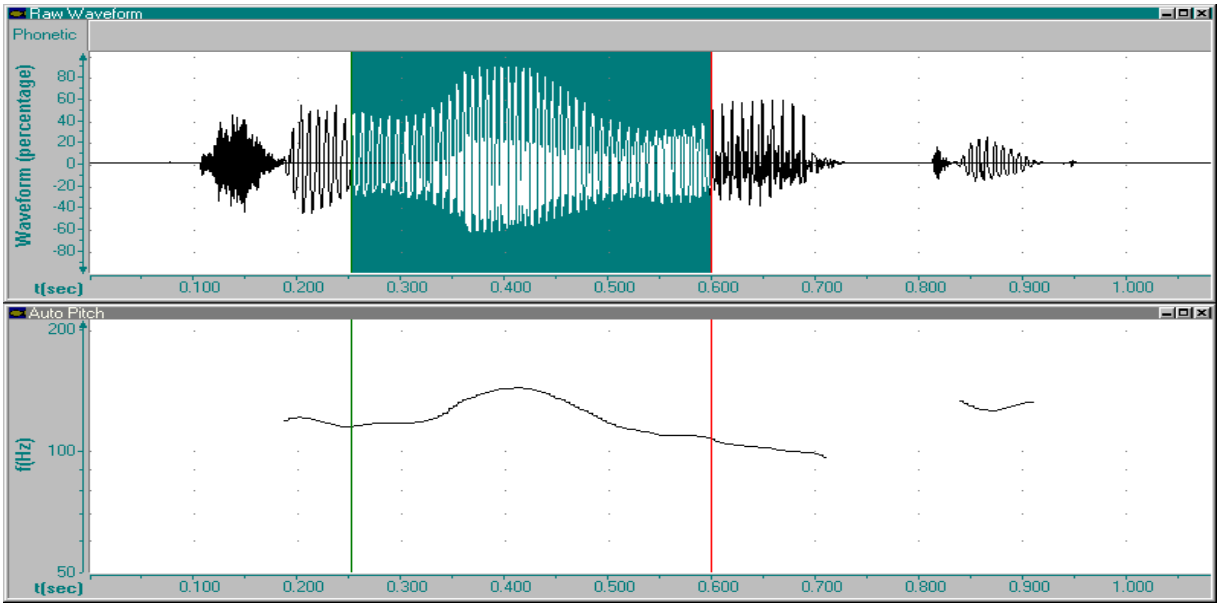
L H L L H

μ μμ μ μ

sa nĩn] la twa 'he is happy'

L HL L H

sə nĩn lat wa



We find that a HL pattern on the last syllable of a verb root will always remain unaltered as long as it is followed by a L tone in the next morpheme. However, if it is followed by a H in the next syllable, the HL on the root changes to a simple H tone, as demonstrated in the form below. [26]

[26] Although the syllable /*nĩn*/ in this form may appear to carry a rising tone, I am regarding it as a simple H since the beginning of the vowel starts at a frequency which is already in the H tone range of this speaker and goes up from there. Until we are obliged to posit a super-H tone for Mamainde, we will stay with a two tone analysis and view these forms as instances of simple H.

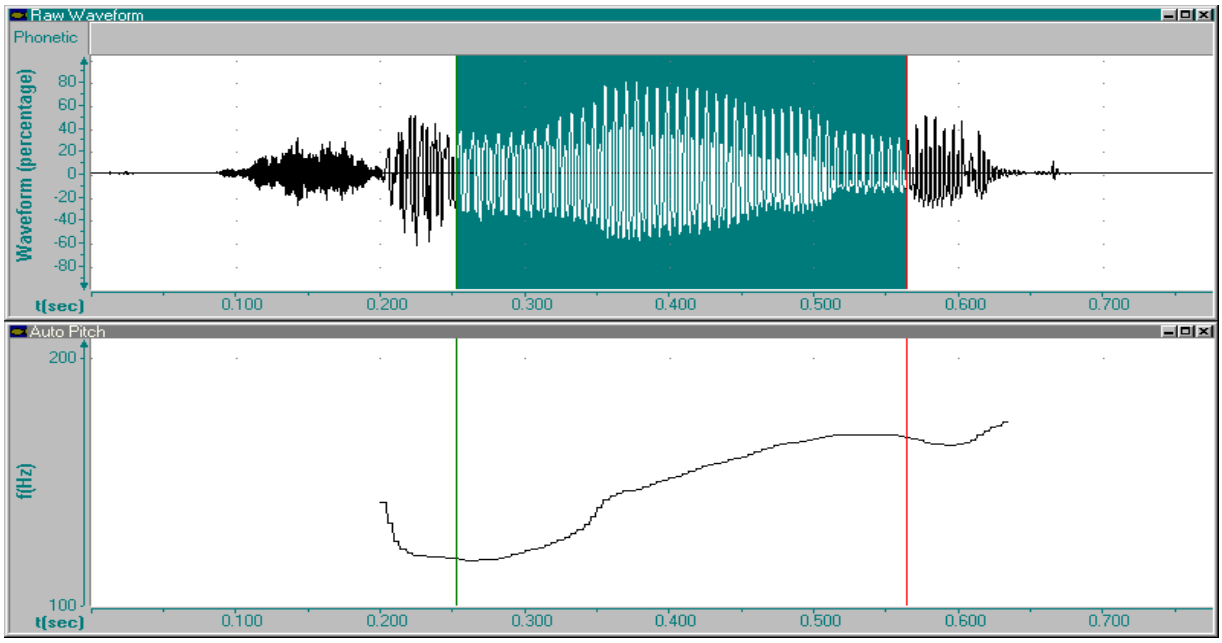
(16)

