“WE HAVE SUCH A NORMAL, NON-ACCENTED VOICE”:

A SOCIOPHONETIC STUDY OF ENGLISH IN KANSAS CITY

A Dissertation

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Doctor of Philosophy

by

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

“WE HAVE SUCH A NORMAL, NON-ACCENTED VOICE”: A SOCIOPHONETIC STUDY OF ENGLISH IN KANSAS CITY

presented by Christopher Strelluf, a candidate for the degree of doctor of philosophy, and hereby certify that, in their opinion, it is worthy of acceptance.

Professor Matthew J. Gordon

Professor Vicki Carstens

Professor Claire Horisk

Professor Michael Marlo

For Shelley,

who makes fun of the way I say *hockey*,

and for William,

who should acquire his father's PIN-PEN merger,

and not his mother's slight distinction.

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A study like this depends completely on the kindness of strangers, who generously sacrifice their time and privacy for the benefit of a researcher engaged in a fairly esoteric project. The Kansas Citians whose speech is documented in this dissertation accommodated my research by missing work and giving up personal time. Interviewees invited me into their homes, found quiet spaces in their workplaces, and traveled throughout the Kansas City area to facilitate this project. Many, after being interviewed, helped recruit other interviewees. I am in debt to them for kindly sharing their time and their speech. Generally, in fact, most of my recruitment for this project was done by other people, and I am also grateful to the many Kansas Citians who were not interviewed for this research, but who helped facilitate contact with the friends, family, neighbors, coworkers, colleagues, and acquaintances. My dissertation was a dead end without those people.

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NOTES ON NOTATION

Through most of this research I use lexical sets based on Wells (1982) to refer to phonemes. These sets use keywords to represent vowel classes so that, for instance, FLEECE indicates the phoneme /i/ in words like *feet*, *meat*, *bean*, *believe*, etc. I use this notational set for accessibility—it gives linguists and non-linguists alike an immediate reference for the speech sounds under consideration in this research. This notational system also makes it very explicit when a token is being considered for its phonemic status versus its phonetic realization, in a way that might not be quite as clear with the conventional use of /i/ versus [i]. Lexical sets always point to phonemic status.

I have made some modifications to the sets in Wells (1982) for this research. First, based on patterns general to many American Englishes (and described as such in Wells 1982), I assume that several of his vowel classes are not present in Kansas City English. These include the BATH class, which I assume to be part of the TRAP class, and the CLOTH class, which I assume to be part of the THOUGHT class. Wells (1982) also recognizes the conditioning effect of following /r/ on vowels to create several subsets (e.g., FORCE is GOAT followed by /r/), and following this model I create several novel lexical sets to subset vowels in specific phonetic environments of interest. These include vowels with following /l/ (e.g., BOWL is GOAT followed by /l/) and vowels with following nasal consonants (e.g., PEN is DRESS followed by a nasal). I always print lexical sets in all-caps.

Table i lists lexical sets and their International Phonetic Alphabet (IPA) equivalents. It also lists the corresponding notations from the *Atlas of North American English* (*ANAE*) and in the machine-readable ARPABet used by the CMU Dictionary.

Table i. Correspondences among Lexical Sets, IPA, *ANAE*, and ARPABet Notation

Lexical Set	IPA	*ANAE*	ARPABet
FLEECE	i	iy	IY
KIT	ɪ	i	IH
FACE	eɪ	ey	EY
DRESS	ɛ	e	EH
TRAP	æ	æ/æh	AE
GOOSE	u	uw	UW
FOOT	ʊ	u	UH
GOAT	oʊ	ow	OW
THOUGHT	ɔ	oh	AO
LOT	ɑ	o	AA
STRUT	ʌ	ʌ	AH
PRICE	ɑɪ	ay	AY
MOUTH	ɑʊ	aw	AW
CHOICE	ɔɪ	oy	OY
PALM	ɑ	ah	
SQUARE	ɛɹ	ehr	
CURE	ʊɹ	uhr	
FORCE	oɹ	ohr	
NORTH	ɔɹ	ɔhr	
START	ɑɹ	ahr	
NURSE	ɝ	ʌhr	ER
POOL	ul	uwl	
BULL	ʊl	uhl	
BOWL	ol	owl	
HULL	ʌl		
PIN	ɪ+nasal consonant	iN	
PEN	ɛ+nasal consonant	eN	
PAN	æ+nasal consonant	æhN	

The term “Kansas City” may present some confusion, since it can refer to either one of two cities or the general metropolitan area I am researching. I use “Kansas City” to refer to metropolitan region. I use “KCMO” for the specific city of Kansas City, Missouri, the anchor city for area. I use “KCK” for Kansas City, Kansas, a smaller city on the Kansas side of the border. These labels are consistent with local usages. I use the US postal codes “MO” and “KS” as abbreviations for Missouri and Kansas.

Interviewees are referred to with pseudonyms. Where interviews from members of the same family are included in this study, each interviewee in the family is given a common last initial. For example, Peyton D and Elly D are brother and sister and their interviews are both included in this data, while Bethany is unrelated to any other interviewee. This is intended to allow exploration of family influence on language.

I frequently use linear models throughout this work. The outputs of these models can be used to estimate vowel measurements with the formula:

$$y = \text{coefficient} * x + \text{intercept}$$

The “intercept” and “coefficient” values are outputs of the linear models. In regressions that estimate vowel measurements for categories (e.g., for phonetic conditioning in Table 3.1), $x = 1$. In these cases, a vowel measurement in a given category can be calculated by adding the coefficient and intercept together. In regressions that compare two numerical vectors (e.g., formant values correlated with time in Table 3.11), entering a value for x will provide an estimated value for y. In these cases, a formant measurement can be calculated for a specified year (or for a formant measurement from a structurally related vowel, as in Table 4.4).

CHAPTER 1

KANSAS CITY AND ITS VOWELS

This dissertation is a study of English in Kansas City. Specifically, I focus on the vowel system of white Kansas Citians, and on exploring that system for change. I hope to characterize the way Kansas Citians produce their vowels and to identify differences in production that may be a result of diachronic changes or of social factors like gender and socioeconomic class.

The language of Kansas City has previously been the central focus of one major study, Lusk (1976), and has been of interest to a few other projects (e.g., Gordon 2006a, 2009, 2010; Ash 2006; Labov, Ash & Boberg 2006). My study seeks to test and update findings in those works. Below the surface of this chronicling of the dialect of Kansas City, I hope that my study might also inform more general knowledge of language variation and change.

