Dialectal Differences in Lushootseed Vowels*

Ted K. Kye
University of Washington

Abstract: This study compares two speakers from the Northern dialect and the Southern dialect of Lushootseed. It was claimed that there were differences in the realization of the vowels /i/ and /u/ between the two dialects (Hess & Hilbert 1976; Zahir 2019), where the Southern dialect tends to realize /i/ as [e] and /u/ as [o], whereas the Northern dialect tends to realize /i/ as [i] and /u/ as [u]. This study tests this claim by conducting an acoustic phonetic analysis on formants (F1 and F2) of each vowel and comparing them between the two dialects. The findings showed that there was little-to-no systematic differences in the vowel qualities between the two dialects. This paper concludes with a discussion on dialectal differences in vowel quality in Lushootseed.

Keywords: Northern Lushootseed, Southern Lushootseed, formants, vowels, normalization, dialects

1 Introduction

Lushootseed is a Coast Salish language that has four vowels in its phonemic inventory: The close front /i/, close back rounded /u/, open central /a/, and the schwa /ə/. Dialectal differences in the realization of some of these vowels have been documented in the literature (Hess & Hilbert 1976; Snyder 1957; Zahir 2019). According to Hess and Hilbert (1976) and Zahir (2019), Northern Lushootseed tends to realize /i/ as [i] and /u/ as [u], whereas Southern Lushootseed tends to realize /i/ as [e] and /u/ as [o]. However, both sources note that these were tendencies and were not absolute. Snyder (1957) transcribed the vowels phonemically as /e/, /o/, and /a/ for speakers of Southern Lushootseed, stating that [i] and [u] were free variations of /e/ and /o/ respectively.

However, systematic phonetic analysis on the realization of vowel qualities in Lushootseed has not been conducted. Although it was claimed that the Southern dialect realizes /i/ as [e] and /u/ as [o] (where Snyder (1957) even transcribed these two vowels phonemically as /e/ and /o/, respectively), an acoustic phonetic analysis that compares the formants of these vowels between the two dialects has not been conducted to confirm these claims. In this paper, I conduct an acoustic phonetic analysis to compare the formants of each vowel between the two dialects. Based on my own impressionistic analysis of the vowels /i/ and /u/, the vowels did not sound different between the two dialects. As we will see in the following sections, there are little-to-no systematic differences in the vowel qualities between the two dialects.

* Many thanks go to the Burke Museum for making these recordings available. I would also like to thank Laurel Sercombe of UW's Ethnomusicology Archives, who gave me the privilege to access these recordings. Special thanks go to the late Leon Metcalf, who spent about five years tape-recording elder speakers of Lushootseed during the 1950s. I would also like to acknowledge the family members of the speakers in this study: Denise Bill (great-granddaughter of Annie Jack Daniels), Will Bill Jr. (great-grandson of Annie Jack Daniels), Elise Bill-Gerrish (great-great-granddaughter of Annie Jack Daniels and daughter of Denise Bill), Justice Bill (great-great-grandson of Annie Jack Daniels and son of Will Bill Jr.); and Hank Williams (grandson of Martha Lamont), his daughter, and his (and Martha's) descendants. Most of all, I am strongly in debt to the speakers themselves: Annie Jack Daniels and Martha Lamont, renowned storytellers whose legacies will never be forgotten and forever be preserved in these recordings. May the language and spirit of Annie Jack Daniels and Martha Lamont continue to live on within their descendants.

Papers for the International Conference on Salish and Neighbouring Languages 58.
D. K. E. Reisinger, Laura Griffin, Gloria Mellesmoen, Sander Nederveen, Julia Schillo, Bailey Trotter (eds.). Vancouver, BC: UBCWPL, 2023.

2 Background

Lushootseed (ISO 639-3: lut) is a Coast Salish language that is spoken in the Puget Sound region of the Pacific Northwest (PNW). There are two regional dialects of Lushootseed: Northern Lushootseed (AIPA: *dxʷləšucid*) and Southern Lushootseed (AIPA: *xʷəlšucid* and *txʷəlšucid*). Figure 1 is a map of the distribution for these two dialects.

