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Accent in Uspanteko

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Abstract

Uspanteko (Guatemala; ∼2000 speakers) is an endangered K'ichean-branch Mayan language. It is unique among the K'ichean languages in having innovated a system of contrastive pitch accent, which operates alongside a separate system of non-contrastive stress. The prosody of Uspanteko is of general typological interest, given the relative scarcity of 'mixed' languages employing both stress and lexical pitch. Drawing from a descriptive grammar and from our own fieldwork, we also document some intricate interactions between pitch accent and other aspects of the phonology (stress placement, vowel length, vowel quality, and two deletion processes). While pitch accent is closely tied to morphology, the location of lexical tone is entirely a matter of surface phonology. We propose that the position of pitch accent and stress is determined by three factors: (i) feet are always right-aligned, and preferably iambic; (ii) pitch accent must fall on a stressed syllable; and (iii) pitch accent cannot fall on a final mora. These assumptions derive default final stress, as well as a regular pattern of tone-triggered stress shift. Interactions between prosody and segmental phonotactics are attributed to further constraints on footing. Surprisingly, we find robust evidence for foot structure in Uspanteko, even though these patterns could easily be described in non-metrical terms. Interactions between tone and vowel length also provide evidence for lexical strata within the Uspanteko vocabulary.

1 Introduction

Uspanteko is a Mayan language spoken in and around the municipality of Uspantán (Tz'unun Kaab') in the department of Quiché in the western highlands of Guatemala. While the K'ichean-branch as a whole is large and robust, Uspanteko is severely threatened.

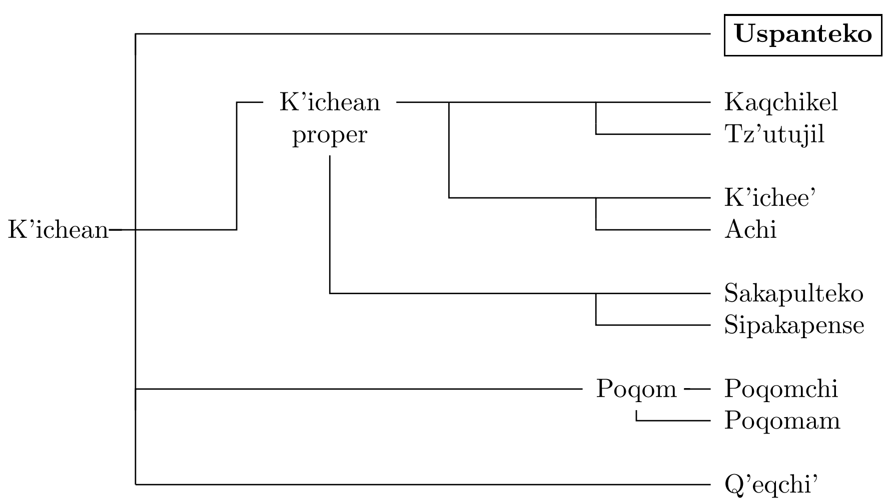

Figure 1: K'ichean-branch Mayan languages (after Kaufman 1974; Richards 2003)

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Though there have probably never been many Uspanteko speakers, there are now only about 1500–2000 (Richards 2003), and they are for the most part trilingual, speaking both K'ichee' and Spanish as well (Can Pixabaj 2006). With these considerations in mind, Uspanteko can be classified as endangered.

Figure 2: Map of Guatemala showing Uspanteko-speaking region (adapted from Icke 2007)

Uspanteko is also underdocumented. Currently available materials include a descriptive grammar and dictionary, both published recently by Oxlajuuj Keej Maya' Ajtz'iib' (OKMA) (Can Pixabaj 2006; Méndez 2007). Campbell (1977) also discusses the language briefly in his reconstruction of Proto-K'ichean. Despite these excellent resources, the phonology is still largely underdescribed (at least relative to the morphosyntax of the language, which is better understood). The paucity of phonological description for Uspanteko is a critical gap because it is the only language in the K'ichean-branch that makes use of lexical tone.

Building on these extant resources with our own original fieldwork, this paper pushes forward our understanding of Uspanteko stress and tone. Contrary to earlier work that ascribes a binary tonal inventory to Uspanteko (Grimes 1971; Campbell 1977; Can Pixabaj 2006), we show that Uspanteko has a single H tone that is restricted to the penultimate mora of the word. Since default stress in Uspanteko is word-final, and tone and stress must co-occur on the same syllable, tone realization sometimes requires stress shift. We argue that this tone-driven stress shift should be treated as an iambic-trochaic foot-form reversal. We then analyze a series of complex, and otherwise puzzling tone-segment and tone-morphology interactions through the simple combination of footing constraints and constraints barring final H tone. One interesting outcome is that different stems behave differently with respect to the interaction of tone and vowel length, which we take to motivate distinct cophonologies in the nominal domain.

The overarching goal of this paper is to provide a fairly comprehensive description and analysis of word-level prosody in Uspanteko. While pursuing that core aim, we will also argue that the accentual system of Uspanteko has a number of theoretically and typologically interesting properties, despite the surface simplicity of the system itself. Since this is the first in-depth treatment of Uspanteko prosody, it necessarily touches on a range of diverse phenomena. A secondary goal of this paper, then, is to show that Uspanteko prosody is also less complex than it might at first seem, in that a number of apparently disparate empirical facts can be explained with only a small set of assumptions about prosodic structure.

We begin by introducing the basic phonology of Uspanteko in Section 1.1. Section 2 extends this description by detailing the properties of tone in Uspanteko. In Section 3 we provide an analysis of these basic facts. Section 4.1 looks at a non-local tone blocking effect manifested by a particular type of coda cluster. Section 4.2 zooms in and considers cophonologies that require slight permutations of the analysis proposed in Section 3. Section 5 concludes.

1.1 Basic phonology

As is typical in Mayan languages, the morphophonology of Uspanteko is built around a set of CV(V)C roots. Complex words are mostly formed through suffixing derivational morphology and prefixing inflectional morphology. There is also a large number of clitics in both the verbal and nominal domains. The word-level prosodic integration of some of these clitics is discussed in the appendix. Barring the consideration of clitics, main word stress is final and there is no evidence of secondary stress.

All examples in this paper are presented in standard Mayan orthography.[1] The Mayan orthographic system is largely phonemic, with the following departures from the IPA consonant system:

	IPA	Standard Mayan
Velar fricative	/x/	*j*
Palato-alveolar fricative	/ʃ/	*x*
Palatal approximant	/j/	*y*
Palato-alveolar affricate	/t͡ʃ/	*ch*
Alveolar affricate	/t͡s/	*tz*
Glottal stop	/ʔ/	*'*
Glottalized consonants	/ɓ/, /kˀ/, etc.	*b'*, *k'*, etc.

Figure 3: Divergences between Mayan orthography and IPA transcription

The phonemic consonants of Uspanteko are given in Figure 4 (in standard Mayan orthography). There are no examples of a glottal stop directly following another consonant in this paper, so [C'] unambiguously indicates a glottalized consonant rather than a consonant-glottal stop sequence.

	Bilabial	Alveolar	Palato-alveolar	Palatal	Velar	Uvular	Glottal
Stop	p b'	t t'			k k'	q q'	'
Affricate		tz tz'	ch ch'				
Fricative		s	x		j		
Sonorant	m w	n l r		y			

Figure 4: Uspanteko consonant phonemes

The vowel inventory of Uspanteko consists of short [i e a o u] and their long counterparts. The orthographic representation of vowels also corresponds fairly closely to their actual IPA values, with one important exception: in unstressed syllables, orthographic short ⟨a⟩ is phonetically [ə] (see Section 3.3).

2 Tone

This section considers the core properties of Uspanteko tone that we examine: namely, the basic tonal inventory, and the interaction of tone with segmental, suprasegmental, and morphological phenomena.

As far as we are aware, all previous work dealing with Uspanteko agrees that the language makes use of contrastive lexical tone (e.g. Grimes 1971; Campbell 1977; Can Pixabaj 2006). There is also a general consensus that word-level stress is obligatory, but lexical tone is not: all words in Uspanteko bear stress, but only some words carry contrastive tone as well.

[1] Since we provide orthographic forms, a number of regular allophonic processes (e.g. nasal place assimilation, initial glottal stop insertion, etc.) are not represented in the data. Such processes are discussed where relevant.

(1) Stress is obligatory in Uspanteko; tone is not

a. $[\ldots{}^{\text{ˈ}}\sigma\ ]$
b. $[\ldots{}^{\text{ˈ}}\sigma^{T}]$

c. $*[\ldots\ \sigma\ ]$
d. $*[\ldots\ \sigma^{T}]$

To restate the generalization, there are no words in the language that bear lexical tone without also bearing stress (1-d), though there are many words with regular final stress and no independent specification of word-level tone (1-a). On these broad points, we are in agreement with the existing literature on Uspanteko.

However, there are important differences between our understanding of Uspanteko tone and the views espoused in earlier research. Beginning with the tonal inventory, we depart from previous treatments of Uspanteko in assuming that all surface tones are the expression of a single, privative, high tone pitch accent.

(2) Uspanteko tone is a privative high tone

a. $[\ldots \mathrm{CV}^{H}.\mathrm{CV}]$
b. $[\ldots \mathrm{CV}^{H}\mathrm{V}]$

This contrasts with Grimes (1971), Campbell (1977), and Can Pixabaj (2006), who each propose that there are two distinct tones in Uspanteko. For example, Can Pixabaj (2006) claims that there is an H tone that only occurs on penultimate short vowels, as well as an L or falling tone that only occurs on final long vowels.

(3) Analysis of Uspanteko tone in Can Pixabaj (2006) (to be rejected)

a. Tone 1: $[\ldots \mathrm{CV}^{H}.\mathrm{CV}]$
b. Tone 2: $[\ldots \mathrm{CVV}^{L}]$

Note that the assumption of this two tone inventory for Uspanteko is not motivated by the actual tonal contrasts found in the language. For one, the proposed H and L tones never contrast with each other because they never appear in the same positions. They also do not co-occur: words of the shape [CV.CVV] can only bear tone on the final long vowel, and not on both syllables simultaneously. Before getting off the ground, then, such an analysis misses the generalization that the two purported tones do not behave like separate tonemes: they are in complementary distribution, and they never co-occur.

Grimes (1971) and Campbell (1977) sketch a slightly different picture of tone in Uspanteko (though Campbell is quite clear that his analysis is a working hypothesis, and not a definitive claim). In their view, contrastive tone is limited to stressed, word-final long vowels. Stressed long vowels may bear either high tone or low tone; short vowels may not carry tone of any sort, even when stressed.

(4) Analysis of Uspanteko tone in Grimes (1971) and Campbell (1977) (to be rejected)

a. Tone 1: $[\ldots \mathrm{CVV}^{H}]$
b. Tone 2: $[\ldots \mathrm{CVV}^{L}]$

As we show below, this view is incorrect. Short vowels have higher pitch in stressed penults than in stressed word-final syllables. This position-dependent increase in pitch can be straightforwardly understood as the the phonetic realization of a phonological H tone on stressed CV(C) penults, which is wholly unexpected under the assumption that only long vowels can bear lexical tone.

Given these difficulties, we prefer to posit just one underlying tone for Uspanteko, deriving any surface allophonic differences in how that tone is realized (i.e. as high vs. falling) from the properties of the environment it appears in. In line with this goal, we simplify the tonal inventory by assuming a single, privative H tone, as in (2) above. With this simplification, a better distributional generalization emerges: H tone appears as close to the end of the word as possible, while satisfying additional constraints on where tone may be realized.

We take the tone-bearing unit (TBU) for Uspanteko to be the vocalic mora (μ_V) (see Section 4.1 for why we limit TBUs to vocalic moras alone). We further assume that the H tone of Uspanteko can only appear on a non-word-final TBU (more on this in Section 3).[2,3] Under these assumptions, H tone will surface on the penult in words ending in a light CV(C) syllable: when the final vowel is short, the nucleus of the penult will be the rightmost non-final TBU, and will thus host tone (if tone is present). In tonal words ending with a heavy CVV(C) syllable, H will appear on the final syllable itself because tone can associate with the first mora of the long vowel, again the rightmost non-final TBU. Long vowels only appear word-finally in Uspanteko, so these two structures exhaust the space of possible tonal configurations. (From here on [V́] indicates a vocalic mora bearing high tone.)

(5) Uspanteko tone: privative H tone on rightmost non-final TBU
  a. $[\ldots \mathrm{C\acute{V}}_\mu.\mathrm{CV}_\mu]$
  b. $[\ldots \mathrm{C\acute{V}}_\mu \mathrm{V}_\mu]$
  c. $*[\ldots \mathrm{CV}_\mu \mathrm{V}_\mu \ldots]$

We thus eliminate the L tone proposed by previous authors—which under the analysis of Can Pixabaj (2006) would be in complementary distribution with H at any rate—in favor of a single H tone along with conditions on where that tone can be realized. The appearance of tone on a final heavy syllable or a light penult is entirely determined by well-formedness conditions on where tone can appear, so the position of H tone does not need to be underlyingly specified.

If the sole tone in Uspanteko is indeed a high tone H, as we propose, the question arises as to why previous researchers posited a low or falling tone on final long vowels instead. We think that tone on long vowels may have been *perceived* as low or falling because the H target is on the first mora, and after that H target is reached pitch may fall through the rest of the vowel (see e.g. Myers 1998). In our own fieldwork we've found no phonetic indication of distinct word-level L tones; and phonologically, the evidence clearly favors a single tone analysis.[4]

2.1 Tone-stress interactions

Now that we have a picture of the tonal inventory, we can begin to consider the interaction of tone and other phonological processes, beginning with stress. Like other K'ichean-branch Mayan languages, default stress in Uspanteko is on the final syllable (from here onward, stress is indicated by underlining). This is true whether the final vowel is long or short, and whether the final syllable is open CV(V) or closed CV(V)C. (Examples come from our original fieldwork, unless otherwise noted. Data cited from Can Pixabaj (2006) were verified by our consultants whenever possible.)

(6)
  a. [chikach] 'basket'
  b. [xib'alb'al] 'half-brother'
  c. [tiqab'ana'] 'we're doing it'
  d. [lajori] 'today'
  e. [xinlowisaaj] 'I sheparded it.' (Can Pixabaj 2006:22,33,70–71,280)

Final stress is thus 'default' in two senses: syllable quantity does not affect where stress falls; and non-tonal words have final stress without exception (we return to stress shift in tonal words shortly).

We use the term 'stress' primarily in its phonological sense: stressed syllables are syllables that, in virtue of their position within some word, bear abstract structural prominence. This abstract prominence may (but need not) be phonetically expressed by increasing the relative acoustic salience of stressed syllables along

[2]Carlos Gussenhoven (p.c.) has suggested to us that the functional grounding of this constraint might be linked to the fact that Uspanteko has large rising pitch excursions at the ends of phrase-level intonational domains. The language-internal motivation for barring lexical H from final moras, then, is the avoidance of tonal crowding at the right edge of phrases (e.g. Gordon 2000). See also **?** for related discussion of phrase-final intonational targets in K'ichee'.

[3]The avoidance of domain-final high tones is well-attested crosslinguistically: for example, see Cassimjee and Kisseberth (2007) and Hyman (2007) on Bantu languages; Pulleyblank (1986) on Margi (Chadic); Kawahara and Shinya (2008) on Japanese; Demers et al. (1999:43) on Yaqui; Silverman and Pierrehumbert (1990) on English (at the phonetic level); various examples in Yip (2002:29,66,90–1); and the general discussion in Hyman (1977).

[4]As for the high $[\ldots \mathrm{CVV}^H]$ tone in Grimes (1971) and Campbell (1977), we suspect that those authors may have misinterpreted phrase-level H tones—which also dock to final stressed syllables—as being instances of lexical tone. Alternatively, their high tone may be our tonal $[\ldots \mathrm{C\acute{V}V}]$, and their low tone our toneless $[\ldots \mathrm{CVV}]$. Given the very small number of example words provided by those authors, it's difficult to determine which of these alternatives is more plausible.

dimensions like intensity, duration, etc. (see Fry 1955, Bollinger 1958, Liberman 1975, Liberman and Prince 1977, Hayes 1995, and Cutler 2005 for extended discussion on these points). Two distributional facts point toward default final stress in Uspanteko. First, long vowels are permitted only in word-final syllables, as evidenced by length alternations like (7).

(7) No non-final long vowels in Uspanteko

a. [chuun] 'lime (mineral)'
b. [x-chun-aj] 'he covered it with lime' (Can Pixabaj 2006:53)

Since stressed syllables commonly host more phonological contrasts than unstressed syllables (e.g. Trubetzkoy 1939; Beckman 1998), the fact that vowel length contrasts are limited to final position is a credible indication that stress is final as well (especially given the cross-linguistic tendency to *neutralize* length contrasts in final syllables, e.g. Buckley 1998; Barnes 2006; Myers and Hansen 2007).

Second, syllable codas consisting of a glottal stop and a following consonant are also restricted to final position.

(8) No non-final [CV'C] syllables in Uspanteko

a. [ka'n] 'animal'
b. [kuwa'y] 'horse'
c. *[wa'yku]

As we argue in Section 3 and 4.1, this is no coincidence: only [VV(C)] and [V'C] rimes count as heavy in Uspanteko, and heavy syllables are only allowed word-finally. This distributional restriction on syllable types follows naturally if default stress is word-final: like many languages, Uspanteko enforces an outright ban on unstressed heavy syllables; and given final stress, this has the effect of limiting heavy syllables to final position as well.

