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Vowel Production and Canadian Raising in Southern Alberta and Saskatchewan English

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The undersigned certify that they have read and recommend to the Faculty of Arts for acceptance, a thesis entitled *Vowel Production and Canadian Raising in Southern Alberta and Saskatchewan English*, submitted by Bryce Jacob Wittrock in partial fulfillment of the requirements for the degree of Bachelor of Arts.

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ABSTRACT

This thesis presents an acoustic analysis of a collected corpus of Southern Alberta and Saskatchewan English (SASE). Acoustic information of vowels (formant values, duration, etc.) are measured for SASE monophthongs and Canadian Raising (CR) diphthongs. Variation in the acoustic properties of these vowel productions related to social variables (age, sex, style) is explored within the corpus and compared (to the extent it is possible at this stage) to findings in other regions. Results show homogeneity within Inland Canadian English but substantial style differences for productions of monophthongs and CR diphthongs within the collected data. Age/sex differences are described that suggest both female- and male-led innovations regarding the Canadian Shift, centralized [u], and CR. Canadian Raising/aɪ- and aʊ-raising is shown to be highly variable in production, depending on phonetic environment and speaker characteristics. Support is found for a separate formant trajectory of CR diphthongs before [ɹ] in the prairies. It has been shown that [aɪ] patterns differently in this environment than before voiced or voiceless obstruents (Onosson, 2010) and the present work shows that [aʊ] does as well, among other findings.

ACKNOWLEDGEMENTS

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CHAPTER 1. INTRODUCTION AND BACKGROUND

1.1 A Brief Typology of Canadian English and Research Goals

"Relatively homogeneous" is an often-repeated descriptor of Canadian English. Despite this, there exists a growing body of work on variation in Canadian English pronunciation. Large-scale studies have parsed a handful of major dialect groups based on the presence or absence of several phonetic markers (Labov et al, 2006; Boberg, 2010). One such group outlined in this categorization is an Inland variety, which spans thousands of kilometers from the Rocky Mountains in the west to northwestern Ontario in the east (Labov et al., 2006, p. 224). This thesis investigates speech data from a subset of this Inland variety, southern Alberta and southern Saskatchewan, with the fundamental goal of exploring phonetic variation within this area as well as in relation to other regional descriptions. Phrased differently, this project addresses the question: what is English pronunciation like in southern Alberta and southern Saskatchewan and how does it compare to other Canadian English varieties?

The present study addresses the above question by contributing an account of acoustic features of southern Alberta and Saskatchewan English vowels, specifically monophthongs and Canadian Raising diphthongs. Canadian Raising is defined and explored in section 1.2. Analyzing monophthong production in this understudied region deepens our understanding of pronunciation in Canadian Englishes. Further, investigating how Canadian Raising manifests in southern Alberta and Saskatchewan enriches our understanding of this modern linguistic phenomenon. An account of vowel production and Canadian Raising in Southern Alberta and Saskatchewan English (SASE) is investigated using the following research questions:

1. What are the acoustic characteristics of monophthongs and Canadian Raising diphthongs in SASE?
2. How do these characteristics pattern along social variables (age, sex, style)?
3. How do acoustic properties of SASE vowels compare to existing regional datasets?

Preliminary evidence gathered in Wittrock (2019) suggests that SASE productions of [aɪ] in different phonetic environments are perceived differently by English speakers from Ontario. Therefore, this speaker group may have forms in particular phonetic environments that are different from the traditionally described criterion for raising being a pre-voiceless environment (Chambers, 1973). This finding is further explored in the present work by way of a fourth research question:

4. In what phonetic environments do SASE speakers vary their pronunciations of [aɪ] and [aʊ] and how do their realizations differ acoustically depending on phonetic environment?

Three phonetic environments are considered for Canadian Raising diphthongs: before voiceless obstruents (symbolized by T), before voiced obstruents (D) and before [ɹ] (R). A notation of [aɪT], [aɪD], [aɪR], [aʊT], [aʊD], and [aʊR] referring to each diphthong in a given environment is used in this work.

1.2 The Phenomenon of Canadian Raising

One phonetic feature that characterizes, but is definitely not limited to Inland Canadian English is *Canadian Raising*. Canadian Raising (CR) is a term introduced by Chambers (1973) and defined as a rule where [aɪ] and [aʊ] change to [ʌɪ] and [ʌʊ] respectively before voiceless obstruents throughout Canadian English varieties. Although described under the same label, [aɪ]- and [aʊ]-raising behave independently and therefore should be analyzed as distinct phenomena (Chambers, 1989). CR is also perhaps the most widely recognizable feature of Canadian English. Canadians transforming [aɪ] into [ʌɪ] and [aʊ] into [ʌʊ] before voiceless obstruents is a change that North Americans notice and even stereotype – [aʊ]-raising is the source of the famous 'a boot' rather than 'about' pronunciation.

1.2.1 A Brief History of Canadian Raising

The origins of Canadian Raising and the development of [aɪ] and [aʊ] across time have been thoroughly studied. Labov (1963, pp. 281-282) classifies the vowel nucleus of [aɪ]/[ʌɪ] as central (ə~ʌ) in the 16th and 17th centuries and lowered generally in North American varieties by the late 19th century. Gregg (1973) corroborates Labov's description by tracing a central [ʌɪ] back to the Great Vowel Shift of Middle English and suggests that an un-lowered [aɪ]/[ʌɪ] form has been the marked one throughout history rather than a "raised" [ʌɪ]. [aʊ]/[ʌʊ] has a development over time unique from that of [aɪ]/[ʌɪ]. The historical data presented in Labov (1963) describes the nucleus of [aʊ] as considerably low when [aɪ]/[ʌɪ] was still central, with raising to [ʌʊ] before voiceless sounds being highly unlikely. In the North American English of the time, the pronunciation of [aʊ] was highly variable by region with vowel nuclei ranging

across the vowel space from [ɛ] to [ɑ] to [o] (Labov, 1963, p. 282). Moving into the 18th and 19th centuries, Labov (1963) recounts that this "truly impressive" amount of variation was gradually levelled and [aʊ] became the unmarked American English standard. The allophonic relationship between [aɪ] and [ʌɪ] and [aʊ] and [ʌʊ] we know today as Canadian Raising was established in Canada between the late 19th and early 20th centuries (Chambers, 2006).

Our conceptualization of "Canadian Raising" as a defined object of study began with Joos (1942). Joos (1942) noted in Ontario that the flapping of intervocalic [t] in words like 'typewriter' was a determining factor for a raised or unraised [aɪ]. For some speakers, turning [t] into [ɾ] eliminated the pre-voiceless condition that would in turn raise [aɪ] to [ʌɪ], and for others, the flap appeared not to block the raising to [ʌɪ]. This meant that some speakers pronounced 'writer' with a raised [ʌɪ] and some with an unraised [aɪ], despite both flapping the [t]. Which form a speaker produces can be thought of as dependant on the ordering of two rules: a flapping rule that changes [t] to [ɾ] between vowels with the following vowel unstressed and a raising rule that changes [aɪ] to [ʌɪ] before [t]. If the raising rule is applied before the flapping rule, the [t] would necessitate the change of [aɪ] to [ʌɪ] and then itself change to [ɾ] resulting in the speaker producing 'writer' as [ɹʌɪɾɚ]. If the flapping rule is applied before the raising rule, the intervocalic [t] changes to [ɾ] and [aɪ] would remain unchanged since it is no longer in the pre-[t] environment that conditions the change to [ʌɪ] and the speaker would produce 'writer' as [ɹaɪɾɚ] – indistinguishable from 'rider.' This analysis was expanded upon in Chambers (1973) to include [aʊ] raising to [ʌʊ] and the condition of the above phonological rule was generalized to any voiceless consonant. These two studies together form much of the foundation for all subsequent work on Canadian Raising.

1.2.2 Variation in Production and Geographical Distribution of Canadian Raising

Despite a common public perception of how all Canadians allegedly talk, CR is not uniform across regions nor is it restricted to the country it gets its name from. CR or CR-like phenomena are in fact ongoing phonological shifts in many North American English varieties (e.g. Vance, 1987). There are two important dimensions to consider regarding the distribution of "Canadian" "Raising" in North American Englishes – hence the quotations around both words to suggest greater nuances to both "Canadian" and "Raising" than the label implies. First, that the acoustic characteristics of the speech varieties that transform [aɪ] and [aʊ] all do so in the same way, and second, that the varieties that transform them are all Canadian varieties.

I first explore variation in how CR is realized across communities where it has been attested. Conceptualized as a phonological rule, the simple description of Canadian Raising in Chambers (1973) is that a tense vowel nucleus becomes non-low when preceding an off-glide and then a voiceless consonant. As recognized in Chambers (1973), this rule is not hard and fast for every Canadian speech community from coast to coast. For example, members of the Church of Jesus Christ of Latter-day Saints (also known as Mormons) in southern Alberta participate significantly less in CR than others in the area who are socially similar except for religious affiliation (Meechan, 1999). Sadlier-Brown (2012) reports that there are some (often female) "non-raisers" or "weak-raisers" of [aɪ] in Vancouver. She also notes that some degree of [aɪ]-raising tends to be shared between speakers in Vancouver and speakers in the neighbouring Washington State, but the raising of [aʊ] remains a shibboleth of non-American speech. Onosson (2010) finds that in Manitoba, instances of [aɪ] before [ɹ] have durations and formant paths in between those of [aɪ] before voiceless obstruents (aɪT) and [aɪ] before voiced obstruents (aɪD). This result is significant given that one would expect the pre-[ɹ] environment to pattern like the

pre-voiced obstruent environment, but in Manitoba at least this is not the case. The present study will relate findings of how CR is realized in SASE to these descriptions of other regions in Canada (such as Vancouver and Manitoba) in an attempt to gain deeper insight into the isogloss boundaries drawn by Labov et al. (2006).

The second wrinkle in describing CR is that it is not confined to Canadian Englishes. Raising of [aɪ] and [aʊ], but especially [aɪ], has been attested in many speech communities in the United States. For example, "Canadian Raising" is reported in the northern United States including (but not limited to) Michigan (Dailey-O'Cain, 1997), Philadelphia (Fruehwald, 2016), and Seattle (Sadlier-Brown, 2012) but also in regions further away from the Canadian border such as New Orleans (Carmichael, 2020). Despite a name that reflects a history of this phenomena being observed in Canada, some contemporary works that handle Canadian Raising do not consider it exclusive enough to be a defining feature of Canadian English (e.g. Boberg, 2010, p. 150).

1.3 Hypotheses and Expected Findings

In order to begin answering the above research questions, I look to existing descriptions of English wherein SASE would be considered a subset. In other words, descriptions of Inland Canadian English, or Canadian English more generally, should in principle also apply to southern Alberta and Saskatchewan English. Based on the findings of previous work I form a set of acoustic features one would expect to find when examining phonetic variation in SASE. In this way, I establish hypotheses about vowel production in southern Alberta and southern Saskatchewan that can be revisited later when considering the results of the present study. In

order to disentangle evidence that supports the current understanding of English in the prairies from potentially novel findings that may expand this knowledge, one must clearly articulate the default description of SASE informed by earlier literature that stands prior to the undertaking of the current project. The scope of what is covered here is not exhaustive. Notably missing are considerations for pre-velar raising and reduction of [ɑ] before [ɹ]. These and other topics could be investigated in future research to expand the investigation of SASE, and Inland Canadian English more generally.