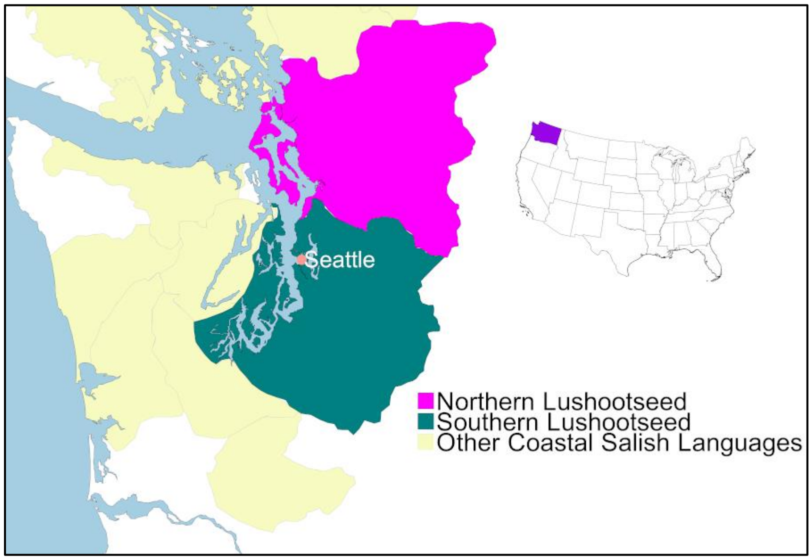

Figure 1: Regional dialects of Lushootseed (adapted from Thom 2011).

Phonological differences between the two dialects are not well understood. According to Hess (1977), the dialects differ by their placement of stress. For example, the first non-schwa syllable of a stem is the location of primary stress in the northern dialect, while the primary stress is always the first syllable of a stem in the southern dialect. As mentioned in Section 1, it was claimed that the vowels /i/ and /u/ tend to be realized as [e] and [o], respectively, in the Southern dialect, whereas the Northern dialect tend to realize these vowels as [i] and [u] (Hess & Hilbert 1976; Zahir 2019). As we will see in the following sections, there are little-to-no systematic differences in the vowel qualities between the two dialects.

Dialectal differences can also be understood based on some vocabularies and a few grammatical elements. For example, the conjunction 'and' (used to separate DPs) in the Northern dialect is *ʔi*, whereas the conjunction 'and' (used to separate DPs) in the Southern dialect is *yəxʷ*. Another example comes from the word 'traditional story or myth', which is *sx̌ʷiʔab* in the Southern dialect and *syəhub* in the Northern dialect. Another example of dialectal differences can be found in the use of determiners. The Northern dialect uses the form *tiʔəʔ* for the proximal demonstrative and *ti* for the definite determiner. However, the proximal demonstrative and definite determiner was leveled to *ti* in the Southern dialect.

The division between the Northern and Southern dialects reflects the current situation, which is based on recorded and extant speech varieties (Beck & Hess 2014). However, before European contact and the redistribution of the population to reservations, dialectal differences could be used to identify individual villages and households (Bates et al. 1994).

3 Methods

3.1 Speakers

To compare differences in vowel quality between the two dialects, two speakers (one Northern and one Southern) were examined. The Northern Lushootseed speaker was Martha Lamont (ML), and the Southern Lushootseed speaker was Annie Jack Daniels (AD). Martha Lamont (ML) was a female elder speaker of Northern Lushootseed. ML was identified as a Snohomish speaker and was born around the 1880s. Her descendants include Hank Williams (grandson), Hank's daughter, and his descendants. Annie Jack Daniels (AD) was a female elder speaker of the Southern dialect. AD was born near the Green River around the 1870s or 1880s. She was a Muckleshoot and Duwamish speaker who lived in the Muckleshoot tribal reservation. Her descendants include Iola Bill (daughter), Will Bill Sr. (grandson), Denise Bill (great-granddaughter), Will Bill Jr. (great-grandson), Elise Bill-Gerrish (great-great-granddaughter and daughter of Denise Bill), and Justice Bill (great-great-grandson and son of Will Bill Jr.).

