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On the phonetic duration of Huariapano rhymes

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On the Phonetic Duration of Huariapano Rhymes[1]

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Huariapano, an extinct language of Peru, exhibits an unusual process of coda epenthesis by which the segment [h] is inserted in odd-numbered syllables of the prosodic word. Crucial to an understanding of this phenomenon is the correct interpretation of its metrical function: do these [h]'s represent an augmentation of the strong syllables of trochaic feet, or a partial devoicing of the nuclear vowel in the weak syllables of iambic feet? This article presents the results of an instrumental study which indicates that insofar as their relative duration is concerned, syllable-final [h]'s in Huariapano pattern as fully moraic coda consonants in keeping with the trochaic constraint HEAVYFOOTHEAD.

1. Statement of the problem

Huariapano, an extinct Panoan language of Peru, exhibits a unique and interesting process of coda epenthesis by which the voiceless glottal fricative [h] is predictably inserted to close off the nuclear vowel in odd-numbered syllables of the phonological word. The basic facts and details of this phenomenon were originally presented in Parker 1994. In a more recent work (Parker 1998), I argue that the prosodic motivation behind the rhythmic nature of alternations involving syllable-final [h] should be captured by positing a constraint which requires the head syllable of trochaic feet to be heavy (bimoraic). This analysis assumes and predicts that epenthetic [h]'s add a significant durational increase to the rhymes of which they form the second element, roughly equivalent to that of canonical coda consonants. On the other hand, an alternative explanation for the odd syllable pattern which governs phonetic [h]'s in Huariapano was suggested to me by Alan Prince (p.c.). He proposed instead that these segments might represent a partial devoicing of the nucleus in the *weak* syllable of iambic feet. A significantly different claim implicit in Prince's suggestion is that syllable-final [h]'s are not moraic and therefore the combined duration of the voiced plus voiceless portions of these "weakened" rhymes should be roughly equivalent to that of fully-voiced nuclei in normal, open syllables. Fortunately, the inherent assumptions and predictions of these two competing hypotheses can be tested empirically. The purpose of this paper is to present the results of an instrumental study in which I measured the phonetic duration of various sequences of Huariapano segments in order to determine the relative contribution of syllable-final [h]'s. Although these laryngeal fricatives are somewhat shorter than underlying coda consonants, they do in fact significantly lengthen the rhymes in which they occur. I conclude that these findings support my analysis of phonetic [h]'s as epenthetic moras which effectively double syllable weight in response to the constraint HEAVYFOOTHEAD (Parker 1998).

2. Background

The phonemic inventory of Huariapano consonants consists of fifteen segments:

[1] Thanks to John Kingston for helpful suggestions as I was analyzing the results of this study. I am also indebted to Mark Karan for reviewing an earlier draft of this paper.

(1)

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

/ş/ is a voiceless retroflexed alveopalatal fricative. /β/ is a voiced bilabial obstruent which fluctuates phonetically among a stop and a fricative articulation. 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*
[hawį̈́] *his*; *hers*
[awį́] *woman*; *wife*

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]. Canonical (underlying) coda consonants consist of one of the three sibilants /s š ş/. Nasal consonants also occur syllable-finally, but in this position they often coalesce with the preceding vowel. Consequently, in this study I will not take into account the duration of syllable-final nasals.

The fact that underlying coda consonants contribute a second mora to syllabic weight in Huariapano is easy to demonstrate. The assignment of primary stress is quantity-sensitive. In words which end with a light (open) syllable, stress defaults to the penultimate vowel in most cases. However, forms which end with a canonical coda consonant are regularly stressed on the ultima:

(4) [kanóti] *bow (weapon)*
[átsa] *manioc*
[ràmboşóβo] *knees*
[yawíš] *opossum*
[şaβín] *bee*

In Huariapano the segment [h] is predictably inserted as the coda of odd-numbered syllables of the prosodic word, provided that the following consonant (the onset of the next syllable) is voiceless:

(5) [nohpóş] *snail*
[yòmïràhkatíhką̃ỹ] *they hunted*
[kïβǫ́ŋ] *[kïhβǫ́ŋ] *species of turkey (Penelope)*

In general this process is totally oblivious to the presence, absence, or degree of stress in those syllables which receive a final [h]. In rapid, unguarded speech this epenthetic coda often surfaces as the voiceless counterpart of the preceding vowel: [2]

[2] Following the vowel /a/ the only phonetic form which the epenthetic coda exhibits is [h]. This is also the basic or default quality with which it surfaces in more careful speech following all of the other vowels as well. Consequently, in all other discussions throughout this article I exclusively refer to this segment as [h], for the sake of simplicity.

(6) [içtúri] *hen*
[pïxtá] *wide*
[kuWšúška] *fresh-water dolphin*

At first glance this fact might appear to support Prince's hypothesis that syllable-final [h]'s represent a weakening or partial devoicing of metrically nonprominent rhymes. However, since glottal consonants inherently lack supra-laryngeal place features, the "allophonic" pattern illustrated in (6) is precisely what we would naturally expect anyway as an implementational effect of phonetic coarticulation or gestural overlap. In other words, this is not a true case of phonological spreading in the classical autosegmental sense.

