SILVA, Glauber Romling da. **A feature geometric analysis of Pirahã phonology and tonology (Mura).** Revista LinguíStica / Revista do Programa de Pós-Graduação em Linguística da Universidade Federal do Rio de Janeiro. Volume 10, número 2, dezembro de 2014. ISSN 1808-835X 1. [http://www.letras.ufrj.br/poslinguistica/revistalinguistica]

A FEATURE GEOMETRIC ANALYSIS OF PIRAHÃ PHONOLOGY AND TONOLOGY (MURA)

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ABSTRACT

In this squib we review some facts about Pirahã tonology presented in previous works (Everett (1979), Everett (1983), Sheldon (1974, 1988), K. Everett (1988)) with new data. Initially, we present the main aspects of the segmental phonology and syllable structure. Then, we talk about phonetic tones and present the results of pitch measurements in nouns in isolation. We proceed to the tonological analysis of the Pirahã system describing the nominal tonal patterns found. According to D. Everett (1979) *apud* K. Everett (1998, p.108) Pirahã has two phonological tones, L (low) and H (high), which are realized through four possible tone patterns: H, L, LH and HL. The two latter contour tones - rising or falling - are argued to be the result of sequences of level tones. We present preliminary evidence that the four phonological tones possible on syllables in Pirahã result from distribution across two registers: [+stiff] and [-stiff] (Bao, 1999), with rising and falling tones interpreted as units. Their allotones are further encoded by the features [+slack] and [-slack].

KEYWORDS: Pirahã, tone, contour tones, feature geometry.

RESUMO

Neste trabalho revisamos alguns fatos da fonologia e da tonologia Pirahã apresentados em alguns trabalhos anteriores (Everett (1983), Sheldon (1974, 1988), K.Everett (1998)) com novos dados. Inicialmente apresentamos os principais aspectos da fonologia segmental e da estrutura silábica. Falamos sobre tons fonéticos e apresentamos resultados de medições de pitch em nomes em isolamento. Procedemos à análise tonológica do sistema Pirahã descrevendo os padrões tonais encontrados em nomes. De acordo com D. Everett (1979) apud K. Everett (1998, p.108) Pirahã tem dois tons fonológicos, L (baixo) e H (alto), que são realizados em quatro padrões tonais possíveis: H, L, LH e HL. Sequências ascendentes e descendentes são interpretadas como sequências de tons nivelados. Apresentamos evidências preliminares de que Pirahã em seu atual estágio tem quatro tons: baixo, alto, ascendente e descendente distribuídos em dois registros, [+stiff] and [-stiff] (Bao, 1999), com tons ascendentes e descendentes interpretados como unidades. Seus alotons são codificados pelos traços [+slack] e [-slack].

PALAVRAS-CHAVE: Pirahã, tom, tons de contorno, geometria de traços.

1. This research was funded with resources from FAPESP (2013/11693-7) and CNPq (478189-2013-3, 2012/17869-7).

1. INTRODUCTION

Pirahã is described as a lexical tone language. It has been described as a system with four phonetic tones and two phonemic level tones, not analyzing sequences as contour tones (units) by D. Everett (1983) and K. Everett (1998). On the other hand, Sheldon (1974, 1988) described Pirahã as a three level system.

We argument for the existence of contour tones based on the fact that if we consider this possibility we can capture the generalization that **the first tone must be mapped only within the first syllable** (It only spreads if it is alone in the same word). Previous approaches, adopting only level tones, lose this robust generalization.

We describe Pirahã with four phonemic tones, low, high, falling and rising, distributed in two registers: a [+stiff] and a [-stiff] (Bao, 1999). The [+stiff] register has the following phonemic tones (with their respective allotones indicated in *italics*): 3 (L), 4 (H), 42, *43* (HL) and 23, *24*, *34* (LH). The [-stiff] register has the following tones: 1 (l), 2 (h), 32, *31* (hl) and (lh) 13, *14*. The allotone *34* is caused by an upstep when followed by the 23 tone. All the another allotones occur initially when the first syllable is (C)VV(j,w).

We organize this squib as follows: we present the basic information about the language and people in section 2. After a brief note on data and methodology in section 3, in section 4 we review the main aspects of Pirahã segmental phonology and propose a feature representation (Clements & Hume, 1995) to account for the free variation observed in obstruents and nasals in post-pausal position, namely (/ʔ,g/ → [n], /b/→ [m]). We claim that the glottal and the velar do not have a place of articulation feature [dorsal] specified and as a result they have the same output [n]. If we consider that /h/ also does not have a [dorsal] feature specified, this perfectly explains its occurrence as the output of the debuccalization /s/ → [h] before the [coronal] /i/, a process which is optional for men and stable for women. In section 5, we propose the syllable structure (C)V(V)(j,w) for Pirahã. In section 6 we confirm, based on acoustic and statistical analysis, as has been claimed previously (D. Everett, 1983, K. Everett 1998) that Pirahã has four phonetic tones. In section 7, we present arguments for our tonological analysis based on contour tones and on section 8 we offer concluding remarks.

2. LANGUAGE AND PEOPLE

Currently the Pirahã are 740 people (IBGE, 2010) who live on the borders of the Maici and Marmelos rivers (Madeira river tributaries) in the Humaitá municipality, in the south of state of Amazonas, Brazil. Most men show rudimentary control of the Portuguese language. While women seem to have the same command of Portuguese, they do not express themselves in a non-native language (Goncalves, 2001).

3. A NOTE ON DATA AND METHODOLOGY

For this preliminary analysis, we elicited and transcribed 125 words with a 24 year old male speaker from the Piquiá village. We asked the consultant to repeat each token more than once and selected as the clearest word one in an intermediary position. For pitch extraction we selected each phone with the PRAAT software (Boersma, 2002) and ran the script "collect data from two tiers", created by Mietta Lennes and available on the internet. For the statistical analysis, we ran a one-way ANOVA test with the GraphPadPrism software. All sessions were recorded on digital recorders and saved in wav format. They were analyzed in PRAAT using the recommended standards for male voices, i.e., 75Hz to 300Hz (Oh, 2011).