3.2 Recordings

Lushootseed is classified as a language that does not have an L1 speaker remaining (Eberhard et al. 2021). To study the acoustic properties of Lushootseed vowels, recordings dating to the early 1950s were examined. These recordings come from the Metcalf Collection, which is part of University of Washington's Burke Museum's Special Collections (Metcalf 2015). These recordings were made by the musicologist Leon Metcalf in the early 1950s. Unfortunately, details on the kinds of instrumentation (i.e., what microphone or recording device) that was used to record these elders are lost (Miller 2005). However, these recordings come from analog reel-to-reel tapes. Some of the recordings were very clear[1]. The recordings used for this study were carefully selected based on their clear quality, which made them suitable for acoustic analysis. Each recording was digitized at 44.1kHz and a 16-bit depth. These recordings were later resampled to 22.05kHz to increase precision and attenuate high-frequency noise. From this collection, six recordings were examined. Five recordings (with a combined length of 44mins) were examined for the Southern Lushootseed speaker AD. These were recordings of traditional Salish myths. One recording (with a length of 8mins 16secs) was examined for the Northern Lushootseed speaker ML. This was a recording of a private correspondence.

3.3 Sampling procedure

Each of the vowels (i.e., /ə i a u/) were selected for analysis. At least 50 or more observations for each sample of vowels were examined. According to Kye (in press), uvular consonants have the coarticulatory effect of increasing the frequencies of the first formant (F1) and decreasing the frequencies of the second formant (F2) on adjacent vowels. To minimize the amount of consonant-vowel coarticulation from uvular consonants, vowels adjacent to uvular consonants were omitted from the analysis. Following the procedure of Kye (in press), vowels that were adjacent to glides were also excluded from the analysis because it was difficult to determine the onset and offset of vowels when adjacent to glides. When the voices of other speakers were present in the background,

[1] This was verified by professors Richard Wright (personal communication) and Sharon Hargus (personal communication) from UW's Linguistic department, who agreed that the recordings can be used for acoustic analysis.

vowels were excluded during these intervals. Both speakers would sometimes sing in these recordings. Vowels that occurred during these intervals were excluded from the analysis. Loud or abrupt noises that interfered with the speech signal (e.g., sounds of the door slamming shut) would sometimes occur in these recordings. Vowels that occurred during these intervals were excluded from the analysis. Vowels that followed a rounded obstruent (i.e., C^wV) were excluded from the analysis because the rounding of the consonant obscured the selection of the vowel's midpoint by rounding the vowel. This was not observed for stressed vowels that were followed by a rounded obstruent (i.e., VC^w), which is illustrated in Figure 2, where the preceding vowel (that is stressed) showed little (to no) effect of rounding (F2 lowering), while the following vowel showed a strong effect of rounding. Moreover, close back rounded vowels /u/ always occurred in C^wV environments. To increase the sample size for each vowel, stressed vowels that preceded rounded obstruents or the close back rounded vowel /u/ in C^wV environments were included in the data.

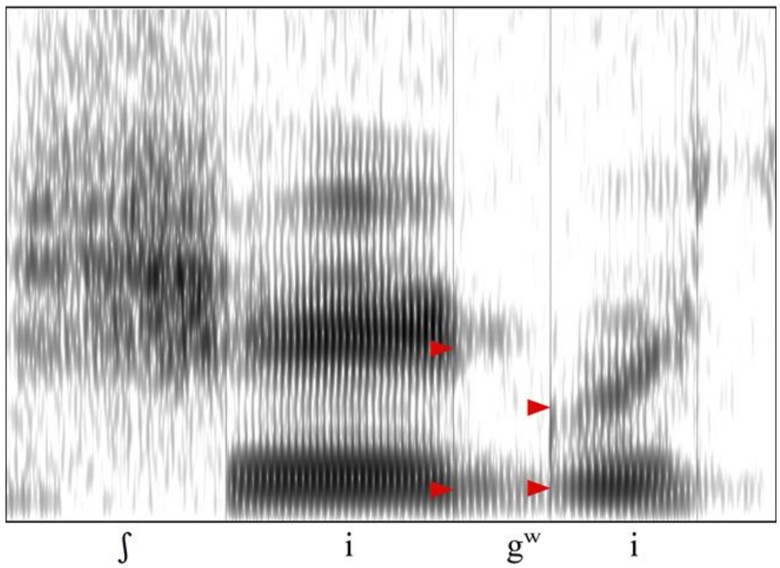

Figure 2: Formant transitions for the vowel /i/ in VC^w and C^wV environments for a labialized pulmonic velar stop. Arrows point to where the transition ends and where the transition begins.

