# A Note on the Phonetic Correlates of Stress in Yakima Sahaptin*

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## 1 Introduction

In this article we two aspects of what previous researchers on Sahaptin have referred to as "stress" in that language. First, we are interested in establishing the phonetic correlates of stress in YS. For practical reasons, much of the descriptive work on Sahaptin (e.g. for lexicography, Beavert and Hargus in preparation-a) has been accomplished via impressionistic transcriptions prepared by non-native speakers. However expedient, this process is risky (although rarely questioned in documentary linguistics), as non-native speakers' judgments of stress placement may be at odds with those of native speakers (see Hargus 2005 for more discussion). Therefore, one goal of this article is to see whether non-native speaker impressions of the location of primary stress can be confirmed instrumentally. If not, the basis for much of the prior and current description of Sahaptin must be re-examined. Secondly, we are also interested in whether or not YS should be categorized as a "pitch-accent" (or simply "accentual") language.

We focus here on the Yakima dialect of Sahaptin (YS). Yakima Sahaptin is highly endangered, with five remaining speakers, all elderly. All data in this study come from one speaker, the second author, who is a native speaker of the Yakima dialect, one of the northwest cluster of Sahaptin dialects (Rigsby and Rude 1996). The Yakima dialect is the only northwest Sahaptin dialect which is still spoken.

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Following presentation of segment inventories in §1, we summarize various qualitative aspects of Sahaptin stress (§3), presenting pitch tracks for selected YS words. Next (§4) we present a quantitative study of stress in YS. In (§5) we discuss characteristics of stress, tone and pitch accent systems, and describe how YS fits within this typology. In §6 we outline a number of areas for possible future investigation.

## 2 Segment Inventory

The Sahaptin consonant inventory is given in (1):

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | p p’ | t t’ | tɬ tɬ’ | ts ts’ | tʃ tʃ’ | k k’ | kʷ kʷ’ | q q’ | qʷ qʷ’ | ʔ |
| | | | ɬ | s | ʃ | x | xʷ | χ | χʷ | h |
| | m | n | l | | | | | | | |
| | w | | | | j | | | | | |

The Sahaptin vowel inventory is given in (2):

| | | | |
|---|---|---|---|
| (2) | i ii | ɨ | u uu |
| | | a[1] aa | |

There are both short vowel and long vowel ‘diphthongs’ in Sahaptin. The short vowel diphthongs consist of [iw uj aw aj]. The long vowel diphthongs consist of [iiw uuj aaw aaj]. The term diphthong is put in quotes because it will be seen in 3.4 that the short vowel diphthongs do not pattern with long vowels, so diphthong is something of a misnomer.

## 3 Qualitative Observations about Sahaptin Stress

### 3.1 Unpredictability of Stress

Rigsby and Rude 1996 noted that ‘primary stress...is distinctive and...occurs on one syllable of every word’ (p. 671). They noted that [ámapa][2] ‘husband’ (obj.) and [amápa]

[1] We use the IPA to transcribe Sahaptin, except that we transcribe long vowels as two vowels rather than with the colon, we transcribe stress/accent with an acute accent over the vowel, and we use [a] rather than [ɑ] for the mid-to-low central unrounded vowel. The vowel transcribed [a] is actually closer in quality to [ə] than to [ɑ]. Instrumentally obtained vowel charts for Sahaptin stressed and unstressed vowel qualities are presented in Hargus 2001.

'island' are a minimal pair for stress in the Umatilla dialect. In YS there are similar (near-) minimal pairs for stress; e.g. [wjánawi]-[3] 'arrive', [anáwi]- 'be hungry', [kʷ'ajawí] 'mountain lion'.

In an earlier study (Hargus and Beavert 2001), we noted that despite such contrasts, there were nonetheless statistical preferences for stress placement in roots. There is a greater-than-random attraction of stress to heavy syllables (–VV or -VC), a preference for trochaic stress when syllable weight is not a factor (e.g. initial stress in CVCV roots), and a preference for right-directionality (penultimate stress in CVCVCV roots).

Note that "predictability" here means predictability of the location of the accent within an accented morpheme. Whether or not a morpheme has an accent is a separate issue, discussed next.

## 3.2 Contrast Possibilities within Morpheme Classes

Jacobs 1931:118-119 noted that certain prefixes ('anterior root elements') and suffixes 'invariably obtain word accent', presenting examples such as those in (3).

(3) [pá]- inverse vs. [pa]- 3PL.NOM
[páwat'ana] 'he struck at him'
[pawát'ana] 'they struck'

Such examples reveal that there is a distinction between stressed and unstressed affixes in Sahaptin. In our current lexical files (Beavert and Hargus in preparation-a), more than half (57%, or 54 of 95) have no underlying accent.

In contrast to affixes, there do not appear to be many unaccented roots in Sahaptin. We define root here as a morpheme which either undergoes the type of affixation characteristic of nouns, verbs or adjectives in Sahaptin, or else is not clearly an affix to a lexical or functional category. All known unaccented roots are listed in (4):

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[2] It is traditional in Sahaptin linguistics not to transcribe word-initial glottal stop, which is predictable on the surface. We will adopt this practice in this article, as the presence vs. absence of word initial [ʔ] is not crucial for present purposes.

[3] Verb roots must surface with an affix in order to form a well-formed word. Hence the hyphen indicates that the verbal root is a bound morpheme, although it is somewhat arbitrary to place the hyphen after the verb root. The verbal affix which can be added may be either a prefix (such as ʔi- 3S.NOM or a suffix, such as –k IMP.SG). (We use the affix glossing conventions of Rigsby and Rude 1996.)

(4) Unaccented roots

a. conjunctions: ku 'and', uu 'or', kutja 'but, however'

b. wa 'be'

c. evidentials:[4] akut/jakut 'supposedly', χaʃ 'I wonder', χat 'in the world, on earth'

Note that the stressed root [kú]- 'do' is thus a minimal pair with [ku] 'and' for presence/absence of stress.

Morphemes are normally simply specified for stress or not. In addition, there are a small number of suffixes which appear to requires stress on the preceding syllable:

(5) a. -´t'a ~ -át'a 'want'

b. -´łam AGT

The pre-stressing suffix in (5)b. appears to be unproductive, relative to the very productive -łá AGT, and is so far only attested in the lexical items in (6):

(6) atł'awíłam 'beggar'; cf. atł'áwi- 'ask, beg for, request'

paχwíłam 'thief'; cf. páχwi- 'steal'

The vowel-initial form of the suffix in (5)a. is used after consonant-final roots and after monosyllabic short vowel roots. The consonant-initial, stress-shifting form is used after other vowel-final roots or vowel-final affixes. Compare the forms in (7):

(7) Pre-stressed –´t'a

tʃíi- 'drink'

tʃíi-t'a- 'want to drink'

tʃii-tá-t'a 'want to go drink'

### 3.3 Culminativity

It is implicit in Jacobs' description and examples that there is only one main stress per word. Rigsby and Rude 1996 also agree that 'primary stress… occurs on one syllable

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4 The evidential morphemes in (4)c. appear to occupy second position in the sentence, a position shared by another class of unstressed morphemes, the better-known second position pronominal clitics of Sahaptin (=naʃ/Vʃ 1SG; =nam/Vm 2SG; =maʃ 1SG.2SG; =mataʃ 1PL.2, 1SG.2PL; =na, =nataʃ 1DU.INCL; =taʃ 1DU/PL.EXCL; =natk/namtk 1PL.INCL., =pat 3PL.INVERSE).