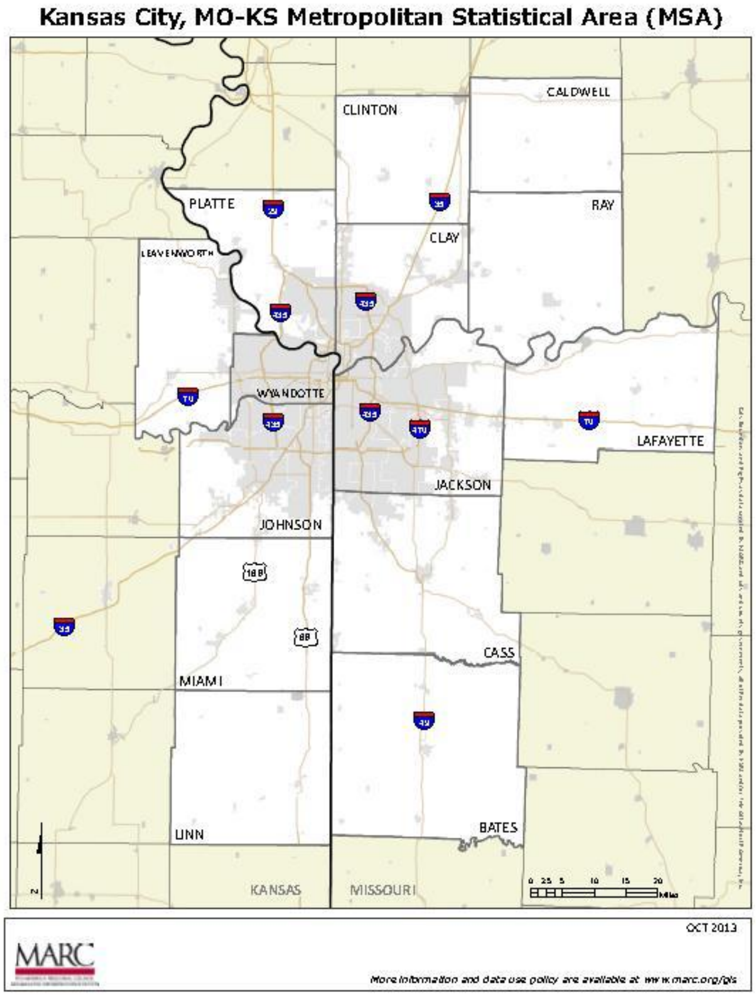
In this chapter, I'll introduce the study of language in Kansas City by very briefly describing Kansas City's emergence from western outpost to mid-American metropolis. I'll then discuss some general principles of theoretical interest and importance for the study of language change to emerge from recent work in American sociolinguistics and dialectology. I'll conclude with an overview of previous research on language in Kansas City that will drive my particular concentrations.

1.1. Kansas City

Kansas City is a large metropolitan area that spans the western border of Missouri and eastern border of Kansas at a point roughly in the center of the continental United

States. The US Census estimates the 2013 population of the Kansas City Metropolitan Statistical Area (MSA) at 2,054,473 (US Census, *Annual Estimates* 2013). As of 2013, the MSA consisted of fourteen counties—nine in Missouri and five in Kansas—spread over 7,857 square miles (US Census 2014). Figure 1.1 shows the counties included in the Kansas City MSA by the US Census Bureau, as mapped by the Mid-America Regional Council. The gray regions of the map represent urbanized areas.

Figure 1.1. Counties within the Kansas City MSA



(Image courtesy of Mid-America Regional Council)

Given the city’s name, outsiders are usually surprised to learn that the urban core of Kansas City is in Missouri. The tiny settlement that was chartered as the City of Kansas in 1853 predated the entry of the state of Kansas into the union. Its name was indicative of its position on the westernmost edge of the United States, beyond which was the Kansas territory and the start of the “Great American Desert” (Brown & Dorsett 1978:3). The City of Kansas was positioned on the south bank of the Missouri River, at the bend where the river’s course changes from east-west to north-south. The river provided a connection for traffic from St. Louis on the eastern Missouri border, and made it a potential embarkation point for traders who wanted to capitalize on markets made available by the Louisiana Purchase. The first white settlement in Kansas City was Fort Osage (in present-day Independence, MO), completed in 1808, the primary purpose of which was to facilitate fur trade between the US Government and the Osage Indians (Schirmer & McKinzie 1982:11-13). This was followed in 1821 by Francois Chouteau’s (French-speaking) settlement near present-day downtown Kansas City, Missouri (KCMO), established to provide an outpost for the Great American Fur Company’s trappers and traders (Schirmer & McKinzie 1982:13-14).

Soon after, larger waves of settlers began following the Missouri River to Kansas City. As of 1840, most settlers in the area had come from Kentucky, Tennessee, Virginia, and North Carolina. Schirmer and McKinzie (1982:18) speculate that these settlers stopped in Kansas City because its hilly, wooded terrain was reminiscent of the areas where the settlers had come from, unlike the grass prairies downriver and to the west. Many of these settlers were farmers, but others capitalized on the commercial possibilities afforded by Kansas City’s location. Overland trade had been established with

Mexico in the 1820s, and towns like Independence, MO (and later Westport—now a neighborhood in KCMO) built themselves on outfitting traders for the 1,500-mile trip on the Santa Fe Trail (Brown & Dorsett 1978:5-6). (Today's neighborhood names in south KCMO, like the Santa Fe Hills neighborhood, occasionally reflect the jockeying of early settlements to position themselves as the last outpost before entering the frontier [Morton 2012]). With the opening of the Northwest Territory to trade and settlement in the 1830s and 1840s and the California Gold Rush in the 1840s and 1850s, the Kansas City area further expanded its hold on equipping pioneers. At its peak in the 1840s, $3 million in trade passed through Independence annually and nearly all of the 12,000 US settlers who had gone to the Oregon Territory had been outfitted in Independence (Schirmer & McKinzie 1982:23-25).

These commercial motivations also drew influence to Kansas City from outside the South Midland areas that had initially dominated the area's settlement. This was especially true in KCMO, which was incorporated primarily as a commercial venture by the business owners in Westport (Brown & Dorsett 1978:6). To break the cycle of successive westernmost settlements replacing previous westernmost settlements as commercial centers (the process by which Westport had wrested business from Independence), in the years surrounding the Civil War KCMO's founders focused on bringing capital investment from the northeast United States to Kansas City. Despite the city's South Midland origins, by the 1850s in KCMO, "Southern, pro-slavery 'easterners' were no longer well received as they brought no money" (Brown & Dorsett 1978:21).

