Vowel duration in Upriver Halkomelem*

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There are various claims in the literature concerning the existence and role of vowel length in Upriver Halkomelem (UH), from compensatory lengthening (Elmendorf and Suttles 1960), to a general process targeting stressed vowels (Kava 1972, Brown and Thompson 2005), to a separate phoneme marking a morphological operation (Galloway 1993). There has not as yet been an instrumental study of vowel length in UH, a gap that this paper seeks to address. Based on the nature of the claims made it is predicted that UH will display a tri-modal distribution of full vowel length[1] corresponding to unstressed vowels, stressed vowels, and stressed vowels that are further targeted by morphology.

1 Introduction

There is an opposition introduced in Peterson and Lehiste (1960) between languages for which '...a meaningful difference may be associated with a change in the duration of a consonant or vowel' and those for which '...changes in duration of a sound may be determined by the linguistic environment' (693). Whether these authors intended this to be interpreted as a choice between mutually exclusive options or not, the available literature on Upriver Halkomelem suggests that both forces may be at work in the language. That is to say, it has been claimed both that vowel length is contrastive in certain contexts (e.g. Galloway 1993), and that it is the result of (phonologically real) lengthening of stressed vowels (e.g. Elmendorf and Suttles 1960, Brown and Thompson 2005). There has yet to be any experimental confirmation of these claims, and it is to this issue that this paper is addressed.

In a survey of the Halkomelem dialect continuum[2], Elmendorf and Suttles (1960) note that, among other innovations, the Upriver dialect lost both

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[1] The duration of schwa is not considered in this paper, but could very well add a fourth distinction.

[2] The three main branches of Halkomelem are Downriver, Upriver, and Island, with further subdivisions historically (cf. Gerdts 1977). There are fewer than 80 native speakers across all dialects, but active revitalization programs are in place in the communities.

glottalized resonants and coda glottal stops. They found also that loss of laryngeal activity in codas triggered what can be analyzed as compensatory lengthening of stressed vowels. Where vowel length in the Upriver dialect does not correspond to the presence of a glottal stop in the other dialects, Elmendorf and Suttles treat it as an extension of the compensatory lengthening. In a more focused study that looks only at vowel length across the dialect continuum, Kava (1972) reports a number of these cases where no loss of glottal stop or glottalized resonant could be postulated. She argues that the existence of these other forms could be the result of a reinterpretation of closed syllables as open in UH, and subsequent lengthening of stressed vowels, or as the reinterpretation of open syllables as closed in the other dialects, with the concomitant shortening of the vowel. Gerdts (1997) notes however that length is not in fact peculiar to the Upriver dialect, and that it's presence in the Island and Downriver dialects presents a difficulty for a phonemic analysis of length in Upriver. Brown and Thompson (2005) argue that it is a matter of phonologization of length on stressed vowels, and thus that one would expect phonologically real length (as opposed to phonetic lengthening that typically accompanies stress) to be a general property of stressed vowels in UH. It should be said though that the specific mechanism employed in that account to achieve this only forces heads to be *prominent* within feet. Prominence can be achieved via tonal contrast as well durational (Mellander 2003). It has been argued independently that UH has arranged its phonetic cues such that the functional load of pitch can be increased (Brown and Thompson 2005a,b). Thus it is possible that the prominence needs can be met tonally, rather than by means of durational contrast. Nonetheless, there is reason to assume that lengthening of stressed vowels is a robust pattern, and this study proceeds on the assumption that it is worth checking how robust that pattern is.

Vowel length is given a different treatment altogether in Galloway (1993), where it is itself referred to as a phoneme[3]. While morphologically simplex minimal pairs are exceedingly difficult to find[4], there is a morphological operation[5] that is signaled by or results in vowel lengthening. Depending on the stress pattern of the unmarked form, this can have different results. For instance, when stress falls on the second syllable, application of this morphology will result in a long vowel in the initial syllable, referred to by Galloway as stress shift. If, on the other hand, the initial syllable already bore stress, it is marked orthographically as long, suggesting that again, length is playing a role.

If *all* of these claims are correct, then the expectation ought to be that UH will display a tri-modal distribution of (full) vowel length. Unstressed vowels will be distinguished from stressed vowels, which will in turn be distinguished from underlyingly stressed vowels that are augmented via the

[3] He actually claims that length is the phoneme, and that it can follow all vowels except schwa and certain consonants intervocalically. I am not concerned with geminates in this paper though, restricting my attention only to long vowels.
[4] I have come across two so far.
[5] The morphology referred to here is [PLURAL], and can operate across nominal and verbal domains.

aforementioned morphological operation (stressed+). I believe the prediction regarding underlyingly unstressed vowels that are targeted by that operation (unstressed+) is that they will pattern with 'normal' stressed vowels. This study is intended to provide instrumental verification (or falsification) of these predictions.