Although the last known fluent speaker of Huariapano died in 1991, in the course of my fieldwork earlier that year I providentially recorded two spontaneous oral texts. In order to use these corpora as the raw data for this present study, I digitized the two stories using a Nakamichi MR-2 cassette deck and the XWAVES+ software package (version 5.1.1) running on a SunOS operating system, via an Ariel Proport 656 analog to digital converter. By means of visual and auditory examination of waveforms in combination with wide-band spectrographic displays, I bracketed the relevant stretches of speech and read off the automated duration intervals provided by XWAVES+, accurate up to a hundredth of a millisecond. A list of the individual words and segments which were measured in this way is provided in the Appendix. These data serve as the basis for all of the statistical calculations which I will now discuss.

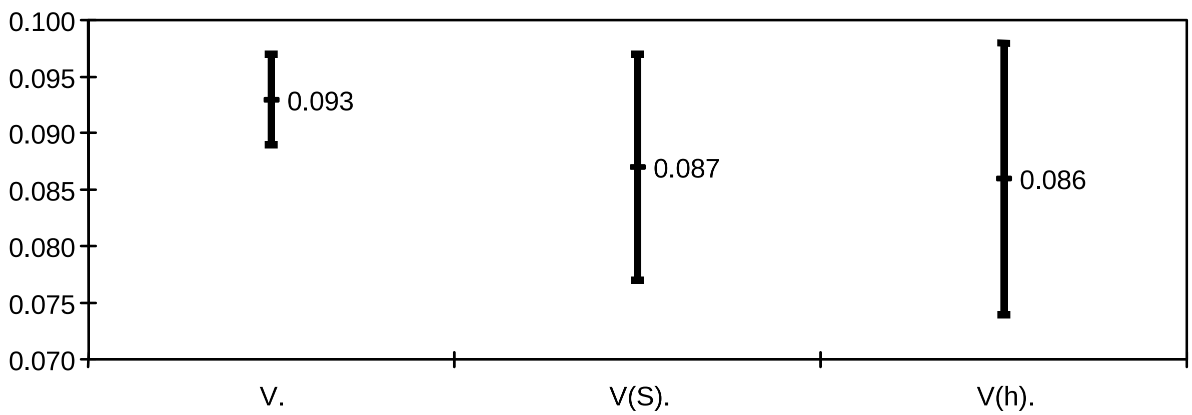
3. Presentation of results

Due to the nature of the physiological and acoustic transitions between a syllable-final [h] and the following onset consonant (which in the two recorded texts is always a stop), it was unfortunately not possible to measure the intrinsic duration of these [h]'s individually. That is, although the exact point at which [h] begins is fairly obvious in most cases (it corresponds with the termination of periodic vibration in the preceding vowel), it is virtually impossible to discern with a consistent degree of accuracy where [h] ends and the subsequent oral occlusion commences. Consequently, it was necessary to group syllable-final [h]'s together with the onsets which follow them and record only the combined durations of both segments together. These measurements can then be compared with the durations of relevant control sequences in order to calculate an approximate absolute duration of [h] indirectly.

A second difficulty for this study is the limited amount of data on which it is based. Since my corpus of recorded texts is small, some of the combinations of phonotactic patterns which we need to examine amount to fewer than ten tokens. Consequently, the conclusions which we will eventually posit must be regarded with some caution. Nevertheless, since there is no hope of ever obtaining more Huariapano data, it is better to draw the tentative conclusions which we can rather than to refrain from making any at all. As we will see, the results I have obtained do exhibit a general consistency in terms of supporting the predictions of my hypothesis.

Having noted these two caveats, we can now proceed with a statistical analysis of the data. In the first place, the mean durations of vowels in stressed and unstressed syllables were calculated in order to control for this prosodic variable. As the chart (7) indicates, the presence, absence, and/or degree of stress has no reliable effect on vowel duration:

Figure 1



(7)

	V́	V̀	V̌
number of tokens	89	30	105
mean duration	.092	.093	.090
standard deviation	.025	.026	.028

Since the three mean durations recorded in (7) are so extremely similar, there is no point in submitting these values to further statistical analysis. In the remaining calculations, the variable of stress can now be ignored since it plays no significant role in influencing vowel length.

Secondly, vowel duration was also compared in open vs. closed syllables. As (8) indicates, there is a tendency for vowels in closed syllables to be slightly shorter (by about 7%) than open vowels. Nevertheless, given the relatively low number of tokens of vowels closed by a canonical sibilant coda (22), this slight drop in length is not statistically significant.

(8)

	vowel in open syllable	vowel closed by a canonical coda	vowel closed by [h]
number of tokens	177	22	24
mean duration	.093	.087	.086
standard deviation	.027	.023	.031

Figure 1 displays the 95% confidence intervals for the three categories, indicating that the differences in the means may be due to sampling coincidence .

Nevertheless, insofar as the data may be accurate, we can note that [h] has the same effect on vowel duration as syllable-final sibilants do, tending to shorten the nucleus only slightly. If the total combined duration of rhymes closed by [h] were comparable to regular “non-weakened” nuclei, we would expect the duration of the fully-voiced portion of the vowel to be much shorter than normal. This is not what we find.

A comparison was also made between plain monomoraic rhymes in open syllables vs. the combined duration of a vowel plus a tautosyllabic sibilant coda. As chart (9) indicates, canonical codas establish a controlled increase in rhymal duration of 94% over lone vowels. This is clearly consistent with the analysis of such syllables as bimoraic, and can serve as one of the standards of comparison for syllables closed by [h].

