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Acoustic analysis of high vowels in the Louisiana French of Terrebonne Parish

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Abstract

This study investigates high vowel laxing in the Louisiana French of the Lafourche Basin. Unlike Canadian French, in which the high vowels /i, y, u/ are traditionally described as undergoing laxing (to [ɪ, ʏ, ʊ]) in word-final syllables closed by any consonant other than a voiced fricative (see Poliquin 2006), Oukada (1977) states that in the Louisiana French of Lafourche Parish, any coda consonant will trigger high vowel laxing of /i/; he excludes both /y/ and /u/ from his discussion of high vowel laxing. The current study analyzes tokens of /i, y, u/ from pre-recorded interviews with three older male speakers from Terrebonne Parish. We measured the first and second formants and duration for high vowel tokens produced in four phonetic environments, crossing syllable type (open vs. closed) by consonant type (voiced fricative vs. any consonant other than a voiced fricative). Results of the acoustic analysis show optional laxing for /i/ and /y/ and corroborate the finding that high vowels undergo laxing in word-final closed syllables, regardless of consonant type. Data for /u/ show that the results vary widely by speaker, with the dominant pattern (shown by two out of three speakers) that of lowering and backing in the vowel space of closed syllable tokens. Duration data prove inconclusive, likely due to the effects of stress. The formant data published here constitute the first acoustic description of high vowels for any variety of Louisiana French and lay the groundwork for future study on these endangered varieties.

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1 Introduction

The Louisiana French (hereafter LAF) variety of the Lafourche Basin, comprised of Terrebonne and Lafourche Parishes, has three phonemic high vowels: /i, y, u/ (Guilbeau, 1950; Oukada, 1977; Papen & Rottet, 1997).[1] While this is similar to the phonemic inventory of high vowels in the French spoken in France (see, e.g., Tranel, 1987), referred to here as Hexagonal French (or HF), phonetically, the high vowels of the Louisiana French varieties have been described as being less tense than those varieties spoken in France in both open and closed syllables (Conwell & Juilland, 1963, pp. 91–95). Additionally, the high vowels in the French of the Lafourche Basin are described as undergoing a process of high vowel laxing, in which the lax allophones [ɪ, ʏ, ʊ] surface in word-final closed syllables (Guilbeau, 1950; Papen & Rottet, 1997). High vowel laxing also occurs in Canadian French (see Poliquin, 2006, and the references below),[2] but previous studies (particularly Oukada, 1977) suggest that the contexts that trigger laxing in the LAF of the Lafourche Basin may be less restricted than those of Canadian French (hereafter CF): specifically, laxing may occur in the Lafourche Basin varieties in word-final syllables closed by any consonant, while in CF, laxing is restricted to syllables closed by consonants other than /v, z, ʒ, r/ and /vr/.

The goal of this study is to provide an acoustic analysis of the phonemic high vowels, /i, y, u/ in word-final syllables in the LAF of the Lafourche Basin, focusing specifically on the French of Terrebonne Parish. LAF is both endangered (see Bankston & Henry, 1998; Blythe, 1997; Kilroe, 2001; Rottet, 1995, 2001) and understudied (Papen & Rottet, 1997). Few phonetic studies conducting acoustic analyses on LAF have been published (e.g. Blainey, 2009; see Phillips, 1936, for an early study using spectrograms); this current study is the

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[2]We follow Poliquin (2006), among others, in using the term "Canadian French" instead of "Quebec French," to refer to the varieties of French spoken in Canada with the exclusion of the French spoken in the Maritime provinces ("Acadian French").

first to focus on the high vowels of LAF and the first to publish acoustic measurements on any variety of LAF. Additionally, by focusing on high vowels in open and closed word-final syllables, this study contributes to the understanding of the cross-dialectal variation in both the high vowel system and of the phenomenon of high vowel laxing within French. To investigate this phenomenon, this study analyzes the acoustic productions of high vowels in pre-recorded interviews of three older male speakers of the Terrebonne variety of LAF.

1.1 High vowel laxing in Canadian French

French has three phonemic high vowels, /i, y, u/. In HF these vowels do not have lax allophones (however, see Coveney, 2001, for an overview of studies of lax allophones in some regional varieties of French spoken in France, as well as some European varieties).[3] In CF, the high vowels have lax allophones, [ɪ, ʏ,ʊ] (Brent, 1971; Coveney, 2001; McLaughlin, 1986; Ostiguy & Sarrasin, 1985; Picard, 1987; Poliquin, 2006; Walker, 1984), which Coveney (2001, p. 134) describes as "rather less close, more centralized and shorter [in duration]" than the tense allophones. The distinction between "tense" vs. "lax" allophones has been described with the advanced tongue root feature (Poliquin, 2006, p. 4), with the tense high vowels as having a [+ATR] feature, and the lax high vowels as having a [-ATR] feature.

In CF the lax allophones [ɪ, ʏ, ʊ] appear in word-final syllables that are closed by any consonant except /v, z, ʒ, r/ and /vr/. The consonants /v, z, ʒ, r/ have often been referred to as "lengthening consonants" in the literature (e.g. Brent (1971); Dumas and Boulanger (1982); Martin (2002); Walker (1984)), because they have the effect of lengthening the preceding tautosyllabic high vowel in word-final closed syllables (McLaughlin (1986); Walker (1984)). We will refer to these consonants as "voiced fricatives," as does Poliquin (2006). Note, however, that according to Walker (1984, p. 116), the productions of /r/ are variable in

[3](Coveney, 2001, pp. 3), uses "supralocal French" (SF) in the same way that we intend Hexagonal French (HF) here: the "neutral form of pronunciation...characteristic of the well-educated middle classes from the northern two-thirds of France."

Canadian French, and the phoneme could be realized as a uvular fricative [ʁ] or as the apical trill [r] (we use the symbol /r/ to include either allophone).[4]

Poliquin (2006, p. 25) notes that in CF laxing is "obligatory" in word-final syllables closed by any consonant other than a voiced fricative. The laxing rule adapted from Poliquin (2006, p. 27) is given in example (1); it is stipulated elsewhere in his text (Poliquin, 2006, p. 25) that the consonant closing the syllable must be "a consonant other than a voiced fricative" (see Déchaine (1991) and Hannahs (1989) for alternative analyses that propose that the CF high vowels are underlyingly lax rather than underlyingly tense). [5]

(1) *Obligatory closed final syllable rule*

[+high] → [-ATR] / _____ C(C)# (Poliquin, 2006, p. 27)

When a word-final syllable is closed by /v, z, ʒ, r/, the vowel undergoes lengthening, with possible diphthongization (McLaughlin, 1986). In word-final open syllables, the vowel is tense ([i, y, u]). The range of patterns are exemplified in examples of high vowel laxing for /i, y, u/ in CF are shown in Table 1.[6]

Finally, stress seems to play a role as well in high vowel laxing in CF. Importantly, French has word-final stress when a word is pronounced in isolation but phonological group final stress when words appear in combination (Walker, 1984, p. 28). While some studies on high vowel laxing (in word-final position) mention that the syllable must also be stressed for the vowel to undergo laxing (e.g., Walker, 1984, p. 28; Coveney, 2001, p. 28), others do not comment on the role of stress (e.g. stress is not mentioned in the laxing rule in Poliquin, 2006). However, Dumas and Boulanger (1982, p. 50) explicitly state "Laxing is categorical

[4]As for LAF, the /r/ of the Lafourche Basin variety is described as "always dentoalveolar" (Papen & Rottet, 1997, p. 79), or as a "tongue-tip flap produced in the alveolar region" (Oukada, 1977, p. 152).