Inland Canadian English is characterized by peripheral and less diphthongal [e] and [o] vowels, [aʊ] before voiceless obstruents being further back than in Eastern Canada, and participation in the *Canadian Shift* (Clarke et al., 1995; Labov et al., 2006; Boberg, 2010, pp. 146-149). Clarke et al. (1995) also describes the Canadian Shift as a lowering (higher F1) and retraction (lower F2) of the lax front vowels [æ] [ɛ] [ɪ] that has been reported in southern Alberta English (Rosen & Heinrichs, 2014). It is expected that SASE would be incredibly similar to other subsets of the Inland Canadian English variety. In the present study, I compare SASE with an account of Edmonton English in section 3.6. Following broader innovations in standard Canadian English, one would expect SASE to display a fronted/centralized [u] and lowered [æ] (Boberg, 2011). Being a subset of Canadian English, I hypothesize that SASE exhibits archetypal Canadian Raising (raising of [aɪ] and [aʊ] to [ʌɪ] and [ʌʊ] before voiceless obstruents) as established in Chambers (1973). A more nuanced investigation of Canadian Raising in Chapter 4 explores in greater detail the productions of these diphthongs by different age/sex groups in different phonetic environments.

These documented features above describe what one would expect to find when collecting speech data within the bounds of the Inland group, and therefore form a set of

hypotheses that the findings of the present investigation may be measured against. The present work aims to investigate how the above features are manifested in SASE by following the path established by the research goals outlined in section 1.1. Chapter 2 provides a description of the SASE corpus recorded and annotated for the present thesis. Chapter 3 explores variation of the acoustic features described above that relate to monophthongs in light of the research questions outlined in section 1.1. Chapter 4 handles the same for variation in productions of Canadian Raising diphthongs. Chapter 5 summarizes the results of the investigation found in the previous chapters and discusses the relevance of these results to other work on Canadian Englishes.

CHAPTER 2. CORPUS OF SOUTHERN ALBERTA AND SASKATCHEWAN ENGLISH

2.1 Participants

The SASE corpus consists of audio recordings of 24 native English speakers (22 monolinguals) from southern Alberta and southern Saskatchewan. 13 participants indicated a home community in southern Alberta, 9 in southern Saskatchewan, and 2 participants considered themselves to have grown up in the southern part of both provinces. Figure 1 below is a map of southeastern Alberta and southwestern Saskatchewan with pins marking where participants considered themselves to have grown up. In the top left corner we see a highlighted area in Canada that the rest of the figure is focussed on. Edmonton, Alberta is marked with a small blue star. Sampling ranges from Vulcan, Alberta in the west to Wadena, Saskatchewan in the east. Some participants cited more than one place (which are all marked) and some places are cited more than once. Collecting from both sides of a provincial border was not judged to be problematic since the divided populations are very similar in terms of lifestyle, especially in more rural communities. In my own personal experience, movement between southern Alberta and southern Saskatchewan is incredibly fluid. Many families are spread across both southern Alberta and Saskatchewan and it is common for people to have lived in and have ties to the other province. People cross the border often to shop, socialize, and work. Further, the boundary marks only one noted isogloss, the smallest difference among any two Canadian provinces (Boberg, 2005). Possible phonetic differences between the provinces (or the lack thereof) are examined in section 3.3.

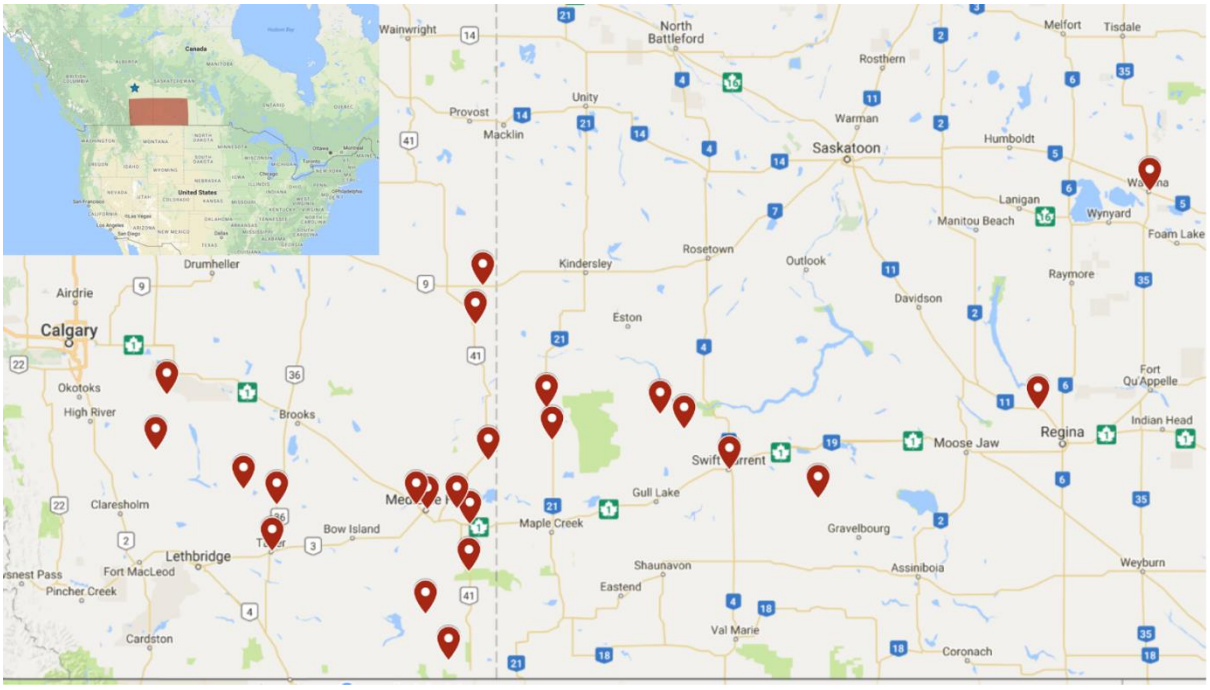

Figure 1: A map with pins marking where participants considered themselves to have grown up.

The participant pool consists of 5 men over the age of 40, 7 men under 40, 6 women over 40, and 6 women under 40, forming four age/sex groups. Although such an absolute age boundary can be misleading (a 39-year-old and a 41-year old would not be expected to differ much) these age groups were minimally about a generation apart. The youngest over-40 male and the oldest under-40 male are separated by 15 years, and for women the gap is larger. Age and sex are not controlled for within each province, meaning even numbers of older and younger men and women were not sampled from each province. The average age, age range, and standard deviation for each age/sex group are given in Table 1 below.

	Average Age	Age Range	Standard Deviation
Older Men (OM)	58	47-75	9.5
Older Women (OW)	55.8	52-58	2.4
Younger Men (YM)	22	18-32	4.2
Younger Women (YW)	21.8	19-29	8.05

Table 1: Averages, ranges, and standard deviations for the age of participants in each age/sex grouping.

2.2 Methods & Data Collection

The speech data that makes up the SASE corpus was collected by the author between May and July 2018. Recordings were made using a Marantz digital recorder with a sampling rate of 44,110 Hz and an omnidirectional Countryman E6 earset. Recordings took place in quiet and controlled, yet comfortable environments, not uncommonly in participants' own homes. Collecting speech data in various unpredictable settings meant that measures to ensure audio quality fit for acoustic analysis were taken at every session. TVs and similar noise-making devices were turned off, kids were sent to another room, and flat surfaces that could produce echo such as kitchen tables were covered with a cloth. Despite this, some interruptions such as a clock chiming, a vacuum, and third party commentary persist in the recordings and were either replaced with silence or checked to ensure that the sounds did not overlap with the speech analyzed. Personally identifying information (such as names) that persist in recordings were replaced with silence.

Participants were recruited via word-of-mouth and personal relationships. Since I (the interviewer) would be considered part of the speech community of study, I had two important advantages when collecting the data. First, I had an existing network of potential participants I

could readily contact. Most of the Alberta data was collected through this strategy – participants were often friends or friends of friends and sometimes family. A larger portion of the Saskatchewan data came from strangers who were put in touch with the study through word of mouth from other participants. After recording sessions I would ask participants if they knew of other people who fit the criteria (native English speaker who grew up in southern Alberta and/or southern Saskatchewan) and I met several participants this way. The second advantage to my being an in-group interviewer is that this relative social similarity can facilitate participants' use of maximally naturalistic speech (Giles & Coupland, 1991).

At the beginning of recording sessions, participants were told that they were invited to participate in a study on "how different groups of people speak" as non-compensated volunteers. Once consent was obtained, participants first answered questions about where they grew up, what languages they spoke, and other information deemed relevant to the study seen in Appendix A. Although participants often grew up elsewhere, most recordings took place in Medicine Hat, Alberta and Pennant, Saskatchewan.

Each recording is approximately 25 minutes long, and can be divided into three sections based on speech style or genre: a sociolinguistic interview, a word list (Appendix B), and two reading passages (Appendix C). In this setup, three different speech styles of varying carefulness may be compared: carefully produced word list items in isolation, relatively careful reading, and near-casual spontaneous speech. In an attempt to ensure the interview data is as naturalistic as possible, the more structured word list and reading passage tasks were kept at the end of recording sessions so that the "test" component comes later. Recordings consist primarily of the 20-minute sociolinguistic interview, which targets "the style in which the minimum attention is given to the monitoring of speech" (Labov, 1972). Discussions are free, light, and

conversational, often branching from summer holiday plans or leisure activities in an attempt to elicit maximally naturalistic vernacular. Following the interview, participants read a 129-item word list that was created as a part of this project (Appendix B). The word list contains items eliciting productions of Canadian English monophthongs as well as Canadian Raising diphthongs in pre-voiceless obstruent, pre-voiced obstruent, and pre-[ɹ] contexts. The word list also contains items that target other phenomena in Canadian English that would be useful for future research, for example tokens of potential pre-velar raising and reduction of [ɑ] before [ɹ]. Word list items were presented to participants as a slideshow on a laptop screen. Slides contained one legibly-sized word at a time (in an attempt to mitigate a list-reading intonation), and were advanced at a calm and steady pace controlled remotely by the researcher. Carrier phrases were not used – the words were produced in isolation one after the other. Items that were misread during this task were kept given that these items were still in the desired style, just not the exact item on the screen. For example, a few participants said “beginning” when shown “begging.” Finally, participants read two standardized passages (Appendix C) extracted from and described in Weinberger & Kunath (2011) and Kendall (2013). Both reading passages are considered to be the same speech style, and so vowel productions from the two reading passages are clumped together.

2.3 Data Analysis

Once collected, recordings were orthographically transcribed and divided according to speech style (interview, reading passage, and word list). A script in Praat was used to import these transcriptions into TextGrids (Boersma & Weenink, 2019). The CMU pronunciation dictionary (Weide, 2005) was then used (with some localized additions) to map the orthography onto phones. Orthographically transcribed words are matched with standard pronunciations so that individual vowel sounds, rather than letters, can be targeted and measured. Items present in the corpus but not in the CMU dictionary such as *Ovechkin* and *Shrek* were manually added to the dictionary. The Penn Phonetics Lab Forced Aligner (Yuan & Liberman, 2008) subsequently mapped phones assigned by the dictionary onto the acoustic signal. Audio files were resampled to 11025 Hz prior to data analysis in order to augment the alignment process. In Figure 2 we see an example of transcribed and force-aligned speech data. Although the generated phone boundaries are imperfect, no manual alterations were made for the sake of consistency. The alignment in a portion of each recording was manually inspected to ensure relative accuracy, but as mentioned no modifications were made.