(9)

	vowel in open syllable	vowel plus a canonical coda
number of tokens	177	16
mean duration	.093	.180
standard deviation	.027	.031

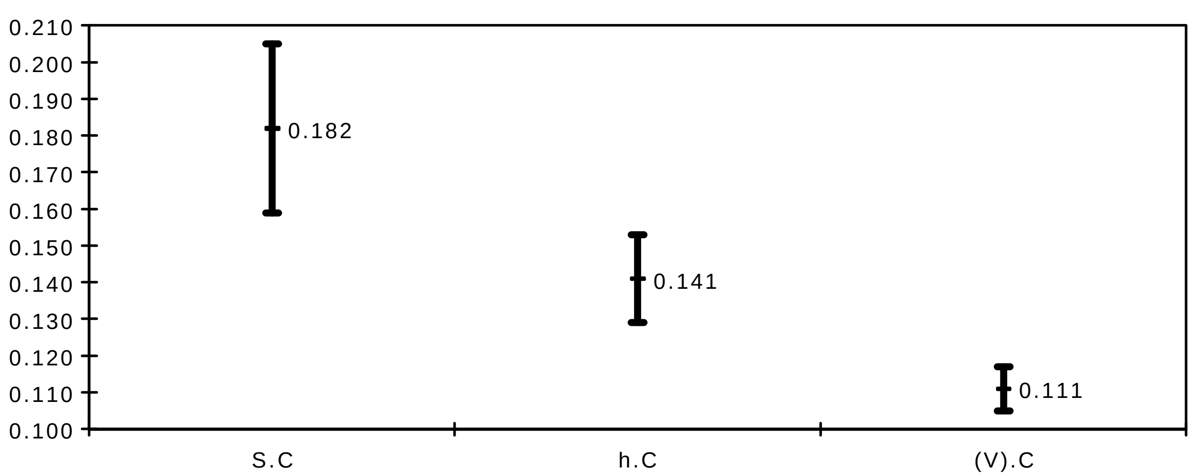
We now proceed to measurements which directly involve syllable-final [h]. In the first place, I compared the combined duration of sibilant coda plus onset versus [h] plus onset, as well as lone onsets immediately preceded by a vowel (all such tokens included here were limited to cases in which the onsets were voiceless). Chart (10) is supplemented by Figure 2, where we observe the 95% confidence intervals for the three categories.

(10)

	canonical coda plus onset	[h] plus onset	onset preceded by vowel
number of tokens	13	29	77
mean duration	.182	.141	.111
standard deviation	.042	.032	.027

These differences are clearly significant since there is no visual overlap between the three ranges. This result demonstrates that the presence of a syllable-final [h] has a statistically observable impact on the additional length of an onset consonant (by 27%). However, a preceding sibilant adds 64% to the duration of a lone onset, implying that the stretch of time occupied by [h] amounts to 42% of the length of a canonical coda consonant. Of course, this conclusion rests on the assumption that the duration of an onset consonant is identical following a sibilant, following an [h], and following a vowel, a hypothesis which is not necessarily true. In order to control for this factor, onset duration was also measured in isolation (without the preceding coda). As chart (11) shows, onsets following a canonical coda are 14% shorter than onsets in an intervocalic position. However, Figure 3 shows that this difference is not statistically significant since there is a complete overlap between the two confidence intervals. Nevertheless, it is reasonable to conjecture that voiceless stops following an [h] are also somewhat shorter than lone onsets, even though we cannot measure this directly. I will discuss this issue in more detail in the next section.

Figure 2



(11)

	onset preceded by vowel	onset preceded by canonical coda
number of tokens	77	13
mean duration	.111	.096
standard deviation	.027	.035

The other measurement which includes syllable-final [h] involves the total duration of an entire rhyme plus the following onset. Comparing chart (12) with Figure 4, we observe a complete independence between the 95% probability spreads of open vowel plus onset versus vowel plus [h] plus onset. The latter value is greater than the former by an average of 18%. An inspection of the combined totals involving sibilants and [h] in (12) reveals that syllable-final [h] adds 43% of the duration that a canonical coda does. This is very consistent with the percentage arrived at in conjunction with chart (10) earlier.

(12)

	vowel plus onset	vowel plus canonical coda plus onset	vowel plus [h] plus onset
number of tokens	56	9	23
mean duration	.193	.275	.228
standard deviation	.039	.051	.050

