Prevelar Vowel Raising and Merger in Manitoba English

Sky Onosson

Affiliation:

Department of Linguistics, University of Manitoba

Winnipeg, Manitoba, Canada R3T 5V5

+1 204-474-9596

Permanent address/contact information:

1039 Garfield St. N.

Winnipeg, Manitoba, Canada R3E 2N7

+1 204-997-0717

sky@onosson.com

ORCID: 0000-0001-9308-7202

Acknowledgments

This research was conducted in present-day southern Manitoba, being original lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and the homeland of the Métis Nation. This study was made possible thanks to a Post-doctoral Fellowship (#756-2019-0627) from the Social Sciences and Humanities Research Council of Canada. Data collection and transcription relied in part on the team of undergraduate and graduate research assistants working in the Sociolinguistics Laboratory at the University of Manitoba's Department of Linguistics, without whose efforts this study could not have been completed. Finally, many thanks to Dr. Nicole Rosen for inviting me to participate in the Languages in the Prairies Project and providing access to the LIPP corpus, thereby enabling this contribution to the linguistic documentation of my home region and dialect.

1. Introduction

This study investigates the production of the phonological process known as "prevelar raising" or "*bag*-raising" among English speakers in the province of Manitoba. Under prevelar raising, the vowel /æ/ in *bag* or similar words having a final /g/ is raised to a higher position in acoustic space. This process has been documented in several North American English dialect regions including the Pacific Northwest and U.S. Upper Midwest, among others. In such dialects, a raised /æ/ vowel as in *bag* can overlap acoustically with the otherwise contrasting vowels /ɛ/ in *beg* and/or /e/ in *bagel* such that these classes of words, i.e., these separate vowels when they occur in prevelar contexts, are homophonous or merged to some extent. In Canada's Prairies region which includes Manitoba, situated between the Pacific Northwest and the Upper Midwest, occurrence of prevelar raising has been previously documented. However, the extent to which Prairie *bag*-raising involves actual or potential merger with either *beg* or *bagel* is currently unknown, nor is the precise realization or degree of prevelar raising as it is produced across the three Prairie provinces. This study, focused on the easternmost Prairie province of Manitoba, examines acoustic productions of the vowels /æ/, /ɛ/, and /e/ across various phonological contexts, including in prevelar position. The results provide a platform for comparison to studies on prevelar raising in other regions, while also expanding the scope of the investigation in two respects. Ethnolinguistic differentiation, a social aspect of language variation that is under-researched in Manitoba and the Prairies more generally, is addressed through the inclusion of several major ethnic groups. Methodologically, the scope of analysis is also expanded by addressing both spatial (acoustic formants) and temporal (acoustic duration) aspects of

production: first under separate linear regression models of spatial and temporal differences, and then using generative additive models of formant trajectories which unite the two.

2. Geographic Context: Prevelar Raising and Front-Vowel Merger in North American English

Prevelar raising has been documented in two key regions of the United States: the Pacific Northwest, particularly in Washington state (Reed 1952, 1961), and the Upper Midwest, particularly in Wisconsin (Zeller 1997). While its origins are not entirely agreed upon, researchers have identified several phonetic and phonological factors which may have driven this change to occur independently in different dialects (see Mielke, Carignan & Thomas 2017 for an excellent overview). The western Canadian region of the Prairies, comprising the provinces of Alberta, Saskatchewan, and Manitoba, is yet a third key location for prevelar raising, forming a geographic link between the Pacific Northwest and Upper Midwest (Figure 1).

[FIGURE 1 HERE]

Prevelar raising in the Prairies has been documented by numerous studies, including the Atlas of North American English (ANAE; Labov, Ash & Boberg 2006); however, outside of the Pacific Northwest (Swan 2016), Canadian prevelar raising is not typically linked with American productions as a common cross-border dialectal feature. In a multi-provincial study, Boberg (2008:145-147; *n*=86) found Canada-wide occurrence of prevelar raising, with the greatest degree of raising occurring in western Canada and particularly on the Prairies. Here, the Cartesian distance (across the vowel space as a two-dimensional plane) between non-raised /æ/ e.g., *trap* vs. raised *bag* was significantly greater than regions in eastern Canada including southern Ontario, but only slightly greater than British Columbia. In Boberg (2010:208), raising

of BAG (i.e., the class of words containing /æ/ in prevelar position) is described as one of the clearest contributors to western Canadian regional identity, wherein "the separation of the Prairies from Ontario within [ANAE's] Inland Canada is a more important division than the separation of the Prairies from British Columbia". In a recent continent-wide survey study, Stanley (2021; *n*=5269) found that the Prairies are among the highest-rated regions for raising of both BAG and BEG, but with some intriguing cross-provincial variation; parts of Saskatchewan show a higher prevalence of BEG-raising, while in Manitoba there is generally a higher degree of BAG-raising. The latter matches the relative prevalence of raising variants in Manitoba's regional neighbours of northwestern Ontario, North Dakota, Minnesota, and (near-neighbour) Wisconsin; however, it should be noted that the Manitoba speaker sample in Stanley's study does appear to be relatively small.

Evidence for prevelar raising in the Pacific Northwest was perhaps first documented in dialectological studies by Reed (1952, 1961). Modern research on the acoustic productions of the BAG, BEG and BAGEL classes in the region began in earnest with a research program initially focused on Seattle, Washington, in Wassink et al. (2009; *n*=17), Wassink and Riebold (2013; *n*=19), Freeman (2014; *n*=20), and Wassink (2015; *n*=25). The latter study found that both men and women exhibited raising of BAG, and that raising of BAG and BEG were present among even the very oldest speakers (93 years). Evidence for ongoing change involving vowel overlap was shown, with up to 40 percent of the youngest speakers exhibiting production overlap of BAG, BEG, and BAGEL, with overlap of BAG and BAGEL showing the most evidence for a change in progress. Adding to this, Riebold (2015; *n*=71) and Wassink (2016; *n*=48) examined the role of ethnicity, finding that speakers belonging to all ethnic groups investigated (Caucasian, Mexican

American, Yakama, Japanese American, and African American speakers) exhibited some degree of prevelar raising, while between-group variation was not significantly distinct.

In Victoria, B.C. — just across the Canadian border from Seattle — Roeder, Onosson, and D'Arcy (2018:101-102; *n*=114) showed both that the degree of BAG raising closely aligned with Boberg's (2008, 2010) general results for western Canada. This was found to be a stable feature for speakers born as early as 1913 with neither gender- nor age-based production differences. Victoria's lack of age-graded variation corresponds with Seattle's (Wassink 2015), suggestive of regional similarity if not direct influence. Swan (2016; *n*=40) looked more directly at the issue of cross-border differences in a study of Seattle and Vancouver speakers, finding that both groups participated in BAG raising, but also noting demographic differences between the two cities. BAG raising was generally greater (in degree) in Vancouver, but less so for older Vancouverites, indicating that this may be an ongoing change (this is only somewhat conclusive, as Swan's cohort were all less than 36 years old). Gender patterns differed as well: in Vancouver, women's prevelar raising productions were greater than men, while this was not true in Seattle; this conforms with other work on Seattle where it is older men who tend to have more advanced raising patterns (Freeman 2014 & 2021; Wassink 2015).

In the Prairies, Rosen and Skriver (2015; *n*=58) documented social patterning of BAG raising in Alberta. Raising occurred across all social groups, showing significant gender and age differences, with younger women leading the change. Religion also played an important role, with BAG raising productions of Mormons being reduced in degree compared with other speakers. This was also mitigated by age, with the greatest reduction (i.e., the least degree) of raising occurring for both older and younger Mormon women, who contrast with middle-aged Mormon women, who typically had greater engagement with non-Mormon society. Rosen &

Skriver's study identifies two important factors relevant to the investigation of prevelar raising in Manitoba. First, although there is evidence that prevelar raising (but not necessarily any associated merger) has been present in parts of the Pacific Northwest for roughly a century or more, it is not known whether this is similarly true for the Prairies and therefore whether a change in progress is underway there, nor which vowels are involved (as the BEG and BAGEL classes were not investigated). In addition, the significant effect of religion in Alberta has implications for the wider Prairies due to the presence of numerous religious communities having varying degrees of integration with mainstream society. These include not only Mennonites, but also the Amish and the Hutterites, the latter being an Anabaptist sect whose worldwide membership is concentrated in the Canadian Prairies, and specifically in Alberta and Manitoba (Ryan 2019). However, the insular nature of the latter two groups makes their inclusion in such research especially challenging.

Returning to the U.S., prevelar raising in the Upper Midwest was first documented by Thomas (1947; cited in Bauer & Parker 2008). Analysis of this as a change in progress began under Zeller (1997; *n*=10). The ANAE subsequently identified a prevelar merger of Wisconsinite BAG-BAGEL. Other studies of Wisconsin describe raising of BAG but absence of a merger with either BEG or BAGEL (Bauer & Parker 2008; *n*=8), differentiation between the voiceless (i.e., /k/) and voiced (i.e., /g/) velar coda environments, with pre-/g/ context being more raised (Purnell 2008; *n*=10), and the complicated interplay between prevelar raising and other vowel processes in the region such as the Low Back Merger and Northern Cities Shift (Benson, Fox & Balkman 2011; *n*=40). To the west, prevelar raising patterns have also been documented in Minnesota (ANAE; Benson et al. 2011; Koffi 2014, *n*=24; Stanley 2021), although that state has received less attention in terms of detailed phonetic analysis.

Manitoba's particular geopolitical position along with its economic and cultural ties provide multiple linkages to those dialect regions where prevelar raising is a prominent feature. As a Prairie province, Manitoba shares many commonalities with Alberta, linguistically and otherwise. As a western Canadian province, it is further linked to British Columbia and, by proximity, the extended Pacific Northwest. However, Manitoba also lies immediately adjacent to the Upper Midwest, specifically the state of Minnesota. Minneapolis (population 3.6 million; U.S. Census Bureau 2021) is the closest major centre to Winnipeg at approximately 700 kilometres distance, with which it has important economic and cultural ties. In contrast, the closest comparably-sized Canadian cities of Vancouver (4.7 million; Statistics Canada 2016) and Toronto (13.5 million) are each more than 2,000 kilometres away from Winnipeg, and even the two largest Prairie cities, Edmonton (1.3 million) and Calgary (1.4 million), are twice as far from Winnipeg as Minneapolis. It would not then be very surprising if there were indeed more similarities between Minnesota and Manitoba speech than have already been documented (Lopez-Backstrom & Koffi 2020), including production of prevelar raising.

3. Social Context: Mennonite and Filipino Settlement in Southern Manitoba

As with any colonized territory, the original linguistic landscape of Manitoba has been dramatically reshaped over the course of its colonization. Some of the Indigenous languages of the province are in relatively healthy shape in comparison with other parts of Canada and the United States, but they all have nonetheless been overwhelmed and had their viability threatened by the migration into Manitoba of settlers and other immigrants from countries and regions around the world bringing their languages with them.[1] The transformation of the ethnic and linguistic makeup of Manitoba over the past century and a half is certainly remarkable. According to the most recent census data (Statistics Canada 2016), the top ten ethnicities by proportion currently represented in Manitoba's population (total of 1.28 million) include: English (19.8%), Canadian (19.4%), German (17.8%), Scottish (16.8%), Ukrainian (14.5%), Irish (12.6%), French (12%), First Nations (11.5%), Métis (7.3%), and Filipino (6.7%). Of those languages with a greater than one-percent share of "mother tongue" speakers, English is by far the largest reported in the census at 71.4 percent, followed by German (5.1%), Tagalog (3.8%), French (3.1%), Punjabi (1.5%), and Cree (1.1%), the latter being the only Indigenous language to surpass this very minor threshold. While religion was not surveyed in the 2016 Canadian census, data from 2011 shows Mennonites comprising 3.8 percent of the population (Statistics Canada 2011). This last statistic is relevant to the connection between ethnicity and language use because, within the Manitoba context, German ancestry, German language fluency or heritage, and Mennonite religious affiliation (personal or familial) are strongly linked.

Despite its history of diverse in-migration and settlement, ethnolinguistic variation is little-documented in Manitoba. Certain distinctive production patterns of ethnically Filipino-

Winnipeggers (Tran 2018; Onosson, Rosen & Li 2019) and Mennonite-Manitobans (Hadei 2020; Onosson 2020) have only recently been documented. Being of particular social and linguistic importance within Manitoba, the Mennonite and Filipino communities were therefore selected to form major components of the corpus utilized for the present study (see 4.1. Data Collection). The following subsections provide a short synopsis of each community.