[5]In CF, the lax allophones can also appear in non-final syllables via vowel harmony with a lax high vowel in the final syllable (Déchaine, 1991; Fast, 2008; Poliquin, 2006). Note additionally that certain studies point out a third set of allophones, the voiceless allophones as well, [i̥, y̥, u̥] (e.g. Martin 2002; Picard 1987). Since these appear in non-final syllables (Martin, 2002), they will not be discussed further here.

[6]While the sources cited above consistently refer to the tense and lax high vowels as allophones, a reviewer points out the existence of some minimal pairs created by the borrowing of English words, such as [dʒɪn] 'gin,' and [dʒin] 'jeans.' Word-final high vowels in "relatively recent" borrowings do not undergo laxing (McLaughlin, 1986, p. 21).

Word-final syllable environment	Phonetic outcome of word-final high vowel	Examples
Syllable closed by a voiced fricative: /v, z, ʒ, ʀ/	Vowel lengthens, with possible diphthongization: [iː, yː, uː]	[piːʀ] 'worse' [cyːv] 'vat' [buːʒ] 'move' (sg. indic.)
Syllable closed by a consonant other than a voiced fricative	Vowel undergoes laxing: [ɪ, ʏ, ʊ]	[pɪl] 'battery' [ʒʏp] 'skirt' [cʊt] 'cost' (sg. indic.)
Open syllable	Vowel is tense: [i, y, u]	[vi] 'life' [tu] 'you' (sg./informal) [cu] 'cost'

Table 1: The distribution of word-final high vowels in CF (adapted from McLaughlin 1986, pp. 21-22)

in closed word-final stressed syllables, and variable in other contexts, such as in closed word-final unstressed syllables..." (our translation). Because no previous discussion of high vowel laxing in LAF mentions stress, and because in LAF individual words can be stressed within a phonological group (Lyche, 1996, p. 42), we do not explore the role of stress here but note it as important for further investigation.

1.2 High vowels in the Louisiana French of Terrebonne Parish

The term "Louisiana French" ("Cajun French" has also been used in the literature) encompasses several different varieties. Papen and Rottet (1997, p. 72) note that "very little thorough scholarly work exists on CF [Cajun French], of whatever part of Louisiana," and that "[t]he speech of Terrebonne Parish is less well represented in the literature than that of some of the other areas." Therefore, while this current study focuses on the speech of Terrebonne Parish, we have necessarily relied on the descriptions available for the speech of the neighboring Lafourche Parish (Guilbeau, 1950; Oukada, 1977). Finally, Papen and Rottet (1997, p. 73) note that "there is a tremendous amount of variation in the phonetic realization of most of the phonemes in CF [Cajun French]."

Similar to HF and CF, the phonemic high vowels of LAF, including the Lafourche

Basin varieties, are /i, y, u/ (Conwell and Juilland 1963; for the Lafourche variety, see Guilbeau, 1950 and Oukada, 1977). As mentioned above, Conwell and Juilland (1963, pp. 91-95) describe the high vowels in LAF in general [i, y, u] as phonetically more lax than in Hexagonal varieties (this may be to what Guilbeau, 1950, pg. 43, is referring when he describes a vowel intermediate between [i] and [ɪ], which he transcribes as (i); what corresponds to [i] in the IPA, he transcribes as (í)).

Within the Terrebonne and Lafourche varieties, Papen and Rottet (1997, p. 74) observe that high vowels undergo laxing in syllables closed by consonants other than voiced fricatives (similar to the pattern attested for CF).[7] Additionally, they observe that Oukada's (1977, pp. 143-144) phonological analysis for the Lafourche variety of Louisiana French indicates that voiced fricatives also trigger high vowel laxing. Stated differently, high vowel laxing may be triggered in word-final syllables closed by any consonant. Oukada's (1977) laxing rule is reproduced in example (2).

(2) *Oukada's laxing rule:*

$[i] \rightarrow [ɪ] \ / \ \_\_\_\_ \ C^{\$}$ (Oukada, 1977, p. 143)

Two important observations emerge from a review of the literature. First, from Guilbeau's (1950) discussions, laxing appears to be optional (compare with CF, where it is obligatory in word-final syllables closed by consonants other than voiced fricatives), for all three high vowels /i, y, u/. For example, he states the following with regard to /i/: "/i/ is generally (í) or (i) [the intermediate value], interchangeably, in all positions. In the case of some speakers

[7] It is unclear from the literature how widespread high vowel laxing is across different varieties of LAF (this is likely a combined effect of the great degree of variation, even within dialects (Papen & Rottet, 1997), and the variable quality and/or detail in the transcriptions in the previous works). Laxing is not mentioned as a general phenomenon of LAF in Conwell & Juilland's work. It is not mentioned in some of the other existing descriptions (Dubois, 2005; Lane, 1934; Picone & Valdman, 2005; Read, 1963), nor is it a feature of Louisiana Creole (Valdman & Klingler, 1997). Pronunciation is not included in Ditchy (1932). No lax variants are included in the pronunciation guide in Valdman et al. (2009). The pronunciation guides in Faulk (1977) and Daigle (1984) include [ɪ], but not lax variants for the high round vowels. On the other hand, laxing for all three vowels is mentioned in Phillips (1945), and Fagyal, Kibbee, and Jenkins (2006, p. 26) state that high vowel laxing "is one of the most marked pronunciation features of the French spoken in Canada and Louisiana." There are a number of Masters Theses, in the forms of lexicons or glossaries, from the 1930s and 40s by students at Louisiana State University (see the discussion in Oukada, 1977, pp. 128-129) that may provide data bearing on this question.

these alternate with (ì) [what corresponds to [ɪ] in the IPA], freely in a checked syllable, sporadically elsewhere" (Guilbeau, 1950, p. 43).[8] Note that this description also suggests that high vowel laxing does not necessarily occur among all speakers of the LAF variety of his study.

Second, a closer review of Oukada's (1977) laxing rule reveals that among the three phonemic high vowels, the rule is only written for /i/. Indeed, unlike Guilbeau (1950), which clearly mentions the existence of lax vowels (and vowels intermediate between tense and lax) for /i, y, u/, there is no mention of lax variants of /y/ and /u/ in Oukada's table of the "Phonetic Output of the Oral Vowels" (1977, p. 131). Thus, one may ask how /y/ and /u/ pattern in word-final closed syllables. Does Oukada's (1977) laxing rule apply to /y/ and /u/? How robustly attested are lax variants of these two vowels, since Guilbeau's (1950) description affirms their existence? If these vowels do not undergo laxing, is there any difference in their articulation in open versus closed syllables? Although this is a phonetic study, responses to these questions may contribute to a better phonological description of this variety of LAF and will add to the existing documentation of an understudied and endangered variety.

Third, Conwell and Juilland (1963, pp. 91-95) indicate that /i, y, u/ have a more lax articulation in LAF than in HF in open syllables as well as closed syllables. This observation can be evaluated by comparing F1 and F2 vowel measurements for the LAF speakers of Terrebonne Parish with data in previously published acoustic analyses of high vowels in HF. Table 2 reports the average F1 and F2 of the vowels /i, y, u/ produced by 10 male speakers of HF (2 repetitions each of the vowels in the context [pV] (for /y, u/ or [pVR] (for /i/); no other information is available about the speakers). Kamiyama (2011, p. 99) reports obtaining similar values to those in Tubach (1989), for four native speakers "from the northern half of France."