Figure 3

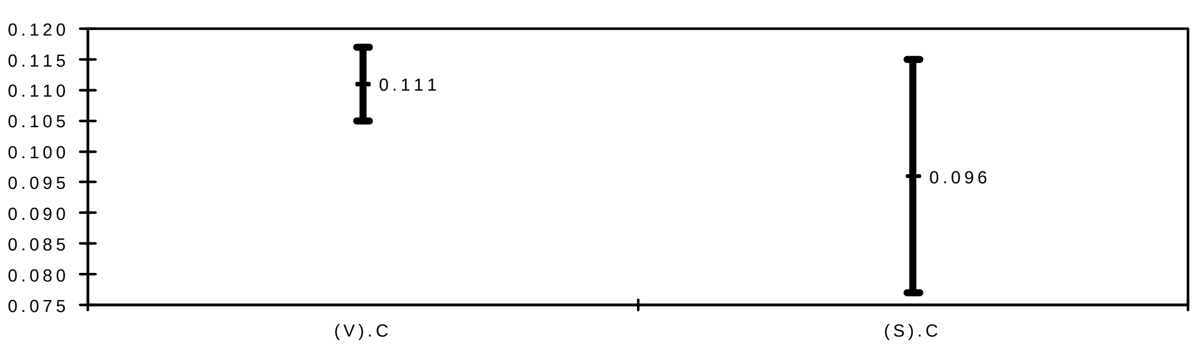
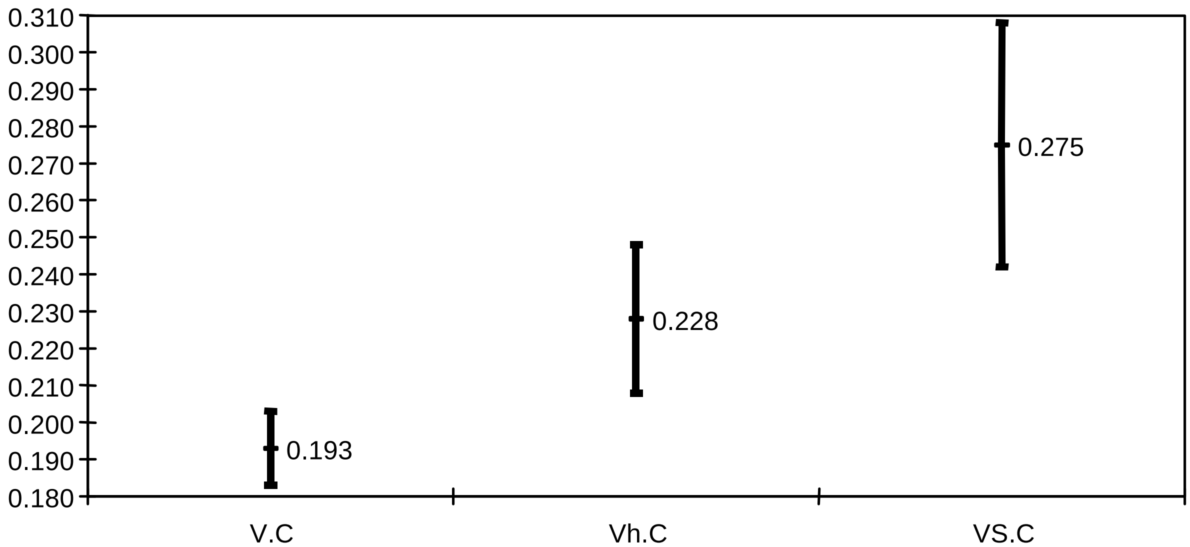


Figure 4



These calculations allow us to estimate the mean duration of syllable-final [h] by subtracting its contribution to combined length from that of surrounding segments. There is another way to extrapolate the predicted length of [h] which involves comparing it directly with the observed duration of sibilants in analogous positions. These measurements are indicated in chart (13).

(13)

	word-initial (canonical) /h/	word-initial S	syllable-final S
number of tokens	34	13	15
mean duration	.079	.133	.093
standard deviation	.031	.027	.020

As we observe in (13) and the corresponding Figure 5, sibilants in coda position are 30% shorter than when they are word-initial. [3] Furthermore, word-initial (phonemic) /h/'s are 41% shorter than their sibilant counterparts. Both of these gaps are statistically significant.

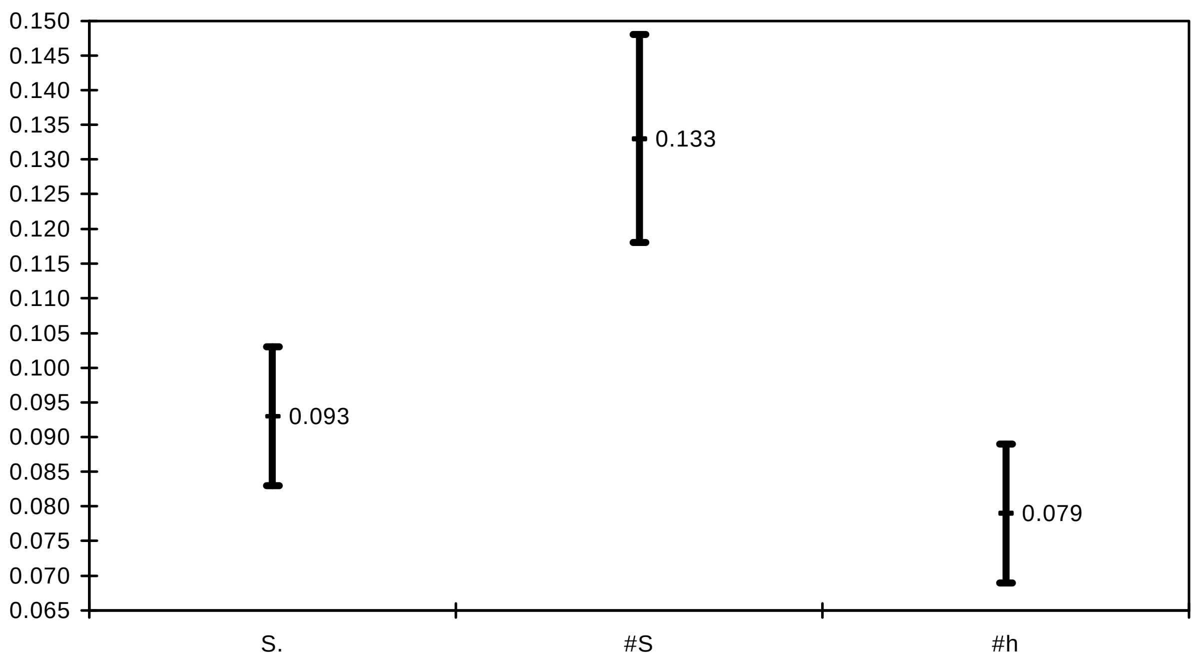
If we make the reasonable assumption that the duration of syllable-final [h] tends to abide by these same proportions, we can estimate its length very easily. Sibilants shorten by 30% when comparing word-initial with syllable-final position; if syllable-final [h] is also shorter than word-initial /h/ by 30%, its value can be posited as .055 seconds. Similarly, word-initial /h/'s are 41% shorter than word-initial sibilants, and subtracting 41% from the duration of syllable-final sibilants (.093) again gives us an estimated duration of .055 for syllable-final [h], confirming the result.