3.1 Mennonite-Manitobans

The majority of ethnic German-Manitobans trace their ancestry back to Mennonite communities who migrated en masse to Canada from a region centred in and around present-day Ukraine (then part of the Russian Empire) towards the end of the nineteenth century. Mennonites living in Imperial Russia found their pacifist way of life threatened by the removal in 1870 of previous military exemptions amid a program of Russification (Sawatzky 1970:150). In that same year, Manitoba entered the Canadian confederation as its first western province, following the Métis uprising under Louis Riel, who were seeking self-governance in their territory which was centred in the region around the modern-day city of Winnipeg. This was followed by a strong push by the Canadian federal government for increased immigration to the province to counteract further civil unrest and aid in rapid development of the Canadian West (Friesen 1987:195-204). The out-migrating Mennonite communities thus became one of the principal groups targeted by Canadian government initiatives promoting Canadian in-migration, such that two regions of the province, the West and East Reserves, were specifically dedicated for Mennonite immigrants. Settlement proceeded quickly, and by 1880 nearly 7000 migrants occupied the two Reserves (Sawatzky 1970:147), an impressive number considering that a decade earlier Manitoba's total population

had been only some 12,000 people (Friesen 1987:201). During their time in Russia/Ukraine, the Mennonite communities had diverged along religious lines, with some favouring a more liberal view and greater integration with non-Mennonite society, and others being more conservative and insular. When re-settling in Manitoba, the latter more conservative sect occupied the East Reserve while more liberal-minded groups (including a splinter group from the East Reserve) occupied the southerly West Reserve along the international border (Klassen 1981:22–23).

Although originating as religious communities and functioning as such in other regions in the present day, Mennonites may be considered a kind of ethnicity within the twenty-first century Manitoba context, as some of the descendants of those early migrants abandon the formal religion itself and yet maintain cultural ties with other, more religiously-minded Mennonite communities. Labov (2001:245) noted that ethnicities are not comparable across different social contexts, because "[w]hat makes one ethnic group different from another will differ from one society to another." The function of being Mennonite in Manitoba was discussed explicitly by one of the interviewees in the present study, a Winnipeg resident partially descended from early Mennonite migrants to the province:

> Because my last name is [REDACTED], it's a Mennonite name, it came from my dad's side. So, I've always had sort of an, identified with Mennonites, largely due to the last name, and the fact that my dad grew up in an area of the province that's heavily Mennonite, and they did go to a Mennonite church, and they did farming. The Mennonites, a lot of them do, they are farmers. So that whole world is connected to the farming, and the last name, and my dad can speak some of the German … I was eight, my brother was twelve when my grandfather died. That sort of ended that era of the farm, 'cause then they sold a

> bunch of the farm off, my dad sold off his part. And so that experience came to an end … And so, I didn't have that connection anymore to the farm. But growing up we went to … a multi-denominational church. There were a lot of people in the church that had Mennonite backgrounds, but it wasn't, it was not a Mennonite church. And in a lot of cases, people say that you're not actually a Mennonite. A Mennonite is actually, should be, is by definition someone who goes to a Mennonite church, because it's a religious, but it's also cultural … My dad argues that you have to be going to a Mennonite church if you're Mennonite, if you call yourself a Mennonite. Of course, you can say you have Mennonite background. So, I have Mennonite background. (LIPP interview #435)

3.2 Filipino-Manitobans

Arriving in Manitoba much more recently than Mennonites and other early-period (pre-20th century) settler communities, Filipino-Manitobans have quickly become one of its most influential and sizeable ethnic groups. Following the implementation of Canada's 1967 Federal Skilled Worker Program, Winnipeg became a focal point for Filipino migration, beginning with the recruitment of nurses and textile workers who helped to raise its profile as a location with employment opportunities for skilled and professional-class female migrants from The Philippines (Mais 2012; Malek 2019). The Philippines has continuously ranked as the top-ranked source country for migration to Manitoba since the 1980s, providing between 23 to 36 percent of all in-migration over the past forty years (Statistics Canada 2016). Ethnic Filipinos comprise 9.7 percent of Winnipeg's overall population and 37.8 percent of its visible minority population,

more than double the equivalent proportions of any other major Canadian city; nationally, ethnic Filipinos make up just 2.3 percent of the general Canadian population.

Although Filipino is a considered a distinct ethnicity within Canada, it is important to mention that The Philippines, like Canada, is a multi-ethnic society within which Filipino is simultaneously a nationality and an ethnicity, akin to some usages of Canadian in that respect (see the earlier reference to Canadian as the second-largest ethnic group in Manitoba). While a range of distinct Philippine ethnic groups and languages are represented in Manitoba, including Ilocano, Visayan, Kapampangan, Cebuano and others, it is the Tagalog language, associated with the eponymous ethnicity (the second-largest ethnic group in the Philippines) which is by far the most widely-spoken, to the extent that mother-tongue Tagalog speakers outnumber French as well as all of Manitoba's Indigenous languages, and are only exceeded numerically by English and German (typically Mennonite) speakers.

Among the Filipino participants in the present study, all of whom are Canadian-born, ethnic self-identity was a common topic of discussion, typically framed as a choice between Filipino, Canadian, Filipino-Canadian, and the least common variant: Canadian-Filipino. As with Mennonite-Manitobans, this choice of ethnic self-identification can be framed in terms of cultural membership, familial ties and heritage, and personal history: "[I identify as] probably like Filipino-Canadian just because, I don't know. I don't feel myself as really Canadian, uh, just because, I don't know, I can speak Tagalog and stuff I guess, so both, but not fully Filipino 'cause I wasn't born there," (LIPP interview #209). Cultural differences, especially for these second-generation participants, were often a point of reference: "I think of myself as Canadian but, Filipino roots or traits. How is that differentiated from Filipino-Canadian? Generally, when people relate Filipino-Canadian, in my opinion, is they think of themselves as Filipino first

before Canadian. I don't identify myself as that because I'm born here so I have Canadian values. I carry some traits from my parents, from what they taught us … but no, I'm more Canadian," (LIPP interview #208). Unlike most Mennonites, in the case of Filipino-Manitobans ethnic identity can also pertain to phenotypic differences, as mentioned by another participant: "I would say I'm Canadian-Filipino, I would be Canadian first 'cause I feel like that's my identity, like I am Filipino background, but in terms of culture I'm more Canadian but my skin is just brown so I'm Filipino," (LIPP interview #212).

4. Methods

4.1 Data Collection

This study examines data drawn from the Languages in the Prairies Project speech corpus (LIPP; Rosen & Skriver 2015; Onosson et al. 2019). LIPP contains multi-mode recordings documenting several speech communities within the Canadian provinces of Alberta and Manitoba. All participants (n=64) in the present study were born and/or raised in Manitoba and are first language speakers of English. Participants from Manitoba's capital of Winnipeg fall into two ethnic sub-groups: Filipino, and European. The latter form a non-homogenous group whose familial ancestry is tied to several regions across modern-day European countries ranging from Portugal to Russia and who lack known or reported ancestry from outside of this region. As one of the LIPP interviewers for the European cohort, I can report that "white" would be a fair descriptor for most or all participants in this group, although this was not necessarily their own self-reported identity. All Mennonite participants reside in rural Manitoba. Birth year ranges varied across sub-groups, with European Winnipeggers having both the largest range and being on average the oldest participants, while Filipino participants were the youngest group on average. Because not all groups had very broad coverage across birth years, AGE was employed as a simple binary distinction in the study by classifying participants as either older or younger relative to 1983, the median birth year across all participants. Table 1 provides a summary of relevant demographic information.[2]

[TABLE 1 HERE]

LIPP interview sessions were typically held at the residence of the interviewee and conducted by an interviewer who shared the same ethnic background or identity as the interviewee. Digital recordings were made at 44.1 kHz in uncompressed 16-bit WAV format, using an H2n Zoom handheld audio recorder, with individual Sennheiser EK 100G2 wired lavaliere microphones. Each LIPP recording session consisted of three components: a word list, two reading passages, and a sociolinguistic interview typically lasting between forty-five to ninety minutes in duration. For this study, only the interview recordings were analyzed. Most prior research on prevelar raising has relied on data deriving from reading tasks; indeed, interview data is relatively under-utilized across sociolinguistic studies, most likely due to the inherent additional workload which it necessitates. However, because of the possibility that prevelar raising in Manitoba may represent a change in progress, it was deemed optimal to investigate speech captured in a relatively low formality context.

4.2 Data Analysis

Manual transcription of the LIPP interview audio files was carried out in ELAN (v5.6-FX; Wittenburg et al. 2006). The transcribed text was then processed in FAVE (v1.2.2; Rosenfelder et al. 2014), which provides per-token global data measurements including formant means and durations, as well as discrete timepoint-based formant values at five evenly-spaced intervals between 20 to 80 percent of token duration, inclusive. Tokens of the /æ/, /ɛ/, and /e/ vowels were extracted from the LIPP Manitoba interviews. Tokens were restricted to those bearing primary stress and not occurring before liquid segments (/l/ and /ɹ/) or non-velar nasals (/m/ and /n/), to

limit potential confounds when considering non-velar codas as a group,[3] yielding 44,936 tokens in total (23,374 for /æ/, 9177 for /ɛ/, and 12,385 for /e/). Further data processing and statistical analysis was conducted in R (R Core Team 2020), with extensive use of the tidyverse package suite (Wickham et al. 2019) for data manipulation and plotting (with its ggplot2 sub-package), the sjPlot package (Lüdecke 2021) for compiling model outputs and plotting, and the viridis package (Garnier et al. 2021) for producing colorblind-vision-friendly color palettes.

Two formant normalization methods are utilized. For statistical comparisons, the normalized values in Hertz provided by FAVE were adopted, as this scale is familiar and therefore readily interpretable (with the caveat that different normalization methods may produce different results from those obtained here). For data visualization, the z-score or Lobanov method (Lobanov 1971) was used,[4] wherein raw formant values in Hz are transformed as a proportion of their aggregated range across all vowels on a per-speaker basis; z-scaled formant data arguably produces a superior visual representation of cross-formant dynamicity and relative proportions in the vowel space.

As discussed previously, some phonetic and language-internal motivations for prevelar raising have been proposed. The ANAE notes that the likelihood of merger of the BAG and BAGEL classes may be enhanced by their low functional load in prevelar position, with very few contrasting words and no minimal pairs between them (Labov et al. 2006:181). Another motivation concerns coarticulation effects (Baker, Mielke & Archangeli 2008; Purnell 2008; Mielke, Carignan & Thomas 2017). The traditionally low, front tongue position of /æ/ conflicts with the velar articulation of /g/, motivating a more compatible articulation for /æ/, with raising being one way to achieve this; the laryngeal voicing gesture increases this incompatibility, which is why voiceless /k/ does not produce the same effect on /æ/. While the present study does not

include an articulatory component and so cannot speak directly to coarticulation effects, their postulation has implications for how data analysis should be conducted. To wit, productions of /æ/, /ɛ/, and /e/ before the three velar segments /g/, /ŋ/, and /k/ warrant separate investigation, to see how the observed patterns either conform to or depart from those found elsewhere, along with comparisons to non-prevelar contexts.

The first stage of analysis examines static positional differences between vowel tokens. For this, FAVE-normalized mid-point F1 and F2 values were evaluated using linear regressions. Linear mixed effects regression models (LMERMs) were built using the lme4 package (Bates, Mächler, Bolker & Walker 2015). Dependent variables included (FAVE-normalized) mean F1 & F2, and DURATION. Independent variables included linguistic factors of CODA (four levels: velars /k/, /g/, /ŋ/, and OTHER) and VOWEL (three levels: /e/, /ɛ/, /æ/), social factors of GENDER (two levels: woman, man), ETHNICITY (three levels: Mennonite, European, Filipino), and AGE (two levels: older, younger); random intercepts for SPEAKER and WORD were also included. A set of LMERMs were built for each dependent variable for each vowel. The simplest model in each set excluded all social factors and was structured as follows: DEPENDENT.VARIABLE ~ CODA + (1|SPEAKER) + (1|WORD). Subsequent models added to this the social factors of GENDER, ETHNICITY, and AGE; first individually (three models), then in combination as pairs (three models) or with all three factors together (one model), and finally cycling through the various additive and/or interactive combinations (e.g., GENDER * ETHNICITY + AGE) between them (seven models), amounting to fifteen models in total. The most parsimonious model was then determined through pairwise ANOVA comparisons. The factor intercept levels across all models were set at: VOWEL = /e/, CODA = other, GENDER = man, ETHNICITY = Mennonite, and AGE = older. The social factor intercept levels were all selected to represent groups which could a priori

be expected to have more conservative productions. Women are well known to be generally more linguistically innovative than men. Mennonite speakers as a group reside in more conservative rural communities, in contrast with the other two ethnicities in the study who reside in the urban centre of Winnipeg. And the speech of younger speakers generally presents a greater degree of innovation than that of older speakers. Under this view, significant differences from the intercept levels by any social factor group may therefore identify relatively innovative productions, given that they uniformly depart from those of more conservative groups. The LMERM results are accompanied by data visualizations as 2-dimensional mappings of vowel token density estimate distributions in F1xF2 (z) space.

The second stage of analysis examines durational differences. Studies such as Wade (2017) demonstrate that durational differences can play a critical role in distinguishing vowels which are otherwise merged acoustically. Vowel duration differences were compared under LMERMs following the same procedures discussed for static formants. These are accompanied by visualizations of duration as boxplots, a standard statistical tool for representing a single continuous variable.