An important point of interaction in this goal to orient economic ties away from the South was that, after 1850, increasingly large numbers of migrants came to Kansas

City from northern and Midwestern states (Schirmer & McKinzie 1982:31). Many of these settlers were motivated to help establish the new territory of Kansas as a free state. The northerners were hated in many parts of the Kansas City area—as evidenced by the brutal border war that took place between Missouri and Kansas prior to the Civil War, culminating in Quantrill's raid on Lawrence, KS, which resulted in the city's destruction and the murder of most of its male inhabitants (Brown & Dorsett 1978:29-30). But Westport and KCMO remained agonistic about slavery and the Civil War and generally operated in whatever manner best kept open trade routes and best encouraged eastern investment. In 1863, for instance, Robert Van Horn was elected mayor of KCMO over a pro-secessionist candidate, which prompted the pro-Confederate Missouri state government to strip all municipal powers from the city. In response, the Mayor traveled across the state to receive a Union commission, and then organized a force in KCMO on behalf of the Union to quell Confederate sympathizers inside city limits (Brown & Dorsett 1978:26). Subsequently, a number of other KCMO founders received Union commissions and used their forces to guard routes into the city from Independence, MO, at least in part so that KCMO could stay open for business (Brown & Dorsett 1978:26).

While this depiction is at once an extreme reduction of the brutal experience of Kansas Citians during the Civil War and something of a cynical portrait of KCMO's motivations during it, it provides potentially important notes on the cultural development of Kansas City. Under the doctrine of first effective settlement (e.g., Zelinsky 1992), which suggests that the first population to establish a strong cultural presence in an area sets the cultural norms and practices of the area for future settlers, the initial dominance of South Midland settlers would have had an extremely large influence on establishing the linguistic and cultural norms of the region. However, the large influx of settlers from more northern areas and the interaction with them, especially in the city that grew to dominate the region, would potentially create an adstratal relationship that would influence and shape language and culture in the area.

An especially important subtext in Kansas City's negotiation of North and South was the desire to convince railroads headquartered in Boston and Philadelphia to bring routes through Kansas City rather than through the larger towns of St. Joseph, MO and Leavenworth, KS (Brown & Dorsett 1978:11). To do so, KCMO's founders formed a series of imaginary railroad companies and filed plans for imaginary lines and bridges to show that the area was about to become a hub of railroad traffic (Brown & Dorsett 1978:31). These plans convinced the real railroads to build real routes through Kansas City. As a result of these efforts and despite the Civil War, the Pacific Railroad of Missouri terminated in KCMO in 1865 and the Hannibal Bridge connected the city across the Missouri River with lines to the north in 1869 (Brown & Dorsett 1978:33).

The new opportunities created by the connections increased and diversified immigration into the city and region. By 1870, about one-quarter of KCMO's population was foreign-born, with the largest contingents coming from Ireland and Germany (Brown & Dorsett 1978:41). The largest numbers of migrants from within the United States to Kansas City now came from the old Northwest Territory (e.g., Illinois, Indiana, and Ohio), and there was dramatic growth in migrations from New York, New Jersey, Pennsylvania, and Delaware (Brown & Dorsett 1978:41; see also Lance & Faries 1997). South Midlanders continued to move to Kansas City at roughly pre-Civil War rates—larger numbers were likely discouraged by the draconian "internal Reconstruction" policies against ex-confederates set in place by Missouri's post-Civil War Radical Republican Government (Parrish 1973\2002). Between 1870 and 1881, Kansas City also began receiving large influxes of people who had actually been born in Missouri (Brown & Dorsett 1978:41). The African American population of KCMO also grew from 11.6 percent to 14.5 percent during this time (Brown & Dorsett 1978:41).

In short, because of Kansas City's physical location and commercial goals—most particularly those of KCMO—the cultural and linguistic composition of the city became increasingly complex through the very early years of the area's development. This accompanied a period meteoric growth. Table 1.1 shows census estimates for KCMO each ten years from KCMO's chartering to 2010.

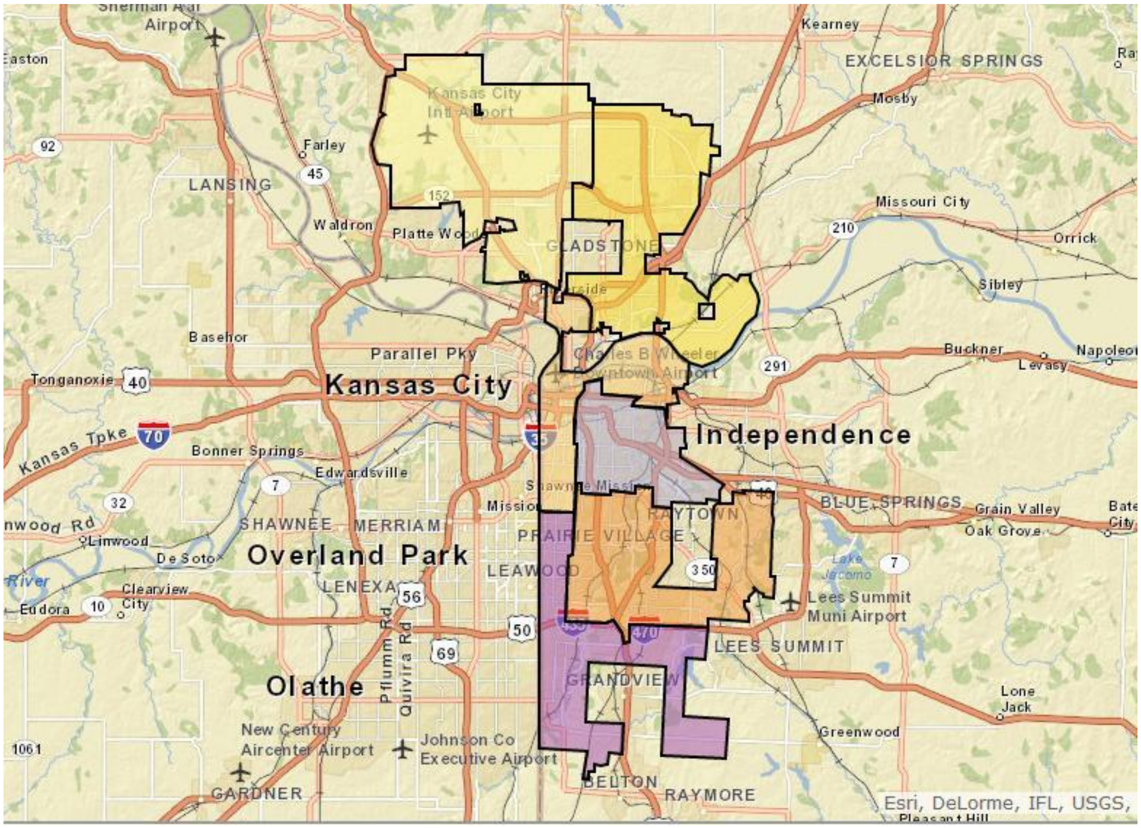
Table 1.1. Census estimates for the population of KCMO