The orthographic representation that will be used in the section 7 is all phonemic: one phoneme, one grapheme. The only difference in contrast with Everett's orthography is the adoption of the graphemes <j> and <w> to express the approximants in all contexts (Everett uses <i> and <o>, respectively).

The tonal phonetic notation adopted will follow the Chinese tradition of the 'Chao tone letters', Chao (1980): 1 is the lowest tone and 4, the highest. The tonal phonemic notation will only be used when necessary.

4. SEGMENTAL PHONOLOGY

Pirahã presents a 10 (up to 12) consonant inventory. A series of obstruents in split into [-continuant] and [+continuant], and a series of sonorants, divided in [+nasal] and [+approximant]. Stable allophones are in *italics* after an '→' and free allophones are after a '~' on Table 1. Dubious phonemes are in parenthesis. Previous work does not include the approximant series, nor the consonant /m/. We represent the phonemes based on Clements & Hume's (1995) features for explanatory reasons that we justify:

Table 1: Pirahã consonants

	LABIAL	**CORONAL**			
[-voice]	p	t → *tʃ*	k		**[-continuant]**
				ʔ ~ *n*	
[+voice]	b ~ *m* (bʷ)		g ~ *n*		
		s ~ *h*		h	**[+continuant]**
	(m)				**[+nasal]**
	w	j			**[+approximant]**

The only allophonic process that affects a consonant obligatorily is the following: before any /i/ allophone, [e, i, ɪ], [t] becomes an affriccate (Everett, 1983, p.207). We indicate the tones on respective sylalbles to the side of their segmental representation, to avoid clutter above the nasal tilde.

(1)	**tʃ**i.wẽẽ	3.33	'rubber'
(2)	**tʃ**iõ.ba.hãj	2.4.2 or 2.4.3	'child'
(3)	**tʃ**ɪ	3(2)	'1sg'
(4)	**tʃ**ee	24	'shit'

The another allophonic process is free. At the beginning of words or after a pause (#), the series of [-continuant, +voice] consonants /b,g/ are in free allophonic distribution with the nasals /m,n/ (Everett, 1983, p.208):

(5) #*m*a.ʔa, *b*a.ʔa 'It's fine'
(6) tʃɪ 32 **b**a.ʔa 3.3 'I am fine'
1sg be.fine

(7) #*n*a.hĩ.ãw, *g*a.hĩ.ãw 2.2.2 'airplane'
(8) tʃɪ 32 **g**a.hĩ.äw 'my airplane'
1sg airplane

In the same context, we find /ʔ/ varying with [n] in our data:

(9) # ʔaj, naj 11 'It is'
(10) # giʔaj, ni.ʔaj, 1.22 'you'

We choose to represent the consonants /g/, /ʔ/ with an empty place of articulation (Table 1) because both are affected by the same [+nasal] feature and both have the same output [coronal]. On the other hand, /b/ must have its [labial] feature specified, because it has its output a [+nasal, labial] consonant[2].

A free alternantion is also found between [s] and [h] in male speech before /i/ (Everett, 1983, p.208). The consonant /h/ is also represented with an empty place of articulation. This is motivated by the fact that the process in (11-12) is caused by the debuccalization of the /s/ [coronal] place of articulation feature. So, the mininum features needed to represent /ʔ, g, h/ are: [-continuant], [+voice] and [+continuant], respectively. The [dorsal] place of articulation feature seems not to be active:

(11) tõj.h**ĩ** 22.2 'eagle'
(12) tõj.s**ĩ**

Everett (1983, p.210) states that women pronounce /s/ as /h/ before /i/ ((13) and (14)) and optionally in another environments (15) and (16)). So, in female speech the debuccalization of the [coronal] feature seems to be obligatory before a [coronal] vowel:

2. Everett (1983, p.209) claims that in some dialects all the series of [-voice, -continuant] can freely vary across place of articulation (koxopai, koxotai, koxokai 'stomach'). We did not find this pattern in our data.

(13)	tõj̃.**si**	22.2	'eagle' (male speech)
(14)	tõj̃.**hĩ**		'eagle' (female speech)
(15)	mõõĩ.**s**ãj̃	13.11	'bee, honey' (male speech)
(16)	mõõĩ.**h**ãj̃		'bee, honey' (female speech)

The contrast in minimal and analogous pairs is shown below:

(17)

a	**p**ɪɪ	22	'water'
b	**ʔ**ɪɪ	24	'bushes'
c	**tʃ**ɪɪ	24	'shit'
d	**ʔ**ɪ(s-)	(2)3	'3, non-human'

We have found one intervocalic realization of /m/ and an analogous pair for that:

(18)

a	naa.**t**a.hãj̃	44.2.22	'tin'
b	nã.**m**a.ʔaj	2.2.44	'saracura (a bird)'

(19)

a	**p**ee.sɪ	42.2	'cotton'
b	**h**ee.sɪ	2.4	'sun'

(20)

a	**k**a.we	1.2	'mouth'
b	**ʔ**ã.w̃ẽ	2.3	'barbarian'

(21)

a	ko.**b**aj	3.2	'to see'
b	ko.**p**aɪ	2.2	'glasses'

The phone /b^w/ is only found in the following example.

(22)

a	a.**ɡ**e	2.4	'path'
b	ʔa.**w**e	2.2	'ear'
c	aa.**b^w**e	22.2	'lagoon'

(23)

a ʔɪ.**<u>sɪɪ</u>**.hĩ (2)3.22.4 'broth'
b ʔɪ.**<u>gĩ</u>**.hĩ (2)3.2.4(3) 'family'

(24)

a ʔa.**<u>j</u>**o 2.4 'hello!'
b (ʔ)aa.**<u>p</u>**o 11.3 'on'

Both approximants can occur in onset position. Everett (1983) interprets the sequences [wa] and [ja] as VV vowels, /oa/ and /ia/, respectively. We interpret these as a CV syllable:

(25) **w**ãã.**w**ẽẽ 24.43 'shotgun'
(26) **j**a.po.hẽ 2.2.2 'Yapohen (male proper name)'
(27) ʔa.**j**o 2.4 'Hello!'