[8]Note that Guilbeau does not state explicitly that the closed syllable must be in word final position in order for the lax allophone to occur; this may be an oversight, as his descriptions of /y/ and /u/ do clearly state that the lax variant appears in *word-final* (our emphasis) closed syllables. .

Formants	/i/	/y/	/u/
Average F1	308	300	315
Average F2	2064	1750	764

Table 2: Average formant values for /i, y, u/, for 10 male speakers of HF (Tubach, 1989, p. 84)

For comparison with the results of Tubach (1989), we can also consider the results reported by Strange, Weber, Levy, Shafiro, and Hisagi (2007). The average F1 and F2 of /i, y, u/ produced by four male speakers of Parisian French from this study are given in Table 3 (the average is across 12 tokens per vowel). Formants were converted from a Bark scale (used by Strange et al. (2007)) to a Hz scale using the conversion calculator found here: http://www2.ling.su.se/staff/hartmut/umrechnung.htm. Finally, see Meunier and Espesser (2011) for F1 and F2 values for French vowels produced by female and male speakers from southeast France, extracted from conversational data. The formant values reported are broken down by three different duration sets.

Formants	/i/	/y/	/u/
Average F1	259	269	269
Average F2	2088	1853	780

Table 3: Average formant values for /i, y, u/, for four male speakers of Parisian French (Strange et al., 2007, p. 1117 & p. 1128)

We can also compare the results of our study with F1 and F2 values reported for CF. A study comparing high vowel production of bilingual and monolingual speakers of CF (MacLeod, Stoel-Gammon, & Wassink, 2009) publishes formant values for /i/ and /u/ (they do not include /y/). Table 4 summarizes their results regarding average formant values for early bilingual speakers (nine females and one male) and Table 5 regarding average formant values for monolingual speakers of CF (three females and five males).

F1 and F2 values for male and female speakers of CF are also reported in Martin (2002), and are included below for comparison with the values from MacLeod et al. (2009). Table 6 reports the average F1 and F2 values of six male speakers from l'Université Laval in Quebec

	[i]	[ɪ]	[u]	[ʊ]
Average F1	289	410	291	422
Average F2	2613	2255	884	1221

Table 4: Average F1 and F2 values for CF /i/ and /u/ produced by 10 early bilinguals (adapted from MacLeod et al. (2009, p. 382))

	[i]	[ɪ]	[u]	[ʊ]
Average F1	273	360	303	369
Average F2	2208	1945	824	1047

Table 5: Average F1 and F2 values for CF /i/ and /u/ produced by eight monolingual speakers (adapted from MacLeod et al. (2009, p. 382))

City, Quebec (all speakers native to Quebec). The speakers are between 20 and 25 years old. The values are roughly approximated from the figure "Trapze vocalique chez les garons" (Martin, 2002, p. 84).

From the data of both studies reported above for CF, we can see that the lax allophones are lower and more centralized in the vowel space. Acoustically, this correlates to a higher F1 value than the tense allophone, and in the case of /i/ and /y/, a lower F2 value, and in the case of /u/, a higher F2 value.

Finally, Martin (2002) also reports duration of vowels for males and females, for high vowels in word-final open syllables (in which the tense allophone surfaces) and word-final closed syllables (closed by a consonant other than a voiced fricative, thus a context in which the lax allophone surfaces). Martin does not report duration data for syllables closed by a voiced fricative. The values for the male speakers are reported below in Table 7. As Table 7 shows, the lax allophones are shorter in duration than the tense allophones.

	[i]	[ɪ]	[y]	[ʏ]	[u]	[ʊ]
Average F1	250	360	260	375	265	350
Average F2	2050	1875	1825	1550	750	950

Table 6: Average F1 and F2 values for CF /i, y, u/ produced by six male speakers of CF (adapted from Martin (2002, p. 84))

Word-final open syllable		Word-final closed syllable	
[i]	114	[ɪ]	95
[y]	121	[ʏ]	100
[u]	122	[ʊ]	106

Table 7: Average duration of vowels in ms produced by six male speakers of Canadian French (adapted from Martin (2002, p. 81))

No previous research undertakes an acoustic analysis of high vowels in LAF. This study is therefore the first in providing acoustic measurements of high vowels across open and closed word-final syllables for any variety of LAF.

1.3 Current study

This study examines the laxing of high vowels in the LAF of Terrebonne Parish, with the specific aims of providing an acoustic analysis of high vowels across conditions that are hypothesized to trigger the tense and lax allophones, and addressing questions raised by the previous phonological studies or descriptions of the language variety. To maximize interspeaker comparability and minimize variation due to dialectal differences, we analyze the speech produced by three older male speakers from Terrebonne Parish. The data come from a collection of pre-recorded oral histories. Our study compares formant values for the three high vowels /i, y, u/, in four conditions, crossing syllable type (open vs. closed) by following consonant type (voiced fricative vs. all other consonants) (see Table 8 in the following section).

Based on previous phonological analyses of LAF in general and of the French of the neighboring Lafourche Parish, we have formulated the following hypotheses for the high vowels of the Terrebonne Parish variety: First, we hypothesize that the front, unrounded vowel /i/ will undergo laxing in all closed, word-final syllables, regardless of coda consonant (following Oukada, 1977). Given that Oukada's vowel laxing rule only applies to /i/, we raise the question of how /y/ and /u/ pattern across the same environments; following the description in (Guilbeau, 1950), we hypothesize that these vowels will also undergo optional

laxing in closed word-final syllables, regardless of coda consonant. We are operationalizing laxness following (Coveney, 2001) as lower and more centralized in the vowel space: a lax variant will thus have a higher F1 than a tense variant. For the front high vowels /i, y/, the lax variant will have a lower F2, while for /u/, the lax variant will have a higher F2.

Second, we hypothesize that vowels in open syllables will have a longer duration than vowels in closed syllables, regardless of type of coda consonant. However, as vowels in syllables closed by /v, z, ʒ , r/ have been described as undergoing lengthening in CF (see McLaughlin, 1986), the current study explores whether the type of coda consonant will also affect vowel duration in LAF.

Third, we hypothesize that the high vowels in the data from the current study will be produced with a more lax articulation than the high vowels in HF, in open syllables. This is suggested by both the claims in Conwell and Juilland (1963, pp. 91-95), described above, and the mention of an intermediate value between the tense [i] and lax [ɪ] (also for /u/ and /y/) mentioned in Guilbeau (1950).

2 Methods

2.1 Corpus

The data for this project come from previously recorded interviews with three older male speakers of LAF from Terrebonne parish. The interviews are part of a collection called "Memories of Terrebonne, 1890-1945," undertaken "to capture life at the turn of the century as parish residents remembered it."[9] The interviews were recorded in the early 1980s by Glen Pitre (Pitre, 1983). The original recordings are housed in the Terrebonne Parish Main Branch Library, Houma, LA. Each interview is approximately 30 minutes long. The speakers are referred to as Speaker #169, Speaker #69, and Speaker #63, corresponding to a previous numbering system. The three speakers are bilingual speakers of English and

[9] http://bayoureference.blogspot.com/2011/07/voices-of-terrebonnes-past.html.

