The realization of /a/ in ay in Southern Lushootseed storytelling*

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Abstract: This study examines the realization of /a/ in /ay/ (IPA: [aj]) in Southern Lushootseed storytelling speech. It has been shown that /a/ is realized as an open central vowel (Kye 2021, 2023ab). However, upon impressionistic hearing, /a/ is variously pronounced as either [a] or [ɐ] when followed by the glide /y/ or /ẏ/ in storytelling speech. The goal of this study is to examine (a) whether acoustic measurements of the vowel /a/ in /ay/ matches these impressionistic observations, and (b) what predicts the realization of /a/ as either [a] or [ɐ] when followed by the glide /y/. The findings reveals that /a/ is sometimes realized as either [a] or [ɐ] when followed by the glide /y/. Moreover, /a/ in /ay/ is realized as [ɐ] when the duration of the vowel portion is shorter. These findings provide important implications on the effects of storytelling speech on vowel quality and vowel duration.

Keywords: Southern Lushootseed, storytelling speech, open vowel, reduction, formants

1 Introduction

Lushootseed is a Coast Salish language with only four contrastive vowels: /ə i a u/. Based on data from vowel formants of elder speakers, the vowel /a/ approximates closer to an open central vowel rather than an open back vowel (Kye 2023ab). However, after carefully hearing the vowel /a/ produced in storytelling speech, I have noticed that there were several instances where the vowel /a/ sounded closer to [ɐ][1] when followed by the palatal approximant /y/ (IPA: /j/) or /ẏ/ (IPA: /jˀ/). This does not happen all the time, however. Sometimes, I have encountered instances where the adverbial auxiliary *dayˀ* 'only' was variously pronounced as either [dɐẏ] or [daẏ]. A similar observation was made by Warren Snyder (1957) in the past.

In the 1950's and 1960's, the anthropologist Warren Snyder conducted field research on the Southern Lushootseed variety spoken by the Suquamish (*suq̓ʷabš*) (Snyder 1957). In his grammar of Southern Lushootseed (at the time, called "Southern Puget Salish"), Snyder described three contrastive vowels in Lushootseed: /e a o/. Snyder attested a wide range of free variation of these vowels, stating that the vowel /a/ was variously pronounced as [ə ʌ a]. Snyder argued that the schwa [ə] was a variant of /a/, and that the schwa [ə] was not contrastive from [a].

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[1] Here, I use the symbol [ɐ] to represent a range of pronunciations in the open-mid and mid central range, encompassing vowels that are used in the standard IPA as [ə ɜ ʌ ɐ].

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However, there are several examples of words in Lushootseed revealing that /ə/ is a phoneme. Later developments from Hess (1967) reveals that there is clear evidence of /ə/ being phonemic, where there are clear cases of contrastive distribution for /a/ and /ə/ from examples of (near) minimal pairs. Table 1 lists a few (near) minimal pairs (not an exhaustive list) illustrating the contrast between /a/ and /ə/.

Table 1 List of (near) minimal pairs illustrating the contrast between /a/ and /ə/ (from Bates et al. 1994)

/a/	**/ə/**
bak̓ʷ 'move rapidly'	bək̓ʷ 'all'
baɬ '(shaman) cures someone'	bəɬ 'full (from food or drink)'
c̓aʔkʷ 'wash'	sc̓ək̓ʷ 'worm (generic), bug'
c̓apx̌ 'cedar root; split cedar roots'	c̓əp̓ 'stagnant'
gʷad 'talk'	gʷəd 'down'
g̱ʷal 'overturn, capsize'	g̱ʷəl 'and'
k̓ʷaɬ 'examine, scrutinize'	k̓ʷəɬ 'pour, spill'
x̌aču ʔ 'lake'	x̌əč 'think, feel'

One argument that Snyder made to support his claim that [ə] is not a phoneme is that, according to him, schwas can never occur in reduplications (Snyder 1957:16). However, this is not entirely true. Schwas *can* occur in some of the reduplications. When the distributive reduplication (which is typically CVC+) is used on the word *bədaʔ* 'child, offspring', it reduplicates the first syllable of the word, as in *bədbədaʔ* 'children, offsprings'. Similarly, the distributive reduplication can be used on the word *sčətxʷəd* 'black bear', as in *sčətčətxʷəd* 'bears'. This suggests that the schwa can occur in reduplications in Lushootseed. Another argument that Snyder makes is that the schwa has no allophones, whereas the other three vowels have many. However, even though this argument doesn't prove that [ə] itself cannot be a phoneme, Snyder's assessment of the schwa as having no allophones is not entirely true based on later evidence. For example, Kye (2021) revealed that in uvular environments, all four vowels (including schwas) are more open and retracted, suggesting that there is a predictable environment (i.e., uvular environment) where the schwa is realized closer to [ʌ]. In unstressed environments, when the schwa /ə/ is followed by a labiovelar consonant (such as the labiovelar fricative [xʷ]), it becomes rounded, as in [ʉ] (Kye 2023b). This suggests that there is complementary distribution of the schwa [ə].

Despite being certain that the schwa has phonemic status in Lushootseed, there is one noteworthy observation that Snyder made from his impressionistic observations. There were three words that contained an /ay/ sequence in his grammar, where he transcribed it as *ʌy*. Snyder gives the following narrow transcriptions for these three words: *yóq̓ʷʌyʔ* (*yuq̓ʷay̓*) 'rotten stick', *sładʌy* (*sładayʔ*) 'woman', *sqʷubʌ́yʔ* (*sqʷəbayʔ*) 'dog' (Snyder 1957). The first two words is predictable because /a/ is often centralized in unstressed syllables. However, the /a/ is stressed in *sqʷəbayʔ* 'dog', and Snyder transcribed it as *ʌ*. There was one root containing the /ay/ sequence that Snyder did not narrowly transcribe as *ʌy*, but instead transcribed as *ay*, which was *uáytxʷčid* (*ʔuʔaydxʷ čəd*) 'I found it'.