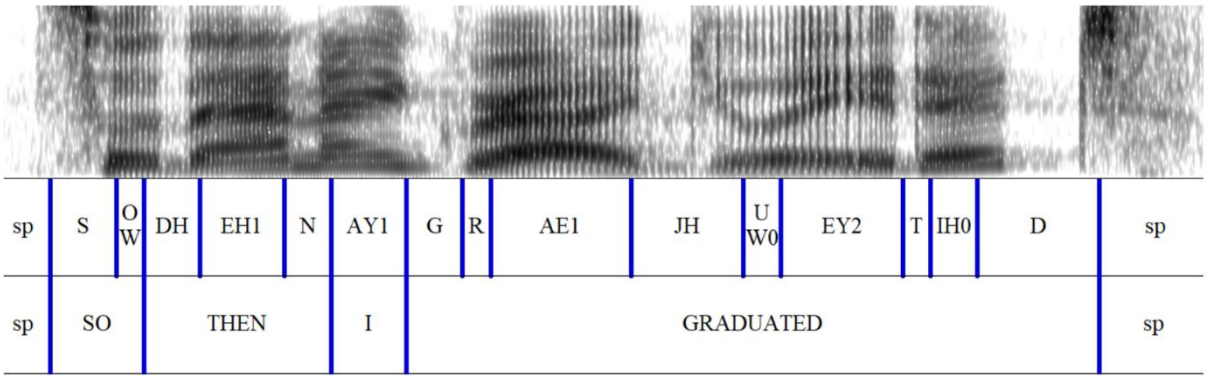

Figure 2: Spectrogram with orthographic transcriptions and segmented phones of Speaker 7, an older woman, in the interview.

Acoustic information of vowels (F1 and F2 values, duration, etc.) was extracted and analyzed using R (R Core Team, 2013). Extracted F1 and F2 values are normalized to account for anatomical differences among speakers such as vocal tract size (Lobanov, 1971). F1 and F2 measurements at the midpoint of monophthong productions sketch vowel spaces of SASE depending on the age, sex, and style of speakers. F1 and F2 values at 25% and 75% of the duration of CR diphthongs are measured in order to trace the change in quality of these vowels over time. By measuring at these two time points, one obtains formant frequency information of both the vowel nucleus (the first [a-] portion) and the off-glide (the second [-ɪ] or [-ʊ] portion). I compare realizations of these diphthongs in three different phonetic environments: before voiceless obstruents (T), voiced obstruents (D) and [ɹ] (R). Productions more than 1.96 standard deviations away from the mean are considered outliers and are not included in the figures. The phonTools package in R was used to generate vowel plots that allow us to visualize F1 and F2 values for vowel productions, as seen throughout the next two chapters (Barreda, 2015).

I would like to acknowledge two challenges for the dataset analyzed below. First, it was intended that this project focus only on the acoustic analysis of vowels in primary stress positions. The stress of each vowel was noted, but mistakenly never actually used to subset the data. Time constraints have not allowed for additional analysis separating stressed from unstressed vowels and results ought to be considered accordingly with this caveat in mind. Second, instances of filler speech (“um,” “uh,” etc.) have not yet been removed from the data. These challenges will be addressed in future analysis of the data.

CHAPTER 3. MONOPHTHONGS IN THE SASE CORPUS

This chapter investigates monophthong productions in SASE, variation within the corpus according to province, style, age, and sex, as well as an attempt to address regional variation by comparing the SASE data to an account of Edmonton English.

3.1 Observations

The number of observations for each vowel in each style by each age/sex grouping are expressed in the following three tables. For each speech style, counts of each vowel token by the age/sex groupings are listed. Table 2 shows the vowel counts for interview speech, Table 3 shows those for the reading passages and Table 4 shows those for the word list. Later in the chapter, formant frequencies for these vowel productions are plotted and described. For this reason, it is important to know the number of observations that the plots are drawing from. Taken together, these tables below show just how much interview data there is relative to the smaller reading passage and wordlist data. At the same time however, we see that observations from the smallest dataset – that of the word list – are still not so small that conclusions cannot be drawn based on them. For example, our number of observations for word list vowels is not so small that the Lobanov normalization would cease to work as intended. Note that the high number of observations of [ʌ] is largely due to filled pauses such as ‘um’ and ‘uh’ that have yet to be removed from the data.

Interview Monophthongs	N Total	N OM	N OW	N YM	N YW
æ	*7633*	1403	1879	2063	2288
ɑ	*4775*	1096	1096	1274	1309
e	*3188*	685	802	821	880
ɛ	*5854*	1261	1485	1476	1632
i	*7813*	1399	1981	2224	2209
ɪ	*12230*	2346	2856	3294	3734
o	*4383*	865	1055	1103	1360
u	*3458*	684	922	832	1009
ʊ	*1193*	230	307	293	363
ʌ	*19725*	4017	4851	5291	5566

Table 2: Observations of monophthongs in the interview style. OM = older men, OW = older women, YM = younger men, YW = younger women.

Reading Passage Monophthongs	N Total	N OM	N OW	N YM	N YW
æ	*798*	139	180	248	231
ɑ	*853*	174	189	265	225
e	*490*	105	107	142	136
ɛ	*717*	153	158	217	189
i	*749*	139	178	230	202
ɪ	*1231*	249	279	376	327
o	*308*	61	70	96	81
u	*384*	89	92	110	93
ʊ	*166*	39	39	49	39
ʌ	*2045*	456	473	615	501

Table 3: Observations of monophthongs in the reading passage style. OM = older men, OW = older women, YM = younger men, YW = younger women.

Word List Monophthongs	N Total	N OM	N OW	N YM	N YW
æ	*205*	43	46	65	51
ɑ	*648*	123	150	205	170
e	*88*	19	19	27	23
ɛ	*102*	23	21	31	27
i	*283*	48	68	88	79
ɪ	*473*	95	104	149	125
o	*109*	22	22	35	30
u	*229*	47	55	68	59
ʊ	*149*	32	36	45	36
ʌ	*391*	80	83	124	104

Table 4: Observations of monophthongs in the word list style. OM = older men, OW = older women, YM = younger men, YW = younger women.

3.2 Explanation of Vowel Plots and the Measurements that Inform Them

At this point, an explanation of the measures and the plots such as the one shown in Figure 3 in the next section is necessary. F1 is measured along the x-axis and F2 is measured along the y-axis. Rather than frequency values in Hz, a normalized scale is used as in Lobanov (1971). To account for speaker differences such as different pitched voices and different vocal tract sizes, vowel productions are plotted in relation to a relative zero. Methods such as this allow for more meaningful comparison of age and sex variables. The intersection of the F1 and F2 zeros is the theoretical centre of the vowel space. Therefore, comparative notions of "more front" or "higher" are understood in terms of standard deviations away from this centre point instead of frequencies in Hz. For monophthongs (this chapter), vowel labels are placed at the mean of measurement for a given vowel at its midpoint. For diphthongs (Chapter 4), two vowel labels mark F1 and F2 at 25% and at 75% of the way through a diphthong's duration. In this way, there

is a dynamic measure of the quality of diphthongs. Ellipses represent the range of productions for a given vowel that are within one standard deviation of the mean – where the vowel label is. Appendix D contains tables of the mean frequency measures that are plotted and discussed throughout this paper. Also included are average durations of a given vowel. For organizational purposes these tables are kept outside the main body of the thesis.

3.3 Comparing Speakers from Southern Alberta and Southern Saskatchewan

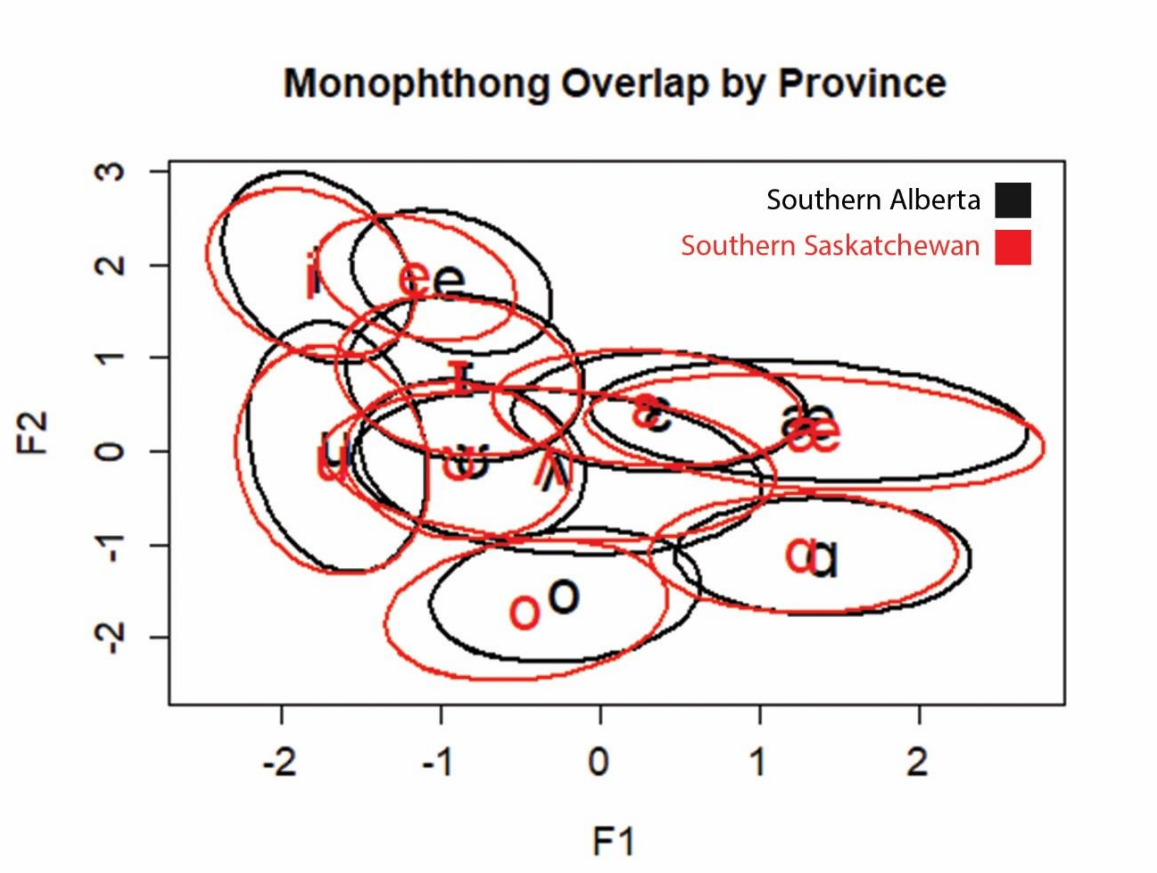

Figure 3: Monophthong productions sorted by the province speakers considered themselves to have grown up in. 2 speakers who considered themselves to have grown up in both Alberta and Saskatchewan are excluded from this plot. Vowel labels at mean of midpoints, SD = 1.