Louisiana French (in fact, most speakers of Louisiana French are bilingual, (Blythe, 1997, p. 30). However, due to the nature of the data, little other linguistic background is available.

2.2 Vowel conditions

As discussed above, we focus on the three high vowels in word-final position, in four phonetic environments. Table 8 illustrates each of the four test conditions. The period "." indicates a syllable boundary, and the hash mark "#" indicates a word boundary. The target syllable for each condition is underlined. As French resyllabifies word-final coda consonants as part of the onset of a following vowel-initial word (see Fagyal et al., 2006, p. 64, and the references cited therein), all tokens for the closed syllable conditions were necessarily followed by a consonant-initial word.

	Following consonant	/i/	/y/	/u/
Open σ conditions	A voiced fricative	/pə.ti#vi.laʒ/ 'small village'	/ply#ʒœn/ 'younger'	/vu#vwa.je/ 'you (formal) see'[10]
	Any other consonant	/ki#di/ 'who says'	/ply#gro/ 'bigger'	/bu#də/ 'end of'
Closed σ conditions	A voiced fricative	/e.gliz#la/ 'church there'	/yz#lə/ 'use the'	/tu.ʒur#sa/ 'always that'
	Any other consonant	/vil#pur/ 'city for'	/a.bi.tyd#də/ 'habit of'	/pus#la/ 'push the (fem.)'

Table 8: Open and closed syllable conditions for /i, y, u/

In the third condition, syllables closed by a voiced fricative, we included syllables closed by /vr/. This type of token was numerous in our corpus. In the fourth condition, syllables closed by any other consonant, we included tokens such as *poudre* [pʊd], 'powder,' which underlyingly is disyllabic: /pud.rə/. As Poliquin (2006, p. 25) notes for CF, "final schwas are typically deleted in casual speech, and resulting complex codas are simplified." If there

[10]Julie Auger (pers. comm.) points out that in this example, the target syllable is the subject clitic *vous* "you(pl)". In the data collected for this project, tokens for this syllable environment containing the vowel /u/ are rare in the corpus, and therefore we included vowels in subject clitics, although this does introduce another variable. In a follow-up study in which data would be elicited from speakers in a laboratory, we would control for part of speech.

was any doubt that the final coda was not simplified, i.e. that the liquid consonant was still detectable, we excluded the token.

Since the data were extracted from pre-recorded interviews, we were unable to control for the number of tokens in all test conditions. We aimed to collect 5 tokens per speaker per condition. Table 9 gives a token count for all test conditions for the three speakers. As illustrated in the table, the first test condition (V#Cvf, a word-final open syllable followed by a voiced fricative) was especially difficult for the vowel /u/. We collected 152 vowel tokens in total.

		Open σ conditions		Closed σ conditions		
Speaker	Vowel	V#Cvf	V#C	VCvf#	VC#	Total
Speaker #169	/i/	4	5	6	5	20
	/y/	2	5	4	5	16
	/u/	-	5	5	5	15
	Total	6	15	15	15	51
Speaker #69	/i/	4	5	3	5	17
	/y/	3	5	5	5	18
	/u/	-	4	5	4	13
	Total	7	14	13	14	48
Speaker #63	/i/	2	5	5	5	17
	/y/	5	5	5	5	20
	/u/	-	5	8	3	16
	Total	7	15	18	13	53

Table 9: Final token counts per speaker across all test conditions[11]

[11]The target number of tokens was 5 per condition. Numbers greater than 5 are the result of the conflation of what were originally two separate conditions: syllables closed by /v, z, ʒ/ and syllables closed by /r/ or /vr/. We conflated these categories due to low token counts for syllables closed by /v, z, ʒ/.

2.3 Vowel measurements

First, we identified potential vowel tokens using the transcripts. All vowel tokens were in word-final position, and those word-final closed syllables were necessarily followed by a pause or a word-initial consonant. This ensured that a word-final consonant was syllabified as part of a coda and that the target vowel was in fact in a closed syllable. When selecting the 5 tokens per test condition, we tried to balance the number of tokens from lexical items with tokens from functional items when possible. Potential tokens were then verified using the recordings. At times, the transcript was in conflict with our judgements. If we were in doubt as to the identity of the word, we excluded the token from analysis. Any token that was ambiguous as to whether it was French or an English code-switch was likewise excluded.

We took the vowel duration and formant measurements manually using Praat (Boersma & Weenik, 2013). First, using both the spectrogram and waveform, we identified the vowel in the target syllable for each token. At this point, we excluded further tokens if there was any doubt that they did not meet the test conditions. For example, we found that word-final /r/ seemed to variably undergo deletion when the following onset was a liquid, and this caused us to exclude several tokens. For each vowel, we first measured the vowel duration, and extracted F1 and F2 measurements at the $\frac{1}{3}$ and $\frac{2}{3}$ duration points (following Clopper, Pisoni, & De Jong, 2005). At times the formant tracker in Praat produced F1 or F2 values that seemed erroneous. In these cases, we took an alternative measurement near the $\frac{1}{3}$ or $\frac{2}{3}$ duration point. Also following Clopper et al. (2005), only the measurements taken at the $\frac{1}{3}$ duration point were used in the analysis.

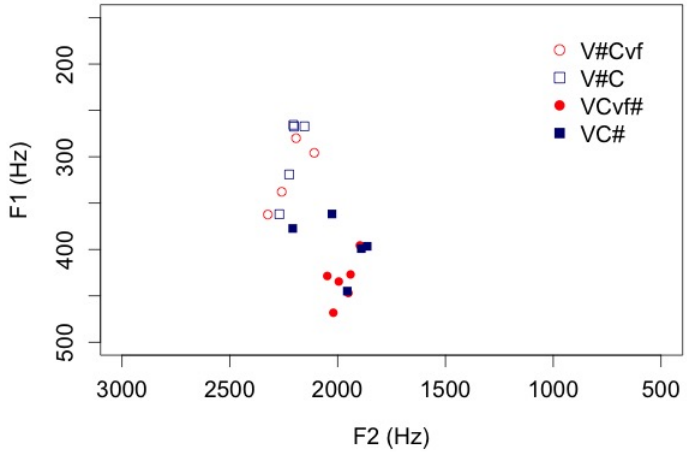
3 Results

3.1 Acoustic analysis

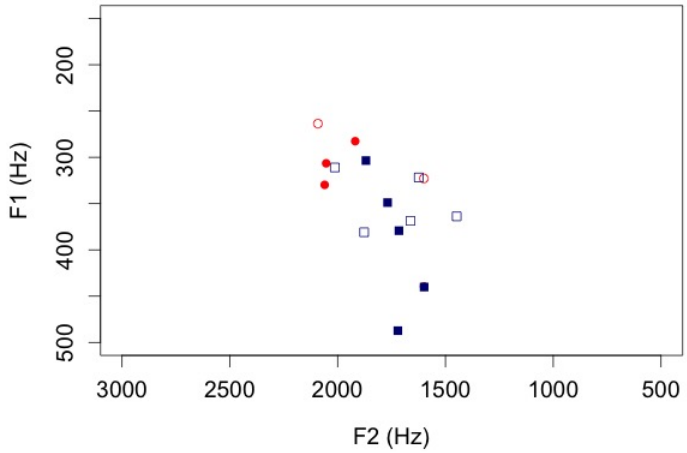
Figures 1-3 present the vowel plots for each vowel for each speaker, with the F1 and F2 values of each token plotted in Hz. The F1 and F2 values for each token correspond to the measurement taken at the $\frac{1}{3}$ duration point (following Clopper et al., 2005). All of the vowel plots share the same scale on the horizontal axes (F2), but the vertical axes (F1) differ slightly. This is particularly the case for the final plot for Speaker #63. In the vowel plots, the non-shaded symbols represent vowel tokens in open syllable environments, and the solid symbols represent vowel tokens in closed syllable environments. The circles represent vowels in tokens from environments in which the consonant across the syllable boundary, or closing the syllable, was a voiced fricative. The squares represent tokens from environments in which the consonant across the syllable boundary, or closing the syllable, was any consonant other than a voiced fricative.