The Pirahã vowels are described Everett (1983) as a three oral vowel system: /i, a, o/ (Table 2):

Table 2: Pirahã vowels (Everett, 1983, Sheldon, 1988)

i [i,e,ɪ]		
		o [o,ʊ]
	a [a]	

The vocalic allophones vary without any salient segmental conditioning.

(28)

/i/
a ʔɪ.sɪɪ.hĩ (2)3.22.4 'broth'
b wãã.wẽẽ 24.43 'shotgun'
c e.sow.ee (2)3.34.43 'guitar'
d tõj̃.si 22.2 'eagle'

/o/
a pʊ̃ʊ̃.gãj̃.hĩ.ãj̃ 33.44.3.33 'banana
b (ʔ)aa.po 11.3 'on'

/a/
a ʔa.we 2.2 'ear'

The contrast in minimal and analogous pairs is shown below:

(29)				(30)				(31)			
a	p**ɪ**.ʔaj	2.11	'also'	a	**ãã**j	14	'foot'	a	h**ĩ**	3	'3, human'
b	p**a**.ʔãj̃	4.22	'a fish'	b	**õõ**ɪ	14	'skin'	b	-h**a**	4	'telic aspect'
c	p**a**.ʔaɪ	3.32	'chicken'	c.	**ĩĩ**	14	'wind'				
d	p**õ**.ãɪ	3.32	'pacu (fish)'								

The process of nasalization is not phonemic and it will not be discussed here (for a discussion, cf. Sandalo & Abaurre (2010)). Long vowels and long diphthongs also seem not to be phonemic[3] and all examples are interpreted as sequence of vowels (VV) and a vowel+vowel complex nuclei (VV^j or VV^w).

5. SYLLABIC STRUCTURE

The possible syllabic structures are described in previous works as CVV, CV and VV, without V syllables or vowels at the beginning of the word (Everett, 1983); diphthongs are interpreted as VV sequences. There is no coda. We consider two differences from Everett's approach: (i) at the present moment in the language we have found syllables formed only by V (32) (not as a whole word), including occurring at the beginning of words (33), and (ii) we interpret diphthongs as complex nuclei formed by a vowel and a secondary articulation (34-36):

(32)	ʔɪ.sɪ.bɪ.**o**.**ɪ**	4.2.4.2.4	'liver'	CV.CV.**V**.**V**	
(33)	**a**.ge	11.4	'agouti'	**V**.CV	
(34)	t**aaj**	14	'axe'	C**VV^j^**	(*(C)VVV)
(35)	**ãã**j	14	'foot'	**VV^j^**,	(*VVV)
(36)	**aaw**.hoj	31.11	'manioc'	**VV^w^**.CV^j^	(*VVV.CVV)

If we do not consider complex nuclei for diphthongs, we would be obliged to consider the existence of three vowel syllables in examples like (34-36) with the special rule that the last one must be /i,o/, which is not natural or explanatory.

Heavy syllables are those with (at least) one diphtong or with a sequence of vowels: $(C)V^{jw}$, (C)VV or $(C)VV^{jw}$. Only heavy syllables can receive contour tones. The minimum word is bimoraic.

6. PHONETIC TONES

Pirahã has four phonetic (level) tones, 1, 2, 3 and 4, respectively, from the lowest to the highest.

3. We have found only one minimum pair that contrasts short and long /a/: aa.gɪ 22.4 'agouti' and a.gɪ 2.4 'path'. Based on only one pair, it is not possible to state that we have phonemic long vowels.

(37) ɪɪ.gaɪ 11.11 'back'

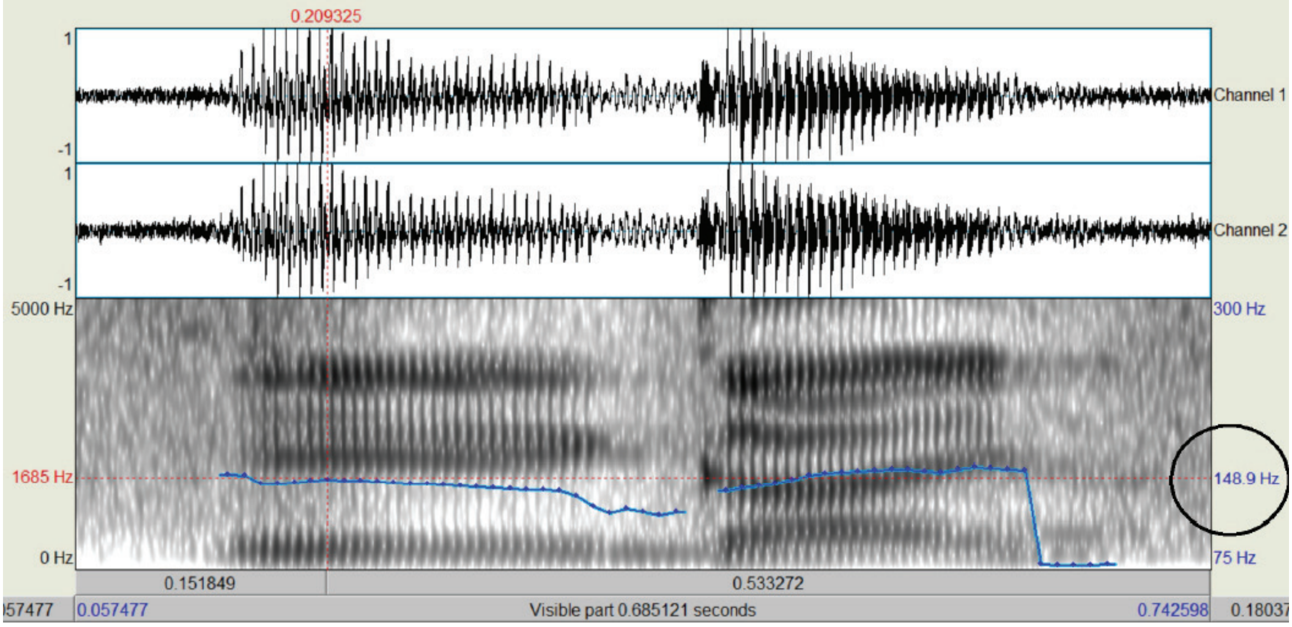


Figure 1: ii.gaj 11.11 'back'

(38) toj.si 22.2 'eagle'