Finally, the phonologically exceptional status of final syllables in Uspanteko would be deeply puzzling under the assumption that such syllables are unstressed. Initial syllables are often positions of phonological privilege, probably for psycholinguistic reasons concerning the role of initial syllables in lexical access (see e.g. Beckman 1998; Nelson 2003; Smith 2005). Final syllables are rarely (perhaps never) privileged in the same way, unless some other phonological factor (like stress) renders final position prominent on independent grounds (though cf. Barnes 2006). There are thus sound language-internal and typological motivations for assuming final stress for Uspanteko. Since Campbell (1977) and Can Pixabaj (2006) are in accord with this view, we believe that the existence of default final stress in Uspanteko is beyond plausible doubt.[5]

Exceptions to default final stress are entirely systematic: non-final stress is found only when word-level tone falls on the penultimate syllable. If a word bears pitch accent (i.e. H tone), tone and stress must coincide; and in words with a tonal penult (i.e. tonal words ending in a short vowel), the non-finality condition on tone placement takes precedence over default final stress, leading to stress shift.

(9)
a. [wálib'] 'my daughter-in-law'
b. [áb'aj] 'stone'
c. [mú'xix] 'bellybutton'
d. [íwir] 'yesterday' (Can Pixabaj 2006:56)

In the remainder of the paper, the term 'accented' refers to the syllable (or vowel) bearing stress, or bearing both stress and tone. When referring to tone in isolation, apart from stress, we will sometimes use the more specific term 'pitch accent'.

Before we derive these tone-stress interactions, we want to forestall an alternative analysis that takes penultimate stress placement to be a case of stress shift alone, lacking an independent tonal element. We know that penultimate H is not merely stress shift because stress and tone have separable phonetic correlates: penultimate H involves a pitch excursion above and beyond any pitch perturbations associated with final stress. Compare the minimally different forms [intz'i'] 'I am a dog' (Figure 5) and [íntz'i'] 'my dog' (Figure

[5] Note also that the closely-related Mayan languages K'ekchi, Kaqchikel (Berinstein 1979), K'ichee' (Pye 1983), and Tz'utujil (Dayley 1985) uncontroversially have final stress as well.

6).[6]

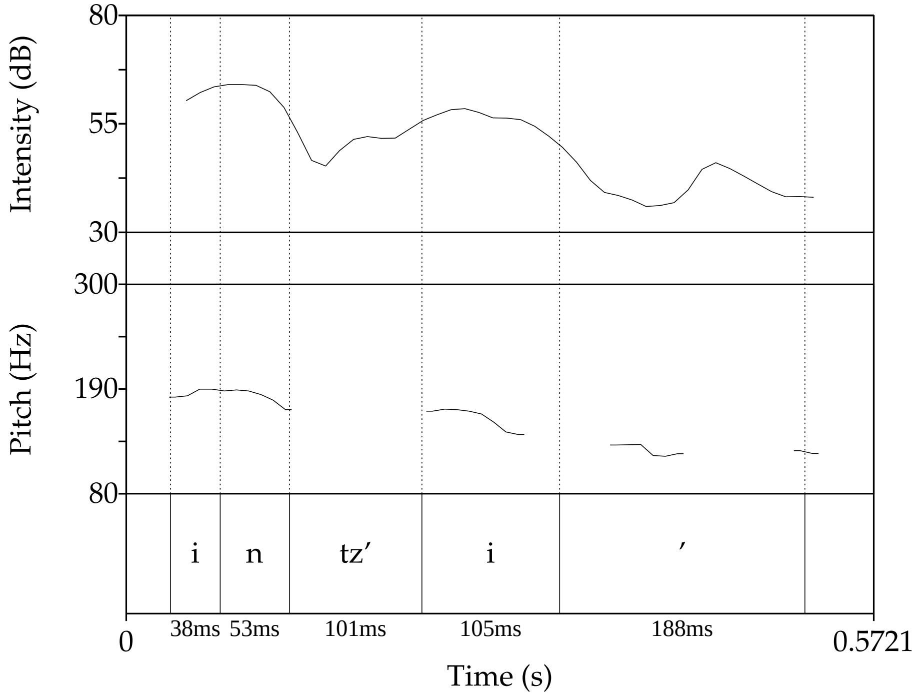


Figure 5: Intensity, pitch, and duration for [intz'i'] 'I am a dog' (final stress, no tone)

Tonal [íntz'i'] has a clear pitch peak on the accented syllable (the penult), whereas the stressed final syllable of non-tonal [intz'i'] lacks any such pitch excursion. For non-tonal [intz'i'], the ratio of mean pitch during the penultimate vowel versus the final vowel is 1.26 (difference: 38 Hz); the ratio of the pitch peaks during those vowels is 1.14 (difference: 23 Hz). For tonal [íntz'i'], the pitch differences between the penult and ultima are quite a bit larger: the ratio of means is 1.63 (difference: 100 Hz), and the ratio of peaks is 1.53 (difference: 91 Hz). If penultimate accent were a simple case of stress shift, we might expect final stress to also be correlated with raised pitch on the stressed vowel; instead, in Figure 5 we find uninterrupted pitch declination from the penult to the ultima. Penultimate accented vowels thus have an independent tonal component not found on stressed final short vowels.

A reviewer expresses concern that the final glottal stop in non-tonal [intz'i'] 'I am a dog' might be depressing pitch in the last syllable, thereby obscuring any tonal correlates of default final stress. But as Figures 7 and 8 show, stressed final syllables in non-tonal words lack appreciable pitch movement even when ending in a sonorant or non-glottalized obstruent. Compare these examples to tonal [lékej] 'up' (Figure 9), which has a strongly uneven pitch profile marked by a sharp rise during the penult. Pitch measurements for Figures 5–9 are given in Table 1.[7]

[6]The utterances shown in Figures 5–9 were produced by a female speaker of Uspanteko in her mid-thirties. This speaker is originally from Uspantán, though for the past few years she has been living in Dueñas, a small town outside of Antigua in Guatemala. For ease of comparison, all phonetic diagrams presented in this paper correspond to productions by this same speaker, recorded over a single three-day period in March 2011.

All tokens were elicited in a phrasal context. For example, we elicited [íntz'i'] 'my dog' by asking the question (in Spanish) "*Who* saw **your dog** on Monday?". This prompted a response like [*Tek* xril **íntz'i'** lunes] "*Tek* saw **my dog** on Monday". This method allowed us to elicit target words in phrase-medial position (thereby avoiding interference from phrase-final intonational contours) and in a discourse-given context (thereby avoiding potential interference from focus prosody on the word of interest).

[7]The same reviewer argues that the gently rising pitch contour on the final syllable of [tulul] (Figure 7) indicates that high pitch is in fact a correlate of stress in Uspanteko. While this may ultimately prove correct, it remains true that pitch perturbations on stressed penults are larger and steeper than corresponding pitch changes on stressed ultimas. It is this asymmetry that motivates our claim that penultimate accent involves an additional phonological H tone.

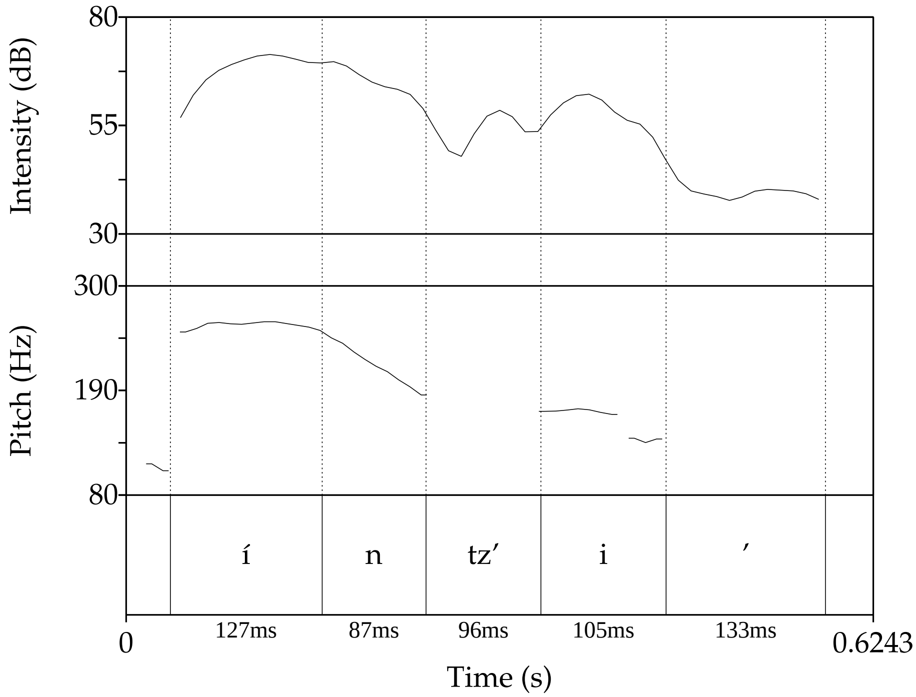


Figure 6: Intensity, pitch, and duration for [íntz'i'] 'my dog' (penultimate stress with tone)

Word		Mean vowel pitch (Hz)				Peak vowel pitch (Hz)			
		Penult	Final	Diff.	Ratio	Penult	Final	Diff.	Ratio
Non-tonal	[intz'i']	187	149	38	1.26	192	169	23	1.14
	[tulul]	209	212	3	0.99	221	224	3	0.99
	[in-chiij]	220	211	9	1.04	223	214	9	1.04
Tonal	[íntz'i']	259	159	100	1.63	262	171	91	1.53
	[lékej]	266	189	77	1.41	280	193	87	1.45

Table 1: Relative pitch measurements for penultimate and final vowels in Figures 5–9

Having demonstrated that lexical pitch can be phonetically distinguished from stress, it remains to be shown that penultimate pitch accent also involves the retraction of stress from the final syllable to the penult. In non-tonal words, default final stress is often realized with some degree of vowel lengthening, relative to unstressed vowels of the same quality and phonemic length. For example, the stressed final [i] in non-tonal [intz'i'] 'I am a dog' (Figure 5) is about 2.75 times as long as the unstressed [i] in the penult (difference: 67ms). Similarly, the stressed final [u] in non-tonal [tulul] 'zapote (sp. of tree)' (Figure 7) is about 1.7 times as long as the unstressed [u] in the penult (difference: 38ms). We thus take it as a working hypothesis that vowel lengthening is a correlate of stress in Uspanteko.

Now note that the nucleus of the accented, penultimate syllable in [íntz'i'] (Figure 6) has over three times the duration of its unaccented counterpart in the penult of non-tonal [intz'i'] (Figure 5; difference: 89ms). The penultimate, tone-bearing [í] in [íntz'i'] is also 22ms longer than the final [i] in the same word. Finally, in [lékej] (Figure 9) the penultimate, tone-bearing [é] is 2.4 times as long as the [e] in the last syllable (difference: 68ms). We conclude from all of this that the vowel lengthening found on tone-bearing penults is in fact indicative of stress shift, as claimed by Can Pixabaj (2006:71).[8]

[8]If duration is indeed a correlate of stress in Uspanteko, we might ask why the final [i] in Figures 5 and 6 is 105ms long whether or not it is stressed. While we have not yet conducted a full-scale study of the phonetics of stress in Uspanteko, we suspect that

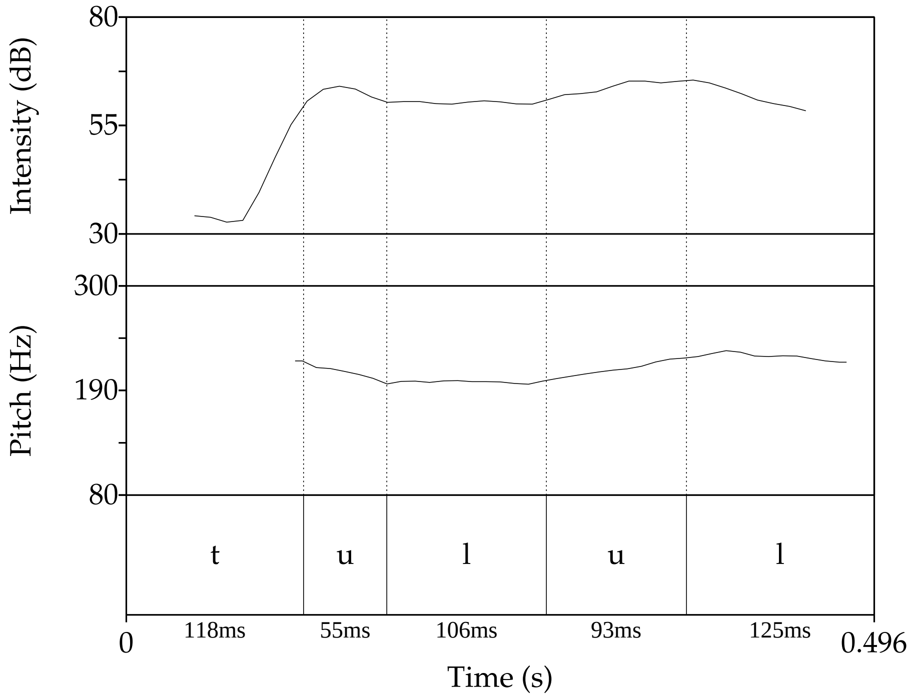


Figure 7: Intensity, pitch, and duration for [tulul] ‘zapote (sp. of tree)’ (final stress, no tone)

While we are still investigating the phonetic correlates of stress in Uspanteko, it is nevertheless clear that stress and tone are dissociated, independent aspects of word-level accent in the language. We conclude, then, that the realization of tone on the penult does indeed draw stress away from its default final position, under pressure for tone and stress to coincide. A satisfactory analysis of Uspanteko accent must capture this fact.

2.2 Tone-segment interactions

Tone regularly interacts with segmental structure in Uspanteko. We find segments that block tone realization, as well as segments that are correlated with its appearance. This work focuses primarily on the first class, though we present an analysis of the latter class in Section 3.3.1.

The first generalization is that while long vowels can bear tone lexically, it is more generally the case that long vowels block the realization of tone when introduced by other morphemes. For instance, some possessive prefixes introduce an H tone that must be realized on the penult (10), but it is not normally realized on nominals with long vowels (11) (see also Figure 8).

(10) a. [tz’i’] ‘dog’
b. [ín-tz’i’] ‘my dog’

c. [laq] ‘plate’
d. [ín-laq] ‘my plate’

e. [teleb’] ‘shoulder’

duration is sometimes suppressed as a correlate of stress in word-final syllables, since vowel length is only contrastive in final position. See Berinstein (1979) for discussion of similar facts in the closely-related Mayan languages Kaqchikel and K’eqchi; and see Campos-Astorkiza (2007) for general discussion. Alternatively, it may be that duration is a general correlate of stress in Uspanteko, but the phonetic cues of stress are only weakly and irregularly realized, as in many languages with fixed stress (e.g. French and Czech, Cutler 2005; Bengali, Hayes and Lahiri 1991; Bininj Gun-Wok, Bishop 2002).

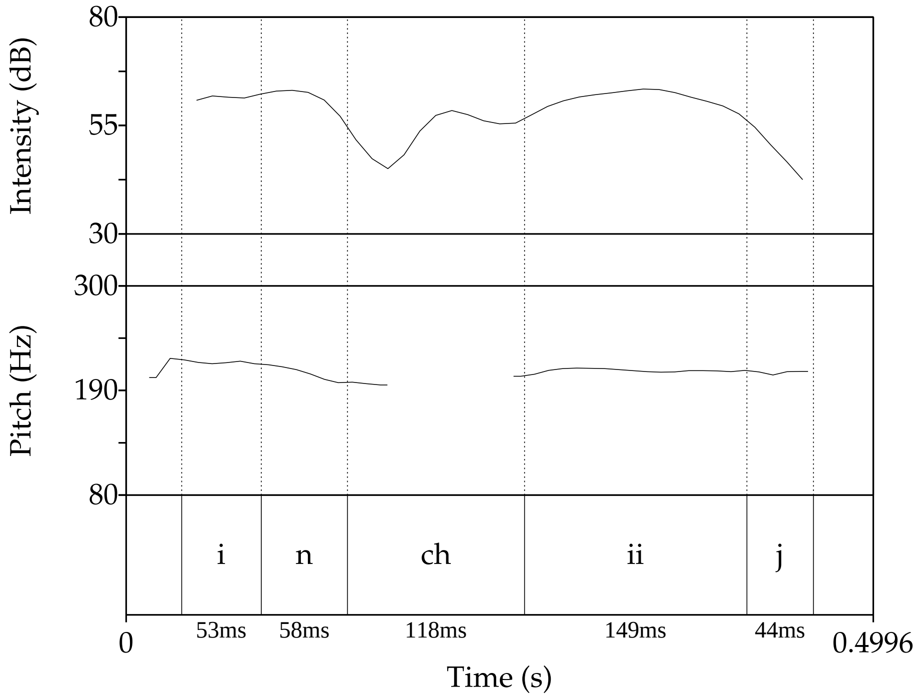


Figure 8: Intensity, pitch, and duration for [in-chiij] ‘my hair ribbon’ (final stress, no tone)

f. [intéleb’] ‘my shoulder’

(11) a. [in-chaa] ‘my obsidian’
b. [in-b’aaq] ‘my bone’
c. [in-b’iis] ‘my sadness’

The effect is not limited to long vowels. We see the same behavior with CV’C syllables ([CVʔC] in IPA notation).

