Disjoint Metrical Tiers and Positional Markedness in Huariapano (Panobo)

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Abstract: Huariapano, an extinct Panoan language of Peru, exhibits a unique and intricate process of coda epenthesis by which an epenthetic [h] predictably occurs in syllable-final position. There are four environmental conditions which must be met in order for this rule to be triggered: (1) the targeted syllable must be light; (2) it must be an odd numbered syllable of the word; (3) the following consonant (the onset of the next syllable) must be voiceless; and (4) if the targeted syllable is word-initial, it cannot bear primary stress. Because of the second constraint above, epenthetic [h]s occur in first, third, and fifth syllables of prosodic words, but not in second or fourth syllables. This strongly suggests that binary metrical feet are what drive this odd vs. even pattern. However, many of the syllables which receive epenthetic codas are unstressed and some of them even occur between two stressed syllables, whereas in other cases [h]s are inserted in stressed syllables. Consequently, we cannot rely on the metrical stress system alone to explain and predict when [h] will be inserted. Rather, I will argue that an adequate account of this phenomenon can only be achieved if we posit a second metrical tier for this language. This parallel yet autonomous tier encodes "rhythm" but not stress. The prohibition against coda epenthesis in a word-initial syllable bearing primary stress can then be attributed to a clash between the two metrical tiers. In this situation, the main stress foot and the main rhythmic foot target the same syllable, and consequently the first syllable on the rhythmic tier is demoted (de-footed), thereby blocking coda epenthesis.

1. Introduction

It has long been recognized that metrical structure can influence phonological processes other than stress assignment.[1] Indeed, as Mester (1994) clearly notes, Latin grammarians over two millenia ago expressed insightful understanding of the versification of their language which went beyond a mere surface intuition concerning its accentual patterns. Nevertheless, when a linguist today encounters the term *metrical phonology*, the first image which is most likely to be invoked in his or her mind is a reference to patterns of stress. It is hard to conceive of metrical structure which does not derive its existence in one way or another from a more basic algorithm of accentuation. Along these lines, for example, Hayes (1995) makes the following claim: "Rhythmic distribution of phonological properties other than stress, at least in most cases, involves phenomena that are themselves stress-conditioned" (p. 25). In

[1]This was originally a generals paper written at U.Mass. in 1998. I never did like my analysis, so this manuscript has not been previously published. Nevertheless, I have been pleasantly surprised to see that a few works since then have used these data and improved on my formal account. One of these is the recent dissertation of Bennett (2012). Consequently, in order to make this original paper more accessible to other researchers who may be interested in consulting it, I am posting it on this venue at this time. It is basically unchanged from the 1998 version, so I have not bothered to update many of the references, etc.

spite of this strong tendency, Huariapano (a Panoan language of Peru) exhibits a very intricate metrical process which is not directly related to its stress system at all.[2] In Huariapano, a syllable-final [h] predictably occurs in odd-numbered syllables of the word, provided that other environmental conditions are also fulfilled. The purpose of this article is to provide an account of this phenomenon in terms of Optimality Theory (OT; Prince and Smolensky forthcoming). In the course of my analysis I will propose that, in order to adequately capture the prosodic motivation for this process of coda epenthesis, we need to posit in Huariapano a second metrical tier distinct and apart from the tier which encodes stress placement. One of the questions which will then be of interest for phonological theory is, how does this parallel tier contrast with traditional metrical tiers which govern the distribution and behavior of stress?

The Huariapano language became extinct when the last known fluent speaker died in 1991. Until that time it was spoken in the Amazonian lowlands of eastern Peru. A basic, informal description of the facts of coda epenthesis in Huariapano is provided in Parker (1994a). All of the data and analysis presented in that article (as well as in Parker (1992)) are the result of my own fieldwork. In this present paper I will draw heavily from the account in Parker (1994a) but will supplement the exposition with further data from my partially unpublished corpus when appropriate.

The remainder of this paper is organized as follows. In §2 I will give a brief overview of the relevant details of Huariapano phonology, except for stress assignment and *h* epenthesis. In §3.1 I present a detailed description of stress placement in this language, followed in §3.2 by an OT account of those facts. In §4.1 I introduce the data which illustrate the systematic insertion of syllable-final *h*, and in §4.2 (the heart of my analysis) I posit a second metrical tier in order to explain the distribution of epenthetic codas. In §4.3 I briefly comment on a few alternative analyses which were considered but proved to be inadequate. I conclude the paper in §5 with a summary of my findings and a short reflection on their theoretical significance.

2. Overview of Huariapano phonology

The phonemic inventory of Huariapano consonants consists of the following fifteen segments:

(1)

p	t				k	
	t^s	č				
	s	š	ṣ			h
β						
m	n					
	r					
w				y		

[2]For a description of analogous phenomena in other languages, see Benki (1995) on vowel lengthening in Tübatulabal and Rappaport (1984), Halle and Vergnaud (1987), and Churchyard (1990) on vowel reduction in Tiberian Hebrew.

/ʂ/ is a voiceless retroflexed alveopalatal fricative. /β/ is a voiced bilabial obstruent which fluctuates phonetically among a stop, a fricative, and a glided articulation ([w]). /r/ is basically a flap but it also exhibits a trilled allophone as well. The contrastive or unpredictable occurrence of the voiceless glottal fricative /h/ is limited to word-initial position, as in forms such as

(2) [híwi] 'branch, stick'
[íwi] 'stingray'
[hawɨ́] 'his; hers'
[awɨ́] 'woman; wife'
[hwɨ́nti] 'heart'
[wínti] 'oar, paddle'

The underlying vowel system of Huariapano consists of four contrasting segments:

(3) i ï
o
a

/ï/ is high, back, and unrounded. The rounded vowel /o/ fluctuates rather freely with [ʊ] and [u]. The nasalization of vowels is not phonemic in Huariapano, even though it is contrastive in many other languages of the Panoan family. Rather, given the fact that words containing phonetically nasalized vowels in Huariapano nearly always retain a following nasal consonant in at least one of their alternate forms, we can logically derive all surface nasalized vowels from an underlying sequence of vowel plus tautosyllabic nasal consonant:

(4) /βïroišin/ → [βïroyšɨ́] 'soul; spirit'
/βinon/ → [βinṍ] 'species of palm tree (*Mauritia flexuosa*)'

Nevertheless, both the gradient nasalization of vowels as well as the deletion of syllable-final nasal consonants are optional, leading to quite a bit of phonetic fluctuation. However, the patterns exemplified in (4) above illustrate at the very least one of the theoretically possible outcomes of just about every instance of an underlying nasal consonant in coda position.

When a Huariapano word which ends with a vowel in its underlying form is pronounced in isolation, it often surfaces phonetically with a word-final [ʔ] in free variation with Ø:

(5) /pino/ [pínoʔ] ~ [píno] 'hummingbird'
/awa/ [awáʔ] ~ [awá] 'tapir'
/rïsβi/ [rïzβíʔ] ~ [rïzβí] 'rope'

This is the only circumstance in which [ʔ]s appear in surface forms, so I analyze them as optional, transitional phonetic reflexes which do not contribute in any way to syllable weight (unlike other coda consonants). For a more complete justification of this position, see Parker (1994a).

With respect to syllable structure, I note that the maximal template required to exhaustively parse all Huariapano surface forms is [CGVC], where *G* stands for any glide. The presence of both the onset and the coda is optional in all positions of the phonological word. That is, there are no language-specific conditions which either require onsets or eschew codas in any particular phonotactic environment. The list of consonants which can occur in syllable-final position consists of the voiceless fricatives [s š ʂ h], the nasals [m n ŋ], and the glides [y w ɰ̟]. However, an important distinction to point out is that of all these coda segments, [h] (and only [h]) is entirely predictable in this position and so in many cases will be inserted as a result of constraint interaction. All other syllable-final consonants are contrastive (as we would normally expect) and therefore must always be specified in underlying representations.

To close this section, it would be worthwhile to mention that Huariapano exhibits a prosodic constraint of bimoraic minimality on all content words. That is, no independent lexical item can have a monomoraic shape at the surface level: ***(C)V***.[3] Rather, all monosyllabic forms must contain either a coda consonant ([yą́n] ‘lake’; [páw] ‘shell’) or a long vowel ([βó:] ‘hair’; [čí:] ‘fire’). Furthermore, long vowels occur only under these circumstances and nowhere else, and there are only a handful of such examples. Consequently, since vowel length is not contrastive in Huariapano, we can posit that the constraint which prohibits long vowels (*V:) is ranked quite highly in this language; it is violated only when certain monosyllabic forms would otherwise be in danger of not satisfying the surface minimality constraint.[4]

[3]Monosyllabic words containing nasalized vowels are also systematically unattested among the lexical vocabulary: *$[C\tilde{V}]_{PrWd}$.

[4]Actually, this bimoraic constraint is not absolutely inviolable at the surface level. Among my data I have recorded the two exceptional forms [pwí] ‘excrement’ and [kwí] ‘jaw’. Since the second member of complex onset clusters always consists of a glide (as in these cases), I posit that these segments are derived from underlying vowels through a process of demorafication. In other words, for these two examples we can posit the phonemic forms /poi/ and /koi/, respectively. Then we can make the inviolable claim that in Huariapano, bimoraic minimality is always met ***either*** underlyingly ***or*** on the surface, but not necessarily at both levels. This is an interesting problem for Optimality Theory since one of its basic tenets is that all constraints hold only in phonetic forms, and not in the lexicon. If we adhere to this principle and say that Huariapano has ***only*** a surface minimality constraint—which furthermore can be violated (when a situation of hiatus is resolved by devocalization)—we seem to be missing an important generalization. Of course, prosodic minimality is not itself directly encoded as an OT constraint but rather derives from FootBinarity (among other things). Furthermore, it is commonly assumed that hierarchical structure such as metrical feet are not present underlyingly. Consequently, an alternative analysis suggested to me by Paul de Lacy (p.c.) would be to posit that both /poi/ and /koi/ have candidates in which the /o/ does not undergo glide formation, and FootBin is satisfied there in a sympathetic fashion.

3. Stress patterns in Huariapano

3.1 Basic facts of stress placement

In this section I introduce a corpus of illustrative forms which exemplify the basic patterns and details of stress assignment in Huariapano. Let us start with primary stress. The overwhelming number of forms which end with a light (open) syllable bear primary stress on the penultimate syllable:

(6)	[kanóti]	'bow (weapon)'
	[tápoʔ]	'cot'
	[átˢa]	'manioc'
	[kóʂ̌ni]	'beard'
	[ràmboʂ̌óβo]	'knees'

My claim that the penultimate syllable is the default, unmarked locus of primary stress is further confirmed by the fact that stress predictably moves to the right when a suffix (such as /-βo/ 'plural' or /-ra/ 'topic') is added to a root:

(7)	[máyti]	'hat'
	[maytíβʊʔ]	'hats'
	[póaʔ]	'potato'
	[poáβoʔ]	'potatoes'
	[payáti]	'hand-held fan'
	[pàyatíra]	'fan (topic)'
	[βín̋a]	'male'
	[βɪ̀naβóra]	'males (topic)'

However, whenever a word ends with a consonant underlyingly, the final heavy syllable always attracts the stress:

(8)	[hǫntˢís]	'claw; fingernail'
	[yawíš]	'opossum'
	[ʂ̌omóʂ̌]	'needle'
	[ʂ̌aβín]	'bee'

This predictable pattern also applies to those cases in which a word-final nasal consonant coalesces with the preceding vowel; words that end with such sequences underlyingly are regularly stressed on the ultima (cf. the forms [βïroyšį́] and [βinǫ́] from example (4) earlier).[5] Of course, one obvious implication of this fact is that

[5]As discussed in §2, however, word-final [ʔ]s do not contribute to syllable weight for the purposes of stress assignment since they are only transitional phonetic segments (they disappear when such words are placed inside a phonological phrase). Therefore, most of the words which end with a [ʔ] are stressed on the penultimate syllable, in keeping with the unmarked pattern established above.

perhaps nasalized vowels in Huariapano are compensatorily lengthened at the phonetic level. I am presently carrying out an instrumental study on the duration of Huariapano vowels and rhymes to ascertain whether this hypothesis has any validity. Nevertheless, there are two *prima facie* arguments which already suggest that it is incorrect. First, in the previous section (footnote 2) I mentioned that Huariapano systematically avoids monosyllabic forms containing nasalized vowels, in obedience to prosodic minimality. If nasalized vowels are in fact bimoraic, words which have them automatically fulfill FootBin and thus should always be able to surface. The fact that they never do will have to be ascribed to mere coincidence if such vowels are indeed phonetically long. Secondly, in §4.1 I will show that the automatic insertion of syllable-final [h]s is not blocked in rhymes whose nucleus consists of a nasalized vowel. This is further evidence indicating that such vowels remain short after coalescence takes place since they pattern just like all of the corresponding monomoraic oral vowels do in this language. Therefore, unless and until I find evidence to the contrary, I will proceed under the assumption that all nasalized vowels in Huariapano are in fact short.

To summarize our findings thus far, the basic pattern is that primary stress in Huariapano falls on the final syllable of the word if it is heavy (closed by a coda consonant), and otherwise on the penultimate. In terms of the formal parameters of metrical phonology (Hayes 1995), these facts translate straightforwardly into a simple algorithm: construct a single moraic trochee at the right edge of each word.

Nevertheless, in spite of this basic, default pattern of penultimate stress in words whose final syllable is underlyingly open, there exist a number of exceptional forms which surface with primary stress on the final syllable, even though it is light. The following words exemplify this phenomenon:

(9) [uštá] ‘garbage’
[yoβ́í] ‘witch’
[kïwí] ‘lip’
[šanó] ‘species of venomous snake (*Bothrops pictus*)’

Oxytonic words such as these occur at a rate of 1:3 when compared with paroxytones. That is, within a list of 225 bisyllabic nouns and adjectives, 169 of them (75.1 percent) exhibit regular penultimate stress, whereas the remaining 56 words (24.9 percent) surface phonetically with stress on a light ultima. There is one crucial detail shared in common by all of these exceptional forms which is worth noting: none of them are verbs. In the next section I will analyze this as a prototypical noun faithfulness effect (Smith 1997).

We now come to the question of secondary stress. Since primary stress in Huariapano is assigned by means of a moraic trochee, the simplest and most natural expectation would be that secondary stress can also be reduced to the same mechanism. However, this is not the case. As I will demonstrate below, the metrical feet which are responsible for assigning secondary stress do not show the effects of quantity-sensitivity, although they are still left-headed. Consequently, the iterative foot type which needs to be constructed in this language is the syllabic trochee. A second complication is that the direction of parsing for these quantity-insensitive feet varies;

both left-to-right and right-to-left assignment of secondary stress is needed in order to account for the attested patterns in Huariapano.

In general, both nouns and verbs are governed by the same accentual principles in Huariapano. However, one difference between these two lexical classes which will be exemplified below is that many verbal suffixes are extrametrical. A second difference is that no verb bears primary stress on a final light syllable, as noted above.

Let us now begin to illustrate the patterns of secondary stress in this language. In those cases in which the primary stress is preceded by an even number of light syllables, the alternating positions of secondary stress are uncontroversial and do not argue either for quantity insensitivity or for direction of footing:

(10)	[nòβirána]	‘we’
	[hi̊̀manóra]	‘in the village’
	[ki̊̀yokáŋki]	‘they finished’
	[mànapáyri]	‘I will wait’
	[yòmïrànoṣíki]	‘he is going to hunt’

The forms above are neutral or ambiguous in the sense that the secondary stresses could be accounted for either by moraic trochees or syllabic trochees. Furthermore, either direction of parsing would produce the correct results in these cases. Therefore, I need to present clear and unambiguous data in order to substantiate the claims made above.