Before exploring any sort of variation within the SASE corpus, one must first establish that it is fair to consider southern Alberta and southern Saskatchewan as one cohesive speaker group. Figure 3 above visualizes a largely concordant SASE grouping. We see a high degree of overlap for all vowels, including [e] and [o] which appear to have the least overlap among the provinces. Even among these vowels however, the difference between Alberta and Saskatchewan is miniscule. As used in Hay et al. (2006), Pillai scores indexing the overlap of these vowels yield values of 0.0297 for [e] and 0.0260 for [o], indicating effectively zero distinction between

the southern Alberta and southern Saskatchewan monophthong productions. This finding supports the treatment of the SASE data as a single speaker group.

3.4 Variation by Style

I first consider the distribution of all monophthongs together, illustrated in Figure 4 below. The inclusion of [e] and [o] as monophthongs is motivated by their description in Inland Canadian English as "less diphthongal" (Boberg, 2010, p. 147). Note that this plot most closely resembles the interview data (top left plot in Figure 5, below) because the vast majority of vowel tokens come from the interview portion (compare the total number of observations in Table 2 to those in Tables 3 and 4). For example, there are 4775 total observations of [ɑ] from interviews compared to 853 from reading passages and 648 from word list recitals. With this in mind, we see here that [u] and [ʊ] are centralized and that [ʊ] falls almost completely within the range of [ʌ]. This categorical overlap would raise the question of a possible merger of [ʊ] and [ʌ], if they were in fact indistinguishable. However, we see in Figure 5 that they become distinct in the careful speech of the word list data. Length further distinguishes these vowels, with [ʊ] being longer than [ʌ] in the more careful reading passage and word list contexts for all age/sex groups (see Appendix D). The reverse is true for the interview data where [ʌ] is longer, and this is presumably because of the filler speech that persists in the data. It is also possible that other factors such as F3 distinguish these vowels further. Also observable in the figure are what may be lowered F2 values for the lax front vowels affected by the Canadian Shift, [ɪ] [ɛ] [æ]. The

quality of these vowels and their possible implications for the Canadian Shift in SASE are addressed in section 3.5.

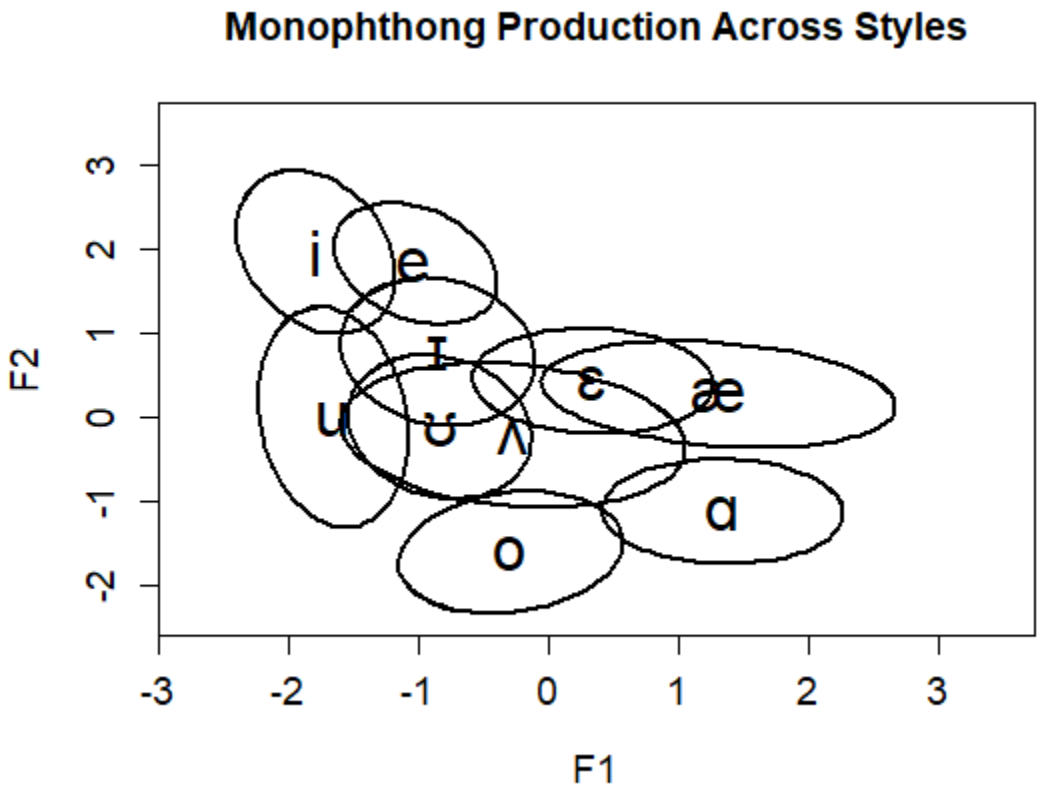

Figure 4: All monophthong productions in the corpus unsorted by social variables. Vowel labels at mean of midpoints, SD = 1.

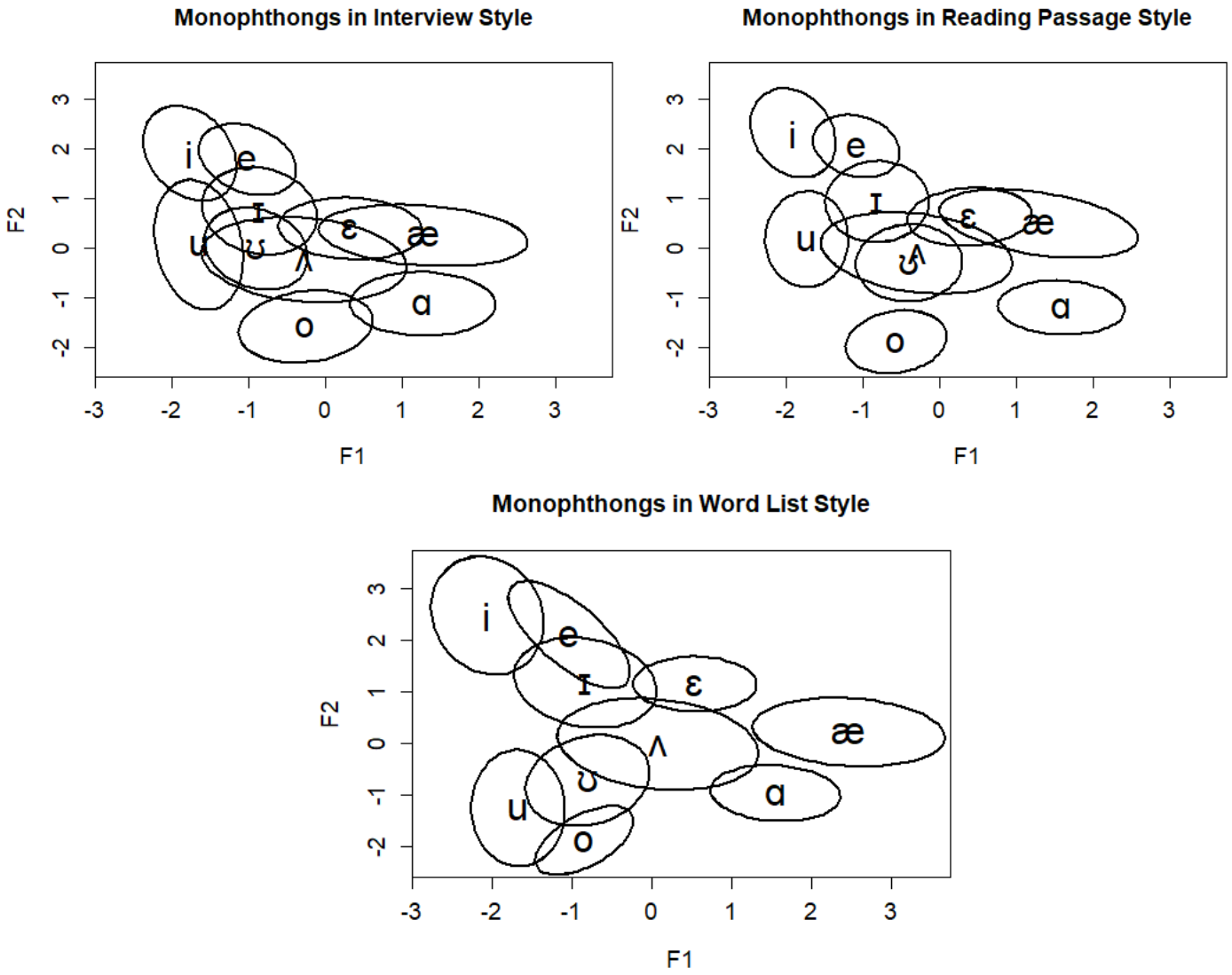

Figure 5: Monophthongs produced during the sociolinguistic interview, reading passages, and word list respectively. Vowel labels at mean of midpoints, SD = 1.

Figure 5 above separates the monophthong productions shown previously in Figure 4 according to speech style. By sorting the data in this way, we can see the effects of more careful or casual speech on vowel quality and the overall layout of the vowel space. Generally, we notice an incremental transition from casual to careful speech as we move from interview to reading passage to word list productions. As speakers become more careful, the vowel space perimeter

expands, becomes more triangular, and individual vowel categories spread out. In particular, [æ] is lower in the word list and surpasses the F1 of [ɑ], forming the low point of a now triangular vowel space. The vowel [u] is more decentralized and backer in the careful word list context than in the interview or reading passages. This lowering of [æ] creating a triangular vowel space as well as central [u] are consistent with known innovations in Standard Canadian English (Boberg, 2011). Moving from interview to word list reading, [ʊ] also shifts back, distinguishing itself from [ʌ], providing evidence that SASE speakers do use spectral characteristics to distinguish these vowels from each other even though they are often acoustically similar in the connected speech contexts. Considering how the F2 of [ʊ] varies by style in this way dispels the idea that it may be merging with [ʌ]. Ranges for [e] and [o] become more oblong in the word list context. This is likely due to the fact that [e] and [o] are not true monophthongs and display more movement towards the corners of the vowel space the more carefully speakers are in producing them. Midpoint measurements are marking different points of each vowel's trajectory – especially when the dynamic nature of these vowels is more exaggerated – resulting in ellipses that trace these vowels' movement more than they express a range of productions.