Census	Population	National Rank
1860	~4,400	NA
1870	32,268	38
1880	55,785	30
1890	132,716	24
1900	163,752	22
1910	248,381	20
1920	324,410	19
1930	399,746	19
1940	399,178	19
1950	456,622	20
1960	475,539	27
1970	507,087	26
1980	448,159	27
1990	435,146	31
2000	441,545	36
2010	459,787	37

In these estimates, the 1860 population count is from Parrish, Foley, and McCandless (2000:134); Brown & Dorsett (1978:36) note that the 1870 census is probably nearer to 25,000, because city officials egregiously padded numbers; all other data compiled from Gibson (2012). During the first half of the twentieth century, the population of KCMO continued to grow and shift. Italians, who had made up just 1 percent of foreign-born Kansas Citians in 1900 became the largest foreign-born group by 1920 (Brown & Dorsett 1978:185). The Russian-Jewish community also grew (Brown & Dorsett 1978:187). At the same time, overall the proportion of foreign-born immigrants declined relative to the numbers of people born in KCMO or immigrating from within the United States. The Depression, in particular, brought many people from rural areas in Missouri and Kansas to Kansas City to seek better job opportunities, as did the years immediately after World War Two (Shortridge 2012). Indeed, many of the people I spoke to for this study described earlier generations in their families coming to Kansas City during these periods.

Census figures show a sharp drop off in population between 1970 and 1980. This reflects important shifts in Kansas City and more generally in the United States, as white people overwhelmingly moved out of large cities and into suburbs. In fact, the population growth observed from 1940 to 1970 is misleading, because during this period KCMO enacted an aggressive plan to annex unincorporated regions of Kansas City. Between 1940 and 1960, KCMO expanded from sixty square miles to nearly 130 square miles (Brown & Dorsett 1978:251), and today KCMO sprawls across 315 square miles (US Census, *State & County QuickFacts* 2013). (By contrast, New York City, with eighteen times KCMO's population, is 303 square miles.) Figure 1.2 shows the city council districts of KCMO, and illustrates the vast spread of the city across the region.

Figure 1.2. Map of KCMO in 2014



(Map courtesy of the City of Kansas City, MO)

North to south, KCMO today stretches nearly forty miles. It has expanded from its original position tucked into the northwest corner of Jackson County into three additional counties: Clay, Platte, and Cass. An interesting consequence is that many Kansas City suburbs are now surrounded by KCMO. This creates some geographical confusion. For instance, the small enclave just north of the Missouri River from downtown KCMO is North Kansas City. The area of KCMO itself that is north of the river and surrounds North Kansas City is referred to as “Kansas City, North.” The entire region north of the river (including both North Kansas City and Kansas City, North) is "the Northland." And for good measure, Northeast Kansas City is a neighborhood south of the river between KCMO and Independence.

KCMO's expansion was a response to the flight of white people into the suburbs. In other words, as white people moved out to the suburbs, KCMO expanded into all unincorporated space so that the suburbs could not expand to take in more of KCMO's people. This was, in part, intended to maintain tax revenue levels. Brown and Dorsett (1978:251) evaluate the strategy positively:

> The economic advantages to Kansas City of its program of ambitious physical expansion are obvious enough when compared with other American cities where tax receipts have been falling as residential developments outside their limits have been growing.

With a longer view, KCMO's expansion is not quite so easy to evaluate. In a practical sense, while the population by 2010 had recovered to 1950 levels, that population is spread over a much larger area across which the city must provide services. This has consequences both in terms of cost as well as in terms of the dispersion of services. An intermediary who helped me arrange interviews (see Chapter 2) complained of Kansas City being "Los Angeles with snow" because the professional sports stadiums, airport, and other attractions are located far away from downtown. As a result, there are few activities to draw locals to downtown.

In a more qualitative sense, annexation generated a great amount of resentment, especially in the Northland. One older interviewee whose data is not included in this study was very particular in indicating that she was from North Kansas City and not Kansas City, North. She told a story of the mayors of KCMO and North Kansas City having lunch, of the mayor of North Kansas City sharing his city's plans to annex areas in the Northland, and of the mayor of KCMO sneaking away to surreptitiously annex the areas first. While the story must be apocryphal, it is true that KCMO kept its annexation plans in the Northland secret and then was eventually caught in a four-year court battle with North Kansas City over the issue (Brown & Dorsett 1978:246-249). Another older interviewee, Molly, described the Northland as "God's country" and indicated that she had grown up in North Kansas City and Riverside, MO. She later grudgingly admitted that her addresses had actually been in KCMO, but made it clear that she identified with the Northland and not KCMO. Interestingly, such resentment appears to have faded among younger Kansas Citians. Danielle and Maya, for instance, are younger interviewees who grew up in Kansas City, North. They were both very particular about indicating that they were from KCMO and not North Kansas City—in other words, expressing an opposite disposition toward KCMO from the older interviewees.

Probably more important, though, is that the annexation policy could not account for the distances to which white Kansas Citians were willing to go to avoid living in KCMO. The suburbs on the Kansas side of State Line Road have been major beneficiaries of this trend, particularly Overland Park, KS, Olathe, KS, and other suburbs in Johnson County, KS. Table 1.2 shows changes in the population of the counties in the Kansas City MSA. Data is divided into one table for Missouri counties and one for Kansas counties. Light gray shading shows the census periods in which counties were included in the Kansas City MSA.

Table 1.2. Kansas City MSA Census Counts by County, 1830-2010

Census	Missouri Counties									
	Bates	Caldwell	Cass	Clay	Clinton	Jackson	Lafayette	Platte	Ray	Total
1940	19,531	11,629	19,534	30,417	13,261	477,828	27,856	13,862	18,584	632,502
1950	17,534	9,929	19,325	45,221	11,726	541,035	25,272	14,973	15,932	700,947
1960	15,905	8,830	29,702	87,474	11,588	622,732	25,274	23,350	16,075	840,930
1970	15,468	8,351	39,448	123,322	12,462	654,558	26,626	32,081	17,599	929,915
1980	15,873	8,660	51,029	136,488	15,916	629,266	29,925	46,341	21,378	954,876
1990	15,025	8,380	63,808	153,411	16,595	633,232	31,107	57,867	21,971	1,001,396
2000	16,653	8,969	82,092	184,006	18,979	654,880	32,960	73,781	23,354	1,095,674
2010	17,049	9,424	99,478	221,939	20,743	674,158	33,381	89,322	23,494	1,188,988