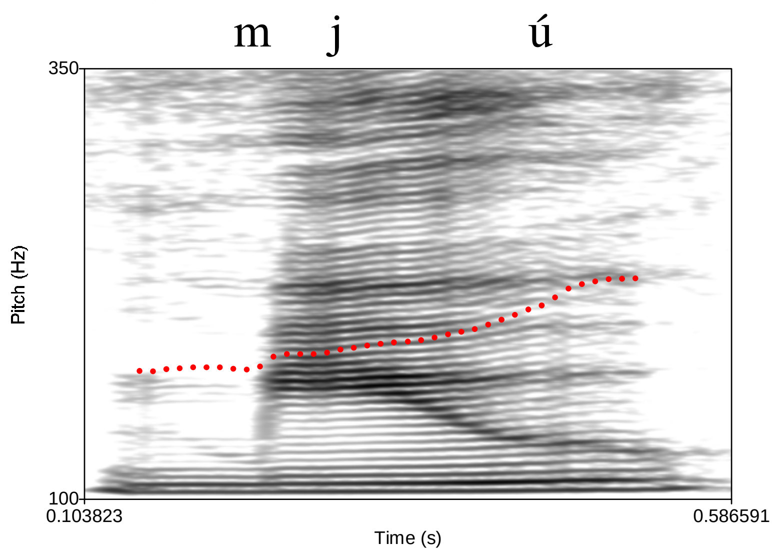
of every word'. Predicting which syllable surfaces with stress when a word contains multiple stressed affixes, Jacobs 1931:119 wrote that prefixes and anterior root elements are stressed 'except where…the suffix receives the accent…In the verb…the root is stressed if nothing else is stressed.' In other words, suffixes attract stress over prefixes, and prefixes attract stress over roots. Exemplification of this rule can be found in Hargus and Beavert 2002a, Hargus and Beavert 2002b and throughout this article.

### 3.4 Stress Realized as High Pitch

Jacobs 1931:117 noted that 'stress and high tone are one phenomenon in northern Sahaptin; they are very strongly marked in northwest Sahaptin…light monosyllabic words are invariably stressed and have high tone…in all dialects the syllable that has the stress takes high or falling—that is, high to normal—tone. Short vowels have high tone'.

In our inspection of pitch tracks of words containing short vowels, we concur with Jacobs that short vowels have high and essentially non-falling pitch. A good example of this pattern is shown in (8). The mean pitch of the vowel in this word is 211 Hz. For reasons of space, in this section we compare syllables in only one position within the word, namely word-finally.[5]

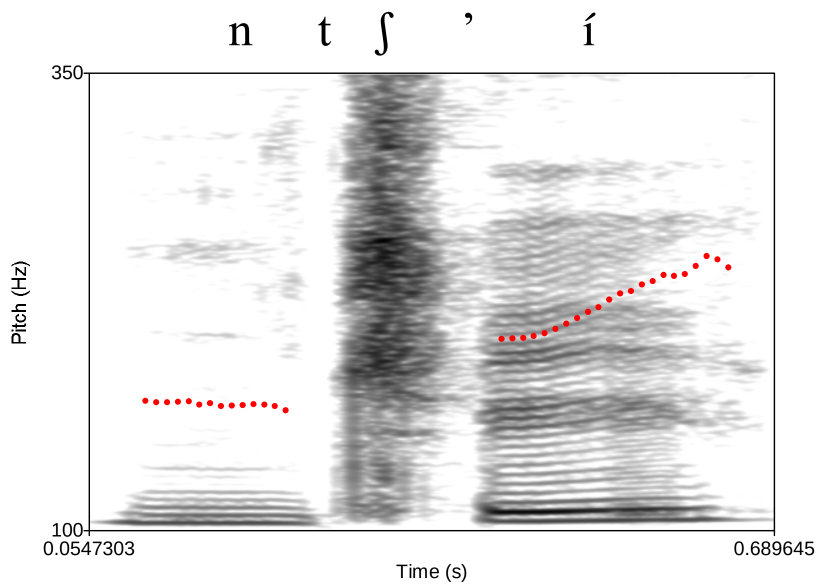
(8) mjú 'brother-in-law (man's wife's brother)'




[5] The pitch tracks in this section were generated with Praat 4.3.27. The following 'advanced' pitch settings were used: Voicing threshold = 0.45, Octave cost = .04, Octave jump cost = 16.0, Voiced/unvoiced cost = 0.6.

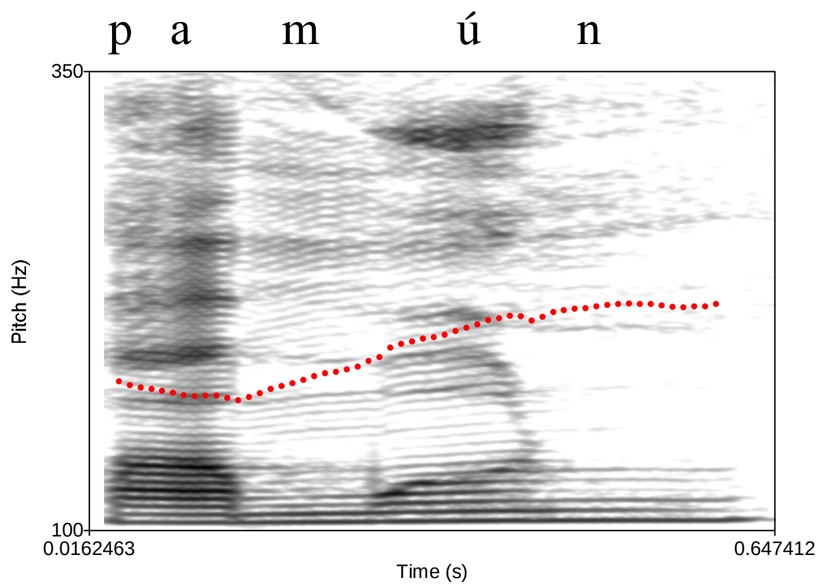
If there is a fall in such CCV words, it is very short and occurs only on the final few milliseconds of the word, and is quite different from the long pitch fall that starts in the middle of a long vowel (as can be seen below in (12) and other graphs). For example, in (9), the final pitch fall occurs over the final 4 ms of the word. The mean pitch over the final vowel in this word is 226 Hz.

(9) [ntʃ'í] 'big'



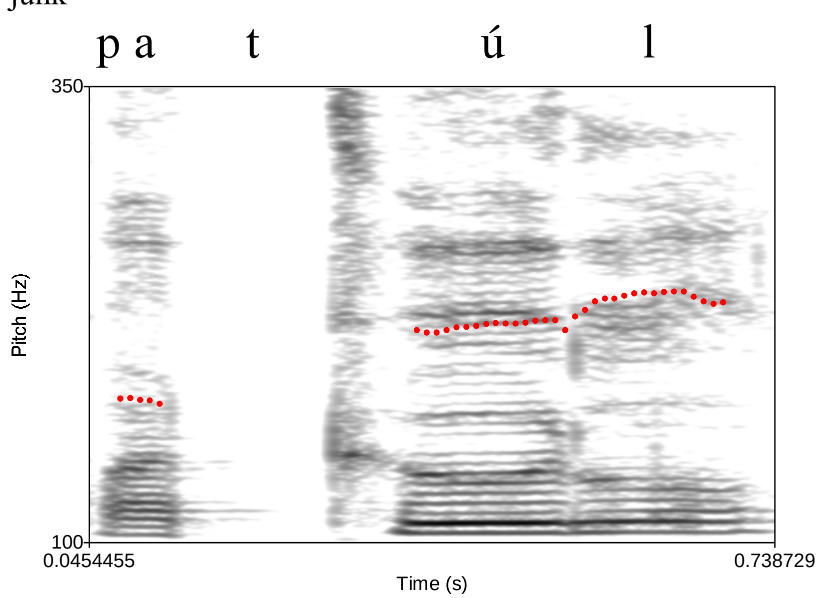

Stress in syllables closed with sonorant consonants [n m l] also appears to be realized with high, non-falling pitch. This point was also essentially noted by Jacobs 1931:117, who writes that 'One moraed or light monosyllabic words are invariably stressed and have high tone. A tonal glide back to normal is rarely heard, either in the monosyllable, or in the succeeding mora or word. Thus, wá́, ná́xc, t̓sá́, mú́n, ... q̓á́p.' (Jacobs 1931 is transcribing 'tone beside primary stress' in these and other words in this section of his grammar.) (10) contains an example of this high, non-falling pitch pattern. The average pitch over the final rhyme [un] is 218 Hz.