3.5 Variation by Age and Sex

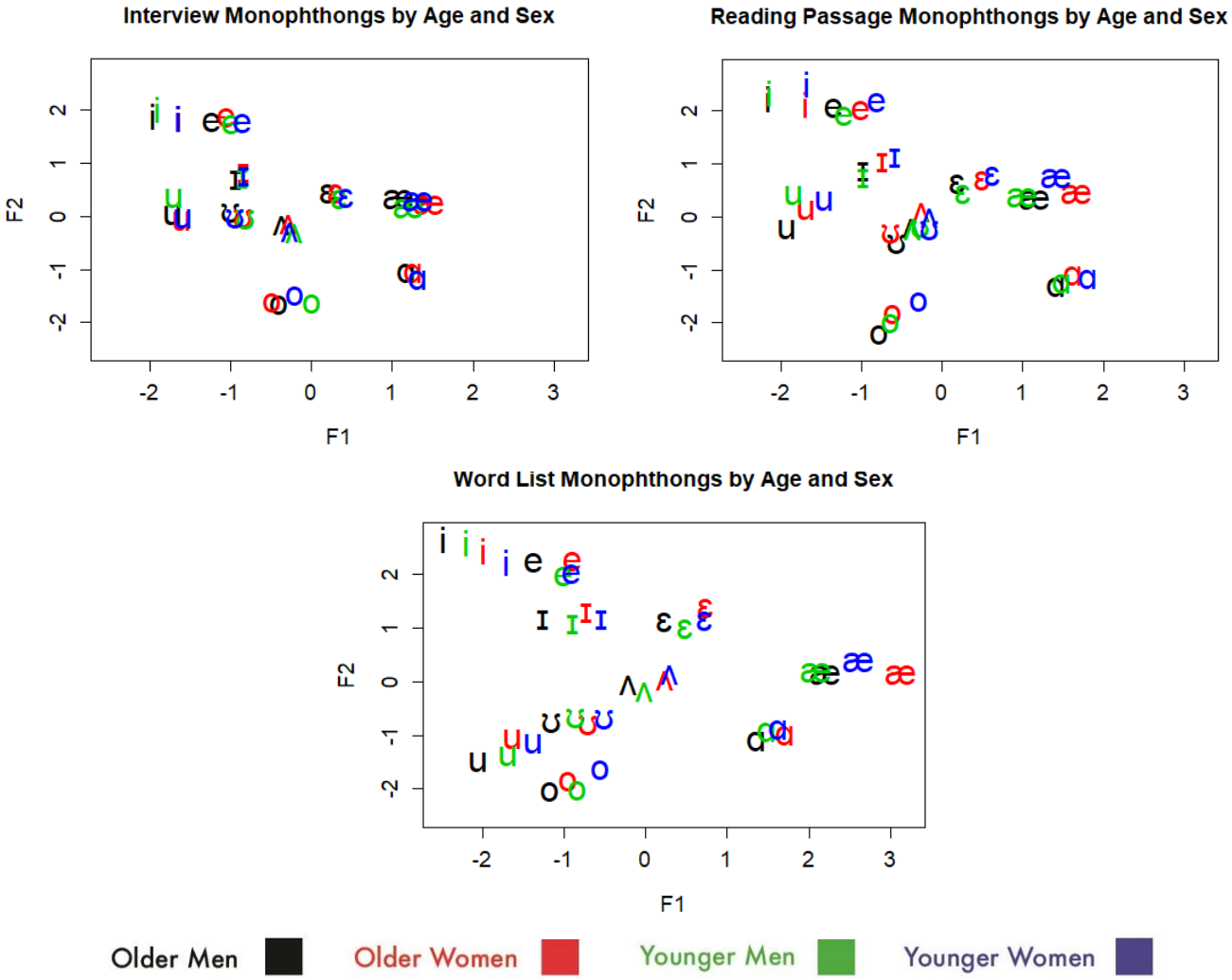

Figure 6: Monophthongs produced during the sociolinguistic interview, reading passages, and word list respectively separated by age and sex of speakers. Vowel labels at mean of midpoints.

Here I discuss the role of the age and sex variables on monophthong F1 and F2 values. Like in the previous figure, in Figure 6 above we can see style differences regarding monophthong production but now variation along the lines of speaker age and sex is also considered. Productions by older men are plotted in black, older women in red, younger men in green, and younger women in blue. Vowels by different age/sex groups cluster tightly in the

interview context, but we observe greater contrasts based on age and sex in the more careful reading passage and word list contexts. There is a pattern of men's vowels being higher than women's that appears true for most of the monophthongs plotted in Figure 6. Women have a lower [æ], especially older women, best illustrated by its position in the word list plot. Women also generally have higher F1 values for the other lax front vowels, [ɛ] and [ɪ], suggesting that women are leading the Canadian Shift with respect to the lowering of these vowels. Recall however that this tendency of a higher F1 for women is not limited to vowels involved in the Canadian Shift, and therefore this interpretation may in fact be unfounded. The second dimension of the Shift – F2 retraction – may be lead by men. Younger men have lower F2 values for [æ], [ɛ], and [ɪ] in the reading passage and word list plots, suggesting they may be at the front of this aspect of the change. Young men also have the most front [u] productions in the speech styles where [u] is not backed. Young women however have an [u] that is almost identical to that of young men in the reading passage plot, so it may be the case that the advancement of [u] is an innovation equally adopted by both sexes. If this is true, we may be observing a fronting of [u] that is near completion, given that Labov et al. (2006) found an effect for sex on the F2 of [u] but more recent studies such as Clopper et al. (2019) and the present work do not.

3.6 Comparing to an Account of Edmonton English

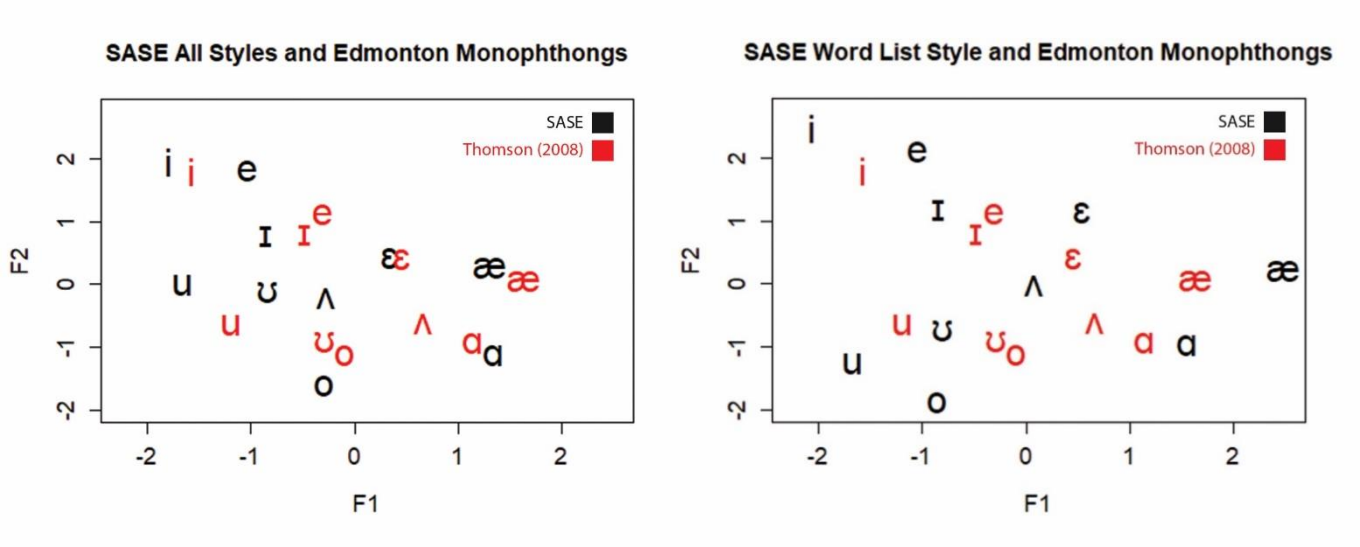

Figure 7: SASE (black) monophthongs across styles (left) and from the word list only (right) are plotted with Edmonton English monophthongs (red). Vowel labels at mean of midpoints.

Figure 7 above compares two configurations of the SASE data (all styles together, left plot, and word list style only, right plot) to Edmonton English as collected in Thomson (2008) with the aim of investigating variation by region – the more rural SASE as opposed to the more urban Edmonton English. The Edmonton data from Thomson (2008) consists of native English speakers from Edmonton, Alberta repeating real or nonce syllables they heard spoken by another native speaker from Edmonton in a laboratory setting. As a result of the speech data collection being based on repetition, there may be some effect of mimicry relevant here. Participants repeated syllables containing every Canadian English monophthong: [bæ], [bɛ], [be], etc. Participants were told to pay particular attention to the vowel component of each syllable.

Wittrock & Tucker (2019) considered a subset of the SASE word list data shown in the plot on the right in relation to the Thomson (2008) data from Edmonton. Mean F1 and F2 values of vowels from hVd tokens (*heed, hid, had,* etc.) were compared to the Edmonton dataset. The

results of this preliminary comparison suggest that the SASE productions [ɪ] [ɛ] are more acoustically similar to each other than in Edmonton where there is a greater phonetic distinction between these two vowels. When considering more SASE data such as the entire word list and the entire recording across speech styles as this study does, we see that this finding disappears. With more data to work with, visualized in Figure 7, we actually see an opposite effect where [ɪ] and [ɛ] appear to have a larger acoustic distance between their mean productions for the SASE speakers.

In the two plots of Figure 7 we also notice however that depending on which configuration of the SASE data one considers (across styles or word list style), different conclusions about how the regional samples compare to each other are suggested. In other words, when I hold a different SASE style to Thomson's Edmonton data, one can no longer make the same comparisons and is forced to choose between sometimes opposite interpretations. For example, one could argue that [u] in SASE is either more or less fronted then in Edmonton depending on which style matchup one believes is more analogous. This is a challenge of this comparison – due to the fact that these two datasets have different collection methods, it is difficult to tease apart differences in vowel production based on region rather than the context of their collection. An account of Edmonton English gathered with techniques more similar to those used in the present work is necessary for a more in depth exploration of regional differences between these speaker groups.

CHAPTER 4. CANADIAN RAISING DIPHTHONGS IN THE SASE CORPUS

This section discusses productions of CR diphthongs in SASE. Variation by phonetic environment, age, and sex are considered, but not variation by style due to an insufficient number of observations for each diphthong in each phonetic environment in the reading passages and word list.

4.1 Observations

Table 5 below shows the number of observations that make up this analysis of CR broken down by speaker age/sex. We notice substantially more observations of [aɪ] and [aʊ] before voiceless obstruents than before voiced obstruents, and in turn, more observations before voiced obstruents than before [ɹ]. This is a known skew in the data and more observations for these latter two conditions would be beneficial for future work. Additionally, we see that young women are responsible for almost half the total number of observations for [aɪT] and by a large margin the most of the four age/sex groups. This bias is due to a single lexical item – 'like.' 1083/1515 total instances of [aɪT] for young women are measurements from the diphthong in this word. While young women have the largest number of [aɪT] observations being 'like,' this item makes up a remarkable portion of [aɪT] observations for the other age/sex groups as well: for older men 105/441, for older women 175/482, and for younger men 448/942. It is possible that this finding reflects a shift in progress that is noticed by younger people using this word more often in casual connected speech, such as the focus of Tagliamonte & D'Arcy (2004). The fact that a single lexical item accounts for almost half of all [aɪT] observations for young men and over two thirds for young women is important to keep in mind when considering this data.

Diphthong and Environment	N Total	N OM	N OW	N YM	N YW
aɪT	*3380*	441	482	942	1515
aɪD	*1884*	338	433	576	537
aɪR	*86*	15	26	31	14
aʊT	*874*	192	196	260	226
aʊD	*260*	49	55	87	69
aʊR	*84*	11	24	28	21

Table 5: Observations of CR diphthongs in each phonetic environment. OM = older men, OW = older women, YM = younger men, YW = younger women.