First, we consider the results for Speaker #169, as shown in Figure 1. The vowel plot for /i/ in Figure 1a shows a clear tense-lax pattern according to whether the syllable is open or closed, with the vowels in closed syllables having a higher F1 and a lower F2 value. Additionally, the syllables closed by a voiced fricative pattern with the syllables closed by any other consonant. This is in accord with our hypothesis based on the laxing rule proposed in Oukada (1977), which stated that /i/ in word-final syllables closed by any consonant will undergo laxing. We also find that the vowels in open syllable conditions pattern together. This suggests that there is not an effect of following segment across a word boundary.

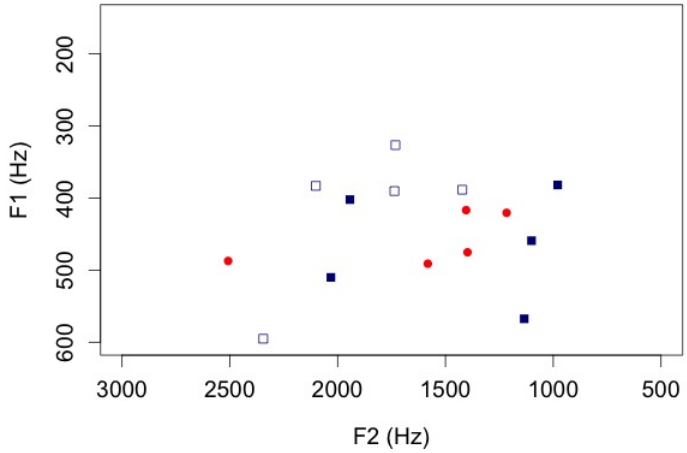
However, we do not find the same distinct tense-lax pattern for /y/ and /u/. For /y/ (Figure 1b), we find that the majority of tokens, whether in open or closed syllable conditions, pattern together, with F1 values between 300–400 Hz. Those vowels in syllables closed by a voiced fricative are among the tokens with the lowest F1 values and pattern with the tokens in open syllables, contrary to the expected laxing pattern (note though that there is a fourth token