(10) [pamún] 'sometimes'



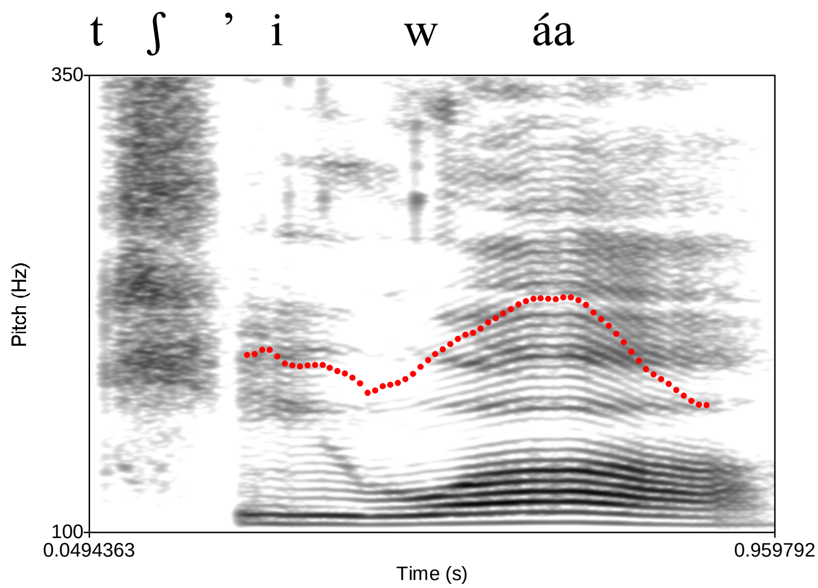

If there is a pitch fall in sonorant-consonant-closed short-vowel words, it is confined to the final few milliseconds, as with word-final short vowel words. An example with a final short fall is given in (11). In this word, the average pitch over the final rhyme is 228 Hz, and the pitch fall occurs over the final 3 ms.

(11) [patúl] 'junk'



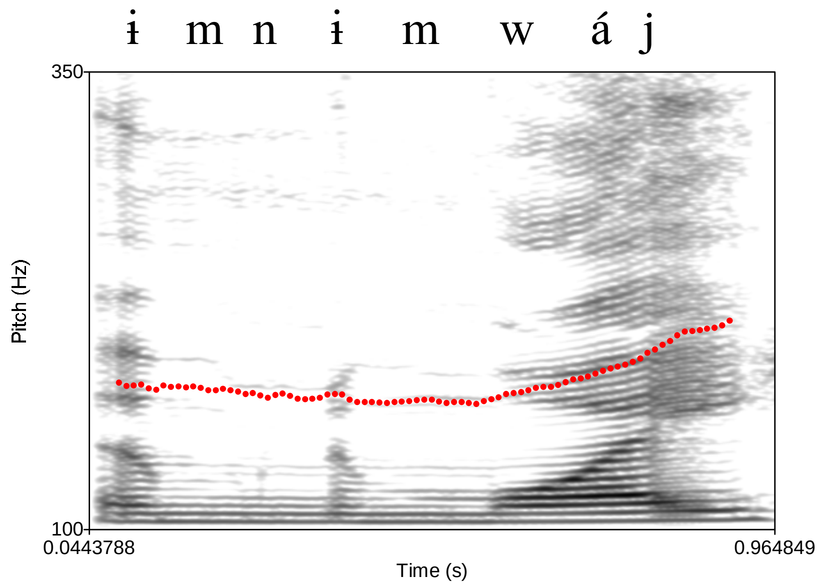

Jacobs 1931:117 noted that 'long vowels or diphthongs in accented syllables have falling tone, high to normal. Two moraed or heavy monosyllabic words invariably take stress with falling — high to normal — tone ... ấu, tı̂́:n, wấu, cp'ấu, hû́i.' Inspection of pitch tracks again shows that Jacobs was right on this point, at least as far as the long vowels are concerned. We find that stressed long vowels in open syllables are pronounced with a fall in pitch which begins around the midpoint of the vowel. In the example given in (12), the average pitch over the final rhyme is 207 Hz:

**(12)** [tʃ'iwáa] 'bow-legged'



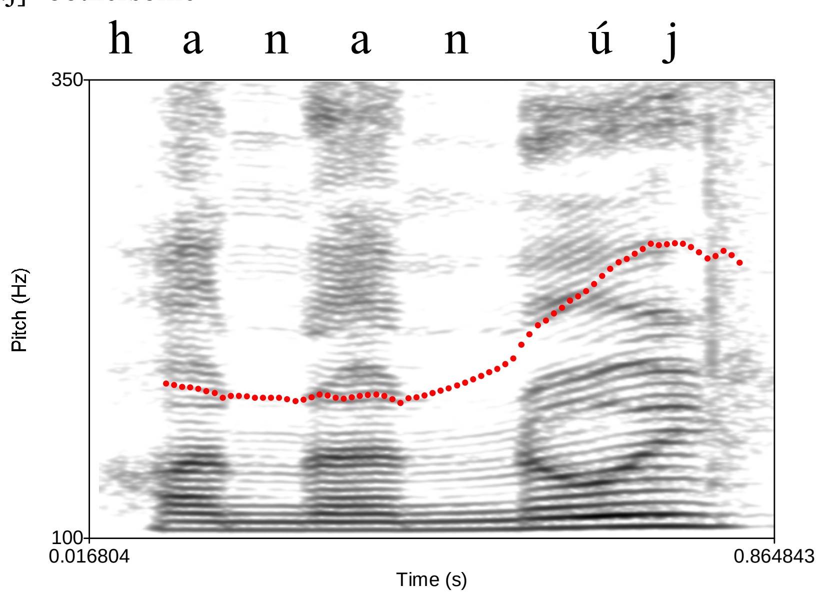

Jacobs' ambiguous phrase 'long vowels or diphthongs' apparently meant 'long vowels or short diphthongs', judging from the examples provided (above (10)) in illustration of the supposed falling pitch on both types of rhymes. On this point we differ from Jacobs, in that we find that short diphthongs are characteristically pronounced without the pitch fall found with long vowels. An example can be seen in (13). The average pitch over the final rhyme is 199 Hz.

(13) [ɨmnɨmwáj] ‘playful, mischievous’



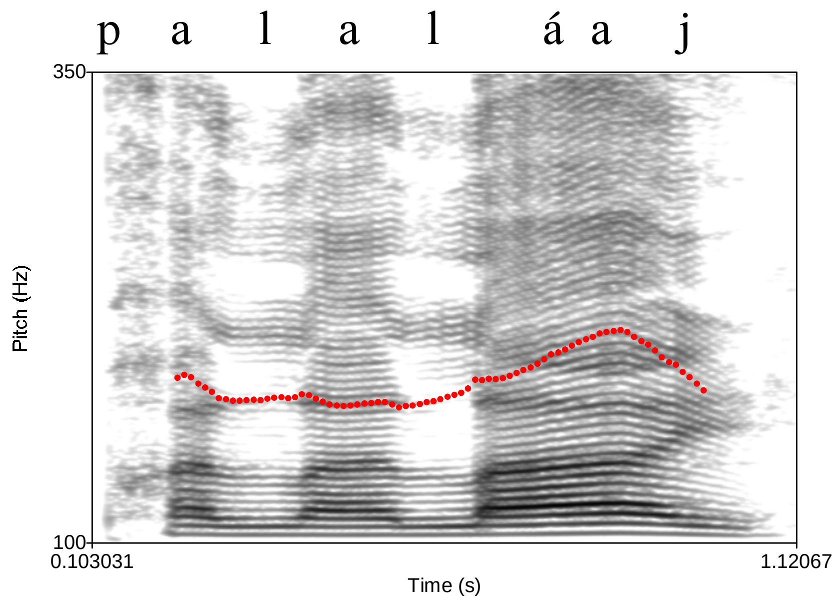

If there is a pitch fall in words with final short-vowel diphthongs, it is confined to the final few milliseconds of the rhyme, as with short vowels in open or sonorant-consonant closed syllables. An example can be seen in (14), where the pitch falls over the final 7 ms. only. The average pitch on the final rhyme is 243 Hz.