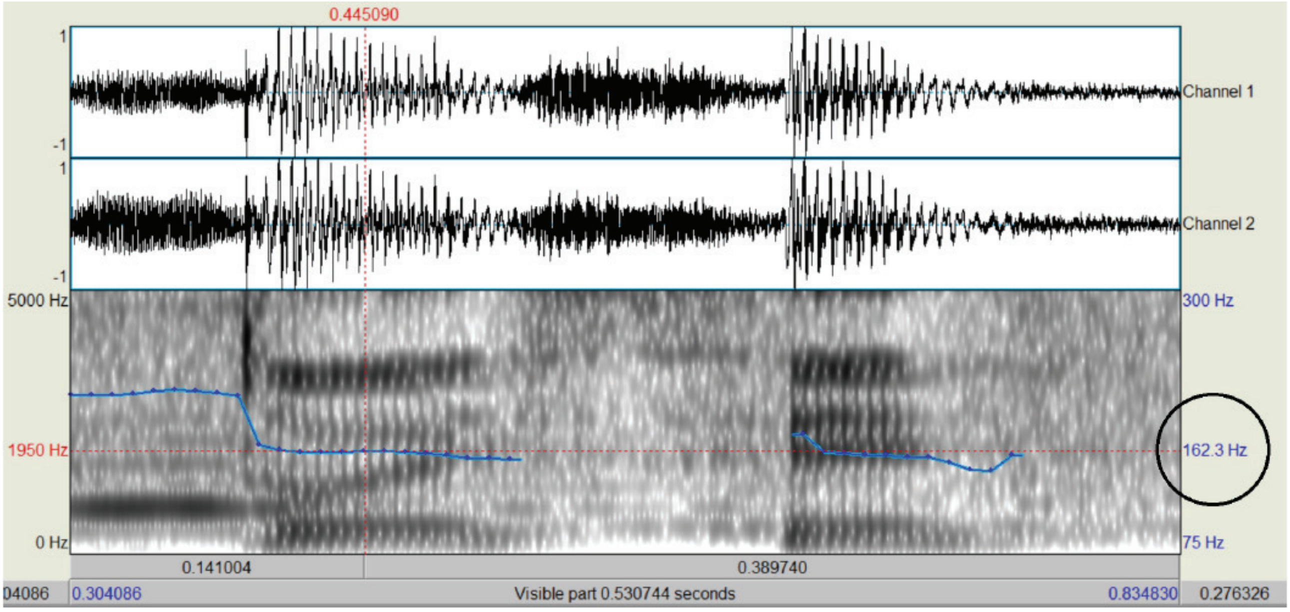


Figure 2: toj.si 22.2 'eagle'

(39) tʃi.w̃ĩı 3.33 'rubber'

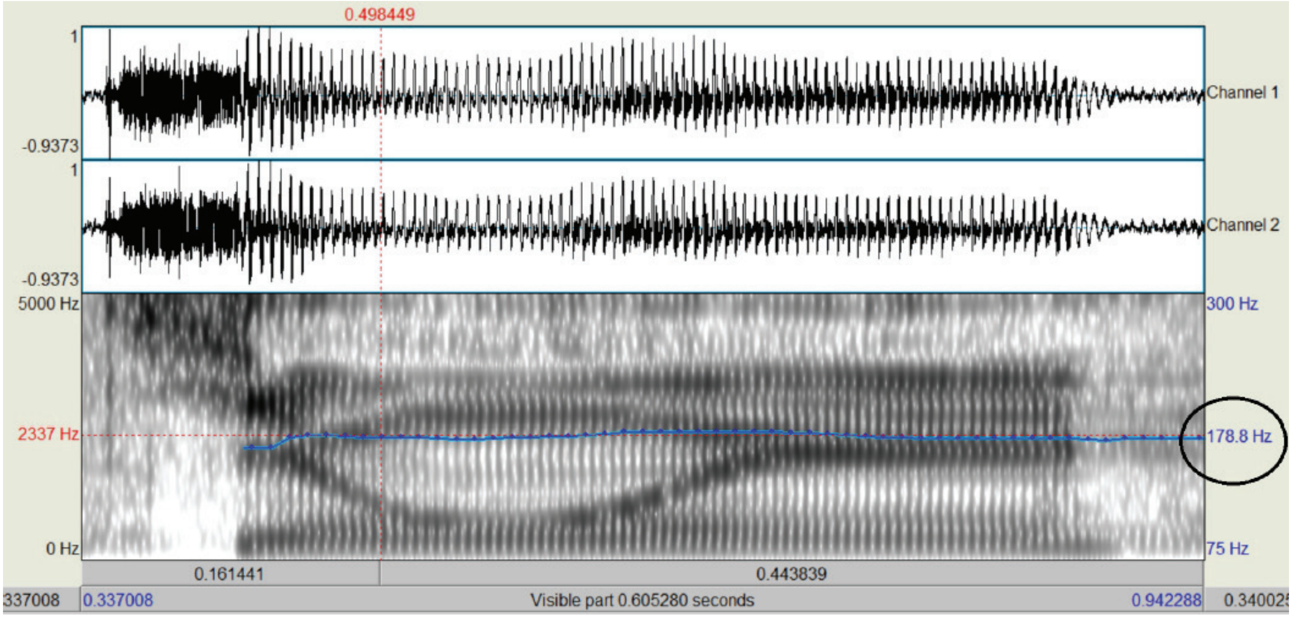


Figure 3: tii.wii 33.33 'rubber'

(40) tʃɪ.hɪ 4(3).44 'chestnut'