(12) a. [in-ch’o’j] ‘my fight’
b. [in-kuwa’y] ‘my horse’
c. [in-ka’n] ‘my animal’

Especially interesting is the fact that the conditioning CV’C syllables are word-final, so they themselves are not even potential hosts for the tone. We thus need an analysis that can explain why these syllables trigger tone deletion at a distance.

While CV’C syllables block tone realization, there are other syllables that are correlated with tone. Can Pixabaj (2006) notes that a large number of bisyllabic words that have final [a]/[i] nuclei bear tone. It is important to recognize that /a/ reduces to [ə] in unstressed syllables, which we transcribe here for explicitness.

(13) a. [íchij] ‘greens’
b. [íxim] ‘corn’
c. [ájij] ‘cane’
d. [xílik] ‘inside’
e. [íjəj] ‘seed’
f. [áb’əj] ‘stone’
g. [túnəq’] ‘Adam’s apple’

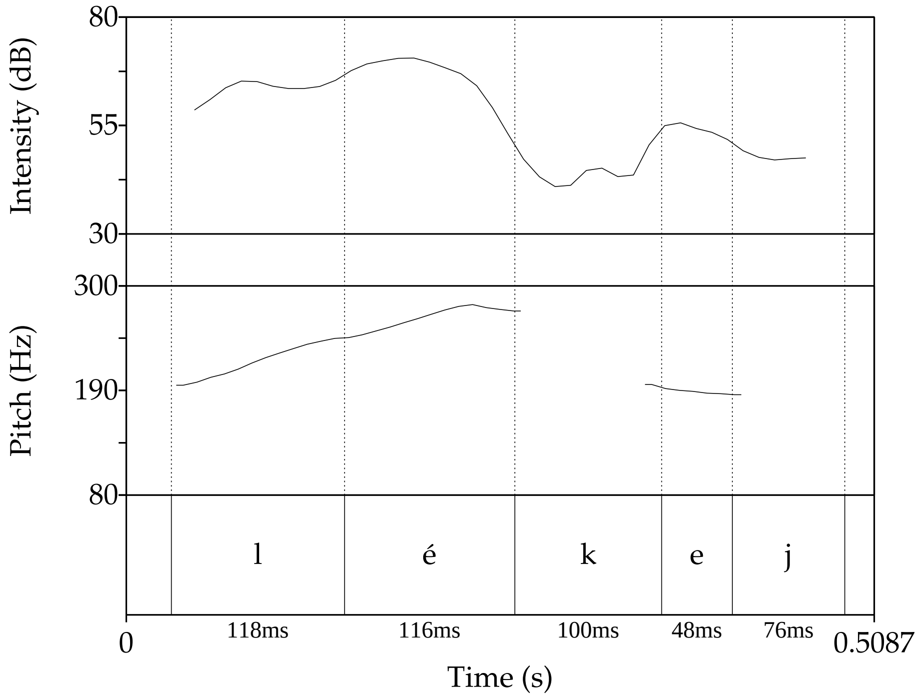


Figure 9: Intensity, pitch, and duration for [lékej] ‘up’ (penultimate stress with tone)

h. [pátən] ‘burden’
etc.

The basic pattern is that tone appears in bisyllabic forms when the final, and ultimately post-tonic syllable would have relatively low sonority. Further examples provide evidence that the sonority profile of these bisyllabic words is really what’s at issue. Tone is also very common for bisyllables with [a] in the penult—that is, tone appears in the vast majority of bisyllabic words where it would yield a tonic syllable with relatively high sonority.

(14) a. [ák’el] ‘child’
b. [cháqej] ‘dry’
c. [ájche’] ‘matazano (species of tree)’

Finally, a large number of disyllabic words with vowels of equal sonority have tone.

(15) a. [étzel] ‘evil’
b. [ójor] ‘a long time ago’
c. [túkun] ‘blackberry’
d. [lékej] ‘up’
e. [tz’únun] ‘hummingbird’

Taking into consideration these extensions to Can Pixabaj’s (2006) generalization about final [a]/[i] in bisyllabic words, the basic pattern is that tone is inserted (with stress shift) when the relative sonority of the tonic vowel with respect to the post-tonic vowel is no worse than it would be if the word did not bear tone. Of course, we have to make precise what it means for a word’s sonority profile to be ‘no worse’ under tone insertion, as well as account for why this calculation is restricted to bisyllabic root words. While we wait till Section 3.3.1 to build our account of these facts, what’s important to draw from these data is that, just as with syllables that block tone, the properties of non-local segments matter for conditioning tone.

2.3 Tone-morphology interactions

Finally, in addition to tones specified on lexical words, there are certain functional morphemes that introduce an H tone. Certain possessive prefixes, for instance, are associated with the appearance of tone (10). However, since H has a restricted distribution, morphemes introducing tone often do not bear that tone themselves.

(16) *-ib'* plural

a. [ajk'ay] 'seller'
b. [ajk'áy-ib'] 'sellers'

c. [ajchaak] 'worker'
d. [ajchák-ib]' 'workers'

(17) *-wu* VP focus clitic

a. [kla' xintíj-wu] 'It was there where I ate.'
b. [lamaas wí-wu] 'Where did you eat?'

(18) Local person possessive prefixes[9]

a. [ixk'eq] 'fingernail'
b. [w-íxk'eq] 'my fingernail'

c. [teleb'] 'shoulder'
d. [in-téleb'] 'my shoulder'

(19) Phrase final status suffix *-ik*[10]

a. [xinchakun ...] 'I worked ...'
b. [xinchakún-ik] 'I worked.'

c. [xinel ...] 'I left ...'
d. [xinél-ik] 'I left.'

The possessive prefixes are particularly interesting because they also serve as ergative agreement markers, but do not trigger tone when crossreferencing the subject of a transitive verb.

(20) a. [t-in-loq']
INC-E1s-buy
'I bought it.'
b. *[t-ín-loq']

The conclusion is that the H tone is associated with an abstract morpheme implicated in agreement with genitive nominals, and not simply part of the phonological spellout of the ergative prefixes in general. A nice morphological consequence is that we can use H tone as a probe for true nominal possession. For instance, Mayan languages are known for marking oblique relations using what are called relational nouns. These are bound morphemes that crossreference their arguments with a single ergative agreement morpheme, exactly like possessed nouns crossreference their possessors. While relational nouns look like possessed nominals, we can show through the distribution of tone that they are not in fact possessed.

(21) [-ik'il] 'with'

a. [w-ik'il] 'with me'
b. *[wík'il]

[9] Third person possessive prefixes do not introduce tone, a fact that we will return to.
[10] Status suffixes indicate verb class membership, where classes are defined in terms of TAM, transitivity, and whether the verb is root or derived (see Kaufman 1990; **?** for a discussion of status suffixes in the closely related language K'ichee').

(22) [-ib'] REFLEXIVE
a. [aw-ib'] 'yourself'
b. *[áwib']

3 Analysis

3.1 Sources of tone

With the basic facts laid out in the previous section, we now build an analysis of Uspanteko tone. Since there is only one toneme, namely H, and its distribution is predictable, we assume that words bearing tone in the output contain a free-floating H tone associated with some morpheme in the input.[11]

(23) a. /anim, H/ 'woman' → [ánim]
b. /ajchaak + -ib', H/ 'workers' → [ajchák-ib']
(Can Pixabaj 2006:58,62)

The eventual placement of H is determined entirely by surface phonological constraints, so there is no empirical reason to assume that tone is ever linked to a particular position in the underlying representation.

While some instances of H tone need to be specified in the lexicon, there are certain cases where tone predictably appears across a morpho-syntactic paradigm. For example, possession is realized through a combination of prefixal ergative marking and tone realization.

(24) Tone and possessive marking
a. [aqan] 'leg'
b. [w-áqan] 'my leg'
c. [aw-áqan] 'your leg' (Can Pixabaj 2006:27,54,546)

[11] See Yip (2002:Section 9.3), Gussenhoven (2004:Section 3.5), and Kubozono (2008:171) on related 'diacritic' approaches to tone and pitch accent.

d. [pix] 'tomato'
e. [ín-pix] 'my tomato'
f. [qá-pix] 'our tomato'
g. [á-pix=aq] 'your (pl.) tomato'[12]

In the absence of tone examples like (24) are either ungrammatical, or can only be interpreted as a segmentally homophonous non-verbal predication structure (with an absolutive rather than an ergative prefix).[13]

(25) Non-verbal predication lacks tone

a. [ín-kar]
ERG.1S-fish
'my fish'

b. [in-kar]
ABS.1S-fish
'I am a fish.' (Can Pixabaj 2006:64)

c. [ín-jal]
ERG.1S-ear.of.corn
'my ear of corn'

d. [in-jal]
ABS.1S-ear.of.corn
'I am an ear of corn.'

One analytical option is to assume that the ergative prefixes are themselves specified with tone in the input. The problem with this approach is that we miss the generalization that all and only those ergative prefixes appearing in possessive constructions bear tone—*verbal* ergative markers are always non-tonal.

(26) Verbal ergative marking lacks tone

a. [x-**in**-qej]
ASP.COMP-**erg**.1S-lend
'I lent it.' (Can Pixabaj 2006:42)

b. *[x-**ín**-qej]

c. [k-**oj**-a-chap-e']
IMP-ABS.1P-**erg**.2S-grab-IMP
'Grab us!' (Can Pixabaj 2006:226)

d. *[k-**oj**-a-cháp-e']

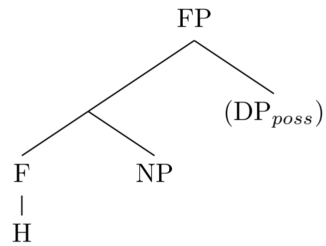
Assuming an underlying tonal specification for the ergative prefixes also leads to non-trivial redundancy. Each ergative prefix has multiple phonologically-conditioned allomorphs: for example, the first-person singular ergative possessive prefix is [in-] before consonants (e.g. [ín-chi'] 'my mouth'), but normally [w-] before vowels (e.g. [w-íxk'eq] 'my fingernails') (Can Pixabaj 2006:57,92). Any account of Uspanteko possessives that assumes tone is underlyingly associated to the ergative prefixes must then posit tone on each individual ergative allomorph—thereby reducing a systematic fact about tone distribution to the level of a lexical accident.

Instead, we propose that tone is the spell-out of the syntactic head responsible for assigning genitive Case to possessors. We call this head F, and remain non-committal with respect to its actual syntactic category. We further assume that possessive constructions like (24) have the following syntactic structure:

(27) Basic syntax of possessive constructions in Uspanteko

[12] On the plural clitic [=aq], see the appendix and example (97).

[13] There are cases of possession in which tone fails to surface for phonological reasons. These cases are discussed and analyzed in later sections.



Tone, then, is simply the spell-out of the F head that assigns genitive Case in possessive constructions.[14] (Note that both full DP and null possessors are allowed in Uspanteko; see e.g. Aissen 1999 for related discussion.)

A further complication arises when we consider that morphological tone only appears on possessed nominals if their possessor is first- or second-person.[15]

(28) No tone triggered by third person possessors[16]

a. [kaa'] 'grinding stone'

b. [ín-ki'] 'my grinding stone'
c. [qá-ki'] 'our grinding stone'

d. [á-ki'] 'your grinding stone'
e. [á-ki'=aq] 'your (pl.) grinding stone'

f. [j-kaa'] 'his/her grinding stone'
g. *[j-káa']

h. [j-kaa'=aq] 'their grinding stone'
i. *[j-káa'=aq]

We assume that first- and second-person possessors—so-called *local person* possessors—are syntactically distinguished from third-person possessors by virtue of bearing the feature specification [+PARTICIPANT] (see e.g. Nevins 2007 and references therein). We make the additional assumption that when F assigns genitive Case to a possessor, F takes on the ϕ-features of that possessor, including its person features. A feature-copying mechanism of this sort is fundamental to much recent work in Minimalist syntax (e.g. Chomsky 2001), though our account departs from standard forms of Minimalism in assuming that feature-copying happens in a SPEC-HEAD configuration in possessives. In the presence of a local person possessor, then, F will come to bear the feature [+PARTICIPANT] as well. The distribution of tone in possessive configurations can then be formalized as in (29), using notation familiar from work in Distributed Morphology (DM; Halle and Marantz 1993, 1994; Harley and Noyer 1999; Embick and Noyer 2007).

(29) Insertion rules for head F

a. F, [+PARTICIPANT] $\leftrightarrow$ H
b. F $\leftrightarrow$ Ø

These rules of vocabulary insertion (along with an elsewhere condition like the SUBSET PRINCIPLE; e.g. Halle and Marantz 1993, 1994; Embick and Halle 2005, etc.) guarantee that possession-triggered tone will only surface in the presence of a local person possessor.

What of the ergative possessive prefixes? While providing a full account of the syntax of possession in Uspanteko is well beyond the scope of this paper, we would nonetheless like to speculate on the syntactic realization of the ergative prefixes. Following proposals in DM (e.g. Marantz 1991/2000; Embick and Noyer

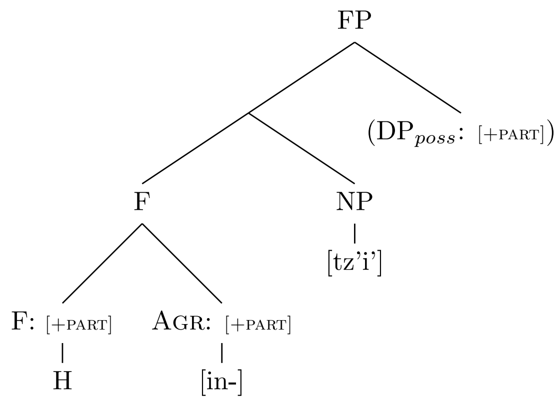
[14] We thank Judith Aissen for suggesting to us that morphological tone in possessives might be linked to genitive Case.

[15] This observation is hinted at in Can Pixabaj (2006:64), and is implicit in some of the examples provided there. Our own fieldwork confirms that the restriction to local person possessors does indeed hold.

[16] The [aa] $\sim$ [i] ablaut seen in (28) is a fairly common, though morpheme-specific feature of Uspanteko nouns. For our consultants, ablaut is optional when [kaa'] 'grinding stone' is possessed, so [ínka'] is also possible.

2007), we assume that Uspanteko makes use of a post-syntactic operation known as AGR-insertion. That is, after the completion of all narrow syntactic operations, a head AGR adjoins to F and copies its ϕ-features. AGR insertion of this sort is assumed to be an arbitrary, language-specific property of Uspanteko morpho-syntax. The effect of AGR-insertion is to create a second syntactic node with the ϕ-features of F (and indirectly, the ϕ-features of the possessor). We propose that this AGR node is the locus of the morphological realization of the ergative possessive prefixes in Uspanteko.

(30) Syntactic structure for [ín-tz'i'] 'my dog'



Tone (on F) and ergative morphology (on AGR) then combine with the possessed noun to form a complex morphological word.

One might ask what role AGR-insertion plays in the larger morpho-syntax of Uspanteko. Our basic intuition is that the presence of an ergative prefix simply indicates that a SPEC-HEAD agreement relation has taken place. (Recall that verbal ergative prefixes index the subjects of transitive verbs, which presumably originate in a specifier of VP/vP; e.g. Manzini 1983; Kitagawa 1986; Woolford 1997, and much subsequent work.) In other words, AGR nodes attach to verbal or nominal heads whenever their specifier position is filled. While we offer no formal account of the connection between ergative morphology (as AGR-insertion) and filled specifiers, it is this connection that we would pursue in a more fully developed account of Uspanteko possessive syntax.[17]

3.2 Distribution of tone

Having considered the ways in which tone can be introduced, we now consider its distribution. First, we capture the generalization that tone is never final with the constraint NONFIN(T, TBU), which is undominated.[18]

(31) NONFIN(T, TBU)
Assign one violation for every tone on a final TBU in the output.

[17]Note that, on our account, both tonal insertion and ergative morphology result from the SPEC-HEAD relation holding between F and the possessor in [SPEC, FP]. One might then object to this (apparent) functional redundancy: both tone and ergative agreement serve to 'signal' possession (as a SPEC-HEAD relation). On the other hand, functional redundancy of this sort is often found in natural language (e.g. Hockett 1966), so we find it unsurprising that possession is sometimes marked in multiple ways in Uspanteko.

[18]Campbell (1977) proposes the following stress placement rule for Uspanteko:

(i) $V \rightarrow [+\textsc{stress}]\ /\ \_\_\ C_0VC_0\#$

This rule is an important conceptual precursor to NONFIN(T, TBU), in that it marks the penultimate mora ('V', in Campbell's notation) as a privileged position for the realization of accent. However, this rule has several shortcomings: the default position of stress in [CV.CV] words is final, not penultimate; the rule conflates stress and tone, which, as we have argued, should be decoupled (though the two are interdependent); and it is standardly assumed that the syllable, not the mora, is the unit to which stress is assigned (e.g. Hayes 1995; though see Cairns 2002 for a dissenting view).