The goal of this study is to examine the realization of /a/ in /ay/ in Southern Lushootseed storytelling speech, and address the following questions: (1) do acoustic measurements confirm these impressionistic observations; and (2) if so, what predicts the realization of /a/ as either [ɐ] or [a] in /ay/?

2 Background

Lushootseed (ISO 639-3: lut) is a Coast Salish language spoken in the Puget Sound region of the Pacific Northwest. The borders extend from south Puget Sound to north past the Skagit Valley, as well as the east parts of Kitsap Peninsula and western parts of the Cascades. Although there are no fluent L1 speakers today, there are several emerging L2 speakers of Lushootseed, as it is a revitalizing language. There are two dialects of Lushootseed: Southern Lushootseed and Northern Lushootseed. Figure 1 is a map illustrating the geographic distribution of Lushootseed, as well as the two dialects.

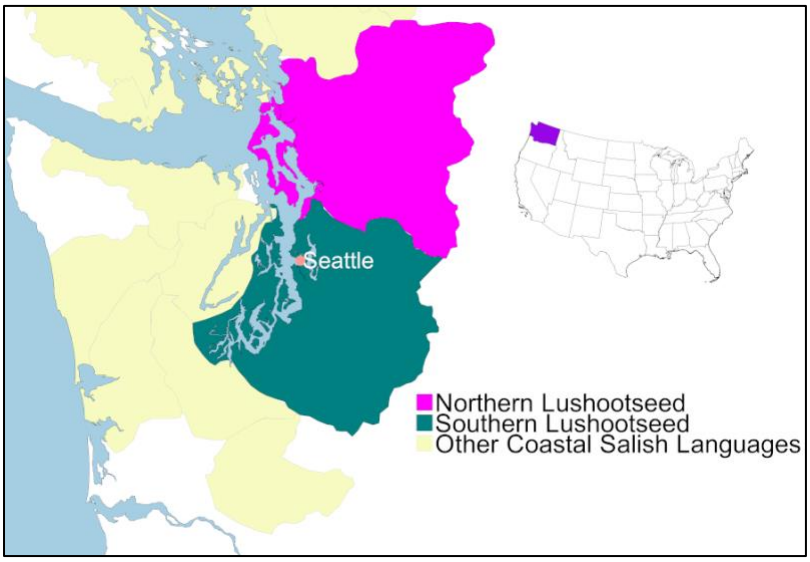

Figure 1: Geographic distribution of Lushootseed and its regional dialects (adapted from Thom 2011).

There are some phonological features that are unique to the Southern dialect. For example, the lateral approximant /l/ in the inchoative suffix *-il* is not pronounced (e.g., *sləx̌il* is realized as *sləx̌i*) when it occurs word-finally (and followed by a pause) or when it's followed by a word initialized with an obstruent (e.g., *łəčil ti stubš* 'the man arrived' is realized as *łəči ti stubš*). However, when the suffix *-il* is followed by a vowel-initial morpheme (such as the clitics *=əx*^{w} 'now' and *=əlg*^{w}*ə* 'they/them'), a suffix (such as the 3rd-person possessive *-s*, reflexive *-cut*, relational applicative *-bi-*, etc...), or unstressed particles that are initialized with a glottal stop (such as *ʔə* and *ʔal*), the lateral approximant is produced. This is not observed in the Northern dialect, where /l/ in *-il* is always pronounced, regardless of its environment.

There are also dialectal differences in the location of primary stress in a word. Hess (1977) notes that the first non-schwa syllable of a stem is the location of primary stress in the Northern dialect, while the primary stress is usually the first syllable of a stem in the Southern dialect. This can be observed in the word *təyil* 'go upstream', where the location of primary stress is on /i/ (as in *təyíl*) in the Northern dialect, while it is on the schwa /ə/ (as in *táyil*) in the Southern dialect.

3 Methods

3.1 Recordings

In this study, I examine legacy archival recordings dating back to the 1950's. These recordings come from the Metcalf Collection, which is part of the University of Washington's Burke Museum's Special Collections. These recordings were made by the musicologist Leon Metcalf, who spent over five years (1950-56) visiting and tape-recording several elder speakers of Lushootseed throughout the Puget Sound (Hilbert 1995:viii). Because of his close ties with several Indigenous members of Tulalip, Metcalf was able to meet and record several Indigenous elders in the Puget Sound region. Metcalf recorded a variety of language materials from these elders. These included Salish traditions, legends, songs, oral histories, and private correspondences. These recordings were digitized at a sampling rate of 44.1kHz with a 32-bit depth.

3.2 Speaker

The speaker for this study is Annie Jack. Annie Jack was an elder speaker of the Southern Lushootseed dialect who was born near the Green River in the 1870's, where she lived in the Muckleshoot Tribal Reservation her entire life. She spoke the Duwamish, Green River, and White River varieties of Southern Lushootseed. She was recorded by Leon Metcalf sometime between 1951-1954. Some of her living descendants include Denise Bill (great-granddaughter), Willard Bill, Jr. (great-grandson), Elise Bill-Gerrish (great-great-granddaughter and daughter of Denise Bill), and Justice Bill (great-great-grandson and son of Willard Bill, Jr). In this study, six recordings of Annie Jack (with a total duration of approximately 63 minutes) were examined. These are recordings of traditional Salish stories and oral histories.