First, with respect to syllable weight, if all of the metrical feet employed by Huariapano are moraic trochees (the simplest and hence preferred analysis), we would expect there to be a tendency for heavy syllables to attract secondary stress. However, this is not what we find:

(11)	[hàβombíβi]	‘they’
	[ìnawkónra]	‘jaguar (topic)’
	[čìβaŋkáŋki]	‘they followed’

In the forms in (11) above, the second syllable of each word is unstressed even though it is heavy, while the light initial syllables are stressed. This is an indication that the parsing algorithm for secondary stress does not take weight into account. However, these cases are not entirely decisive since they could also be explained by clash avoidance (the third syllable of each word bears primary stress). That is, assuming that the constraint NoClash is undominated in Huariapano, it would potentially suppress a secondary stress on these heavy syllables even if the remaining metrical parameters would otherwise call for them to be present. Therefore, crucial evidence to rule out the possibility of moraic trochees for secondary stress would consist of forms that contain heavy syllables which are ***not*** adjacent to the primary stress. The following words illustrate exactly such a pattern:

(12)	[mi̊̀rayβašíki]	‘we found’
	[kùβyayβašíki]	‘I cooked’

[čùkayβahkáŋki] ‘they washed’

As the forms in (12) above demonstrate, the assignment of secondary stress in Huariapano systematically disregards syllable weight. The third word is especially instructive since it contains a span of two unstressed heavy syllables. If this form were to be parsed with moraic trochees from right to left (and assuming clash avoidance), the logical outcome would be *[čukàyβahkáŋki], with the secondary stress falling on the second syllable. Similarly, parsing it in a quantity-sensitive fashion from left to right should also yield the same result (*[čukàyβahkáŋki]) since the heavy second syllable would take preference over the light initial syllable. In order to generate the attested form by assigning moraic trochees from left to right, we would need to invoke two highly dubious stipulations. First, we would need to create a degenerate foot on the initial light syllable, and secondly, we would have to posit that the clashing secondary stress which deletes in this case is the one which we would otherwise expect on the heavy second syllable, rather than the one on the noncanonical first syllable. Both of these maneuvers are objectionable on theoretical grounds since they are highly marked options cross-linguistically and furthermore, neither one is independently motivated in Huariapano apart from this specific metrical configuration. Consequently, I conclude that the foot type needed to correctly assign all secondary stresses in this language is the syllabic trochee, which is inherently quantity-insensitive. This selection of distinct foot types for primary and secondary stress has also been proposed for Spanish (Hayes 1995) and Latin (Mester 1994).

The second major issue which we must attend to is the direction of parsing for secondary stress. As the forms in example (12) above illustrate, the default or unmarked setting for Huariapano is left to right. Furthermore, words such as [čùkayβahkáŋki] indicate that a leftover single syllable (/βah/ in this case) which immediately precedes the primary stress surfaces unstressed, even if it is heavy. This fact can be easily accounted for by ranking NoClash at the top of the hierarchy in this language. Some further data which clearly motivate a left to right parse (except for primary stress) are the following:

(13) [wànïkiráŋki] ‘they have returned’
[pàht^{s}ayβaṣíki] ‘I washed’
[yòmïràyβakanṣ̌íki] ‘they hunted’

On the other hand, there is also a robustly attested pattern in Huariapano by which secondary stresses iterate backwards from the primary stress in a right to left fashion. This phenomenon is illustrated by the following examples:

(14) [miβòmbiráma] ‘you (plural)’
[rahkì̌čaíki] ‘it is scary’
[ihkàṣ̌čąŋkáti] ‘you would shake with fear’
[βismànohkònoṣ̌íki] ‘I forgot’

These forms clearly contrast with the ones seen above in terms of direction of parsing for secondary stress. Furthermore, there is no basis for predicting which pattern a given word will take, as the following quasi-paradigmatic chart demonstrates:

(15)

	left to right footing	right to left footing	
'they washed'	[čùkayβahkáŋki]	[arìβahkáŋki]	'they repeated'
'when they called'	[kǐ̀namahkáŋki]	[yumùt^{s}uhkáŋki]	'they robbed'
'it came running'	[ìštokiráŋki]	[βismànohkòyamáykay]	'I forget'

The contrastive direction of scansion exemplified in (15) above cannot be explained as a cyclic effect because several of the forms contain exactly the same suffixes: /-kan/ 'third person plural' and /-ki/ 'perfective'. In addition, many of the verb roots which are left over after affixes are stripped away are otherwise metrically identical, e.g., /kïnama-/ 'call' vs. /yumut^{s}u-/ 'rob'. Furthermore, the nondefault right to left parsing of secondary stress is also attested in a few monomorphemic nouns:

(16) [himàŋkošó] 'species of ant'
[šïnàkoṣón] 'spider'

Since the nouns in (16) above are unsuffixed, there is no hope for an analysis whereby we invoke a sympathetic behavior with respect to a derivationally-related member of the paradigm. Further evidence also suggests that, just like in (15), the unit of exceptionality which must be diacritically marked in the lexicon is always the verb or noun root, not their corresponding suffixes.[6] Consider the following data:

(17) [βismànohkònoṣíki] 'I forgot'
[yòmïràyβakanṣíki] 'they hunted'
[kùβyayβaṣíki] 'I cooked'

All three forms in (17) end with the suffix /-ṣiki/, a perfective aspect marker. The secondary stress in [βismànohkònoṣíki] iterates from right to left and thus results in an atonic initial syllable. Compare this with [yòmïràyβakanṣíki], which has the same number of syllables. Here the unmarked directionality is in effect and thus the secondary stressing begins on the first syllable. [kùβyayβaṣíki] follows the same pattern. Thus it is clear that suffixes (like /-ṣiki/) are not the morphemes which trigger this contrast. Furthermore, semantically-related forms which share these same roots invariably parse their secondary stresses in the same direction even when different suffixes are present:

(18) [βismànohkòyamáykay] 'I forget'
[yòmïrayníhkąỹ] 'they are hunting'

[6]I have never discovered any productive prefixes in Huariapano.

I thus conclude that the elements which encode or trigger the irregular right to left footing for secondary stress in Huariapano are the lexical roots. In the following section I will examine this issue in more detail.

An alternative analysis which might be considered is to invoke initial extrametricality for those cases which appear to require across-the-board right to left footing. This would have the advantage of allowing us to parse all secondary stress feet in the same direction (left to right). However, there are two good reasons for rejecting this hypothesis. First, left-sided extrametricality in conjunction with syllabic trochees is otherwise unattested in the languages of the world (Hayes 1995:78). Secondly, if initial extrametricality were truly an option in Huariapano, it would predict that we should find examples in which the secondary stress commences on the second syllable of the word, but there is a "prosodically trapped" (Mester 1994) unparsed syllable left over immediately preceding the primary stress: [tatàtatàta***ta***táta]. Such forms are systematically absent in Huariapano. This fact is an embarrassment for the hypothesis of initial extrametricality, which would have to consider this lacuna an accidental coincidence. On the other hand, if the forms in examples (14)-(16) are derived via a persistent right to left footing, such a gap is predicted and expected since the secondary stress would always begin exactly two syllables preceding the primary stress. I thus conclude that Huariapano has phonemic secondary stress, in the sense that Hayes (1995:144) has posited for Fijian and Icelandic as well: contrastive or unpredictable direction of scansion.[7] As I have noted above, footing the secondary stresses from left to right is the default, unmarked option for this language. I base this claim on statistical frequency: among those forms in which the direction of parsing would make a difference, the secondary stress begins on the initial syllable about twice as many times as it begins on the second syllable. That is, not counting ambiguous cases such as the examples in (10) above, we observe the following proportions:

(19)	left-to-right footing:	σ̀ σ σ̀ σ σ σ́ σ	66%
	right-to-left footing:	σ σ̀ σ σ̀ σ σ́ σ	34%
	unattested (initial extrametricality):	*⟨σ⟩ σ̀ σ σ̀ σ σ σ́ σ	0%

To close this section, I note that the majority of Huariapano's verbal suffixes are extrametrical. This can be diagnosed by the fact that many verbs which end with a heavy syllable nevertheless bear primary stress on the penultimate:

(20)	[nìniβïránʂǫn]	'pulling it'
	[nìhkapánan]	'that you might hear'
	[ìnankánon]	'that they might give'

In the first word in (20) above, /-anʂ/ is a gerundive suffix. In the second form the suffix /-panan/ is the past tense subjunctive marker. In the third word /-ka/ is probably a past tense suffix and /-non/ is the causitivizer. Because of the limited time I had to elicit verbal paradigms in Huariapano, I am not able to gloss the other suffixes in the

[7]Estonian is a weaker contender for such a distinction (Hayes 1995:316).

first word. Nevertheless, the roots are as follows: /nini-/ ‘pull’, /nika-/ ‘hear’, and /inan-/ ‘give’. We cannot simply say that all verbs, unlike nouns, are parsed with a syllabic trochee even for primary stress since many verbal forms do stress a heavy final syllable:

(21) [kïhpʃ̈n] ‘I open’
[pohṣ́óy] ‘I fall down’
[nɻ̨hkáṣ́] ‘hearing; listening’

3.2 OT analysis

In this section I translate the stress patterns just discussed into a formal analysis relying on the language-specific ranking and interaction of potentially violable universal constraints, the central premise of Optimality Theory. In the first place, we have seen that all metrical feet in Huariapano are left-headed, so the following foot shape constraint must be undominated in this language:

(22) Trochaic
Align (Head-Syllable, L, Foot, L)
The left edge of every stressed syllable must be aligned with the left edge of some foot.

The ranking of this constraint over Iambic is straightforward and has no exceptions, so I will not include it in most tableaux. Two other constraints which we will also invoke are likewise well-known in the OT literature:

(23) Parse Syllable (ParseSyl)
All syllables must be footed.

(24) Foot Binarity (FtBin)
All feet must consist of at least two moras.

FootBin has the effect of ruling out degenerate (monomoraic) feet which are left over at the end of the parse. It is crucial that we not define this constraint so as to require every foot to have two ***syllables*** since we need to allow for monosyllabic moraic trochees in assigning primary stress. In order to capture the fact that primary stress is attracted to the right edge of the word, the following constraint is also necessary:

(25) Main Right (MainR)
Align (Head-Foot, R, PrWd, R)
The right edge of every main stress foot must be aligned with the right edge of some Prosodic Word.

This series of constraints allows us to correctly capture the placement of primary stress in the most simple cases. In the following tableaux I enclose each metrically parsed foot within parentheses. We will derive here two sample words from example (6) earlier.

(26)

UR /kanoti/	MainRt	FtBin	ParseSyl
a. (káno)ti	*!		*
b. ☞ ka(nóti)			*
c. (kà)(nóti)		*!	
d. kanoti			**!*
UR /koṣni/			
a. ☞ (kóṣni)			
b. (kóṣ)(nì)	*!	*!	
c. (kóṣ)ni	*!		*
d. (kòṣ)(ní)		*!	

In the evaluation of the word /kanoti/ above, candidate (a) is eliminated by the MainRight constraint since the primary stress foot is separated from the end of the word by the final syllable (/ti/). Candidate (b) is the correct winner since it only violates low-ranked ParseSyl once. Candidate (c), on the other hand, forms the initial syllable into a degenerate foot and thus completely satisfies ParseSyl. In so doing, however, it fatally violates FootBin. This outcome thus establishes our first crucial ranking: FootBin ⟩⟩ ParseSyl. At this point we have no evidence to critically rank MainRight with respect to ParseSyl. However, following Tesar (1997), I assume that language learners begin life with all constraints at the top of the hierarchy and demote one of them only when compelled to by a direct conflict. I note that candidate (c) would also be ruled out by NoClash (which is independently needed in any case, as we will see below) since it has stress on adjacent syllables. Finally, candidate (d) shows that the requirement to parse a word into feet, even though it is low-ranked, makes its presence felt by penalizing a word for doing nothing (thereby avoiding metrical structure altogether). This is an effect of the emergence of the unmarked (TETU: McCarthy and Prince 1994).

The form /koṣni/ is also of interest since it has a heavy penultimate syllable. As tableau (26) demonstrates, parsing the light final syllable into its own foot fatally violates FootBin, regardless of whether it bears primary or secondary stress (candidates (d) and (b), respectively). The competition between candidates (a) and (c) shows that the most harmonic strategy involves parsing the entire word into a single and all-inclusive foot since this outcome does not violate any of the constraints. This

result indicates that final light syllables are not left stranded in Huariapano, although I know of no other evidence in the language apart from this tableau which confirms this hypothesis.[8] The fact that candidate (a) is the winner in this case clarifies that the primary stress foot is not always a moraic trochee, but rather at times a generalized trochee, since it can consist of three moras (Kager 1992, 1993; Mester 1994).

We now need to deal with the facts of syllable weight. Recall that in Huariapano, primary stress is quantity-sensitive and thus assigns a single moraic trochee to a final heavy syllable. However, for secondary stress the feet we construct need to be quantity-insensitive (syllabic trochees). Capturing this dichotomy in the constraint system is a major challenge. To start off, we can incorporate Prince and Smolensky's (forthcoming) PeakProminence constraint:

(27) Peak Prominence (PkProm)
Ĥ > Ĺ

PeakProm as I use it here is meant to imply a markedness subhierarchy in which a heavy syllable constitutes an inherently better stress bearing unit than a light syllable. In spite of my employment of acute accents in the formulation of (27), I do not intend this constraint to distinguish between primary and secondary stress. It is clear that this is an important issue since allowing PeakProm to monitor both primary and secondary feet alike will produce incorrect results. To resolve this dilemma, I borrow and adapt Beckman's (1997, forthcoming) concept of positional faithfulness. Beckman has shown that certain phonological domains, such as syllable onsets and root-initial syllables, are perceptually and functionally prominent and thus allow a greater variety of contrastive segments and features to surface than in less salient positions (syllable codas, non-initial syllables, etc.). Her response is to posit special faithfulness constraints which are limited to the more prominent positions. Then by ranking a relevant markedness constraint between the more specific and the more general versions of the faithfulness constraints, correct results are obtained. I illustrate this with an example from Cuzco Quechua (Parker 1997). In this Peruvian language, glottalized (ejective) obstruents occur in lexical roots, but never in affixes. In order to capture these facts, I posit the following three ranked constraints:

(28) MaxRoot(CG) ⟩⟩ *CG ⟩⟩ Max(CG)

The highest constraint, MaxRoot(CG), prohibits deletion of an ejective feature which starts out specifically in a root. This dominates the markedness constraint which bars all ejectives. At the bottom of the hierarchy we place the more general faithfulness constraint which calls for all ejectives to surface. As a result an

[8]I would be hard pressed to come up with any empirical facts in Huariapano which crucially decide between candidates (a) and (c) in tableau (26). On the other hand, this point does not affect any other issue discussed in this paper, as far as I am aware. Consequently, since candidate (a) fares better on ParseSyllable (an independently needed constraint), I will assume that it is in fact the correct representation.

underlying ejective will be preserved only if it is in a root. This is the idea of positional faithfulness.

I propose that we modify this strategy and adapt it to the facts of Huariapano stress. Let us posit a constraint which has the effect of calling for quantity-sensitivity only insofar as the primary stress is concerned:

(29) Peak Prominence Main (PkPromMain)
With respect to main stress, Ḿ > Ĺ.