(14) [hananúj] ‘bothersome’



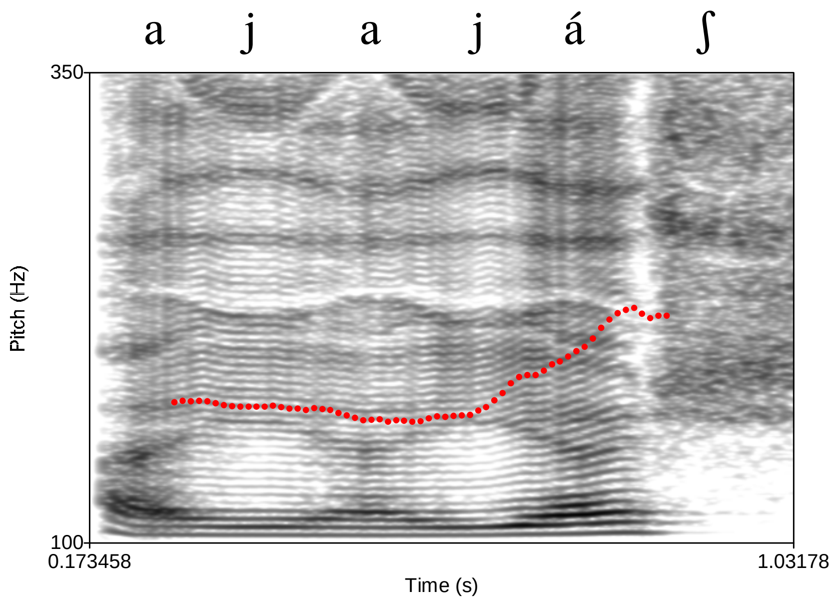
In contrast to short diphthongs, with long diphthongs we find the same pitch fall as with long vowels. An example is shown in (15). The average pitch on the final rhyme is 193 Hz.

**(15)** [palaláaj] 'lots'



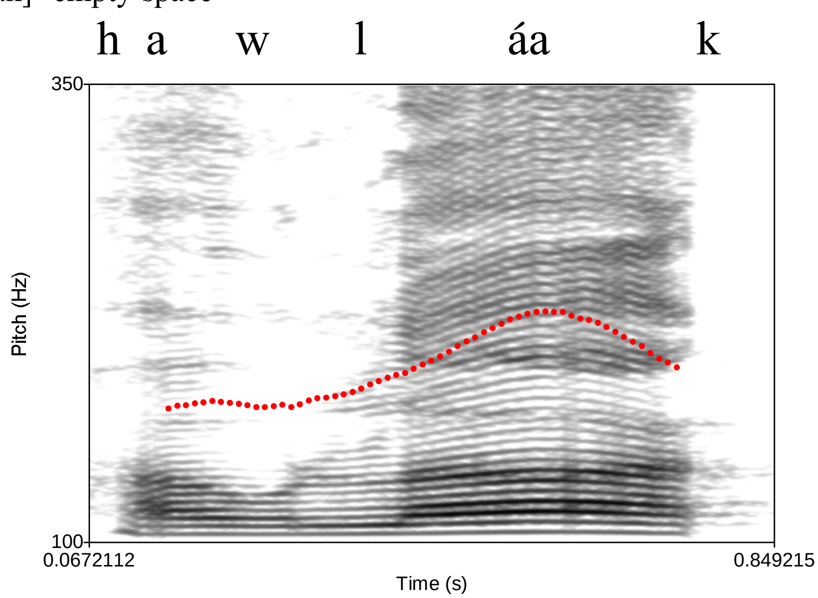

In short vs. long vowels in word-final syllables closed with an obstruent here too we find that the pitch peak of a short vowel is aligned either with the end of the vowel or very close to its end. A representative pitch track on a short-vowel obstruent-closed syllable is shown in (16). The average pitch on the final rhyme is 204 Hz:

(16) [ajajáʃ] ‘stupid person, idiot’




Contrast the pitch pattern seen in (17), which also contains a long vowel closed with an obstruent. The average pitch on the final rhyme is 211 Hz.

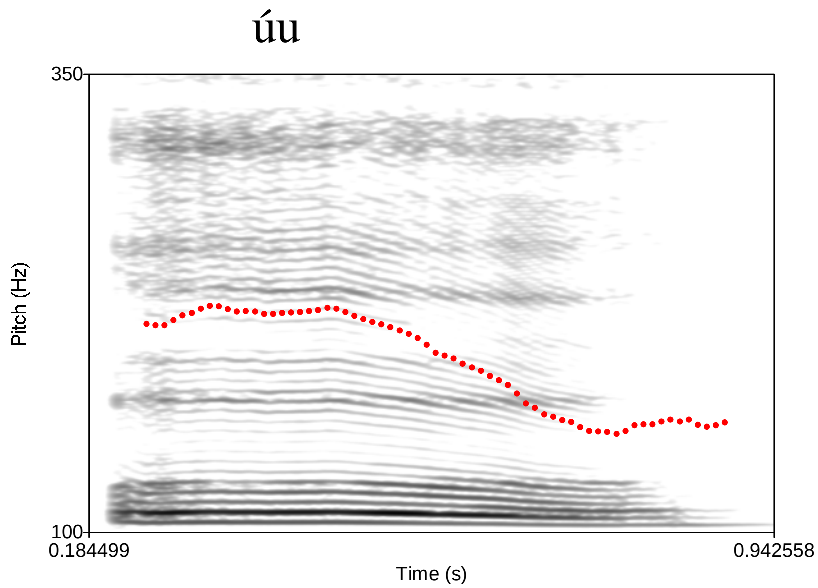
(17) [hawláak] ‘empty space’



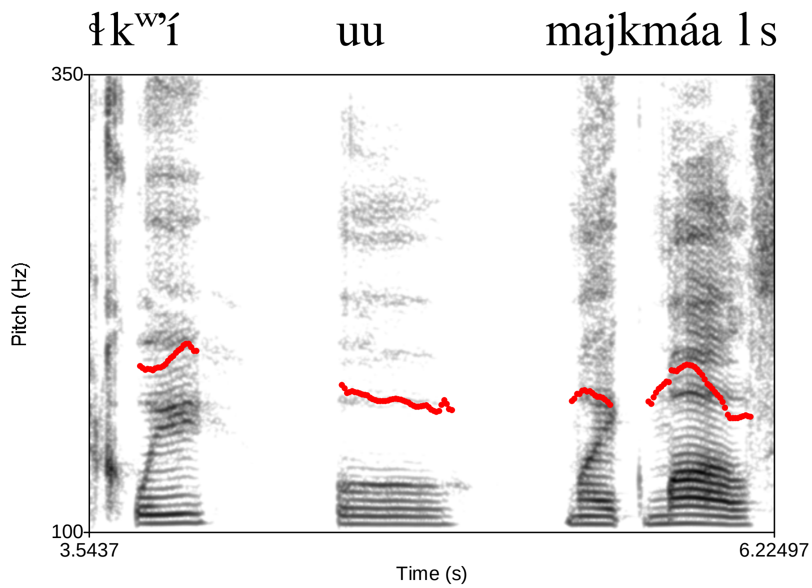

## 3.5 Stress Insertion

In addition to selecting the strongest stress or moving stress to the preceding syllable, the phonology associated with Sahaptin stress also appears to insert accent in unaccented words. The unaccented free morphemes in (4) are not normally said in isolation. However, in the course of preparing Beavert and Hargus in preparation-b, a dictionary with sound files accompanying every lexical entry, we recorded the normally unaccented conjunctions [ku] 'and', [uu] 'or', and [kutja] 'but', as well as the variably accented [wa] 'be' (see Hargus and Beavert 2006 for discussion of this morpheme). We found that these morphemes have a word initial high pitch (or falling pitch in the case of [uu]) pitch when pronounced in isolation. (18)-(19) present pitch tracks for [uu] 'or' in isolation and in the middle of a phrase.

**(18)** [uu] 'or' (pronounced in isolation as [úu])



(19) [uu] ‘or’ in context, showing intrinsic lack of accent. The phrase is [ʃukʷáataj míʃ áw iwáta majkmáal ɬkʷ’í uu majkmáal sts’át] ‘to find out whether there would be longer day or longer night now’




This alternation between unstressed and stressed forms of conjunctions suggests that there is insertion of accent in some accentual domain, since stressed morphemes have not been observed to lose stress in any phrasal contexts. Insertion of stress is consistent with our previous account (Hargus and Beavert 2006) of the accentual properties of [wa] ‘be’, which is also predictably stressed or not in surface forms. There we suggested that [wa] becomes accented when a stress lapse of more than two syllables would otherwise occur.

## 3.6 Summary

Previous descriptions of Sahaptin have stress have noted that there is one primary stress per word. When multiple morphemes with underlying stress coincide in the same word, stress is realized on the outermost suffix, then the outermost prefix, and then on the root.

The primary phonetic correlate of stress was previously described as high or falling pitch. Our pitch tracks of stressed word-final syllables in open syllables or in syllables closed with various types of consonants confirm this description. We have seen that short stressed vowels have a high (non-falling) pitch contour whereas long stressed vowels fall in pitch.