3.3 Analysis, measurements, and sampling procedures

The software that was used to annotate and extract acoustic measurements was Praat (Boersma & Weenink 2023). Both a qualitative and quantitative analysis was conducted to assess the production of /a/ in /ay/ by Annie Jack. For the qualitative analysis, I used my ears to listen to how /ay/ was being produced, as well as examining spectrograms of the recordings to observe the formants and their trajectories. Using impressionistic observations (using my ears and eyeballing the formant trajectories in the spectrogram), I identified and labelled /a/ in /ay/ that sounded like either [ɐ] (i.e., the [ɐy] condition) or [a] (i.e., the [ay] condition), where these two conditions were compared with each other. The /a/ in these two conditions was also compared with the vowel /a/ produced elsewhere (i.e., not in the /_y/ environment) and the schwa /ə/. These vowels were analyzed exclusively in stressed environments. Vowels preceded by a labio-dorsal consonant were excluded from the analysis because of the coarticulatory effects of rounding onto the following vowel. Kye (2021) revealed that uvular consonants have a significant effect on vowel quality in Lushootseed, where all four vowels are more open and retracted in uvular environments. Because of potential confounds due to the coarticulatory effects of uvular consonants on vowel quality, vowels adjacent to uvular consonants were excluded from the analysis. The words that were produced in either of these two conditions (and their frequency of occurrence) was also examined.

To analyze (quantitatively) /a/ between the two conditions [ɐy] and [ay], the first two formants (F1 and F2) and the vowel's duration were measured. Vowel height is inversely correlated with the first formant (i.e., higher F1 corresponds to a more open (lower) vowel, lower F1 corresponds to a closer (higher) vowel), while vowel backness and rounding is associated with F2 (i.e., higher F2

corresponds to a more front vowel, lower F2 corresponds to a more back and/or more rounded vowel). The maximum formant setting was adjusted to 5500Hz to match the maximum formant range for vowels produced by Annie Jack. A modified version of the script *Semi-auto formant analysis* by Daniel McCloy (McCloy 2014) was used to extract the formants. Two formant analyses was conducted to compare the two conditions of /ay/: *dynamic formant analysis* and *static formant analysis*. For the dynamic formant analysis, the entire /ay/ sequence was analyzed, where the first two formants was extracted at a step of 5% throughout the entire duration of /ay/ (i.e., F1 and F2 were extracted at 5%, 10%, 15%, 20%, etc… of the /ay/ duration). For the static formant analysis, the midpoint of just the /a/ portion of /ay/ was analyzed for these two conditions. These measurements were compared with previous formant measurements extracted for the schwa /ə/ and /a/ produced elsewhere. Vowel duration was measured for the /a/ portion of /ay/ in these two conditions.

3.4 Statistical analysis

The software *R Studio* (R Core Team 2018) was used for statistical analyses. Packages that were used include *mgcv* (Wood 2011) and *effects* (Fox 2003). For data visualization, packages *ggplot2* (Wickham 2016) and *phonR* (McCloy 2016) were used. For dynamic formant analysis, a smoothing spline ANOVA using Generalized Additive Models (GAM's) was used to analyze the formant trajectories of [ɐy] and [ay]. For static formant analysis, the data was fit into a linear model, with formants as dependent variables and the vowels themselves as independent variables. Backwards difference coding was used to compare F1 and F2 of [a] elsewhere with the vowel portion of [a] in [ay], [a] in [ay] with [ɐ] in [ɐy], and [ɐ] in [ɐy] with the schwa [ə]. F1 and F2 (for the static formant analysis) were plotted in a formant chart with ellipses to show the degree of confidence in the location of the mean of each vowel group. The ellipses has a confidence level of roughly 68%, which corresponds to ±1 standard deviations of the normal density contour estimated from the data. For vowel duration measurements, the two conditions [ɐy] and [ay] were compared. Vowel duration and formants were fit into a linear model to test the relationship between the duration of /a/ and its F1 and F2.

4 Results

4.1 Observations of /ay/ realized as either [ay] or [ɐy]

Table 2 lists the words containing /ay/ realized as either [ay] (or [ay̓]) or [ɐy] (or [ɐy̓]) from the data, as well as their frequency of occurrence. While there are some words that can be realized as either [ay] or [ɐy] (i.e., *ʔayił* 'pretend'; *day̓* 'just, only'; *kayəʔ* 'grandmother'; and *kaykay* 'Steller Jay'), there are many words that are realized exclusively as [ay] (i.e., *ʔaydxʷ* 'find it'; *ʔay̓gʷəs* 'exchange'; *hay* 'know'; *ƛ̓əlayʔ* 'shovel-nose canoe'; *p̓ayəq* 'hew'; *sqʷəbay̓* 'dog'; *tay* 'to raid'; and *x̌payac* 'cedar tree'), while others are realized exclusively as [ɐy] (i.e., *bayac* 'meat'; *cay* 'very'; *kayu* 'dead, corpse'; and *šay̓* 'show, reveal, light').

Table 2 List of words containing /ay/ realized as either [ay] (or [ay̓]) or [ɐy] (or [ɐy̓]), where the number enclosed in parentheses (followed by 'x') marks the number of times the word was produced as either [ay] or [ɐy].

/ay/ realized as [ay]	/ay/ realized as [ɐy]
ʔaydxʷ 'find it' (1x)	ʔayił 'pretend' (2x)
ʔayił 'pretend' (1x)	bayac 'meat' (4x)
ʔay̓gʷəs 'exchange' (1x)	cay 'very' (7x)
day̓ 'just, only' (4x)	day̓ 'just, only' (6x)
hay 'know' or 'and so' (11x)	kayəʔ 'grandmother (21x)
kayəʔ 'grandmother' (1x)	kaykay 'Steller Jay' (1x)
kaykay 'Steller jay' (6x)	skayu 'dead, corpse' (5x)
ƛ̓əlayʔ 'shovel-nose canoe' (1x)	šay̓ 'show, reveal' (2x)
p̓ayəq 'hew' (1x)	
sqʷəbay̓ 'dog' (1x)	
tay 'to raid' (1x)	
x̌payac 'cedar tree' (1x)	

When examining [ay] and [ɐy] in the spectrogram, there are a couple noteworthy observations to consider. As Figure 2 illustrates, F1 for the vowel portion [a] in [ay] (Figure 2a) is greater than [ɐ] in [ɐy] (Figure 2b), while the F2 for [ay] is slightly lower than [ɐy]. Another noteworthy observation is that the duration of the vowel portion [ɐ] is shorter than [a]. On average, the duration of /a/ realized as [a] is 237ms (*SD* = 158.6), whereas the duration of /a/ realized as [ɐ] is 96ms (*SD* = 39.19). In other words, [a] is (on average) 141ms longer than [ɐ].