L H L H H

μ μμ μμ μ

sa nĩː naʔ wa ' I am happy'

sə nĩː naʔ wa



All roots ending with a HL pattern on the last syllable undergo this tone change before another H. Other examples can be seen below[27]:

(17)

HL H H H

ʔjaih-hĩʔ > *ʔjaih-hĩʔ*

sad-then ‘sad, the

HL H H H H H

tu-henʃoʔ > *ɗuː-heᵍŋʃoʔ*

get-always ‘always getting’

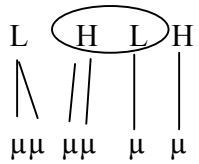
[27] This data involves a contracted form as well as several alternations including devoicing, implosion, and vowel feature spreading to coda consonants. These processes can not be discussed here for lack of space.

HL H H L H H H H L H
se^{i}k-ki-da-latwa > *se^{i}k-gi-ɾa-latwa*
speak-about-1pOB-3pSU-NonInterogative ‘he is speaking about me’

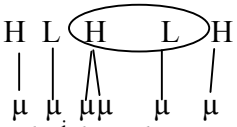
L HL H H H L H H H H
waʔnĩn-t^{h}unnawa > *waʔñin-t^{h}u^{d}nawa*
perform.magic-3pSU-FUT-NonInterogative ‘he will perform magic’

Of course the most straightforward way to analyze this tone change would be to posit that the underlying representation on the last syllable of the root in each case is not HL at all, but a simple H. Before another H it remains H. Then, when it occurs before L, the L spreads to the left creating a HL pattern. This would be a straightforward analysis needing few constraints. Unfortunately, this simple analysis won't work when we look at the rest of the data. MD has many verb roots which end with a simple H tone. When these are followed by a morpheme with a L tone, they never perturb to HL. For example:

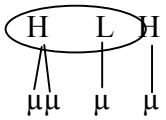
(18)



a) *taʔluk] latwa* ' he/she is coughing'

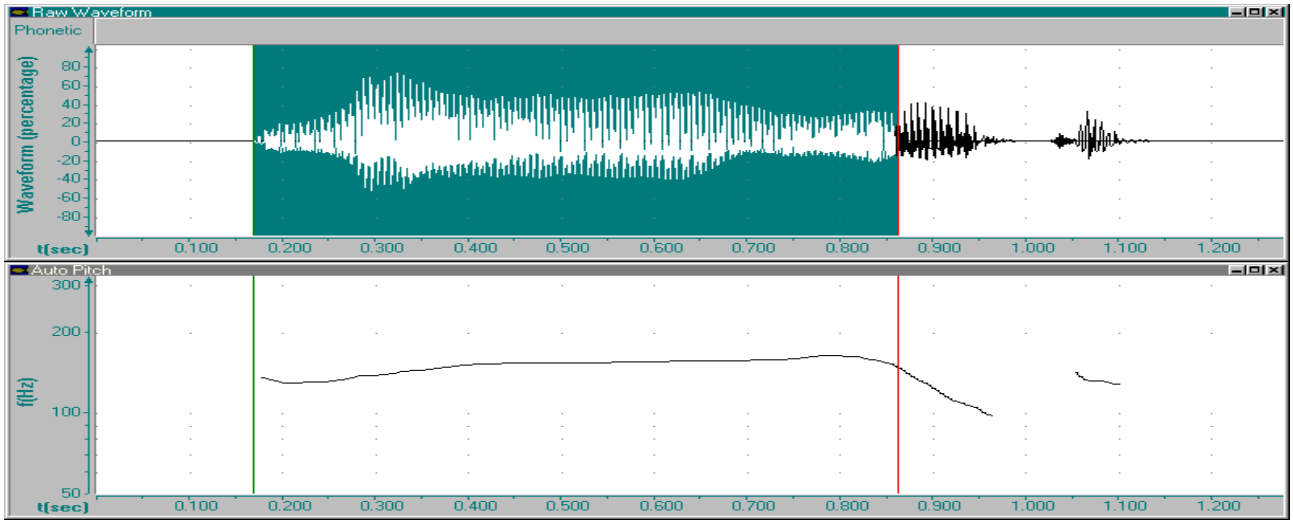


b) *jaha^{i}dũn] latwa* 'he/she is shy'



c) *wan] latwa* 'he/she is returning'