The final stage analyzes vowel formant trajectories, uniting the positional and temporal data, using generalized additive mixed models (GAMMs; Hastie and Tibshirani 1990; Wood 2017). GAMMs compute "smooths" across different conditions, e.g., between different vowels in a unique coda context. Visual comparison of the degree of cross-smooth overlap provides an indication of where, when and whether they represent significantly different conditions. It is thus possible to examine more precisely how the various trajectories are differentiated from each other in a way that single-variable analyses cannot. GAMMs were built following the general formula y ~ s(x, k = 5, bs = "cs") + s(random.effect, bs = "re") where y represents a given

formant, x represents a given phonological condition (vowel or coda type), and k (knots) relates to time-series (here, the five timepoints provided by FAVE), based on methodology described in Sóskuthy (2017). Inclusion of SPEAKER as a random effect[5] was implemented in *ggplot2* by modifying its smooth algorithm (which ordinarily does not permit their inclusion) via a custom R script (Beare 2020), following methods discussed in Tabain et al. (2020).

5. Results

Figure 2 plots the mean formant positions across Manitoba's monophthongal vowel system in F1xF2 space, aggregated across all participants and undifferentiated for region, ethnic background, gender, or age. Several features of the Manitoba vowel space are notable: it is somewhat compact in the F2 dimension, with the most back vowel being /o/ at F2 = 1256 Hz; /u/ is advanced/centralized; /ʌ/ is very low and back; and /æ/ is the lowest vowel in the system. The lowest-vowel status of /æ/ in Winnipeg was previously observed by Hagiwara (2006) who noted it as being consistent with production of Canadian Shift (Clarke, Elms & Youssef 1995). With regards to the focus of the present study, it is worth mentioning that the mean positions of the vowels /æ/, /ɛ/, and /e/ are relatively distant from each other.

[FIGURE 2 HERE]

5.1 Static Vowel Positions

The examination of static vowel positions using LMERMs approaches the data from two distinct viewpoints. The first compares vowel formants (F1 and F2) as they occur within each of the three target VOWELS according to various independent effects, including CODA context. The second compares vowel formants as they occur within specific CODA contexts according to a similar set of independent effects, including VOWEL.

5.1.1 Static Vowel Positions Across Coda Contexts

The LMERM results for F1 and F2 of /æ/, /ɛ/, and /e/ are summarized in Table 2.

[TABLE 2 HERE]

The social factors will be considered first. AGE was not significantly correlated with any vowel formant differences. GENDER was correlated with formants of /æ/, with women producing modestly higher F1 and lower F2 values than men, indicative of a lower, retracted articulatory position. ETHNICITY was correlated with differences among the formants of /e/. Relative to Mennonite speakers, Filipino speakers exhibited slightly lower F1 values i.e., a closer articulation, while both European and Filipino speakers had significantly higher F2 values, a more advanced articulation. No interaction effects were found between the social factors.

Significant differences between CODA contexts were identified for formants of the three vowels. For /æ/, coda /k/ exhibits only a small increase in F1 (lower articulation) from the intercept (non-velar codas) and no significant difference in F2. The voiced velars /g/ and /ŋ/ both correlate with lower F1 (higher articulation) and higher F2 (advanced articulation) values for /æ/, with /ŋ/ producing the largest differences. /ɛ/ exhibits a similar pattern. Again, coda /k/ correlates with higher F1 (lower articulation). As for /æ/, codas /g/ and /ŋ/ produce lower F1 (higher articulation) and higher F2 (advanced articulation) values for /ɛ/; however, these do not reach the level of significance for /ŋ/, most likely due to low quantity of tokens, only eight, which occur in that condition. For /e/, significant differences only occur in F1, where codas /k/ and /g/ correlate with slightly lower values (a higher articulation); this is the only condition where /k/ and /g/ produce a similar direction of effect. Note that /ŋ/ is categorically prohibited after /e/ in English

(Hammond 1999:113) and so cannot be compared in this context. Visualizations of the differences in VOWEL F1xF2 position according to CODA context are provided as density plots in Figure 3.

[FIGURE 3 HERE]

In the lower (left) panel of Figure 3, the tendency for both /g/ and /ŋ/ to induce raising and advancement of /æ/ relative to non-velar OTHER codas is very clear, and contrasts markedly with /k/ which has a diametrically opposed pattern showing lowering and some retraction relative to OTHER. In the upper right panel, /ɛ/ exhibits a similar pattern as /æ/ albeit with a reduction in magnitude of positional difference between codas (as mentioned before, tokens of /ɛ/ before /ŋ/ were very rare in the data and should not be relied upon too heavily; this is apparent in its uneven density distribution here). The preceding patterns strongly contrast with those for /e/ as depicted in the upper left panel, which shows a much more cohesive arrangement across all coda types.

5.1.2 Static Vowel Positions Within Coda Contexts

The LMERM results for F1 and F2 within CODA contexts are summarized in Table 3. Note: the VOWEL intercept level is set at /e/ except before /ŋ/, where it is /ɛ/.

[TABLE 3 HERE]

Considering first the results pertaining to vowel type, the finding of significant F1 differences for each vowel in the pre-/g/ context (i.e., BAG-BEG-BAGEL) would suggest the absence of, at a minimum, complete merger of any kind. However, comparing these differences to the other contexts indicates that there is much more cross-vowel proximity within this context than any other (except /ŋ/, but see below). Before velar /k/ (i.e., BACK-BECK-BAKE), F1 differences between vowels are at least twice as large than they are before /g/, and F2 differences are robust as well. The results for the OTHER coda class (i.e., BAT-BET-BAIT) are similar to those for /k/. Moreover, significant F2 differences before /g/ only occur between /e/ vs. /æ/, with /ɛ/ not being significantly retracted in relation to /e/; minimally, this suggests the potential for a fair degree of overlap between BEG and BAGEL, mostly in the front-back dimension. For vowel formants before /ŋ/, which pertain only to /æ/ vs. /ɛ/ (i.e., BANG-LENGTH), the low token count for LENGTH limits our ability to rely on these results, which is unfortunate because this context exhibits the least amount of difference between vowels and thus the greatest potential for merger.

Looking at the social factors, GENDER is correlated with lowering of F1 (a closed articulation) before /ŋ/ and slight lowering of F2 (a retracted articulation) before OTHER codas by women. An interaction between GENDER and ETHNICITY further occurs in F1 of /k/, with European women having higher F1 (closer articulation) relative to Mennonite men. Regarding AGE, younger speakers show lower F1 (a raised articulation) and higher F2 (advanced articulation) values before /ŋ/, and slightly lower F1 before /k/.

[FIGURE 4 HERE]

The degree of overlap by vowel across CODA contexts is visualized via density estimate plots in Figure 4. The upper left panel shows the vowel distributions in pre-/g/ context (BAG, BEG, BAGEL). There is substantial overlap in the distributions of BAG and BEG, which both also slightly encroach into the region of BAGEL's distribution such that some portion of the productions of all three vowels do overlap in a single, albeit quite small region of the vowel space. The pre-/ŋ/ context, in the upper right panel, shows a similar if not greater degree of overlap between distributions of BANG and LENGTH; however, the low token quantities for the latter, as discussed before, mean that this cannot be taken as entirely conclusive. The lower left panel shows the pre-/k/ context (BACK, BECK, BAKE). The distributions of BACK and BECK overlap slightly, but BAKE's distribution is entirely separate. In the lower right, distributions before OTHER codas (BAT, BET, BAIT) appear to be medial between the pre-/g/ and pre-/k/ contexts, with all three vowels occurring in closer proximity, and with slightly more overlap between BAT-BET relative to BACK-BECK, but certainly less so than for BAG-BEG.

5.1.3 Summary of Static Vowel Position Results

To summarize the main findings regarding static mid-point vowel positions:

- Women's /æ/ vowels are lower and more retracted than men's
- European /e/ is higher than Mennonite /e/
- Filipino /e/ is higher and more advanced than Mennonite /e/
- Coda /k/ correlates with lowered /æ, ɛ/, and raised /e/
- Coda /g/ correlates with raised and more advanced /æ, ɛ/, and raised /e/
- Coda /ŋ/ correlates with raised and more advanced /æ/

- BAG and BEG show substantial overlap, but there does not appear to be a three-way merger with BAGEL

5.2 Vowel Durations

This section considers vowel durations both across and within different coda contexts. The LMERMs for vowel DURATION across CODA contexts are summarized in Table 4.

[TABLE 4 HERE]

The vowel /æ/ has both the longest average DURATION, and exhibits the least amount of variation by CODA, with only pre-/ŋ/ context showing a significant decrease in DURATION. /ɛ/ has the shortest average DURATION among the vowels, with slight abbreviation before /k/ and substantial lengthening before /g/. Contrastingly, /e/ exhibits a consistent pattern of abbreviation before velars /k/ and /g/ (it does not occur before /ŋ/). To illustrate these various patterns, Figure 5 displays boxplots of vowel DURATION by CODA context. Regarding social factors, the model finds a significant effect of GENDER, with women producing longer vowels than men in every case. ETHNICITY also plays a role in production of /æ/, which is shorter as produced by Filipino speakers compared with Mennonites.

[FIGURE 5 HERE]

The LMERMs for vowel DURATION within CODA contexts are summarized in Table 5. For these models the VOWEL intercept is set at /æ/ due to its status as longest average duration vowel.

[TABLE 5 HERE]

Among social factors, only GENDER is implicated, with FEMALE speakers producing significantly longer vowel durations than MALE speakers in every coda context except before /g/. Looking across VOWELS, /æ/ (the intercept) trends towards longer durations than the other two vowels in nearly every case (and see Figure 5). This difference is significant in comparison with both /e/ and, more substantially, /ɛ/ (the briefest of the three vowels) before /k/ and OTHER codas. Before /g/, the difference in duration between /æ/ and the other vowels is substantially reduced and does not reach the level of significance for /e/. Only before /ŋ/ does no significant durational difference occur at all (between /æ/ and /ɛ/).

5.2.1 Summary of Vowel Duration Results

To summarize the main findings regarding vowel durations:

- /æ/ is the longest vowel with the least cross-coda variation
- /ɛ/ is the shortest vowel with the greatest cross-coda variation
- Coda /k/ correlates with abbreviated duration of /ɛ, e/
- Coda /g/ correlates with increased duration of /ɛ/, and abbreviated duration of /e/
- Coda /ŋ/ correlates with abbreviated duration of /æ/
- Women produce consistently longer vowels than men

- Filipino /ɛ/ is shorter than Mennonite /ɛ/

5.3 Dynamic Vowel Trajectories

The GAMMs analyses of FAVE vowel formant (F1 and F2) trajectory data build upon the preceding results, incorporating both the spatial and temporal qualities of the vowels. Visualizations of the GAMMs for vowel FORMANTS across CODA contexts are shown in Figure 6, and within CODA contexts in Figure 7.

[FIGURE 6 HERE]

It is readily apparent in Figure 6 that the between-vowel differences are markedly reduced for both F1 and F2 before the voiced nasals /g/ and /ŋ/ as compared with /k/ and OTHER codas. For F2 before /g/, the smooths for the vowels /ɛ/ and /e/ overlap across their full durations, which is also true for F2 of /ɛ/ and /æ/ before /ŋ/. Under GAMMs analysis, this cross-smooth overlap indicates that the two trajectories are not significantly different from each other; in other words, /ɛ/ and /e/ have statistically identical F2 trajectories before /g/, as do /ɛ/ and /æ/ before /ŋ/. While the F1 conditions (the lower plots in Figure 9) do not show any cases of full-duration overlap, the cross-vowel trajectories before both /g/ and /ŋ/ are much closer to each other than before /k/ and OTHER. The pre-/k/ context in particular exhibits a greater degree of cross-vowel differentiation than any other, with each vowel having distinct F1 and F2 trajectories.

[FIGURE 7 HERE]

In Figure 7, the trajectories for both F1 and F2 of /æ/ show clear distinctions in all four coda conditions, with the voiced velar codas /g/ and /ŋ/ having the greatest degree of overlap. Interestingly, the formant trajectories of /æ/ before the voiceless velar /k/ are further from the voiced velar contexts than for OTHER codas. /ɛ/ exhibits the least degree of overall cross-coda context difference. For F2, its trajectories before /g/ and /ŋ/ are fully overlapped and clearly diverge from the other conditions, and the respective F1 trajectories are overlapped for most of the vowel duration as well; the pre-/k/ context once again exhibits a distinctive trajectory for both formants. For /e/, the pre-/g/ trajectories of both F1 and F2 depart from both /k/ and OTHER codas for nearly the entire duration (with some overlap towards vowel offset). In contrast, the formant trajectories of /e/ before /k/ and OTHER are full overlapped for at least the first half of the vowel.

5.3.1 Summary of Vowel Trajectory Results

To summarize the main findings regarding vowel trajectories:

- F1 and F2 trajectory differences are generally minimized before voiced velar codas /g, ŋ/
- F1 and F2 trajectory differences are generally maximized before voiceless velar /k/
- F2 trajectories of /ɛ/ and /e/ fully overlap before /g/
- F2 trajectories of /ɛ/ and /æ/ fully overlap before /ŋ/
- F1 and F2 trajectories of /æ, ɛ/ show full or near-full overlap between both voiced velar coda /g, ŋ/ contexts
- F1 and F2 trajectories of /e/ are most divergent before /g/

6. Discussion

This study contributes to our knowledge of the state of language production and variation in Manitoba and the Prairies in several ways. First, it provides an update and expansion to Hagiwara's (2006) study of Winnipeg vowel production by providing an overview of the vowel space of (southern) Manitoba (Figure 3). The examination of ethnolectal differences between European, Filipino, and Mennonite speakers further builds on related work (Tran 2018; Onosson et al. 2019; Hadei 2020) which has begun to indicate how language use can vary between some of the major ethnic groups present in Manitoba. This is important because our understanding of ethnolectal variation in the Canadian west, and especially the Prairies, is somewhat rudimentary at present. This study also provides the first detailed acoustic analysis of prevelar raising/merger among Manitoba English speakers. Given Manitoba's unique position relative to other regions where similar phenomena occur and the general interest on these topics in the research community, this is an important addition to the state of our knowledge.