2 Methods

Due to constraints on the availability of our consultant, I've taken an opportunistic approach to data in this study. Thus there are a few sources represented in the sample set from which measurements were taken. All data comes from a single 88 year old speaker, one of two native speakers remaining. A number of tokens came from an elicitation in which the word list found in Kava (1972) was elicited in a carrier phrase (*'chel x̱ete __ qelat'* – 'I said __ again'). Several are from a separate session in which words from the Halkomelem dialect survey in Gerdts (1977) were reproduced, also in the carrier. The bulk of the tokens though come from the Halkomelem Talking Dictionary[6]. These were not placed in a carrier phrase, but were not elicited in a list format. Rather, the speaker was prompted with a word in UH, and with the English translation if necessary.

All of the tokens in the first two sets were recorded using a Marantz PMD-670 solid state recorder, and were transferred to computer for editing and analysis. The editing, which consisted only of isolating the tokens, was done in GoldWave 4.2/5.0, and the analysis was performed using PRAAT 4.3.12. Some of the tokens from the Talking Dictionary were recorded and processed using the same equipment and software, while others were recorded in a sound studio before being processed along the same lines as the rest.

Several types of vowels were not included in this study. Word-final vowels were typically excluded, particularly in the set taken from the dictionary, to avoid the interference of final lengthening[7]. Vowels involved in reduplication, whether in the base or the reduplicant, were not included either, due to potential complications involving underlying vowel quality. The presence of reduplication itself was not grounds to throw out a token – if a vowel elsewhere in the root was unaffected (i.e. not in the reduplicant or the reduplicated portion of the root) it was considered admissible. Care was taken to ensure that only full vowels are represented in this study, to the exclusion of schwa and it's allophones, so if a vowel was underlyingly a schwa or if it did not sit within the range of a given full vowel on the vowel chart[8] it was not included.

Duration measurements were taken for full vowels in unstressed, stressed, and morphologically targeted positions. As has been previously noted (e.g. Peterson and Lehiste 1960), the principle task in measuring durations is

[6] Tl'i Sqwá:l Pekw (Halkomelem Talking Dictionary) © Stó:lo# Shxwelí Halkomelem Language Program 2005. Used with kind permission of the Sto:lo Nation.
[7] Two forms for which this was demonstrably not the case were included – pékcha and pésk'a.
[8] See the appendix for Elizabeth Herrling's vowel chart.

segmentation – determining where the boundaries of a given segment lie. The difficulties noted in that study, largely centering around voiced obstruent and liquid codas, did not factor into the current study – UH does not have a voiced stop series, and the only liquid (l) consistently displays a marked reduction in energy in the higher formants.

There were also issues involving the stop series. Voiceless stop onsets were followed by a period of aspiration, with the exception of a few tokens with unaspirated allophones[9]. Measurement of the vowel in these cases started at the onset of voicing. With the ejective series, there was typically a lapse between release of the glottal closure and onset of voicing. Again, the onset of voicing was taken as the starting point of the vowel.

Determining the end of the vowel portion of a token was occasionally more difficult for vowels followed by voiceless stops than for other types of segment. Regardless of whether the following consonant was a coda or the onset of the next syllable, the period immediately before it was characterized by a significant drop in energy at all frequencies. Typically, some, but not all, of this period was marked by an continuation of the formant structure of the vowel, after which there was little to no activity registering on the spectrogram until the next segment. In these cases, I took the end of recognizable formant structure to signal the end of the vowel, regardless of the amount of energy in the formants.

Glides were of course a challenge, and it is here in particular that the role of what Peterson and Lehiste refer to as 'human judgment' came into play. In the ideal cases, landmarks such as a noticeable change in energy in the 2nd and 3rd formants matched up with my perception of on/offsets. At worst, these measurements may be off by a few pulses. In the end, however, tokens bounded on either side by a glide make up only about 10% of the sample population, and the distribution of vowel lengths within that group is consistent with norms established over the entire population.

As the measurements were taken, they were recorded in an Excel spreadsheet, where they were coded for stress value as follows: 0 = unstressed; 1 = stressed; 2 = unstressed+; 3 = stressed+. For a given vowel, the durations across the different stress values were compared.

3 Results

Given the nature of the constraints under which this study was conducted, certain vowels are better represented than others. [ɪ] happens to be the most commonly found vowel across all stress values. [æ] only appears 5 times at the '3' value, while unstressed [ɑ] is only found 3 times. This distribution has led to the following strategy: the data has been assembled from comparisons across [ɪ], but only from the stressed/unstressed set for [æ], and only from the stressed/stress+ set for [ɑ].