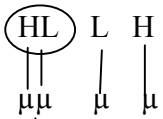
H	*L*	*H*
wan	*lat*	*wa*



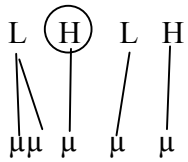
(18b&c are shown with only one instance of H spreading to two mora so as not to violate the OCP. However, since there are two tone bearing units in these forms, there is no reason within Mamaindé phonology why these could not be represented with two adjacent H tones.)

Examples such as the ones above show that an H before an L does not perturb to HL. In fact, we get all the four possible tone patterns exhibited before an L.

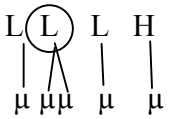
(19)



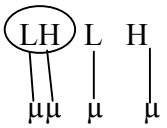
a) *ˌʔjaʲh] latwa* ‘he is sad’



b) *suhnə] latwa* ‘he is afraid’



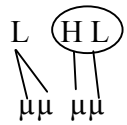
c) *kəloː] latwa* ‘it grows’



d) *wa̱ː] latwa* ‘he comes’

More evidence for HL as an underlying tone pattern on some syllables comes from examples where the HL is permitted in word final position, such as in the following form:

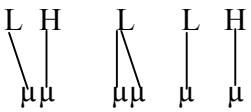
(20)



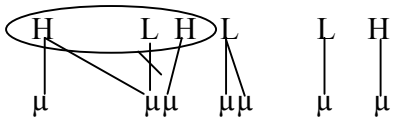
haʔdĩŋ 'quickly'

Forms such as the one above, however, could also suggest another alternative. This involves positing a toneless mora at the right edge of roots which undergo sandhi, such as */sanĩn/* or */haʔdĩn/*. This final mora could then get filled in with H when followed by H, or L when followed by L or end of word. Although plausible for the data cited thus far, this approach runs into problems with forms where the tone sandhi occurs at the left edge of the verb, as opposed to the right. Notice what happens to the tone on the root */wa̱/* ‘come’ when a causative prefix is added.

(21)



a) *[wa̱ː] - nũn- latwa*
‘come –again –3.present.noninterog.’ = ‘it/he is coming again’



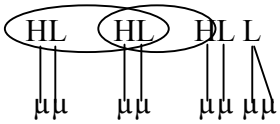
b) ta - wa: -nũn - latwa

'causative – come – again - 3.present.noninterog' = 'he is causing it to come again'

If we continued to assume toneless moras instead of tone sandhi, we would now be forced to posit toneless morphemes at *both* edges of the root, sometimes on the right, sometimes on the left. At times these toneless mora would be the original mora of the root syllable, while at other times they would fill the slot of the extra length of the vowel. Such an adhoc use of the notion of toneless mora would be so overly powerful that it would explain very little.