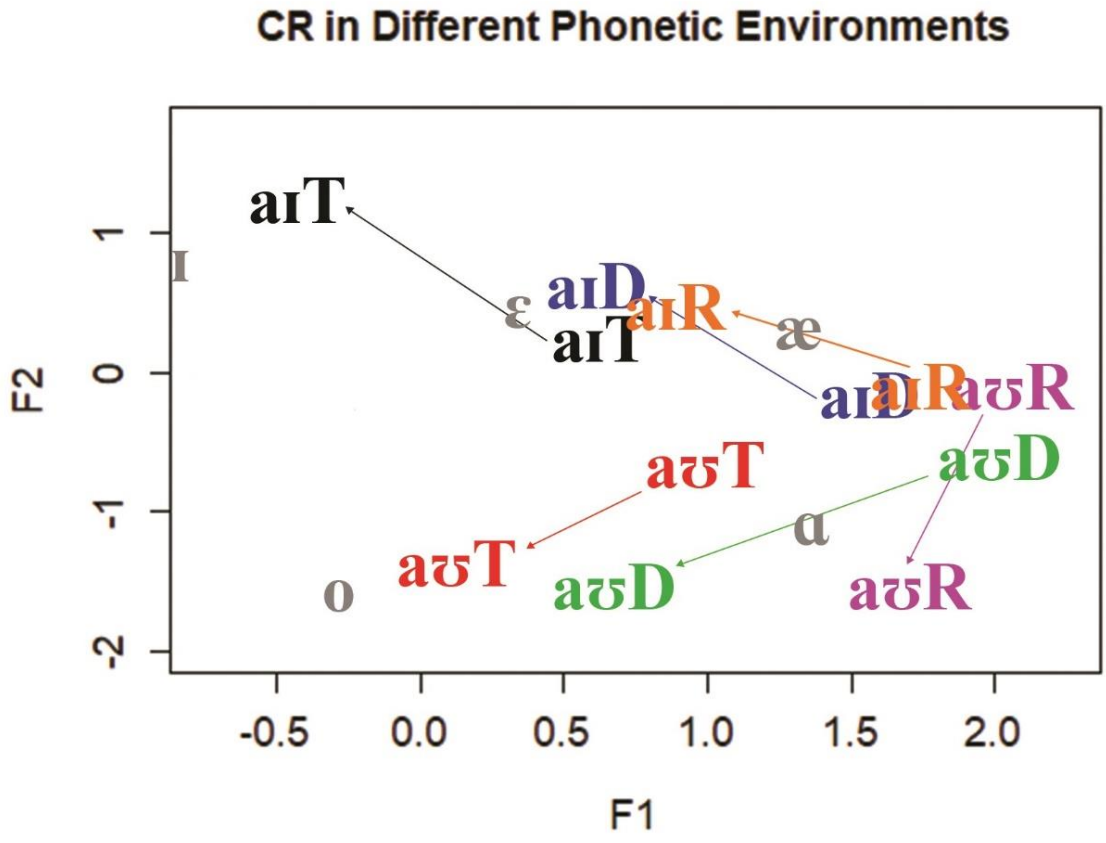

Figure 8: CR diphthongs before voiceless obstruents (T), voiced obstruents (D) and [ɹ] (R). Mean vowels of SASE monophthongs (grey) are overlaid as benchmarks. Diphthongs measured at 25% and 75% of their duration with arrows indicating direction of movement.

Figure 8 expresses various patterns of [aɪ] and [aʊ] before voiced and voiceless obstruents as well as before [ɹ]. The observations of [aɪ] before voiceless obstruents (T) are higher at 25% than in the D or R environments – an indication of archetypal CR with a raised nucleus. The variants before T begin higher than D and R variants, which all begin in a low central place. There is a greater difference between [aɪT] and [aɪD] at 75% than [aʊT] [aʊD] which are more similar at this time point. [aɪT] seems to extend higher over the course of its duration than [aɪD] does. [aɪ] appears to behave similarly in D and R contexts whereas [aʊD] and [aʊR] display visible differences here. [aʊR] and [aʊD] become backer over time to similar extents, but [aʊD] finishes much higher, near [aʊT]. A closer analysis of the differences among [aɪ] and [aʊ] in different environments that accounts for speaker age and sex is conducted over the following two sections.

4.2 Variation of [aɪ] in Different Phonetic Environments by Age and Sex

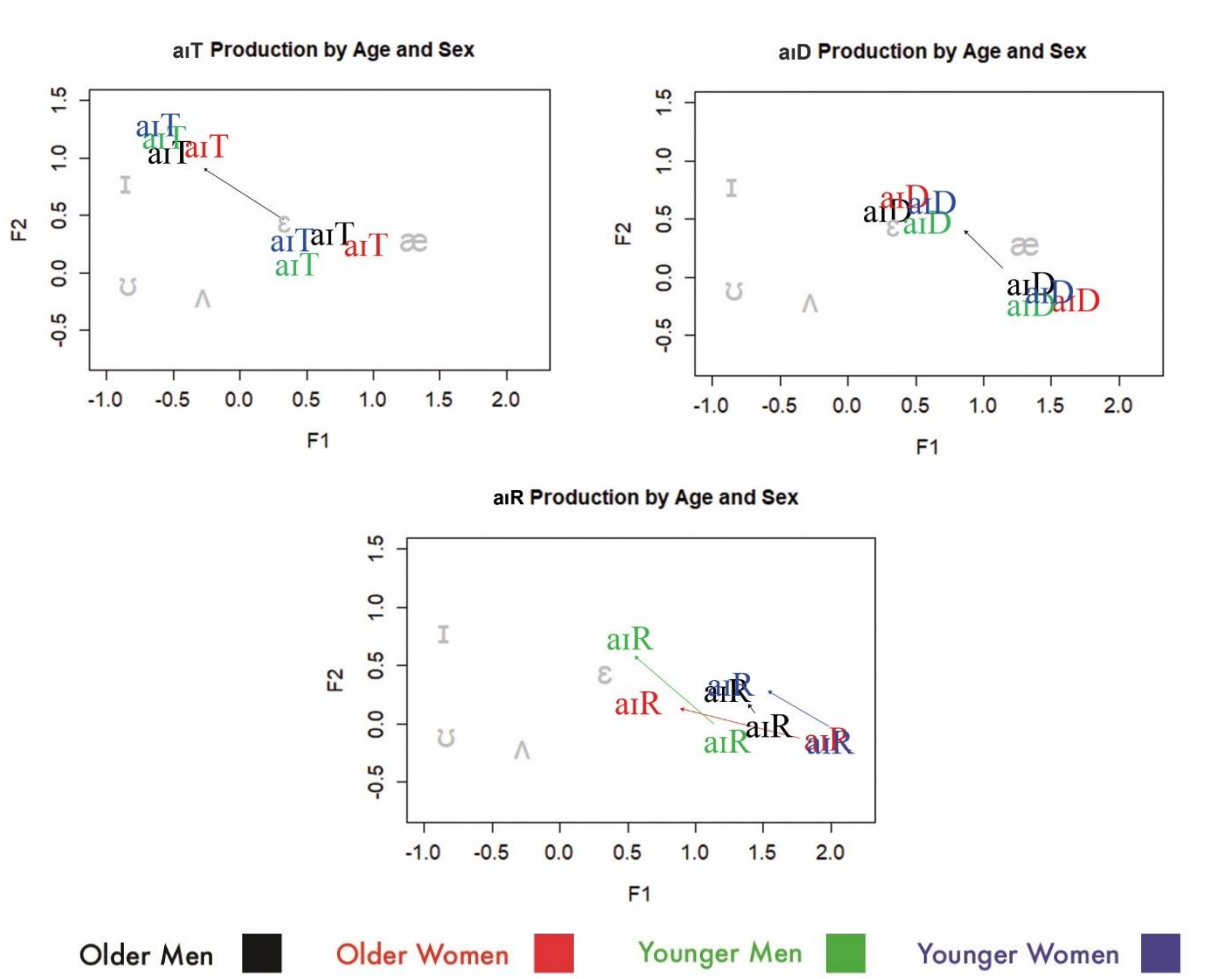

Figure 9: [aɪ] in different phonetic environments produced during the sociolinguistic interview, reading passages, and word list respectively separated by age and sex of speakers. Diphthong measured at 25% and 75% of its duration with arrows indicating direction of movement.

Taking the top left plot of [aɪT] first, we see that younger people have higher productions at 25% and more movement towards the close front corner of the vowel space at 75%. Moving to the plot on the right, we notice relatively uniform patterns of [aɪD] with younger people having slightly lower productions at 75%. Considering these two points together, perhaps the difference

between [aɪT] and [aɪD] is becoming greater, where [aɪT] becomes higher and more peripheral and [aɪD] finishes lower resulting in less movement overall.

Shifting focus to [aɪR] in the bottom plot, we see more variability (recall less observations) among the age/sex groups. Note however that young men (and to a lesser extent older women) have remarkably similar distributions of [aɪR] and [aɪD] whereas other demographics have a separate formant trajectory for [aɪR]. Older men have a near-monophthongal realization of [aɪR] and young woman have a similar but less extreme pattern with their measurements at 75% being very close. Interestingly, the overall pattern may therefore be cyclical where the speech of young women is becoming similar to that of older men, creating a sort of loop in change over time.