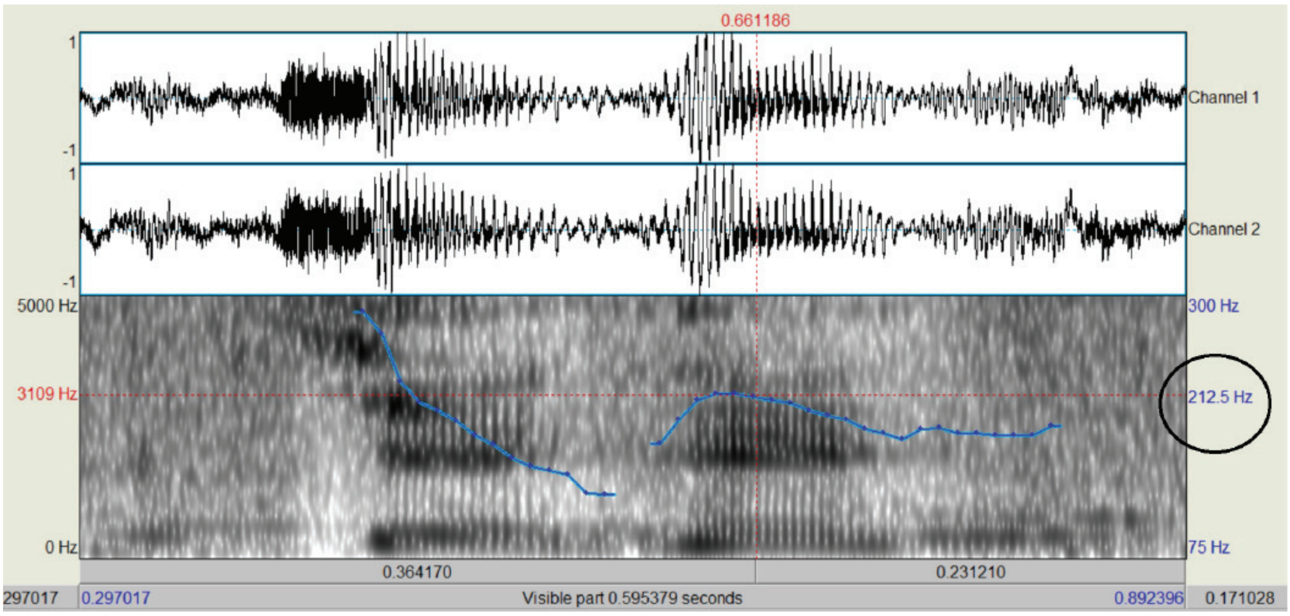


Figure 4: ti.hi 43.44 'chestut'

The difference among the four groups is statistically significant (p <0 .05). In the measurements we used only short vowels and long vowels in level tones (figure 5). Our auditory judgement of the tone (1 up to 4) was the dependent variable and the value extracted of the pitch the independent one.

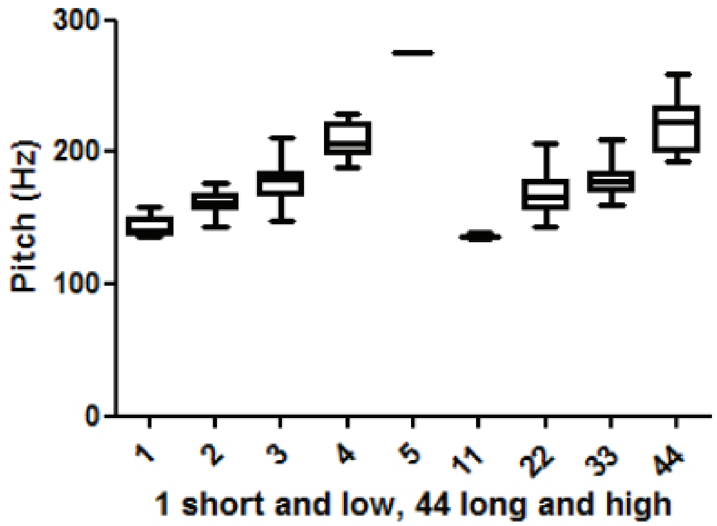


Figure 5: tones, long and short vowels

The median tone ranges are presented in the Table 3[4]:

Table 3: tone ranges (Hz)

1	138.7
2	164.5
3	179.3
4	210.1

For languages with more than one level distinction, what is determinant is the difference between the tonal values of each tone and the lowest tone of the system (Yip,2002). This ratio is shown in the Table 4:

Table 4: difference in Hz between each tone and the lowest tone in the system

four ranges: Pirahã
+71,4
+40,6
+25,5
+0

4. Nevins (personal communication) notes that tones 1 and 2 have an average difference of 30Hz. A parallel difference is found between tones 3 and 4 of the [+stiff] register. By contrast, the difference between tones 2 and 3 is only 15Hz.

7. PHONEMIC TONES

According to D. Everett (1979) *apud* K. Everett (1998) Pirahã is a language with lexical tone and presents two contrastive tones : /H/(high) and /L/(low) and there are no syllables without tone. We present preliminary evidence for an analysis with two level tones and two contour tones distributed in two registers, according to Bao's (1999) features [±stiff], which are equivalent to Yip's [±upper] features (1980, 1989), and were inspired by Halle & Stevens's (1971) [stiff vocal cords] and [slack vocal cords]. The allotones are in *italics* and their tonemic representations are in **boldface** (Table 5):

Table 5: tones and allotones in Pirahã

[-stiff]			[+stiff]		
l	1		**L**	3	
h	2		**H**	4	
lh	1-3	*1-4*	**LH**	2-3,	*2-4, 3-4*
hl	3-2	*3-1*	**HL**	4-2	*4-3*

In the next sections, we will describe the distribution presented in Table 5 and provide an analysis based on Bao's (1999) feature geometry model for the tonemes and their allotones.

7.1. The distribution of level and contour tones

Level tones can occur in heavy and light syllables. The level tone 1 only occurs on grammatical word borders, never twice in the same phonological word and there is only one example of a complete tone 1 word. It is never found between two another tones in the same grammatical word; the examples in (41d) occur a morpheme boundary. The level tones 2, 3, 4 have no restriction on their distribution. They occur at boundaries (41a-c), isolated (41d), twice in the same word, in sequence (41e) and discontinuously (41f), and even in a whole word (41g-l):