[3]For the sake of cross-linguistic comparison, I will cite analogous measurements of fully moraic coda consonants provided by Broselow, Chen, and Huffman 1997. The mean durations of the segments [p, t, s, l] in syllable-final position as pronounced by two native speakers of Hindi were .1156 and .0988. Similarly, a syllable-final [b] in three different dialects of Levantive Arabic had an average length of .0884, .1144, and .0812 seconds.

As a final exercise I performed a linear regression analysis on the relationship between vowels and the [h] plus onset sequences which follow them. All other things being equal, if syllable-final [h] is an inherent part of the nucleus which precedes it, the duration of [h] should be inversely proportional to the duration of the voiced portion of the vowel. Of course this prediction should ideally be tested on the duration of [h] alone, without the following onset. Nevertheless, these values are not available to us, so for the sake of argument I will proceed with the data that we do have. Figure 6 shows the scatterplot of this intersection.

The slope of the regression line is weak but positive (.267), indicating that as vowel length increases, so does the duration of the following [h] plus stop combination. The extremely low r^2 value (.057) demonstrates that this correlation is very weak, so no conclusions of any substance can be based on these figures alone. Nevertheless, insofar as these data may be accurate, they confirm our earlier findings in that the duration of syllable-final [h] does not seem to depend on or interact with that of the preceding vowel in any consistent and significant way. For the sake of

Figure 5

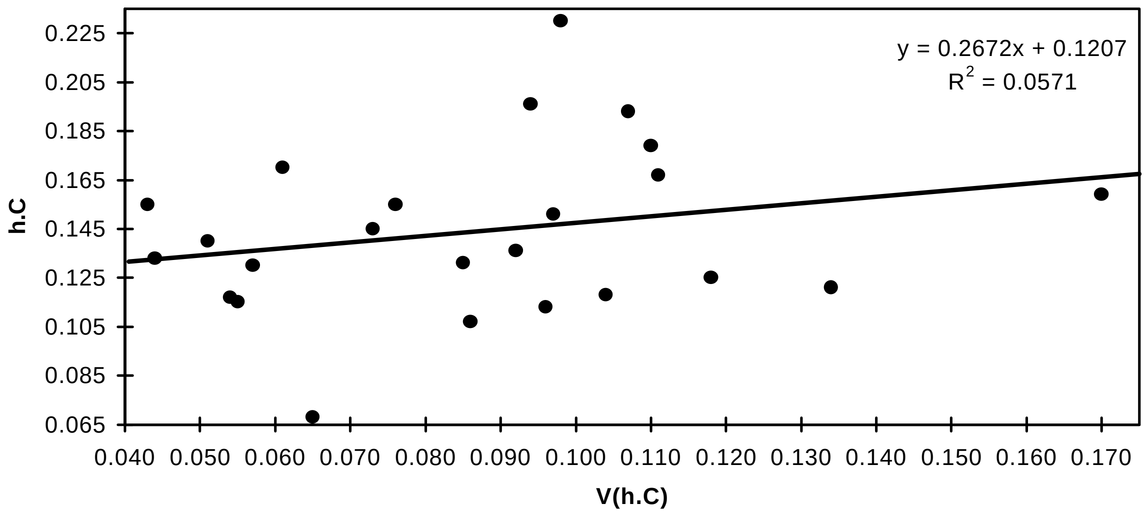


comparison I also include the correlation between vowel duration and the length of canonical coda plus onset sequences (Figure 7). The astronomically small r^2 value (.0008) indicates that no relationship exists between these two variables.

4. Discussion

In spite of the difficulty with directly calculating the absolute duration of syllable-final [h], the data considered in the preceding section do allow us to estimate its length within a range of accuracy and certainty that is moderately reliable. In the first place, subtracting the combined means of analogous sequences involving sibilants and [h] in charts (10) and (12) results in an estimated durational difference of .041 and .047, respectively. The lower of these two values, as we have seen, corresponds to a proportional length of 42% ([h] divided by /s š ʂ̌/). We can thus conclude that even under the most conservative assumptions, syllable-final [h] in Huariapano