[9] See Galloway 1993:17-18 for discussion of aspiration.

The following graphs give the averages across the relevant stress values for a given vowel.

Figure 1: Average durations for [ɪ]

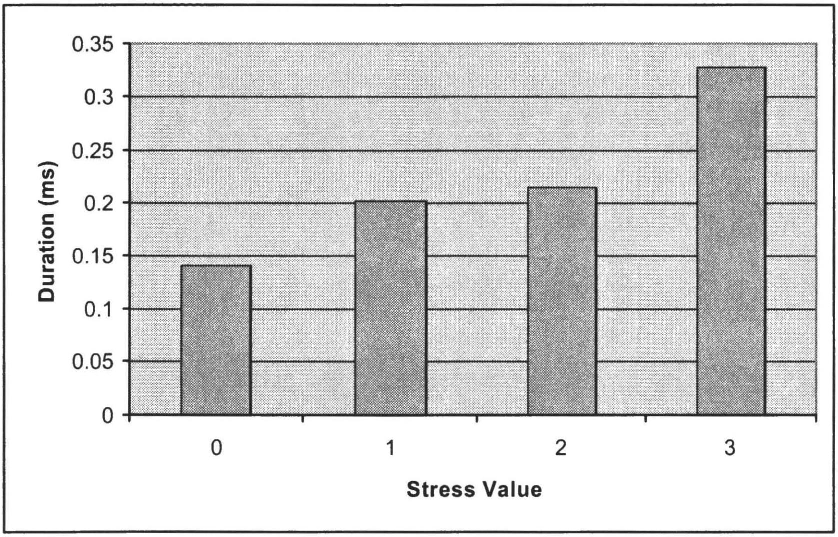


Figure 2: Average durations for [æ]

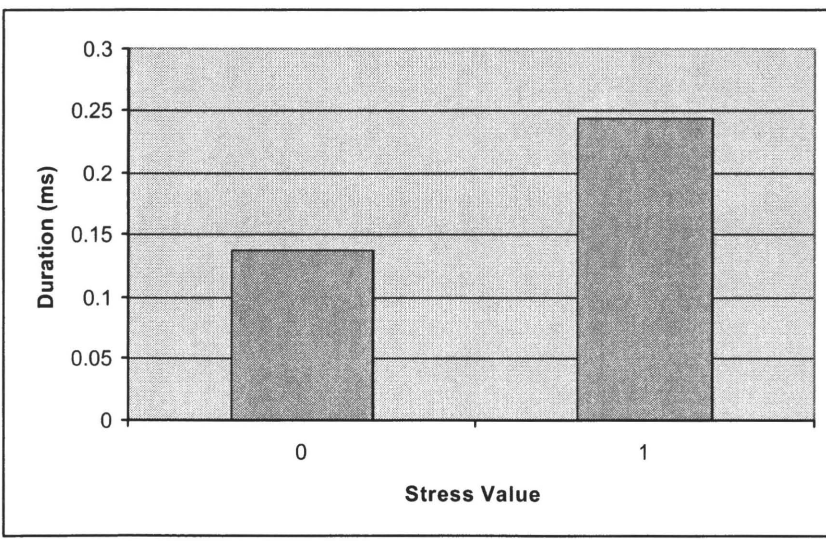
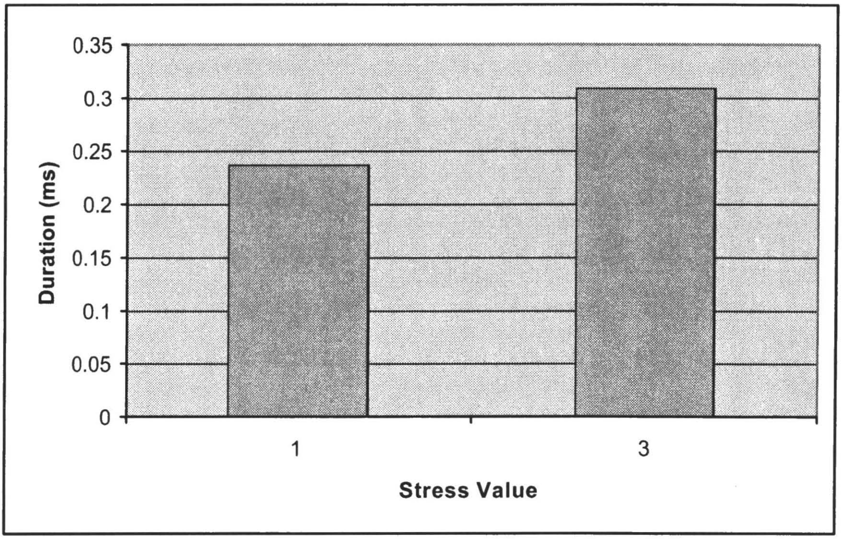