(a) Speaker #169 /i/

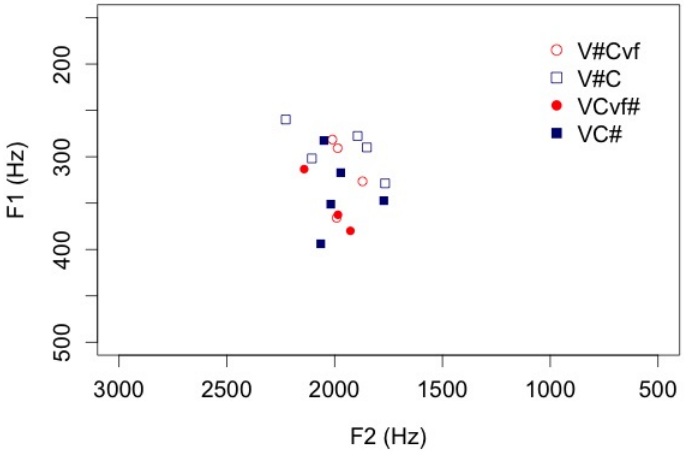


(b) Speaker #169 /y/

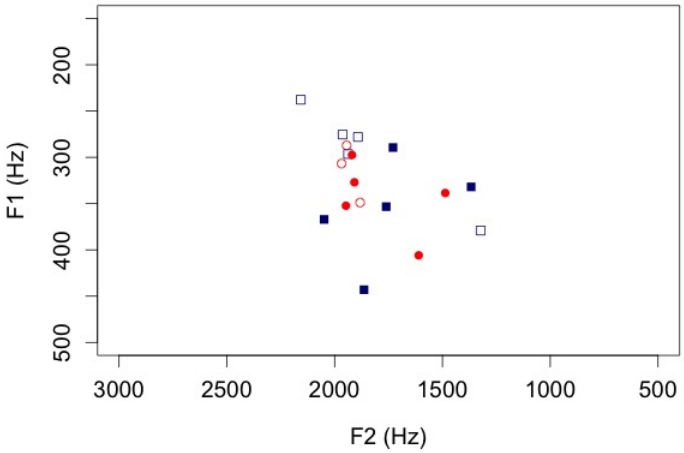


(c) Speaker #169 /u/

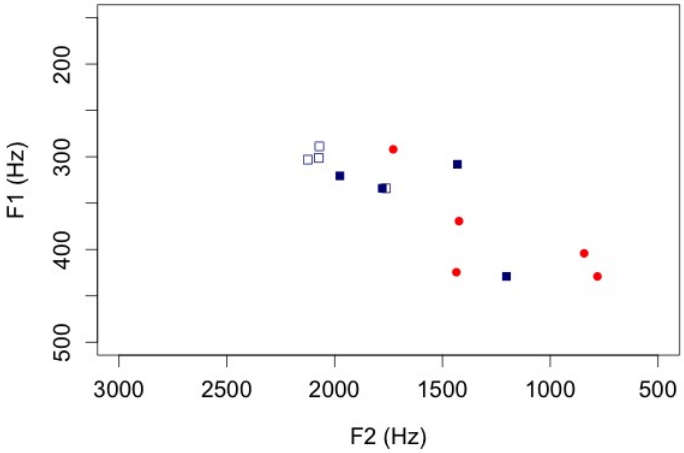
Figure 1: Vowel Plots for Speaker #169



(a) Speaker #69 /i/

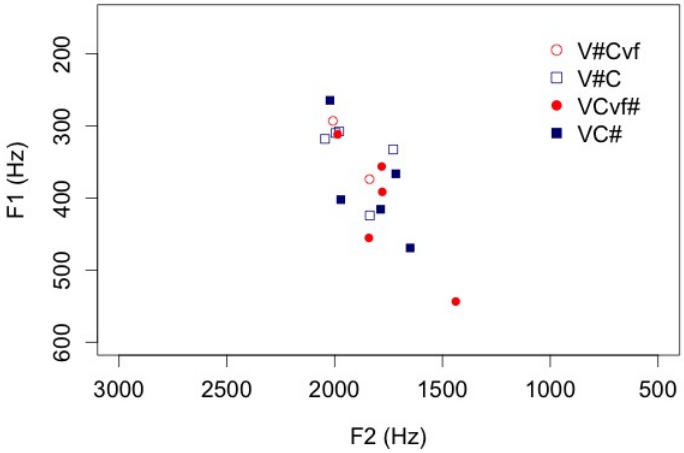


(b) Speaker #69 /y/

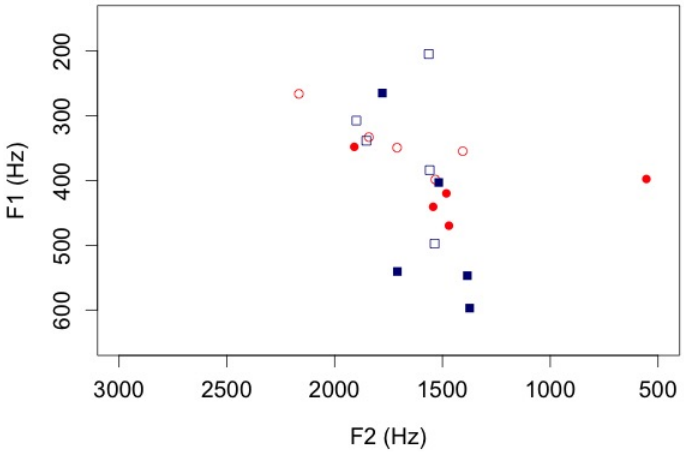


(c) Speaker #69 /u/

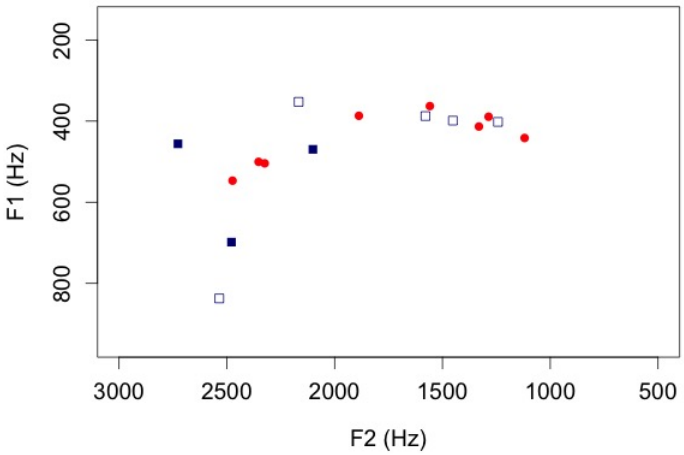
Figure 2: Vowel Plots for Speaker #69



(a) Speaker #63 /i/



(b) Speaker #63 /y/



(c) Speaker #63 /u/

Figure 3: Vowel Plots for Speaker #63

for the VCvf# context that completely overlaps with another token and is concealed by it in Figure 1b, having a F1 value of 440 and an F2 of 1600). Those tokens with the highest F1 values are those corresponding to closed syllable conditions; this suggests possible optional laxing.

The plot for /u/ (Figure 1c) shows no clear tense-lax pattern in which vowels in closed syllables have higher F1 and F2 values (lower and more centralized in the vowel space) as would be expected. Rather, the open syllable tokens generally have lower F1 values (tokens for the first test condition, V#Cvf, were absent for /u/ for all three speakers) than the closed syllable tokens. The closed syllable tokens in general are further back in the vowel space (thus have lower F2 values). There is no evident difference in pattern based on type of consonant closing the syllable.

The vowel plots for Speaker #69 are given in Figure 2. The vowel plot for /i/ in Figure 2a suggests the presence of a tense-lax pattern with the tokens with the lowest F1 values belonging to open syllable conditions. However, there does not seem to be any difference in F2 values based on open vs. closed syllable conditions. Whereas we would hypothesize that lax tokens, those with the highest F1 values, would also have lower F2 values (thus be more centralized in the vowel space), this does not seem to be the case. Additionally, there is more overlap among tokens in open vs. closed syllables than with Speaker #169, suggesting that laxing is optional for Speaker #69. This result is congruent with Guilbeau's (1950, p. 43) observation that the lax variants appear "freely in a checked syllable." Again, as for Speaker #169, with Speaker #63 there does not seem to be any effect of type of consonant following the syllable boundary, as the tokens in the open syllable conditions generally pattern together.

The vowel plot for /y/ (Figure 2b) also suggests the presence of a tense-lax distinction, as generally the tokens with the lowest F1 values and higher F2 values are those from open syllable conditions. Again, as with /i/, laxing seems to be optional, as there is some overlap between open syllable and closed syllable tokens. Regarding /u/, similar to Speaker #169

discussed above, the tokens of /u/ show no tense-lax pattern (Figure 2c). Rather, the tokens in the closed syllable context have lower F2 values, thus are much more back, than the tokens in open syllable conditions.

Similar to Speakers #169 and #69, the vowel plots for Speaker #63 in Figure 3 show some evidence for an optional tense-lax distinction for /i/ and for /y/, and none at all for /u/. Regarding /i/ in Figure 3a, the majority of the vowel tokens in open and closed syllable conditions overlap with one another. However, the tokens with the highest F1 values and lowest F2 values are those in closed syllable conditions. This suggests that laxing, if present for /i/ for this speaker, is optional. Neither the tokens for open nor closed syllable conditions show evidence of influence of consonant type (voiced fricative vs. all other consonants).

The vowel plot for /y/ in Figure 3b also shows some evidence for (optional) laxing, with those tokens in open syllables (regardless of following consonant type) having lower F1 values and higher F2 values in general. Those tokens in closed syllable conditions have, in general, higher F1 values than those tokens in open syllable conditions. Additionally, although there is some variation, it is the closed syllable tokens that generally have the lowest F2 values. Finally, we consider Figure 3c, the plot for /u/ for Speaker #63. Unlike what was shown in Figures 1c and 2c for the previous two speakers, there is no pattern in Figure 3c in which open syllable tokens are fronted compared to closed syllable tokens. Rather, many of the closed syllable tokens are fronted (have higher F2 values); note that the F2 values for /u/ for this speaker are even more fronted (higher) than those of /y/. Like the tokens of /u/ for the previous two speakers, the tokens in the open syllable condition have F1 values at the lowest end of the range attested (thus are high in the vowel space). However, unlike the previous two speakers, this speaker also has vowel tokens in closed syllable conditions in the lowest end of the range of F1 values as well, overlapping with those tokens from open syllable conditions.

In summary, the results show evidence for a tense-lax pattern with /i/, obligatorily for Speaker #169, and optionally for Speakers #69 and #63. The vowel tokens in open syllables

had in general lower F1 values, and higher F2 values, while those tokens in closed syllable conditions had higher F1 values and lower F2 values. The optionality of laxing is suggested by the considerable overlap between open syllable and closed syllable tokens for Speakers #69 and #63. We found no evidence for the effect of consonant following the syllable boundary for open syllable tokens, as the open syllable tokens generally patterned together, regardless of whether the following consonant was a voiced fricative, or any other consonant. We also did not find evidence for an effect of consonant type among the closed syllable conditions. Laxing, if it occurred, was triggered by a syllable closed either by a voiced fricative, or by any other consonant. The results for /i/ are congruent with our original hypothesis that /i/ would undergo optional laxing in word-final closed syllables, regardless of coda consonant type.

Second, the results show evidence for an optional tense-lax pattern with /y/ among all three speakers. While many open and closed syllable tokens overlapped in the vowel space, again suggesting optionality of laxing, those tokens with the highest F1 values and lowest F2 values are found in closed syllable conditions. Again, there is no evidence for the effect of consonant type (voiced fricatives vs. all other consonants) in either open or closed syllable conditions. These two observations are congruent with our hypotheses, formulated in Section 1.3: namely, that /y/ would undergo word-final optional laxing, regardless of coda consonant. Finally, we can note that there seems to be a wider interspeaker variation in the productions of /y/ than with /i/. Additionally, the range of F1 and F2 values is greater (the tokens in the plots are more dispersed) than for /i/.