In one of the most recent studies on North American English prevelar raising, Stanley (2021) found that the Prairies comprise part of the general region where the rates of occurrence of both BAG-raising and BEG-raising are greatest, with the former being more advanced in Manitoba and adjacent U.S. states. The present study's results accord with this finding (and previous observations in the literature) while providing critical detail which can only be gleaned from a direct analysis of production. The analysis of cross-coda vowel formants (see Table 2 and Figure 3) clearly shows that /æ/ is both raised and fronted before voiced velar segments, whereas /ɛ/ in the same position shows a much greater degree of fronting or advancement than raising. A

description of both processes as raising phenomena is, therefore, at best not entirely accurate, and at worst potentially misleading.

While the raised/fronted nature of the productions of /æ/ and /ɛ/ is quite clear in the data from this study, the answer to the question of whether prevelar vowel merger occurs in the speech of Manitobans is less conclusive. Cross-vowel formant comparisons within the various coda contexts (see Table 3 and Figure 4) reveal that the strongest case for merger is between /æ/ and /ɛ/ when occurring before the velar nasal /ŋ/, with the caveat that low token counts for /ɛ/ should induce some caution in making too strong a claim for this. In pre-/g/ context, there is a large degree of overlap between these vowels, moreso than elsewhere; but they nevertheless do maintain some degree of difference from each other. This is also the sole context where some amount of overlap between all three vowels occurs i.e., including /e/. However, there is certainly too little overlap to argue for merger of either /æ/ or /ɛ/ with /e/ in this context. In addition to formant comparisons, consideration of durational differences (see Tables 4 & 5, and Figure 5) suggests that this component of production is further implicated when it comes to any potential for merger. The duration of /ɛ/ is most alike the other two vowels before /g/ and especially /ŋ/ (excluding /e/ from the latter) than in other contexts. The GAMMs trajectory comparisons (Figures 6 & 7) further confirm these observations. Before /ŋ/, the F2 trajectories of /æ/ and /ɛ/ are virtually identical, and they show partial overlap before /g/. And for F1, their trajectories are in closer proximity before both voiced velars than in other contexts. /e/ also shows the closest proximity to the other vowels before /g/; its F1 trajectory approaches them more closely here than elsewhere, and its pre-/g/ F2 trajectory exhibits overlap with /ɛ/ across the entire duration. Taken together, these findings do make a good case for the identification of early or incipient BAG-BEG merger in Manitoba as well as a fair degree of BEG-BAGEL overlap in several respects.

There does not, however, seem to be as compelling an argument for either BAG-BAGEL or BEG-BAGEL merger, nor indeed the triple BAG-BEG-BAGEL merger argued to occur in places like Seattle and Portland (Freeman 2014, 2021; Swan & Becker 2021).

The investigation of ethnolectal effects in this study have revealed a few interesting cross-ethnic differences. Filipino speakers differentiate themselves from Mennonites by producing more raised and advanced /e/, and briefer /ɛ/ vowels. European speakers also produce more advanced (but unraised) /e/ productions than Mennonites, and European women more closed vowel positions before /k/ relative to Mennonite men; conversely stated, Mennonites produce more retracted /e/, and Mennonite men more open pre-/k/ vowels.

A coherent explanation for these differences might be found within concepts such as conservatism and extra-local identity. In establishing the social factor intercepts for the LMERMs, the choice was made to use groups which were thought likely to be more conservative; for gender, this meant selecting male speakers, and for ethnicity it meant selecting the rural and more religiously-affiliated (at least historically) Mennonites. The results showing that (rural) male Mennonites have distinct pre-/k/ vowel productions from European women seem to match the hypothesis that the former would be the most conservative among all social groups, although it is not clear why the locus of this effect should be found here, among all the features investigated. A broader investigation into Mennonite speech production in the future might help to clarify how such productions are situated within their overall vowel system.

A previous acoustic study in Winnipeg (Onosson et al. 2019) found a greater degree of adoption of Canadian Shift (Clarke et al. 1995), an ongoing chain-shift, among Filipino speakers relative to European speakers. Filipino-Winnipegger productions in that study aligned more with e.g., Toronto or Vancouver speakers rather than with local non-Filipino counterparts in

Winnipeg, which was attributed to a greater adherence to extra-local trends occurring in those larger and more influential cities, following Hall-Lew's (2009) "emergent linguistic marketplace" model. The exchange of linguistic capital in the form of the production of prestigious (on the national stage) changes in progress such as Canadian Shift may be more significant to Filipino-Winnipeggers than some of their non-Filipino counterparts. Filipino speakers in Winnipeg may be motivated to not only aim to match their productions to those innovations occurring in communities such as Toronto and Vancouver, but at the same time to also enhance the perception of their adoption of those innovative productions through other means, where available. In the present study, productions of /e/ were found to be significantly advanced or fronted among both Filipino and European (urban) Winnipeggers relative to (rural) Mennonites, with additional significant raising by Filipino speakers. Note that the general production in Manitoba of /e/ and /ɪ/ (see Figure 3) sees these two vowels occupying similar positions in the vowel space, closer to each other than almost any other pair of vowels. While there are many other acoustic differences between these two vowels such as tense/lax quality and duration, increasing their positional difference would inarguably serve to further differentiate them from each other acoustically. Advancement of /e/ represents an urban/rural split within Manitoba, which provides a degree of positional separation between /e/ and /ɪ/. The additional raising of /e/ among Filipino speakers serves to further increase this distance, with the result that the distinction between /e/ vs. /ɪ/, two of the most proximate of all vowels for Manitobans generally, is greater among Filipino speakers than for other ethnicities (among those investigated here). It is possible that the increased distinctiveness of /ɪ/ achieved through /e/-fronting serves to enhance the perception that Filipino speakers are participating more strongly in the Canadian Shift as it pertains to this vowel, which is (currently) the final vowel to be involved in the pull-

chain and whose productions thus differ more across social/ regional dialects in comparison with the other vowels in the chain. This is of course only conjecture at this point; a perception study would need to be performed to establish whether this effect is even perceptible, and how listeners may be responding to it or what sociolinguistic associations it may carry.

A further point related to Canadian Shift concerns women's production of /æ/, which is more lowered and retracted than men's. Canadian Shift, a.k.a. "Short Front Vowel Shift" (Boberg 2019) or "Low-Back-Merger Shift" (Becker 2019), is argued to be driven by the initial down-and-backward movement of /æ/, driving a chain-shift through the lax front vowels, involving first /ɛ/ and eventually /ɪ/. This gender difference supports the analysis of Canadian Shift as an ongoing change in progress, with women leading the change, and with Manitoba productions being generally conservative such that a gender difference can still be observed even for the initiating vowel.

How do this study's findings relate to previous analyses of prevelar raising in Canada? The ANAE reported prevelar merger of /æ, e/ across the Prairies and into northern Ontario, "determined by examining the degree of overlap between /æg/ and /eyC/ … combined with evidence of a front upglide," (p. 181). The present study accords with this: Figure 4 shows a small degree of overlap between the two vowels (which would be even larger under the ANAE's inclusion of all codas for /e/), and Figure 7 shows lowering of /æ/ F1 towards offset. Mielke et al. (2017) looked at differences in realizations of /æ/ before different velar codas, finding that for Canadians "/æŋ/ involves more tongue raising and lower F1 (relative to /æg/ and /æk/)," (p. 344). However, their Canadian sample included only southern/eastern Ontarians (n=3) and one New Brunswicker. The findings from the present study show that, for Manitobans, the relationship between /g/ and /ŋ/ is reversed, finding the former correlating with lower F1 (and higher F2)

values for /æ/ (see Figure 7). Relative to Mielke et al.'s results, this indicates the value in carrying out detailed phonetic analyses of smaller population areas. As already discussed, Stanley (2021) described Manitobans as exhibiting both BAG- and BEG-raising, with the former having a greater incidence of occurrence. While Stanley's survey was based on rate of occurrence, something which this study cannot address directly, the findings presented here are nonetheless compatible, in that /æ/ before voiced velars exhibits more distinctive productions relative to /k/ and non-velar codas in comparison with /ɛ/ (see Figure 3). However, this is complicated by the fact that positional differences regarding /ɛ/ are more related to F2 than F1 — in other words, advancing more than raising — while prevelar /æ/ exhibits differences along both dimensions.

Finally, where do this study's findings situate Manitoba situated with respect to the other major regions where prevelar raising, fronting and/or merger have been shown to occur? Among research focused on communities in the Pacific Northwest, some of the most recent studies such as Swan and Becker (2021) and Freeman (2019, 2021) describe a three-way merger between /æ/, /ɛ/, and /e/; not only are BAG and BEG raising but also prevelar /e/ i.e., BAGEL, is simultaneously lowering; Freeman (2021) argues that BAGEL is the phonetic target of this merger in Seattle. Over the Canadian border in Vancouver, the situation is similar but with some differences; for example, Mellesmoen (2018) argues that only BAG and BAGEL are merged for Vancouverites, but absent the involvement of BEG. Clearly, the present Manitoba data do not fully correspond with either of these patterns. BAG and BEG do exhibit substantial overlap for Manitobans, with BAG both raising and advancing while BEG is mostly only advancing. However, not only is BAGEL production not as substantially overlapped with BAG or BEG, prevelar /e/ is significantly raised and advanced relative to non-prevelar /e/, moving away from the target of any potential merger,

which is to say that BAGEL is certainly not a merger target for Manitoba speakers. Given the relatively minor degree of raising that occurs for BEG, which has the effect of more easily permitting raised production of BAG to occupy much of the same acoustic space, it seems that BEG might be the best candidate to select as the target of prevelar merger in Manitoba, with BAGEL only encroaching into this merger space to a small extent.

Finally, we consider the other region having a strong association with prevelar raising: the Upper Midwest. While closest to Manitoba, the situation in Minnesota is not yet well-documented enough when it comes to many aspects of prevelar raising to make a strong comparison. Koffi (2014) found that BAG is indeed substantially raised to a similar extent as in Manitoba but did not examine prevelar productions of either /ɛ/ or /e/. To the east in Wisconsin, Bauer and Parker (2008) proposed that the raising of BAG does not involve merger with either /ɛ/ or /e/, but that certain lexical items containing prevelar /e/ have been reanalyzed as having (raised, prevelar) /æ/ instead; these include words such as *vague*, *plague*, and *bagel*. Corresponding words are unfortunately rare in the LIPP data for this study, with *bagel* in particular being entirely absent; however, the sole token of *plague* in the dataset and one of two tokens of *vaguely* do occur within the zone of three-way overlap (see the upper left plot in Figure 4), centred roughly at F1 = -0.5 z, F2 = 0.75 z. Considering that BAG and BEG are not merged or merging in Wisconsin, Manitoba may represent a dialectal pattern having a unique arrangement of features present at either end of the (very large) prevelar-raising region spanning central and western North America. On the one hand, there is fairly strong indication of the occurrence of BAG-BEG merger in Manitoba, as in the Pacific Northwest. But unlike that region, and like Wisconsin, there is no real indication of further merger with BAGEL, and quite good evidence that this is probably not generally occurring. In another similarity to Wisconsin, there is at least the

possibility that those forms in the BAGEL class with productions that fall within the BAG-BEG merger acoustic region may have been reanalyzed by (some) Manitobans as containing /æ/ (or possibly /ɛ/?) rather than /e/, although there is not yet strong enough evidence for this to be more than supposition at this point.

This study has documented the productions of /æ/, /ɛ/, and /e/ in Manitoba and examined their potential for changes in production and/ or merger in prevelar contexts. It has also revealed some of the important social factors at play, such as conservatism and the contrasting effect of adherence to extra-local speech patterns, in either the maintenance or development of ethnolectal difference in the province. This work contributes to research concerned with western Canadian/ Prairie/ Manitoba English, to the literature on prevelar raising and merger, and to the study of ethnolectal differentiation in Canada. All three of these fields represent ever-growing bodies of research, to which this study offers some important findings to be integrated into our broader understanding of North American English dialect patterns.

Notes

1. The role of government policy, both federal and provincial, in determining the relative statuses of different languages in Manitoba cannot be overstated, and it would be remiss of me not to mention this in the context of research which focuses on a colonially-imposed and governmentally-mandated language such as English. While this study does not aim to explore the historical or contemporary effects of such policies, it is unequivocal that any study of English in Manitoba as spoken by multiple ethnic groups, all descendants of migrants to the province, could not take place without the specific historical context which has occurred here, and which must therefore be acknowledged.