This is a specific and restricted markedness constraint which exists alongside the more general and unrestricted PeakProm constraint (27). By ranking these two filters in the logical (Paninian) way and placing a relevant third constraint between them, we can produce the desired results. As I will soon demonstrate, one of these crucial intervening constraints is AllFeetLeft, whose formulation I will delay until later:

(30) PeakPromMain ⟩⟩ AllFeetLeft ⟩⟩ PeakProm

As we will see, AllFeetLeft has the effect of maximizing the size of secondary stress feet at the expense of the general PeakProm constraint. That is, in secondary feet heavy syllables are not necessarily preferred over light syllables in the metrically strong position. At the top of this mini-hierarchy is PeakPromMain, which ensures that the primary stress foot is in fact quantity sensitive. Following Beckman (1998), we can call this effect *positional markedness*.[9]

Let us now go to a tableau. We will start with a simple case involving a heavy final syllable but no secondary stresses, for the moment:

(31)

UR /yawiš/	Trochaic	MainRt	FtBin	PkPromMain	ParseSyl
a. (yáwiš)				L!	
b. (yà)(wíš)			*!	H	
c. ☞ ya(wíš)				H	*
d. (yá)wiš		*!	*!	L!	*
e. (yawíš)	*!			H	

In tableau (31), candidate (a) is eliminated since its primary stress falls on a light syllable. Comparing this with candidate (c) establishes the ranking PeakPromMain ⟩⟩ ParseSyl. The word-initial light syllable is not formed into a degenerate foot (candidate (b)) since this violates FootBin. This is consistent with a claim made by Hayes (1995): he asserts that in a language with a bimoraic minimal word syndrome (such as Huariapano), single monomoraic syllables left over at the end of a directional parse are left unfooted.[10] Finally, including both syllables in a single

[9]For analogous proposals, see Kenstowicz (1997) and de Lacy (1997).
[10]Of course, this correlation does not necessarily follow in OT. Nevertheless, the fact that my analysis

right-headed foot as in candidate (e) fatally violates the undominated foot shape requirement. We thus have the ranking Trochaic ⟩⟩ ParseSyl.

We are now in a position to directly consider secondary stress. As we established in the previous section, in the default or unmarked case we need to iteratively parse secondary stress feet in a left to right fashion. The constraint which enforces this result was alluded to above:

(32) All Feet Left (AFL)
Align (Foot, L, PrWd, L)
The left edge of every foot must be aligned with the left edge of some Prosodic Word.

Clearly we need to rank MainRight above AFL so that the primary stress foot does not get pulled toward the beginning of the word. In the following tableau I evaluate a new form, [βɨ̀nanošíki] 'he is going to seek/look for':

(33)

UR /βïnanošiki/	NoClash	MainRt	FtBin	ParseSyl	AFL
a. ☞ (βɨ̀na)no(šíki)				*	***
b. (βɨ̀na)(nóši)ki		*!		*	**
c. (βɨ̀)(nàno)(šíki)	*!		*!		****
d. (βɨ̀na)(nò)(šíki)	*!		*!		*****
e. βï(nàno)(šíki)				*	****!
f. βïnanošiki				**!***	

In the tableau above I have left out PeakPromMain since it is not relevant for this word (all five syllables are light). In (33) candidate (b) demonstrates that the word-final alignment of the primary stress takes precedence over the left alignment of all feet and thus we have established the ranking MainRight ⟩⟩ AFL (the winning candidate (a) fares worse than (b) does on AFL). For the sake of candidates (c) and (d) I have included the undominated NoClash constraint to show that adjacent stresses are never tolerated in Huariapano surface forms. As I mentioned above, FootBin knocks them out as well, but in the next tableau we will analyze a form in which NoClash is crucial. Candidate (e) shows the critical effect of AFL since it parses the secondary stress foot from right to left, contra the unmarked direction which is preferred in Huariapano. Finally, candidate (f) avoids metrical structure altogether in order to perfectly satisfy AFL (in a vacuous way), but the accrued violations of ParseSyl prove fatal, indicating that the ranking ParseSyl ⟩⟩ AFL is necessary. And so candidate (a) emerges as the optimal representation, with its prosodically trapped third syllable left unfooted.

coincides with Hayes' prediction here is an encouraging confirmation which suggests that we are on the right track.

In the following tableau we now consider a form with unparsed heavy syllables in order to establish the ranking of the two constraints which control for quantity-sensitivity:

(34)

UR /čukayβahkanki/	No Clash	Ft Bin	PkProm Main	Parse Syl	AFL	Pk Prom
a. ☞ (čùkay)βah(káŋki)			H	*	3*	LH
b. (čùkay)(βàh)(káŋki)	*!		H		5*	LHH
c. (čù)(kày)(βàh)(káŋki)	*!**	*!	H		6*	LHHH
d. ču(kày)βah(káŋki)			H	**!	4*	HH
e. ču(kàyβah)(káŋki)			H	*	4*!	HH
f. (čù)(kàyβah)(káŋki)	*!	*!	H		4*	LHH

In the tableau above I leave out MainRight for the sake of conciseness. In (34) candidate (b) foots the third syllable in order to completely satisfy ParseSyl. This time FootBin cannot rule it out since this syllable is heavy, so NoClash is now crucial (NoClash ⟩⟩ ParseSyl). Candidate (e) is another case of footing in the wrong direction. Therefore, even though it satisfies the general PeakProm constraint better than the winner (a) by stressing the heavy second syllable rather than the light initial syllable, its fourth violation of AFL is fatal. This establishes the ranking AFL ⟩⟩ PeakProm. This tableau thus confirms the correctness of splitting PeakProm into two constraints. That is, in conjunction with tableau (31) earlier, we established the need for primary foot quantity sensitivity (PeakPromMain) to dominate ParseSyl. Furthermore, we independently know that ParseSyl dominates AFL (tableau (33)). In this latest tableau, (34), we saw that the general PeakProm constraint is ranked below AFL by comparing candidates (a) and (e). Therefore, by transitivity we can posit the following schema:

(35) PeakPromMain ⟩⟩ ParseSyl ⟩⟩ AFL ⟩⟩ PeakProm

Observe in (35) that the two quantity-sensitivity conditions are split up by two other intervening constraints. If only the single, general PeakProm constraint were available, we would be faced with an intractable ranking paradox. As it is, by positing a specific vs. general dichotomy in the weight-to-stress principle and ranking ParseSyl and AFL in the middle, we have achieved our goal: quantity-sensitivity is enforced for primary stress alone, enabling the footing algorithm for secondary stress to overlook heavy syllables and thereby "stretch out" the feet into syllabic trochees, minimizing their number. I thus conclude that my proposal of positional markedness as summarized in (35) provides us with a viable solution to a potentially recalcitrant dilemma.

A question which naturally arises now is that of cross-linguistic typology. That is, if a markedness constraint such as PeakProm can be specifically limited to the perceptually salient main stress only, and not to secondary stresses as well, this predicts that we should not find any languages which exhibit the inverse of

Huariapano's foot types: (quantity-insensitive) syllabic trochees for primary stress but (quantity-sensitive) moraic trochees for secondary stress. As far as I am aware, no such language has ever been reported. If this prediction is in fact borne out, the analysis I have sketched here provides an explanation for this gap and allows us to establish the positional markedness subhierarchy PeakPromMain ⟩⟩ PeakPromSecondary as a universally inviolable meta-ranking. Or better yet, a stronger and more logical claim is that constraints such as PeakPromSecondary do not even exist at all. This hypothesis thus avoids the ranking problem altogether.[11]

Before we leave tableau (34) for good, there is one other issue I would like to comment on. Suppose we allow a candidate such as [(čùkay)(βah)(káŋki)], in which the third syllable is parsed as a foot yet left unheaded (unstressed). This form would thus completely obey NoClash (beating candidate (b)) as well as ParseSyl, defeating the attested winner, candidate (a). The fact that [(čùkay)(βah)(káŋki)] violates AFL more times than candidate (a) does (because it has an additional foot) is irrelevant since ParseSyl dominates AFL. Given the fact that [(čùkay)(βah)(káŋki)] does not stress the third syllable (avoiding a clash), it would be phonetically equivalent to the optimal form which I have argued for in tableau (34). Teasing apart the difference between these two representations is a very subtle and difficult task. I know of no other facts in Huariapano which bear on this decision. Nevertheless, for the sake of restricting my analysis as much as possible, I assume the typical undominated constraint which requires every prosodic element to have a head and thus be stressed (cf. Selkirk 1984). This is a standard and natural move.

Let us now consider one case in which the secondary stress is parsed in the marked direction, right to left. As I demonstrated in the previous section, the contrastive footing of secondary stress in Huariapano is unpredictable and therefore must be dealt with as a true phonological phenomenon. That is, it cannot simply be dismissed as a matter of "phonetic implementation" since it leads to alternations (see (38) below). The constraint hierarchy which has already been posited straightforwardly accounts for the nondefault pattern provided that we make one obvious adjustment: we need to invoke AllFeetRight and have it dominate AllFeetLeft. This new constraint is defined as follows:

(36) All Feet Right (AFR)
Align (Foot, R, PrWd, R)
The right edge of every foot must be aligned with the right edge of some Prosodic Word.

In the following tableau I derive the word [manàŋkihkási] 'I'm going to speak to you':

[11]Prince (1997) has shown that in principle there can potentially be a subtle difference between these two methods of restricting the theory. Nevertheless, I do not believe that this distinction matters in the case of Huariapano.

(37)

UR /manankihkasi/	No Clash	Ft Bin	Main Rt	PkProm Main	Parse Syl	AFR	AFL
a. ☞ ma(nàŋkih)(kási)				L	*	2*	4*
b. (mànaŋ)kih(kási)				L	*	3*!	3*
c. (mà)(nàŋkih)(kási)	*!	*!		L		6*	4*
d. (mànaŋ)(kìh)(kási)	*!			L		5*	5*
e. (mànaŋ)(kíhka)si			*!	H	*	4*	2*

The evaluation of the candidates above is very similar to the analyses in earlier tableaux. Thus candidate (d) is eliminated because of high-ranking NoClash, while candidate (c) also violates FootBin. Candidate (e) has a non-final primary stress and thus falls to MainRight. Since the main stress in (e) falls on a heavier syllable than in the attested winner (a), we need the ranking MainRight ⟩⟩ PeakPromMain. The most interesting competition in tableau (37) is that between candidates (a) and (b). The latter incorrectly parses the secondary stress from the beginning of the word and thus violates AFR one more time than (a) does. Candidate (a) obviously does worse than (b) on AFL, so this confirms the crucial ranking AFR ⟩⟩ AFL for words of this type. In previous tableaux involving left to right parsing of secondary stress feet, I did not explicitly display the implied ranking of AFL over AFR for those cases. It should be clear that this could have easily been done and would have still led to the correct outcome. Since left to right parsing of iterative feet is the default setting for Huariapano, I posit that the overall grammar of the language has the unmarked ranking AFL ⟩⟩ AFR stipulated just once. Then those forms which are not marked to the contrary obey that hierarchy without incurring any additional expense. On the other hand, those cases which exhibit across the board right to left footing are prespecified in the lexicon with the ranking AFR ⟩⟩ AFL, which overrides the default parameters. Given that the root of each word is the morpheme which controls directionality (as I showed in the last section), I posit that this is where the lexical marking resides.

My treatment of these facts may be seen by some readers as controversial since language-specific ranking is normally assumed to be fixed and unchangeable. Thus irregularity is usually handled by marking lexical items with some type of underlying diacritic which influences how they are evaluated. For example, there seems to be general agreement in the literature that exceptional metrical structure should be captured by positing pre-specified lexical feet or grid marks (Hayes 1995, Inkelas, Orgun, and Zoll 1996, and Alderete 1998). However, this strategy will not work for Huariapano since the location of the marked right to left secondary stress feet varies depending on the number and type of suffixes which happen to be present. Consider the following paradigm:

(38) [rákï] ‘fear’
[rahkȉčaíki] ‘it’s scary’
[rahkȉyamàyβaṣíki] ‘I was afraid of it (the jaguar)’
[ràhkïánay] ‘to be afraid’

Each of the words in (38) contains the root /rakï/ 'fear'.[12] The forms [rahkɨ̏čaíki] and [rahkɨ̏yamàyβašíki] demonstrate that this morpheme induces the nondefault direction of parsing for its secondary stress feet since these iterate backwards from the primary stress. Consequently, in the second and third words in (38) there is a secondary stress on the peninitial syllable of the root (/kï/). In the form [ràhkïánay], on the other hand, the last syllable of the infinitival suffix /-anai/ is extrametrical and thus primary stress falls on the mora immediately following the root. As a result of this configuration, the secondary stress shifts backwards onto the first syllable of the word. We thus see that in the case of marked right to left footing, the presence of different suffixes leads to morphophonemic alternations in the location of secondary stress. Consequently, it would be futile to attempt to construct an underlying metrical foot somewhere in the lexical entries of roots of this type since it is impossible to predict *a priori* where the secondary stress will surface. Rather, as I have argued above, these Huariapano patterns necessitate an analysis whereby parallel co-phonologies are posited for the same language, in keeping with the proposal of Inkelas, Orgun, and Zoll (1996). These unpredictable re-rankings are lexically associated with the underlying forms of the exceptional root morphemes which trigger irregular secondary stress.

I now address the claim that certain verbal suffixes are extrametrical. This is further exemplified by the word [yòmïrayníkąỹ] 'they are hunting', in which the root for 'hunt' is /yomïra-/, the suffix /-ini/ marks progressive aspect, and the final syllable derives from the third person plural agreement marker /-kain/. This word foots its secondary stress in the unmarked left to right direction, and the main stress is obviously striving for right edge alignment. As I noted above in conjunction with example (21), some heavy verbal suffixes do attract regular final stress through a moraic trochee parse, so we cannot simply assign primary verbal stress by means of syllabic trochees in all cases. Rather, it appears that the best solution is to invoke extrametricality for these forms. However, there is a problem with marking the final syllable extrametrical: it makes the wrong prediction in the case of words such as [yòmïrayníkąỹ] above. When we mark off the final syllable and assign a right-aligned moraic (or generalized) trochee to the remaining structure, our constraint system as it stands would incorrectly parse this word as *[yòmïráyni⟨kąỹ⟩]. This is because the penultimate syllable (*ni*) is light, so the quantity-sensitive primary stress must skip over it and fall on the syllable to its left. Therefore, marking the suffix [-kąỹ] as extrametrical does not work. However, let us consider a slight variation of this theme. Suppose we stipulate that only the final ***mora*** of such suffixes is extrametrical. This would then always place the primary stress on the penultimate syllable, even if it is light. In an OT account, we can easily do this by invoking a constraint of the following nature (cf. Inkelas, Orgun, and Zoll 1996):

[12]The systematic insertion of syllable-final [h] will be explained in the next section.

(39) Nonfinality (Nonfin)
Align (Head-Foot, R, μ, L)
The right edge of every main stress foot must be aligned with the left edge of some mora.