(41)	**Level tone 1**	**Level tone 2**	**Level tone 3**	**Level tone 4**
a	**maaj**.toj 'deer' **11**.43	**poo**.hoj 'toad' **22**.44	**koo**.xoi 'belly' **33**.22	**naa**.ta.hai 'tin' **44**.2.22
b	**ka**.we 'mouth' **1**.2	**ka**.pi 'cofee' **2**.4	**mo**.gaaj 'breast' **3**.22	**ti**.hi 'savage cat' **4**.2
c	mooj.**saj** 'bee' 13.**11**	kaa.**xai** 'parrot (arara)' 33.**22**	a.ga.bi.**hi** 'yarn' 2.4.2.**3**	ka.**pe** 'cofee' 2.**4**
d	xi.s-**aa**.xaaj.hi 'catfish' 23.**11**.13.43	i.**tii**.i.si 'flipper' (2)3.**22**.1.1	hwa.**si**.gi.koi 'bullet' 22.4.**3**.43	poo.**gaaj**.hi.aj 'banana' 33.**44**.3.3
	xi.s-**ii**.hi 'broth' 23.**11**.4			
e	i.sa.**aj.si** 'lard' 23.2.**1.1**	xi.**bi.hi.hi** 'bird' 4.**2.2.2**	to.**pa.ga.haj.hi** 'recorder' 2.**3.3.33.3**	tjo.**ba.haj** 'child' 2.**4.44**
f		**a**.aa.haj.**hi** 'sugar' **2**.13.4.**2**	**poo**.gaaj.**hi.aj** 'banana' **33**.44.**3.3**	**xi**.si.bi.o.**i** 'liver' **4**.2.43.2.**4**
g		**pii** 'water' **22**		

h	**ii.gaj** 'back' **11.11**	**a.we** 'ear' **2.2**	**ko.si** 'eye' **3.3**	**ti.hi** 'chestnut' **4.4**
i		**toi.toi** 'parrot' **22.22**	**to.baj** 'rubber tree' **3.33**	
j		**a.ba.gi** 'tucan' **2.2.2**	**ti.wii** 'rubber' **3.33**	
l		**a.ga.wa.xai** 'canoe' **2.2.2.22**	**gjo.ti.ga** 'salt' **33.3.3**	

Contour tones only occur in heavy syllables, i.e., syllables with long vowels or/and a approximant: The tones 13 (lh), 23 (LH) and 32 (hl), 43 (HL) are realized as 14, 24, 31 and 42, respectively, in the first syllable of monomorphemic nouns when occupied by a VV(j,w) nucleus ((42), right column). Note that it does not occur on V(j,w) syllables ((42a), left column):

(42)	**Elsewhere**	**#- and long**
a	**13 lh**	**14**
	aj.ti 'agouti' **13**.2	**taaj**.si 'axe' **14**.3
	a.**aa**.haj.hi 'sugar' 2.**13**.4.1	
	i.saa.**xaj**.hi 'catfish' 3.11.**13**.3	
	xi.s-i-.po.**aaj** 'wing' (3)2.2.3.**13**	
	Elsewhere	**# and long**
b	**23 LH**	**24**
	maw.saj 'clothes' **23**.22	**waa**.wee 'shotgun' **24**.43
	aa.**paj**.taj 'head' 11.**23**.34	**baa**.ga.haj 'potato' **24**.2.43
	oo.pa.**paj** 'duck' 11.2.**23**	**ii**.oo.hoj 'sky' **24**.44.43
	Elsewhere	**#__ and long**

	Elsewhere	#__ and long
c	**32 hl**	**31**
	aj.taj 'straw' **32**.23	**oo**.hoj.hoj.hi.aj 'caterpillar' **31**.42.44.2.22
	i.**tii**.i.si 'fish's flipper' 3.**32**.1.1	**aaw**.hoj 'manioc' **31**.11
	ka.haj.xa.**ii** 'night' 2.44.2.**32**	

	Elsewhere	#__ and long
d	**43 HL**	**42**
	waa.**wii** 'shotgun' 24.**43**	**gee**.sow.ge 'turtle' **42**.4.3
	i.**tii** 'battery' 2.**43**	**pee**.si 'cotton'[5] **42**.2
	ii.oo.**hoj** 'sky' 24.44.**43**	
	xi.s-i-**bii**.o.i 4.2.**43**.2.4	

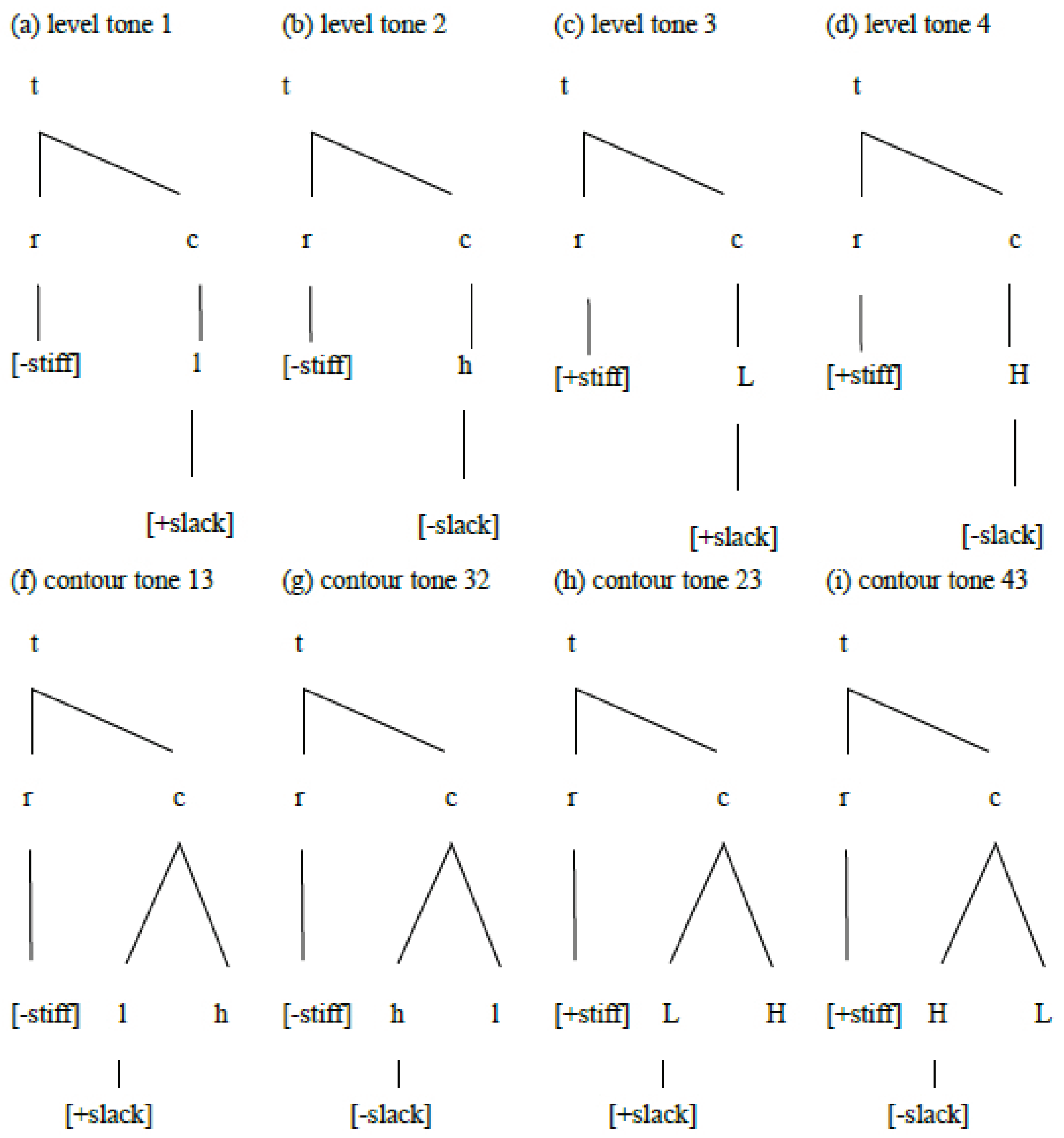
In the next sections, we will formalize these alternances based on Bao's (1999) feature geometry model.