2. Three other demographic factors, REGION, MENNONITE RESERVE, and ETHNIC IDENTITY RATING, were originally examined as part of this study; as they were not found to be significantly correlated with any production differences, they are not discussed further.

3. Thank you to an anonymous reviewer for suggesting these coda exclusions.

4. FAVE's normalization process also incorporates the Lobanov (1971) method, embedded within a more complex procedure which ultimately re-scales converted z-score values back to an equivalent in Hz, thereby abrogating one of the key advantages of z-scores (or similar conversions such as Bark scaling) which is to eliminate the distorting effect of the inherently unequal variances in different dimensions.

5. Unlike the LMERM analyses, WORD was not included as a random effect in the GAMMs due to limitations on available computational resources, with the large number of distinct WORDS (n=3,688; cf. n=64 distinct SPEAKERS) making their analysis prohibitive.

References

Baker, Adam, Jeff Mielke & Diana Archangeli. 2008. More Velar than /g/: Consonant Coarticulation as a Cause of Diphthongization. In Charles B. Chang & Hannah J. Haynie (eds.), *Proceedings of the 26th West Coast Conference on Formal Linguistics*, 60-68. Somerville, MA: Cascadilla Proceedings Project.

Bates, Douglas, Martin Mächler, Ben Bolker & Steve Walker. 2015. Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software* 67(1). 1-48. https://doi.org/10.18637/jss.v067.i01.

Bauer, Matt & Frank Parker. 2008. /Æ/-Raising in Wisconsin English. *American Speech* 83 (4): 403–31. https://doi.org/10.1215/00031283-2008-029.

Beare, Richard. 2020. predictdf.gam [R script]. https://gist.github.com/richardbeare/b679c38dcb644ec50ea34ac061200504 (December 29, 2021).

Becker, Kara (ed.). 2019. The Low-Back-Merger Shift: Uniting the Canadian Vowel Shift, the California Vowel Shift, and Short Front Vowel Shifts across North America. *Publication of the American Dialect Society* 104(1).

Benson, Erica J., Michael J. Fox & Jared Balkman. 2011. The bag that Scott bought: The low vowels in northwest Wisconsin. *American Speech* 86(3). 271-311. https://doi.org/10.1215/00031283-1503910

Boberg, Charles. 2008. Regional Phonetic Differentiation in Standard Canadian English. *Journal of English Linguistics* 36(2). 129-54. https://doi.org/10.1177/0075424208316648.

Boberg, Charles. 2010. *The English Language in Canada: Status, History and Comparative*

Analysis. Cambridge University Press. https://doi.org/10.1017/S0008413100003182.

Boberg, Charles. 2019. A Closer Look at the Short Front Vowel Shift in Canada. *Journal of English Linguistics* 47(2). 91-119. https://doi.org/10.1177/0075424219831353.

Calhoun, Sasha, Paola Escudero, Marija Tabain & Paul Warren (eds.). 2019. *Proceedings of the 19th International Congress of Phonetic Sciences, Melbourne, Australia 2019*. Canberra, Australia: Australasian Speech Science and Technology Association Inc.

Clarke, Sandra, Ford Elms & Amani Youssef. (1995). The third dialect of English: Some Canadian evidence. *Language Variation and Change* 7(2). 209-228. https://doi.org/10.1017/S0954394500000995

Freeman, Valerie. 2014. Bag, Beg, Bagel: Prevelar Raising and Merger in Pacific Northwest English. *University of Washington Working Papers in Linguistics (UWWPL)* 32. 1-23.

Freeman, Valerie. 2019. Prevelar Merger in Production vs. Perception. In Calhoun et al. 2019, 457-61.

Freeman, Valerie. (2021). Vague eggs and tags: Prevelar merger in Seattle. *Language Variation and Change*. https://doi:10.1017/S0954394521000028.

Friesen, Gerald. 1987. *The Canadian Prairies: A History*. Toronto: University of Toronto Press.

Garnier, Simon, Noam Ross, Robert Rudis, Antônio P. Camargo, Marco Sciaini, and Cédric Scherer. 2021. Rvision - Colorblind-Friendly Color Maps for R [R package]. Version 0.6.2. https://sjmgarnier.github.io/viridis/ (December 28, 2021).

Hadei, Marzieh. 2020. A sociolinguistic study of English negation in Manitoba. University of Manitoba Master's thesis.

Hagiwara, Robert Elliott. 2006. Vowel Production in Winnipeg. *The Canadian Journal of Linguistics* 51(2). 127-41. https://doi.org/10.1353/cjl.2008.0022.

Hall-Lew, Lauren. 2009. Ethnicity and Phonetic Variation in a San Francisco Neighborhood. Stanford University Ph.D. dissertation.

Hammond, Michael. 1999. *The Phonology of English: A Prosodic Optimality-Theoretic Approach*. Oxford: Oxford University Press.

Hastie, Trevor J., and Robert Tibshirani. 1990. *Generalized Additive Models*. New York: Chapman and Hall.

Klassen, Doreen. 1981. Singing Mennonite: Low German Songs Among the Mennonites of Southern Manitoba. University of Manitoba Master's thesis.

Koffi, Ettien N. 2014. The Acoustic Vowel Space of Central Minnesota English: Focus on Female Vowels. *Linguistic Portfolios* 3(1). 1-16.

Labov, William. 2001. *Principles of Linguistic Change: Social Factors*. Malden MA: Blackwell.

Labov, William, Sharon Ash & Charles Boberg. 2006. *The Atlas of North American English: Phonetics, Phonology and Sound Change*. Berlin: Mouton de Gruyter.

Lobanov, Boris M. 1971. Classification of Russian Vowels Spoken by Different Speakers. *Journal of the Acoustical Society of America* 49(2). 606-8. https://doi.org/10.1121/1.1912396.

Lopez-Backstrom, Michel & Ettien Koffi. 2020. A Sociophonetic Account of the Similarities Between Northern Minnesota English and Winnipeg Canadian English. *Linguistic Portfolios* 9. 1-13.

Lüdecke, Daniel. 2021. sjPlot: Data Visualization for Statistics in Social Science [R package]. Version 2.8.7. https://CRAN.R-project.org/package=sjPlot (March 12, 2021).

Mais, Julia Kathleen. 2012. Behind the resume: influences on the educational and employment trajectories of 1.5 and second generation Filipino-Canadians in Vancouver. Toronto: York

University Master's thesis.

Malek, Jon G. 2019. The Pearl of the Prairies: The History of the Winnipeg Filipino Community. The University of Western Ontario Ph.D. dissertation.

Mellesmoen, Gloria. 2018. A Remedial Path to Merger: Merger by Phonological Transfer in British Columbia. *Toronto Working Papers in Linguistics* 40. 1-15. https://twpl.library.utoronto.ca/index.php/twpl/article/view/29162 (June 25, 2020).

Mielke, Jeff, Christopher Carignan & Erik R. Thomas. 2017. The articulatory dynamics of pre-velar and pre-nasal /æ/-raising in English: An ultrasound study. *The Journal of the Acoustical Society of America* 142(1). 332-349. https://doi.org/10.1121/1.4991348

Onosson, Sky. 2020. Ethnolinguistic Vowel Differentiation In Winnipeg, Canada. Poster presented at the Annual Meeting of the American Dialect Society, New Orleans, LA.

Onosson, Sky, Nicole Rosen & Lanlan Li. 2019. Ethnolinguistic Differentiation and the Canadian Shift. In Calhoun et al. 2019, 368-372.

Purnell, Thomas C. 2008. Prevelar raising and phonetic conditioning: Role of labial and anterior tongue gestures. *American Speech* 83(4). 373-402. https://doi.org/10.1215/00031283-2008-028

R Core Team. 2020. R: A Language and Environment for Statistical Computing [programming language]. Version v3.6.1. Vienna, Austria: R Foundation for Statistical Computing. https://www.r-project.org/ (June 25, 2020).

Reed, Carroll E. 1952. The Pronunciation of English in the State of Washington. *American Speech* 27(3). 186-189.

Reed, Carroll E. 1961. The Pronunciation of English in the Pacific Northwest. *Language* 37(4). 559-564.

Riebold, John M. (2015). The social distribution of a regional change: /æg, ɛg, eg/ in Washington state (University of Washington). Seattle, WA: University of Washington Ph.D. dissertation. http://hdl.handle.net/1773/33996.

Roeder, Rebecca, Sky Onosson & Alexandra D'Arcy. 2018. Joining the Western Region: Sociophonetic Shift in Victoria. *Journal of English Linguistics* 46(2). 87-112. https://doi.org/10.1177/0075424217753987.

Rosen, Nicole & Crystal Skriver. 2015. Vowel Patterning of Mormons in Southern Alberta, Canada. *Language and Communication* 42. 104-15. https://doi.org/10.1016/j.langcom.2014.12.007.

Rosenfelder, Ingrid, Josef Fruehwald, Keelan Evanini, Scott Seyfarth, Kyle Gorman, Hilary Prichard & Jiahong Yuan. 2014. FAVE (Forced Alignment and Vowel Extraction) [software application suite]. https://doi.org/10.5281/zenodo.22281.

Ryan, John. 2019. Hutterites in Canada. *The Canadian Encyclopedia*. 21 October 2019. https://www.thecanadianencyclopedia.ca/en/article/hutterites. (March 15, 2021).

Sawatzky, H. L. 1970. Viability of Ethnic Group Settlement, With Reference to Mennonites in Manitoba. *Canadian Ethnic Studies* 2(2). 147-160.

Sóskuthy, Márton. 2017. "Generalised Additive Mixed Models For Dynamic Analysis In Linguistics: A Practical Introduction." Working paper. http://eprints.whiterose.ac.uk/113858/ (June 25, 2020).

Stanley, Joseph A. 2021. Regional patterns in prevelar raising. *American Speech.* https://doi.org/10.1215/00031283-9308384.

Statistics Canada. 2011. Data products, 2011 Census. https://www12.statcan.gc.ca/census-recensement/2011/dp-pd/index-eng.cfm. (March 7, 2021).

Statistics Canada. 2016. Data products, 2016 Census. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/index-eng.cfm. (June 25, 2020).

Swan, Julia Thomas. 2016. Language Ideologies, Border Effects, and Dialectal Variation: Evidence from /æ/, /aʊ/ and /aɪ/. Chicago: University of Chicago PhD dissertation.

Swan, Julia Thomas & Kara Becker. 2021. Raising or Merger? Perceptual evidence for Bag-Beg-Bagel merger in Pacific Northwest English. Unpublished paper.

Tabain, Marija, Andrew Butcher, Gavan Breen & Richard Beare. 2020. A formant study of the alveolar versus retroflex contrast in three Central Australian languages: Stop, nasal, and lateral manners of articulation. *The Journal of the Acoustical Society of America,* 147(4). 2745-2765. https://doi.org/10.1121/10.0001012

Thomas, Charles Kenneth. 1947. *An Introduction to the Phonetics of American English*. New York: Ronald.

Tran, Thanh H. 2018. General extender use in southern Manitoban and Filipino-Winnipegger speech. Proceedings of the 2018 Annual Conference of the Canadian Linguistic Association. 1-13.

U.S. Census Bureau. 2021. Metropolitan and Micropolitan Statistical Areas Population Totals and Components of Change: 2010-2019. https://www.census.gov/data/tables/time-series/demo/popest/2010s-total-metro-and-micro-statistical-areas.html (June 8, 2021).

Wade, Lacey. 2017. The role of duration in the perception of vowel merger. *Laboratory Phonology,* 8(1):30. 1-34. https://doi.org/10.5334/labphon.54

Wassink, Alicia Beckford. 2015. Sociolinguistic Patterns in Seattle English. *Language Variation and Change* 27(1). 31-58. https://doi.org/10.1017/S0954394514000234.

Wassink, Alicia Beckford. 2016. The Vowels of Washington State. In Fridland et al., 2016.

Wassink, Alicia, & John Riebold. 2013. Individual Variation and Linguistic Innovation in the American Pacific Northwest. Paper presented at the Workshop on Sound Change Actuation (CLS 49), Chicago, April 18-20.

Wassink, Alicia Beckford, Robert Squizzero, Mike Scanlon, Rachel Schirra & Jeff Conn. 2009. Effects of style and gender on fronting and raising of /e/, /e:/ and /æ/ before /g/ in Seattle English. Paper presented at NWAV 38, Ottawa, ON.

Wickham et al. 2019. Welcome to the tidyverse. *Journal of Open Source Software* 4(43). 1686. https://doi.org/10.21105/joss.01686.

Wittenburg, Peter, Hennie Brugman, Albert Russel, Alex Klassmann, and Han Sloetjes. 2006. ELAN: A Professional Framework for Multimodality Research [Software application]. In *Proceedings of LREC 2006, Fifth International Conference on Language Resources and Evaluation*. Nijmegen, The Netherlands: Max Planck Institute for Psycholinguistics, The Language Archive.

Wood, Simon N. 2017. *Generalized Additive Models: An Introduction with R*. 2nd edn. Boca Raton: Taylor and Francis Group.