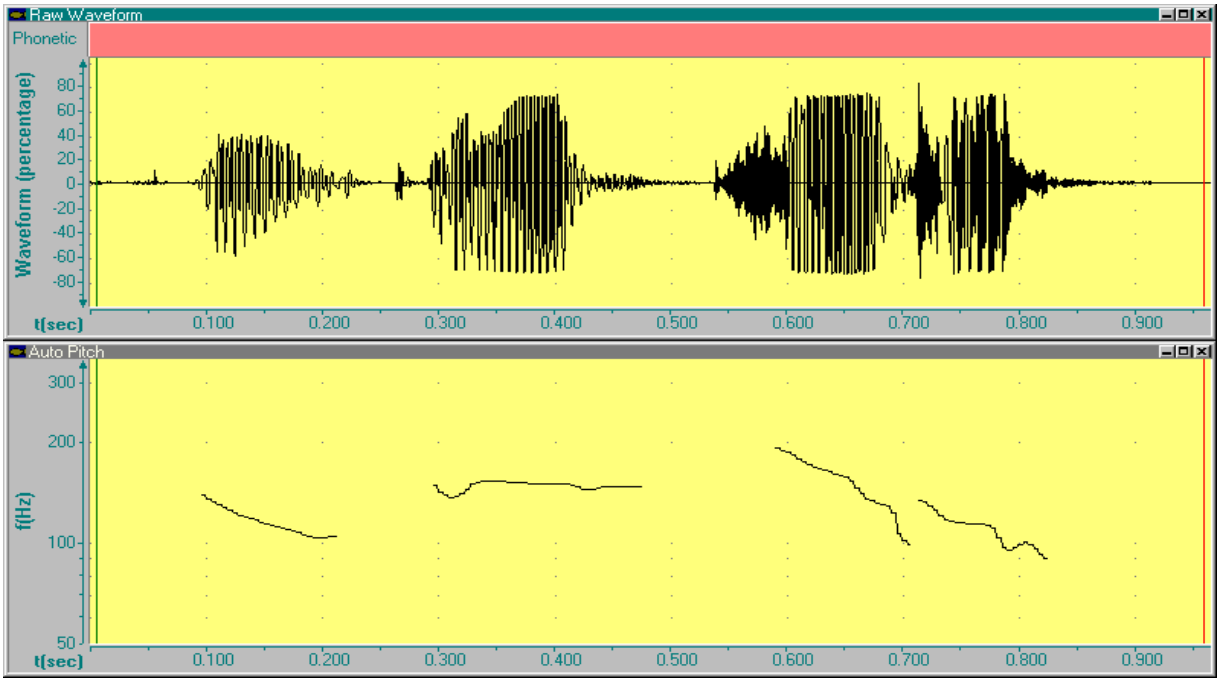
Finally, the 'toneless mora' approach would simply be unable to account for forms where the L is not peripheral at all, such as when it is embedded within a compound verb stem. Below we have the complex verb stem */tu-ʔnĩ^{u}/* 'get-return' = 'bring', followed by the suffix */-sihta̲ʔ/* 'in order to', which gets resyllabified as *[du̲ʔ.nĩ^{u}p.sih.ɾa̲ʔ].* (The /p/ is an epenthetical consonant which is the result of vowel feature spreading which we are not concerned with at this time). Here we have the form with the underlying tones. Notice it has two instances of HLH:

(22)



tuʔ - nĩ^{u}p - sihta̲ʔ 'in order to bring'

HL	H	HL	L
duʔ	*nĩ^{u}p*	*sih*	*ɾa̰ʔ*

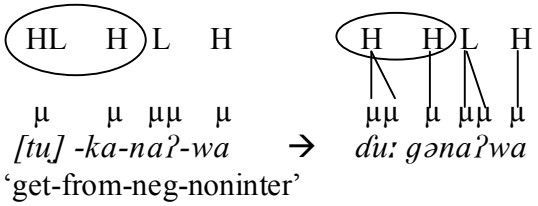


Although the L tone in the second syllable gets deleted,[28] the L of /*tu*/, 'get', is obviously still present in the first syllable, located between two H's and not adjacent to the word edge. Here the L must clearly be an underlying tone. Toneless moras cannot explain its presence.

But in other contexts the L *is* deleted. For example, the same root */tu/* in a different form *[duːgənaʔwa]* 'he did not get it (from him)' loses its association to L. See below:

[28] This deletion of the L on [nìup] follows the pattern in (16) where a HL on the root boundary goes to H before an H in the following suffix. This deletion does not apply to the first syllable, however, since it is not peripheral and is embedded within the stem.

(23)

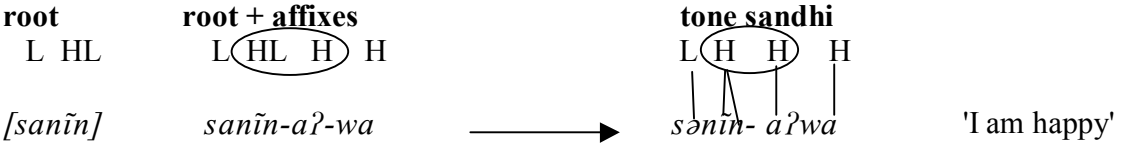


This type of behavior cannot be accounted for except by positing that the L was there underlyingly, and that there is some type of constraint, or group of constraints, operating in the language which would cause the L to delete in certain environments. The HL and LH sequences, therefore, must be regarded as part of the lexical form of certain vowel roots. The following pages will present a single solution that will account for both types of tone sandhi occurring in these forms.

7. The constraints

Given the underlying tones described thus far, we will now attempt, by means of constraints, to account for the tone changes in verbs like */sanĩnaʔwa/* below, where a HL pattern on the last syllable of the root becomes simple H.

(24)



However, before constructing formal constraints, I will run the risk of oversimplifying in order to paint a general picture of what seems to be going on in three, simple prose statements.