7.2 Feature assimilation and OCP

Bao (1999) postulates that tone is built by two tiers, the register tier, represented by 'r', which codifies the [±stiff] feature and the contour tier, represented by 'c', which codifies the [±slack] feature. The [stiff] feature determines the 'range group' of the tones: high register tones are [+stiff] (tones 3, 4, 23, 43), low register tones are [-stiff] (tones 1, 2, 13, 32). The [slack] feature basically codifies the trajectory of the contour, so the low and high counterparts of a contour tone will be [+slack] and [-slack], respectively. The four tones and two registers of Pirahã system can be represented by Bao's (1999) model as follows:

5. We have only one counter example which comes from a borrowing: ko.poo.hoj 2.42.22 'glass', from Portuguese 'copo'.

(43)



As any feature geometry model, assimilation, dissimilation processes and OCP (Obligatory Contour Principle) take place. All the allotones presented in (42) and represented in (43,44) must have the second counterpart of their contour specified by their [slack] value on initial syllables with two available VVs (45). The allotones can be explained by a full specification requirement of the feature [slack] in the first syllable followed by an OCP (Obligatory Contour Principle) adjustment. This causes the enhancement of the falling or rising tone depending on the final value of the [slack] feature, which is always the inverse of the first part of the contour tone.

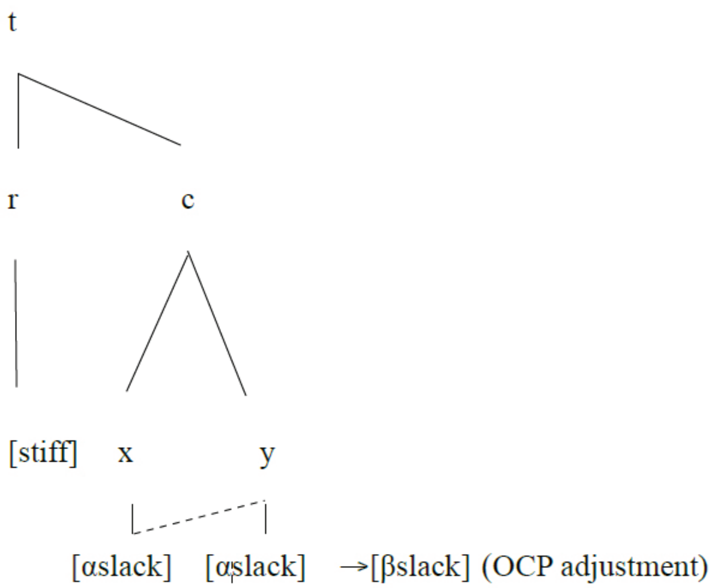
(44) /13, 23, 32, 43/→[14, 24, 31, 42] / # ____
(C)VV

(45) Full [slack] feature specification under (c) at the first syllable.

Formally, it can be interpreted as the assimilation of the slack feature by the non-specified contour counterpart which only takes place in long vowel initial syllables to obey the principle in (45). After the assimilation, the OCP operates changing the value of the second contour to the inverse of the first one (46). On (46b-c) we show derivations of falling and rising tones, respectively.