3.4 Measurements

To obtain an approximation of vowel height and vowel backness, the first two formants were extracted from each selection. Each recording was annotated with a corresponding TextGrid, which was used to define each interval of the speech signal. The software that was used to analyze these recordings was Praat (Boersma & Weenink 2021). Formants were extracted at the midpoint of the total vowel duration. The script that was used to extract formants was the *Semi-auto formant analysis* by Daniel McCloy (McCloy 2014). The maximum formant setting was adjusted to 5500Hz for the speaker AD and 6500Hz for the speaker ML. The window length for the formant setting was 25ms with a dynamic range of 35dB. A broadband spectrogram was used to analyze the speech signal. The transient signal of the burst release noise was the start selection for vowels in syllables with initial stop consonants. The glottal pulse for voicing and/or the onset of visible formant structure was selected as the vowel's start selection for syllables initialized with a fricative, affricate, or ejective. End selections were made when the voicing of the vowel ended or if there were clear signs of dissipation of visible formant structure in the spectrogram.

3.5 Analysis

The software that was used to run statistics was *R-Studio* (2018). Formants were normalized by speakers using *z*-scores to remove unwanted variability in formants due to gross anatomical differences in individual vocal tract size and length, while preserving "desirable" variation of interest — i.e., differences due to linguistic or dialectal factors (Lobanov 1971; Adank et al. 2004; Watt et al. 2010; DiPaolo et al. 2005). A formant plot was used through the package *phonR* (McCloy 2016) to compare the distribution of each vowel (with the average normalized F1 and F2 plotted) in the formant chart (in the form of a vowel polygon). A two-sample *t*-test was used to test the mean difference of normalized F1 and F2 for each vowel between the two speakers.

4 Results

Table 1 summarizes the means and standard deviations of the raw F1 values for the two speakers AD and ML. As Table 1 summarizes, the raw F1 was slightly greater for the speaker ML than AD. However, the F1 of /u/ for the speaker AD was greater than the F1 of /u/ for the speaker ML.

Table 1: Raw F1 means and standard deviations (with 95% CI) for speakers AD and ML.

	AD			ML		
Vowel	*n*	*M (SD)*	*95% CI*	*n*	*M (SD)*	*95% CI*
ə	86	503 (72.54)	[487, 518]	119	532 (86.3)	[516, 547]
i	107	391 (27.82)	[385, 396]	81	418 (41.01)	[410, 428]
a	55	684 (75.88)	[664, 705]	77	731 (55.59)	[718, 743]
u	58	476 (40.29)	[464, 488]	86	456 (45.7)	[447, 465]

Table 2 summarizes the means and standard deviations of the normalized F1 values for the two speakers AD and ML. As Table 2 summarizes, the values of normalized F1 for the two speakers were approximately the same for three of the four vowels.

Table 2: Normalized F1 means and standard deviations (with 95% CI) for speakers AD and ML.

	AD			ML		
Vowel	*n*	*M (SD)*	*95% CI*	*n*	*M (SD)*	*95% CI*
ə	86	0.102 (0.63)	[-0.03, 0.24]	119	0.01 (.67)	[-0.11, 0.13]
i	107	-0.87 (0.24)	[-0.92, -0.82]	81	-0.87 (0.32)	[-0.94, -0.8]
a	55	1.67 (0.66)	[1.5, 1.84]	77	1.55 (0.43)	[1.46, 1.65]
u	58	-0.13 (0.35)	[-0.22, -0.04]	86	-0.58 (0.36)	[-0.66, -0.51]

Figure 3 is a boxplot of the normalized F1 values between the two speakers AD and ML.