## 4 A quantitative Study of the Phonetic Correlates of Primary Stress

The pitch tracks presented in 3.4-0s partially confirm our (and previous researchers') auditory impression that stress is realized as high pitch in Sahaptin, at least in the restricted word-final environment considered there. However, as noted by e.g. Fry 1955, stress may be realized on vowel nuclei as longer duration, higher pitch, and/or increased amplitude. Our research question in (20) therefore remains unanswered by the information presented in the previous section:

**(20)** What are the phonetic correlates of primary stress in Sahaptin?

### 4.1 Methods

An acoustic study of the correlates of stress in a controlled sample of Yakima Sahaptin words was undertaken.

#### 4.1.1 Word List

In this study, we compared the underlined vowels in the words in (21).

**(21)** Word list

| *primary stress location* | *word-initial morpheme* | |
|---|---|---|
| second syllable | [pa]- third person plural nominative | [p<u>a</u>p'ɨ́χʃa] 'they remember' |
| | | [p<u>a</u>pnúʃa] 'they're sleeping' |
| initial syllable | [pápa]- reciprocal | [páp<u>a</u>p'ɨχʃa] 'they remember each other' |
| | [pá]- inverse | [p<u>á</u>ptɬ'aʃa] 'he's baptizing her' |

The words in (21) control for (a) vowel quality in the initial syllable, (b) surrounding consonantism, and (c) syllable closure. Only four words were examined in this study. However, the vowels of interest in these words occur in balanced numbers of open (pa̲p'ɨ́χʃa*,* pá̲pap'ɨχʃa) and closed syllables (pa̲pnúʃa*,* pá̲ptɬ'aʃa), an important consideration since syllable closure can affect vowel duration (Maddieson 1985). The word list could have been expanded to include other words with [pa]- third person plural nominative, [pápa]- reciprocal, [pá]- inverse, but it was felt that additional words with these prefixes would not increase the generalizability of the study. The word list was not expanded to include other words, say those with initial [tat], because there are no other affixes which occur in the same position in the word and which differ only in stress like these affixes do.

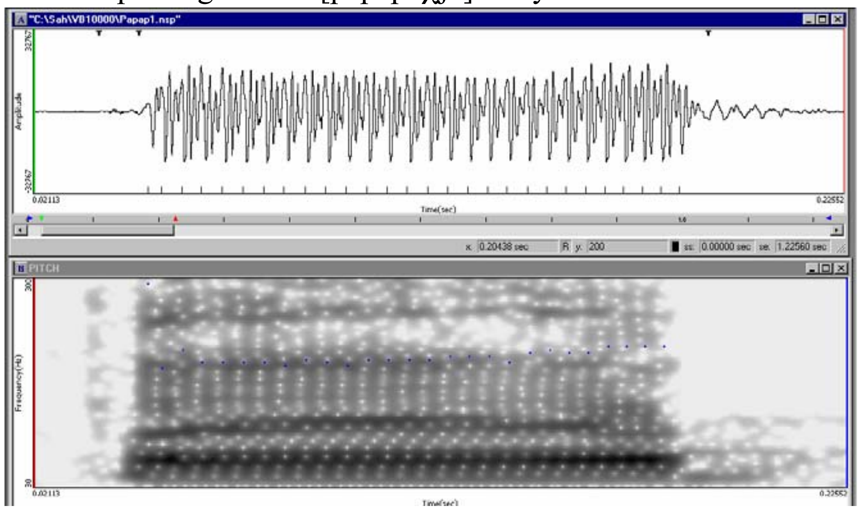
### 4.1.2 Recording

Each word was pronounced in isolation five times by the second author in her home in Toppenish, Washington. The four words were recorded in random order (in blocks of five repetitions each). Recordings were made on an analog tape recorder (Sony WM-D6C) with an external microphone (Sony ECM-929LT). The recording was later digitized at a sampling rate of 10,000 samples/second using SoundEdit.

### 4.1.3 Measurements

Measurements were performed with Multi-Speech 2.5.1. In a first pass through the data, tags were inserted in three places: before the stop burst (of the [p] preceding the vowel of interest), at the onset of the vowel, and at the offset of the vowel. Vowel onset was defined as the onset of the relatively high amplitude portion of the vowel, and vowel offset as the point in the vowel where amplitude drops sharply. Vowel onset and offset did not always coincide with the onset or offset of periodicity. Also in the first pass through the data, voiced period marks inserted by Multi-Speech were inspected for accuracy and corrected by hand, if necessary. (22) shows a waveform and spectrogram for one repetition of [pápap'ɨχʃa] 'they remember each other'. Note that the bulk of the vowel occurs between the second and third tags.

(22) Waveform and spectrogram for [pápap'ɨχʃa] 'they remember each other'




In a second pass through the data, the location of the tags were examined for consistency throughout the data set. Then duration, pitch and energy were measured as described below.

Two duration measures were obtained from the first vowel in each word, from the burst of the preceding stop to vowel onset, and from vowel onset to vowel offset. Pitch and energy were calculated over a 30 ms. average of the vowel midpoint for each of the first and second vowels. Pitch was measured from the voiced period marks inserted by Multi-Speech.

### 4.1.4 Normalization

Measuring the pitch and energy of the first and second vowels of each word allowed word-normalized pitch and energy measures to be calculated by subtracting the pitch of the vowel of the second syllable pitch from that of the first syllable. Normalized energy was calculated in an analogous way.

Duration was not normalized in this manner because the consonant offset following the first vowel — [p'], [pn], [p], [ptɬ'] — could not be controlled for, nor could the quality difference seen in the second syllable. Since both of these factors could affect the duration of the vowel of the second syllable, any conclusions about stress based on second syllable vowel duration could not be regarded as untainted by factors unrelated to stress.

The vowel quality differences of the second syllable are also a potential confound for the normalization method for energy. Consider the initial unstressed sequences [a] ... [ɨ́], [a] ... [ú] vs. the initial stressed sequences [á] ... [a], [á] ... [a]. High vowels contain lower intrinsic amplitude than non-high vowels (Ladefoged 1992). The high vowels of the second syllables in the first case should make it easier to obtain a statistically significant result for energy, since there is already an energy difference between the two types of sequences independent of stress. The energy difference between the vowels in the first case should be smaller than the energy difference between the vowels in the second case.

### 4.1.5 Statistics

Inferential and descriptive statistics were obtained using StatView 5.0.1. The inferential statistical tool used in this study was factorial analysis of variance (ANOVA).

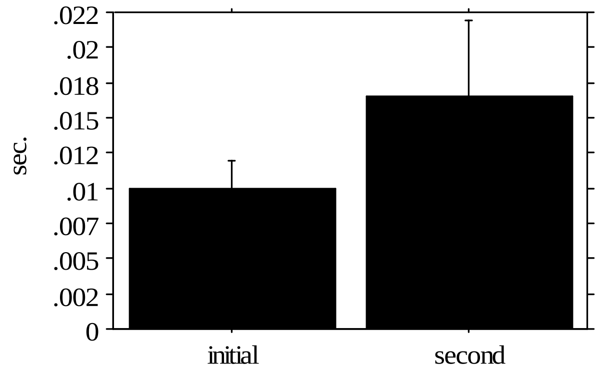
## 4.2 Results

### 4.2.1 Duration

The results for each of the duration measures, burst-vowel onset and vowel onset-offset, are first presented separately. Then the result of adding the measures together is presented.

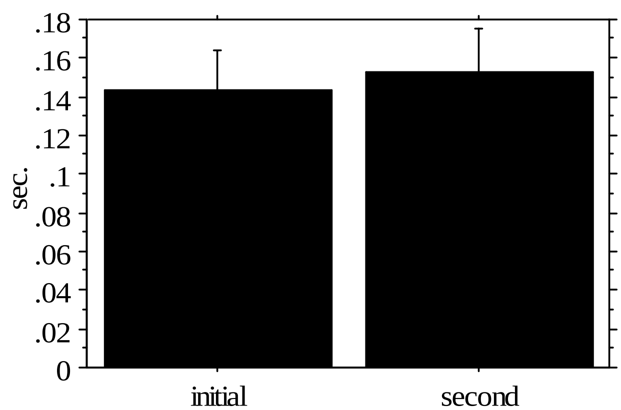
(23) shows the average duration of the burst-vowel onset measure for the word-initial vowels in pá̲pap'ɨχʃa, pá̲ptɬ'aʃa (initial stress) vs. pa̲p'ɨ́χʃa, pa̲pnúʃa (second syllable stress). Error bars in this and other graphs represent one standard derivation. The average duration of the burst-vowel onset measure for the vowels predicted to be stressed was 10 ms. (s = 1.9), and that of the vowels predicted to be unstressed 17 ms. (s = 5.5). The difference in burst-vowel onset duration for stressed and unstressed vowels was statistically significant (F[1,19] = 13.632, p = .00015), although the opposite of what would be predicted if the vowels in (21) are correctly transcribed for stress (and if duration is a phonetic correlate of stress).