Census	Kansas Counties						
	Franklin	Johnson	Leavenworth	Linn	Miami	Wyandotte	Total
1940	20,889	33,327	41,112	11,969	19,489	145,071	271,857
1950	19,928	62,783	42,361	10,053	19,698	165,318	320,141
1960	19,548	143,792	48,524	8,274	19,884	185,495	425,517
1970	20,007	220,073	53,340	7,770	19,254	186,845	507,289
1980	22,062	270,269	54,809	8,234	21,618	172,335	549,327
1990	21,994	355,021	64,371	8,254	23,466	162,026	635,132
2000	24,784	451,086	68,691	9,570	28,351	157,882	740,364
2010	25,992	544,179	76,227	9,656	32,787	157,505	846,346

The most relevant comparison is between Jackson County, MO and Johnson County, KS. Since World War Two, the latter has expanded by 481,396 people. Much of this population is concentrated in Overland Park, estimated at 173,362 in 2010, and Olathe, at 125,872 (US Census, *State & County QuickFacts* 2013). Each suburb contains more than twice as many people as the entire county held in 1950. Jackson County has grown by 133,123 over the same period, but more than half that growth occurred between 1950 and 1960. Since then, growth in Jackson County has been concentrated to suburbs like Lee’s Summit, at 91,391 in 2010, and Blue Springs, at 52,580. Kansas City, Kansas (KCK), which takes up most of Wyandotte County and has a downtown that abuts downtown KCMO, has experienced a similar exodus away from the urban core, shown by declining county populations in each census since 1970.

A central social issue underlying these population shifts away from the core city and into the suburbs is the history of racism in Kansas City. In the early history of KCMO, poor African Americans, Irish, and Italians lived in a slum area between the Missouri River and the river bluffs known as “Hell’s Half Acre” (today’s West Bottoms). From 1890 to 1900, African Americans began moving northeast, and generally settled in an area just east of Troost Avenue (Brown & Dorsett 1978:185). As the African American population expanded, it pushed south and east—often in the face of bombings and other attacks from white residents (Brown & Dorsett 1978:185). At the same time, as the African American community expanded south, whites moved even farther south. The real estate mogul J.C. Nichols began buying and developing land in the areas that are now know as Midtown and South Kansas City in KCMO, and catered these developments to white middle class and upper class buyers. His strategies included establishing the first home associations in the United States, which expressly forbade African Americans from moving into neighborhoods (Brown & Dorsett 1978:170-175; Worley 1990). His developments all took place on the west side of Troost.

Over time, Troost became the de facto border between whites and African Americans in KCMO. As the city provided few services to African Americans and their access to jobs and education was limited, the area declined. Moreover, with Federal enforcement of desegregation laws, many middle class and upper class African Americans eventually joined the exodus out of areas east of Troost, leaving only the poorest of the community there (Bryce 2013). When schools were formally desegregated, the (all-white) KCMO school board set Troost as the boundary for school attendance, with the feeder populations of all schools being determined by whether children lived east or west of Troost (O’Higgins 2014). Today, Troost remains a stark racial and socioeconomic dividing line in Kansas City. (Kansas City Public Radio’s ongoing series *Beyond our Borders*, available at http://kcur.org/topic/beyond-our-borders, explores current efforts to remove the community barrier created by Troost.)

More broadly, as is the case in many large American cities, the division between whites and African Americans that started in the core city has expanded to generally reflect a division between suburban and urban areas. Table 1.3 lists the estimated 2012 populations of the ten largest cities in the Kansas City MSA, and the racial composition, median per capita income, and poverty level of each.

Table 1.3. Select demographics for the ten largest cities in the Kansas City MSA

City	Population	Percent White	Percent African American	Percent Latino	Percent Asian	Percent Foreign-born	Per capita income	Percent below poverty
KCMO	464,310	54.9	29.9	10.0%	2.5	7.6	$26,806	18.8
Overland Park, KS	178,919	80.8	4.3	6.3%	6.3	10.1	$39,985	5.8
KCK	147,268	40.2	26.8	27.8%	2.7	14.6	$18,771	24.5
Olathe, KS	130,045	77.7	5.3	10.2%	4.1	10.0	$31,623	7.1
Independence, MO	117,270	82.2	5.6	7.7%	1.0	4.7	$23,238	16.1
Lee’s Summit, MO	92,468	83.7	8.4	3.9%	1.7	3.4	$34,358	6.9
Shawnee, KS	63,622	81.8	5.3	7.5%	3.0	6.8	$33,389	6.8
Blue Springs, MO	53,014	84.6	6.2	5.0%	1.2	2.1	$28,457	8.8
Lenexa, KS	49,398	80.6	5.8	7.3%	3.8	8.8	$36,906	8.1
Leavenworth, KS	35,816	70.6	15.1	8.1%	1.8	4.6	$24,162	12.8

(Compiled from US Census, *State & County QuickFacts* 2013)

This small set of city demographics shows the dramatically higher proportion of African Americans relative to whites in KCMO and KCK. It also shows the relatively high poverty levels in KCMO and KCK, especially compared with suburbs besides

Independence and Leavenworth, and relatively low per capita income levels in the urban center. In short, population changes in Kansas City reflect broad national trends of the last half of the twentieth century, which have caused many large cities to be divided between relatively poor, primarily African American urban cores, and relatively affluent, primarily white suburbs. In Kansas City, streets, city limits, county lines, and state borders form sharp social and economic barriers that have tremendous bearing on people's interactions and experiences.

Long-term socioeconomic issues, then, continue to shape the cultural and physical geography of Kansas City. Its history shows a rapid influx of diverse linguistic and social backgrounds, which have interacted (and continue to interact) across a complex range of pathways and barriers. These create many potential points of influence on the sociolinguistics of English in Kansas City.

Influences on language and culture in Kansas City, of course, continue to shift. From 1994 to 2004, Kansas City had a net in-flow of more than 54,000 people from outside the MSA (MARC Research Services 2004). Kansas City drew strongly from all areas of western Missouri and eastern Kansas, as well as from St. Louis, Chicago, Denver, and southern California. Kansas City also sent emigrants to the Ozarks in Missouri, and to places farther west including Denver, Dallas, Phoenix, and southern California. Within the metropolitan area during that period, Jackson County shed 35,065 residents to other Kansas City counties and Wyandotte shed 18,988. Suburban Cass, Johnson, and Clay Counties were the primary beneficiaries of this MSA-internal migration.

Even more recently, attitudes toward and experiences of KCMO itself may be changing. In the last decade, KCMO has engaged in a series of efforts to re-energize its downtown core. These have included public efforts, like the development of the Power and Light Entertainment District downtown, as well as private ones, like the emergence of the Crossroads Art District downtown. A new arena, the Sprint Center, opened in 2007, and a new performing arts center, the Kauffman Center, opened in 2011. At the time of this writing, construction has just begun on a downtown streetcar line, and ground has been broken on a twenty-five story luxury apartment tower, the first residential high-rise to be built downtown in forty years (Paul 2014). The long-term consequences of these efforts will not likely be clear for many years. But they may suggest social and cultural currents affecting Kansas Citians today, and may in the future be looked at as having provided the impetus for the new evolutions of life and language in Kansas City.