4.3 Variation of [aʊ] in Different Phonetic Environments by Age and Sex

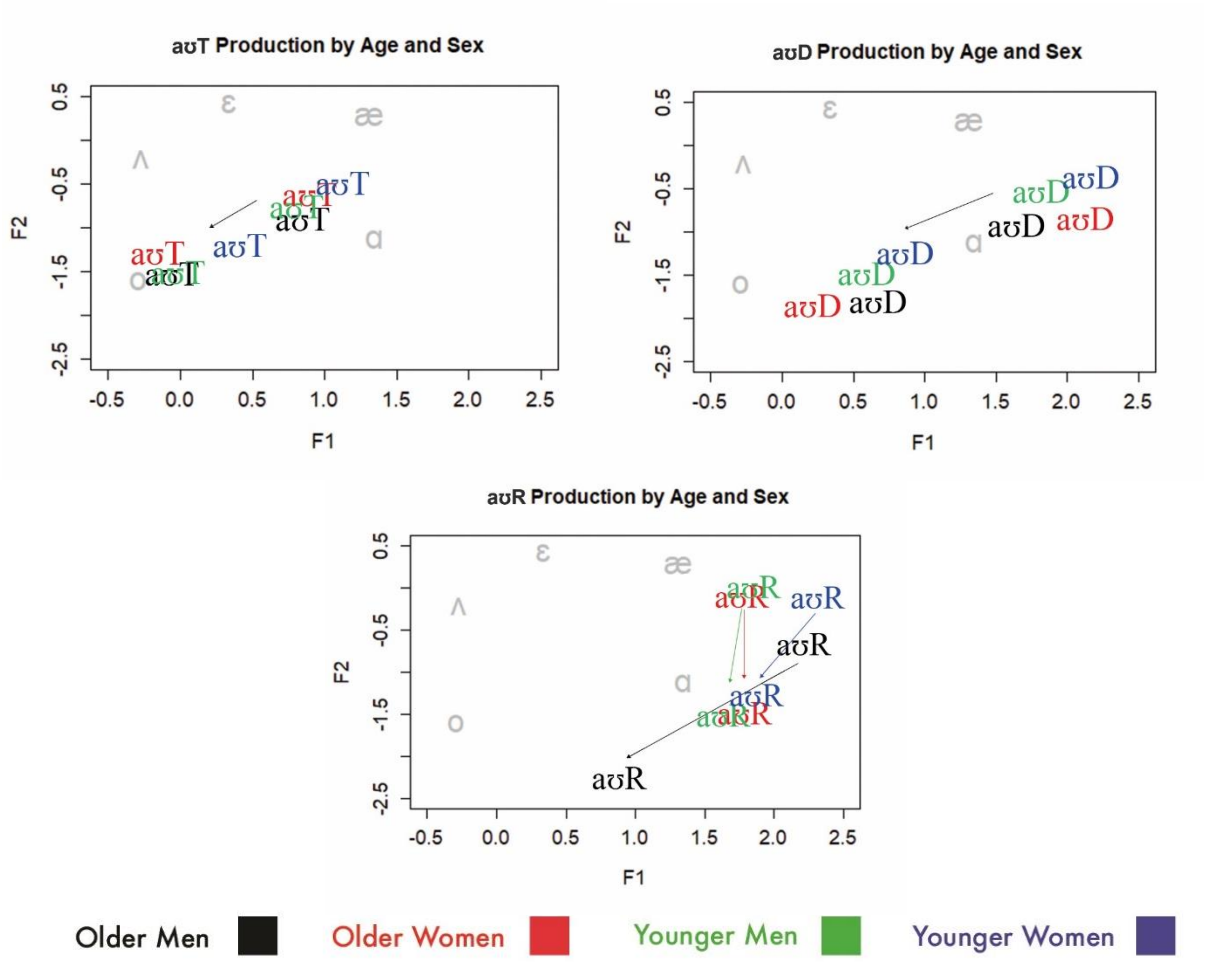

Figure 10: [aʊ] in different phonetic environments produced during the sociolinguistic interview, reading passages, and word list respectively separated by age and sex of speakers. Diphthong measured at 25% and 75% of its duration with arrows indicating direction of movement.

Figure 10 expresses differences in speaker age, sex, and phonetic environment for the CR diphthong [aʊ]. Looking at the top two plots together, we see the difference between raised [aʊT] forms and unraised [aʊD] forms as echoed by Figure 9 earlier. Taken together, we see in these plots that young women have the lowest [aʊT] and [aʊD] measurements at both time points. This may coincide with the finding in Vancouver English of "weak-raisers" of this diphthong, who were not uncommonly young women (Sadlier-Brown, 2012). It may be the case

that such “weak raising” is gaining traction in the prairies as well, at least regarding [aʊ]. Recall however that young women raised [aɪ] in this environment the most, so a “weak-raising” of [aɪ] in Vancouver is not found in SASE – the raising in this case is conversely “stronger.” Men have a higher [aʊD] at 25% but not high enough for these productions to be considered partially raised – there is still a clear distinction between [aʊT] and [aʊD] for these speakers. Regarding instances of [aʊR] in the bottom plot, the productions of older men are the obvious odd ones out. Other age/sex groupings mostly back this diphthong over time, but older men contrastively display a lot of upward movement. While older men’s productions of [aʊR] have a similar formant trajectory angle to their productions of [aʊD], it is important to note that [aʊR] is lower than [aʊD] at both 25% and 75%, meaning that this grouping too has a unique pattern for the pre-[ɹ] environment. This pre-[ɹ] articulation differs for [aɪ] and [aʊ] however, as older men interestingly have the most dramatic movement for [aʊR] but an almost static [aɪR]. The other age/sex groups of course also have unique formant paths for [aɪ] and [aʊ] before [ɹ], just different patterns than that of the older men.

CHAPTER 5. DISCUSSION & CONCLUSION

This thesis contributes several findings to our understanding of monophthong and CR diphthong production in Canadian English varieties. High overlap among monophthong productions by speakers from southern Alberta and southern Saskatchewan as well as a current inability to thoroughly compare the SASE data to Edmonton English supports the claim of a largely homogenous Inland Canadian English variety. Commonalities are also found with Onosson (2010)'s analysis of CR in Manitoba in that both speaker groups display separate patterns for CR diphthongs before T, D, and R. The present work has built upon these findings by demonstrating speakers have unique realizations of [aʊR] in addition to [aɪR]. Thus, this work supports a cohesive Inland/Prairie variety and expands our knowledge of phonetic phenomena within it. Future work ought to examine if these findings for SASE such as a unique [aʊR] pattern also apply to other subsets of Inland Canadian English, or perhaps even Canadian Englishes outside of this classification.

Throughout the SASE corpus we observe a considerable amount of style shifting. Style differences are shown to influence vowel quality and overall vowel space distribution, most notably regarding the lowering of [æ] and centralization of [u] – a finding consistent with general Canadian English trends (Boberg, 2011). This work shows that SASE [e] and [o] (described as less diphthongal in Boberg (2010)) become more diphthongal in careful speech and more monophthongal in casual and connected speech.

This work also explores ways in which age and sex co-vary with manifestations of modern language changes in SASE: the Canadian Shift, centralization of [u], and CR. Results may suggest that women lead the F1 raising dimension of the Canadian Shift and men lead F2 lowering. However, an investigation more explicitly targeting the Canadian Shift in southern

Alberta and southern Saskatchewan is needed to claim this strongly. Young people of both sexes are shown to have a more advanced [u].

[aɪT], [aɪD], [aɪR], [aʊT], [aʊD], and [aʊR] all pattern differently in SASE. Younger people have a higher [aɪT] at 25% and [aɪD] and [aɪR] pattern similarly for young men but differently for other age/sex groups. We find what may be a cyclical change in progress regarding [aɪR] where the relatively monophthongal productions by older men appear to be approximated by younger women. Younger women are also found to raise [aʊT] the least, echoing the finding of "weak-raisers" in Vancouver for this diphthong (Sadlier-Brown, 2012). Regarding [aɪT] however, the SASE data yields an opposite result. Young women (and also young men) have the highest productions of [aɪT] at both time points measured. Therefore, in SASE we observe the opposite of what is attested in Vancouver – young people appear to raise [aɪ] even more before voiceless obstruents in the prairies.

Older men are the only age/sex group to raise [aʊR] rather than only back [aʊ] in this environment. This group that has a near monophthongal [aɪ] before [ɹ] exhibits the most movement of [aʊ] in the same environment. This finding provides further evidence for handling [aɪ]- and [aʊ]-"raising" as independent phenomena (Chambers, 1989).

Overall, this thesis has contributed to our collective understanding of variation in the pronunciation of Canadian English vowels. A corpus of English in the understudied region of southern Alberta and southern Saskatchewan is described and hopefully, it may act as a starting point for future research on English vowel production in the Canadian prairies.

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APPENDIX A: Participant Metadata

Participant information and responses to questions asked prior to recording.

Sub. #	Recording Date (2018)	Optional Release	Sex	Age	Native Eng?	Other Ls	Proficiency (1-3)	Where born?	Where grew up?	Live now?	Lived outside Southern AB/SK?	Where?	How Long?	Issues with speech or hearing?	Current work	Past work	Highest Ed. Completed	Religious Background
1	23-May	y	f	58	y			Wilkie, SK	Swift Current SK	Medicine Hat AB	n			n	teacher assistant	library technician, secretary	post-secondary degree, library technician	Catholic
2	24-May	y	m	55	y			Hodgeville, SK	Hodgeville SK, Swift Current SK	Medicine Hat AB	n			n	grocery store manager	grocery clerk, farm hand (childhood)	gr12	Lutheran/none
3	28-May	y	f	29	y			Melfort SK	Vauxhall AB, Fox Valley SK	Medicine Hat AB	y	Texas	3y	n	pharmacy assistant	cashier, farm hand	2 year diploma (early learning)	raised Baptist
4	30-May	y	f	58	y			Maple Creek SK	Onefour AB, Elkwater AB, Manyberries, AB, Schuler AB	Medicine Hat AB	n			n	bakery manager	seamstress, waitress, lumber yard, bowling alley, farm hand (childhood)	gr12	n
5	2-Jun	y	f	21	y	Japanese	1	Medicine Hat AB	Medicine Hat AB, Acadia Valley AB	Calgary AB	n			minor speech delay	researcher, student	karate insrtuctor, private art commisions, farm hand (childhood)	BSc	Catholic
6	3-Jun	y	m	20	y			YellowKnife NWT	Vulcan AB, Arrowwood AB	Edmonton AB	y	Hull, PQ	1y (as infant)	n	student	cashier, sandwich artist	1 year of 3 year diploma (design)	n
7	5-Jun	y	f	53	y			Leader SK	Liebenthal SK	Medicne Hat AB	n			childhood lisp	nursing manager	staff nurse, staff health consultant, shift supervisor, farm hand (child hood)	4 year degree	raised Catholic
8	5-Jun	y	m	21	y			Medicine Hat AB	Medicine Hat AB, Fox Valley SK	Medicine Hat AB	n			n	pharmacy assistant, book keeper, student	wendy's, farm hand (childhood), porter (hospital)	1.5 years of post-secondary	raised Lutheran/none
9	6-Jun	y	m	22	y			Medicine Hat AB	Medicine Hat AB	Medicine Hat AB	n			n	tire installer	petsmart, bargain store	gr12	raised Christian
10	6-Jun	y	f	20	y			Medicine Hat AB	Irvine AB	Medicine Hat AB	n			n	cashier, student	concession worker, fast food	1 year post-secondary	Christian
11	8-Jun	y	m	60	y			Medicine Hat AB	Medicine Hat AB	Medicine Hat AB	n			n	grocery manager	newspaper director of distribution	gr12	Anglican
12	11-Jun	y	f	21	y			Medicine Hat AB	Medicine Hat AB	Medicine Hat AB	n			n	lifeguard	receptionist, maintenance, day camp facilitator	1 year post-secondary	Catholic
13	14-Jun	y	f	21	y	French	2	Medicine Hat AB	Medicine Hat AB	Medicine Hat AB	n			n	retail manager	retail associate	2 year diploma	n
14	14-Jun	y	f	57	y			Medicine Hat AB	Clearwater Distcrict AB	Medicine Hat AB	n			n	book keeper	waitress, front desk clerk, office clerk	gr12	n
15	15-Jun	y	m	32	y			Swift Current SK	Pennant SK	Pennant SK	n			saw speech pathologist as a kid	farmer, welding inspector	welding assistant, oil field consultant	2 year diploma	raised United
16	15-Jun	y	f	57	y			Cabri SK	Cabri SK	Pennant SK	n			n	government administration	car dealership, bank teller, RM office, waitress, plucking barn	gr12	raised United
17	15-Jun	y	m	75	y			Cabri SK	Pennant SK	Pennant SK	y	Saskatoon SK	5y (adult)	n	farmer	farm management specialist	Bachelor Science & Agriculture	Christian
18	15-Jun	y	f	52	y			Moosomin SK	Swift Current SK	Pennant SK	y	Red Deer AB, Saskatoon SK	3y, 11m (as adult)	n	book keeper	retail sales	gr12	n
19	15-Jun	y	m	53	y			Hodgeville SK	Hodgeville SK	Pennant SK	y	Red Deer AB, Saskatoon SK	3y, 11m (as adult)	n	retired	oil field worker, power engineer, cattle farmer, grain farmer	2 year post-secondary	raised United
20	17-Jun	y	m	21	y			Medicine Hat AB	Medicine Hat AB, Redcliff AB	Medicine Hat AB	n			n	surveyor	lifeguard, retail sales	2 year post-secondary	Catholic
21	17-Jun	y	f	19	y			Lethbridge AB	Taber AB, Enchant AB	Enchant AB	n			tubes in ears age 4-8 (not noticeable)	assistant manager seed cleaning plant	feed lot, farmer, ice cream server, museum tour guide, camp counselor	1 year post-secondary	Christian
22	18-Jun	y	m	18	y			Pincher Creek AB	Medicine Hat AB	Edmonton AB	y	Edmonton AB	6m (as adult)	n	student	n	gr12	raised Catholic
23	1-Jul	y	m	47	y			Swift Current SK	Swift Current SK, Lumbsden SK, Wadena SK	Medicine Hat AB	n			self-described poor hearing	pipeline construction	n	gr11	n
24	7-Jul	y	m	20	y			Medicine Hat AB	Sibbald AB	Esther AB	n			n	rancher	construction worker	gr12	n