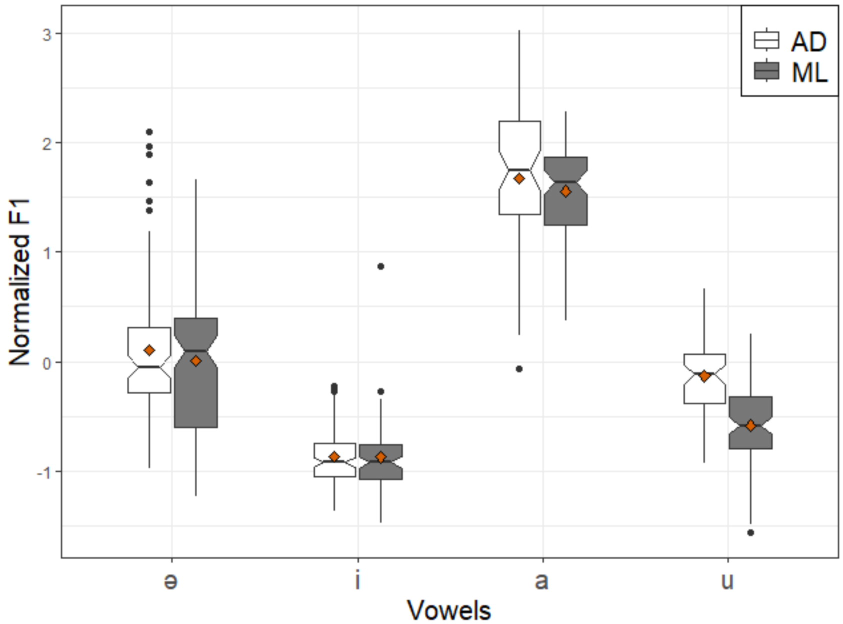

Figure 3: Boxplot for normalized F1, with means (represented in red diamonds) plotted. Box = 25%–75%, line = median, whisker = 10%–90%, black dots = outliers beyond 10%–90%.

Table 3 summarizes the means and standard deviations of the raw F2 values for the two speakers AD and ML. Like the raw F1 values, the raw F2 values were slightly greater for the speaker ML than AD. This was not the case for the close back rounded vowel /u/, which was greater for the speaker AD than ML.

Table 3: Raw F2 means and standard deviations (with 95% CI) for speakers AD and ML.

	AD			ML		
Vowel	*n*	*M (SD)*	*95% CI*	*n*	*M (SD)*	*95% CI*
ə	86	1521 (215.79)	[1475, 1567]	119	1558 (197.61)	[1523, 1594]
i	107	2014 (106.77)	[1994, 2035]	81	2122 (199.55)	[2079, 2166]
a	55	1484 (78.16)	[1463, 1505]	77	1493 (137.02)	[1462, 1524]
u	58	1302 (222.9)	[1243, 1361]	86	1128 (240.27)	[1077, 1179]

Table 4 summarizes the means and standard deviations of the normalized F2 values for the two speakers AD and ML. As Table 4 summarizes, the normalized F2 for the speaker ML was slightly greater than the speaker AD, suggesting that the vowels may have been slightly more fronted for the speaker ML than AD.

Table 4: Normalized F2 means and standard deviations (with 95% CI) for speakers AD and ML.

	AD			ML		
Vowel	*n*	*M (SD)*	*95% CI*	*n*	*M (SD)*	*95% CI*
ə	86	-0.38 (0.65)	[-0.52, -0.25]	119	-0.02 (0.5)	[-0.11, 0.07]
i	107	1.13 (0.33)	[1.07, 1.2]	81	1.41 (0.51)	[1.3, 1.52]
a	55	-0.5 (0.24)	[-0.56, -0.43]	77	-0.19 (0.35)	[-0.27, -0.11]
u	58	-1.06 (0.69)	[-1.23, -0.88]	86	-1.12 (0.61)	[-1.25, -0.99]

Figure 4 is a boxplot of the normalized F2 values between the two speakers AD and ML.