Now by ranking Nonfinality above MainRight, we can force the primary stress foot to start one mora in from the end of the word when suffixes marked with this ranking are encountered:

(40)

UR /yomïrainikain/	Nonfin	Main Rt	Ft Bin	PkProm Main	Parse Syl	AFL	Pk Prom
a. (yòmï)(ràyni)(ką́ỹ)	*!			H		6*	LHH
b. (yòmï)(ràyni)(ką́)ỹ		*	*!	H	*	6*	LHH
c. (yòmï)ray(ní)kąỹ		**!	*	L	**	3*	LL
d. (yòmï)ray(níkąỹ)	*!			L	*	3*	LL
e. ☞ (yòmï)ray(níką)ỹ		*		L	**	3*	LL
f. (yòmï)(ráyni)kąỹ		**!		H	*	2*	LH

In (40) I leave out NoClash for the sake of conciseness. I also ignore the constraints which compel devocalization and vowel-nasal coalescence in the suffix /-kain/. The latter process is dealt with at the end of this section. In the tableau above candidate (d) correctly stresses the penultimate syllable but includes the word-final segment (*ỹ*) in the main foot and thus fatally violates Nonfinality. Candidate (e) repairs this by metrically stranding this final glide and eventually emerges as the winner. Candidate (a) is also very important since it would otherwise win if it were not for Nonfinality. It totally complies with MainRight and ParseSyl, but only at the expense of ignoring the highly-ranked extrametricality requirement. We have thus established that Nonfinality crucially dominates MainRight. As candidate (f) shows, it is now crucial to clarify that violations of MainRight must be assessed gradiently rather than categorically. That is, if MainRight were considered to be equally violated by both (e) and (f), the outcome between these two candidates would then pass down to a lower constraint, PeakPromMain. In that case (f) would incorrectly emerge as the winner since its main stress falls on a heavy syllable. Consequently, in order to ensure that candidate (e) be selected as the representation of choice, I assign one * mark for each mora by which the main stress foot is separated from the end of the word. Incidentally, in this tableau I have interpreted ParseSyl as requiring that every segment in the syllable be included in a metrical foot. Thus candidate (e) violates this constraint twice, once for [ray] and once for the final syllable, [kąỹ]. While this interpetation may be interesting, it is not of critical importance since ParseSyl is low enough in the hierarchy that all other plausible candidates have already been eliminated by higher-ranked constraints. We thus see that by ranking Nonfinality 〉〉 MainRight we obtain the desired extrametricality effect. Nevertheless, a potential objection to this approach is that it contradicts a claim made by Hayes (1995). In his comprehensive work

surveying an impressive array of languages, he does not find any compelling arguments for moraic extrametricality (p. 58). Consequently, for the sake of restricting our analytic possibilities, he proposes that extrametricality should be confined to units the size of one whole syllable or larger. My analysis of Huariapano, insofar as it is correct, provides evidence against Hayes' proposal to exclude extrametricality for individual moras.[13]

Another detail of Huariapano stress which we also need to account for are the cases of unpredictable primary stress on word-final light syllables. Here I will discuss the word [šanó] from example (9) earlier. As I noted above, several sources concur in proposing that exceptional forms of this type are best dealt with by prespecifying the irregular metrical structure in the lexicon, a strategy which ***does*** work in this case. Consequently, we build a degenerate monomoraic foot on the final syllable in the underlying representation of such words:

(41)
x
/ša(no)/

We now posit a high-ranking faithfulness constraint which overrides the default metrical parameters that would otherwise apply. The relevant constraint is the following:

(42) Stress Ident
If mora μ1 is specified as [αstress] in the Input, then its Output correspondent μ2 must be [αstress].

I intend this constraint to be interpreted as militating against both deletion of an underlying prominence and shifting it to a different mora. This captures the combined effects of two independently proposed constraints, Alderete's (1998) MaxProm and Smith's (1997) NoShift. The following tableau uses this new constraint:

[13]Paul de Lacy (p.c.) proposes a different way of treating this apparent extrametricality effect. He suggests that a portion of heavy suffixes (like /-kain/) is gramatically reaffiliated with the preceding root. Thus the winning form in (40) would be morphologically analyzed as [yòmïrayníkạ-ȳ] on the surface. Then we could modify our Nonfinality constraint along the following lines: either Align (verb, R, Head-Foot, R) or Align (verbal affix, L, Foot, R). Nevertheless, an argument against this proposal of "morpheme absorption" (Lubowicz 1998) is that it inherently violates Consistency of Exponence (McCarthy and Prince 1993a and 1993b). Consequently, I will not pursue this alternative here.

(43)

UR x /ša(no)/	Stress Ident	Trochaic	No Clash	Main Rt	Ft Bin	Parse Syl	AFL
a. ☞ ša(nó)					*	*	*
b. (šá)no	*!			*!	*	*	
c. (šà)(nó)			*!		**		*
d. (šá)(nò)	*!		*!	*!	**		*
e. (šáno)	*!						
f. (šanó)		*!					
g. šano	*!					**	

In (43) above candidate (g) deletes the underlying accent and leaves the input form totally unparsed. A comparison of this candidate with (a) establishes that StressIdent dominates FootBin. Similarly, retracting the primary stress to the initial syllable (candidate e) in order to form a bimoraic trochee also fatally violates StressIdent. If we wish to rule out candidate (f) we need to assume that Trochaic dominates FootBin as well. Although candidates (f) and (a) are presumably phonetically indistinguishable, I posit that (a) is the correct analysis of this word. Candidate (f) involves an iambic foot shape which is otherwise unattested in Huariapano. Furthermore, iambic parses tend to induce headedness effects such as the lengthening of prominent vowels, a phenomenon which I have never encountered in this language. The correct winning candidate is thus (a).

Recall from the previous section that verbs are systematically prohibited from stressing a final light syllable. This is a typical noun faithfulness effect (Smith 1997). That is, Smith proposes that faithfulness constraints such as StressIdent can be restricted so that they apply only to nouns, but other lexical categories (such as verbs) cannot be tied to domain-specific conditions in this way. So in tableau (43) we should actually name the top constraint StressIdent(Noun). The more general version of this constraint is then ranked at the bottom of the hierarchy so that the default metrical parameters can "undo" any noncanonical phonemic accents which Gen might provide in underlying verbal forms.

Before I leave this topic I note that Huariapano also exhibits several exceptional words which surface with primary stress on the antepenultimate syllable:

(44) [βímana] 'face (noun)'
[ríškiti] 'whip (noun)'
[pahtášpora?] 'narrow'

There are a total of twelve such irregular forms in my corpus, and none of them are verbs. I posit that these morphemes, just like certain verbal suffixes, are lexically marked with the undominated Nonfinality constraint. We cannot simply assign them an underlying prominence because we need to simultaneously prevent lexical stress from

surfacing on syllables preceding the antepenultimate (since no such forms are attested in Huariapano), and the most straightforward way to achieve this objective is by ranking MainRight above StressIdent. Thus in a hypothetical underlying form such as /tátatata/, for example, if MainRight dominates StressIdent, the primary stress will surface at least one syllable to the right of its prespecified location.[14] Once we have established the ranking MainRight 〉〉 StressIdent, however, we need to contend with the fact that in forms such as [tĭ́piti], MainRight is violated by at least one mora. This can be dealt with by calling back into play the extrametricality effect which we motivated in conjunction with (39) and (40): Nonfinality 〉〉 MainRight. Once we have opted for this analysis, it then becomes irrelevant whether a lexical accent is also posited on the antepenultimate syllable in the underlying forms of words such as [tĭ́piti]. Even without this prespecified structure the head of the default trochaic foot will fall on the correct syllable due to high-ranking Nonfinality. In summary, primary stress in Huariapano must surface on one of the last three syllables of every prosodic word. The classical explanation for the existence of a right edge window of this type is that it represents the maximal distance which can be obtained from the joint combination of a single binary metrical foot plus one optional mora (or syllable) of extrametricality. Outside of this domain no underlying prominence ever surfaces since MainRight dominates StressIdent. In the following tableau I analyze one of the attested forms with antepenultimate stress as well as a hypothetical input with a lexical prominence on the preantepenultimate syllable:

(45)

UR /βïmana/	Nonfinality	MainRight	StressIdent
a. ☞ (βĭ́ma)na		*	
b. βï(mána)	*!		
UR x /(ta)tatata/			
a. (táta)tata		**!	
b. ☞ ta(táta)ta		*	*

As the tableau above shows, invoking Nonfinality again leads to the desired extrametricality effect; this time it produces irregular antepenultimate stress in the handful of exceptional words which are lexically marked as following this pattern. In the case of hypothetical underlying forms with an infelicitous prespecified accent too far to the left, however, Nonfinality is not as crucial since even if it is violated a conceivable Huariapano word will emerge. Therefore, the competition is decided by the next constraint down, MainRight (TETU). Since MainRight dominates StressIdent, the phonemic stress is forcibly pulled within the three-syllable window at the right edge of the word. We thus see that the constraint hierarchy which I have posited here

[14]In a form like /šanó/, MainRight is satisfied by the lexical accent on the final light syllable and so is irrelevant in determining the outcome in such cases.

outputs all and only those candidates which are (or would be) well-formed surface representations in Huariapano, regardless of inputs.

The last issue which I need to confront in this section is how to derive word-final stress on forms which undergo vowel-nasal coalescence. Our test case will be the word [βinǫ́] from example (4) above. Recall that no noun ends with an unstressed nasalized vowel in its surface form: *CV́CṼ#. (Some verbs do terminate in this way due to extrametrical suffixes.) The fact that this pattern is systematically unattested in Huariapano confirms my hypothesis that all nasalized vowels are derived from a vowel plus nasal sequence. The reason is because forms such as [βinǫ́] always stress the ultimate ***as though the final nasal consonant were there***. If nasalized vowels were phonemic in this language, we would expect some cases in which they occurred in word-final syllables that were underlyingly light (open). In that situation they would not be followed by a nasal consonant, so the primary stress would go on the penult: (hypothetical) /tatą/ → [tátą]. If Huariapano did have phonemically nasalized vowels, the absence of nouns such as *[tátą] would be a glaring accidental gap. However, if all nasalized vowels are derived from an underlying /VN/ sequence, we correctly predict that final nasalized vowels should always be stressed, provided we set up our metrical constraints to take into account the syllable-final consonant which is present in the input. Another argument against phonemically nasalized vowels in Huariapano is the fact that they never occur together with oral codas. That is, we never find syllables such as *[tąs], *[čįš], etc. If vowel nasalization were directly encoded in the underlying nucleus, the absence of syllables of this type would also be unexpected (or at least noteworthy). On the other hand, a coalescence account predicts this hole in the pattern since syllables like [tąs] would have to be derived from /tans/, which is trimoraic. Since Huariapano does not otherwise attest superheavy syllables, analyzing vowel nasalization as resulting from coalescence thus explains this gap as well. Consequently, I posit that Huariapano has a very highly-ranked constraint prohibiting nasalized vowels in surface forms: *Ṽ. The only harmonic situation in which this can be violated is under compulsion of the constraints which induce coalescence, which therefore must dominate *Ṽ.

Processes of coalescence can be handled in OT by appealing to the model of Correspondence Theory (McCarthy and Prince 1995). The following two constraints are relevant:

(46) Max Input-Output (MaxIO)
Every segment in the Input has a correspondent in the Output.

(47) Uniformity (Uniform)
No element of the Output has more than one correspondent in the Input.

MaxIO prohibits segmental deletion and Uniformity militates against coalescence. Another constraint which also comes into play is of the Ident family:

(48) Ident(Nas)
Correspondent segments have identical values for the feature [nasal].

Finally, a constraint prohibiting syllable-final nasal consonants will serve as the impetus driving the coalescence process:

(49) Nasal Coda (NasCoda)
A syllable cannot end with a nasal consonant: *N]$_\sigma$

Observe the interaction between these constraints in the following tableau:

(50)

UR /βino$_1$n$_2$/	Ident(Nas)	NasCoda	MaxIO	*Ṽ	Uniform
a. ☞ βinǫ́$_{1,2}$				*	*
b. βinó$_1$n$_2$		*!			
c. βinó$_{1,2}$	*!				*
d. βinó$_1$			*!		

In (50) above I have subscripted the relevant segments with numerical indices in order to focus on the correspondence relationships. Furthermore, I will ignore the issue of stress assignment until the next paragraph. Candidate (d) completely eliminates the final nasal consonant and thus fatally violates high-ranked MaxIO. Candidate (b) preserves the coda and thus falls to the undominated NasCoda constraint. Candidate (c) coalesces the vowel-nasal sequence but maintains the orality of the vowel. By ranking Ident(Nas) over *Ṽ we can achieve the elimination of this candidate. Consequently, candidate (a) emerges as the most harmonic form since it maintains the feature [nasal] from the final /n/ at the expense of violating Uniformity. By placing *Ṽ and Uniformity at the bottom of the hierarchy we thus derive the attested coalescence process.

The most important detail of tableau (50) still needs to be explained: how do we get the (primary) stress to land on the final syllable? In a derivational model this would be easy because we could simply posit a counterbleeding rule ordering:

(51)

UR	/βinon/
Stress Assignment	βinón
Coalescence	βinǫ́
PR	[βinǫ́]

The key is that we want our quantity-sensitive primary stress to take effect as though the final nasal were present, even though it deletes in the optimal surface form. This type of situation is known in the SPE literature as *opacity*. In OT, of course, there are only two levels of phonological representation, so rule ordering is out of the question. Rather, as McCarthy (1997) shows, opaque phonetic forms can be obtained by appealing to the notion of sympathy, an Output-Output relationship between two surface candidates. Consider the following quasi-tableau:

(52)

/βinon/	NasCoda	Uniform	PkPromMain	FtBin	ParseSyl
a. ☞ βi(nǫ́)		*	L	*	*
b. ☜ (βínǫ)		*	L		
c. ❀ βi(nón)	*!		H		*

The basic idea works as follows. We need candidate (a) (with final stress) to win. However, candidate (b) is a problem since it violates only a subset of the constraints which (a) violates (the latter violates FootBin and ParseSyl while the former obeys these constraints, and they fare the same on Uniformity and PeakPromMain). Thus the hierarchy which we have posited up to this point predicts that (b) should win, an undesirable result which McCarthy flags with the symbol ☜. No re-ranking of our present constraints would enable (a) to win. Rather, we appeal to a sympathetic relationship between candidates (a) and (c). The latter is eliminated by NasCoda, but it still makes its presence felt (symbolized with ❀) by triggering an interpretation of StressIdent in which the final syllable must be prominent (as it is in [βinón]). This interaction is displayed in the following mini-tableau:

(53)

UR /βinon/, ❀ βinón	StressIdent ❀☞	FtBin
a. ☞ βi(nǫ́)		*
b. ☜ (βínǫ)	*!	

In (53) we rank the faithfulness constraint StressIdent over FootBin and force both candidates to be evaluated for the location of stress as though the final nasal were present, as it is in [βinón], which induces the O-O sympathetic effect. Consequently, since candidate (a) correctly stresses the final syllable (as [βinón] does, in obedience to PeakPromMain), it wins. Candidate (b) is now eliminated because it has a different pattern of accentuation than [βinón] does. It is still the case that the candidate [βinón] gets eliminated by NasCoda, just as before:

(54)

UR /βinon/, ❀ βinón	NasCoda	StressIdent ❀☞
a. ☞ βi(nǫ́)		
b. βi(nón)	*!	