**(23)** Burst-vowel onset measure for stressed vowels (“initial”) vs. unstressed vowels (“second”)



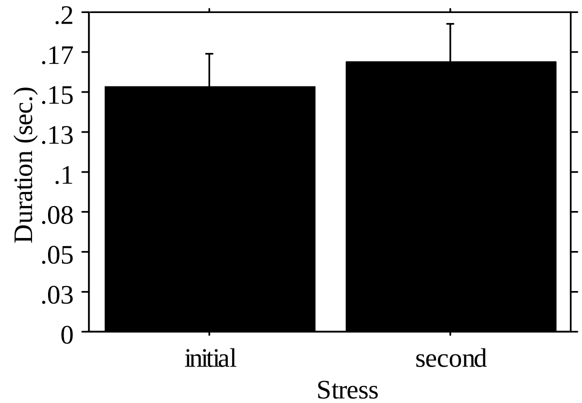

(24) shows the average duration of the vowel onset-offset measure for the first syllables in pá̱pap’ɨχʃa, pá̱ptɬ’aʃa (initial stress) vs. pa̱p’ɨ́χʃa, pa̱pnúʃa (second syllable stress). The average onset-offset duration of the vowels predicted to be stressed was 143 ms. (s = 20.3) and that of the vowels predicted to be unstressed 153 ms. (s = 22.6). The difference was not statistically significant.

**(24)** Vowel onset-offset measure for stressed vowels (“initial”) vs. unstressed vowels (“second”)




Finally, (25) shows the average duration of the sum of these two measures for the word-initial vowels in pá̱pap’ɨχʃa, pá̱ptɬ’aʃa (initial stress) vs. pa̱p’ɨ́χʃa, pa̱pnúʃa (second syllable stress).

(25) Sum of duration measures for initial vowels in words with initial vs. second syllable primary stress

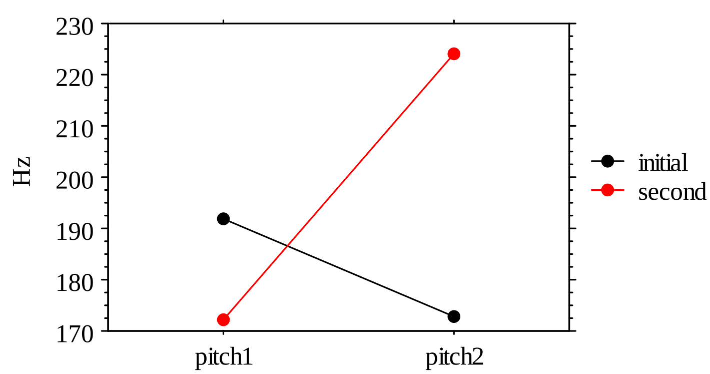



The sum of the duration measures for the first vowels in the words with initial syllable stress was 154 milliseconds (s = 20.7). The sum of the duration measures for the first vowels in the words with second syllable stress was 170 milliseconds (s = 23.9). This difference was not statistically significant.

### 4.2.2 Pitch and Energy

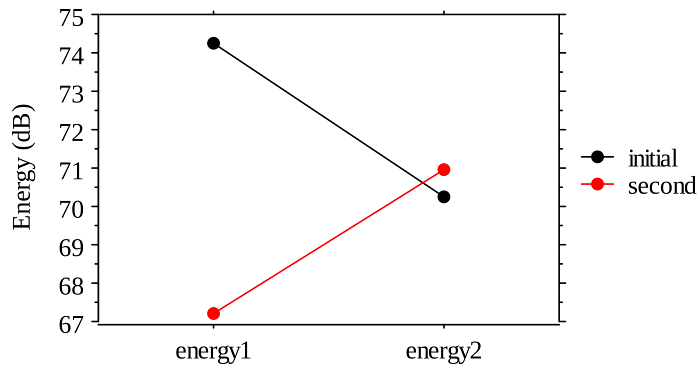
(26) plots the average pitch of the vowels of the first (pitch1) vs. second (pitch2) syllables for words with initial vs. second syllable stress. As can be seen from (27), there is a fall in pitch from the first (192 Hz) to the second (173 Hz) syllables in pá̲pap'ɨχʃa, pá̲ptɬ'aʃa but a rise in pitch from the first (172 Hz) to the second syllables (224 Hz) in pa̲p'ɨχʃa, pa̲pnúʃa.

(26) Pitch contours of words with initial vs. second syllable primary stress



(27) plots the average energy of the vowels of the first (energy1) vs. second (energy2) syllables for words with initial vs. second syllable stress. There is a fall in energy from the first (74.3 dB) to the second syllable (70.3 dB) in words with stress on the first syllable, whereas words with second syllable stress have a rise in energy from the first (67.2 dB) to the second syllable (71.0 dB).

**(27)** Energy contours of words with initial vs. second syllable primary stress




Initial syllable stressed words showed an average fall in pitch of 19 Hz ($s = 12.2$) and fall in energy of 3.9 dB ($s = 3.63$), whereas second syllable stressed words showed an average rise in pitch of 52 Hz ($s = 10.5$) and a rise in energy of 3.8 dB ($s = 3.76$). The difference in normalized pitch and energy for initial vs. second syllable stressed words was significant for both measures (pitch, $F[1,19] = 199.404$, $p < .0001$; energy, $F[1,19] = 23.224$, $p = .0001$). As discussed in 4.1.4, there are intrinsic differences in energy between the two comparison sequences which stem from vowel quality differences in the second syllables. Given the nature of the current results, this potential concern can be ignored. The vowel quality difference between the vowels with second syllable stress should cause the energy difference to be smaller than it would otherwise be if the vowels of the second syllable were [a] rather than high vowels. Therefore, we conclude that the statistically significant result for normalized energy would only have been greater if the vowels of the second syllables had been perfectly matched for vowel quality.

## 4.3 Discussion

Our finding of pitch as a phonetic correlate of stress at the left edge of the word is in accord with our qualitative finding that stress at the right edge of the word is marked by higher pitch. Our finding that energy is also a phonetic correlate (at least in syllables at the left of the word) was not predicted but not unexpected from a cross-linguistic point of view. As mentioned above, in a survey of the phonetic correlates of stress, Fry 1955 notes that higher pitch, longer duration or greater energy are all possible phonetic correlates of stress. Lehiste 1970:144 has noted that is not surprising for both pitch and energy to mark stress:

There is solid evidence…that various dependence relationships exist between [fundamental frequency and intensity]…[I]ncreases in subglottal pressure produce an increase in the rate of vibration of the vocal folds, unless there is some compensatory adjustment in their tension.

Two out of the three duration measures were not significant, and the one duration measure that was statistically significant could not be explained by stress, as the longer duration occurred before the vowels which were predicted to be unstressed. We therefore conclude that duration is not a phonetic correlate of stress. This is perhaps not surprising given that Sahaptin uses duration to contrast long and short vowels (e.g. /tun/ 'what', /tuun/ 'which'). Hayes 1995 predicted that languages with vowel length distinctions would not in fact employ duration as a phonetic correlate of stress. On the other hand, this is not the case in Aleut (Rozelle 1997, Taff, Rozelle, Cho, Ladefoged, Dirks and Wegelin 2001), which has a vowel length contrast like Sahaptin.

## 5 Is Sahaptin a Pitch-Accent Language?

In this article we have referred to the "stress" system of Sahaptin, using the term of previous researchers (Jacobs, Rigsby, Rude) (although Jacobs also refers to "accent" in Sahaptin). However, we have seen that pitch, along with energy, is a phonetic correlate of stress in Sahaptin. The question then arises as to whether Sahaptin might best be classified as a 'pitch-accent' language, as opposed to a 'stress(-accent)' language.