1.2. Studying Language Change

In this section I turn from the specific case of Kansas City, and more broadly to issues of general theoretical interest in examining a dialect for change. In the United States, non-linguists are often surprised to learn that American Englishes are becoming more different from one another than they have been previously. This violates the common-sense belief that, because Americans watch the same shows on television and travel to many of the same places, dialect differences should be disappearing (e.g., Labov 2012a). Nevertheless, while it is true that many highly localized dialects are disappearing, the North America-wide pattern is that large regions are coalescing into patterns of change that often increase the relative differences in dialects (see, most prominently, Labov, Ash & Boberg's 2006 *Atlas of North American English* [*ANAE*]). In particular, many of the most salient and systematic changes are occurring in the vowel systems of speakers in these regions. For example, in the region that *ANAE* identifies as the Inland North, the vowel in TRAP may be produced with a high-front nucleus rather than as a low-front monophthong. In this region, which includes major cities around the Great Lakes like Chicago, Detroit, Cleveland, and Buffalo, a speaker might pronounce the word *cat* as [kiət]. On the other hand, in Canada the vowel in TRAP may be produced as a low-back monophthong, so that a speaker might say *cat* as something more like [kɑt]. Neither pronunciation matches the canonical idea of the word's pronunciation in American or Canadian English as [kæt]. Both appear to be changing in time, meaning that speakers in either dialect region would regularly encounter other speakers who fall on a different point in the continuum of potential phonetic realizations of the vowel. And, perhaps most surprisingly, neither change appears to draw attention from speakers in the regions, so that a young Detroiter may say *cat* differently from their grandparents and differently from a Canadian peer, but generally be unaware of the difference (for examination of speaker awareness of the vowel changes occurring in the Inland North, see Niedzielski 1999).

In the case of this example, the vowel has changed in the sense that speakers articulatorily form the central tendency of the vowel in a different way from what might be canonically expected. In the case of the Inland North production of *cat*, the phoneme /æ/, which would conservatively be formed by a speaker positioning their tongue in a relatively low position toward the front of their vowel space, is instead produced with the tongue at a relatively higher position in vowel space closer to the conservative articulation of the phoneme /i/. In this sense, the speaker would have “raised” their TRAP vowel, referring to the relative production of the phoneme as a high front vowel. The Canadian speaker, by contrast, would be shaping the vowel at a position slightly farther back in vowel space and would thereby be “backing” TRAP. “Lowering,” “fronting,” and “centralizing” are also possible vowel changes.

Consequences of these types of vocalic changes are that 1) a vowel’s “movement” will leave open space in the vowel system and 2) a vowel might “move” into space occupied by another vowel. In these cases, two larger patterns of change are of interest. First, the movement of one vowel might cause another vowel to move in a “chain shift” (e.g., Labov, Yaeger & Steiner 1972; Labov 1994; Gordon 2001). In the case of movement leaving vowel space open, the vowel that moves first might “drag” another vowel in a parallel fashion so that the relative distance between them in vowel space is maintained. The Northern Cities Shift (NCS), while characteristic of the Inland North and not presumably operating in Kansas City, usefully illustrates the drag chain shift. In most accounts of the NCS, TRAP raises and fronts leaving low front vowel space open, which drags LOT forward and leaves the low back space open, which drags THOUGHT lower and fronter (this is the account given, e.g., in Labov 1994, 2010; Eckert 2000; Labov, Ash & Boberg 2006; see Gordon 2001:10-13 for theoretical complications with this model and Gordon 2001:195-199 for empirical complications). It is also possible that, as the first vowel moves into the space of a second vowel, it might push the second vowel away to maintain distinctions. This is, again, part of the standard explanation of the NCS, where DRESS lowers in vowel space, finds LOT occupying that position, and so backs to a central position. In doing so, it pushes STRUT back in vowel space. Again, Gordon (2001:10-11, also Gordon 2011) illustrates problems with this explanation—especially that there is no basis by which DRESS would be rebuffed by the presence of LOT but then enter a push chain with STRUT. More generally, there is no clear reason that why the vowel encroaching on the space of another would not simply lead to merger between the two. Nevertheless, push chains offer a second possibility for the realization of a chain shift. While these specific examples from the NCS are unlikely to appear in Kansas City, they are useful examples of a mechanism that might be sought in Kansas City to identify and explain structurally interrelated changes in the community's sound system.

These shift patterns have the effect of maintaining distinctions among vowels. As hinted just above, though, distinctions may also be lost. This is the case of vowel mergers. Mergers can occur conditionally, where only specific phonetic environments are affected, or unconditionally across the entirety of vowel classes. An example of a conditional merger occurs in most dialects of American English when /ɔ/ and /o/ occur before /r/ (the NORTH and FORCE classes, respectively). Most American dialects have merged the specific subsets of NORTH and FORCE into a single vowel (e.g., Wells 1982:159-162; Labov 1994:315-316; Thomas 2001), but the broader THOUGHT and GOAT vowels that were historically present in the affected words remain distinct in other phonetic contexts. By contrast, an unconditional merger occurs in many dialects of American English between LOT and THOUGHT, where the phonemic distinction between the low back vowels collapse regardless of phonetic environment so that, e.g., *Don* and *Dawn*, *cot* and *caught*, *hock* and *hawk* are all homonyms and speakers have only one phoneme where there were previously two (e.g., Herold 1990, 1997; Labov 1994:316-319; Johnson 2010).

Mergers are typically discussed as occurring in one of three patterns (see especially Herold 1990, 1997; Labov 1994:321-323). In “merger by approximation,” the distinction between two vowels breaks down gradually as the vowels move together in vowel space, resulting in a single vowel in an intermediate position between the original two. In “merger by transfer,” words individually change phonemic categorization across classes, so that eventually all tokens of one vowel have moved over to the other, leaving the original vowel class empty. In “merger by expansion,” the phonemic distinction between vowels breaks down, but neither vowel necessarily surrenders phonetic space, so that the two vowels become a single vowel that is spread over the space of the original two vowels. A token from either of the original two vowel classes might be produced anywhere across the combined space. Herold (1990, 1997) proposes this specific explanation for the low back merger in eastern Pennsylvania. Labov (1994:323) argues that all three types of merger occur and that the task for researchers is to identify which is occurring in a given situation. He also notes different outcomes in terms of rates of progress: “merger by transfer is the slowest; merger by approximation may take three or four generations; merger by expansion appears to be complete in a single generation.”