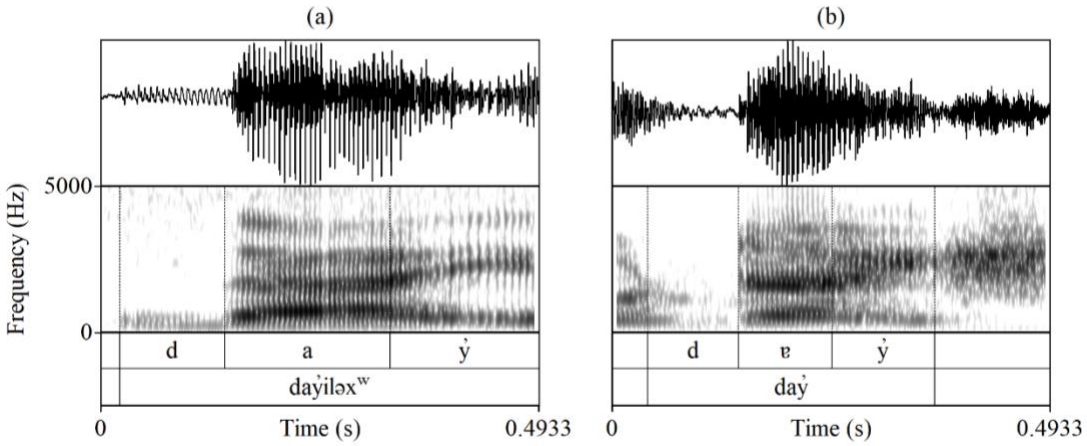

Figure 2 Example of /ay/ in the root day̓ 'just, only', where (a) /a/ is produced as [a], and (b) /a/ is produced as [ɐ].

4.2 Formant analysis

Figure 3 plots the formant trajectories (using GAM's) in the production of [ay] and [ɐy]. As Figure 3 illustrates, F1 for the [ay] variant is higher than the [ɐy] variant throughout its production. For F2, [ay] was slightly lower than [ɐy] up to 90% of its production, which suggests that the [ɐy] variant was slightly more fronted compared to [ay]. The formants begin to transition into the glide

/y/ around 25-35% for the [ɐy] condition, wheras it transitions into the glide around 35-45% for the [ay] condition. F1 during the glide portion /y/ was always higher in the [ay] variant than the [ɐy] variant, while F2 of /y/ was lower in the [ay] variant than the [ɐy] variant up to 90%. The results from the smoothing spline ANOVA reveals that the trajectory of F1 for [ay] is significantly greater than [ɐy] (***p < .001), while the trajectory of F2 for [ay] was significantly less than [ɐy] (***p < .001).