Four general observations regarding tone plateauing in Mamaindé verbs:

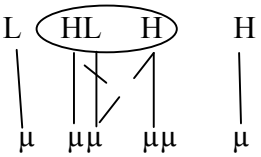
- ***HLH is not permitted in certain contexts***
- ***The repair strategy involves the deletion of the L tone (never a high).***
- ***This deletion occurs only within polytonic syllables (multiple-tone syllables), never unitonic (single-tone syllables).***
- ***Lastly, deletion of L occurs only when the L is located at the edge of a stem (never elsewhere).***

In the following section we will define the constraints needed to account for these observations.

7.1 The HLH sequence

The heart of the tone sandhi issue in Mamaindé verbs revolves around sequences of HLH. There seems to be some sort of restriction against any HLH sequences in certain contexts (across the verb stem/affix boundary). When this illegal sequence occurs, the intermediate L is always delinked. Autosegmentally this could be looked at as tone spreading and a consequent de-linking.

(25)



sə nĩn] - aʔ - wa 'I am happy'

This prohibition against HLH appears to be quite common in many languages, particularly in the Bantu family of Africa. As Odden points out (2001), this phenomenon of HLH becoming HHH is sometimes referred to as "plateauing" in African languages[29]. Yip (2002:137) mentions a *TROUGH constraint in regards to Digo, a Bantu language. KiHunde, another Bantu language of

[29] Cahill adds that "there is the additional complexity of downstep in this process in some African languages"(p.c.)

Eastern Zaire, has a Plateauing rule which also disallows HLH (Goldsmith, 1990:36). This restriction is also evident in Deg (Crouch, 1994), and Mianmin (Cahill, 2000). Plateauing even seems to make its presence felt in several dialects of Chinese. Cantonese Chinese (see Yip, 2002:175) disallows a 535 tonal sequence across certain syllable boundaries, replacing it with 555, thus achieving a plateauing effect (in Asian tonology, tone numbers were traditionally assigned with 5 being the highest tone and 1 the lowest). Mandarin Chinese (see Norman, 1988:147-8) exhibits the well-known sandhi of the 'third tone' (the 'third tone' is actually a 214 contour which obviously contains a trough). When a sequence of two third tones occurs in adjacent syllables, the first 214 contour will change to a simple rising tone. Again, it appears that a prohibition against HLH is motivating all these changes. So we will adopt the constraint already found in the literature:

***TROUGH**
The sequence HLH does not occur in the output

I believe that what occurs in Bantu and other languages is roughly the same process that is occurring in Mamaindé as well. But in Mamaindé, we will soon see that the effects of plateauing are only felt in a very specific domain, namely, at the verb stem+affix boundary.

The simple tableau below, using the form */sanĩnaʔwa/* 'I'm happy', does not intend to show a large field of candidates or constraints. What it does do is to show that a restriction on HLH exists in the language and that the *TROUGH constraint is therefore necessary.

Tableau 1

	L HL H H sanĩn]- aʔ-wa	*TROUGH
	L HL H H sanĩn aʔwa	*!
☞	L H H H sa nĩn aʔwa	

7.2 The L deletion

Second, we must account for the fact that when we get tone sandhi in Mamaindé verbs, the L of a HL pattern deletes while the H does not. The motivation for this behavior is a familiar one. It is simply the result of two very common faithfulness constraints which are crucially ranked in respect to each other. The first one is:

MAXH
H tones in the input have an identical correspondent in the output

This means that when there is a H tone in the input, it must also appear in the output. Or to put another way, H tones will not be deleted.

The second constraint is it's opposite:

MAXL
L tones in the input have an identical correspondent in the output

The way we account for L tone deletion is by ranking MAXH higher than MAXL. This ranking of H and L is fairly common cross-linguistically and has been proposed as a harmonic or universal

ranking by Pulleyblank (1997:92). It is no surprise that we see these same constraints and this same ranking in the Mamaindé data.

MAXH > *MAXL*

This constraint ranking means that H tone is more stable than L. The end result is that when we get a LH or HL pattern in Mamaindé, the language will feel pressure to delete the L, but never the H. The H remains stable[30].

When we add these faithfulness constraints to *TROUGH, we find that *TROUGH is crucially ranked in respect to MAXL.

Tableau 2

	L HL H H *sanĩn] -aʔ-wa*	MAXH	*TROUGH	MAXL
	L HL H H *sanĩn aʔwa*		*!	
	L LL H H *sanĩn aʔwa*	*!		
☞	L H H H *sanĩn aʔwa*			*
	L HL L H *sanĩn aʔwa*	*!		