Zeller, Christine. 1997. The investigation of a sound change in progress: /ae/ to /e/ in midwestern american english. *Journal of English Linguistics* 25(2). 142-155. https://doi.org/10.1177/007542429702500207

TABLES

TABLE 2

Participant Demographics

Ethnicity or Ancestry	Gender		Birth year		
	Women	Men	Low	High	Median
European	11	8	1955	1999	1976
Filipino	8	9	1973	1995	1989
Mennonite	16	12	1962	1994	1983
All participants	$n = 35$	$n = 29$	1955	1999	1983

TABLE 2

Linear Mixed Effects Regression Models: VOWEL Formants by CODA Context

	/æ/ F1 (Hz)	**/æ/ F2 (Hz)**	**/ɛ/ F1 (Hz)**	**/ɛ/ F2 (Hz)**	**/e/ F1 (Hz)**	**/e/ F2 (Hz)**
Predictors	*Estimates*	*Estimates*	*Estimates*	*Estimates*	*Estimates*	*Estimates*
(Intercept)	865.59 ***	1679.51 ***	709.94 ***	1776.12 ***	565.91 ***	2165.51 ***
coda [k]	13.55 *	-2.20	32.97 ***	-3.54	-9.86 **	-2.03
coda [g]	-106.58 ***	186.81 ***	-43.17 ***	188.98 ***	-16.27 ***	19.54
coda [ŋ]	-139.84 ***	301.03 ***	-47.61	152.08		
gender [women]	12.41 *	-46.32 ***				
ethnicity [European]					5.45	26.81 *
ethnicity [Filipino]					-12.12 *	28.60 *
Random Effects						
σ^2	10129.18	41448.92	6713.60	40238.70	4521.28	40942.15
τ_{00}	1585.54 $_{word}$	7981.84 $_{word}$	1343.29 $_{word}$	11940.12 $_{word}$	936.05 $_{word}$	18791.32 $_{word}$
	386.84 $_{speaker}$	1793.78 $_{speaker}$	295.89 $_{speaker}$	1138.63 $_{speaker}$	259.26 $_{speaker}$	1596.70 $_{speaker}$
ICC	0.16	0.19	0.20	0.25	0.21	0.33
N	64 $_{speaker}$	64 $_{speaker}$	64 $_{speaker}$	64 $_{speaker}$	64 $_{speaker}$	64 $_{speaker}$
	823 $_{word}$	823 $_{word}$	736 $_{word}$	736 $_{word}$	747 $_{word}$	747 $_{word}$
Observations	23374	23374	9177	9177	12385	12385
Marginal R^2 / Conditional R^2	0.024 / 0.183	0.030 / 0.215	0.013 / 0.207	0.007 / 0.251	0.011 / 0.218	0.003 / 0.334

** p<0.05 ** p<0.01 *** p<0.001*

TABLE 3

Linear Mixed Effects Regressions: VOWEL Formants Within CODA Contexts

	F1 (Hz) before /g/	**F2 (Hz) before /g/**	**F1 (Hz) before /ŋ/**	**F2 (Hz) before /ŋ/**	**F1 (Hz) before /k/**	**F2 (Hz) before /k/**	**F1 (Hz) before [other]**	**F2 (Hz) before [other]**
Predictors	*Estimates*	*Estimates*	*Estimates*	*Estimates*	*Estimates*	*Estimates*	*Estimates*	*Estimates*
(Intercept)	605.79 ***	2014.17 ***	681.45 ***	1877.98 ***	589.10 ***	2121.07 ***	561.15 ***	2173.00 ***
vowel [ɛ]	65.85 ***	-53.57			173.04 ***	-349.11 ***	147.23 ***	-381.95 ***
vowel [æ]	134.32 ***	-128.64 **	67.81 *	48.13	306.32 ***	-469.64 ***	299.06 ***	-504.46 ***
gender [women]			-29.84 *		-6.24			-26.19 ***
age [younger]			-29.12 *	77.37 *	-16.63 ***			
ethnicity [European]					-27.34 **			
ethnicity [Filipino]					-13.08			
ethnicity [European] * gender [women]					28.44 *			
ethnicity [Filipino] * gender [women]					11.00			
Random Effects								
σ^2	4690.97	37903.70	5858.43	34018.73	6669.13	33879.08	8249.24	42998.49
τ_{00}	2197.49 word	6503.97 word	1079.60 word	33860.76 word	946.41 word	5900.92 word	1230.68 word	13882.79 word
	417.26 speaker	0.00 speaker	1067.26 speaker	3838.41 speaker	223.84 speaker	973.30 speaker	171.57 speaker	726.58 speaker
ICC	0.36		0.27	0.53	0.15	0.17	0.15	0.25
N	62 speaker	62 speaker	56 speaker	56 speaker	64 speaker	64 speaker	64 speaker	64 speaker
	73 word	73 word	64 word	64 word	422 word	422 word	1775 word	1775 word
Observations	418	418	253	253	4305	4305	39960	39960
Marginal R^2 / Conditional R^2	0.273 / 0.533	0.060 / NA	0.074 / 0.322	0.021 / 0.536	0.699 / 0.744	0.514 / 0.596	0.629 / 0.683	0.444 / 0.585

** p<0.05 ** p<0.01 *** p<0.001*

TABLE 4

Linear Mixed Effects Regressions: VOWEL Duration by CODA Context

	/æ/ duration (ms)	**/ɛ/ duration (ms)**	**/e/ duration (ms)**
Predictors	*Estimates*	*Estimates*	*Estimates*
(Intercept)	130.76 ***	93.07 ***	118.79 ***
coda [k]	-3.20	-8.23 *	-27.75 ***
coda [g]	-3.12	22.38 **	-30.11 ***
coda [ŋ]	-42.82 ***	-2.86	
gender [women]	15.98 ***	8.88 ***	14.08 ***
ethnicity [European]		-4.36	
ethnicity [Filipino]		-6.91 *	
Random Effects			
σ^2	6970.77	3484.99	4966.46
τ_{00}	449.67 $_{word}$	246.36 $_{word}$	822.58 $_{word}$
	207.41 $_{speaker}$	63.94 $_{speaker}$	161.91 $_{speaker}$
ICC	0.09	0.08	0.17
N	64 $_{speaker}$	64 $_{speaker}$	64 $_{speaker}$
	823 $_{word}$	736 $_{word}$	747 $_{word}$
Observations	23374	9177	12385
Marginal R^2 / Conditional R^2	0.011 / 0.096	0.010 / 0.091	0.023 / 0.184

** p<0.05 ** p<0.01 *** p<0.001*

TABLE 5

Linear Mixed Effects Regressions: VOWEL Durations Within CODA Contexts

	Duration (ms) before /g/	**Duration (ms) before /ŋ/**	**Duration (ms) before /k/**	**Duration (ms) before [other]**
Predictors	*Estimates*	*Estimates*	*Estimates*	*Estimates*
(Intercept)	141.44 ***	78.53 ***	132.69 ***	131.11 ***
vowel [e]	-25.65		-26.39 ***	-14.30 ***
vowel [ɛ]	-28.34 *	-3.83	-53.18 ***	-45.85 ***
gender [women]		35.80 **	11.91 ***	14.75 ***
Random Effects				
σ^2	3664.16	5585.39	2964.87	6053.24
τ_{00}	743.54 word	0.00 word	480.32 word	492.20 word
	158.79 speaker	235.80 speaker	142.67 speaker	144.10 speaker
ICC	0.20		0.17	0.10
N	62 speaker	56 speaker	64 speaker	64 speaker
	73 word	64 word	422 word	1775 word
Observations	418	253	4305	39960
Marginal R^2 / Conditional R^2	0.023 / 0.216	0.054 / NA	0.107 / 0.262	0.052 / 0.142

*$p<0.05$ **$p<0.01$ ***$p<0.001$

FIGURES

Note: The grayscale versions of the figures are directly converted from the colour originals.