(32)

/ in-kar, H /	NonFin(T, tbu)
a. ☞ ín.kar	
b. in.kár	*!

[ín-kar] 'my fish' (Can Pixabaj 2006:64)

It is important to note that we do not want to achieve this result in terms of general extrametricality, because default stress is word-final in Uspanteko.

(33) a. [alq'oom], *[alq'oom] 'thief'
b. [mewa], *[mewa] 'fast' (Can Pixabaj 2006:14)

It is far from clear why extrametricality would be disregarded in non-tonal words, but respected in words bearing tone. General extrametricality, then, cannot be the driving force behind the avoidance of final tone. (See also Green and Kenstowicz 1995 on problems with the context-specific revocation of extrametricality.)

Since tone never surfaces on monosyllabic words containing short vowels, NonFin(T, tbu) must dominate Max(T), the constraint banning tone deletion.[19]

(34) No tone on CV(C) words: NonFin(T, tbu) ≫ Max(T)

/ CVC, H /	NonFin(T, tbu)	Max(T)
a. ☞ CVC		*
b. CV́C	*!	

In Section 2.1 we saw that default final stress placement can be violated in the presence of tone, because stress and H tone must coincide. We capture this fact with the constraint *Unstressed-H (de Lacy 2002), which states that H tone must appear in a stressed syllable (see also Hayes 1995:279).

(35) *Unstressed-H
Assign one violation for every H tone on an unstressed syllable in the output.

[19]Without further elaboration, the ranking NonFin(T, tbu) ≫ Max(T) predicts that CV(C) roots could have 'latent' tone: in the isolation form of the root, underlying tone would be deleted rather than appear on the final mora; but the addition of an affix would allow stem-final tone to surface by insulating it from word-final position.

(i) Latent tone on nonce forms [pok] and [pók-a-j]
a. / pók / → [pok]
b. / pók-a-j / → [pókaj]

To the best of our knowledge, there are no words in Uspanteko that manifest latent tone in this way. While our analysis does predict that latent tone should be possible, we believe that the lack of underlying /CV(C), H/ roots is essentially an accidental gap. Most root-types (e.g. verb roots, positional roots, etc.) cannot appear in their unaffixed, isolation forms to begin with. While nominal roots can appear in isolation, there are very few productive nominal affixes, and many nominal affixes bear tone independently, thus obscuring any trace of latent tone on the noun itself.

For example, plural [-ib'] and instrumental [-b'Vl] trigger tone (Can Pixabaj 2006:60), as do the local person ergative possessive prefixes (Section 3.1). The third-person ergative prefixes [j-] and [r-] do not trigger tone; but since they do not add a TBU either, they would never cause latent tone to appear. The semi-productive abstractivizing suffix [-VVl] does not trigger tone on its own, but nouns bearing [-VVl] are obligatorily possessed, and may thus bear tone for other reasons (Can Pixabaj 2006:130). Finally, while the verbalizing suffixes that apply to nouns are toneless (e.g. the [-(a)aj] suffix of derived transitives, Can Pixabaj 2006:123), they are also not fully productive.

If Uspanteko ever had CV(C) noun roots with latent tone, it seems plausible that the toneless, bare forms would have been more frequent than the affixed forms; and further that any tone in affixed nouns could often be attributed to the affix itself. Over time, then, any words with latent tone may have been reanalyzed as simply toneless, in accord with their isolation forms. We thank Larry Hyman for bringing the question of latent tone to our attention.

(36)

/ in-kar, H /	NonFin(T, tbu)	*Unstressed-H
a. ☞ ín.kar		
b. ín.kar		*!
c. in.kár	*!	

So far we've seen that stress will shift one syllable leftward in order to coincide with tone on a penultimate syllable. We should ask, then, why stress never shifts *two* syllables leftward, satisfying *Unstressed-H and licensing tone on an antepenultimate syllable.

(37) a. [in-chíkich] 'my large basket'
b. *[ín-chikich] (Can Pixabaj 2006:61)

(38) a. [ájwu] 'proprietor'
b. /ájaw + ub/ → [ajáw-ub] 'heads of a *cofradía*'
c. *[ájaw-ub] (Can Pixabaj 2006:66)

(39) a. [lékej] 'up'
b. /léke + l + ik/ → [lekélik] 'to be high up'
c. *[lékelik] (Can Pixabaj 2006:22,307)

Example (37) shows that tone appears on the penult even when the antepenultimate syllable is the possessive prefix associated with the appearance of tone in the first place. For examples (38) and (39), shifting stress to the antepenult would allow the derived forms *[ájaw-ub] and *[lékelik] to preserve the tone placement found in the stem forms [ájwu] and [lékej]—presumably a desirable result from the perspective of paradigm uniformity, lexical access, etc. (e.g. Steriade 2000). Since NonFin(T, tbu) will be satisfied in either case, the restriction to final or penultimate tone remains unexplained.

One possibility that we can immediately discard is that there is a high-ranked constraint directly aligning tone to the right edges of words, say Align-R(H, ω). For Uspanteko, positing such a constraint would miss an important generalization: tone coincides with stress, and stress is drawn to the right edge of the word even in the absence of tone. An explanatory analysis of Uspanteko phonology must therefore account for the fact that tone placement is derivative of the pressures that independently govern stress placement.[20]

The core intuition of this analysis is that stress placement, tone placement, and stress shift in Uspanteko all emerge from strict constraints on the realization of foot structure. It is the interaction of these metrical and tonal constraints that derives the two-syllable accent window of Uspanteko. To begin, we assume that footing is iambic, non-iterative, and right-aligned in Uspanteko.

(40) Iambic footing
a. [(chen.kleen)] 'lame'
b. [i(ti.neb')] 'place for bathing'
c. [xri.xo(qi.laaj)] 'he made her his wife'
d. [(o.keb')] 'entry' (Can Pixabaj 2006:21–2,52,124)

The assumption of iambic footing and right-alignment is motivated by the fact that default stress is word-final in Uspanteko, whether the final syllable is light CV(C) or heavy CVV(C). A trochaic analysis of Uspanteko stress wrongly predicts that words ending in two light syllables should have penultimate stress. This is incorrect: words ending in two [CV] syllables have default final stress.

(41) a. [la(jo.ri)] 'today'
b. *[la(jo.ri)]

A further piece of evidence for iambic footing comes from the distribution of long vowels. In Uspanteko long vowels may only appear word-finally (Can Pixabaj 2006:46; see also the appendix). As a consequence, the

[20] Furthermore, if violations of alignment constraints are reckoned categorically (McCarthy 2003b), Align-R(H, ω) would not by itself guarantee that stress shifts at most one syllable to the right.

only logically possible right-edge feet are of the shape (L L), (L H), (L), or (H) (where L = light, monomoraic syllable, and H = heavy, bimoraic syllable). This set of foot shapes is of course suspiciously reminiscent of the crosslinguistic inventory of well-formed quantity-sensitive iambs (Prince 1991; Kager 1993a; Hayes 1995). Finally, non-iterativity is justified by the fact that Uspanteko lacks secondary stress, as can be seen in words of three or more syllables (e.g. (40-c) above).

In OT terms, both right-alignment and non-iterativity fall out from the assumption that the constraint All-Ft-R (Prince and Smolensky 1993/2004; McCarthy and Prince 1993) is undominated.[21]

(42) All-Ft-R undominated in Uspanteko

/ ti-chomoor-sa-j /	All-Ft-R
a. ☞ ti.cho(mor.saj)	
b. ti(cho.mor)saj	*!
c. (ti.cho)(mor.saj)	*!

[tichomorsaj] 'they are thinking' (Can Pixabaj 2006:606)

Assuming further that Iamb, the constraint enforcing right-headed feet, outranks its mirror-image Trochee, we straightforwardly derive the default stress system of Uspanteko.

(43) Default iambic stress in Uspanteko: Iamb ≫ Trochee

/ ti-chomoor-sa-j /	All-Ft-R	Iamb	Trochee
a. ☞ ti.cho(mor.saj)			*
b. ti.cho(mor.saj)		*!	
c. ti(cho.mor)saj	*!		*
d. (ti.cho)(mor.saj)	*!		**

Default final stress obtains in two situations: words which lack tone, and words which bear tone on a final long vowel. In the absence of tone, tone-stress constraints like *Unstressed-H can exert no effect on the metrical structure of a word, so default stress placement results.

(44) No tone: default stress

a. [(o.kox)] 'mushroom'
b. [(chu.kej)] 'cramp' (Can Pixabaj 2006:24-5)

(45) No tone: *Unstressed-H inactive

/ okox /	All-Ft-R	Iamb	*Unstressed-H
a. ☞ (o.kox)			
b. (o.kox)		*!	

When tone appears on a final long vowel, tone already coincides with the position of default stress, so final stress is once again unperturbed. For words ending in a long vowel, penultimate stress always violates both Iamb and Weight-to-Stress (WSP; Hayes 1981; Prince 1991; Prince and Smolensky 1993/2004), and is therefore impossible.

(46) Tone on long vowel: default final stress

[21] If one were inclined to be more agnostic about iterative footing in Uspanteko, the constraint All-Ft-R could be replaced with a constraint like Align-Head-R, which demands final primary stress but allows for non-final feet (McCarthy and Prince 1993; Pater 2000). Tone-triggered penultimate stress would then require the ranking {NonFin(T, tbu),*Unstressed-H} ≫ Align-Head-R. At present there is no empirical evidence for non-head feet in Uspanteko, so we believe that the burden of proof is on those who assume iterative footing.

a. [(in.wúuj)] ‘my paper’
b. [(in.kúuk’)] ‘my squirrel’ (Can Pixabaj 2006:69)

(47) No tone-stress interaction for long vowels

/ in-siip, H /	NonFin(T, tbu)	WSP	Iamb	*Unstressed-H
a. ☞ (in.síip)				
b. (ín.siip)		*!	*!	
c. (ín.siip)				*!

[in-siip] ‘my tick’ (Can Pixabaj 2006:69)

Even without assuming a ranking between Iamb, WSP, and *Unstressed-H, these three constraints conspire to ensure that tone never falls on the penult if the final syllable contains a long vowel. As shown in (47), such candidates must violate either *Unstressed-H or Iamb/WSP, and are therefore correctly eliminated. We can already see how the interaction of tone-stress constraints and constraints on foot structure derives the right-edge orientation of tone placement in Uspanteko.

The only deviation from default final stress occurs when tone appears on a word with a short vowel in the final syllable. In just those cases tone appears on the penult, and stress retracts one syllable to align with tone.

(48) Tone on short vowel: stress and tone retract to penult

a. [lékej] ‘up’
b. [ák’el] ‘child’ (Can Pixabaj 2006:59)

We propose that tone-driven stress retraction in Uspanteko is in fact a tone-driven iambic-trochaic reversal: to avoid placing tone on a final vocalic mora, Uspanteko reverses the headedness of final feet, yielding penultimate stress and tone.[22]

(49) Tone on short vowel: iambic-trochaic reversal

a. [(lé.kej)] 'up'

b. [(á.k'el)] 'child'

Formally, the constraint penalizing final tone (NonFin(T, tbu)) and the constraint forcing tone and stress to coincide (*Unstressed-H) must both outrank Iamb, which prefers right-headed feet.

(50) Tone on penult drives iambic-trochaic reversal:
{Max(T), *Unstressed-H, NonFin} ≫ Iamb

/ lekej, H /	Max(T)	*Unstr-H	NonFin(T, tbu)	Iamb
a. ☞ (lé.kej)				*
b. (le.kéj)			*!	
c. (lé.kej)		*!		
d. (le.kej)	*!			

As (50) shows, Max(T) must also dominate Iamb to ensure that underlying pitch accent surfaces even when realizing tone requires the construction of trochaic feet.

To summarize, we are claiming (i) that penultimate tone results from constraints barring tone on a word-final vocalic mora; (ii) that deviations from default stress occur in order to align stress with non-final tone; and (iii) that stress retraction in Uspanteko involves an iambic-trochaic reversal; that is, stress retraction is foot-bounded. We are now in a position to explain why stress and tone never appear farther to the left than the penult. Antepenultimate accent would either require tone to appear outside of a foot, and thus on an unstressed syllable; or it would require leftward shift of the default right-aligned foot. The first alternative is ruled out by *Unstressed-H, and the second by All-Ft-R.

(51) No antepenultimate accent:
{All-Ft-R, Max(T), *Unstressed-H} ≫ {Iamb, Ident(T)}

/ léke-l-ik /	All-Ft-R	Max(T)	*Unstr-H	Iamb	Ident(T)
a. ☞ le(ké.lik)				*	*
b. lé(ke.lik)			*!		
c. le(ke.lik)		*!			
d. (lé.ke)lik	*!			*	
e. (le.ké)lik	*!				*

[lekélik] 'to be high up', from [lékej] - 'high up' (Can Pixabaj 2006:58, 124)

(52) Ident(T)(McCarthy and Prince 1995)
Assign one violation for every input-output pair {T_i, T_o}, such that T_i and T_o are tones standing in a correspondence relation and are associated with different tone-bearing units.

The complete absence of antepenultimate accent is thus a direct consequence of the pressure for right-aligned feet, and the pressure for stress and tone to coincide.[23]

As suggested above, the distribution of long vowels in Uspanteko provides further evidence that accent is subject to austere constraints on foot structure. Long vowels only appear word-finally in Uspanteko, and are

[22] Foot-form reversals of this sort—sometimes known as 'rhythmic reversals'—have also been proposed for Choctaw, Southern Paiute, Ulwa, Axininca Campa (Prince and Smolensky 1993/2004:58), Tiriyó Carib (van de Vijver 1998:Ch.2), Hopi (Gouskova 2003:Ch.3), Nanti (Crowhurst and Michael 2005), Panoan languages (Elias-Ulloa 2006), Takia (de Lacy 2007), and Awajún (McCarthy 2008).

[23] Rather than assume right-aligned feet, one might entertain a foot-free analysis of this two-syllable accent window by appealing to a pressure to avoid word-final lapses (e.g. Kager 2001, 2005). However, see Section 3.3 for segmental evidence that Uspanteko accent does indeed depend on metrical foot structure.

therefore always stressed. We take this fact as evidence that the constraint Weight-to-Stress is active in Uspanteko: long vowels must be stressed. Since stress retraction is foot-bounded, the only long vowels that could potentially bear stress are those long vowels appearing in the last two syllables of the word. Final stress is of course perfectly licit; but placing stress on a penultimate long vowel would require a violation of Iamb. As tableau (53) demonstrates, the ranking Iamb ≫ Id(Length) guarantees that shortening non-final long vowels will be preferred to retracting stress to a long vowel in the penult.

(53) No non-final long vowels: {All-Ft-R, WSP, Iamb} ≫ Id(Length)

/ x-r-elk'waal-aj /	All-Ft-R	WSP	Iamb	Id(length)
a. ☞ xrel(k'wa.laj)				*
b. xrel(k'waa.laj)			*!	
c. xrel(k'waa.laj)		*!		
d. (xrel.k'waa)laj	*!			

[xrelk'walaj] 'I sired him/her', from [alk'waal] 'son'

(Can Pixabaj 2006:123)

The only way a non-final long vowel could be prosodified would be by violating All-Ft-R, WSP, or Iamb, all of which dominate Id(Length). Non-final long vowels are thus repaired via vowel shortening, leaving default stress assignment intact. Here we see an important difference in the relative prominence of tone and vowel length: iambic reversals can be conditioned by tone (high-ranked NonFin(T, tbu)), but *not* by length (low-ranked Id(Length)).

Given this dichotomy, one potentially problematic form would be one in which a non-final long vowel were allowed to surface unaltered by virtue of bearing tone.

(54) Tone + length ≠ non-final long vowel

/ júun-kitz /	NonFin(T, tbu)	WSP	Iamb	Id(length)
a. ☹ (jún.kitz)			*	*!
b. ☞ (júun.kitz)			*	

[júnkitz] 'a little' (Can Pixabaj 2006:58, 144)

In (54) a non-final long vowel 'piggybacks' on the iambic-trochaic reversal driven by non-final tone, and is thus indirectly licensed. Note, however, that the troublesome form *[júunkitz] contains an (H L) trochee. As argued in Hayes (1981, 1995); Prince (1991); Kager (1993a,b, 1999), and Mester (1994), (H L) trochees are marked relative to the bimoraic even trochee (L L). One way to rule out this dark horse candidate, then, is to assume that the constraint *UnevenTrochee is active in Uspanteko. (See Pruitt 2010:505 for a brief overview of proposals for capturing the preference for balanced/even trochees in OT.)

(55) *UnevenTrochee
Assign one violation for every trochaic foot of the shape (HL), where H = heavy (bimoraic) syllable and L = light (monomoraic) syllable.

(56) Tone can't save non-final long vowels: *UnevenTrochee ≫ Id(Length)

/ júun-kitz /	Iamb	*UnevenTrochee	Id(length)
a. ☞ (jún.kitz)	*		*
b. (júun.kitz)	*	*!	

Iambic-trochaic reversals in Uspanteko thus instantiate an interesting 'Emergence of the Unmarked' effect (McCarthy and Prince 1994): reversals are permitted if and only if they result in the least-marked trochaic form (L L). Here again we find that Uspanteko imposes strict and varied requirements on metrical structure, despite the descriptive simplicity of the accentual system.