[30] There is some phonetic evidence that the deletion of the L causes a downstep effect on the two surrounding H tones. If the L tone is only disassociated and not actually deleted, it could remain floating and still be available to form tonal feet with the H tones, thus producing the downstep. This is an interesting area for further research.

As this tableau illustrates, *TROUGH must be ranked higher than MAXL for the optimum candidate to be chosen. The correct ranking of these three constraints then is:

*MAXH; *TROUGH>> MAXL*

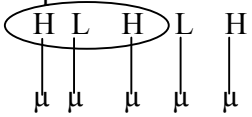
7.3 Polytonic vs. Unitonic

Next we must account for the fact that this perturbation only occurs within polytonic syllables (those syllables which carry more than one tone).

When a polytonic syllable is part of the undesirable HLH sequence mentioned above, the L tone is deleted as in tableau 1. However, if all the syllables in the HLH pattern are unitonic (syllables with only one tone), no tone sandhi occurs.

(26)

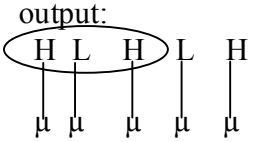
input:



tanu̯]- ta- latwa

'give-2DO-3.present.noninterog.' = 'he is giving (it) to me'

output:



danu̯:]- ɾa- latwa

In the same way that many languages prefer register tones to contour tones (Pulleyblank, 1997:97), it appears that there is a pressure within Mamaindé to prefer unitonic syllables to polytonic ones. Since polytonic syllables can be considered more complex than unitonic ones, with more tones in the same domain of speech, then we can motivate this aspect of Mamaindé

phonology by way of a general articulatory principle which tends to simplify the tone systems of languages.

What is needed in this case is a way to ensure that polytonic syllables undergo sandhi before unitonic ones. At this juncture I will propose a pair of faithfulness constraints.

FAITHUNITONIC
Every unitonic syllable in the input has the same single tone in the output.

FAITHPOLYTONIC
Every polytonic syllable in the input has the same multiple tones in the output.

These constraints can be violated either by the deletion or the addition of a tone. By ranking FAITHUNITONIC over FAITHPOLYTONIC we arrive at a system where unitonic syllables are the most stable and will not undergo either of these changes. Here is the constraint ranking for the constraints we have thus far:

MAXH; FAITHUNITONIC > **TROUGH* > *FAITHPOLYTONIC; MAXL*

The following tableau shows the word *[danu:ɾalatwa]* 'he is giving it to me' as an example of a form with all unitonic syllables. Notice that no sandhi occurs[31].

[31] I use a lengthened vowel in the input in this tableau and elsewhere since the constraints which deal with stress, and consequently length, are not in focus here.

Tableau 3 H.L+H pattern

danu:ɾalatwa - 'he is giving it to me'

	H L H L H *[tanu]- ta-latwa*	MAX H	FAITH UNIT	*TROUGH	FAITH POLYT	MAX L
☞	H L H L H *danu: ɾalatwa*			*		
	H H H L H *danu: ɾalatwa*		*!			*
	H L L L H *danu: ɾalatwa*	*!	*			
	L L H L H *danu: ɾalatwa*	*!	*			
	H H L L H *danu: ɾalatwa*	*!	*			*

If we used the *TROUGH constraint without appealing to FAITHUNITONIC, or if FAITHUNITONIC was ranked below *TROUGH, then the grammar would wrongly choose the second candidate as the optimal output. But by adding these two faithfulness constraints and ranking FAITHUNITONIC above *TROUGH, verb stems with faithful unitonic syllables (such as the form above) satisfy the FAITHUNITONIC constraint before violating *TROUGH.

The tableau below shows a form with a polytonic root in an environment where sandhi occurs. Here *TROUGH must outrank FAITHPOLYTONIC.

Tableau 4 HL+H pattern

ɗu:aʔwa - 'I am getting'

	HL H H *[tu:] - aʔwa*	MAX H	FAITH UNIT	*TROUGH	FAITH POLYT	MAX L
	H L H H *ɗu: aʔwa*			*!		
☞	H H H *ɗu: aʔwa*				*	*
	L H H *ɗu: aʔwa*	*!			*	
	HL L H *ɗu: aʔwa*	*!	*			
	L L H *ɗu: aʔwa*	*!	*		*	
	H L H *ɗu: aʔwa*	*!	*	*	*	*
	HL LH H *ɗu: aʔwa*		*!			

If *TROUGH is productive in this language, we would also expect it to apply to other combinations of HLH, such as H+LH. Thus, if a prefix had a H tone, we would expect it to cause the deletion of L in a LH sequence at the beginning of the stem. And this is exactly what we see happening in the form below, which has a H tone prefix.