Figure 1: Map of Selected Prevelar Raising Areas of North America

Figure 1: Map of Selected Prevelar Raising Areas of North America

Figure 2: The Manitoba Vowel Space

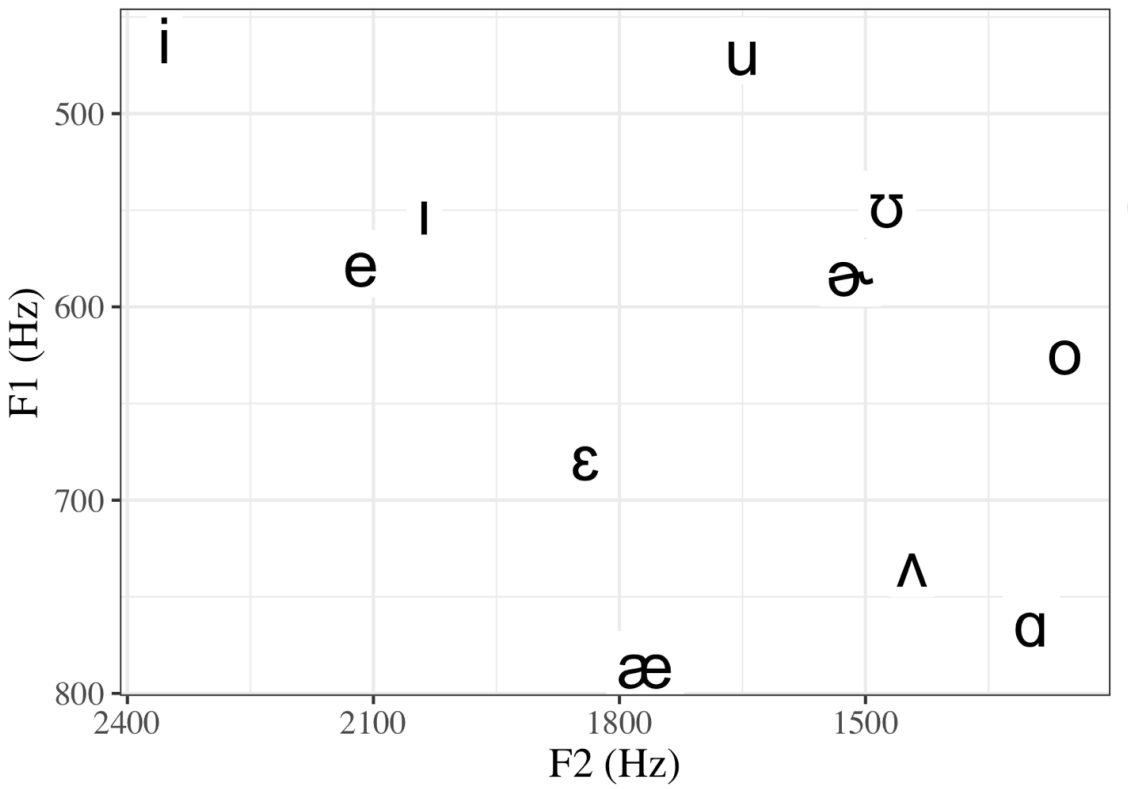

Figure 3: Vowel FORMANT Density Distributions Across CODA Contexts

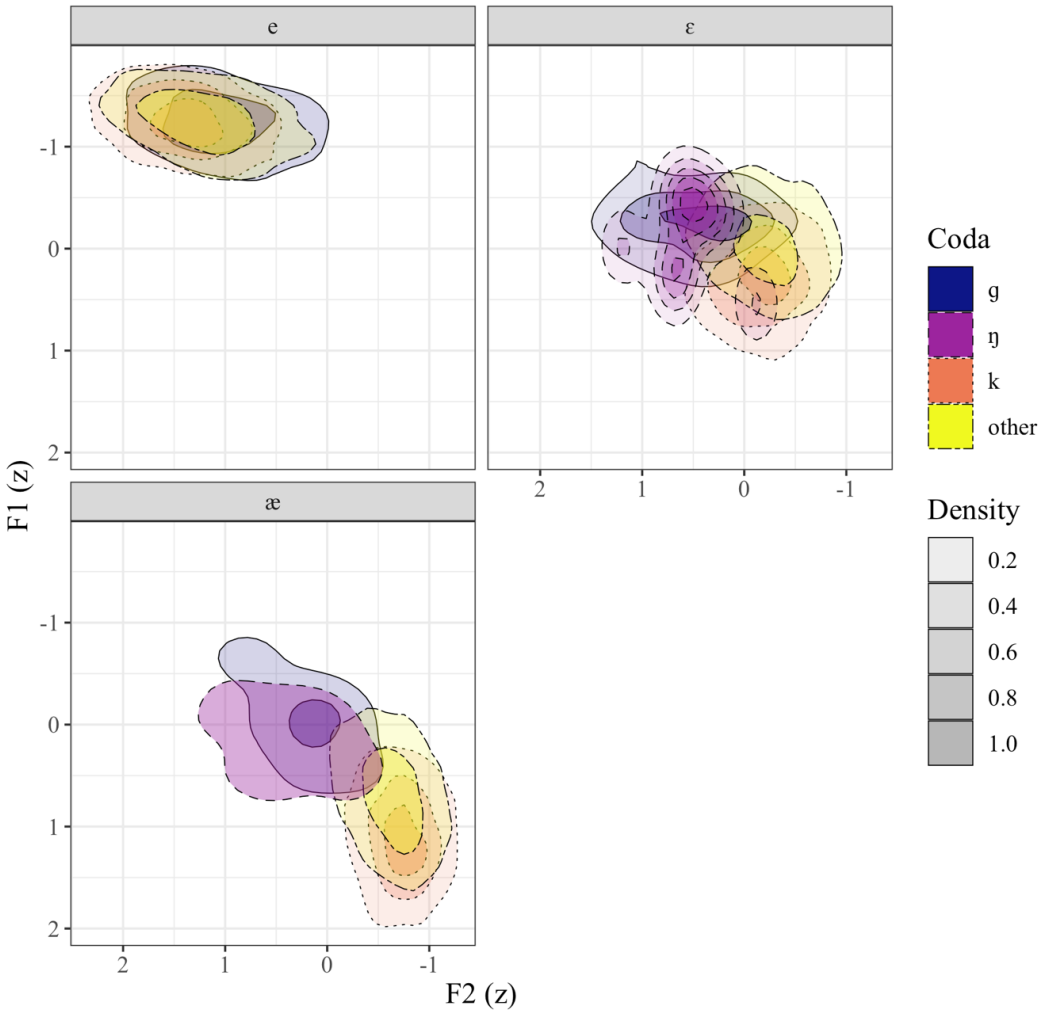

Figure 3: Vowel FORMANT Density Distributions Across CODA Contexts

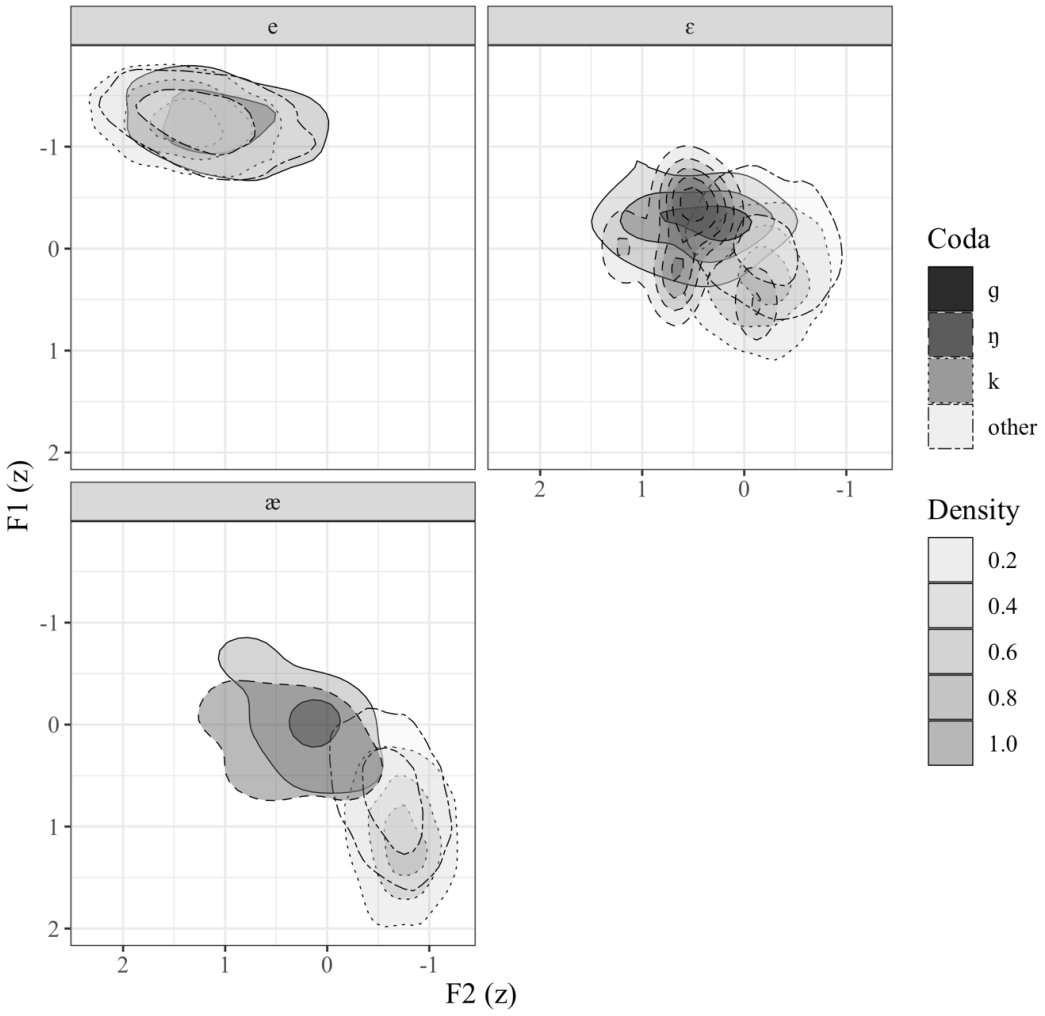

Figure 4: Vowel FORMANT Density Distributions Within CODA Contexts

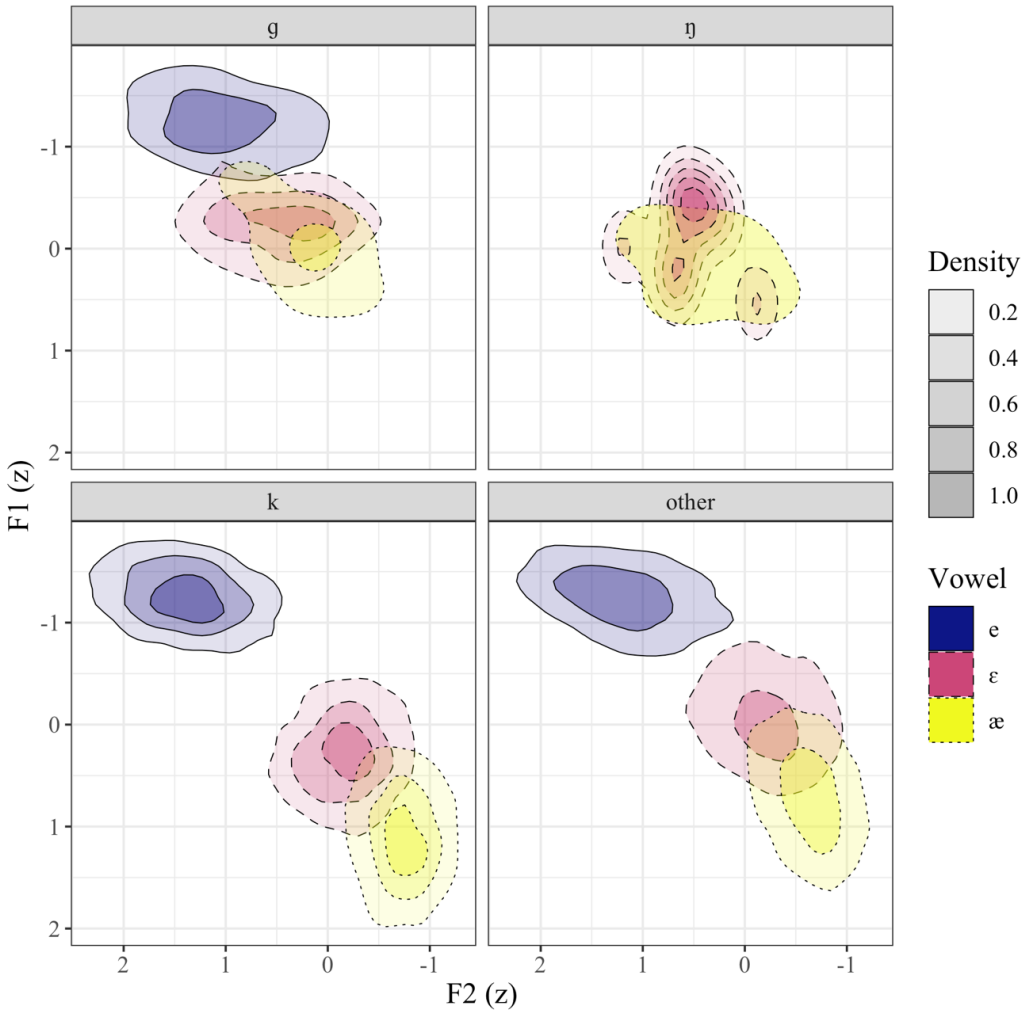

Figure 4: Vowel FORMANT Density Distributions Within CODA Contexts