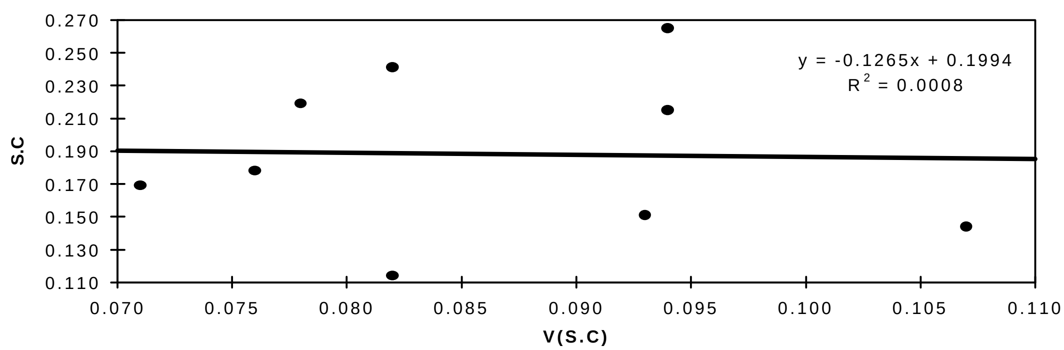
Figure 6



contributes at least 42% of the amount of relative moraic weight that sibilants do in the same position.

A second line of reasoning involves extrapolating an absolute value for [h] by holding constant the relative proportions of similar but canonical segments (sibilants in word-initial and syllable-final position, and word-initial phonemic /h/'s). Based on the means reported in diagram (13), the duration which emerges for syllable-final [h] using this method is .055. This corresponds to a proportional moraic weight of 59% (compared with that of underlying coda consonants), a more felicitious outcome. Since the minimum figure of 42% above is subject to unknown variations in the length of onset consonants following [h], we might surmise that this second calculation is more likely to produce an accurate estimation. I thus posit that syllable-final [h] in Huariapano is potentially at least 59% as long as canonical sibilant codas. This is definitely sufficient evidence to conclude that epenthetic [h] functions as a fully moraic segment, in keeping with the metrical

Figure 7



augmentation effect which my HEAVYFOOTHEAD constraint assumes.

Nevertheless, an obvious question which still remains to be answered is why do these two types of codas—underlying sibilants vs. epenthetic [h]'s —differ in absolute duration by as much as 41% or more? I suggest that three different factors may contribute to this discrepancy. First, voiceless oral fricatives such as /s/ are inherently always longer than /h/. Presumably the physiological and acoustic dynamics which result in this difference are universal in nature and can thus be confirmed by cross-linguistic examinations. While I am not aware of any references which can support this claim, it strikes me as intuitively correct. In Huariapano this tendency is borne out by the comparison of /h/ vs. sibilants in word-initial position (cf. chart 13).

Secondly, it is possible that when I instrumentally measured the combined duration of [h] plus stop sequences, I consistently underestimated the beginning point of the [h]. This would be easy to do, for example, if the transition between periodic vibration (in the preceding vowel) and glottal abduction is gradient in nature rather than abrupt (categorical).

And finally, on the other side of syllable-final [h]'s, we need to take into account the duration of the following onset consonants. Unfortunately it was not possible to measure this increment directly. Nevertheless, it would not be unreasonable to assume that perhaps voiceless stops preceded by [h] are somewhat shorter than they are intervocalically. This tendency was noted with sibilant codas in chart (11). This effect would be especially likely if we interpret coda epenthesis in Huariapano as a type of pre-aspiration process, analogous to that observed in Icelandic (Thráinsson 1978a, 1978b). Since we are not able to pin down the exact instant at which laryngeal friction is rendered impossible by oral occlusion (due to a build up of supraglottal air pressure), we cannot discount the possibility that these onset consonants are consistently shortened and that [h] fills up this extra duration in a complementary way. This outcome would thus imply that the length of syllable-final [h]'s is in fact closer to the absolute duration of sibilant codas than the estimated proportion of 59% calculated above predicts.

5. Conclusion

There remains one final question which has important theoretical and practical implications: how much absolute and/or relative duration must a coda consonant like [h] add to the nuclear vowel in order to conclude that its presence contributes a second mora of rhymal weight? That is, suppose that syllable-final [h]'s in Huariapano were only 25% as long as canonical coda consonants—would that be enough? What if the relative duration were only 15%, or 10% or 5%? How much added duration is sufficient in a case like this? Although I cannot conclusively answer this question with data from just one language, I propose that one guideline which we can invoke is that the difference between the two mean durations being compared must turn out to be statistically significant using some well-established test of reliability. As we have seen, syllable-final [h]'s in Huariapano do meet this criterion in that the relevant 95% confidence intervals are distinct from one another (non-overlapping). I thus conclude that epenthetic [h]'s in this language do pattern as fully moraic coda consonants, a fact which therefore confirms the metrical constraint HEAVYFOOTHEAD of Parker 1988.