In (54) candidate (b) fatally violates NasCoda and thus is less harmonic than (a). Candidate (a) wins by coalescing the vowel-nasal sequence in deference to NasCoda and thus emerges as the winner. The final step is to display a full tableau in which the StressIdent constraint is subcategorized for the sympathetic relationship by indicating the PeakPromMain constraint which [βinón] crucially fulfills. That is, the notation $\text{StressIdent}_{\text{PkPromMain}}$ is interpreted as follows: when scanning for violations of StressIdent, compare the metrical structure of each candidate with that of the

otherwise most harmonic form which bests satisfies PeakPromMain. As we saw in tableau (52), this candidate is [βinón]. We thus obtain the correct results:

(55)

UR /βinon/	Ident (Nas)	Nas Coda	Stress $Ident_{PkPromMain}$	Ft Bin	*Ṽ	Uniform	PkProm Main
a. ☞ βi(nǫ́)				*	*	*	L
b. (βínǫ)			*!		*	*	L
c. βi(nón)		*!					H
d. βi(nǫ́n)		*!			*		H
e. βi(nó)	*!			*		*	L

4. Coda epenthesis

4.1 Basic facts

In this section I introduce a selected corpus of illustrative forms which exemplify the basic patterns and distribution of epenthetic codas in Huariapano. In this language syllable-final [h] presents a rather complicated, yet totally predictable pattern of occurrence. It is a unique and interesting process in that several different environmental conditions must be simultaneously fulfilled in order for a word-medial [h] to appear. In the first place, [h] is inserted only when the following consonant (the onset of the next syllable) is voiceless; [h] never precedes a voiced consonant. Thus, syllable-final [h]s can occur before any of the Huariapano obstruents except /β/:

(56) [no***h***póʂ] ‘snail’
[wi***h***táʂ] ‘shinbone’
[r̃i***h***kín] ‘nose; snout’
[pa***h***t^{s}ákï] ‘we washed’
[βo***h***čǫn] ‘wave (of water)’
[i***h***sáʔ] ‘bird’
[pi***h***šį́n] ‘sleeping mat’
[kï***h***ʂáʔ] ‘mouth’

The fact that a syllable-final [h] appears only before voiceless consonants is borne out by the following forms, in which the onsets of the second syllable are voiced and thus are not preceded by [h]. Indeed, when these words are pronounced with an [h] in the coda of the initial syllable, they are rejected as incorrect:

(57) [kïβǫ́ŋ] *[kï***h**βǫ́ŋ] ‘species of turkey (*Penelope*)’
[kamóʂ] *[ka***h**móʂ] ‘species of venomous snake’
[maníš] *[ma***h**níš] ‘jungle’
[torú] *[to***h**rú] ‘circle; round’
[puyą́n] *[pu***h**yą́n] ‘arm’

A second condition which must be met in order for syllable-final [h] to appear is that the word-initial syllable must not bear primary stress. Thus, in all of the attested occurrences of [h] listed in (56) above, the initial syllable of the word is atonic. In the following forms, however, note that epenthetic [h]s are systematically absent when the first syllable of the word receives primary stress, even though the onset consonant of the following syllable is voiceless:

(58)	[na***h***ká?]	'manioc beer'
cf.	[náka?]	'flea'
	*[ná***h**ka?]	'flea'
	[ʂi***h***kɨ́]	'iguana'
cf.	[ʂɨ́kï]	'door'
	*[ʂɨ́***h**kï]	'door'

The minimal pairs of words listed above demonstrate quite nicely the surface contrast in stress between final and penultimate syllables. In addition, they also illustrate the fact that the coda epenthesis process in Huariapano is sensitive to the location of primary stress. This prohibition against laryngeal codas in word-initial syllables which bear primary stress is also confirmed by the exceptional words that irregularly accent the antepenultimate syllable:

(59)	[tɨ́piti]	'pillow'
	[pwítïrï]	'firefly'

However, *h* insertion is not blocked if the word-initial syllable has received ***secondary*** stress, as the following forms attest:

(60)	[à***h***kompána]	'rattlesnake'
	[čì***h***kïnamáŋ]	'corner'
	[βì***h***t^{s}akáŋki]	'they laughed'

A third condition which must also be present in order for a syllable-final [h] to occur is that the epenthesis site cannot already be occupied by a coda consonant. This follows directly from the fact that Huariapano's phonetic syllable template is maximally bimoraic. Thus, words such as the following are unacceptable when an [h] is deliberately added:

(61)	[βoʂká?]	*[βo***h**ʂká?]	'head'
	[kušβá?]	*[ku***h**šβá?]	'saliva'

Finally, a fourth condition which also governs the process of coda epenthesis in Huariapano is that it only occurs in ***odd***-numbered syllables of the word. We have already seen many examples in this section in which [h]s appear as the coda of word-initial syllables. In the following forms an [h] shows up in the coda position of the ***third*** syllable of the word (cf. also (15) above):

(62) [yòmïra***h***káno̧] ‘let’s go hunting’
[hayàyi***h***káŋki] ‘they possessed, had’

In addition, there also exist a number of forms in which an epenthetic [h] occurs in the ***fifth*** syllable of the word:

(63) [βǐ̀nakànoši***h***ką́ỹ][15] ‘they will look for’
[yòmïrànoši***h***ką́ỹ] ‘they will hunt’

However, [h] never occurs in word-final position in Huariapano, even in odd-numbered syllables. This fact is undoubtedly related to the requirement that syllable-final [h] be licensed by a following voiceless consonant.

Now that I have shown that [h] can be inserted as a coda in noninitial syllables, a crucial refinement to observe is that this segment ***can*** appear in a syllable which bears primary stress, provided that it is not the first syllable of the word. Thus, an epenthetic [h] often shows up in the third or fifth syllable along with primary stress:

(64) [βònoší***h***kąỹ] ‘they will take, carry’
[yòmïrà***h***katí***h***kąỹ] ‘they hunted’

In other words, the prohibition against a laryngeal coda occurring together with primary stress is limited to just the word-initial syllable.

In the preceding discussion I have shown that an epenthetic coda may occur in the first, third, and fifth syllables of prosodic words. However, as the following forms demonstrate, an [h] never appears in the coda position of the second or fourth syllable, even though the other conditions on its occurrence are met:

(65) [ìštokiráŋki] ‘it came running’
[màwašòmpayríra] ‘when I die’
[kàyβakanšíki] ‘they went’
[ihkàščą̣ŋkáti] ‘you would shake with fear’

The generalization is that any odd-numbered syllable, counting from the beginning of the word, is eligible to receive an epenthetic coda. However, [h] is systematically excluded from appearing in even-numbered syllables. Because of this pattern of occurrence, it is possible for a given form to surface with more than one syllable-final [h], as the following words attest (cf. also example (64) above):

(66) [pì***h***katí***h***kąỹ] ‘they ate’
[βù***h***katí***h***kąỹ] ‘they took, carried’
[hù***h***katí***h***kąỹ] ‘they arrived’

[15]The plural suffix [-kąỹ] which occurs in these two forms is analyzed as extrametrical in §3.2. I have no good explanation for why it is stressed here. Perhaps this variation has a grammatical basis; see also (64) and (71) below.

Incidentally, the third form in (66) shows that Huariapano permits two [h]s to surface in the same syllable—the initial one is underlying and the final one is epenthetic. The following contrastive paradigm shows quite nicely the odd vs. even syllable pattern which governs the occurrence of the laryngeal coda. Each word in (67) below consists of a verb stem followed by the suffixes /-ini/ 'progressive' and /-kain/ 'third person plural'. Focus on the juncture between the two suffixes:

(67) No [h] in even-numbered syllables:

[piníkąỹ]	'they are eating'
[βwiníkąỹ]	'they are taking, carrying'
[kayníkąỹ]	'they are going'
[yòmïrayníkąỹ]	'they are hunting'

A predictable [h] in odd-numbered syllables:

[βỳinayní***h***kąỹ]	'they are looking, searching'
[kùβyayní***h***kąỹ]	'they are cooking'
[ràntsayní***h***kąỹ]	'they are dancing'
[pà***h***t^{s}ayní***h***kąỹ]	'they are washing'

The productivity of this rule in Huariapano phonology is further confirmed by assimilated Spanish loan words such as the following:

(68)	[ka***h***káwa]	from *cacao*	'cacao tree'
	[ma***h***čéte]	from *machete*	'machete'
	[βi***h***séno?]	from *vecino*	'neighbor'

The above borrowings demonstrate that alternations involving syllable-final [h] truly involve epenthesis and cannot be reanalyzed as a deletion of underlying codas since there are no corresponding [h]s in the source language.

At this point we should be able to predict several more alternating patterns involving epenthetic [h]s based on the conditions noted above. For example, we have seen that underlying vowel-nasal sequences often coalesce in Huariapano. All other things being equal, we might expect that the deletion of the syllable-final nasal would feed [h] insertion given the appropriate circumstances. This indeed does happen, as the following words attest:

(69)	[nɨ***h***kɨ́]	'tall; long; far away'
	[hǫ***h***šɨ́][16]	'red'
	[yą***h***tą́]	'afternoon; late'

Next, in those cases in which the addition of one or more suffixes causes the primary stress to shift to the right, we can also predict that an epenthetic [h] should no

[16]In this word both of the [h]s are actually somewhat nasalized at the phonetic level.

longer be blocked in a word-initial syllable. This phenomenon is illustrated in the following forms:

(70)	[nḯtï]	‘day’
	[nï***h***tḯno]	‘day (locative)’
	[čípi]	‘sister (of a male)’
	[či***h***pín]	‘sister (ergative)’

In (70), coda epenthesis is impossible in the isolation form of ‘day’ since the initial syllable bears primary stress. Nevertheless, the word [nï***h***tḯno] (with the locative suffix /-no/) occurred in a phrase meaning ‘on another day’. Here the stress has moved to the second syllable of the root in accordance with the default penultimate parameters. Consequently, [h] insertion is now possible and thus predictably occurs. Similarly, when the ergative case suffix /-n/ is added to /čipi/ ‘sister’, the final heavy syllable attracts the stress, so coda epenthesis is again observed in the initial syllable of the word.

Finally, we should also expect to find alternations based on a contrast of voicing in consonant-initial suffixes. That is, in those cases in which a syllable-final [h] is possible because the following onset is voiceless, this [h] should not surface if we substitute into those forms instead a different suffix which begins with a ***voiced*** consonant. This prediction is confirmed as well:

(71)	[yòmïrà***h***katí***h***kąỹ]	‘they hunted’
	[yòmïrànoṣi***h***ką́ỹ]	‘they will hunt’
	[pàyrirá***h***kąỹ]	‘still; yet (they)’
	[pàyriránay]	‘still; yet (we)’

The first form in (71) consists of the verb root /yomïra-/ ‘hunt’, the past tense suffix /-kati/, and the third person plural suffix /-kain/. When these morphemes are concatenated together the third syllable of the root ends with an epenthetic [h] since the suffix /-kati/ begins with a voiceless consonant. On the other hand, when the future tense suffix /-noṣi/ replaces /-kati/, this syllable-final [h] predictably does not occur since /-noṣi/ begins with a voiced consonant. Similarly, the word [pàyrirá***h***kąỹ] consists of the root /pairira/ ‘still; yet’ plus the suffix /-kain/ (Huariapano is a highly agglutinative language; this form and the next one occurred in the paradigmatic context ‘We/they are still eating’). In the corresponding first person plural form the suffix is /-nai/, so coda epenthesis can no longer apply in the immediately preceding syllable.

In summary, we have seen that every occurrence of syllable-final [h] in Huariapano is completely predictable, provided that we take into account four distinct environmental conditions: (1) a following voiceless consonant; (2) an odd-numbered syllable of the word; (3) lack of primary stress in the case of word-initial syllables; and (4) an open epenthesis site. Nevertheless, there are a handful of irregular forms which exceptionally do not exhibit a syllable-final [h] in the expected circumstances. Below are a few examples:

(72)	[kïpúki]	*[kï***h**púki]	‘he closed’
	[rïtʹíki]	*[rï***h**tʹíki]	‘we killed’
	[čùšikáŋki]	*[čù***h**šikáŋki]	‘they dried’
	[čukáyni]	*[čuhkáyni]	‘I am washing’

All such irregular forms are verbs (cf. also (12)-(14) above); I have never encountered any confirmed exceptions among nouns. The total number of irregular morphemes which disobey the pattern is nine, while I have discovered a total of 115 morphemes which predictably follow the coda epenthesis rule.[17] We could thus say that the insertion of syllable-final [h]s in Huariapano exhibits a statistical productivity of about 93%.

4.2 OT analysis

My goal in this section is to provide an in-depth formal analysis of the phenomenon of coda epenthesis which we have just observed. After studying the attested patterns of [h] insertion detailed in the previous section, a number of obvious questions naturally come to mind:

(73)
- Why would a language systematically transform certain open syllables into closed ones, a very marked and unexpected situation cross-linguistically?
- Why does this occur only in odd-numbered syllables of the word?
- Why is this process blocked in word-initial syllables which bear primary stress?

The fact that epenthetic codas occur only in odd-numbered syllables of the word strongly suggests that a prosodic explanation for this process can be found by appealing to the influence of binary metrical feet. An alternative analysis positing a brute-force constraint which directly refers to “odd-numbered syllables” would be highly stipulatory and ad hoc and would therefore lack explanatory force. In addition, it would contradict all the evidence which has been argued to demonstrate that languages cannot “count” beyond two. Hence a solution based on some type of metrical structure would be intrinsically preferred. Naturally, then, the first area of Huariapano phonology which we should consider in this regard is its system of stress placement or accentuation.[18] When we do so, however, we unfortunately find very little correlation between the two phenomena (stress assignment and syllable-final [h]s). In the following list I rearrange some of the examples from the preceding section in order to highlight this interaction:

[17]It makes sense to count each lexical root or suffix only once in terms of its adherence or disobedience to the [h] insertion process. Otherwise, we could include paradigmatically related forms which repeat the same morpheme in slightly different contexts. This would have the undesirable effect of artificially biasing the statistics either in favor of or against the productivity of coda epenthesis.

[18]This is why I presented the facts of stress in such detail in §3.1 and 3.2.

(74)

initial syllable with primary stress:	prohibited as in *[ná***h**ka?]
initial syllable with secondary stress:	[čì***h***kïnamáŋ]
initial syllable unstressed:	[no***h***póš]
third syllable with primary stress:	[βònoší***h***kąỹ]
third syllable with secondary stress:	[yòmïrà***h***katí***h***kąỹ]
third syllable unstressed:	[hayàyi***h***káŋki]
fifth syllable with primary stress:	[yòmïrà***h***katí***h***kąỹ]
fifth syllable with secondary stress:	unattested
fifth syllable unstressed:	[βïnakànoši***h***ką́ỹ]

Graphically displaying this paradigm in chart form will allow us to visually focus our attention on a couple of significant details:

(75) Attested occurrence of syllable-final [h]

	V́	V̀	V̌
first σ	*	✓	✓
third σ	✓	✓	✓
fifth σ	✓		✓

In the chart above we see that the theoretically possible distribution of epenthetic codas with respect to syllable number and degree of stress is nearly complete except for two gaps in the pattern. One of these holes is relatively easy to explain: the lack of [h] in a fifth syllable bearing secondary stress. In order for an example of this type to occur, it would require the existence of a form long enough to place the primary stress at least two syllables to the right, on the seventh syllable of the word. Although there are a few attested examples of Huariapano verbs containing seven syllables (cf. (15) above), none of them fulfills all the conditions we are looking for: secondary stress on a light fifth syllable which is followed by a voiceless onset (in the sixth syllable). Nevertheless, all other things being equal, I think we can safely predict that ***if*** such a form were to be discovered, it should have an epenthetic [h] in the fifth syllable. All of the facts we have seen in the previous section point to this conclusion, i.e., there is no reason to suppose that [h] insertion would be systematically prohibited in these circumstances. I posit, then, that the hole in chart (75) which corresponds to the lack of attested examples of this type is simply an accidental coincidence that can be explained by a natural tendency to limit the average length of words, i.e., it is not a true gap.

On the other hand, we have seen that the prohibition against laryngeal codas in word-initial syllables which bear primary stress is absolute and is in fact confirmed by morphophonemic alternations as well as native speaker intuition. Explaining this lacuna is much more difficult and will have to be postponed until we lay the necessary groundwork, but we will eventually return to this point by the end of this section. As I will show, appealing once more to the notion of positional markedness to account for this phenomenon is arguably our best solution.

To summarize, except for one systematic hole in the pattern, we can declare that the relationship between stress assignment and coda epenthesis in Huariapano is completely arbitrary and random. That is, neither the presence of stress, the absence of stress, nor the degree of stress has any bearing whatsoever on predicting when a syllable-final [h] can appear (with one exception). The somewhat unfortunate conclusion which we must draw, then, is that the metrical constraints and machinery which we posited in §3.2 to deal with stress will be of little use to us in accounting for the odd vs. even syllable nature of the alternations involving epenthetic codas. Consequently, I propose that we establish for Huariapano a second metrical tier distinct from (yet parallel to) the tier which encodes stress placement. This separate tier will enable us to manipulate the metrical structure necessary to motivate and drive the process of [h] insertion without itself altering or being altered by the stress tier. I will refer to this second tier (the one which governs coda epenthesis) as the *rhythm* tier.