This section provided arguments for the following constraint rankings, which are graphically represented with a Hasse diagram in Figure 10:

(57) a. NonFin(T, tbu) ≫ Max(T) (34)
No tone on monosyllabic CV(C) words containing short vowels.

b. Iamb ≫ Trochee (43)
Iambic footing.

c. NonFin(T, tbu) ≫ Ident(T) (not shown)
Prevents tone from surfacing faithfully on word-final moras when underlyingly specified in polysyllabic words.

d. Max(T), *Unstressed-H, NonFin(T, tbu) ≫ Iamb (50)
Tone-driven iambic-trochaic reversals.

e. All-Ft-R ≫ Iamb (51)
No tone-driven leftward foot displacement.

f. All-Ft-R, Max(T), *Unstressed-H ≫ Ident(T) (51)
Underlying pre-penultimate tone surfaces on the stressed penult/ultima.

g. All-Ft-R, WSP ≫ Id(Length) (53)[24]
No non-final long vowels.

h. *UnevenTrochee ≫ Id(Length) (56)
Penultimate long vowels always shorten, even when accented.

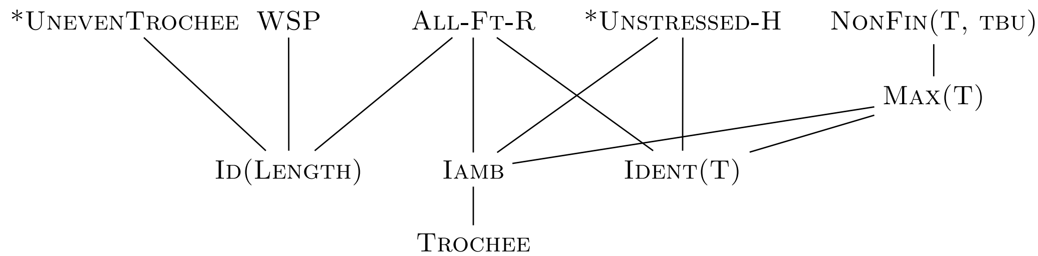


Figure 10: Hasse diagram of ranking arguments

Taking a broader perspective, in this section we have demonstrated that stress placement, tone placement, and the distribution of long vowels in Uspanteko are all determined by simple, crosslinguistically plausible constraints on metrical structure. It is a remarkable fact that Uspanteko is sensitive to foot-based metrical restrictions of *exactly* the same type as found in languages with greater surface complexity in their accentual systems. We defend this claim in the following section, where we provide further segmental evidence for foot structure in Uspanteko. In section Section 4 we address additional tone-segment interactions, focusing on cases where segmental structure interferes with the realization of tone.

3.3 Segmental evidence for foot structure

3.3.1 Tone-driven reversals and perfect prosodic word effects

Section Section 2.2 established the generalization that tone in bisyllabic words is robustly correlated with their sonority profile (Can Pixabaj 2006:58).[25] In particular, bisyllabic words tend to have tone under any of the following conditions: (i) the final syllable, if unstressed, would have a low sonority head, normally [i] or reduced ⟨a⟩/[ə]; (ii) the penult, if stressed, would have a high sonority [a] head; or (iii) the sonority profile across the word is even, in the sense that the penult and final syllable are headed by vowels of equal sonority. In this section we analyze the interaction between tone and vowel sonority in bisyllabic words, and argue that such interactions are mediated by foot structure. The core idea is that the ideal metrical shape for phonological words in Uspanteko is a single bimoraic foot with a sonority profile that does not rise into the weak branch. Tone insertion in bisyllabic roots is licensed when it produces prosodic words meeting these conditions. We start with the sonority generalizations.[26]

We assume that vowel sonority is a function of height, where low vowels are more sonorous than mid vowels, which are in turn more sonorous than high vowels and schwa (e.g. Jespersen 1904; Dell and Elmedlaoui 1985; Clements 1990; Prince and Smolensky 1993/2004, etc.).

(58) Relative sonority scale for vowels:
Low > Mid > High/ə

[24]The ranking *UnevenTrochee ≫ Ident(Length) undermines the argument for Iamb ≫ Ident(Length) in (53). Consequently, the latter ranking is omitted here.

[25]Throughout this section, 'bisyllabic' refers only to forms consisting of two light syllables, i.e. words with a short vowel in the final syllable.

[26]It is important to note that, according to Can Pixabaj 2006, all of these generalizations are statistical. In combing through this work and the Uspanteko dictionary (Méndez 2007), we have only been able to find one clear counterexample. Ideally we would be able to provide a statistical analysis of this area of the lexicon, but large balanced corpora of Uspanteko that reliably indicate tone do not exist. In the future we hope to be able to quantify the strength of these generalizations. In the meantime, we feel that the fact that native speakers find it easy to think of examples obeying these generalizations, but hard to think of counterexamples, is enough to motivate an analysis of these data.

In Uspanteko, tone appears on the vast majority of bisyllabic words with a low sonority vowel nucleus ([i] or ⟨a⟩/[ə]) in their final syllable. We transcribe unstressed /a/ as [ə] in the following examples to highlight this generalization.

(59) a. [ánim] 'woman'
b. [r-úxib'] 'his/her/its aroma'
c. [ísim] 'stamp'

d. [sáq'əj] 'summer'
e. [túnəq'] 'Adam's apple'
f. [íjəj] 'seed' (Can Pixabaj 2006:58)

If vowel sonority truly conditions the presence of tone in such words, we should expect final [u] to pattern with [i] and [ə] in triggering tone, given that [u] is also a low-sonority high vowel. It is difficult to find relevant examples, but at least one word suggests that this prediction is correct.

(60) [ínup] 'ceiba (species of tree)' (Méndez 2007)

In addition, bisyllabic words with the highest sonority vowel, stressed [a], as the initial syllable nucleus overwhelmingly bear tone. This pattern holds regardless of the sonority of the final syllable nucleus.

(61) a. [áb'əj] 'stone'
b. [pátən] 'burden'

c. [ájchi'] 'matazano (species of tree)'
d. [bálik] 'brother-in-law (for a man)'

e. [ák'el] 'child'
f. [chákej] 'dry'

g. [áwus] 'fava bean'
h. [ájwu] 'owner' (Can Pixabaj 2006:58–59)

Finally, tone also appears if both syllable nuclei in a bisyllabic word are of equal sonority.

(62) a. [lékej] 'up'
b. [tz'únun] 'hummingbird'
c. [ójor] 'a long time ago' (Can Pixabaj 2006:59)

The core generalization here is that, with overwhelming frequency, bisyllabic roots with falling or level sonority between successive vowels also bear tone. What we never find is a bisyllabic word with tone and a rise in vowel sonority from the tonic to post-tonic syllable (i.e. a penult high vowel with tone followed by a final mid vowel). For example, roots like the following are always toneless.[27]

(63) a. [ixk'eq] 'nails'
b. [ikeq'] 'twine sling'

c. [chukej] 'cramp'
d. [uke] 'guachipilín (species of plant)'

Note that words like [ixk'eq] are perfectly capable of bearing tone: derived forms like [w-íxk'eq] 'my nails' show that the sonority requirements holding of unaffixed roots do not apply to morphologically complex

[27] We have been able to find a few counterexamples, but most are weak at best. For example, the word [síner] 'dinner', which is a borrowing from the Spanish *cena*, should not have tone according to our generalizations; however, this example does not pose a real problem for our account because Spanish penultimate stress is always reinterpreted as tone in borrowings. Similarly, there are words that have been reported inconsistently in the grammatical literature, like 'his leg', which is found written both as [ráqan] and as [raqan]. The only firm counterexample we have found is [chukuy] 'pine fruit', which does not bear tone despite having two identical short vowels.

forms. It seems that the tone-sonority interactions described above are limited to bare roots alone.

Stepping back, what we see in these examples is more evidence for the foot-based analysis of Uspanteko tone. If we try to conceive of the least marked trochaic foot, it would be a bisyllabic LL foot with every possible prominence contrast favoring its left branch. This is exactly what these distinguished words are converging on in Uspanteko. They are bisyllabic LL forms where the left syllable bears both tone and stress, and is no lower in sonority than the right syllable. If we want a phonological account of the presence of tone in these examples, the analysis needs to insert tone just in bisyllabic words without a sonority rise across the foot. While the most important conclusion of this section lies is the generalization itself, namely assuming that tone insertion entails an iambic-trochaic reversal makes of these data, we propose that this accentual pattern reflects a constraint preferring 'perfect prosodic words' (Zec 1999; Itô and Mester 2011).

As discussed in more detail below, Perfect Prosodic Word (hereafter PPW) is a markedness constraint assigning special status to words that are coextensive with a single foot, and that also meet additional demands on the relative prominence of syllables within that foot. We will present the PPW account first, and then show that an alternative account that decomposes PPW into its constituent constraints runs into problems.

Consider the first feature of PPW, the requirement that each prosodic word ω correspond to exactly one foot. As observed by Zec (1999) (and discussed in Itô and Mester 2011), suffix-triggered vowel shortening in the Neo-Štokavian dialect of Serbo-Croatian occurs if and only if the resulting complex corresponds to a bimoraic trochee. (This pattern of shortening is apparently specific to the adjective-forming suffixes [-ost] and [-ăsk].)

(64) Suffix-triggered shortening and PPW effects in Serbo-Croatian (Zec 1999)

a. [ml**aa**d-] → [ml**a**dost-] 'young'
b. *[ml**aa**dost-]
c. [ž**ii**v-] → [ž**i**vost-] 'lively'
d. *[ž**ii**vost-]

e. [hum**aa**n-] → [hum**aa**nost-] 'humane'
f. *[hum**a**nost-]
g. [op**aa**k-] → [op**aa**kost-] 'vicious'
h. *[op**a**kost-]

As the examples in (64) illustrate, vowel shortening applies if the result is a bimoraic trochee like [(mla.dost)], but not if the resulting form would be larger than a bimoraic trochee, as in *[o(pa.kost)]. Zec captures this fact with a constraint requiring certain morphological domains to correspond exactly to a single foot (thus *[(mlaa)dost]); following Itô and Mester (2011), we interpret this phenomenon as an expression of PPW.[28] Itô and Mester (2011) also show that the distribution of Danish *stød* (essentially a phonologically-driven pitch accent) follows from similar pressures on the alignment of prosodic words and feet.

Languages that are sensitive to PPW effects can also place restrictions on the prosodic shape of the relevant foot. Itô and Mester (2011) argue that the strong statistical preference for initial pitch accent on bimoraic words in Tokyo Japanese is also due to the workings of PPW. While accent placement is foot-based in Tokyo Japanese (e.g. Kubozono 2008), there is no general requirement that foot heads correspond to accented syllables (i.e. there is widespread covert footing). Bimoraic words are of course those words that, in principle, could satisfy the size requirement of PPW. The fact that bimoraic words bear initial accent, however, must be attributed to an independent pressure for the foot-head to be phonetically salient in PPW contexts (footing is trochaic in Tokyo Japanese). The intuition at work here is that prosodic words are only 'perfect' if they correspond to a single foot, and the head of that foot is phonetically prominent (cf. Zec's 1999 FootSalience constraint; see Teeple 2009 for closely related ideas).

We claim that the perfect prosodic word in Uspanteko is coextensive with a bisyllabic foot that has a non-rising sonority profile and a head that bears tone. We define the constraint PPW as in (65), which differs slightly from the formulation proposed by Itô and Mester (2011).

[28] It bears mentioning that these shortening effects cannot be attributed to the constraint *UnevenTrochee (55), since *UnevenTrochee would wrongly favor shortening in [o(paa.kost)], *[o(pa.kost)] as well.

(65) Perfect Prosodic Word (PPW)
Assign one violation mark for every prosodic word ω that does not meet all of the following criteria:
(i) ω is coextensive with a single foot F.
(ii) The head syllable of F (σ_S) bears tone.
(iii) F is bisyllabic.
(iv) The nucleus of σ_S is at least as sonorous as the nucleus of σ_W, the syllable occupying the weak branch of foot F.

Clause (i) captures the basic size requirement behind PPW effects (more on this below). It is important to recognize that clause (i) is *not* a general condition forcing prosodic words to be of some minimal size. Trisyllabic words, for example, necessarily violate clause (i), because the foot in a $[\sigma(\sigma\sigma)]$ structure is not *coextensive* with the entire prosodic word.

Clauses (ii)–(iv) express the second facet of PPW, namely the conditions it places on the prosodic shape of the single foot in the prosodic word. Our general claim is that PPW forces foot heads to have greater phonetic prominence than foot non-heads in PPW contexts. Uspanteko expresses relative prominence by a combination of tone and restrictions on vowel sonority; in other languages, PPW might be satisfied by other means, as made available by the phonetics and phonology of the language. Japanese, for instance, uses pitch to satisfy the relative prominence clause of PPW, but opts not to make use of vowel sonority in the same way.[29]

What of clause (iii), the restriction to bisyllabic feet in PPW contexts? This clause captures the fact that monosyllabic CVV(C) roots—which are necessarily parsed as a single foot—do not all bear tone. Since CVV(C) roots satisfy both clause (i) and clause (iv) of PPW (the latter vacuously), clause (iii) is needed to guarantee that tone does not appear on such roots with the same regularity as for bisyllabic roots.[30] But why might something like clause (iii) hold? Here we appeal to the long-standing idea that prominence is a *relational* notion (e.g. Liberman 1975): no phonological element is 'prominent' in an absolute sense, only more or less prominent than other elements within the same phonological structure. Just as tone insertion and conditions on relative vowel sonority serve to highlight foot heads in PPW contexts, we believe that the bisyllabicity requirement (iii) enhances the prominence of accented syllables by ensuring that a syllable with low phonetic salience will appear within the same foot.[31] In other words, the bisyllabicity requirement forces an explicit comparison between the phonetically salient foot head and the less salient non-head, thereby emphasizing the prominence of the foot head itself.[32]

Note that we are *not* claiming that Uspanteko prefers trochaic footing over iambic footing in PPW contexts (which would be at odds with the general preference for iambs in the language). Trochaic footing *emerges* in PPW contexts under the interaction of constraints governing the relative prominence of foot heads (i.e. foot heads should bear tone), and the non-finality constraint preventing tone from appearing on a final short vowel.[33]

With the basic structure of PPW in hand, we can now see how it captures the tone distributions outlined

[29] Uspanteko also differs from Danish and Serbo-Croatian in that PPW effects are limited to monomorphemic roots. For example, complex forms like [san-s-ik] 'swollen' [k'iy-naq] 'grown' do not bear tone, while simplex forms like [áb'aj] 'stone' do (Can Pixabaj 2006:97,156–7).

[30] See Section 4.2 for evidence that tone is also dispreferred on final long vowels for independent reasons. In connection with this fact, note that bisyllabic roots containing a final long vowel (e.g. [tu.<u>kuur</u>] 'owl', Can Pixabaj 2006:38) do not bear tone with any notable frequency, even though such words can in principle satisfy all four clauses of PPW (65). We assume that the relative markedness of tonal [...CV́VC#] syllables in Uspanteko masks PPW effects in such words.

[31] Along these lines, Kenstowicz (1994); Gouskova (2003); Zec (2003) and de Lacy (2004, 2007) (among others) have suggested that feet may impose different sonority requirements on their strong and weak branches, with a clear preference for high-sonority heads and low-sonority non-heads. Teeple (2009) argues at length that prominence constraints within a phonological domain (like the foot) should refer to both prominent and non-prominent positions simultaneously.

[32] The bisyllabicity requirement also appears to be unique to Uspanteko: in Japanese, for example, PPW makes no distinction between monosyllabic and bisyllabic two-mora words (Itô and Mester 2011). It may be relevant that pitch accent in Tokyo Japanese is an HL contour, and in a certain sense has relative prominence 'built in' to the accent itself. See also footnote 30 for an alternative explanation of the bisyllabicity requirement.

[33] Curiously, apart from Uspanteko PPW effects have so far only been observed for languages with trochaic footing. More research is needed to determine whether this is a real generalization about the content of PPW, or an artifact of limited data. Also interesting in this regard is the fact that "...trochaic systems tend to be characterized by alternations in pitch and intensity, while iambic systems are marked by alternations in length" (Goad and Buckley 2006:115, citing Hayes 1995). In PPW contexts in Uspanteko, we find trochaic feet that show prominence asymmetries in both pitch and intensity (≈ sonority), in line with this general finding about the expression of prominence in trochaic stress accent systems.

above. PPW forces tone to appear on the foot head; since high-ranked NonFin(T, tbu) prevents tone from appearing on the final syllable, a rhythmic reversal occurs to accommodate tone in the usual way.

(66) PPW effects: {NonFin(T, tbu), PPW} ≫ {Iamb, Dep(T)}

/ anim /	NonFin(T, tbu)	PPW	Iamb	Dep(T)
a. ☞ (á.nim)			*	*
b. (a.nim)		*!	*	
c. (ə.ním)	*!			*
d. (a.nim)		*!		

[ánim] ‘woman’ (Can Pixabaj 2006:58)

If any of clauses (i)–(iv) cannot be satisfied—say, if a bisyllabic word has the wrong sonority profile when it bears tone, necessarily violating either clause (ii) or clause (iv)—then tone fails to appear.