Tableau 5

H + [LH pattern with a prefix

tawa:nũnlatwa - 'he is causing it to return again'

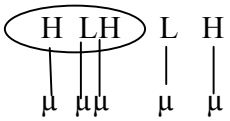
	H LH L L H *ta -[wa:]- nun-latwa*	MAX H	FAITHUNIT	*TROUGH	FAITHPOLYT	MAX L
	H LH L L H *ta wa: nũnlatwa*			*!		
☞	H H L L H *ta wa: nũnlatwa*				*	*
	H L L L H *ta wa: nũnlatwa*	*!			*	
	L L L L H *ta wa: nũnlatwa*	**!	*		*	
	L LH L L H *ta wa: nũnlatwa*	*!	*			

Although other examples like the ones above exist, they are relatively few. HL patterns are simplified to H much more often than LH patterns. The reason for this comes from the distribution of tones and their morphological environment. Since this language has many suffixes and few prefixes, in particular few prefixes with H tone, the LH tones on stems will rarely follow a morpheme with H tone and thus will rarely be affected by the *TROUGH constraint.

7.4 The stem/affix boundary

The biggest difficulty with an OT account of Mamainde tone is the fact that plateauing in verbs occurs only in a very specific environment, namely, across a stem/affix boundary. In other positions, such as within the root, the HLH sequence is permitted, as illustrated in the form */wanũnlatwa/* 'it is good' (the stem/affix boundary is indicated by the right bracket in the form below).

(27)

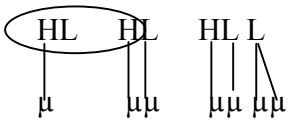


wənũn]- latwa ‘it’s good’

A similar exception to the *TROUGH constraint can be found in compound stems, where the HLH sequence is internal to the stem. We notice again that in these cases the HLH is permitted (again a bracket marks the stem/affix boundary).

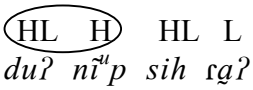
(28)

input:



tu+ʔnĩ^{u}p] sihtɡ̲ʔ ‘in order to bring’
get+return] – CONN

output:



duʔ nĩ^{u}p sih ɾɡ̲ʔ

Notice in the above form that the second instance of HLH must be resolved by plateauing because it occurs across the stem boundary, while the HLH internal to the stem is allowed to violate *TROUGH.

This new information requires two more constraints. These however, must refer to specific morphological structures such as stem and affix. Kager (1999:407) calls these positional faithfulness constraints. Since certain domains are commonly more marked than others, several Ident constraints have been proposed in the literature which relate a specific feature to a specific

edge of a specific domain (Kager, 1999:409,418). The assumption seems to be that positional constraints should be restricted to referring to a whole domain, or to the edge of it. In Mamainde, however, what is needed is a faithfulness constraint which can refer to constituents that are not at *any* edge of a morphological domain, since we have seen that tones internal to the stem are never deleted, while those at either stem boundary are subject to deletion.

Such a non-conventional use of positional constraints is problematic within OT. While the language data calls for some way to allow constraints to reference the middle of a domain, current theory would disallow such constraints on the grounds that they do not consititute a 'natural class' and thus lack any typological motivation. Until a better solution is found, I am forced to resort to a less than satisfactory analysis, keeping in mind that a better way might still be possible. We will come back to this important point in the conclusion.

To restrict HLH sequences across stem boundaries, and yet allow them within the stem, I will employ the following pair of faithfulness constraints, the first of which admittedly appears to be rather language specific.

IDENT-IO(T-STEMMID)
An output tone internal to the stem is identical to its input correspondent.
This constraint enforces faithfulness on stem tones which are stem internal, and thus not located at a stem/affix boundary. Although problematic for the reasons raised above (such as not referencing a natural class), this constraint might be argued for in the following way. When the morphemes of a highly agglutinative language are lexically marked for tone, it follows that the

logical environment for a tone to be affected by other tones around it is when morphemes are juxtaposed, either at the morpheme, stem, or word boundary.

The previous constraint, IDENT-IO(T-STEMMID), reffered to a highly specific domain. Now here is the more general constraint that is the counterpart of the more specific one:

IDENT-IO(T-STEM)
An output tone anywhere in the stem is identical to its input correspondent.

This more general constraint seems quite natural since stems, like roots, are often treated as the more salient position. And as one would expect, the more specific positional faithfulness constraint outranks the more general faithfulness constraint according to a universal ranking (or harmony scale) commonly recognized within OT. (Krager, 1999:409). Thus we get the following ranking of these two contraints in respect to *TROUGH:

*IDENT-IO(T-STEMMID) > *TROUGH > IDENT-IO(T-STEM),*

Here is a tableau for a form we have already seen, *[duʔ-nĩʷp-sihɾgʔ],* which includes two sequences of HLH, the first of which is allowed to violate *TROUGH in favor of satisfying IDENT–IO(T-STEMMID), while the second does not violate IDENT-IO(T-STEMMID), and must then delete the L in order not to incur a fatal violation of *TROUGH.