Defining 'pitch-accent language' is a question which has vexed many generative phonologists. Part of the difficulty is that this term has changed in meaning over time from 'tone language' to refer to a language that uses tone (pitch) in some prosodic way (see Beckman 1986 for a review of the uses of the term 'accent'). For example, in the first part of the 20th century, Sapir 1925 used the term in reference to the prosodic system of Sarcee, as did Hoijer 1943 with respect to languages of the Apachean subfamily (Athabaskan). These are linguistic varieties which are now recognized as having canonical tone.

In this section, we first review the characteristics of pitch-accent, also simply known as ‘accent’, and then see whether this term is applicable to Sahaptin.

## 5.1 Pitch-Accent vs. Tone

Various researchers (McCawley 1978, Beckman 1986, Zhivov 1978, Odden 1999) have suggested that the differences between tone and pitch-accent systems are primarily functional and phonological in nature rather than phonetic.

McCawley 1978 describes the prosodic system of standard Japanese (usually considered a model pitch-accent language), other varieties of Japanese ((a) the central Honshuu dialects and ‘most of Shikoku’, (b) the dialects of western and southern Kyuushuu), which have more complex variations on the standard Japanese prosodic system, such as allowing pitch contrasts on the initial syllable), three Bantu languages (Ganda, Tonga, and Kikuyu, which differ in degree of tonal specification/predictability), and Mandarin Chinese (a canonical tone language). He concludes that pitch-accent and tone languages are two ends of a continuum, and that ‘there is no reason for squeezing the diversity of phonological systems discussed here into a simple dichotomy’ (p. 128).[6]

Zhivov 1978 and Beckman 1986 follow McCawley 1978 in suggesting that the different phonological rules found in accent vs. tonal systems might be a distinguishing property of the two types of languages. Zhivov 1978:97 is primarily concerned with differentiating ‘restricted tone’ languages (term originally due to Voorhoeve 1973) from pitch accent languages, and notes that ‘tone sandhi rules can exist only in [restricted tone] languages (as well as in genuine tone languages) and cannot exist in [pitch accent] languages.’ According to Beckman 1986: ‘unlike tonal alternations…accentual alternations…are best described as the suppression of an accent in order to preserve the culminative principle of one primary accent per lexical unit’. Odden 1999 considers the history of analysis of Bantu pitch-accent systems (e.g. Tonga), and concludes that

[6] This point is essentially echoed by Hulst and Smith 1988:ix: “What we will suggest here is that a simple division among the Non-stress cases into two categories (Pitch Accent Language – Tone Language) represents a gross over-simplification of the facts. Rather, it seems to be the case that languages employing non-intonational pitch distinctions make up a continuum that from a theoretical point of view should be approached in terms of a set of parameters that seem to define systems as being more typically “Tone Languages” or more typically “Pitch Accent Languages”.”

such languages could just as well be analyzed as having restricted tone. However, he stops short of saying that pitch-accent has no theoretical status as a typological prosodic category.

## 5.2 Pitch Accent vs. Stress

Less attention has been paid to distinguishing stress and accent languages than has been paid to the distinction between stress and tone languages. Beckman 1986 suggests that the distinction is primarily phonetic, and provides production and perception evidence from Japanese vs. English for her 'stress-accent hypothesis'; namely, that 'stress accent differs phonetically from non-stress accent in that it uses to a greater extent material other than pitch.' In her production study, she found that the phonetic correlate of Japanese accent was pitch only, whereas the phonetic correlates of English 'stress-accent' were pitch, duration and amplitude. In her perception study, she found that monolingual American English speakers' judgments of stress in stimuli derived from English words were based on pitch, total amplitude, spectral qualities, and duration, although there was some variability among the American English speakers. In contrast, Japanese speakers judging initial vs. final accent in Japanese-derived stimuli consistently judged only pitch as a reliable cue to accent placement; duration, total amplitude and spectral qualities were "completely ineffective" cues (p. 184).

Beckman 1986:1 ff. proposes that stress and accent are two closely related notions, which she defines as follows. '"accent" means a system of syntagmatic contrasts used to construct prosodic patterns which divide an utterance into a succession of shorter phrases and to specify relationships among these patterns which organize them into larger phrasal groupings.' Accent serves an 'organizational function', in that 'in any given utterance, more prominent portions alternate and contrast syntagmatically with less prominent portions, creating a series of accentual phrases that are delimited by or centered around the prominent portions.' In contrast, "stress" means a phonologically delimitable type of accent in which the pitch shape of the accentual pattern cannot be specified in the lexicon but rather is chosen for a specific utterance from an inventory of shapes provided by the intonation system.'

Adding to the confusion in the use of these terms, 'accent' is also used in the intonation literature to refer to a 'prominence-lending pitch movement … a rise, fall, or combination of the two' which is added to a 'word or a word group...in focus' (Sluijter 1995:2).

### 5.3 Yakima Sahaptin as a Pitch-Accent Language

The best agreed upon characteristics of pitch-accent in comparison with canonical stress on the one hand and tone on the other are summarized in (28), which is based on the references cited in 5.1-5.2 and also draws on work by Alderete 1999, Gomez-Imbert 2001, Hyman 2001, and Yip 2002. The last three characteristics in (28) are from Beckman 1986, from her explicit comparison of stress and pitch-accent (tone is not compared with respect to these traits). It can be seen that there is overlap in the characteristics of all three types of prosodic systems, as noted in the literature:

| (28) | stress | pitch-accent | tone |
|---|---|---|---|
| predictability | stress may or may not be predictable | location of accent may or may not be predictable | location of tone may or may not be predictable |
| surface contrasts on monosyllables | no | accented vs. unaccented | more than binary contrasts on monosyllables possible |
| underlying contrasts on morphemes | unstressed vs. stressed | accented vs. unaccented | no tone vs. tone(s) (of particular quality(s)) |
| possible phonological phenomena | one accent per domain<br>alternating stress<br>resolve stress clash | one accent per domain<br>accent shifts | tone sandhi<br>tone spread<br>OCP, dissimilations |
| pitch contour | stress has various possible phonetic correlates, including pitch | pitch predictable from underlying accent | pitch predictable from underlying tone |

| | | | |
|---|---|---|---|
| distinctive load[7] | ? | relatively small number of minimal pairs; relatively predictable 'accentual pattern' | relatively large number of minimal pairs; morphemes may consist of tone alone |
| probable historical origins | ? | 'rephonologization of tone' (Clements and Goldsmith 1984) or 'grammaticalization of intonation' (Hyman 1977) | reanalysis of originally segmental contrast |
| attitude by native speakers | ? | suprasegmentalization makes sense to native speakers | may be puzzled by linguist's suprasegmentalizatio n analysis of tone |

It can also be seen from (28) that pitch-accent appears to be a special case of stress, with a syndrome of characteristics defining a pitch-accent language as such: phonetic realization of stress as high pitch, division of morphemes into accented vs. unaccented, unpredictable location of accent within a morpheme, and the marking of culminativity within a certain domain the phonological phenomenon universally found in such languages. As reviewed in §3, YS appears to have all of the predicted characteristics of a pitch-accent language, including realization of accent with a predictable pitch contour, in this case the high pitch which is often attracted to stress and which stress often attracts (de Lacy 2002).

## 6 Future Work

Our study of the phonetic characteristics of accent in YS raises a number of areas for possible future investigation.