Appendix

word	segment(s)	nucleus	coda	onset	coda plus onset
ïβíra	ï	.133			
	í	.054			
	a	.058			
ráma	á	.087			
nóhkon	óh.k	.057			.130
hḯma	hḯ	.060		.120	
ikáynoaṣ̌	i.k	.044		.085	
	aṣ̌	.089	.113		
nóhkon	óh.k	.051			.140
hȉmanóra	ȉ	.076			
	(m)a	.097			
	ó	.099			
	a	.154			
huníβu	hu	.045		.048	
	í	.086			
	u	.061			
hùhkatíhkąỹ	ùh.k	.043			.155
	a.	.055			
háno	há	.136		.076	
	o	.081			
háy	h			.081	
wáyaṣ̌	ṣ̌		.166		
tahpyą́ṣ̌	ah.p	.097			.151
	ṣ̌		.172		
haβómbi	ha	.083		.035	
hawḯma	h			.045	
βiríki	í.k	.104		.129	
sentrál	s			.140	
ikáṣ̌βɪra	káṣ̌	.061	.092	.138	
	ɪ	.080			
sanáma	sa	.100		.145	
kíntan	k			.112	
sanáma	sa	.076		.099	
kíntan	k			.103	
sánama	sá	.089		.079	
kíntan	k			.133	
pyáṣ̌	ṣ̌		.185		
ṣ̌ḭáṣ̌	ṣ̌(ḭ)			.170	
	ṣ̌		.170		
tahpíno	ah.p	.076			.155
	í	.124			
βákïβu	á.k	.076		.070	
βítan	t			.135	

word	segment(s)	nucleus	coda	onset	coda plus onset
awín	a	.137			
wĩ́tąn	t			.131	
čáyru	č			.058	
hanoáş̌	ha	.073		.044	
	ş̌		.217		
ráma	á	.114			
	a	.112			
ramámaŋ	(r)a	.089			
	á	.066			
yusíβu	í	.066			
	(β)u	.089			
mawàkatíkąỹ	ka	.090		.092	
	tí	.055		.124	
	k(ą)			.086	
ma	a	.077			
kȉyukatíkąỹ	k(ȉ)			.078	
	ka	.090		.082	
	tí	.072		.127	
	k(ą)			.065	
ikáş̌βɩra	i	.054			
	ká	.082		.084	
	ş̌.βɩ	.092	.077	.060	.137
	a	.063			
nóβi	ó	.118			
βákï	kï	.065		.089	
púrana	p			.095	
háyni	h			.040	
hákï	k			.116	
sanáma	sa	.107		.154	
kíntan	k			.077	
señór	s			.144	
hïmáno	h			.047	
kȉnamahkáŋki	kȉ	.103		.077	
	h.k				.106
	k(i)			.121	
nĩ́no	ĩ́	.104			
íki	í.k	.081		.078	
náto	á	.087			
	to	.106		.111	
nóhkon	óh.k	.054			.117
pàpayòsiβunĩ́n	pà	.066		.068	
	p(a)			.121	
manánti	t			.110	
manáş̌	ş̌		.179		

word	segment(s)	nucleus	coda	onset	coda plus onset
hára	há	.107		.063	
hára	há	.164		.083	
ni	i	.078			
hàwïtyámbi	h			.051	
βismànohkòyamáykay	is	.062	.102		
	h.k				.130
màwaşóm	ş			.124	
payrɪ́ra	p			.093	
	ɪ́	.107			
βismànohkònoşíki	is	.059	.114		
	oh.k	.055			.115
	(n)o	.063			
	í	.062			
	k(i)			.075	
nóhkon	óh.k	.065			.068
títa	tí	.111		.067	
	ta	.147		.071	
nóhkon	óh.k	.044			.133
papáβo	pa	.057		.042	
	pá	.108		.116	
	o	.159			
ɪ̈́βɪra	ɪ̈́	.103			
βismànohkòyamáy	is	.058	.113		
	h.k				.144
βakɪ̈́βo	a	.090			
	kɪ̈́	.083		.102	
onàyamakáŋkï	k(á)			.076	
nóhkon	óh.k	.061			.170
hàskaríki	hà	.107		.053	
	s.ka	.072	.094	.050	.144
	í	.113			
señóres	s(e)			.111	
ɪ̈́βɪra	ɪ̈́	.130			
mìtoyúyay	ì.t	.080		.106	
manáş	áş	.134	.162		
nóhkon	óh.k	.094			.196
nóhkon	óh.k	.092			.136
manáş	áş	.109	.131		
ɪ̈́βɪra	ɪ̈́	.143			
	ɪ	.083			
ɪ̈̀tïkáti	ɪ̈̀	.091			
	tï	.082		.105	
	ká	.110		.073	
	ti	.131		.143	
βɪ̈́rona	ɪ̈́	.059			

word	segment(s)	nucleus	coda	onset	coda plus onset
raβɪ́	a	.135			
	ɪ́	.119			
nóko	ko	.062		.129	
rátɪ̈y	á.t	.089		.156	
rahkɪ̏čaíki	ah.k	.111			.167
	ɪ̏.č	.127		.149	
	k			.145	
yùsiβuróŋki	(s)i	.066			
ràhkɪ̈katíkąỹ	ah.k	.096			.113
	ka	.086		.085	
	tí	.090		.130	
	k			.118	
ràhkɪ̈katíkąỹ	ah.k	.098			.230
	ɪ̈	.102			
	ka	.084		.155	
	tí	.087		.150	
	k			.161	
rahkɪ̏čaríki	ah.k	.170			.159
	ɪ̏	.153			
	ča	.112		.143	
	í.k	.072		.085	
ɪ̈βíra	ɪ̈	.089			
	í	.065			
rɪ̈tɪ́ki	ɪ̈	.113			
	tɪ́	.081		.151	
	k			.122	
íki	k			.102	
patrómbo	a	.088			
βɪ́tan	t			.128	
tį̈áş	áş	.046	.069		
níşra	íş	.125	.117		
βɪ̈čànanaŋkáti	ɪ̈.č	.101		.129	
	ká	.095		.101	
	t			.152	
βɪ́tan	ɪ́.t	.063		.156	
ɪ́βɪra	ɪ́	.091			
tòayβaşíki	t			.144	
	şí	.104		.091	
	ki	.063		.145	
hačúpi	ha	.084		.082	
	čú	.088		.099	
	pi	.101		.108	
yàtaŋkáški	à.t	.087		.162	
	ká	.071		.097	
	š.k		.100	.069	.169