Labov, Yaeger, and Steiner (1972; also Nunberg’s 1972 appendix to their study) also introduced the mechanism of the “near merger.” Their interest was primarily to account for instances diachronic history where sounds appeared to merge and then unmerge—in violation of Garde’s Principle that merged sounds could not unmerge by linguistic means. Di Paolo (1992) described a near merger of LOT and THOUGHT in

Utah, with speakers maintaining a small phonetic distinction between LOT and THOUGHT, but perceiving them phonemically as merged. This is evidenced by speakers' closer productions of LOT and THOUGHT tokens during interview tasks that demand relatively high self-attention to speech compared with tasks that demand less attention to speech. Labov (1994:363-364) describes a similar phenomenon as the "Bill Peters effect," named for a man who maintained a LOT-THOUGHT distinction in casual speech, but was nearly merged in production in minimal pairs testing and perceptually claimed that the vowels sounded the same.

It is counterintuitive that speakers might reliably and accurately produce a phonemic distinction that they do not perceive (Labov 1994 devotes Chapter 14 to exploring this paradox, which is attested in the diachronic histories of many languages). Nevertheless, *ANAE*'s data on vowel mergers shows very regular occurrence throughout North America of speakers who are merged in perception and distinct in production of vowels, as well as speakers who are merged in production and distinct in perception, and gradations between merged and distinct for both perception and production. These categorizations may represent transitional stages in the development of a merger (e.g., Labov's 1994:406-418 discussion of the *ferry-furry* merger in Philadelphia) or vowels moving close to each other before separating again (e.g., Labov's 1994:371-384 discussion of the *line-loin* merger in early Modern English).

Beyond patterns of chain shifts and mergers, there is the possibility of general change (i.e., a vowel just changes its production without affecting other vowels and without jeopardizing the system's phonemic inventory). General changes might include parallel shifts where two vowels change in similar ways, but there is not a clear sequence or reason to believe that a change in one caused a change in the other. Durian (2012:166-172) argues that such cases (specifically with regard to the parallel fronting of GOOSE and GOAT that he observes in Columbus, OH) are a result of “phonetic analogy,” where the conditioning effect of a given environment on one vowel might generalize to create the same effect on a phonetically similar vowel. Fruehwald (2013:151-154) makes a slightly different case for the parallel fronting (and subsequent backing) of GOOSE, GOAT, and MOUTH in Philadelphia, suggesting that the general category of back upgliding diphthongs becomes marked for fronting, resulting in the three vowels being fronted in parallel—though technically independent—changes.

I do not approach my study of Kansas City with specific hypotheses for which types of changes will characterize innovations there. Certainly, as will be discussed below, mergers and general changes have been observed in Kansas City. For now, though, this cursory examination of three potential mechanisms of sound change—chain shifts, mergers, and general changes—serves to foreground some of the patterns that may exist in any study of sound change. They will, as necessary, provide a background and vocabulary for changes that emerge from data in Kansas City.

1.3. Previous Studies of Kansas City English

The major study of language in Kansas City is Lusk (1976). She interviewed sixty-eight Kansas Citians born between the beginning of the twentieth century and the 1960s, fifty-seven of whom were included in her analysis. Her sample was socioeconomically stratified by low-, middle-, and high-status speakers. Her sample also included several subsets of members of different generations from the same families (i.e., she was occasionally able to interview kids and their parents) to explore parental influence as a factor in language change.

Lusk (1976) identified a number of linguistic changes in progress in Kansas City—though, because her study occurred early in the history of the field of sociolinguistics, some of her data require some interpretative extrapolation. For instance, she describes all low-status informants raising DRESS to [ɪ] when the vowel occurs before /n/ (1976:75). This surely describes the pre-nasal conditioned merger of DRESS and KIT, which Labov, Ash, and Boberg (2006:67-68) identify as advanced in Kansas City. She also briefly notes GOOSE fronting in contexts where it is not followed by /l/ (1976:77) and FOOT fronting (1976:78). More central to her investigation, she identifies TRAP raising pre-nasally among younger speakers (1976:97), the vowels in LOT and THOUGHT being merged among younger speakers at a value near [ɑ] (1976:103-104), the fronting of GOAT among young and high-status speakers (1976:120), the fronting of MOUTH among low-status speakers (1976:126-127), and PRICE being monophthongal before liquids among older speakers (1976:131-132). As will be seen in the discussion of Labov, Ash, and Boberg (2006) below, Lusk's work in Kansas City shows a remarkable correspondence in many regards with the data collected in the city for *ANAE*.

Shortcomings in Lusk's work are generally consequences of her work being completed early in the history of sociolinguistics. In a broad sense, the field had not yet developed the concepts and approaches that researchers today benefit from. For instance, the observation of pre-nasal TRAP raising (as well as THOUGHT lowering) led Lusk (1976:147) to suggest that Kansas City was in an early stage of the NCS, even though the raising of TRAP in other phonetic contexts was receding among younger speakers

(1976:139). Labov, Yaeger, and Steiner (1972) had shown that raising TRAP pre-nasally is a general pattern in American English, and Labov, Ash, and Boberg (2006:174-175) confirm the nasal system as the most general conditioning pattern for TRAP in North American Englishes. Without the preponderance of knowledge of conditioning effects on TRAP (and the characterization of TRAP raising in the NCS as general to all phonetic environments) that has emerged since the years just before Lusk's work, her correct identification of pre-nasal TRAP raising appears to take her analysis to a likely incorrect conclusion, which may subsequently obscure analysis of another important change: TRAP retraction in non-pre-nasal contexts. Similarly, while her descriptions give evidence of, for instance, back productions of pre-/l/ GOOSE and GOAT, since these had not yet received great attention as general patterns in many American English dialects, Lusk does not give them much attention as changes in apparent time or as socially correlated changes. As such, her research affords a real-time description of these vowels in these contexts, but does not afford much in the way of their examination as changes in apparent time.

Technologically, though Labov, Yaeger, and Steiner (1972) had already introduced acoustic measurements of F1 and F2 to the study of sound change in progress, access to equipment necessary for such studies was obviously very limited when Lusk was working, meaning that she had to rely on impressionistic judgments of vowels. For vowels that she does not analyze closely, she provides comprehensive lists of all observed production. These transcriptions afford extremely fine-grained detail, but, because the analysis is so close, they don't offer much perspective on overall patterns of change. On the other hand, for vowels that she analyzes closely, she creates discrete scales for quantifying changes based on those used in Labov (1966\2006). The scalar analyses are useful for making sense of the relative degree of change emerging. However, with many of the changes Lusk explores, impressionistic judgments may under-determine the actual productions of speakers relative to acoustic measurements. This is especially the case with the potential merger of LOT and THOUGHT, which studies have regularly observed to show statistically significant differences in acoustic productions even among speakers who are judged to be merged by a trained linguist (e.g., Herold 1990; Evanini 2009; Johnson 2010—Johnson's 2010 discussion of coding errors by linguistic atlas fieldworkers leading to incorrect isoglosses for the low back merger in the northeast United States provides an illustrative example from early US dialectology). So, her impressionistic analysis inherently omits some of the detail that would be desirable for direct comparison against today's studies.