(67) Tone blocked by conditions on vowel sonority: NonFin(T, tbu) ≫ PPW

/ ikeq’ /	NonFin(T, tbu)	PPW	Iamb	Dep(T)
a. ☞ (i.keq’)		*		
b. (i.kéq’)	*!			*
c. (í.keq’)		*	*!	*!
d. (i.keq’)		*	*!	

[ikeq’] ‘twine sling’ (Can Pixabaj 2006:55)

To close, we return to clause (i) of PPW, the requirement that a prosodic word correspond exactly to a single foot. To demonstrate that this clause is in effect, we would need to show that monomorphemic words larger than a single foot (e.g. trisyllabic roots) do not have any special tendency to bear tone. There are not many such words because Mayan languages favor monosyllabic and bisyllabic roots. Examples do exist, though, and they do not have tone, even with the correct sonority profile.

(68)
a. [ixpaqar] ‘toad’
b. [ixnakar] ‘wild onion’
c. [lajori] ‘today’
d. [aware] (surname)
e. [chamatun] (surname)

Even though the final two syllables constitute a foot with the right sort of sonority profile, these words do not bear tone. Our account makes the right prediction because inserting tone or altering default stress cannot prevent these words from violating PPW. They are simply too long.

(69)

/ lajori /	NonFin(T, tbu)	PPW	Iamb	Dep(T)
a. ☞ lə(jo.ri)		*		
b. lə(jo.ri)		*	*!	
c. lə(jó.ri)		*	*!	*
d. lə(jo.rí)	*!	*		*

[lajori] ‘today’ (Can Pixabaj 2006:163)

While the PPW account has crosslinguistic support and successfully captures the patterns we see in Uspanteko, one might challenge it on methodological grounds. Since OT derives its predictive power from constraint interaction, we should prefer an account with many separate constraints over an equivalent account that has one constraint with many clauses. What we will show now is that a decompositional account of the

Uspanteko facts must resort to stipulative constraint indexing, essentially recapitulating the PPW account.

The most obvious way to decompose PPW is to assume that that there are active constraints penalizing toneless foot-heads and foot-heads that are less sonorous than foot-non-heads. Since we build only one rightmost foot in Uspanteko, when its right branch is more sonorous than its left branch, we get iambic stress and no tone because of high ranking NonFin(T, tbu). When its left branch is equally sonorous or more sonorous than its left branch, we get an iambic-trochaic reversal that allows the foot head to be both tone-bearing and relatively sonorous within the foot. To implement this analysis we need the following constraints penalizing foot-heads deficient along some relative prominence requirement. We borrow the constraint format in Teeple (2009), though the discussion is not a commentary on the proposals within that work.

(70) PROM(σ, Ft) ⇔ Tone-bearing (Prom/T)
Assign one violation mark for every toneless σ_S.

(71) PROM(σ, Ft) ⇔ Sonorous (Prom/Son)
Assign one violation mark for every σ_S with a nucleus less sonorous than the nucleus of σ_W in the same foot.

When these constraints outrank Iamb and Dep-T, we correctly predict that bisyllabic words with the right sonority profile should bear tone.

(72) {NonFin(T, tbu), PROM/Son, PROM/T} ≫ {Iamb, Dep(T)}

/ anim /	NF(T, tbu)	PR/Son	PR/T	Iamb	Dep(T)
a. ☞ (á.nim)				*	*
b. (a.nim)			*!	*	
c. (ə.ním)	*!				*
d. (a.nim)			*!		

[ánim] ‘woman’ (Can Pixabaj 2006:55)

The fact that tone is not always realized provides a ranking argument that Prom/Son outranks Prom/T. When the right branch of the foot has a more sonorous nucleus, it’s better to foot an iamb than to realize tone on a trochee with a bad sonority profile.

(73) {NonFin(T, tbu), PROM/Son} ≫ PROM/T ≫ {Iamb, Dep(T)}

/ ikeq /	NF(T, tbu)	PR/Son	PR/T	Iamb	Dep(T)
a. ☞ (i.keq)			*		
b. (í.keq)		*!		*	*
c. (i.keq)		*!	*	*	
d. (i.kéq)	*!				*

[ikeq] ‘twine’

This ranking further predicts that when both vowel nuclei are of equal sonority, it is best to foot a trochee bearing tone. The reason is that PROM/Son will prefer neither trochaic nor iambic footing in such cases.

(74) {NonFin(T, tbu), PROM/Son} ≫ PROM/T ≫ {Iamb, Dep(T)}

/ ojor /	NF(T, TBU)	PR/SON	PR/T	IAMB	DEP(T)
a. ☞ (ó.jor)				*	*
b. (o.jor)			*!		
c. (o.jor)			*!	*	
d. (o.jór)	*!				*

[ójor] 'a long time ago' (Can Pixabaj 2006:59)

While the decompositional account makes the right predictions in bisyllabic words, when we move to longer words the analysis makes pathological predictions with no easy solution. Consider, for instance, [lajori] 'today'. As it stands, the decompositional analysis incorrectly predicts tone on the penultimate syllable.

(75)

/ lajori /	NF(T, TBU)	PR/SON	PR/T	IAMB	DEP(T)
a. ☞ lə(jó.ri)				*	*
b. lə(jo.ri)		*!	*		
c. lə(jo.ri)			*!	*	
d. lə(jo.rí)	*!	*			*

[lajori] 'today' (Can Pixabaj 2006:163)

Solving this problem is very difficult, especially if we want to maintain an account in terms of relative prominence in the foot. One approach is to exploit the fact that feet will always be initial in bisyllabic words in Uspanteko, but not in trisyllabic words. If we parameterize PROM/SON and PROM/T so that they only penalize initial feet, then all trisyllabic words will be well-formed with respect to these constraints, allowing iambic footing to emerge.

(76) PROM(σ, FT$_{init}$) ⇔ TONE-BEARING
Assign one violation mark for every toneless σ_S in a word initial foot.

(77) PROM(σ, FT$_{init}$) ⇔ SONOROUS
Assign one violation mark for every σ_S with a nucleus less sonorous than the nucleus of σ_W in a word initial foot.

(78)

/ lajori /	NF(T, TBU)	PR/SON$_{init}$	PR/T$_{init}$	IAMB	DEP(T)
a. ☞ lə(jo.ri)					
b. lə(jó.ri)				*!	*
c. lə(jo.ri)				*!	
d. lə(jo.rí)	*!			*	*

[lajori] 'today' (Can Pixabaj 2006:55)

This trick works, but amounts to a stipulative restatement of PPW: it happens to succeed only because Uspanteko builds a single, right-aligned foot. There are no independent reasons to think that the heads of initial feet should be especially salient in Uspanteko, or any other language for that matter.[34] This is in

[34] While there might not be pressure for initial feet to have an internal tone or sonority contrast, there is reason to believe that initial *syllables* favor prominent elements (e.g. Beckman 1998; Smith 2005). We could abandon the foot-based account in favor of an analysis based on edge prominence, but this would only account for the distribution of tone. That is, while it might make sense to have a constraint penalizing initial toneless syllables, there is no evidence for a constraint demanding that the initial syllable be at least as sonorous as the following syllable regardless of footing. To account for the sonority facts, we would have to resort to the same parameterization mechanism discussed earlier (i.e. PROM/SON$_{init}$). The result is that to build an

contrast to an account based on PPW effects, which are also attested in languages with iterative footing. Positional constraints like PROM/Son_{init} would be of little use in such cases.

Now that we've seen that factoring PPW into independent constraints falls short, we return to the apparently unitary nature of PPW. While we would prefer not to propose constraints with many subclauses, doing so here helps explain why three seemingly unrelated phenomena—syllable count, tone insertion, and relative vowel sonority—are so strongly correlated in the pattern we see in Uspanteko: they are all expressions of the independently-attested pressure for foot-heads in PPW contexts to be maximally salient.

These PPW effects also provide further support for a foot-based analysis of Uspanteko accent. A crucial fact about bisyllabic roots is that the appearance of tone depends not only on the vowel quality of the penult (where tone actually shows up), but also on the vowel quality of the final syllable. The distribution of tone in bisyllables thus has a non-local character, in that the licensing of tone on the penult is contingent on properties of an adjacent, non-tonal syllable. This non-local dependency makes sense if couched in terms of relative prominence within the foot, since prosodic structure is often sensitive to domain-internal prominence relations. The metrical foot thus reduces an apparent non-local effect to a local, domain-internal relation, and thereby captures the interaction between tone and vowel sonority in a principled way. Importantly, the argument for foot structure is independent of our arguments for a PPW-type constraint, since the relational nature of the phenomenon implicates metrical structure whether or not one accepts our explanation for why interactions between tone and vowel sonority are limited to bisyllabic roots.

To summarize, the complex constraint PPW (65) is responsible for interactions between tone and vowel sonority in bisyllabic words in Uspanteko. The necessary rankings established in this section (which are consistent with the Hasse diagram in Figure 10) are given in (79).

(79) Ranking for perfect prosodic word effects in Uspanteko:
NonFin(T, tbu) $\gg$ PPW $\gg$ Iamb, Dep(T)

3.3.2 Syncope

To round out the discussion of tone and its interaction with various morphophonological, prosodic, and segmental phenomena, in this section we present the effects of tone realization on syncope in Uspanteko. Though syncope presents a potential opacity problem for the analysis as presented, at the same time it provides more evidence for the foot, and for the analysis of penultimate accent as a tone-triggered foot-form reversal.

For the time being we will focus on syncope in bisyllabic forms, and even then we must leave a full account of syncope for future work. In fact, while we call this vowel reduction process 'syncope' for the sake of concreteness, we raise the possibility that syncope of this sort preserves syllabicity, in the sense that vowel deletion may not alter abstract syllable structure when it applies (e.g. Kager 1997). What's important here is that the locus of vowel deletion is clearly foot-determined, and that our analysis correctly predicts when syncope will take place in the pre-tonic or post-tonic syllable.

The generalization seems to be that syncope optionally targets the weak branch of the foot (e.g. Kager 1997; Gouskova 2003; Blumenfeld 2006; McCarthy 2008), though it is constrained by the quality of the target vowel and the resulting consonant cluster. Thus in a bisyllabic form with no tone and default stress, syncope targets the initial syllable. This is precisely what we predict if default final stress is the result of iambic footing.

(80) a. [simiin] ∼ [smiin] 'ginger'
b. [chukuy] ∼ [chkuy] 'pine fruit'
c. [kuwa'y] ∼ [kwa'y] 'horse'
d. [raqan] ∼ [rqan] 'his leg' (Can Pixabaj 2006:37)

Syncope of this sort is not simply the context-free deletion of unstressed vowels: in words with final stress, syncope only targets the immediately pretonic syllable.

(81) a. [inachape'] ∼ [inachpe'] 'Grab me!'

account that decomposes PPW, we either have to fully replicate PPW via stipulative constraint parameterization, or partially replicate it via constraint parameterization and a non-uniform analysis of the tone and sonority patterns in bisyllabic forms.

b. *[inchape']
c. *[nachape']

Syncope is variable: in elicitation, speakers produce the same word both with and without vowel deletion. However, speakers still judge certain cases of syncope as ungrammatical. While we do not have enough data to fully characterize when the process can apply, syncope seems to only target low sonority vowels; that is, high vowels and ⟨a⟩ (which is realized as [ə] when unstressed). Thus, the two mid vowels [e o] in (82) cannot be targets for syncope.

(82) a. [keqiix] 'dark-colored mushroom'
b. *[kqiix]

c. [xinkojon] 'I accepted it'
d. *[xinkjon]

While we will not present a full analysis of the Uspanteko facts, differential syncope of this sort is common, and we could pursue a markedness-based analysis like that developed in Gouskova (2003:Ch.4).

Syncope is also blocked to avoid certain consonant clusters (see also Kager 1997). While we do not have a complete inventory of banned clusters, derived geminates are blocked, for example (McCarthy 1986).

(83) a. [jujun] 'some'
b. *[jjun]

We suggested that syncope targets the pre-tonic syllable in forms with default stress because this syllable is in the weak branch of an iamb. Further evidence that syncope takes place over default iambic footing comes from the behavior of bisyllabic forms with final long vowels. Instead of analyzing a form like [masaat] 'deer' as an (LH) iamb, we could imagine an alternative analysis that foots a single (H) trochee at the right edge of the word.

(84) a. [(ma.saat)] (iambic parse)
b. [ma(saat)] (trochaic parse)

Assuming that syncope is governed by foot structure (e.g. McCarthy 2008), pre-tonic syncope in words like [masaat] would argue for iambic footing. This is exactly what we find.

(85) [masaat] ∼ [msaat] 'deer'

The evidence from syncope thus supports our claim that default final stress is due to a right-aligned iambic foot. Pre-tonic syllables delete under syncope because syncope targets the weak branch of the foot.

If this is the right analysis of pre-tonic syncope, we also predict that syncope should target the final syllable in words with penultimate tone. On our analysis, the final syllable in such words would be in the weak branch of the foot, since penultimate tone is due to an iambic-trochaic foot-form reversal. We thus expect *post*-tonic syncope in words with penultimate tone, which is precisely what we find.[35]

(86) a. [ínchaj] ∼ [ínchj] 'my pinetree'
b. [ínpix] ∼ [ínpx] 'my tomato'
c. [íwir] ∼ [íwr] 'yesterday'
d. [wálib'] ∼ [wálb'] 'my sister-in-law'

(87) a. [xinchakúnik] ∼ [xinchakúnk] 'I worked'
b. *[xinchkúnik]
c. *[xnchakúnik]

Our account thus correctly predicts that accent shift, as a foot-form reversal, should correlate with a shift in the locus of syncope. Analyses of tone that do not make use of the foot, or that rely on foot retraction or extrametricality to capture penultimate accent, do not predict these syncope facts. If anything, such

[35]Syncope in words with penultimate accent is hinted at in Can Pixabaj (2006:71), but essentially ignored.

approaches predict that we should always find pre-tonic syncope; that is, when tone appears on the penult, there should be syncope in the antepenultimate syllable, which is unattested in Uspanteko.

Finally, we know we want a unified analysis of pre-tonic and post-tonic syncope because they are subject to the same segmental restrictions. For example, post-tonic syncope in tonal forms is blocked if it derives a geminate, just like syncope under default final stress.

(88) a. [ájij] 'sugarcane'
b. *[ájj]

c. [áxix] 'garlic'
d. *[áxx]

Similarly, we find differential syncope in tone-bearing forms. Post-tonic mid vowels resist syncope in the presence of tone.[36]

[36] We also find ablaut feeding syncope under possession. Optional syncope yields [ínch'] for the first-person singular possessed form of [che'] 'tree', but it alternates with [ínchi'], not *[ínche'].

(89) a. [<u>wíx</u>keq] 'my fingernail'
b. *[wíxkq]

c. [<u>é</u>tzel] 'evil'
d. *[étzl]

In summary, while we do not have a complete account of Uspanteko syncope, the locus of syncope follows from our account, under the assumption that word-level prosody in Uspanteko always involves a right-aligned foot. Default footing is iambic, so when syncope applies in forms with default stress it deletes the vowel nucleus of the penultimate syllable. The final vowel deletes when syncope applies to forms with penultimate tone because, as we have argued, tone insertion results in an iambic-trochaic reversal.

Of course, one complication for this view of Uspanteko syncope is that it is potentially opaque: penultimate accent is due to a pressure against placing high tone on a final TBU, but this is exactly the configuration that results from post-tonic syncope. Whether there is a real opacity problem here depends on the nature of Uspanteko vowel deletion. If the phenomenon described in this section is not true syncope, but rather syllable-preserving vowel reduction (as in Kager's 1997 account of Macushi Carib), then there is no opacity problem.[37] If this pattern of vowel deletion is syllable-destroying syncope, then we do, in fact, have an opacity problem. The upside is that opaque syncope is a problem for which there are standing solutions. For instance, in a serialist treatment of syncope (e.g. McCarthy 2008), feet could be built at a stage derivationally prior to foot-based vowel reduction and deletion. If tone placement happens while building feet, then syncope still renders tone placement opaque, but it no longer poses a formal problem for our foot-based account of the facts.

In the last two sections we provided additional evidence for a foot-based account of Uspanteko accent. This evidence concerned the interaction of tone and segmental structure, especially regarding the distribution of vowels. Beyond establishing the presence of foot structure in Uspanteko, our arguments further supported the claim that penultimate accent in Uspanteko is the result of an iambic-trochaic 'rhythmic reversal'. The following sections wrap up some remaining empirical issues in the accentual system of Uspanteko. In particular, we consider two cases where there is conflict between segmental structure and the morphological need to realize tone. In some cases, tone is blocked and the root is realized faithfully; in other cases the segmental structure of the root is altered in order to realize tone.

[37] The hallmark of this sort of vowel reduction is that the vowel nucleus is still active for phonological processes. While we need to do more work to confirm whether or not syncope affects syllable-based consonant allophony (stop aspiration, nasal place assimilation, etc.; see Can Pixabaj 2006:Ch.2), Uspanteko syncope does have a number of affinities with the syllable-preserving syncope of Macushi Carib. For one, it is variable, and to some extent gradient: non-syncopated weak vowels are reduced to various degrees, and syncope seems to be an endpoint for this gradient reduction. Syncope also derives many clusters that are otherwise unattested in the language (e.g. [chk], as in [chkuy] 'pine fruit'). As Larry Hyman suggests to us, the fact that syncope derives otherwise illicit clusters (a property which it shares with schwa deletion in French; e.g. Dell 1995) might point to the preservation of a mora or vocalic nucleus at the phonological level.