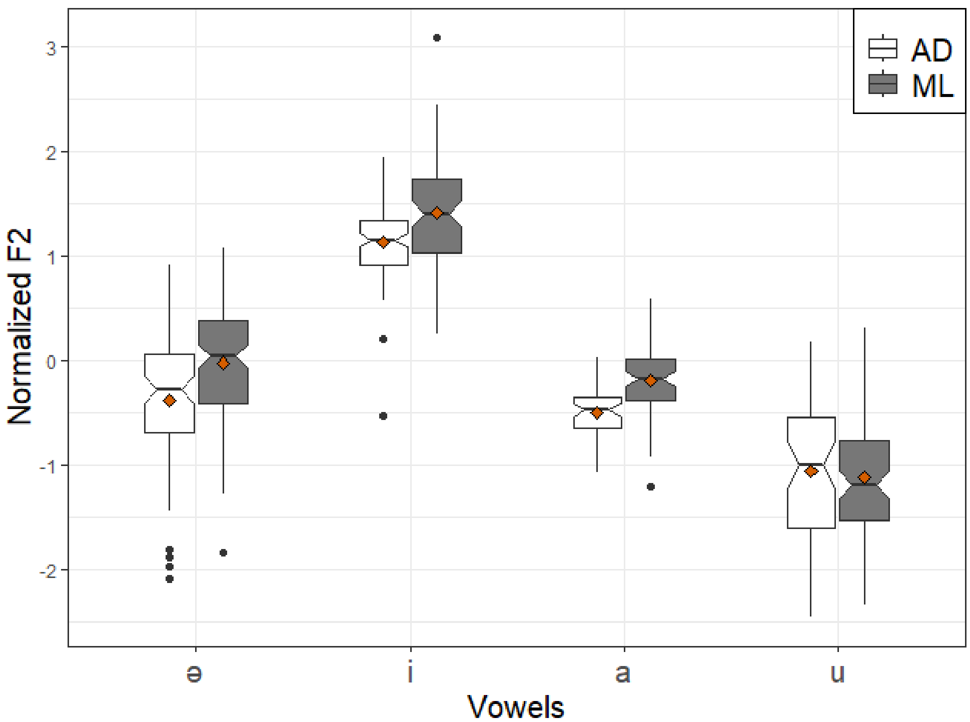

Figure 4: Boxplot for normalized F2, with means (represented in red diamonds) plotted. Box = 25%–75%, line = median, whisker = 10%–90%, black dots = outliers beyond 10%–90%.

Figure 5 is a formant plot (vowel polygon) plotting the means of the normalized F1 and F2 for each vowel, comparing the distribution of each vowel between the two speakers AD and ML. As Figure 5 illustrates, vowels /ə i a/ were slightly more front for the Northern Lushootseed speaker ML than the Southern Lushootseed speaker AD. The close back rounded vowel /u/ was slightly lower for the Southern Lushootseed speaker AD than the Northern Lushootseed speaker ML.

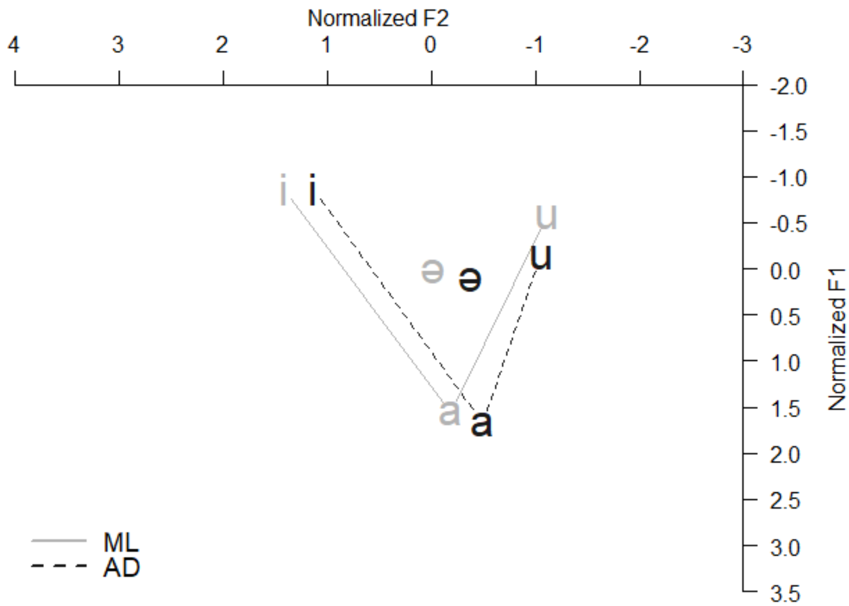

Figure 5: Vowel polygon plotting the means of normalized F1 and F2 (using *z*-scores) of each vowel from the two speakers AD and ML.

The one-degree-of-freedom contrast of primary interest (the mean difference between speakers AD and ML) for normalized F1 was not statistically significant for the schwa /ə/, $t(203) = 1.03$, $p = .305$; close front /i/, $t(186) = 0.047$, $p = .963$; and open central /a/, $t(130) = 1.21$, $p = .227$. However, the mean difference between speakers AD and ML for normalized F1 was statistically significant for the close back rounded /u/, $t(142) = 7.5$, $^{***}p < .001$.