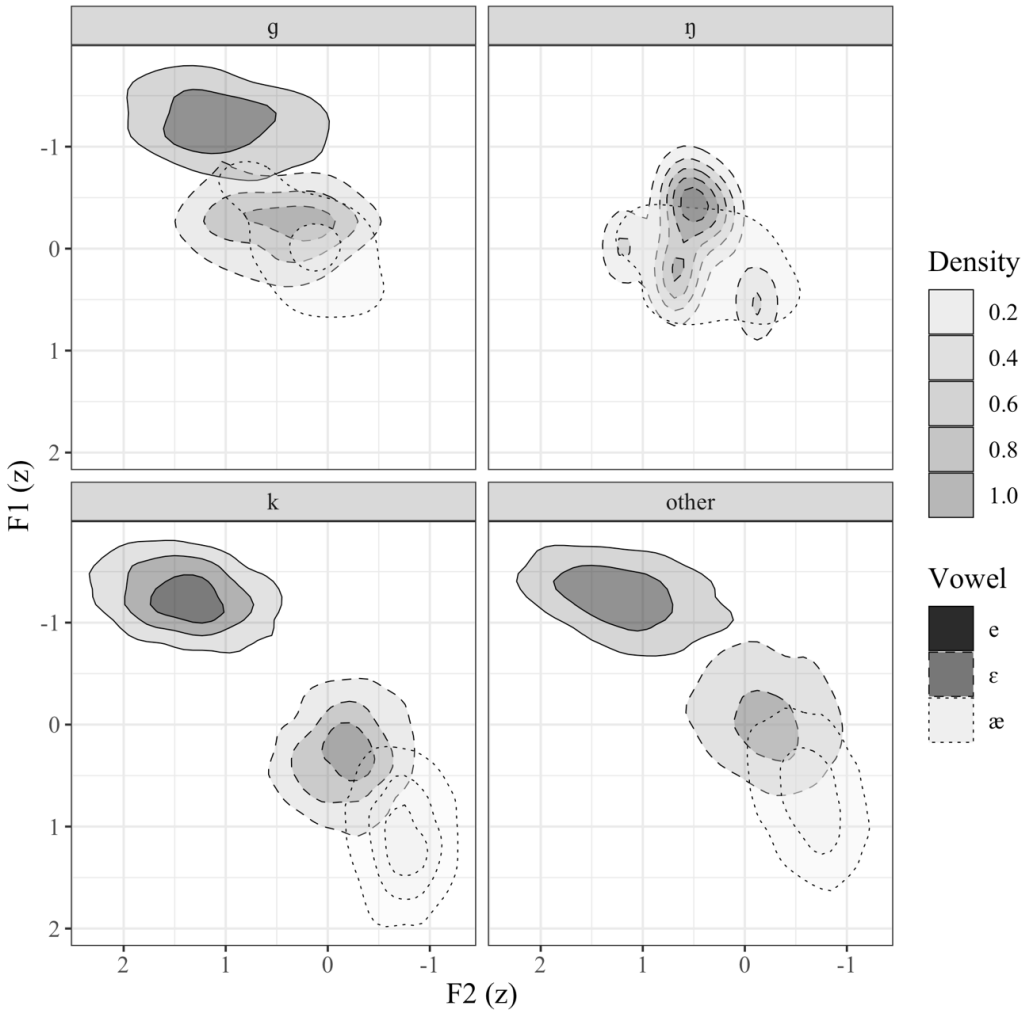

Figure 5: Vowel DURATION Distributions Within CODA Contexts

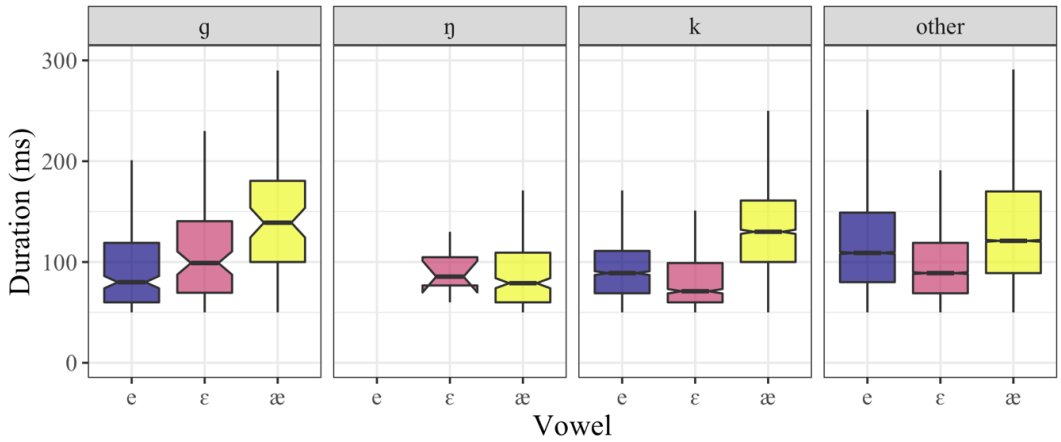

Figure 5: Vowel DURATION Distributions Within CODA Contexts

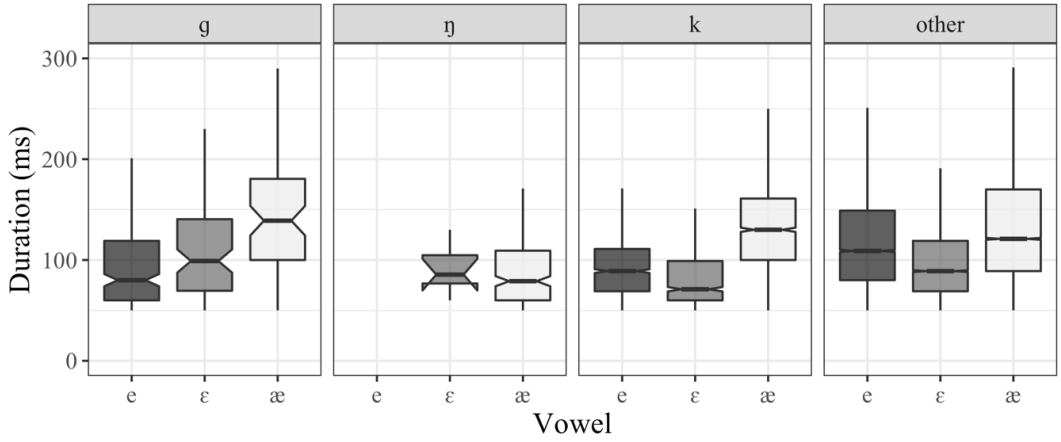

Figure 6: Vowel FORMANT Trajectories Within CODA Contexts

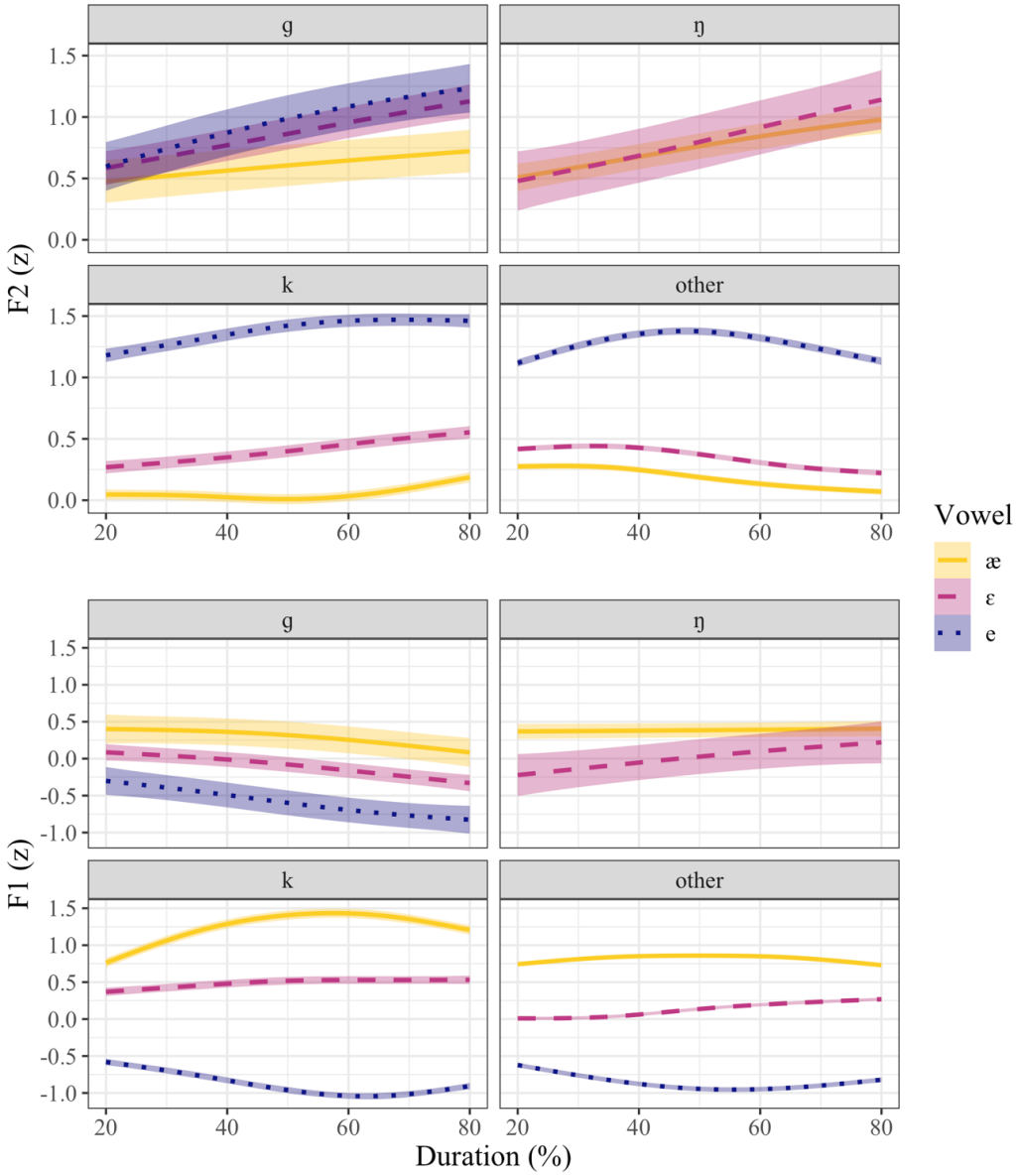

Figure 6: Vowel FORMANT Trajectories Within CODA Contexts

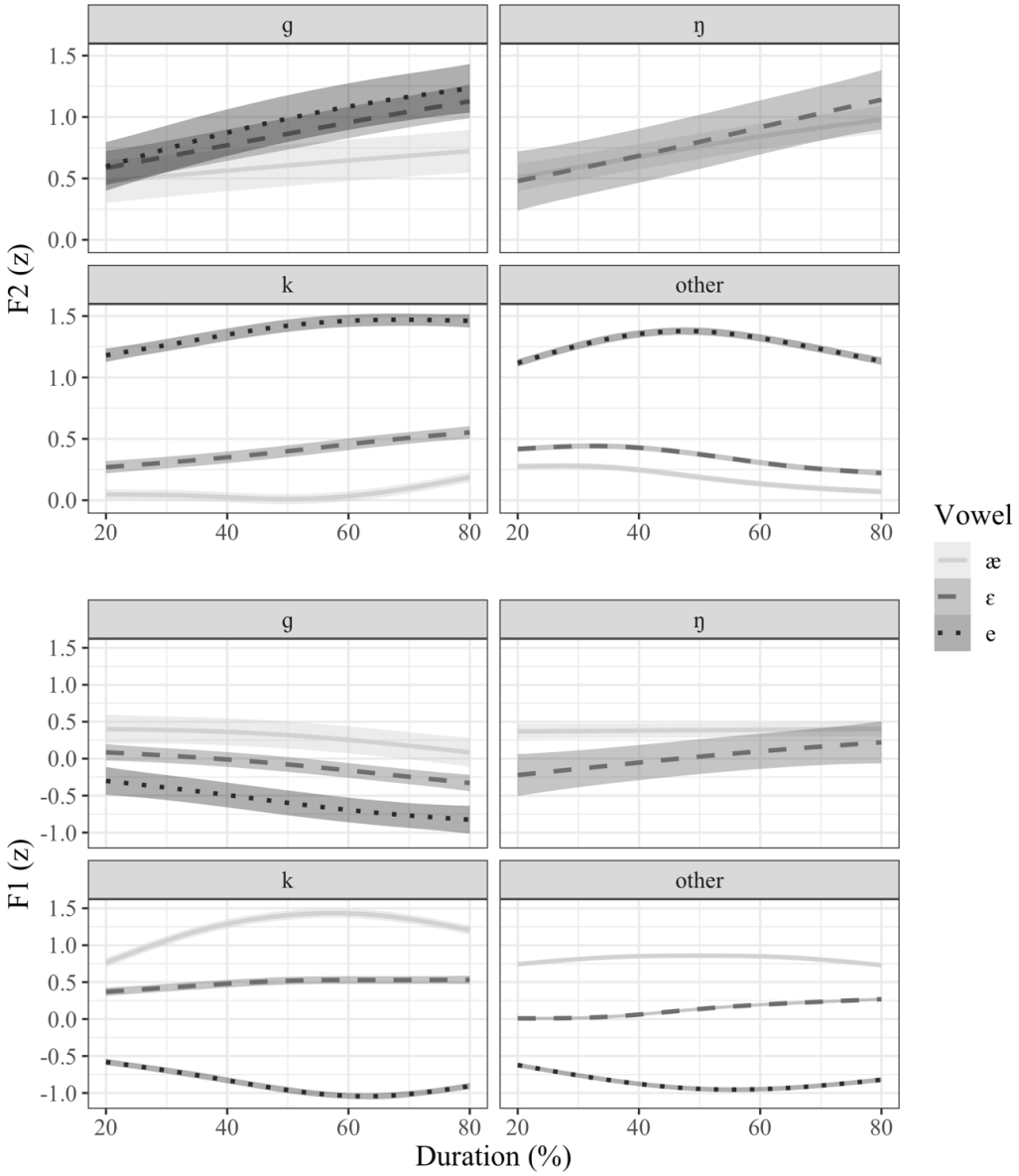

Figure 7: Vowel FORMANT Trajectories Across CODA Contexts

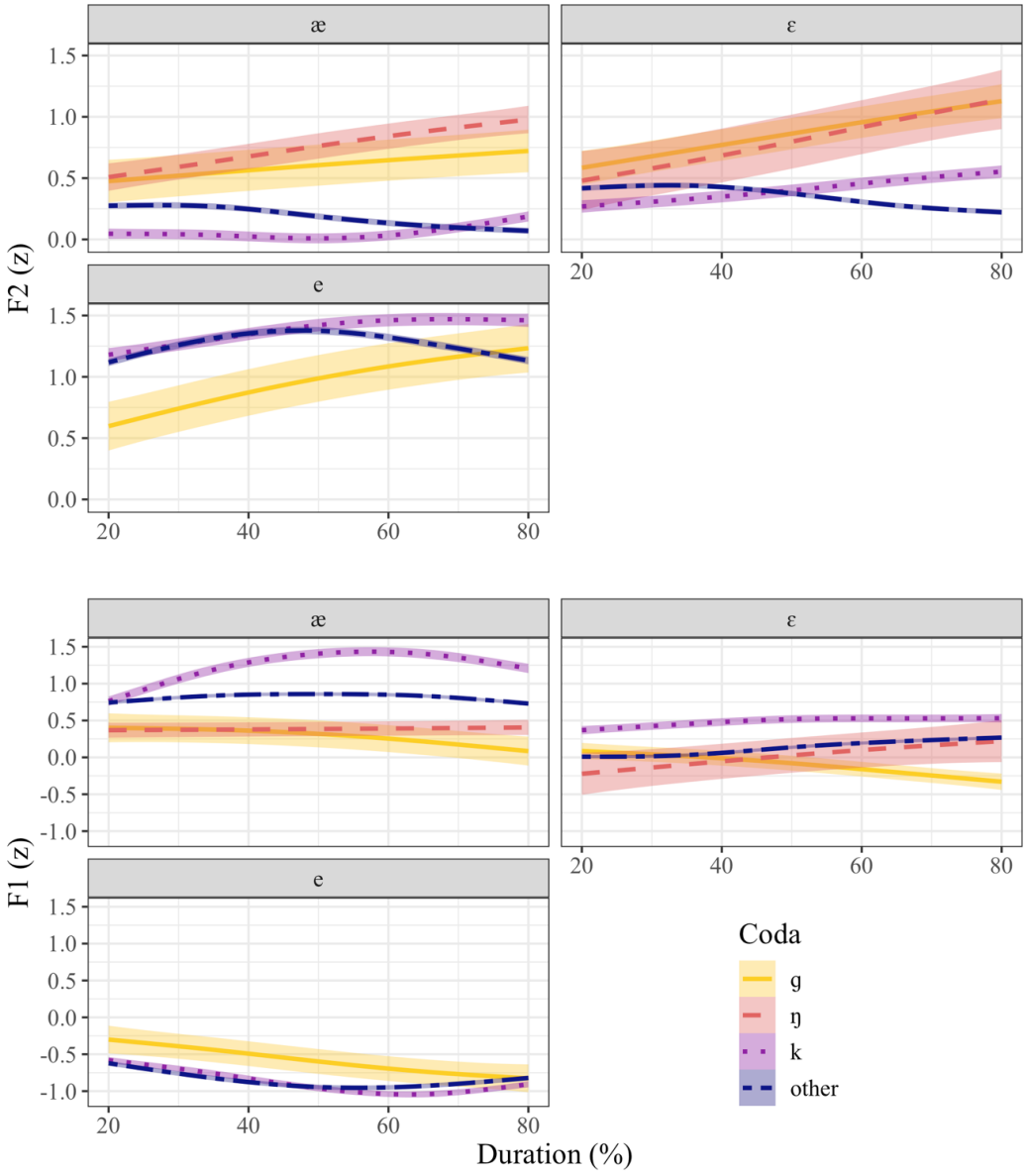

Figure 7: Vowel FORMANT Trajectories Across CODA Contexts