Third, the results show no evidence for a tense-lax pattern with /u/ for any of the three speakers. Evidence for a tense-lax pattern would be supported by lax variants with a higher F1 value and higher F2 value (lower and more centralized in the vowel space). However, for Speakers #169 and #69, those tokens in closed syllable conditions have higher F1 values and lower F2 values, suggesting that closed word-final syllable environments may cause lowering and backing (in the vowel space). For Speaker #63, we found an opposite pattern

as that shown by the first two speakers. Some of the vowel tokens in closed syllables, regardless of type of coda consonant, were fronted (higher F2 values). These tokens had higher F2 values than even those of the tokens of /y/ produced by this speaker. Additionally, some of the tokens produced in word-final closed syllables overlapped with the tokens from open syllable conditions, thus having low F1 values. Neither of these patterns were predicted by our initial hypotheses, nor are they mentioned by any of the previous literature consulted. Finally, note that among open syllables, our data contained no tokens of /u/ in a word-final open syllable, for which the consonant following the syllable boundary was a voiced fricative. Thus, we cannot comment on whether there is an effect of consonant type (voiced fricative vs. all other consonants) across a syllable boundary for word-final open syllables. The data do not suggest any effect of consonant type (voiced fricative vs. all other consonants) for those tokens produced in closed syllable conditions.

3.2 Duration

In addition to F1 and F2 values, we measured duration as a possible indicator of a tense-lax pattern. As noted above, the lax allophones in CF often have shorter durations than tense vowels (e.g. Coveney 2001, p. 134; see also Table 7 above, reporting results from Martin 2002, p. 81). On the other hand, word-final syllables closed by a voiced fricative have been described as triggering vowel lengthening (or diphthongization) in CF (McLaughlin, 1986). Based on our hypotheses (whereby vowels in closed syllables undergo laxing, regardless of type of coda consonant) we hypothesize that vowels in closed syllables pattern together, regardless of coda consonant, in terms of duration as well. We do not expect to see the same effect of lengthening of vowels in syllables closed by voiced fricatives observed for CF.

For each vowel /i, y, u/ and condition, we calculated an average vowel duration. The duration measurements do not show any clear pattern, and the average vowel duration measurements are not reported here. Figure 4 below shows the results of the duration measurements of all tokens for one speaker, Speaker #169. Recall that our data did not

include any tokens of /u/ in an open syllable for which the following segment was a voiced fricative; thus that column is missing in Figure 4.

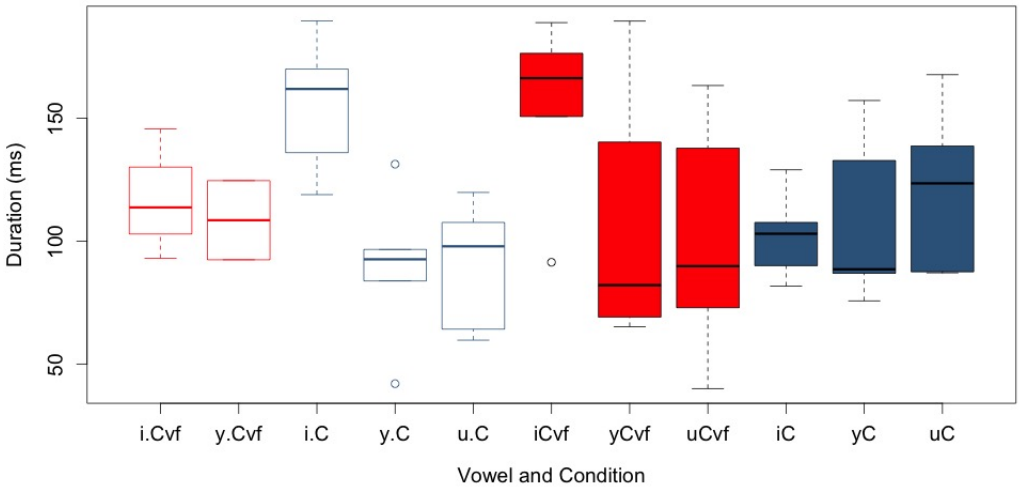


Figure 4: Vowel duration for Speaker #169

To corroborate our hypothesis, we would expect the tokens in the closed syllable conditions (illustrated by the filled-in boxes) to be the shortest, and tokens in the open syllables (illustrated by the empty boxes) to be the longest. Note that as can be seen in Table 7 above, Martin (2002, p. 81) reported duration differences of approximately 20 ms between tense and lax allophones for /i, y, u/. However, Figure 4 does not show evidence to support a similar distinction in LAF. Additionally, there does not seem to be any conclusive effect of consonant type on duration, either among the open or among the closed syllables. Those tokens followed by a voiced fricative (red boxes) are not, in general, longer than those tokens followed by any other consonant (blue boxes).

4 Discussion

4.1 General Discussion

Across all three speakers, the results suggest an (optional) tense-lax pattern for /i/ and /y/, and an unpredicted distribution of tokens with /u/, in which vowels in closed syllables either had higher F1 and lower F2 values (and thus were lower and back in the vowel space, compared to open syllable tokens; Speakers #169 and #69), or had similar F1 values to open syllable tokens (or were fronted in the vowel space; Speaker #63).

Recall that Oukada's (1977) phonological laxing rule for the LAF of the Lafourche Parish (in (2)) indicated that /i/ in word-final syllables closed by any type of consonant undergo laxing; he excluded /y/ and /u/ from this rule and did not report the existence of lax allophones of /y/ and /u/. Our results provide acoustic measurements that corroborate his findings for /i/, and provide evidence that his analysis can be extended to /y/ as well. Our results also corroborate his claim that any coda consonant can trigger laxing, including voiced fricatives. This confirms that high vowel laxing in the LAF of Terrebonne Parish is similar in this way to the LAF of Lafourche Parish (and thus we may conclude that high vowel laxing as described here is general to the LAF of the Lafourche Basin), and unlike what has been described above for CF. Additionally, we find evidence, following Guilbeau (1950), that the laxing seems to be optional (the "free" alternation mentioned by Guilbeau 1950, pp. 43-50).

Our results also corroborate Oukada's (1977) analysis in that /u/ should be excluded from the laxing rule. Recall that Oukada (1977) and Guilbeau (1950) contradict each other for the same variety of LAF; Guilbeau's (1950, p. 49) description includes a lax variant for /u/, while Oukada's (1977) does not. In this way, our results corroborate Oukada (1977) and contradict Guilbeau (1950); however, as we are examining the LAF from a neighboring parish, our results do not bear directly on the LAF of the Lafourche Parish as investigated by Guilbeau (1950) and Oukada (1977). Regarding /u/, the data reported here do suggest a

difference in behavior in open vs. closed syllables, but that pattern is not a tense-lax [u]~[ʊ] pattern for any of the speakers. More data are needed to draw any conclusion about a general pattern of allophonic variation. Finally, in the results for Speaker #63, some of the closed syllable tokens of /u/ had F2 values higher (more fronted) than those of /y/; this raises the question of how and whether minimal pair distinctions are being maintained for /y/ and /u/ for this speaker. Both an adequate description of the variability of /u/, including the variability and robustness of a possible backing or fronting pattern, and the question of the maintenance of a phonemic distinction between /y/ and /u/, merit further investigation.