The one-degree-of-freedom contrast of primary interest (the mean difference between speakers AD and ML) for normalized F2 was statistically significant for the schwa /ə/, $t(203) = 4.45$, $^{***}p < .001$; close front /i/, $t(186) = 4.57$, $^{***}p < .001$; and open central /a/, $t(130) = 5.64$, $^{***}p < .001$. However, the mean difference between speakers AD and ML for normalized F2 was not statistically significant for the close back rounded /u/, $t(142) = 0.58$, $p = .563$.

5 Discussion

As the results showed, the vowels /ə i a/ for the Southern Lushootseed speaker Annie Jack Daniels (AD) were not any lower than those of the Northern Lushootseed speaker Martha Lamont (ML). However, these vowels were slightly more fronted for the Northern Lushootseed speaker ML than the Southern Lushootseed speaker AD. The close back rounded vowel /u/ was slightly lower for the Southern Lushootseed speaker AD than the Northern Lushootseed speaker ML. These patterns do not corroborate how these vowels were previously transcribed and represented for these two dialects (Hess & Hilbert 1976; Zahir 2019; Snyder 1957).

Based on the findings, it is difficult to determine whether there were dialectal differences in the realization of vowel qualities. Although the current findings showed that the vowels /ə i a/ were slightly more fronted for the Northern Lushootseed speaker than the Southern Lushootseed speaker, it should not be taken as evidence for Hess and Hilbert's (1976) and Zahir's (2019) claim that the vowel /i/ tends to be realized more like [e] in the Southern dialect and more like [i] in the Northern dialect. As the results showed, the distribution of /i/ in the Southern dialect had about the same vowel height as the distribution of /i/ in the Northern dialect, suggesting that /i/ was not more-or-less lower (as in [e]) in the Southern dialect than the Northern dialect. In fact, the raw F1 values of /i/ looked like values that are expected of [ɪ] from female speakers of other languages, such as German, Gitksan, and some varieties of American English (Peterson & Barney 1952; Hagiwara 1997; Wassink 2015; Geng & Mooshammer 2009; Brown et al. 2016). It is slightly lower than /i/ for female speakers of these languages; however, it is not as low as Snyder's (1957) phonemic transcription of the vowel as /e/.

The only significant difference (with respect to vowel height) that was observed from the current data was the close back rounded vowel /u/, which was slightly lower for the Southern dialect than the Northern dialect. The distribution of /u/ (based on the raw formant measurements) was not as high as the distribution of /u/ for female speakers of languages such as English, German, Ja'a Kumiai, Bemba, and Gitksan (Hagiwara 1997; Wassink 2015; Peterson & Barney 1952; Geng & Mooshammer 2009; Mai et al. 2019; Hamann & Kula 2015; Brown et al. 2016). However, it appeared to be as low as the distribution of /u/ for female speakers of languages such as Kazak, Mono Lake Northern Paiute, and Khowar (McCollum & Chen 2021; Babel et al. 2012; Liljegren & Khan 2017). For this reason, the vowel can simply be transcribed as /u/ for both speakers. Moreover, the difference (while significant) between the two speakers was too subtle to suggest that there was an underlying difference in the vowel height of /u/ between the two dialects. In other words, it was difficult to determine whether /u/ was underlyingly lower for the Southern dialect than the Northern dialect.

6 Conclusion

The current findings showed that the vowels /ə i a/ were slightly more front for the Northern Lushootseed speaker than the Southern Lushootseed speaker, as well as /u/ being slightly lower for the Southern Lushootseed speaker than the Northern Lushootseed speaker. However, the differences were too subtle to suggest that there was an underlying difference in vowel height and backness between the two speakers. The current findings do not appear to confirm the claims made by Hess and Hilbert (1976) and Zahir (2019). The distribution of /i/ for the Southern Lushootseed speaker had about the same vowel height as the Northern Lushootseed speaker, which suggests that /i/ in the Southern dialect was not more-or-less like [e] than in the Northern dialect. Although there was a significant difference in the normalized F1 of /u/ between the two speakers, it was difficult to interpret this as evidence of /u/ being realized as [o] in the Southern dialect because the difference was too subtle.

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