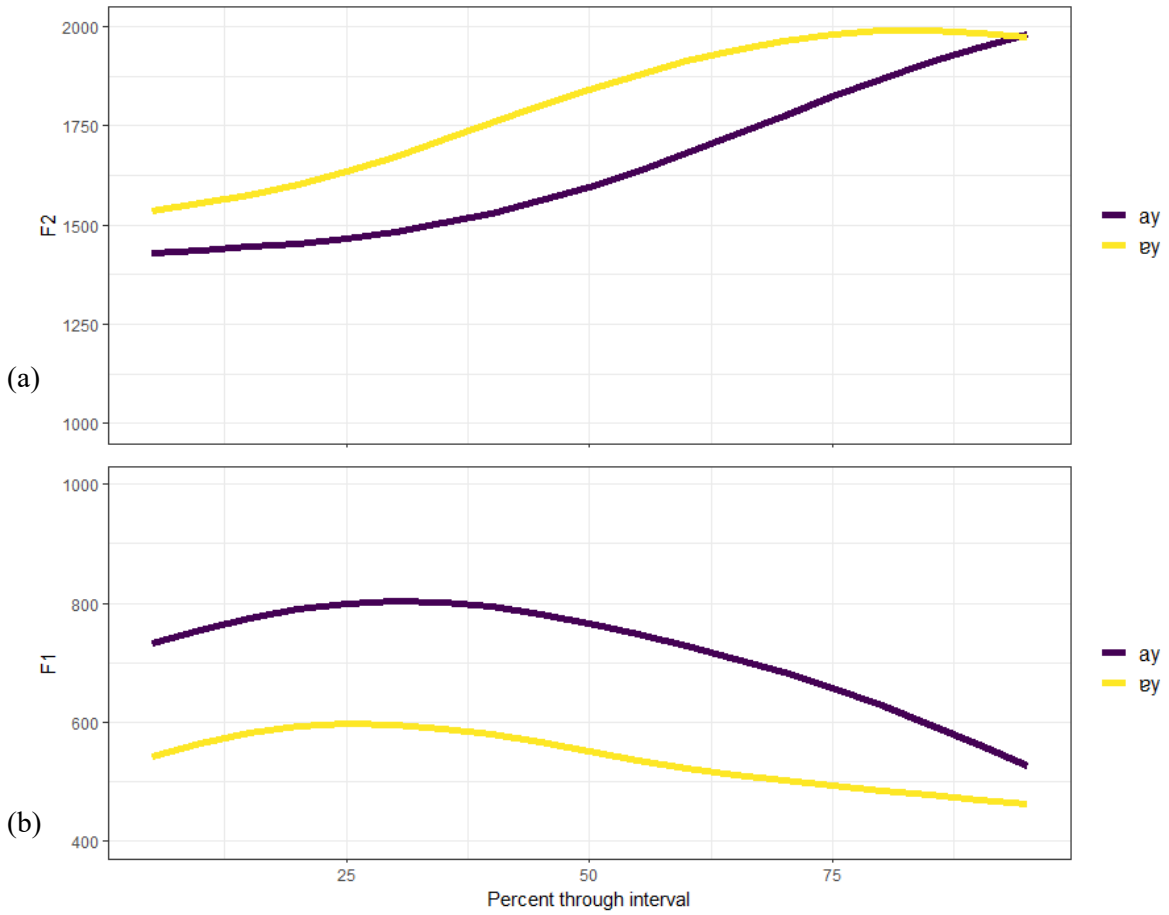

Figure 3 Formant trajectories (using GAMs) of [ay] and [ɐy] for (a) F2 and (b) F1.

Figure 4 is a formant chart illustrating the distribution of the schwa [ə], [ɐ] in [ɐy] (labelled as just [ɐy]), [a] in [ay] (labelled as just [ay]), and [a] elsewhere. As Figure 4 reveals, [ɐ] in [ɐy] is not as open (i.e., as high of an F1) as [a] in [ay] and [a] elsewhere. However, it is not as close (i.e., as low of an F1) as the schwa [ə] either. It falls somewhere in between their distributions. Moreover, the distribution of F1 for [a] in [ay] does not differ from [a] produced elsewhere. F1 for [ɐ] in [ɐy] was significantly greater than [ə] (***p < .001), and [a] in [ay] (and [a] elsewhere) was significantly greater than [ɐ] in [ɐy] (***p < .001). However, [a] in [ay] and [a] elsewhere did not significantly differ from each other. For the second formant F2, [a] in [ay] and [a] elsewhere was slightly (but significantly) lower than [ɐ] in [ɐy] and [ə] (**p = .0089), but [ɐ] in [ɐy] did not significantly differ from [ə] in F2.

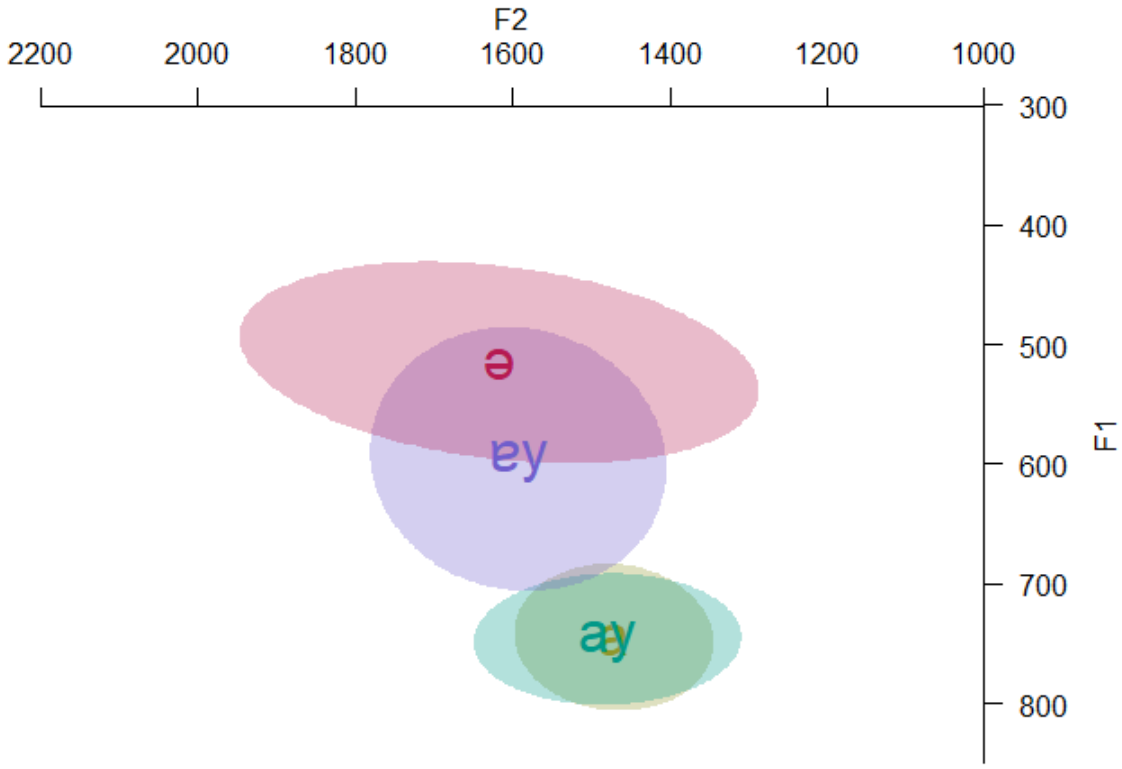

Figure 4 Formant chart plotting the distribution of the schwa [ə], [ɐ] in [ɐy] (labelled as [ɐy]), [a] in [ay] (labelled as [ay]), and [a] elsewhere. Labels plot the average (mean) and ellipses plot the distribution of the vowels formants.