4 Tone-segment conflicts and nominal cophonologies

In this section we present an analysis of how the shape of a nominal root affects or is affected by the affixation of morphemes that require tone insertion. In particular we will see that there is pressure against realizing tone when the final syllable is CV'C or has a long vowel nucleus. With some roots, tone is not realized. With others, the offending segmental material is altered. We will argue that the differential behavior of various roots, especially with respect to long vowel nuclei, motivates a coherent hierarchy of cophonologies.

4.1 CV'C Syllables and disappearing tones

As discussed in Section 2.2, when a morpheme triggering tone attaches to a word ending in a CV'C syllable, tone often fails to be realized (Can Pixabaj 2006:67; recall that [CV'C] = [CVʔC] in IPA notation).

(90) a. [kar] 'fish'
b. [ín-kar] 'my fish' (Can Pixabaj 2006:64)

(91) a. [ka'n] 'animal'
b. [in-ka'n] 'my animal'
c. *[ín-ka'n]

(92) a. [ch'o'j] 'fight'
b. [in-ch'o'j] 'my fight'
c. *[ín-ch'o'j]

(93) a. [q'a'm] 'staircase'
b. [in-q'a'm] 'my staircase'
c. *[ín-q'a'm]

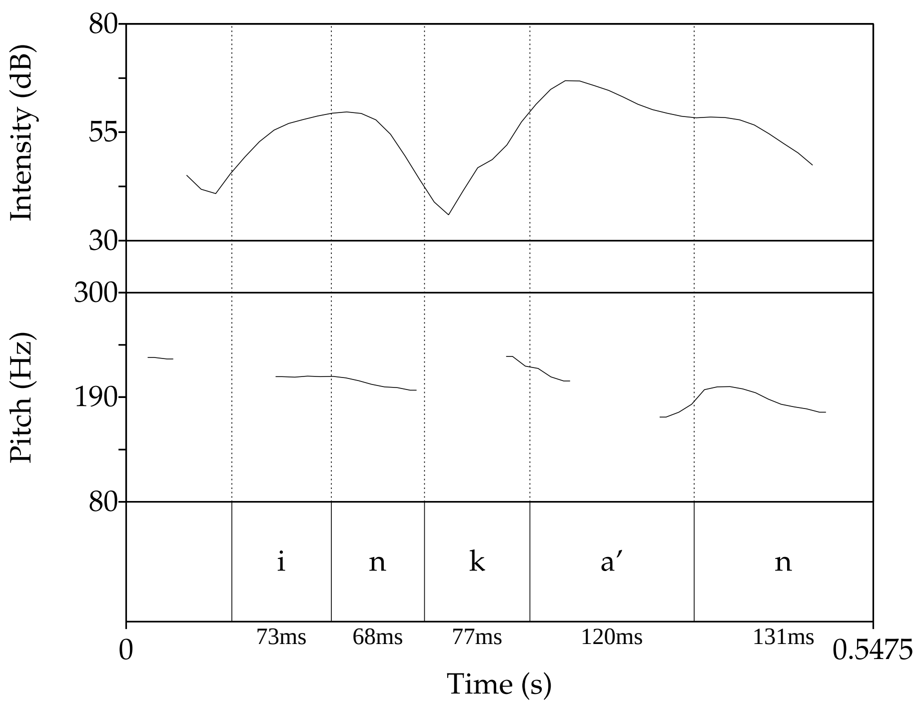


Figure 11: Intensity, pitch, and duration for [inka'n] 'my animal' (final stress, no tone)

It is clear that only ['C] codas block tone, and not ['C] sequences in general: tone *can* appear on a CV'C root when it is followed by a vowel-initial suffix and resyllabification breaks up the final ['C] cluster.

(94) a. /**wa'l**-ik, H/ → [wá'.lik] 'stopped'
b. /x-at-**wi'n**-ik, H/ → [xat.wí'.nik] 'you ate'

(Can Pixabaj 2006:60,203)

For a smaller set of forms ending in CV'C, tone is realized, but only along with the deletion of a final coda consonant (Can Pixabaj 2006:57).[38]

(95) a. [q'u'n-iik] 'wool coat'
b. [ín-q'u'] 'my wool coat'
c. *[ín-q'u'n]

[38] In (95) and (96) -*iik* marks an inalienably possessed noun in its unpossessed form, hence the equivalent glosses.

(96) a. [ti'n-iik] 'meat'
b. [ín-ti'] 'my meat'
c. *[ín-ti'n]

These two subclasses are united under the generalization that final CV'C syllables cannot cooccur with tone. In the first case, this configuration is avoided by the non-realization of tone; and in the second, it is avoided by final consonant deletion. Examples (94)–(96) also show that unlike ['C] codas, codas consisting of a single glottal stop ['] do not block tone (see also (28)).

What about final CV'C syllables makes them incompatible with tone? Our proposal is that CV'C syllables create a clash between stress-placement constraints and tone-placement constraints. This clash can be resolved by failing to realize tone, or by turning the offending CV'C syllable into a CV' syllable.

An obvious question is why CV'C syllables in particular have an adverse affect on accent placement. There is in fact reason to believe that CV'C syllables count as bimoraic in Uspanteko. First, like long vowels, CV'C syllables are only found word-finally; that is, only in the position of main word stress (Can Pixabaj 2006:72–75,90). This striking parallel can be easily explained if CV'C syllables are bimoraic, and therefore subject to the same prosodic constraints that determine the distribution of long vowels (e.g. WSP). Second, some CV'C roots alternate with CVV allomorphs (though the details need to be worked out; see Can Pixabaj 2006:77).

(97) CV'C ∼ CVV alternations
a. [j-po't=aq] ∼ [j-poo=t'aq] 'their blouses'
b. [j-to'q=aq] ∼ [j-too=t'aq] 'their diaper'
c. [r-ati't=aq] ∼ [r-atii=t'aq] 'their grandmother'

This pattern makes sense if (i) CV'C syllables count as heavy, and (ii) such alternations preserve the mora count of underlying forms.

If we are correct in taking CV'C syllables to be bimoraic, then they should attract stress under pressure from high-ranked WSP. Since CV'C syllables are restricted to word-final position, where default stress is assigned, CV'C syllables will not normally exert a visible effect on stress placement.

(98) Final CV'C inert for default stress

/ kuwa'y /	All-Ft-R	WSP	Iamb
a. ☞ (ku.<u>wa'y</u>)			
b. (<u>ku</u>.wa'y)		*!	*

[kuwa'y] - 'horse'

Now consider what happens when tone is introduced. Since tone must coincide with stress in Uspanteko, we might expect stress retraction to occur. However, an iambic-trochaic reversal would leave a final CV'C unstressed, violating high-ranked WSP. A second option would be to realize tone—and thus stress—on the final CV'C syllable. This solution is no better: a final CV́'C syllable would have tone on the penultimate mora of the word, but on the *ultimate* TBU (= **vocalic** mora μ_V), violating NonFin(T, tbu).

The third, attested option is to simply fail to realize tone, thus vacuously satisfying NonFin(T, tbu) and allowing WSP to be satisfied under default word-final stress assignment. As long as constraints enforcing tone realization are ranked relatively low (i.e. Max(T)), the desired outcome is correctly predicted.

(99) Final CV'C blocks tone realization: low-ranked Max(T)

/ in-ka'n, H /	*Unstr-H	NF(T, tbu)	WSP	Max(C)	Max(T)
a. ☞ (in.<u>ka'n</u>)					*
b. (<u>ín</u>.ka')				*!	
c. (<u>ín</u>.ka'n)			*!		
d. (in.<u>ká'n</u>)		*!			
e. (ín.<u>ka'n</u>)	*!				

What about those forms that end in a CV'C syllable, but which undergo final consonant deletion when tone surfaces? We assume that such forms belong to a distinct cophonology in which the pressure to realize input consonants (enforced by Max(C)) is less important than the pressure to realize tone.

(100) CV'C forms with C-deletion: Max(T) ≫ Max(C)

/ in-ti'n, H /	*Unstr-H	NF(T, tbu)	WSP	Max(T)	Max(C)
a. ☞ (<u>ín</u>.ti')					*
b. (in.<u>ti'n</u>)				*!	
c. (<u>ín</u>.ti'n)			*!		
d. (in.<u>tí'n</u>)		*!			
e. (ín.<u>ti'n</u>)	*!				

In the basic case Max(C) outranks Max(T). Final coda consonants will thus be preserved even if it means the non-realization of tone. For a subset of words ending in CV'C this ranking is reversed, and final coda consonants are elided so that tone can appear.

We thus propose an essentially phonological analysis of the unusual behavior of CV'C syllables. One might be tempted to propose an alternate, more phonetically-oriented analysis of these facts instead. In many languages, glottal stops induce non-modal phonation (usually creaky voice) on adjacent vowels (Ladefoged and Maddieson 1996:75, Gordon and Ladefoged 2001). Indeed, glottalized consonants in Uspanteko (including glottal stop) do have some effect on the phonation type of adjacent vowels, at least impressionistically. And as is well-known, non-modal phonation is antagonistic to the realization of high tone (Silverman 1997). We might conclude, then, that CV'C syllables are incompatible with tone because the coda glottal stop gives rise to non-modal phonation on the preceding vowel, thereby interfering with its ability to express tone.

While there is no doubt some truth to this view, there are three reasons to reject it as insufficient. First, the problem isn't simply that CV'C syllables can't bear tone—their presence also blocks the realization of tone on the *preceding* syllable (see (91)–(96)). The non-local effect that CV'C syllables exert on tone argues against any analysis that depends on the local phonetic properties of those syllables themselves. Second, while codas consisting of a single glottal stop ['] also affect the phonation quality of the preceding vowel, they do not affect the realization of tone. The presence of non-modal phonation thus does not suffice to explain the tone-blocking effect of final CV'C syllables. Finally, examples like (94) show that reference to phonological properties (i.e. syllable structure) is independently needed to explain when a ['C] sequence will interfere with tone and when it will not. Since the phonological analysis proposed here is also sufficient to explain the interaction of tone and CV'C syllables, it should be favored over purely phonetic alternatives.

To close, we ask why [CV'C] syllables should count as bimoraic in Uspanteko. We suspect that the glottal stop ['] in [V'C] rimes might actually be parsed as part of the syllable nucleus, creating a branching and therefore heavy nuclear constituent. There are two reasons why this proposal is plausible. First, complex codas are generally disallowed in Uspanteko, so assuming a nuclear parse for the glottal stop in [V'C] rimes is consistent with broader facts about the syllable structure of the language. Second, there are many languages in which glottal stops pattern as vowel-like or as a type of suprasegmental, especially in post-vocalic position (see e.g. various Mesoamerican examples in **?**).

In this section we claimed that tone and final CV'C syllables exert conflicting and irreconcilable demands on metrical structure, which can only be met by eliminating tone or by breaking the ['C] coda responsible for the syllabic weight of CV'C. The behavior of CV'C syllables with respect to tone thus provides further evidence for a metrically-based theory of tone and accent in Uspanteko. We discuss the evidence for cophonologies in the Uspanteko noun system in more detail in the next section.

4.2 Final long vowels and more nominal cophonologies

Uspanteko nouns fall into a number of subclasses with respect to the interaction of tone and vowel length. These subclasses emerge most clearly under possession, since possession often introduces pitch accent on otherwise non-tonal nouns, thereby creating the conditions for tone-length interactions to occur.

First, we find that some nouns show vowel shortening when they appear with a possessive prefix.[39]

(101) a. [kaa'] 'grinding stone'
b. [ín-ka'] 'my grinding stone' (Can Pixabaj 2006:53)

(102) a. [sii'] 'firewood'
b. [ín-si'] 'my firewood' (Can Pixabaj 2006:65)

(103) a. [teem] 'chair'
b. [ín-tem] 'my chair' (Can Pixabaj 2006:66)

Importantly, vowel shortening is not generally required for the realization of tone: forms like *[in-káa'] and *[in-téem] are attested elsewhere in Uspanteko (cf. [in-cháaj], [in-b'óot], etc.; see Can Pixabaj 2006:69 and Section 4.3).

Second, some nouns containing a long vowel fail to realize tone when possessed.

(104) a. [choox] 'godmother'
b. [in-choox] 'my godmother'
c. *[in-chóox], *[ín-chox] (Can Pixabaj 2006:68)

(105) a. [pooq'] 'moth'
b. [in-pooq'] 'my moth'
c. *[in-póoq'], *[ín-poq'] (Can Pixabaj 2006:76)

(106) a. [keem] 'weaving'
b. [in-keem] 'my weaving'
c. *[in-kéem], *[ín-kem] (Can Pixabaj 2006:68)

These two nominal subclasses can be unified under a single generalization: both types of noun avoid realizing tone on a word-final long vowel. It should be stressed that this is a parochial property of only a subset of nouns in Uspanteko: other possessed nouns do allow tone on a final long vowel.

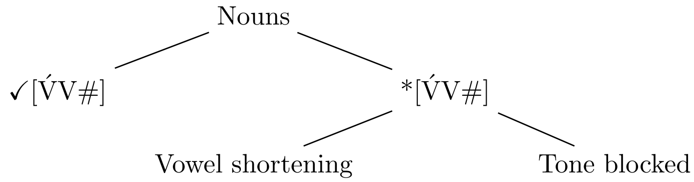
(107) a. [ooj] 'avocado'
b. [aw-óoj] 'your avocado' (Can Pixabaj 2006:93)

We suggest that Uspanteko nouns are sorted into (at least) three distinct cophonologies (Fries and Pike 1949), and that the category boundaries between these cophonologies are determined by the interaction of tone and vowel length. At the coarsest level of organization, we divide Uspanteko nouns into two classes: those nouns that allow the realization of tone on a final long vowel, and those nouns that do not. We then further subdivide the second class into those nouns that repair [V́V#] via vowel shortening, and those that instead block the realization of tone. These nominal categories can be visualized as in (108).[40]

[39]There are also some nouns that lengthen under possession: for example, [k'aj] 'wheat' becomes [in-k'áaj] 'my wheat' (Can Pixabaj 2006:70). Lengthening under possession is a common morphophonemic change in K'ichean-branch Mayan languages (see Dayley 1985 for Tz'utujil, and Campbell 1977 on Proto-K'ichean), and is plausibly not phonological in character.

[40]Cophonologies of this sort generally arise as a result of language contact (e.g. Fries and Pike 1949, Itô and Mester 1995

(108) Structure of Uspanteko noun cophonologies



Following Anttila (2002) and Inkelas and Zoll (2007) (among others), we assume that each level of the lexicon in (108) is associated with a different ranking of constraints. At the root node of the tree, the relative ranking of at least some constraints is underspecified (e.g. A, B $\gg$ C). As one moves from the root node of the tree down toward its terminal nodes, the constraint set is subject to more and more specific rankings of constraints (e.g. A $\gg$ B $\gg$ C, B $\gg$ A $\gg$ C). (See (112) below for an instantiation of this idea.)

We propose that the dispreference for [V́V#] vowels is due to the activity of another tone-related non-finality constraint, NonFin(T, σ). This constraint is simply a specific version of NonFin(T), parameterized to the syllable rather than the TBU.[41] Since long vowels are always word-final in Uspanteko, and final short vowels never bear tone, NonFin(T, σ) will effectively penalize all and only those long vowels associated with pitch accent.

Nouns that allow tone on a final long vowel must be associated with a cophonology in which NonFin(T, σ) is crucially subordinated. Since both tone and underlying vowel length surface in these forms, we assume that NonFin(T, σ) is outranked by Max(T) and Id(Length) as in tableau (109).

(109) Cophonology 1: tone allowed on long vowels; {Max(T), Id(Len)} $\gg$ NF(T, σ)

/ aw-ooj, H /	Max(T)	Id(Length)	NonFin(T, σ)	Iamb
a. ☞ (a.wóoj)			*	
b. (á.woj)		*!		*
c. (a.wooj)	*!			

With NonFin(T, σ) ranked low, familiar constraints on prosodic structure come into play and locate tone on the first mora of the final long vowel as expected. For this class of nouns, then, tone on a final long vowel is tolerated in order to preserve both underlying tone and underlying vowel length.

The workings of NonFin(T, σ) can be seen more clearly in the other two noun classes, which both disallow tone on long vowels. For those possessed nouns that fail to realize tone when it would fall on a final long vowel, NonFin(T, σ) and Ident(Length) must dominate Max(T).

(110) Cophonology 2: tone blocked; {NonFin(T, σ), Id(Length)} $\gg$ Max(T)

/ in-keem, H /	NonFin(T, σ)	Id(Length)	Max(T)	Iamb
a. ☞ (in.keem)			*	
b. (ín.kem)		*!		*
c. (in.kéem)	*!			

With NonFin(T, σ) outranking Max(T), the non-realization of tone will be preferable to placing tone on a final long vowel. The further ranking Id(Length) $\gg$ Max(T) ensures that violations of NonFin(T, σ) will be repaired by the non-realization of tone rather than than by vowel shortening. In other words, for this class of nouns it's more important to preserve underlying vowel length than to preserve underlying H

and related work). Given the lack of large-scale historical work on Uspanteko, it is not currently possible to determine whether the cophonologies we propose correspond to borrowings from different source languages. However, it would be unsurprising if these cophonologies did have their origin in language contact: despite being geographically isolated, Uspanteko speakers have been in contact with speakers of K'ichee', K'eqchi', and the more distantly related language Ixil for a very long time.