Figure 3: Average durations for [ɑ]



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While the sample size is small (138 total measurements), the kinds of *p-values* generated by this set are fairly suggestive. Again, given the relative distribution of tokens per stress value per vowel, much of the evidence will be drawn from [ɪ], while results from the comparison of [æ] 0 and [æ] 1 and that of [ɑ] 1 and [ɑ] 3 will play supporting roles. Because none of the sets of measurements had the same number of tokens, a number of tokens equal to that of the smaller of two sets were randomly selected from the larger. Table 2 gives these figures.

Table 1: P-values for comparisons between stress values[10]

Vowel/ Comparison	0 ~ 1	1~ 2	2 ~ 3	1 ~ 3
[ɪ]	< .001	ns	< .001	< .001
[æ]	< .001	n/a	n/a	n/a
[ɑ]	n/a	n/a	n/a	< .05

Thus we see that (where sufficient tokens were available for measurements) the contrast in duration between unstressed (0), stressed (1), and stressed+ (3) forms are highly significant, while that between stressed and unstressed+ (2) is not significant. Despite the low sample size, I take the strength of (most of) the *p-values*, in either direction, to suggest that these relationships are likely to hold up with greater numbers.

4 Discussion

There are several points to be made on the basis of these data. Perhaps the most striking of these is that there is indeed a tri-modal distribution of vowel length. The averages show a clustering around three different values, and these clusters correspond to unstressed, stressed, and stressed+ vowels. This immediately leads to a second observation, namely that the prediction concerning the patterning of unstressed+, or stress value 2 vowels, was born out. This can be seen in table 1 in the comparison of 2 to 1 and 3 – while the difference between stressed vowels (1) and unstressed+ vowels (2) is statistically insignificant, the difference between unstressed+ and stressed+ (3) is highly significant.

There is also a lack of any real support for claims regarding the inherent duration of vowels in UH. While Peterson and Lehiste (1960) show through a reduction of potentially confounding variables that English vowels fall into two classes with respect to inherent durations, they note up front that other research (Zimmerman and Sapon 1958) had at that point suggested '...that such observed variations are a part of the phonetic system of English rather than a general principle applicable to all languages induced by physiological factors' (693). The available data on UH do not at this point display any clear trends across all stress classes that would point to any natural classes of vowels with respect to duration – there is significant overlap in duration at a given stress value across all vowel types. However, the assembled data does not reflect controls for syllable type (open or closed), or onset/offset types. Perhaps a more nuanced approach along those lines would clarify this, though it is equally possible that there really is no such inherent distinction to be made here.

[10] A comparison between the 0 and 3 stress values is omitted in this chart, but given that the average duration of the latter is more than twice that of the latter I assume this difference would be highly significant.

5 Conclusion

It was suggested in this paper that vowel length is indeed phonologically in Upriver Halkomelem, in accordance with two separate kinds of claims made in the literature. On the one hand, duration appears to be significant in marking the contrast between stressed and unstressed vowels, supporting claims made in Kava (1972) and Brown and Thompson (2005) regarding the lengthening of stressed vowels. On the other, the likely significance of duration in registering a morphological operation as it applies to an underlyingly stressed vowel was shown, supporting the claim in Galloway (1993) that length is contrastive in UH.

The next step in terms of future research is to attempt more elicitation, so as to both control for as much as possible and to generate data sufficient to validate the claims made here.

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Appendix: Elizabeth Herrling's Vowel Chart

It was necessary in conducting this study to get a sense of an UH speaker uses her vowel space, i.e. where her vowels are acoustically located in relation to each other. After several measurements, two things became somewhat clear: 1) EH's full vowels vary consistently along F2/backness and 2) schwa (as has been noted before, e.g. Shaw 2001) is distributed quite widely throughout the insides of the vowel space. The figures given below serve to illustrate both points.

Table 2: Vowel 'Chart' for UH

Vowel/Formants	F1	F2
ɪ	400-420	2100-2400
ɛ	470-500	2000-2300
æ	600-625	1550-1800
ɑ	700	1100-1350
u[11]	400-450	700-1000
ə	550	1750
ə	625	1350
ə	550	1100-1200

[11] This segment has relatively recently been introduced into the Halkomelem dialect continuum via loans (cf. Suttles 2004 for Musqueam).