4.3 Duration measurements

In this section, I report the results for vowel duration of /a/ in /ay/ under the two conditions (i.e., [a] (in [ay]) variant vs [ɐ] (in [ɐy]) variant). Figure 5 is a bar plot illustrating the average duration of [a] and [ɐ] (in milliseconds), where the error bars are 95% confidence intervals. On average, the duration of [a] in [ay] is approximately 237ms (SD = 158.60), whereas the duration of [ɐ] in [ɐy] is approximately 96ms (SD = 39.19). As Figure 5 reveals, there is a strong tendency for the duration of the [a] (in [ay]) variant to be much longer than the [ɐ] (in [ɐy]) variant. This suggests that the [ɐ] variant is much shorter than the [a] variant.

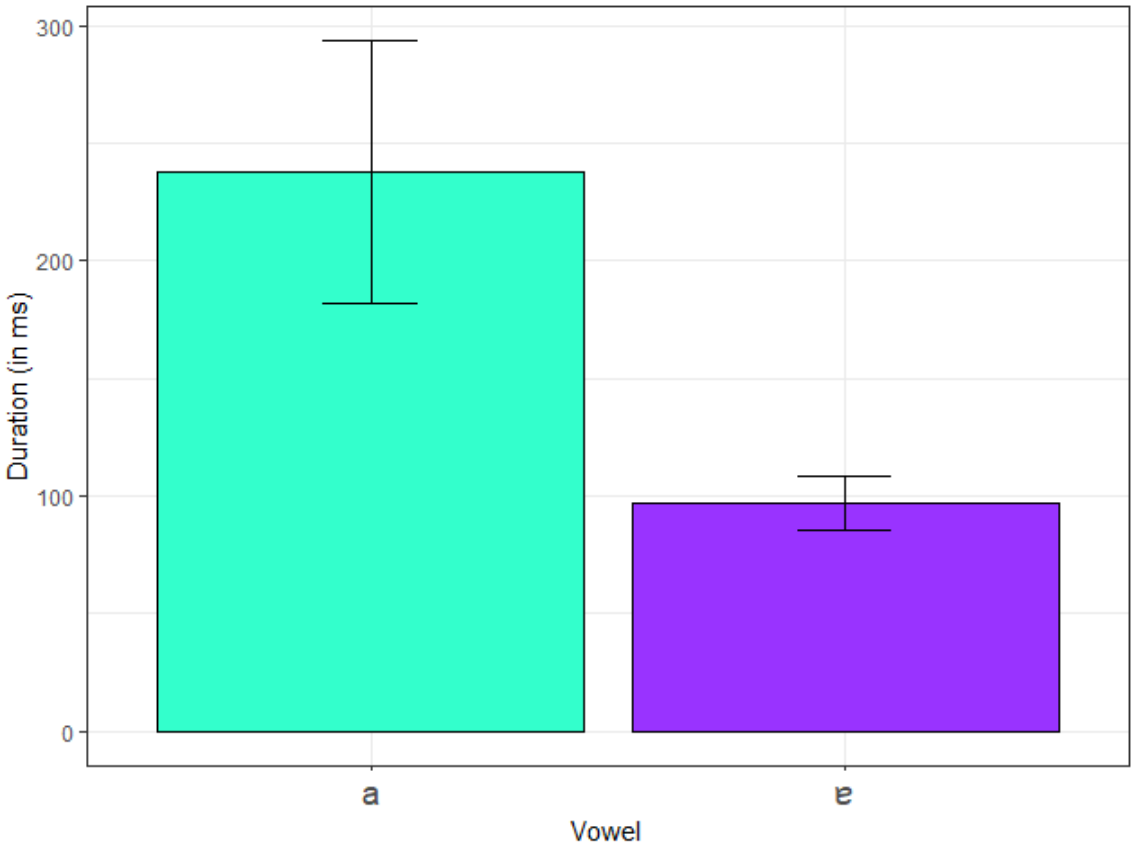

Figure 5 Average duration (in milliseconds) of [a] in [ay] and [ɐ] in [ɐy], where error bars correspond to 95% confidence intervals.

To examine the relationship between vowel formants and vowel duration, these measurements were fit into a linear model (where vowel formants were used as dependent variables and vowel duration as the independent variable) to examine their relationship. The test from the linear model reveals that there was a correlation between F1 and vowel duration (r = .65), while there was no correlation between F2 and vowel duration. The linear relationship between F1 and vowel duration is illustrated in Figure 6, where there is a positive correlation between the F1 of /a/ (which includes both the [a] and [ɐ] variants) and the duration of /a/. This suggests the following: The shorter the vowel, the lower the F1; the longer the vowel, the higher the F1.