[41] See Zec (2003), Flack (2009), and Gordon and Applebaum (2010) for arguments that metrical markedness constraints can be parameterized to different levels of the prosodic hierarchy.

tone.

This of course points the way to our next cophonology. Nouns that shorten final long vowels in order to realize tone must have the opposite ranking of Id(Length) and Max(T).

(111) Cophonology 3: vowel shortening with tone; Max(T) ≫ Id(Length)

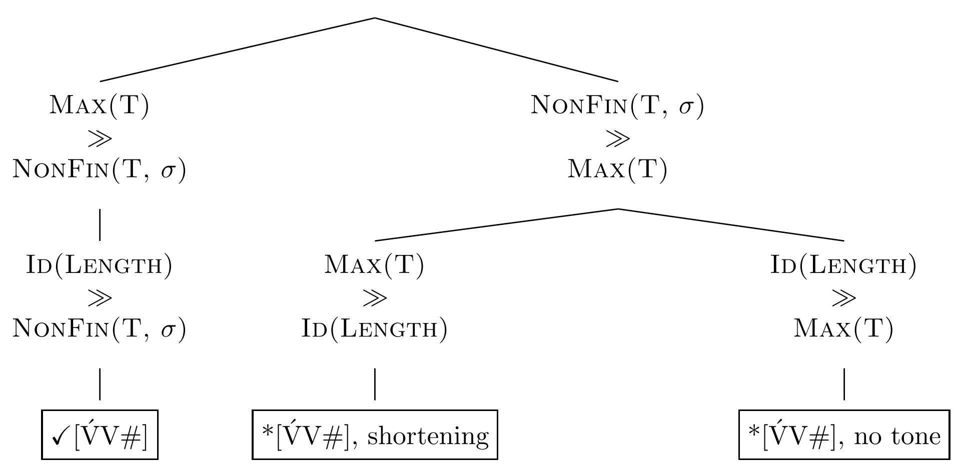
/ in-kaa', H /	NonFin(T, σ)	Max(T)	Id(Length)	Iamb
a. ☞ (ín.ka')			*	*
b. (in.kaa')		*!		
c. (in.káa')	*!			

The ranking NonFin(T, σ) ≫ Max(T) remains unchanged for these nouns, but the new ranking Max(T) ≫ Id(Length) ensures that tone on a final long vowel will be avoided via vowel shortening rather than non-realization of tone. As opposed to the previous noun class, nouns belonging to this third cophonology preserve underlying tone at the expense of underlying vowel length.

Though these last two noun subclasses are superfically quite distinct—one class surfaces with tone but not long vowels, while the other class shows the converse pattern—they differ only in the relative ranking of Ident(Length) and Max(T).[42] To be sure, the ranking NonFin(T, σ) ≫ Max(T) is only crucial for those nouns that fail to realize tone (compare tableaux (110) and (111)), but we can safely assume that it holds across all nouns that disallow final long vowels bearing tone.

In (112) we provide a graphical summary of the Uspanteko noun cophonologies argued for in this section. The first cut concerns the relative ranking of Max(T) and NonFin(T, σ). Nouns that allow tone on a final long vowel are associated with the ranking Max(T) ≫ NonFin(T, σ); nouns that do not are associated with the opposite ranking NonFin(T, σ) ≫ Max(T). For nouns that disallow tone on a final long vowel, either vowel shortening occurs (Max(T) ≫ Id(Length)), or tone is simply not realized (Id(Length) ≫ Max(T)).

(112) Uspanteko noun cophonologies: a partial-ordering model (Anttila 2002)



4.3 Tonal roots

The relation between tone and vowel length is somewhat more straightforward when we consider root nouns that bear underlying accent on a final long vowel.

(113) a. [b'óot] 'cotton'
b. [kúuk'] 'squirrel'
c. [cháaj] 'ash' (Can Pixabaj 2006:69)

[42]We assume that the ranking Max(T) ≫ Iamb holds more generally in Uspanteko (see Figure 10 which shows this), since foot-form reversals normally occur in order to realize underlying tone on penultimate short vowels.

In particular, underlying tones surface faithfully when these nouns are possessed.

(114) a. [in-b'óot]
b. [in-kúuk']
c. [in-cháaj] (Can Pixabaj 2006:69)

This pattern amounts to a 'grandfather effect' (McCarthy 2003a; Baković 2011): tone is permitted on a final long vowel if it is present underlyingly, but may not be permitted if tone emerges because of morphological factors like possessive marking.

Bare root nouns with tonal long vowels must belong to the cophonology in which MAX(T) dominates NONFIN(T, σ) — otherwise, underlying root-specified tone would never surface in the first place.

(115) [V́V#] permitted if accent is underlying: MAX(T) $\gg$ NONFIN(T, σ)

/ kuuk', H /	MAX(T)	NONFIN(T, σ)
a. ☞ (<u>kúuk'</u>)		*
b. (<u>kuuk'</u>)	*!	

This ranking alone is not sufficient to account for the fact that word-final accent remains in place when these nouns are possessed. Some additional constraint—call it FAITH—must penalize candidates that avoid realizing tone on a long vowel by way of vowel shortening.

(116) FAITH protects underlying [V́V#] accent

/ in-kuuk', H /	FAITH	MAX(T)	NONFIN(T, σ)
a. ☞ (in.<u>kúuk'</u>)			*
b. (in.<u>kuuk'</u>)		*!	
c. (<u>ín</u>.kuk')	*!		

FAITH could stand for any constraint that rules out vowel shortening and consequent tone shift for root nouns with underlying [V́V#] accent. For example, either ID(LENGTH) (as in cophonology 2; see (110)) or an output-output constraint (Benua 2000) like MAX-OO(T) would be sufficient for this purpose.

(117) MAX-OO(T)
Assign one violation for every toneless, affixed root that corresponds to a bare root form that does bear tone.

Assuming the relevant constraint is ID(LENGTH) would place tonal CV́VC roots in the same category as non-tonal CVVC roots that bear pitch accent under possession while also preserving vowel length (see Section 4.2). This approach misses the basic generalization that CV́VC roots *always* bear tone when possessed, while only some possessed CVVC roots surface with a pitch accent. So without conclusively settling the issue, we assume that FAITH is just the output-output constraint MAX-OO(T), thereby capturing the fact that tonal CV́VC noun roots behave as a uniform class under possession.

To summarize, this section has shown that constraints on tone placement can conflict with the segmental structure of final syllables. Crucially, though, Uspanteko does not make use of a uniform strategy to resolve these conflicts. Some roots block tone realization, while other roots are unfaithfully realized in order to accomodate tone. Our main proposal is that Uspanteko nouns are arranged into cophonologies that have a hierarchical structure generated by reranking only pairs of constraints.

This concludes our analysis of accent and prosodic structure in Uspanteko. We have shown that a metrical, foot-based analysis of word-level prosody in Uspanteko not only accounts for the basic distribution of tone, but also makes sense of several interactions between accent and segmental structure. The non-local character of some of these interactions provides further support for a foot-based treatment of Uspanteko phonology, a point made explicitly in Section 3.3. Finally, we discussed lexical variation in the interaction of tone and vowel length in Uspanteko, and provided an analysis of possessive inflection in terms of a partial-ordering model of phonological organization (e.g. Anttila 2002).

5 Conclusion

This paper presents the first formal analysis of Uspanteko accent. The accentual system of Uspanteko is an important area of study, not just because the language is threatened and understudied, but because it contributes valuable data to the typology of accent systems. Uspanteko makes use of two distinct non-iterative accent systems. Unlike other accent systems that combine stress and tone (e.g. Stockholm Swedish, Bruce 1977, Gussenhoven 2004:210; Ayutla Mixtec, de Lacy 2002; Somali nouns, Hyman 1981, Gussenhoven 2004:39), non-tonal words are permitted in Uspanteko. Un*stressed* words, on the other hand, are not permitted. Uspanteko thus simultaneously instantiates an obligatory accent system (stress) and a non-obligatory accent system (pitch accent) (Hyman 2006).

Much work on the typology of such 'hybrid' accent systems makes a three-way distinction between languages in which stress placement determines tone placement, languages in which tone placement determines stress placement, and languages in which the two types of accent do not interact (e.g. van der Hulst and Smith 1988, **?**:250-1, **?**). Uspanteko instantiates a fourth, alternative category: stress placement and tone placement are *co-determined*. While tone is attracted to the position of stress, constraints on the distribution of tone (e.g. the NonFinality(T) family) can cause tone to displace rightward, bringing stress along with it. There is no sense in which stress is 'prior' to pitch accent, or vice versa; they each exert independent, but interrelated demands which must be simultaneously met. (See Michael 2010 for related discussion of tone-stress interactions in Iquito.)

We have also shown that both tone and stress in Uspanteko are subject to strict metrical constraints, including constraints on foot structure. In some ways, this is a very surprising result: neither stress or pitch accent are 'rhythmic' in Uspanteko (i.e. there are no secondary or alternating accents); and word-level accent, which is highly regular, could be easily described without any reference to the foot at all. Nevertheless, there is strong evidence that Uspanteko words contain a single, right-aligned foot that governs both accent placement as well as interactions between prosodic and segmental structure. This paper thus adds to a growing body of literature suggesting that a small set of general prosodic categories are universally instantiated in every language (see e.g. Hayes 1995:119, Jun 2005, Goad and Buckley 2006, Kawahara and Shinya 2008, Itô and Mester 2009, Vogel 2009, Selkirk 2011, and references therein for discussion).

Even though accent in Uspanteko is determined by sharp restrictions on prosodic structure, different lexical items show different behavior in coping with these constraints. We saw that tone and vowel length interact in a non-uniform way in Uspanteko words. This otherwise intractable data can be elegantly captured using cophonologies, defined by minimal, pairwise re-ranking of constraints for different subsets of the lexicon.

While this paper provided an analysis of the core facts regarding word-level prosody in Uspanteko, many interesting questions remain. One important issue regards the phonetic realization of stress in Uspanteko, given that stress placement is highly predictable, and common phonetic cues to stress (i.e. vowel length and pitch) are used contrastively in the language (see Berinstein 1979). A related question is whether cues to stress in Uspanteko are identical in tonal and non-tonal syllables. We would also like to better understand the conditions on syncope sketched in Section 3.3.2, as our suspicion is that syncope may be blocked in particular phrasal contexts. Consequently, we would also like to better understand how word-level prosody in Uspanteko is integrated into higher prosodic structure.

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Appendix: domain effects

Up till this point we have assumed that, in Uspanteko, metrical structure is built with respect to the right edge of the prosodic word (ω). This view is complicated by certain prosodic effects found with cliticization. Uspanteko has a number of enclitics (at least emphatic *i'(n)* and plural *aq*) that disrupt otherwise exceptionless phonological generalizations (Can Pixabaj 2006:52–3). As discussed in Section 3, long vowels are restricted to final position within the word.

(118) a. chuun 'lime (mineral)'
b. x-chun-aj 'he covered it with lime' (Can Pixabaj 2006:53)

(119) a. in-jii' 'my son-in-law'
b. ji'-xeel 'son-in-law'
c. ji'-xél-ib' 'sons-in-law' (Can Pixabaj 2006:62,69)

However, unlike true suffixes, enclitics fail to trigger shortening of final long vowels.

(120) a. tz'eet 'true'
b. tz'eet=i' 'it is true' (Can Pixabaj 2006:52,667)

(121) a. poot' 'blouse'
b. j-poot'=aq 'their blouses' (Can Pixabaj 2006:53,76)

Similarly, tone is normally restricted to the penultimate mora (Can Pixabaj 2006:62-69,etc.).

(122) a. ín-pix 'my tomato'
b. *in-píx (Can Pixabaj 2006:64)

(123) a. kúuk' 'squirrel'
b. *kuúk' (Can Pixabaj 2006:22)

(124) a. ji'-xél-ib' 'sons-in-law'
b. *ji'-xel-íb'
c. *jí'-xel-ib' (Can Pixabaj 2006:62)

But when enclitics appear, they fail to trigger rightward tone shift.

(125) a. íxim 'corn'
b. w-íxim=aq 'my corn (pl.)'
c. *w-ixím=aq

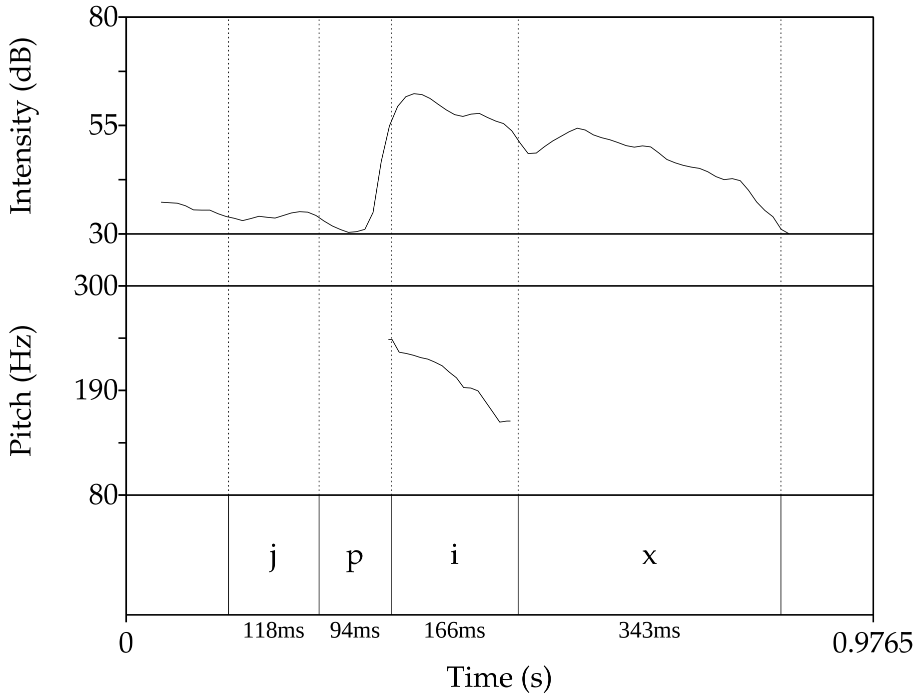

Figure 12: Intensity, pitch, and duration for [j-pix] 'his/her tomato'

Finally, even in toneless forms enclitics do not affect the position of accent on their preceding hosts. As Figures 12 and 13 illustrate, final stress (as cued by phonetic vowel lengthening) stays in place when followed by the plural enclitic *aq*.

We conclude from these facts that the building of metrical structure, and thus the assignment of tone and stress accent, occurs within the minimal prosodic word (ω_{min}) in Uspanteko (e.g. Inkelas 1990; Itô and Mester 2007, 2009). On the assumption that enclitics like *i'(n)* and *aq* adjoin to the minimal prosodic word, the prosodic structure of their hosts is correctly predicted to remain unaltered by encliticization. Given the volume and frequency of clitics in Uspanteko (and in Mayan languages more generally), there is no doubt more to say about the prosodic phonology of cliticization; for now, we leave these questions open for future research.

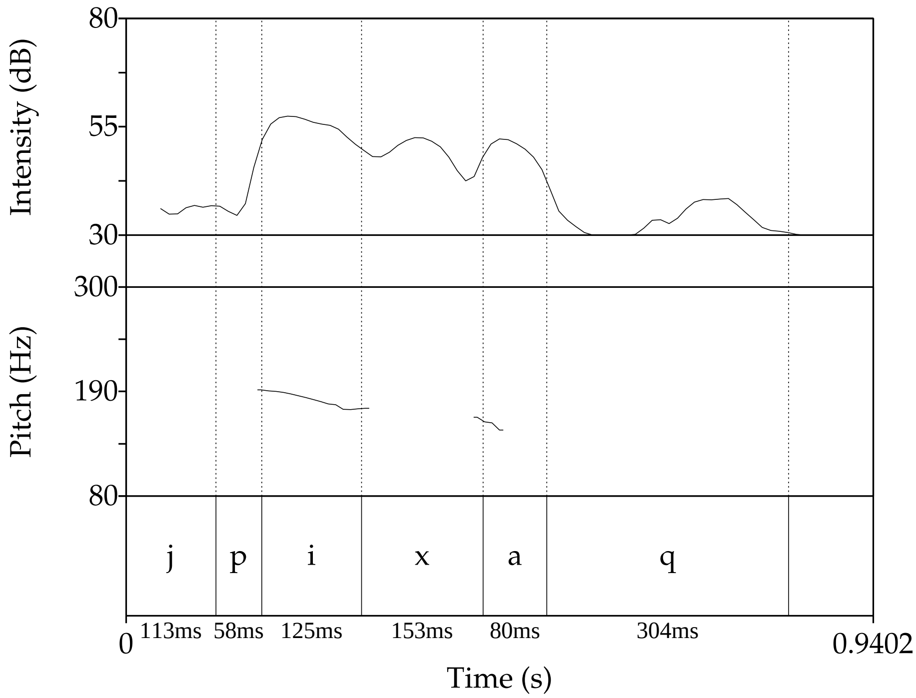

Figure 13: Intensity, pitch, and duration for [j-pix=aq] 'their tomato'