Since syllable-final [h]s in Huariapano occur in odd-numbered syllables counting from the beginning of the word, it should be clear that the binary, alternating feet which we need to set up on the rhythm tier must be left-headed (trochaic). Once we have established these prosodic units, we can then rely on them by positing a constraint which requires the head syllable of every rhythmic foot to be heavy (sort of the inverse of iambic lengthening). This pressure, appropriately ranked with respect to other relevant constraints, compels the insertion of a second mora in odd-numbered syllables which would otherwise be in danger of surfacing light.

Before we actually construct these feet, however, we need to determine whether they should be quantity-sensitive or insensitive. At first glance it might appear that we should build moraic trochees since the process of mora augmentation which I am proposing is more in keeping with the spirit of quantity sensitivity. However, this mechanism leads to problems since it predicts that any light syllable, regardless of whether it is in odd or even position, should be a potential target for coda epenthesis provided that either (1) it follows a heavy syllable or (2) inserting a coda would elevate it from an unparsed degenerate status to a canonical bimoraic foot. For example, consider the word [ìštokíra] ‘although he may run’. Footing this word with moraic trochees from left to right (with the rhythmic tier in mind, of course) leads to the parsing [(iš)(toki)ra]. Here the initial syllable is heavy and thus exhausts the first bimoraic foot. Consequently, the second and third syllables together constitute the second rhythmic foot since both of them are light. The remaining monomoraic final syllable is left unparsed. Now if the motivation for coda epenthesis is to augment the head syllable of a trochaic foot, this form should surface as *[(iš)(to***h**ki)ra] with a final *h* in the second syllable. Likewise, if we parse this word with moraic trochees in the opposite direction (right to left), we initially get the footing [(iš)to(kira)]. Here the second syllable is prosodically trapped in a degenerate situation, and if we are building bimoraic feet a natural expectation is that coda epenthesis would apply so as to allow this syllable to be parsed as a canonical trochee: *[(iš)(to***h**)(kira)]. Nevertheless, [h] insertion never occurs in even-numbered syllables, as we have seen. To illustrate further, a persistent left to right parse using moraic trochees for the rhythmic feet

would lead us to parse the word /miškikanki/ 'you (plural) fished' as [(miš)ki(kaŋ)ki]. Here the second syllable cannot be incorporated since it is a degenerate syllable stuck between two complete bimoraic feet. Consequently, coda epenthesis would serve as a natural repair strategy allowing this syllable to be parsed: *[(miš)(ki***h**)(kaŋ)ki]. The fact that this does not occur is an indication that we cannot analyze Huariapano's rhythmic structure using quantity-sensitive feet since this makes incorrect predictions. Therefore, I conclude that we need to construct syllabic trochees on the rhythmic tier in order to adequately account for the attested patterns of [h] insertion. It makes sense that these feet should be quantity-insensitive since we need to ensure that even-numbered syllables always end up parsed in a metrical foot, but in the weak position. Only in this way (relying on an iterative left to right parse) can we prevent coda epenthesis from applying in even-numbered syllables of the word, the reason being that the constraint which motivates this insertion focuses exclusively on foot heads. Consequently, I conclude that the limitation of final [h]s to odd-numbered syllables in Huariapano is best handled by parsing each word (on the rhythm tier) with syllabic trochees starting at the left edge. Indeed, this is the only algorithm which produces the correct results in every situation.

This being the case, I now discuss the specific OT constraints needed to derive the effects of coda epenthesis in Huariapano. Each constraint which applies specifically and exclusively to the rhythmic tier will be indicated by the notation (Rhy). Obviously we need a highly-ranked constraint which has the effect of iteratively parsing words from left to right:

(76) All Feet Left—Rhythm (AFL(Rhy))
Align (Foot, L, PrWd, L)
The left edge of every rhythmic foot must be aligned with the left edge of some Prosodic Word.

An analogous specification will also be made for the corresponding constraints FtBin(Rhy), ParseSyl(Rhy), PkPromMain(Rhy), Trochaic (Rhy), etc. Since all of the rhythmic feet are quantity-insensitive, the two PeakProm constraints must be relatively low ranked in our new subhierarchy. The constraint which induces coda epenthesis is the following:

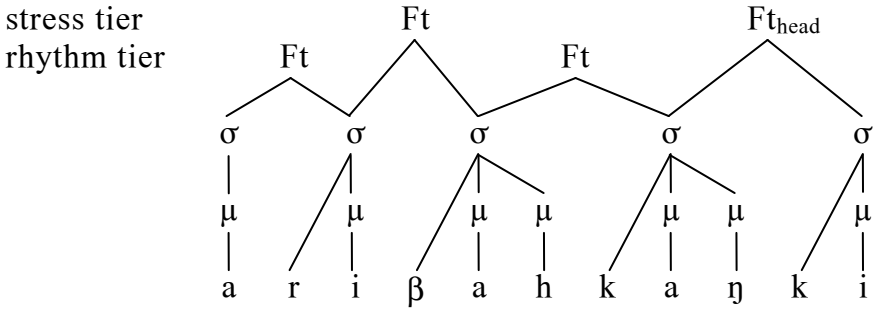
(77) Heavy Foot Head—Rhythm (HvFtHd(Rhy))
The head syllable of a rhythmic foot must be heavy.

The effect which this constraint produces is like that of stress to weight (if stressed, then heavy). Of course, in this case it is not actually stress which triggers this process, but rather ***rhythmic*** prominence. Benki (1995) posits an analogous constraint (Head-to-Weight) for Tübatulabal which requires the foot head to be heavier than the weaker member of each foot. Similar constraints along these lines have also been proposed by Black (1993) and Green (1997). On the other hand, Prince (1990) specifically argues that constraints of this type do not exist.

In analyzing the operation of the coda epenthesis process in Huariapano, it is important to consider the phonological status of syllable-final [h]s vis-à-vis the underlying representations of morphemes. That is, in derivational models any features and segments which are phonotactically predictable are always removed from underlying forms since they can be filled in or inserted by phonological rules. Thus since the occurrence of syllable-final [h]s is entirely predictable in Huariapano, for example, no lexical entry would ever contain one; instead, all of them would be supplied by a regular and automatic process of epenthesis. In OT, however, this is not necessarily the case. Rather, since any introduction of a segment which is not present in the input form trips at least one constraint (DepIO), even if that segment is entirely predictable, the principle of Lexicon Optimization (Prince and Smolenksy forthcoming; Inkelas 1994) dictates that such segments be posited in underlying representations only when morphophonemic alternations show their derived status. Thus in OT if a certain instance of syllable-final [h] occurs in a root which never alternates, we must assume that that particular coda is present in the lexical entry of that morpheme, even though all such segments are completely predictable in Huariapano. For example, let us consider the word [no***h***póṣ̌] 'snail' from (56) above. Since this form ends with a heavy syllable and is thus stressed on the ultimate, an [h] automatically occurs in the coda of the first syllable. Furthermore, no known process of affixation would ever result in a situation in which the initial syllable of this word bears primary stress, blocking the [h] from appearing. Therefore the most harmonic mapping of this surface form from its underlying representation is the one which posits /nohpoṣ̌/ as the input. On the other hand, we have seen in example (70) that [či***h***pín] 'sister (ergative)' derives from a morpheme which is pronounced in isolation as [čípi]. In this case the addition of the suffix /-n/ causes a stress shift which makes coda epenthesis possible. Thus given this specific evidence of alternation, we are justified in positing /čipi/ (without an /h/) as the lexical entry for this root in an OT analysis.

Let us now consider the metrical structure of the form [arìβa***h***káŋki] 'they repeated'. The verb root meaning 'repeat' is /ariβa-/, without a final /h/. This word ends with a light syllable and thus follows the regular penultimate stress pattern. Consequently, we can display the surface parse for this word on both tiers as follows:

(78)



In (78) the last two syllables are parsed into a generalized trochee on the stress tier and thus the penultimate syllable receives the primary stress (cf. (26)). The secondary stress foot encompasses the second and the third syllables since this root follows the nondefault right to left parsing for its syllabic trochees. The first syllable is prosodically trapped and thus remains unfooted (on the stress tier) since if it were headed, there would be a clash with the adjacent secondary stress. On the rhythmic tier, however, we find a different situation. Here the algorithm calls for consistent quantity-insensitive trochees from left to right, so the first two syllables form one foot and the third and fourth syllables are incorporated into the second rhythmic foot.[19] As a result, the third syllable of the word is in a strong metrical position (on the rhythm tier) and thus is required to be heavy (by HvFtHd(Rhy)). Since all of the other relevant conditions for coda insertion are also fulfilled, an epenthetic [h] emerges at the end of the third syllable. Forms like this one thus confirm my proposal for a second metrical tier in Huariapano since as we have seen, this third syllable is ***not*** in a strong position on the stress tier. Rather, since it is in fact in the weak position of its respective foot, it would be futile to appeal to the metrical structure for stress alone to attempt to explain the motivation for coda epenthesis in this case (and others like it). In conclusion, I note that while the two competing and parallel metrical tiers may at times coincide entirely (as they would, for example, in a word such as [nòβirána], from (10) above), there is no requirement that they necessarily overlap at all.

We are now in a position to examine a relevant tableau. One new constraint which comes into play is the following:

(79) Dependency Input Output—Mora (DepIO(μ))
Every mora in the Output candidate must have a correspondent in the Input.

In the following tableau (and all others in this section) I use the paired parentheses to indicate the ***rhythmic*** metrical structure; stress assignment will be completely ignored for the moment. We will derive the form [pi***h***káti] ‘I ate’. In this word /-kati/ is the same past tense suffix we observed in (71). Furthermore, by comparing [pi***h***káti] with [píkï] ‘he ate’, we see that the root for ‘eat’ has the underlying form /pi-/.

[19]I assume that degenerate (monosyllabic) feet are prohibited on the rhythmic tier in Huariapano. Thus final odd-numbered syllables are left unparsed.

(80)

UR /pikati/	HvFtHd (Rhy)	FtBin (Rhy)	DepIO (μ)	No Coda	ParseSyl (Rhy)	AFL (Rhy)	AFR (Rhy)
a. ☞ (pi***h***ká)ti			*	*	*		*
b. (pi***h***ká)(ti)	*!	*!	*	*		**	*
c. (piká)ti	*!				*		*
d. (pi***h***ká***h***)ti			**!	**!	*		*
e. (pi***h***)(ká***h***ti)			**!	**!		*	**
f. pi(ká***h***ti)			*	*	*	*!	
g. (pi)(ká***h***ti)	*!	*!	*	*		*	**

In the tableau above candidates (a)-(d) correctly foot the input from left to right. This places the first syllable of the word in strong metrical position and thus calls for a heavy rhyme. Candidates (a), (b), and (d) correctly respond by inserting a coda, even though this violates DepIO(μ) and NoCoda. Candidate (c) avoids this problem by doing nothing, but this falls to HvFtHd(Rhy), so we have established the ranking HvFtHd(Rhy) ⟩⟩ DepIO(μ) and NoCoda. Candidate (b) parses the final degenerate syllable in violation of FtBin(Rhy). Although this candidate and (a) are phonetically equivalent, we will follow our stress analysis from §3.2 and rule out (b) by crucially ranking ParseSyl(Rhy) below FtBin(Rhy) (cf. candidate (a)). Candidate (d) is of interest since it also inserts a final [h] in an even-numbered syllable (the second one). However, in this case coda epenthesis is not compelled by HvFtHd(Rhy) since the second syllable is in the weak position of its foot. Consequently, this second (and unmotivated) violation of DepIO(μ) and NoCoda proves to be immediately fatal. The established hierarchy thus produces the desired result that epenthetic [h]s must appear in odd-numbered syllables (when they can), and they must not occur in even-numbered syllables. This is further confirmed by examining candidates (e)-(g), which are incorrectly footed from right to left. This forces candidate (e) to foot the left over degenerate initial syllable and supply it with an epenthetic coda as well. This result fares better than the winner (a) on ParseSyl(Rhy) but violates DepIO(μ) and NoCoda twice, demonstrating a critical ranking between these constraints.[20] The alternative which candidate (g) chooses is to not insert a final [h] in the first syllable, but this violates the top two undominated constraints. Finally, candidate (f) ties with (a) all the way down to AFL(Rhy). It inserts an [h] in the head syllable of its foot in order to obey HvFtHd(Rhy) and it strands the initial degenerate syllable in obedience to FtBin(Rhy). Both (a) and (f) thus violate DepIO(μ), NoCoda, and ParseSyl(Rhy) just once each, so the only difference between these two candidates is the direction of footing. Since (a) is the actually attested winner, Huariapano must have the ranking AFL(Rhy) ⟩⟩ AFR(Rhy). We thus see that by constructing syllabic trochees from left to right on the rhythmic tier we correctly derive the coda epenthesis pattern only in odd-numbered syllables.

[20]We cannot obtain this result by ranking AFL(Rhy) over ParseSyl(Rhy) since this would then prevent iterative footing from being carried out on the rhythmic tier.

Let us now return to a fact which I discussed in §2. Recall that the unpredictable or contrastive occurrence of /h/ in Huariapano is restricted to word-initial position (example (2)). We can use this detail to our advantage in ruling out underlying /h/s which Gen might supply in even-numbered syllables of the word. That is, the Richness of the Base principle of OT dictates that there are no restrictions on underlying forms. Rather, the surface constraint hierarchy alone must filter out all inputs which, if unmodified, would not be well-formed phonetic representations in a given language. Consider a hypothetical UR such as /tatahta/, with a final /h/ in the second syllable. Our present grammar would not be able to delete this /h/ and thus would incorrectly output a form which is systematically unattested in Huariapano. To resolve this problem we need to invoke the general markedness constraint which prohibits the segment [h] from appearing in all output forms: *SG. Obviously this constraint must be dominated by HvFtHd(Rhy) in order to allow word-internal epenthetic [h]s to surface at all. At the same time, however, if *SG dominates the Max(SG) faithfulness constraint, underlying /h/s in even-numbered syllables will be deleted since doing so has no effect on the satisfaction of HvFtHd(Rhy):

(81) HvFtHd(Rhy) 〉〉 *SG 〉〉 Max(SG)

In the following tableau I evaluate the hypothetical input /βašnahta/ as well as the attested form [nï***h***tĺ́no] from (70) above:

(82)

UR /βašna***h***ta/	HvFtHd(Rhy)	DepIO(μ)	*SG	Max(SG)
a. ☞ (βašná)ta				*
b. (βašná***h***)ta			*!	
UR /nïtïno/				
a. (nïtĺ́)no	*!			
b. ☞ (nï***h***tĺ́)no		*	*	

In tableau (82) the domination of Max(SG) by *SG compels the deletion of the underlying /h/ in the second syllable of /βašna***h**ta/. Since this /h/ is in a weak syllable on the rhythmic tier, HvFtHd(Rhy) is irrelevant to this competition. At the same time the posited ranking still works correctly to produce [nï***h***tĺ́no]. Failing to insert a syllable-final [h] (candidate (a)) fatally disobeys top-ranked HvFtHd(Rhy). The winning candidate (b) satisfies this requirement and in so doing only violates two lower-ranked constraints, DepIO(μ) and *SG. A dilemma which emerges now is that if left alone, *SG would rule out all occurrences of word-initial /h/ as well, an unacceptable situation (cf. (2)). We can obviate this problem by relying once more on the strategy of positional faithfulness. Let us start by positing a constraint which prohibits the deletion of /h/ specifically in ***onset*** position (Beckman (1988) provides general evidence that constraints of this type are motivated cross-linguistically):

(83) Max Onset SG
Every specification of [sg] which is in syllable-initial position in the Input must have a correspondent in the Output.