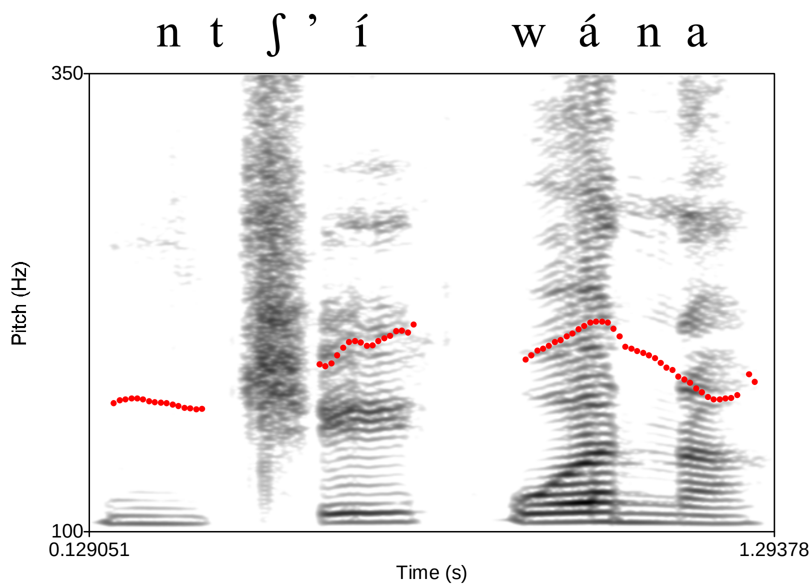
[7] defined as 'the relative amount of work they do as distinctive features' (Beckman 1986:36)

### 6.1 Compounds and Phrases

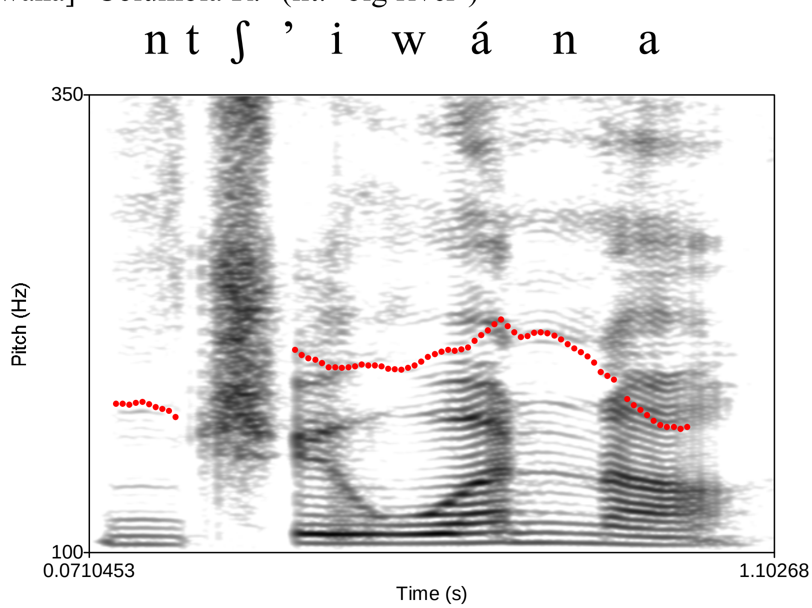
The predictability of accent in compounds and phrases is not entirely clear at this time. However, it appears that normally both phrases and compounds surface with a pitch peak on each word of the phrase/compound.

Some lexical items contrast with homophonous phrases in that the lexicalized form contains one accent whereas the fully compositional form contains two accents. One such pair is given in (29)-(30):

**(29)** [ntʃ’í wána] ‘big river’




**(30)** [ntʃ’i wána] ‘Columbia R.’ (lit. ‘big river’)



Such contrasts are reminiscent of another distinction that we have noted (Hargus and Beavert 2002a) in reduplicative compounds: single vs. double applications of [ɨ] epenthesis within certain sonorant initial clusters; e.g. [wɨχáwχa] 'feet, legs' (collective pl.) vs. [wɨχá wɨχa] 'feet, legs' (distributive pl.). We have analyzed this as one Prosodic Word vs. two Prosodic Words.

## 6.2 Intonation

Beckman 1986:5 notes that 'it is impossible to give an adequate description of the production and perception of accent patterns in English without describing at the same time the phonetic and phonological structures of intonation.' Some very basic questions about the relation between stress and intonation in Sahaptin remain to be answered. Is there a system of intonation pitch contours in addition to the word accent system? If so, are there different boundary intonational contours associated with different types of sentences (declarative, yes/no question, *wh*-question, imperative, etc.)? Do certain words or certain syntactic structures within a sentence attract the highest intonation peaks? If there is downdrift within a sentence, does pitch reset itself with every sentence, or perhaps with every clause (in the case of complex sentences)?

The YS words which were the subject of the acoustic study in §4 were recorded in isolation. This method had the advantage of not introducing a focus-driven pitch on such words which might override the inherent stress. However, recording and analyzing words within two types of carrier phrases, one with focus on the target word and one with focus on some word in the carrier phrase, along the lines of the study carried out by Sluijter 1995 for Dutch,[8] could shed further light on the acoustic characteristics of stress/accent in YS.

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[8] In one experiment, Sljuter recorded target words contrasting in stress in two types of carrier phrases:

| | initial stress | final stress |
|---|---|---|
| accent on the target | Wil je KAnon zeggen (en niet liedje) | Wil je kaNON zeggen (en niet geweer) |
| | 'Will you canon say (rather than song)' | 'Will you cannon say (rather than rifle)' |
| no accent on the target | Wil je **ka**non ZEGgen (en niet opschrijven) | Wil je ka**non** ZEGgen (en niet opschrijven) |
| | 'Will you canon say (rather than write down)' | 'Will you cannon say (rather than write down)' |

See Sluijter 1995:44 ff. for more information.

### 6.3 Secondary Stresses

According to Rude 1988, '[secondary stress] is predictable in bisyllabic reduplication, e.g. k'ùsik'úsi 'dog', and is regular in the imperfective past -*shana* [ʃana] and [habitual past] –*x̲ana* [χana]. It is not at this time clear whether the secondary stress is always predictable.'[9] Rigsby and Rude 1996 note that 'nondistinctive secondary and lesser stresses occur phonetically … but are not discussed here.' Jacobs 1931:117 indicates that presence/absence of secondary stress may differentiate Sahaptin dialects. He writes that in the northwest Sahaptin dialects (which include YS) 'ordinary words have only one syllable accented and no secondary stress … whereas in the Umatilla reservation dialects that may be two, three or four accented syllables to a word.'

Hargus and Beavert 2002a found support for secondary stress in YS from reduplication and from certain asymmetries between prefixes and suffixes. Hargus and Beavert 2002b identified a phenomenon which we called Destressed High Vowel Deletion. Unstressed /i u ɨ/ delete unless an illicit cluster would be formed, with the further restriction that /i u/ must be adjacent to a homorganic glide in order to delete. The examples in (31) illustrate the deletion of [ɨ]. The first example contains the third person singular nominative prefix [i]-, an unstressed prefix, whereas the second contains [á]- absolutive, a stressed prefix. Both are prefixed to a root with underlying stress on the first syllable.

(31) /pɨ́tja/- 'spear'

| | |
|---|---|
| /i-pɨ́tja/ | [májtsqi ipɨ́tja] 'she speared it this morning' |
| /á-pɨ́tja/ | [májtsqiiʃ áptja] 'I speared it this morning' |

In the second example, deletion of [ɨ] has taken place because the surface stress falls on the prefix, and with the removal of the stress from the vowel [ɨ], the vowel too disappears. In Hargus and Beavert 2002a we reported that whereas deletion of destressed [ɨ] regularly takes place when stress shifts to a prefix, this was not the case with suffixes:

9 Note that in YS, 'dog' is [k'usík'usi]; cf. [k'úsi] 'horse'.

| | | | |
|---|---|---|---|
| (32) | /pɨ́tja-ɬá/ 'spear'-agentive | [pɨtjaɬá] | 'spearer' |
| | | cf. [ptjaw] | 'mink' |
| | /amɨt-mí/ 'grey squirrel'-genitive | [amɨtmí tánawit] | 'the grey squirrel's den' |
| | | cf. [pamt] | 'nephew' |
| | /pajúwi-t-pamá/ 'be sick'-gerundive-'for, concerning' | [pajuwitpamá] | 'hospital' |
| | | cf. [ɨwájwiʃ] | 'collar, necklace' |

We suggested that the presence of the destressed high vowels in the examples in (32) could be accounted for if they carried a secondary stress. Since unstressed high vowels would basically be deleted in analogous contexts, these data suggest that the difference between secondarily stressed and unstressed vowels may involve duration (i.e. some vs. no duration).

The phonetic correlates of the possible secondary stresses noted by Rude 1988, Rigsby and Rude 1996, and Hargus and Beavert 2002a remain to be investigated. Although the experiment reported in §4 showed that duration is not a phonetic correlate of primary stress, the phenomenon mentioned above suggests that duration may be relevant for secondary stress. In future experimental work on Sahaptin stress, it would be good to test the phonetic correlates of secondary stress relative to both primary stressed and unstressed syllables. However, in practice it may be impossible to construct examples which control for all confounding factors. Note that if secondary stresses can be shown to exist in YS, this would set YS apart from canonical pitch-accent languages, where secondary stresses are not reported.

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