Finally, we reported inconclusive duration results, which we believe to be the result of effects of stress. French has word-final stress when words are produced in isolation, and rhythmic group final stress when words are produced in connected discourse (Tranel, 1987, pp. 193-200). Importantly, LAF can have individual word stress, which is not a feature of HF (Lyche, 1996, p. 42). We conclude that word stress affected duration to the extent that it rendered duration measurements uninformative without controlling for stress.

4.2 Cross-varietal comparisons

We return to the observation of Conwell and Juilland (1963, pp. 91-95) that /i, y, u/ have a more lax articulation in LAF than in HF in open syllables as well as closed syllables. Table 10 below presents the average F1 and F2 values for /i/ for all three speakers and for all four conditions (the average F1 and F2 values for /y/ and /u/ for all three speakers can be found in the Appendix). We selected this vowel as a starting point as it seemed to display the least amount of intraspeaker and interspeaker variation (with /u/ showing the widest range of variation).

First, Table 10 shows that for every speaker, average F1 values are higher and F2 values are lower for the closed syllable conditions, indicating vowel laxing. This is expected based on Figures 1a, 2a, and 3a above, which showed evidence of laxing for /i/. However, the average values obscure the optionality of laxing evident in the vowel plots; as noted above,

		i#Cvf	i#C	iCvf#	iC#	Average
Speaker #169	F1	319	296	433	396	361
	F2	2221	2211	1975	1989	2099
Speaker #69	F1	316	292	352	338	325
	F2	1964	1969	2018	1975	1982
Speaker #63	F1	334	338	411	384	367
	F2	1923	1917	1765	1829	1859

Table 10: Average F1 and F2 values of /i/, measured at the $\frac{1}{3}$ duration point, for all three speakers

only the productions of /i/ of Speaker #169 do not exhibit optionality in laxing in our data.

We can compare the values in Table 10 with the values of /i/ reported for HF and CF in Section 1.2. Compared with the data for HF (Tables 2 and 3), we can see that the F1 values for Speakers #169 and #69 for open syllable conditions are similar to the data reported in Tubach (1989, pg. 84) but higher than the F1 data reported in Strange et al. (2007, p. 1117 & p. 1128). Additionally, the F2 values for Speaker #169 for open syllable conditions are higher than the F2 values reported in those studies; thus, for open syllable productions of /i/, for this speaker, the values are very much comparable to the values of /i/ reported for HF. However, for Speaker #63, the F1 and F2 values in Table 10 suggest that /i/ is produced with more lax articulation (given the higher F1 and lower F2 values) in open and closed syllables, when compared with HF. As expected, the closed syllable productions of /i/ in our LAF data show that the productions are more lax than in HF, which lacks a lax allophone. We can also compare the values in Table 10 with the values reported for [i] and [ɪ] for CF, in Tables 4-6. Of the values reported in those tables, the data in our study are the most similar to those in Table 4, values produced by 10 early bilinguals of CF (note however that of those 10 bilingual speakers, only one is male).

4.3 Limitations

The analysis of spontaneous speech proved to be both challenging and rewarding. By using pre-recorded data, we were able to provide the first acoustic analysis of an understudied and under-resourced variety of French. Given the endangered status of Louisiana French (see Blythe, 1997), there is an urgency to probe these gaps in the research. However, in conducing this project, we became acutely aware of the limitations of using spontaneous, previously recorded data. It was impossible to obtain the target number of tokens for certain vowels and in certain conditions, meaning that a complete description of the phenomenon was impossible. This also would prevent us from collecting additional tokens for the same speaker in certain contexts for which we would have wanted more evidence to substantiate a strong conclusion (for example, as regards the tense-lax pattern for /y/). We had to contend with stress effects of connected discourse, which we hypothesize to be strong, though we are unsure of the exact nature of their influence on our data, beyond increasing vowel duration. Finally, it is clear that there are many possible contributing factors to variation, both linguistic and sociolinguistic, for which we were unable to control. Any further investigations must be able to control for these factors to have more conclusive results.

5 Conclusion

This study proposed an investigation of high vowels in the Terrebonne Parish variety of LAF, using pre-recorded data from three older male speakers from the parish. The Terrebonne Parish variety of LAF is a particularly understudied variety of LAF (Papen & Rottet, 1997, p.72), and this study constitutes the first acoustic description of high vowels for this variety, and any variety, of LAF. Additionally, we were able to probe gaps in the previous literature to explore the phenomenon of high vowel laxing in the Terrebonne Parish variety of LAF. Unlike CF, in which lax allophones appear word-finally in syllables closed by any consonant

other than a voiced fricative, Oukada (1977) suggested that the phenomenon was more general in LAF: closed syllables in general triggered laxing, regardless of type of coda consonant. However, Oukada (1977) described a lax allophone only for /i/, and his laxing rule applied only to /i/, whereas the description in Guilbeau (1950) suggested that laxing also applied to the high vowels /y/ and /u/.

By analyzing the F1 and F2 of vowel tokens in four different phonetic environments, open and closed syllables in which the consonant following the syllable boundary (or closing the syllable) was a voiced fricative vs. any other consonant, we were able to corroborate or contradict previous descriptions of the LAF of the Lafourche Basin. The data provide evidence for optional high vowel laxing of the high vowels /i/ and /y/ in word-final closed syllables; this is congruent with the discussion in Guilbeau (1950), and also suggests that Oukada's (1977) high vowel laxing rule should be expanded to include /y/. We also show that unlike what is traditionally reported for CF, in which a high vowel undergoes laxing in word-final syllables closed only by consonants other than voiced fricatives, any closed syllable triggers laxing in the Terrebonne Parish data considered here.

On the other hand, our data show unanticipated results for /u/. The phonetic environment of open vs. closed syllables does seem to affect the behavior of /u/, but our data are inconclusive. The results of two speakers show lowering and backing in the vowel space of /u/ in closed syllables, while the results of a third speaker show possible fronting (with higher F2 values) for some tokens, with F2 values that are even higher than those tokens produced for /y/. Finally, we also measured vowel duration, but found inconclusive results, likely due to effects of stress.

This study thus lays the foundation for future work on high vowels in LAF which will involve expanding the study to include more speakers, both male and female, and supplementing pre-existing data with elicited data bearing on the research questions. It could also probe other varieties of LAF, or longitudinal changes in LAF as the pre-recorded data here was collected in the 1980s. Finally, this study shows the wealth of information

that an understudied variety has to contribute to the phenomenon of high vowel laxing in French, and urges more research on this endangered variety.

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A Appendix

		y#Cvf	y#C	yCvf#	yC#	Average
Speaker #169	F1	293	349	340	392	344
	F2	1846	1725	1908	1734	1830
Speaker #69	F1	314	293	344	356	327
	F2	1931	1854	1774	1754	1828
Speaker #63	F1	340	347	415	471	393
	F2	1731	1682	1391	1553	1589

Table 11: Average F1 and F2 values of /y/, measured at the $\frac{1}{3}$ duration point, for all three speakers

		u#Cvf	u#C	uCvf#	uC#	Average
Speaker #169	F1	-	417	458	464	446
	F2	-	1867	1621	1438	1642
Speaker #69	F1	-	307	389	348	348
	F2	-	2008	1242	1597	1616
Speaker #63	F1	-	476	443	541	486
	F2	-	1795	1792	2435	2007

Table 12: Average F1 and F2 values of /u/, measured at the $\frac{1}{3}$ duration point, for all three speakers