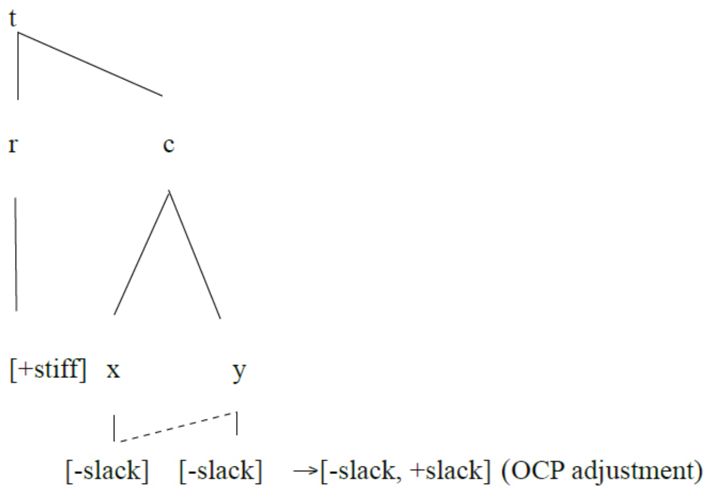
(46) a Assimilation

\# (C)VV



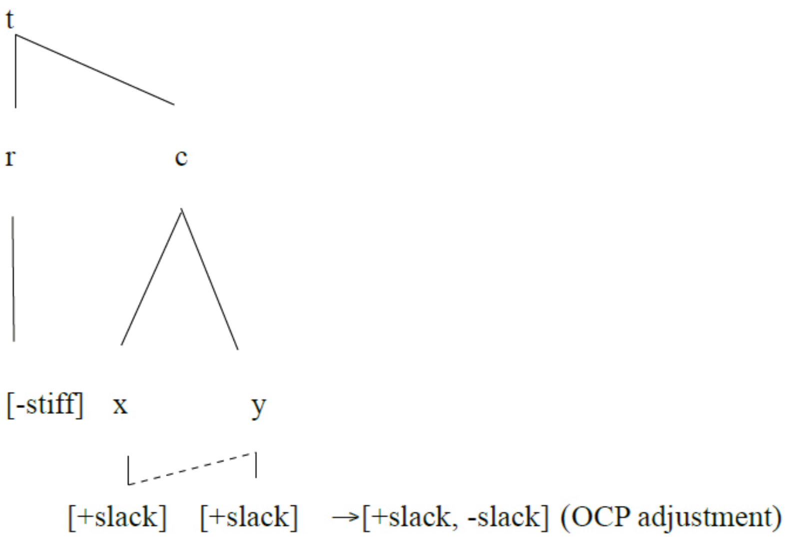
b **gee**.sow.ge 'turtle' **42**.4.3

/43/→ [42] / #___
(C)VV



c **taaj**.si 'axe' **14**.3

/13/→ [14] / #___
(C)VV



In the next section, we will present evidence for the existence of contour tones as units.

7.3. Why contour tones?

What is the evidence for considering contour tones instead of a sequence of level tones mapped into the same syllable in (43f-i)? Note that a sequence of level tones never starts from the beginning of the word ((41e) is repeated as (47)).

(47)

a	b	c	d
i.sa.**aj.si** 'lard'	xi.**bi.hi.hi** 'bird'	to.**pa.ga.haj.hi** 'recorder'	ti.o.**ba.haj** 'child'
23.2.**1.1**	4.**2.2.2**	2.**3.3.33.3**	2.2.**4.44**

We postulate that what is causing this general ban is what we state in (48). The respective derivations are in (49).

(48) In words with more than one tone, the first tone is mapped only onto the first syllable.

(49)

a	b	c	d
pii. si 'cotton'	**aaw**.hoj 'manioc'	**ti**.hi 'savage cat'	**ka**.we 'mouth'
HL. h	h l l	H. h	l. h
42. 2	**31**.11	**4**. 2	**1**. 2

e

baa.ga.haj 'potato'
LH h HL

24. 2. 42

f

taaj.si 'axe'
l h L

14.3

g

mo.gaaj 'breast'
L. h

3. 22

g

ka.pi 'cofee'
h. H

2. 4

This predicts that only words with an unique tone can have a sequence of (phonetic) tones starting from the begining.

(50)

a
ii.gaj 'back'
l

11.11

b
a.we 'ear'
h

2.2

c
ko.si 'eye'
L

3.3

d
ti.hi 'chestnut'
H

4.4

If we do not consider the existence of contour tones operating as units, we lose the generalization in (48). In an only level tones approach, we should consider that the correct generalization would be the alternative statement (51):

(51) a. map the first tone into the first syllable if it is short;
b. and map the first two tones into the first syllable if it is heavy.

The postulation of contour tones predicts that if a word beginning with a long initial syllable (heavy) and carrying an initial level tone and one or more different tones, will have its first level tone mapped alone into the whole long initial syllable and leave the second tone for the second syllable (and so on). That is exactly what happens (52):

(52)

a
maaj.toj 'deer'
l. HL

11. 43

b
poo.hoj 'toad'
h H

22.44

c
koo.xoj 'belly'
L h

33.22

d
naa.ta.haj 'tin'
H h

44.2.22

This proves that (51) is incorrect and fails to capture the generalization in (48) as seen in the crashing derivations of (52) in (53):

(53)

a	b	c	d
maaj.toj 'deer'	**poo**.hoj 'toad'	**koo**.xoj 'belly'	**naa**.ta.haj 'tin'
l H L	l h H	L h	H h
14.2*	24.44*	**32**.22	**42**.2.22*

7.4. Upstep

The tone 34 only occurs when followed by 23 (54-55). We interpret it as an upstep of the [+stiff] rising tone (56):

(54)
aa.paj.taj 'head'
11.23.**34**

(55)
xii.poj 'leg'
23.**34**

(56)

$$/LH/ \rightarrow [{}^{\uparrow}LH]\ /\ /LH/\ \_\_$$

The upstep causes a shift upwards on the global value of the /LH/ tone, which is pronounced [34]. It has been claimed that it is much rarer than its inverse, the process of downstep.

8. CONCLUDING REMARKS

We described Pirahã as a four tone language, including two level tones and two contour tones distributed in two registers. Previous works stated it as a two tone language without contour tones. This squib contributed as directions for the next falsifiable steps of research. If we are right, we are supposed to find processes affecting the [stiff] tier and the contour tier (c) also. The hypothesis presented here must be tested with polymorphemic nouns and another lexical categories.

We can not ignore the fact that this comparison is mainly based on an analysis of 31 years ago (Everett, 1983). Since then, the language may have changed. Another factor that should be taken into account is the fact that Pirahã has a lot of dialectal variation (as stated by Everett (1983)), which can skew the comparison. In a very small group such as Pirahã, which suffered in the last decades a considerable oscillation in population size, due to government neglect of healthcare and consequent epidemics of malaria and tuberculosis, language changing processes could be potentiated.

Sauerland (2010) described tonal differences contrasting the two different '-sai' morphemes which occur as verbal suffixes. Its low tone version is a conditional, and its version with a higher tone is a nominalizer (contradicting D. Everett's claims). This shows that a careful description of tones could amount to a difference between finding recursive structures or not, which is a disputed topic about Pirahã syntax and theoretical discussion on the design of natural language (cf. see Everett (2005, 2009) and Nevins *et alii* (2009a-b) for further discussion). Our next steps are to advance the morphosyntatic description to start a morphotonemic analysis and explore more in depth some already informally observed phonetic dialectal diferences in gender and age.

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