This constraint in and of itself, however, is not sufficient because we simultaneously need to rule out /h/s which serve as the onsets of medial (non-initial) syllables. That is, hypothetical phonetic forms such as *[nóha] are systematically unattested and therefore ill-formed in Huariapano. We can block these from surfacing by ranking *SG over MaxOnset(SG); it is not just ***any*** syllable-initial /h/ which we need to preserve, but specifically onset /h/s in word-initial position. Consequently, we need to posit a second positional faithfulness constraint which targets the initial syllables of roots as well:

(84) Max σ_1 SG
Every specification of [sg] which is in the initial syllable of a root in the Input must have a correspondent in the Output.

Just as in the case of MaxOnset(SG), we cannot allow Maxσ_1(SG) to preserve all /h/s in root-initial syllables; some of these will have to be ruled out since syllable-final [h]s can only be followed by a voiceless consonant (cf. (56) and (57)). Thus, we need to delete the /h/ in hypothetical inputs such as /ya***h***mí/. This can be achieved by having *SG dominate Maxσ_1(SG) as well. It is only when an underlying /h/ is simultaneously in onset position and in the root-initial syllable that we need to ensure its preservation in the surface form in every case. Consequently, in order to output [h]s specifically in absolute word-initial position, we need to combine the effects of MaxOnset(SG) and Maxσ_1(SG) into one constraint. The mechanism which accomplishes this is local conjunction (Smolensky 1993, 1995; Crowhurst and Hewitt 1995; Alderete 1996; Lubowicz 1998):[21]

(85) [MaxOnset(SG) & Maxσ_1(SG)]$_\sigma$

In order to produce the desired positional faithfulness effect, we rank the locally conjoined constraints in (85) above *SG and place the individual and more general versions of these filters at the bottom of the subhierarchy:

(86) [MaxOnset(SG) & Maxσ_1(SG)]$_\sigma$ $\rangle\rangle$ *SG $\rangle\rangle$ Max(SG),

MaxOnset(SG), Maxσ_1(SG)

In the following tableau I analyze the word [híwi] from (2) as well as a hypothetical underlying form, /noha/:

[21] Although positing a single constraint such as MaxOnsetσ_1(SG) would be simpler, it would abuse the power of the theory since there is no other cross-linguistic precedent for such a combination of features in one constraint.

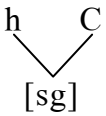
(87)

UR /hiwi/	[MaxOnset(SG) & Maxσ_1(SG)]$_\sigma$	*SG	Max (SG)	Max Onset(SG)	Maxσ_1 (SG)
a. ☞ híwi		*			
b. íwi	*!		*	*	*
UR /noha/					
a. nóha		*!			
b. ☞ nóa			*	*	

In the evaluation of forms such as /hiwi/ above, the domination of *SG by the locally conjoined positional faithfulness constraints ensures that underlying word-initial /h/s surface intact. The fact that coda epenthesis does not take place in forms like [híwi] will be dealt with below. In the hypothetical input /noha/, the /h/ must delete since it is not in the root-initial syllable and the prohibition against this segment (*SG) outranks the relevant faithfulness constraints Max(SG) and MaxOnset(SG). The winning candidate which emerges ([nóa]) is thus a theoretically possible well-formed surface representation in Huariapano.

The next detail which I will consider is the fact that coda epenthesis is blocked preceding voiced consonants. That is, a syllable-final [h] is inserted only when the following onset is voiceless (cf. (56) and (57)). In certain respects this resembles the process of pre-aspiration in Icelandic (Thráinsson 1978a, 1978b; Selkirk 1990). Consequently, we can account for this voicing dichotomy in Huariapano by positing a licensing constraint specific to the feature [spread glottis]:

(88) License SG (Lic(SG))
The segment [h] is licensed only in the following configuration:



By ranking Lic(SG) above HvFtHd(Rhy) we prevent [h] from being inserted before voiced consonants.[22] In the following tableau I analyze the word [yamḯ] ‘night’:

(89)

UR /yamḯ/	Lic(SG)	HvFtHd(Rhy)	DepIO(μ)
a. (ya***h***mḯ)	*!		*
b. ☞ (yamḯ)		*	

[22]The existence of the constraint Lic(SG) also helps to explain why the second mora of monosyllabic lexical items is manifested as vowel length rather than as an epenthetic [h]: in word-final position there would be no way for an [h] to be licensed.

Thus the requirement that the head syllable of a rhythmic foot be heavy must be abandoned when it conflicts with the more highly ranked constraint which licenses [h]. The net effect is that coda epenthesis can only apply before voiceless consonants. Obviously if Lic(SG) is completely undominated in Huariapano it will indiscriminately cause word-initial [h]s to delete as well, an incorrect result. The obvious solution is to rely on the positional faithfulness strategy once again and invoke our locally conjoined constraint combination. We rank [MaxOnset(SG) & $\text{Max}\sigma_1(\text{SG})]_\sigma$ over the Lic(SG) markedness constraint and then place the more general Max(SG) requirements at the bottom of this subhierarchy. The result is that underlying /h/s will be preserved in word-initial position, but not word-internally if they are followed by a voiced consonant. In the following tableau I again derive the word [híwi] from (2), the hypothetical underlying form /ya***h***mí́/ (cf. 89), and the word [pi***h***káti] (cf. 80):

(90)

UR /hiwi/	[MaxOnset(SG) & $\text{Max}_\sigma 1(\text{SG})]_\sigma$	Lic (SG)	HvFtHd (Rhy)	Dep IO(μ)	*SG	Max (SG)
a. ☞ (híwi)		*	*		*	
b. (íwi)	*!		*			*
c. (hí***h***wi)		**!		*	**	
UR /ya***h***mí́/						
a. (ya***h***mí́)		*!			*	
b. ☞ (yamí́)			*			*
UR /pikati/						
a. ☞ (pi***h***ká)ti				*	*	
b. (piká)ti			*!			

In the analysis of the word /hiwi/ above, candidate (b) is eliminated because it deletes the word-initial /h/. Candidate (c) correctly retains this segment but also inserts a syllable-final [h] in compliance with HvFtHd(Rhy). However, since this epenthetic [h] is not followed by a voiceless consonant, the second accrued violation of Lic(SG) removes it from consideration. As a result, this grammar ensures that underlying word-initial /h/s surface intact.

For the hypothetical input /ya***h***mí́/, the completely faithful candidate (a) preserves the underlying word-internal /h/. Since [MaxOnset(SG) & $\text{Max}\sigma_1(\text{SG})]_\sigma$ is irrelevant in this case, this violation of Lic(SG) is immediately fatal. Thus it is more harmonic to violate HvFtHd(Rhy) (candidate b) by leaving the first syllable light than it is to retain an /h/ which is followed by a voiced consonant. Consequently, the correct results achieved in tableau (89) above are still maintained here as well.

Finally, in the form /pikati/ the epenthesis site is followed by a voiceless consonant, so Lic(SG) will no longer play any role in determining the outcome. In this scenario HvFtHd(Rhy) emerges as the significant constraint to ensure that [h] insertion

correctly takes place. Consequently, candidate (b) is penalized for doing nothing and hence [pi***h***káti] is the attested winner.

Let us consider next the question of why Huariapano's epenthetic mora defaults to [h]. There is a growing body of literature demonstrating that the unmarked place node for consonantal articulations is not coronal, but pharyngeal (see Parker 1994b, 1997). We can thus posit the following markedness hierarchy as the universally default ranking:

(91) *Place/Labial, *Pl/Dorsal 〉〉 *Pl/Coronal 〉〉 *Pl/Pharyngeal

Wherever this constraint subsystem is inserted within the grammar of Huariapano, it will ensure that the epenthetic consonant be specified as a pharyngeal. In order to choose between [h] and [ʔ], I assume that the constraint *CG is undominated in this language since glottal stops play no role whatsoever in its phonological inventory (cf. §2). I note that even if Huariapano did have the phoneme /ʔ/, [h] would be more natural as a default epenthetic segment in syllable-final position since it is higher in sonority that /ʔ/ and thus better complies with Clement's (1990) Sonority Dispersion Principle. A syllable-final fricative minimizes the nucleus-coda sonority slope more than a stop does and thus better fulfills the targeted desire to end the rhyme with an open vocal tract.

We must also account for why the default mora is not realized as vowel length. As I mentioned in §2, long vowels are not contrastive in Huariapano since they only surface under the pressure of prosodic word minimality. I thus posit that the constraint NoLongVowel is ranked quite highly in this language. For our purposes here it is only necessary that *V: dominate *Pl/Phar in order to produce the correct results. An alternative would be to modify the constraint HvFtHd(Rhy) so that it demands specifically a ***closed*** syllable rather than just any heavy rhyme (cf. Black 1993). Nevertheless, since long vowels do not pose much of a problem in Huariapano anyway, I will maintain the more general formulation of this constraint because it is more natural and thus has greater potential for use in other languages as well.

Another question to be answered is why do we not observe a different epenthetic segment in those cases when [h] cannot appear due to the influence of Lic(SG)? That is, in a word such as [yamʹí], for example, coda epenthesis is blocked because the onset of the second syllable is voiced. But what is to rule out a surface candidate such as *[ya***s**mʹí], which epenthesizes an [s] rather than an [h]? As a matter of fact, the analysis we have posited thus far would actually favor this candidate over the correct winner since *[ya**s**mʹí] complies with HvFtHd(Rhy) while [yamʹí] does not. The effect we need to achieve, then, is that in those cases in which [h] epenthesis is blocked by Lic(SG), we do not want any other syllable-final consonant to be inserted either. We can obtain this result by interspersing the constraints which govern coda epenthesis into the appropriate spots in the place markedness hierarchy discussed earlier in conjunction with (91):

(92) Max(Ft), [MaxOnset(SG) & Maxσ_1(SG)]$_\sigma$ 〉〉 *Pl/Lab, *Pl/Dors, Lic(SG) 〉〉 *Pl/Cor 〉〉 HvFtHd(Rhy) 〉〉 DepIO(μ), Max(SG), MaxOnset(SG), Maxσ_1(SG), *Pl/Phar, *SG

The key rankings in (92) can be summarized as follows. The top-ranked Max(Ft) constraint is used as a convenient abbreviation for the entire family of Max requirements ***except*** SG. That is, Max(Ft) is a shorthand device standing for Max(nasal), Max(continuant), Max(labial), etc., but specifically excluding Max(SG). This general faithfulness constraint group thus prevents the deletion of all underlying consonants except /h/. Max(Ft) dominates the place markedness hierarchy, which in turn outranks HvFtHd(Rhy)—the force which provokes coda epenthesis. However, a crucial refinement is that the markedness constraint applying specifically to [h] (*Pl/Phar) is separated from the rest of the place markedness scale and ranked below HvFtHd(Rhy). Since the general Max(Ft) constraints are top-ranked, they ensure that the place markedness hierarchy will be relevant only for ***epenthetic*** segments. As a result, given the fact that only *Pl/Phar is ranked below HvFtHd(Rhy), the net outcome is that if you need to epenthesize something, insert an [h] (when possible); otherwise, do not insert anything. These interactions are exemplified in the following tableau, in which violations of the place markedness constraints are computed ***only*** for epenthetic segments:

(93)

UR /yamí/	Max (Ft)	*Pl/ Lab	*Pl/ Dors	Lic (SG)	*Pl/ Cor	HvFtHd (Rhy)	Dep IO(μ)	*Pl/ Phar
a. ☞ (yamí)						*		
b. (ya***h***mí)				*!			*	*
c. (ya***s***mí)					*!		*	
UR /pikati/								
a. (pi***w***ka)ti			*!				*	
b. (pi***s***ka)ti					*!		*	
c. ☞ (pi***h***ka)ti							*	*
d. (pika)ti						*!		

Tableau (93) above shows that when the epenthesis site is followed by a voiced consonant (/yamí/), the best strategy is to do nothing. Inserting an [h] violates Lic(SG), as we have already seen. Furthermore, inserting an [s] (or any other non-pharyngeal consonant) incurs a violation of one of the place markedness constraints which outrank HvFtHd(Rhy). In the form /pikati/, on the other hand, the spot where coda epenthesis is called for is followed by a voiceless consonant, so Lic(SG) is no longer relevant. Consequently, failing to insert a coda (candidate d) is fatal since a

more harmonic outcome is available: insert an [h], which only violates lower-ranked DepIO(μ) and *Pl/Phar (candidate c). This establishes the ranking HvFtHd(Rhy) ⟩⟩ *Pl/Phar. Finally, the fact that candidates (a) and (b) are not possible outputs for this underlying representation confirms the need for the subhierarchy favoring [h]: *Pl/Lab, *Pl/Dors, *Pl/Cor ⟩⟩ *Pl/Phar.

As I mentioned in §4.1, vowel-nasal coalescence can feed the process of coda epenthesis. However, I am not aware of any forms which exhibit an alternation between syllable-final [n] and [h]. Nevertheless, for the sake of illustration I will provide one sample tableau in order to show that the analysis posited thus far can straightforwardly handle cases such as [nį̈***h***kǐ] from example (69):

(94)

UR /nï$_1$n$_2$kǐ/	HvFtHd (Rhy)	Ident (Nas)	Nas Coda	Dep IO(μ)	Max IO	*SG	Uniform
a. (nï$_1$n$_2$kǐ)			*!				
b. (nį̈$_{1,2}$kǐ)	*!						*
c. ☞ (nį̈$_{1,2}$***h***kǐ)				*		*	*
d. (nï$_1$***h***kǐ)				*	*!	*	
e. (nï$_1$***h***$_2$kǐ)		*!				*	

In tableau (94) it is necessary to rank NasCoda above DepIO(μ) and *SG, as a comparison between candidates (a) and (c) shows. Thus it is better to insert a new syllable coda than it is to retain the final nasal in that position. We already know that HvFtHd(Rhy) is top-ranked (in this mini hierarchy), so candidate (b) fails by virtue of its initial light syllable. Candidate (d) fatally violates MaxIO since the nasal indicated by *2* in the input has no correspondent in the output. In candidate (e) the underlying /n/ has been transformed into an [h]. Ranking Ident(Nas) over DepIO(μ) and *SG eliminates this candidate. Thus [nį̈***h***kǐ] correctly emerges as the representation of choice.

We are now ready to confront the third and final question which I raised at the beginning of this section (73): why is coda epenthesis blocked in word-initial syllables which bear primary stress? The analysis which I have posited up to this point does not yet account for this detail. As I will show, an attempt to explain this fact by invoking positional faithfulness comes close to solving this problem, but it ultimately fails to contend successfully with the Richness of the Base principle. I will therefore argue that we should adopt instead a similar line of analysis which involves the related concept of positional markedness. As we will see, these two approaches basically offer the same explanation for why [h] insertion is prohibited in this environment and they employ the same methodology for dealing with it. However, they diverge in their ability to cope with problematic underlying forms. Consequently, I will pursue the analysis using positional faithfulness up to the point that it breaks down in order to illustrate its application and show why positional markedness offers a way out of the dilemma.

Beckman (1998) has demonstrated that certain phonological constituents are psychologically and functionally prominent and thus exhibit privileged behavior which their non-prominent counterparts are not allowed to imitate. Two of these specialized environments are root-initial syllables and stressed syllables (especially those which bear primary stress). One of the asymmetries which Beckman notes is that such syllables often fail to undergo regular phonological processes which otherwise generally apply in the languages in question. In the case of Huariapano, the specific instantiation of this tendency is that coda epenthesis is blocked in syllables which simultaneously overlap for two prominent domains: main stress and root-initial position. This phenomenon may have a psycholinguistic explanation: initial syllables and stressed syllables are the ones which are most critical for lexical access and processing. Therefore, in the mapping between underlying and surface forms, a change in either of these two domains makes the recognition task of the hearer more difficult (Hall 1988, 1992; Hawkins and Cutler 1988). We can thus posit two positional faithfulness constraints which militate against segmental insertion in root-initial syllables as well as in syllables which bear primary stress:[23]

(95) Dep(μ)-σ_1
Every mora in the word/root-initial syllable in the Output candidate must have a correspondent in the Input.