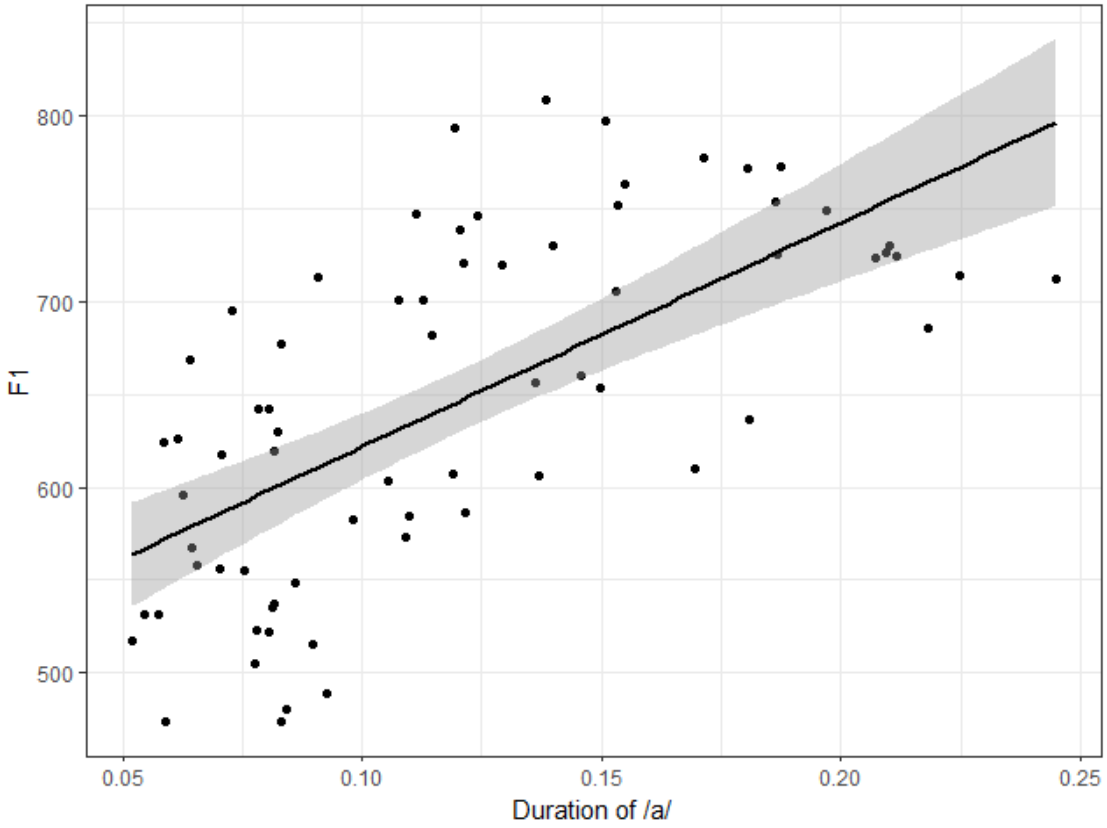

Figure 6 Scatter plot with a fitted regression line illustrating the relationship between the F1 of /a/ and the duration of /a/.

5 Discussion

The current findings suggest that the raw acoustic measurements matches my overall impressionistic observations of how the /ay/ sequence is sometimes realized as [ɐy]. The formant trajectories of the [ay] variant was significantly different from the [ɐy] variant. Moreover, the formant distribution of [ɐ] in [ɐy] was not as low as [a], but it was not as high as the schwa [ə] either. It was somewhere in between [ə] and [a]. The duration of the [ɐ] variant was significantly shorter than the [a] variant, which suggests that [ɐ] in [ɐy] is predictable when the duration of the vowel is shorter. There are a few reasons why the vowel /a/ in /ay/ is slightly raised when it is shorter.

One explanation involves articulatory timing. Producing an open vowel, such as [a], involves the lowering of the tongue body. One way to easily lower the tongue body is through depressing (lowering) the mandibles (i.e., the jaws), which can help in lowering the tongue body considerably. Other muscles involved in the depression of the tongue body includes the hyoglossus muscle and the genioglossus muscle. When producing /ay/ very slowly, you will observe (quite noticeably) the depression of the jaws, which gives a much more open (low) vowel quality in the production of [a]. However, when producing /ay/ very fast, you'll quickly notice far less jaw displacement in the production of /a/ in /ay/, often "laxing" (or centralizing) the tongue body. This results in a vowel quality that is much higher than a prototypical [a] (i.e., it is produced more like an [ɐ]). Another

reason has to do with the timing of the transition from /a/ to /y/. It is possible that, when /ay/ was being produced faster, there was far less time for the tongue body to reach its maximal displacement for the articulation of /a/. This would lead to /a/ being articulated in a manner that makes it easier to transition to /y/.

A similar phenomenon has been observed in some dialects of English. This phenomenon is known as "Canadian Raising" (Chambers 1973). In Canadian Raising, when the diphthong /aɪ/ is followed by a voiceless consonant (such as [f]), the onset vowel (diphthong's nucleus) /a/ is raised to [ɐ], as in [wɐɪf] *wife*.[2] One of the primary reasons for this is because of how voiceless consonants have a tendency of shortening the preceding vowel (House & Fairbanks 1953; Peterson & Lehiste 1960; Lisker 1973; Port 1981; Crystal & House 1988). Moreover, in English, this shortening phenomenon comes at the expense of the diphthong's nucleus [a] rather than the offglide [ɪ] (Peterson & Lehiste 1960; Gay 1968). This will often result in raising the nucleus /a/ to [ɐ] to assimilate to the offglide [ɪ] (Moreton 2021).

Unlike Canadian Raising, however, the current data in Lushootseed reveals that almost all words containing /ay/ is not followed by a voiceless consonant in coda position (see Table 2 above). In fact, there is nothing within its conditioning environment that causes the vowel in /ay/ to become shorter and "raised" to [ɐy]. This raises the question: What is causing the vowel to sometimes become shorter and raised to [ɐy] in Lushootseed? Here, I will propose two possible explanations for this: (1) the varying rate of speech in Lushootseed storytelling, and (2) lexical tendencies.

When Annie Jack was varying her rate of speech, this may have caused the vowel /a/ to become shorter in some instances and /a/ to become longer in other instances. The rate of speech in storytelling is not only faster but is also highly variable. Evidence of how storytelling speech is variable comes from the use of rhetorical lengthening. Rhetorical lengthening is the stretching out of the pronunciation of a word to add meaning or convey a narrative effect and to enliven the performance of storytelling (Gerdts et al. 2024). In this sense, rhetorical lengthening can be analyzed as an extreme form of hyperarticulation on a segment that cannot be observed in isolated (wordlist) style speech. This suggests that various rhetorical devices can affect the rate of speech during storytelling.