Tableau 6

HLH internal to the stem

du-ʔnĩ^{u}p]sihɾgʔ - 'in order to bring'

	HL HL HL L *duʔ-nĩ^{u}p] sihɾgʔ*	MAX H	FAITH UNIT	IDENT-IO (T-STEMMID)	*TROUGH	FAITH POLYT	MAX L	IDENT-IO (T-STEM)
	HL HL HL L *duʔ-nĩ^{u}p] sihɾgʔ*				**!			
☞	HL H HL L *duʔ-nĩ^{u}p] sihɾgʔ*				*	*	*	*
	H HL HL L *duʔ-nĩ^{u}p] sihɾgʔ*			*!	*	*	*	*
	H H HL L *duʔ-nĩ^{u}p] sihɾgʔ*			*!		**	**	*
	HL HL L L *duʔ-nĩ^{u}p] sihɾgʔ*	*!	*		*			

Notice that both of these positional constraints are crucially ranked in respect to *TROUGH. If IDENT-IO(T-STEMMID) were ranked below *TROUGH. If this were not the case, the third candidate would have been chosen as the optimal output. Likewise, if the more general IDENT-IO(T-STEM) were ranked above *TROUGH, the optimal output would have been the first candidate.

As we mentioned earlier, this approach is problematic since it employs a language specific constraint. The only other alternative open to us within OT would be to posit a positional markedness constraint instead of the positional faithfulness constraint. This new markedness constraint would have to reference the tones at the stem/affix boundary instead of the tones internal to the stem. It could be worded in the following manner:

***TROUGH(STEM/AFFIXEDGE)**
HLH does not occur across the stem/affix boundary

This specific constraint would then presumably be ranked higher than the more general *TROUGH constraint.

**TROUGH(STEM/AFFIXEDGE)* > **TROUGH*

But this analysis is still just as language specific as the previous one. And it doesn't seem to be able to explain why we don't get plateauing when the L is internal to the stem (instead of on the stem edge), unless we do away with the more general *TROUGH. To posit a very specific positional constraint (which is questionable) without also recognizing the more general constraint (which has already been attested to in various languages) is clearly not the right direction to go, so we will not pursue this alternative any further.

7.5 The Final Constraint Ranking

Our final constraint ranking for tone in Mamaindé verbs is the following:

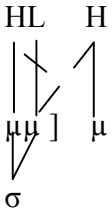
MAXH; FAITHUNIT
> *IDENT-IO(T-STEMMID)*
> **TROUGH*
> *FAITHPOLYT; MAXL: IDENT-IO(T-STEM)*

8. Conclusion

This paper has been a description of the Mamaindé tone system using an OT framework, with the particular purpose of understanding the motivation behind the plateauing of tones found in this language. First, we demonstrated that tone, intonation, and stress are distinct in Mamaindé, but we also pointed out that the tone system is based on the foundation of the mora in much the same way that the stress system is based on the concept of syllable weight. Secondly, we were able to describe this tone system without having to resort to contour tones. Finally, we analyzed plateauing as a restriction on HLH sequences in specific contexts, and were able to account for this tonal behaviour by proposing a set of 7 constraints.

But maybe the most important outcome has been that the OT analysis described here is not totally satisfactory. The fact that this language requires some way to refer to the faithfulness of tones which are internal to a given domain, as opposed to peripheral constituents of it, is a problem for current theory because these do not constitute a 'natural class'. Our analysis, then, has been forced to include a positional constraint (IDENT-IO[T-STEMMID]) which refers to morphological structure in a way that appears more language specific than universal. When we realize that autosegmental theory can account for all of the constraints in this paper by means of a single autosegmental rule we are forced to pause and wonder.

An autosegmental representation of plateauing in Mamaindé verbs:
(where] refers to the verb stem boundary)



= mirror image rule

But of course the autosegmental rule above is even more language specific since it combines the effects of 7 constraints into one rule. Clearly, such a rule has less typological motivation and phonetic grounding than the IDENT-IO constraint mentioned earlier. So we are left with the end result that neither model can account for Mamaindé tone changes in a manner that is completely satisfactory.

While we would certainly welcome any improvements to the solution presented in this paper, the conclusion we must come to is that whatever theoretical framework we employ, we are forced to refer to morphological structure in unique ways at some point in order to account for the behaviour of tonal features in this language.

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