APPENDIX B: Word List Items

Presented in the order from top to bottom, left to right:

ACE	YARD	TOUR
EASY	WIRE	SASKATOON
BUDDY	RIPE	BIKE
WRENCH	HOW'D	TROUT
BOOK	HARVEST	EGG
POWDER	SPIDER	HIDE
GARBAGE	LEARN	STARVING
SIZE	OAT	FOUR
HEAD	BEGGING	STOOL
GUITAR	HARD	TIGER
HOUSE	POOL	COUCH
VANILLA	TRUCK	RAW
RETIRED	EYEBROWS	CIGAR
BERNARD	HAWED	HOOD
COW	COYOTE	STACKING
HID	AUGUST	DEMISE
BLACK	PRAIRIES	UGLY
OUNCE	WRITER	OUT
BARN	IDEA	SPY
SINGING	R	WHO'D
LIGHT	HOED	PARK
BOTTLE	BEAR	IRON
SCARF	THAT'S OURS	MANURE
LURE	DESIRE	WEEK
CLOUD	ALLEY	FROWN
INCHES	HEART	GUYS

HEED	PAID	HOID
GUARD	ARGUE	FIRED
LOG	TIRE	POOR
WORD	HUD	DISEASE
HIRED	TOWN	LIE
RENEWAL	SPIT	PILLOW
BROWNIES	MILES	HAD
LAWYER	SEWER	LIFE
START	FATHER	TIME
HAYED	CARDS	CHOIR
SIREN	COAT	HERD
MILK	FLOWER	TARGET
LAUGHING	ARMY	HOWL
GARLIC	HOD	CURE
BAG	BEER	FARM
ISLAND	HOUR	FAMILY
MICE	TOOLS	TOQUE

APPENDIX C: Reading Passages

Reading Passage 1 as in Kendall (2013):

Some mornings in the summertime, when the sky is fair and the lawn covered in dew, the good Duke Post and his wife Peg walk down to the brook by their house. There, beside the trees, is their favorite place to sit, talk and sip coffee. Her father, Don, and his dog, Bookie, often stop by to chat while their children, Betty and Kate, toss off their shoes and leap headfirst into the deep brook. It makes Peg feel like a kid again to watch them dive, shout and slosh around in the water and swing off the old black tire tied to the oak tree.

One hot hazy, dull afternoon, she gave a call to their friends Pam and Ben Powder, inviting them over for supper. On the way, their truck got stuck in the mud and they showed up an hour late, for which they caught a good deal of teasing. But soon the crowd was having fun and the good hosts put out tuna fish sandwiches, hot dogs, a big pot of bean soup and beer bread. When they were done eating, it was a sin that no one had saved room for Peg's tasty spice cake that was yet to come.

After supper, Duke, Ben and his pal Bill went out on Duke's inflatable boat. Unfortunately, the sky got grey and started to pour rain. Bill lost his footing on the slick bank and fell in the water. After ten minutes he finally got into the boat. Once back on shore, the sudden weather shift sent everyone home, and the party was over.

Reading Passage 2 as in Weinberger & Kunath (2011):

Please call Stella. Ask her to bring these things with her from the store: Six spoons of fresh snow peas, five thick slabs of blue cheese, and maybe a snack for her brother Bob. We also need a small plastic snake and a big toy frog for the kids. She can scoop these things into three red bags, and we will go meet her Wednesday at the train station.

APPENDIX D: Vowel Measures Corresponding to Plots

Measures of Monophthongs by Age and Sex across Styles

		æ	ɑ	e	ɛ	i	ɪ	o	u	ʊ	ʌ
Dur.	**OM**	109	113	107	69	98	62	127	111	69	73
	OW	111	108	123	71	110	57	123	106	60	68
	YM	127	116	115	74	107	61	135	103	63	79
	YW	128	122	124	78	108	63	127	94	54	73
F1	**OM**	566	571	391	498	331	411	449	350	413	455
	OW	662	643	405	551	340	427	456	345	431	487
	YM	639	653	427	557	341	444	519	359	451	502
	YW	713	717	469	613	384	477	542	390	476	536
F2	**OM**	1558	1165	1951	1588	1992	1656	1008	1438	1422	1411
	OW	1652	1218	2202	1736	2202	1847	1045	1524	1517	1516
	YM	1557	1191	1975	1593	2062	1703	1063	1568	1462	1423
	YW	1695	1247	2145	1711	2157	1829	1148	1582	1572	1511

Table 6: Mean midpoint measures for monophthongs in each age/sex group irrespective of style. OM = older men, OW = older women, YM = younger men, YW = younger women. Duration rounded to the nearest ms, frequency to the nearest Hz. Formant frequencies shown here are plotted in Figure 4.

Measures of Monophthongs by Age and Sex in the Interview Style

		æ	ɑ	e	ɛ	i	ɪ	o	u	ʊ	ʌ
Dur.	**OM**	108	95	100	66	91	76	120	106	59	76
	OW	111	95	112	69	100	60	113	99	51	71
	YM	127	107	110	72	100	65	130	104	55	81

	YW	129	120	123	78	108	65	125	95	54	73
F1	**OM**	571	574	408	507	359	441	470	382	440	485
	OW	649	631	431	555	378	469	501	372	451	528
	YM	642	648	436	561	366	477	543	382	457	529
	YW	717	714	475	616	399	495	551	403	481	548
F2	**OM**	1558	1260	1918	1564	1940	1643	1112	1491	1484	1439
	OW	1631	1268	2073	1695	2099	1825	1170	1553	1554	1547
	YM	1554	1216	1942	1562	2028	1702	1184	1612	1484	1454
	YW	1705	1270	2137	1706	2124	1837	1185	1590	1570	1535

Table 7: Mean midpoint measures for interview monophthongs in each age/sex group. OM = older men, OW = older women, YM = younger men, YW = younger women. Duration rounded to the nearest ms, frequency to the nearest Hz. Formant frequencies shown here are plotted in Figure 6 (top left plot).

Measures of Monophthongs by Age and Sex in the Reading Passage Style

		æ	**ɑ**	**e**	**ɛ**	**i**	**ɪ**	**o**	**u**	**ʊ**	**ʌ**
Dur.	**OM**	103	135	116	73	117	57	160	127	79	53
	OW	101	133	129	82	120	57	136	124	69	47
	YM	111	137	125	73	126	57	150	126	75	55
	YW	107	140	118	83	121	60	127	119	59	55
F1	**OM**	563	579	380	491	313	408	420	338	445	449
	OW	685	675	404	571	338	439	455	344	455	494
	YM	614	662	407	547	317	429	460	345	490	485
	YW	719	762	475	633	384	504	534	405	548	548

F2	**OM**	1541	1103	1996	1618	2062	1683	854	1392	1318	1409
	OW	1731	1196	2279	1821	2293	1933	950	1586	1441	1577
	YM	1600	1159	2015	1616	2126	1693	952	1598	1430	1431
	YW	1800	1243	2257	1828	2335	1935	1111	1686	1510	1584

Table 8: Mean midpoint measures for reading passage monophthongs in each age/sex group. OM = older men, OW = older women, YM = younger men, YW = younger women. Duration rounded to the nearest ms, frequency to the nearest Hz. Formant frequencies shown here are plotted in Figure 6 (top right plot).

Measures of Monophthongs by Age and Sex in the Word List Style

		æ	**ɑ**	**e**	**ɛ**	**i**	**ɪ**	**o**	**u**	**ʊ**	**ʌ**
Dur.	**OM**	169	155	209	148	188	68	207	149	131	84
	OW	175	138	215	136	213	68	222	153	124	74
	YM	152	132	179	132	188	68	217	126	102	73
	YW	168	132	204	163	226	73	192	126	115	84
F1	**OM**	640	579	380	496	290	386	391	327	393	470
	OW	832	676	418	602	308	443	405	353	441	547
	YM	731	665	432	578	313	434	442	358	441	524
	YW	847	742	452	646	377	504	507	412	506	595
F2	**OM**	1499	1146	2039	1753	2194	1789	886	1049	1246	1429
	OW	1589	1239	2344	2039	2406	1988	941	1204	1295	1587
	YM	1544	1241	2032	1805	2197	1819	948	1122	1316	1458
	YW	1712	1321	2275	1943	2262	1944	1103	1250	1391	1630

Table 9: Mean midpoint measures for word list monophthongs in each age/sex group. OM = older men, OW = older women, YM = younger men, YW = younger women. Duration rounded to the nearest ms, frequency to the nearest Hz. Formant frequencies shown here are plotted in Figure 6 (bottom plot).

Measures of Canadian Raising Diphthongs in Different Phonetic Environments

		aɪT	aɪD	aɪR		aʊT	aʊD	aʊR
Dur.	**OM**	96	126	110		122	163	183
	OW	93	139	142		118	177	149
	YM	95	130	135		141	175	174
	YW	95	138	135		143	162	167
F1 25%	**OM**	538	586	598		545	595	625
	OW	613	686	726		610	742	698
	YM	574	661	647		604	699	700
	YW	611	730	798		690	800	821
F1 75%	**OM**	435	491	550		459	507	514
	OW	475	534	548		486	521	653
	YM	463	559	553		508	558	640
	YW	483	601	675		581	626	719
F2 25%	**OM**	1546	1437	1444		1195	1184	1309
	OW	1612	1495	1529		1322	1387	1500
	YM	1535	1447	1467		1292	1363	1502
	YW	1667	1552	1544		1447	1472	1572
F2 75%	**OM**	1777	1655	1567		1110	1039	950
	OW	1900	1817	1686		1200	1124	1249
	YM	1840	1648	1706		1133	1143	1130
	YW	1982	1802	1720		1271	1252	1246

Table 10: Total duration, mean F1 and F2 measurements at 25% and 75% of the duration of Canadian Raising Diphthongs. OM = older men, OW = older women, YM = younger men, YW = younger women. Duration rounded to the nearest ms, frequency to the nearest Hz. Formant frequencies shown here are plotted in Figure 8.