In fact, in Annie Jack's speech, there were many instances where the /a/ in /ay/ was rhetorically lengthened. However, there was also one instance where the approximant /y/ in /ay/ was rhetorically lengthened. When /y/ was rhetorically lengthened, the duration of the preceding vowel /a/ was considerably short, reducing the vowel to [ɐ]. This can be observed in the waveform and spectrogram in Figure 7, where Figure 7a illustrates the rhetorical lengthening of /a/ in /ay/ while Figure 7b illustrates the rhetorical lengthening of /y/ in /ay/. As the spectrogram in Figure 7b illustrates, F2 of /a/ in /ay/ is considerably raised (i.e., more "fronted") when /y/ is rhetorically lengthened, which is (presumably) to make the transition from /a/ to /y/ more "easier" and less effortful. This is not observed in Figure 7a, however, where /a/ is rhetorically lengthened. Varying the rate of speech in this way can have an effect on the length and quality of /a/ in /ay/. In other words, Annie Jack may have varied her rate of speech intentionally to either add emphasis (or focus) on the vowel during narration (via lengthening), or when making the transition from the vowel to the following approximant more "fluid" and less effortful (via shortening).

[2] This rule also occurs with flapped /t/'s (i.e., [ɾ]), such as in the word *writer* [wɪɐɪɾəˠ] (Chambers 2006; Rosenfelder 2007). It has also been revealed that flapped /t/'s shorten the preceding diphthong, whereas /d/ lengthens it (contrast *writer* vs *rider*) (Moreton 2021; Rosenfelder 2007). While Canadian Raising from flapped /t/'s poses its own set of problems, this is irrelevant for the present study, because the process of "shortening" the preceding diphthong is the only relevant aspect of Canadian Raising to this discussion.

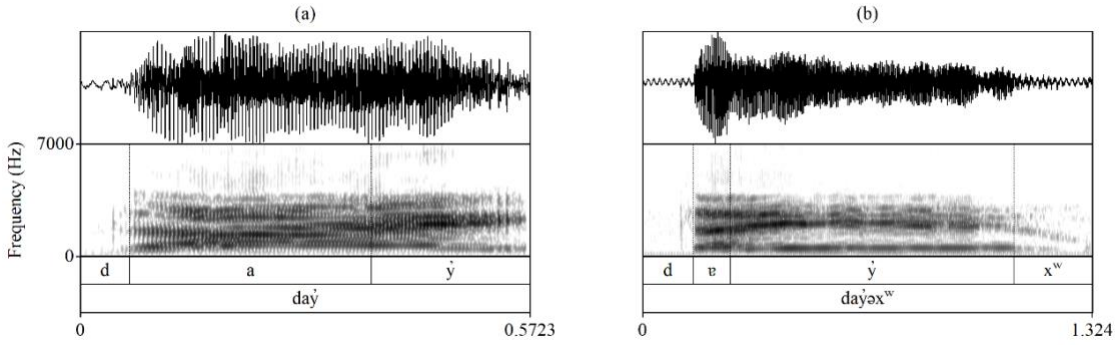

Figure 7 Rhetorical lengthening (RL) used on the root *dayẏ* 'only, just', where (a) RL is used on the vowel /a/, whereas (b) RL is used on the approximant /ẏ/.

Another possible reason for Annie Jack to shorten and raise the vowel to [ɐ] is due to lexical tendencies: There are some words that tend to be produced as [ay] and others as [ɐy]. As Table 2 (see Section 4.1 above) revealed, while there were a few words that can be realized as both [ay] and [ɐy] (i.e., *ʔáyił* 'pretend'; *dayẏ* 'just, only'; *káyəʔ* 'grandmother'; and *káykay* 'Steller Jay'), while there were many words that were realized exclusively as either [ay] (i.e., *ʔaydx*^{w} 'find it'; *ʔayẏg*^{w}*əs* 'exchange'; *hay* 'know'; *ƛ̓əlayʔ* 'shovel-nose canoe'; *p̓payəq* 'hew'; *sq*^{w}*əbayẏ* 'dog'; *tay* 'to raid'; and *x̌payac* 'cedar tree') or [ɐy] (i.e., *bayac* 'meat'; *cay* 'very'; *kayu* 'dead, corpse'; and *šayẏ* 'show, reveal'). While the word *kayəʔ* 'grandmother' can be realized with either [ay] or [ɐy], there was a strong preference for Annie Jack to produce the /ay/ sequence as [ɐy], where only but one instance of *kayəʔ* was realized as [ay] (i.e., 1 out of 22 instances). Moreover, there was a strong preference for Annie Jack to realize /ay/ in the first (stressed) syllable of the word *káykay* 'Steller Jay' as [ay], where six of the seven instances of *káykay* were realized as [ay] on the stressed syllable. This suggests that while these words underlyingly contain an /a/, there were tendencies where some words were realized as [ay] while others were realized as [ɐy]. This suggests that there might have been a preference for 'laxing' (or centralizing) the vowel /a/ in certain words.

6 Conclusion

The current findings suggest that the acoustics matches my impressionistic hearing of /ay/ as sometimes being produced as [ɐy] and other times as [ay]. This also appears to match (more or less) how Snyder (1957) heard the /ay/ sequence impressionistically for some words in his grammar of Southern Lushootseed. The current findings also reveal that when /ay/ is realized as [ɐy], the vowel portion [ɐ] has a shorter duration than [a]. The shorter the duration of /a/ in /ay/, the more "lax" and "centralized" it will be produced. My speculations on why Annie Jack sometimes produced /ay/ as [ɐy] in Southern Lushootseed storytelling are as follows: (1) the varying rate of speech in Southern Lushootseed storytelling, and (2) lexical preferences. Annie Jack would sometimes vary her rate of speech, which may have been used to either add emphasis on the vowel /a/ (realizing it as [a]), or when making the transition from /a/ to /y/ more "fluid" and less effortful to produce (realizing it as [ɐ]). Moreover, there were several words that Annie Jack would tend to produce as either [ay] or [ɐy], which suggests that the shortening of /a/ in /ay/ might be due to lexical preferences.

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