word	segment(s)	nucleus	coda	onset	coda plus onset
ḯβɪra	ḯ	.103			
rïtḯ̀yβaṣ̌íki	ï.t	.098		.128	
	a	.097			
	ṣ̌í	.076		.056	
tówati	ti	.046		.140	
βìβɪrą́ẖtan	ì	.114			
	ą́ẖ.t	.073			.145
nį̈ẖkḯno	ẖ.kḯ	.107			.193
hákaču	h			.054	
	ka	.065		.081	
	č			.139	
wḯt^{s}a	ḯ	.068			
ìštokiráŋki	š.to	.081	.066	.102	.168
	k(i.r)			.057	
háβïβi	há	.088		.076	
háču	há	.118		.172	
	ču	.050		.139	
ákï	á	.121			
hàkɪríβi	hà	.070		.075	
ìštokáŋki	ìš	.124	.114		
	o.k	.051		.086	
há:	h			.091	
nóhkon	óh.k	.110			.179
βḯtan	t			.146	
βḯ̀naṣ̌ónra	ḯ̀	.083			
	(n)a	.138			
hawį̈́n	h			.099	
hawį̈́n	h			.087	
hawį̈́n	h			.089	
raβḯy	a	.139			
rïtḯkï	(r)ï	.082			
	tḯ	.063		.127	
	k			.106	
ḯβi	ḯ	.092			
hára	há	.108		.084	
mìtoyúyey	ì.t	.072		.142	
señóres	s(e)			.128	
hakáču	ha	.104		.065	
	ká	.101		.104	
	č			.137	
wḯt^{s}a	t^{s}a	.074		.110	
nïhtį̈́n	ïh.t	.104			.118
hàkïríβi	hà	.116		.085	
	kï	.072		.108	
mïrákï	k			.090	

word	segment(s)	nucleus	coda	onset	coda plus onset
hára	h			.109	
šùtikayára	š			.168	
ɨ́βi	ɨ́	.112			
rahkɨ̏yamàyβaṣ̌íki	ah.k	.085			.131
	(β)a	.092			
ìštokiráŋki	ìš.t	.076	.070	.108	.178
	o.k	.080		.127	
	k			.058	
tùʔayβaṣ̌íki	ù	.068			
	í.k	.062		.073	
haβíβi	í	.078			
hawɨ̨́n	ha	.081		.071	
hináno	i	.121			
yahtáṣ̌on	ah.t	.118			.125
háwi	h			.074	
nìniβïránṣ̌ǫn	i.(β)	.095			
híwi	hí	.136		.134	
hàskatą́nra	hà	.082		.124	
	s.ka	.068	.063	.051	.114
	t			.075	
ɨ́βi	ɨ́	.159			
rɨ̏tïkáti	ɨ̏	.086			
	tï	.049		.093	
	ká	.070		.086	
	t			.098	
ìnawkónra	ì	.133			
dispwésta	is.p	.094	.094	.121	.215
	s.t		.080	.104	.184
ikáṣ̌	i	.131			
	ká	.102		.115	
siná	si	.189		.135	
há:	h			.133	
βɨ̏naβǫ́ra	ɨ̏	.121			
	(n)a	.153			
	a	.090			
čiβą́ỹ	i	.066			
ináwkon	i	.079			
šúku	šú	.073		.094	
	k			.097	
ìštokíra	ìš.t	.078	.072	.147	.219
hahtǫ́n	h.t				.133
káčo	ká	.119		.126	
	č			.133	
čúŋga	č			.124	

word	segment(s)	nucleus	coda	onset	coda plus onset
ráβï	á	.079			
	ï	.076			
čúŋga	č			.124	
čúŋga	č			.117	
inàwkumbúra	ú	.088			
čiβáŋkąỹ	či	.078		.183	
hàβokán	hà	.071		.083	
	o.k	.069		.098	
βàkïtamára	à	.132			
	kï	.119		.100	
	ta	.091		.093	
	á	.095			
haβómbi	a	.108			
kyástąŋ	ás.t	.094	.104	.161	.265
syáŋ	s			.127	
ipàkïkáỹ	i	.077			
	pà	.064		.101	
	kï	.096		.079	
	k			.123	
nį̀hkapáną	į̀h.k	.134			.121
	a	.100			
	pá	.092		.108	
ináwkǫŋ	i	.093			
dispwésta	is.p	.082	.136	.105	.241
	s.t		.075	.089	.164
hàskaríki	às.k	.093	.075	.076	.151
	a	.082			
	í	.103			
nihkáška	h.k				.120
	ş.k		.097	.061	.158
wíŕï	í	.127			
ihkàşčąŋkáti	ih.k	.086			.107
	à	.081			
	ká	.086		.133	
	t			.140	
háyra	h			.050	
mìtuyúyey	ì.t	.066		.099	

The texts which contain the words listed above are transcribed and translated into Spanish in Parker 1992.

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