(96) Dep(μ)-σ́
Every mora in the main stressed syllable in the Output candidate must have a correspondent in the Input.

Neither of these filters in isolation is sufficient to block coda epenthesis, so they both need to be dominated by HvFtHd(Rhy):

(97)

UR /βonošikain/	HvFtHd(Rhy)	Dep(μ)-σ_1	Dep(μ)-σ́
a. ☞ (βòno)(ṣí***h***kąỹ)			*
b. (βòno)(ṣíkąỹ)	*!		
UR /witaṣ/			
a. ☞ (wi***h***táṣ)		*	
b. (witáṣ)	*!		

However, by relying once more on local conjunction, we can allow the combined effect of violating both of these constraints at the same time to outrank HvFtHd(Rhy) and thus impede the insertion of syllable-final [h] in words such as [ṣ́íkï] (from (58) above):

[23]Alderete (1995) proposes a very similar family of Head-Dep constraints.

(98)

/UR/ /ʂïkï/	[Dep(μ)-σ_1 & Dep(μ)-ǵ]$_\sigma$	HvFtHd(Rhy)
a. (ʂíhkï)	*!	
b. ☞ (ʂíkï)		*

The result is that coda epenthesis ***can*** apply in a root-initial syllable, provided that it does not coincide with primary stress. And a final [h] may also be inserted in the main-stressed syllable, provided that it is not word-initial at the same time. However, when these two conditions are both simultaneously present, and only then, the pressure to not obscure Input-Output identity is pushed beyond its threshold limit in Huariapano and thus coda epenthesis is blocked. We have therefore motivated the following subhierarchy:

(99) [Dep(μ)-σ_1 & Dep(μ)-ǵ]$_\sigma$ 〉〉 HvFtHd(Rhy) 〉〉 Dep(μ)-σ_1, Dep(μ)-ǵ

Up to this point the strategy of positional faithfulness leads to a very elegant analysis which adequately explains the empirical facts. However, suppose that Gen now supplies us with a hypothetical input form which contains a syllable-final /h/ in exactly the prohibited position: /ta***h***ta/. As the following tableau demonstrates, our current grammar cannot force this underlying /h/ to delete and it thus outputs a surface representation which Huariapano does not actually permit:

(100)

UR /ta***h***ta/	[Dep(μ)-σ_1 & Dep(μ)-ǵ]$_\sigma$	HvFtHd(Rhy)	Dep(μ)-σ_1	Dep(μ)-ǵ
a. ☹ (tá***h***ta)				
b. (táta)		*!		

As tableau (100) shows, the DepIO family of constraints is impotent to affect a syllable-final /h/ which pre-exists in hypothetical input forms of this type. Consequently, the candidate which this grammar incorrectly outputs (a) must preserve this coda in obedience to HvFtHd(Rhy). Furthermore, we cannot appeal to the general *SG prohibition against surface [h]s since, as we have seen in (81ff.), we need HvFtHd(Rhy) to outrank *SG in order to produce any laryngeal codas at all. I therefore conclude that, in spite of its inherent benefits, positional faithfulness cannot contend with all of the relevant facts since it makes an incorrect prediction in the case of hypothetical underlying representations such as /ta***h***ta/. We are thus obliged to abandon this approach and look for some other solution to this problem.

I propose that instead of positional faithfulness we rely on a very similar strategy, positional markedness. Rather than focusing exclusively on the Input-Output relationship with Dep constraints, we can introduce positional filters of the general *SG type. These new constraints will then rule out all [h]s in the relevant environments, regardless of their origin (underlying or epenthetic). We thus completely eliminate the faithfulness constraints posited above in (95), (96), and (99) and replace them with the following markedness devices:

(101) *SG-σ_1
*SG-ǵ
[*SG-σ_1 & *SG-ǵ]$_\sigma$

Now by ranking this series of constraints in the familiar way we generate the correct output forms in all cases:

(102)

UR /witaš/	[*SG-σ_1 & *SG-ǵ]$_\sigma$	HvFtHd(Rhy)	*SG-σ_1	*SG-ǵ	*SG
a. (witáš)		*!			
b. ☞ (wi***h***táš)			*		*
UR /šïkï/					
a. ☞ (šík̈ï)		*			
b. (šï***h***kï)	*!		*	*	*
UR /ta***h***ta/					
a. (tá***h***ta)	*!		*	*	*
b. ☞ (táta)		*			

As we see in tableau (102), the concept of positional markedness in tandem with local conjunction allows us to both permit and prevent coda epenthesis in all of the right situations. In /witaš/, for example, an [h] can appear in the initial syllable since it does not coincide with primary stress. In the form /šïkï/, on the other hand, the introduction of an epenthetic [h] is blocked because the conjunction of the two positional filters outranks HvFtHd(Rhy). And crucially in the case of the hypothetical input /ta***h***ta/ (with an underlying /h/), the markedness constraints succeed in repairing this anomaly where faithfulness could not. I thus conclude that the strategy of positional markedness provides us with adequate machinery to capture all the relevant facts of coda epenthesis in Huariapano.

One last remaining detail needs to be clarified in order to complete the treatment of this phenomenon: in light of the high-ranked markedness conjunction, how do we leave word-initial phonemic /h/s intact? In order to prevent these contrastive segments from being deleted, we must add one final ranking stipulation:

(103)

UR /hiwi/	[MaxOnset(SG) & Maxσ_1(SG)]$_\sigma$	[*SG-σ_1 & *SG-ǵ]$_\sigma$	HvFtHd(Rhy)
a. (hí***h***wi)		**!	
b. ☞ (híwi)		*	*
c. (íwi)	*!		*
d. (í***h***wi)	*!	*	

In tableau (103) a comparison of candidates (b) and (c) shows that the combination of positional faithfulness constraints motivated to preserve word-initial /h/s must dominate the conjunction of positional markedness filters that targets certain [h]s in surface forms.

To conclude this section I wish to add a few general comments about the phenomenon of positional markedness. As we have seen, this concept allowed us to explain an asymmetry in the inventory of metrical foot types cross-linguistically: quantity-sensitivity can be restricted specifically to primary stress, but not to secondary stress feet alone. At the same time, positional markedness has enabled us to successfully deal with the one systematic gap in Huariapano's coda epenthesis patterns. Nevertheless, markedness constraints such as *SG-σ_1 and *SG-σ́ are not frequently attested in the languages of the world, so Beckman (1998) is logically justified in eschewing them. Positional markedness constraints are themselves quite marked, and yet in some cases they appear to be unavoidable. This is the tension which presently confronts phonological theory. Consequently, in the next section I will briefly mention some alternative analyses and discuss why they do not work in Huariapano. But first I would like to note one beautiful case of positional markedness which any approach to Optimality Theory must find a way to deal with. Chamicuro, an Arawakan language of Peru, exhibits the unusual condition that the two glottal phonemes /ʔ/ and /h/ are restricted to syllable-final position (Parker 1994b). In this language the two laryngeal consonants (and no others) are systematically prohibited from occurring in syllable onsets. Some phonologists have actually denied that this type of situation can exist (e.g., Goldsmith 1990). To account for the distribution of /ʔ/ and /h/ in Chamicuro, we have two options, neither of which has precedents in the literature, as far as I am aware. First, we can establish a reverse positional faithfulness hierarchy: MaxCoda(Laryngeal) ⟩⟩ *Laryngeal ⟩⟩ Max(Laryngeal). A second approach is to invoke a positional markedness constraint which targets syllable-initial segments only: *Onset(Laryngeal). Either way, the outcome is a sort of anti positional faithfulness which further weakens the universality of Beckman's (1998) claims. I thus conclude that positional faithfulness is a strong tendency, but not an absolute, inviolable generalization.

4.3 Alternatives considered

Since positional markedness may be seen as a controversial solution, in this section I will discuss a few alternative methods which have been considered for dealing with the Huariapano facts. In particular, we are looking for some other approach to explain why coda epenthesis is blocked in word-initial syllables that bear primary stress. Since the motivation for [h] insertion in this paper has been couched in terms of metrical structure, a prosodic account of this detail would be very appealing. In other words, if we can find some way to prevent forms such as [ʂ́íkï] from being rhythmically parsed, then we can claim that no metrical foot is present on the rhythmic tier and thus the HvFtHd(Rhy) constraint has no power to require a second mora. One way in which this might be accomplished is by positing a slightly abstract constraint

which requires the leftmost rhythmic foot in each word to be the head of that metrical tier. That is, just as the stress tier has a main foot, so it is natural to hypothesize that the rhythmic tier has a most prominent foot as well. Furthermore, since the rhythmic tier in Huariapano is parsed from left to right, it is logical to assume that the primary rhythmic foot is aligned with the beginning of the prosodic word. Now if we go one step farther and posit a nonfinality requirement on this main rhythmic foot, we have achieved our objective. That is, if we assume that degenerate (monosyllabic) feet are prohibited on the rhythmic tier, then we can combine this fact with a constraint that compels the main rhythmic foot not to fall on the final syllable. This effectively blocks all two-syllable words from being footed on the rhythmic tier. Consequently, inserting a syllable-final [h] in a form such as [ʂ́íkï] would needlessly violate DepIO(μ) and *SG without any compensating advantage. However, there is one fatal problem with this account: coda epenthesis is also systematically unattested in three-syllable words which bear irregular initial stress (cf. [tí́piti] from (59)). In forms of this type the binary rhythmic foot naturally falls on the first two syllables of the word, so Nonfinality(Rhy) would automatically be fulfilled by the unparsed third syllable. Therefore, since there is no motivation for leaving this word rhythmically unfooted, our explanation for why [h] insertion fails no longer has any merit. I thus conclude that this approach must be rejected.

A second alternative was suggested to me by Alan Prince (p.c.). He proposes that we see syllable-final [h] not as a strengthening of head rhythmic syllables, but rather as a partial devoicing of the vowel in metrically ***weak*** position. In this approach we posit iambic feet on the rhythmic tier in Huariapano and allow vowels to trail off (devoice) everywhere except in the head syllables of these right-headed feet. This analysis is diametrically opposed to my account in §4.2 since it crucially requires syllable-final [h]s ***not*** to count as moraic. This predicts that rhymes consisting of a vowel plus [h] should not be significantly longer in duration than light, monomoraic rhymes in which coda epenthesis has not applied. The phonetic study which I mentioned in §3.1 will hopefully provide confirmatory evidence indicating which of these two points of view is correct. Nevertheless, in anticipation of the results I foresee one major problem with Prince's suggestion: his explanation of why this phenomenon is blocked in word-initial syllables bearing main stress requires the same Nonfinality(Rhy) constraint we have just rejected. That is, in this approach we need the rhythmic foot head in words like [ʂ́íkï] to fall on the initial syllable so that it is not metrically weak. Then the tonic vowel is rhythmically prominent and hence cannot devoice. This can be accomplished by invoking the Nonfinality requirement discussed above. However, this case of "iambic reversal" also collapses when confronted with words such as [tí́piti]. In forms of this type the right-headed binary foot on the rhythmic tier can quite comfortably encompass the first two syllables and still satisfy final misalignment. Consequently, the initial vowel is metrically weak and should be able to devoice. The fact that it does not causes this explanation to collapse for the same reason that we dismissed the first alternative above as well.

A third and final alternative which I consider is that coda epenthesis fails to apply in words like [ʂ́íkï] due to a metrical clash between the two tiers. That is, recall that we have motivated a left-aligned main foot on the rhythmic tier. The head of this

trochaic foot falls on the initial syllable of all words. Now in a bimoraic form with two light syllables the main stress foot also targets this same initial syllable. Consequently, words such as [ʂ́íkï] have the unique distinction that the head of their primary stress foot and the head of their main rhythmic foot coincide on exactly the same mora. Therefore, if we consider this to be a type of intolerable metrical clash, we can posit that both syllables of the word remain unparsed on the rhythmic tier. Hence, if there is no rhythmic foot present then there is no motivation for coda epenthesis. A nice advantage of this approach is that it simultaneously explains forms such as [tĩ́piti] as well. In words of this type the lone stress foot and the lone rhythmic foot would still coincide in falling on the first two syllables due to the extrametricality of the final mora on the stress tier. Hence this analysis accounts for all the relevant data quite nicely. Its shortcoming, on the other hand, is that it is not clear and obvious why this type of "clash" would produce the antagonistic effect that it does. That is, if the head foot of both metrical tiers falls on the same syllable, this should actually serve to enhance the expected prominences, making coda epenthesis all the more likely. Thus we are forced to conclude that this explanation is counterintuitive and must also be rejected. In summary, all of the most feasible alternatives to positional markedness have inherent problems which remove them from more serious consideration.

5 Conclusion

From the perspective of cross-linguistic typology, the metrical system of Huariapano is unusual in several respects. I base this claim on the fact that the constraint rankings for stress in this language contradict a number of universal tendencies noted by Hayes (1995). In the first place, closed syllables count as heavy for computing primary stress even though long vowels are not contrastive, a pattern noted in Hixkaryana as well. Hayes comments, "This is unusual, in that the great majority of languages with a weight distinction also have phonemic vowel length" (p. 205). In OT terms this means that both Weight by Position and *V: are very highly ranked in the hierarchy. Secondly, Huariapano has phonemic secondary stress in the sense that its direction of parsing is unpredictable. As we saw in §3.2, this can be accounted for by lexically marking certain roots with a co-grammar in which AllFeetRight dominates AllFeetLeft. Third, primary stress and secondary stress are assigned by different kinds of feet, contrasting for quantity-sensitivity. This is marked since Hayes asserts that "when more than one rule creates feet, the feet created should be the same" (p. 55). In our approach we captured this dichotomy with the positional markedness constraint PeakPromMain. Finally, we have seen evidence suggesting that extrametricality needs to be stipulated for the last mora of certain verbal suffixes and noun roots, a possibility which Hayes would like to rule out for lack of compelling evidence (p. 58). In OT the effect of extrametricality is achieved by ranking Nonfinality above MainRight.

And then of course there is the process of coda epenthesis which occurs only in odd-numbered syllables of the word. What is perhaps most striking about this phenomenon is the fact that it cannot be derived in any way from the algorithm which assigns stress. This too is noteworthy (Hayes 1995:25). What is more, the process of

head syllable augmentation which HvFtHd(Rhy) induces is much more typical of iambic systems than trochaic ones. In addition, the rhythmic foot type that I have posited for Huariapano (the syllabic trochee) is not otherwise known to display quantity-sensitive behavior of this sort.

One might naturally wonder whether this alternate syllable pattern in Huariapano is an isolated curiosity, or whether similar effects can be found in other languages as well? As it turns out, we do not have far to look. According to Eugene Loos (p.c.), odd vs. even syllable-based phonological alternations are rather common in the Panoan language family overall. For example, in Shipibo (an extant language which was mutually intelligible with Huariapano), Lauriault (1948) discovered a semantically-empty "timing morpheme" which is realized as /a/ in odd syllables (counting from the beginning of the word) and as /i/ in even-numbered syllables. Furthermore, this variation is also oblivious to stress placement. And in Capanahua (Loos 1969) a syllable-final /ʔ/ is deleted when it occurs in an even-numbered syllable counting either from a previous closed syllable or from the beginning of the word. These languages thus appear to be additional candidates for analyses involving disjoint metrical tiers. My hope is that the Huariapano facts examined here might prove to be a fruitful impetus for future research.

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