As noted above, though, the picture Lusk paints of language and change in Kansas City shows remarkable agreement with the one created by Labov, Ash, and Boberg (2006). *ANAE* researchers interviewed four Kansas Citians by phone (as well as speakers in the nearby city of Lawrence, KS) as part of their tremendous project to document dialects of English across North America. They include Kansas City in the Midland dialect region, an area stretching from Pennsylvania in the east to central Kansas in the west. The Ohio River provides a general line for the southern border of the region, and the Inland North forms the northern line. With these borders, *ANAE*'s Midland roughly corresponds to the region often identified as the North Midland based on Kurath (1949).

Labov, Ash, and Boberg (2006:263) indicate that the Midland is difficult to characterize, based on a lack of homogeneity compared with other major dialect regions, making it something like “the lowest common denominator of the various dialects of North America.” Nevertheless, they note several features that, in combination, mark the region as distinct from others. These include:

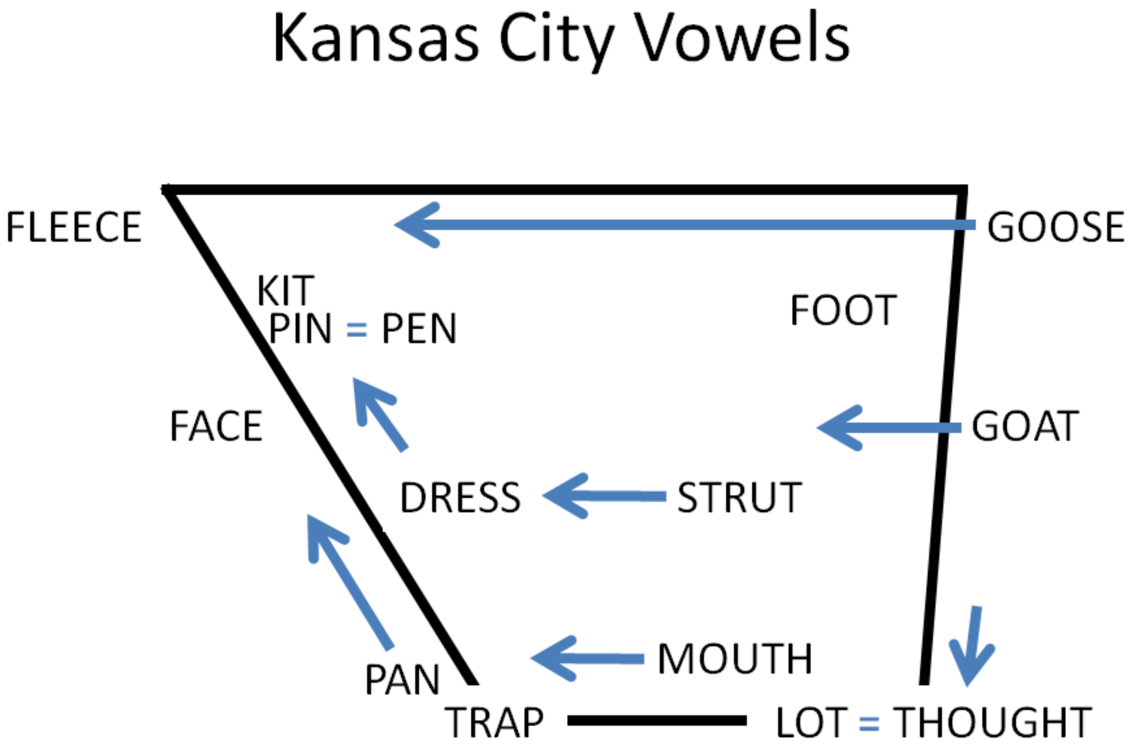
1) A transitional status with regard to the low back merger between LOT and THOUGHT, with the vowels being neither completely distinct nor completely merged. In *ANAE*, one Kansas City speaker is judged to be merged in production and perception, one to be merged in production or perception, one to be close in production or perception, and one to be different in production and perception—in other words, the city manifests nearly every possible merger status among just four speakers (Labov, Ash & Boberg 2006:66).
2) The fronting of GOAT except when followed by /l/ (Labov, Ash & Boberg 2006:265).
3) Fronting MOUTH. In *ANAE,* Kansas City shows extreme fronting of MOUTH, placing the nucleus well into TRAP territory (Labov, Ash & Boberg 2006:267).
4) Fronting STRUT. All four Kansas Citians interviewed for *ANAE* front STRUT beyond a central position (Labov, Ash & Boberg 2006:269).
5) Monophthongization of PRICE before resonants like nasals, /l/, and /r/, but not before obstruents (Labov, Ash & Boberg 2006:268).

As noted above, Kansas City also shows a relatively high rate of conditioned merger of pre-nasal KIT and DRESS—which is a more Southern pattern, but shows robust distributions in a few Midland cities (Labov, Ash & Boberg 2006:68). And, like other Midland cities, Kansas City participates in the fronting of GOOSE after coronals; while this is a general pattern most dialects of American English, Kansas City shows some of the most extremely fronted productions on the continent (Labov, Ash & Boberg 2006:154). On all these counts, Kansas City's productions are characteristic of (or, more accurately, help define) the Midland dialect region.

The weakness of *ANAE* in the discussion of any single city is that the project was a continent-wide survey. As such, it does not provide much depth to data or analysis on any one city, and does not afford any analysis in terms of social factors. Nevertheless, the characteristics of Midland speech that *ANAE* outlines seem to match Lusk's findings for Kansas City on nearly all counts—the only clear exception is in STRUT fronting, which Lusk (1976:143) characterizes as showing little variation. Based on their common findings, Figure 1.3 offers a stylized depiction of changes observed in the Kansas City vowel system.

Gordon (e.g., 2006a, 2009, 2010) has provided closer examinations of the progress of the low back merger and pre-nasal merger of KIT and DRESS. Using self-reported data from written questionnaires, Gordon (2006a) finds LOT and THOUGHT nearing merger in pre-/t/, -/n/, and -/l/ environments, with more than 80 percent of respondents under the age of twenty-six reporting minimal pairs to be the same or close for each of the three pairs. Kansas City leads all regions of Missouri besides the state's

Figure 1.3. Proposed Model of the Kansas City Vowel System



northwest corner in the progress of the merger (Gordon 2006a:62). He also identifies a female lead in the merger (Gordon 2006a:64). Additionally, he notes a strong presence of the pre-nasal merger of KIT and DRESS in Kansas City, however, the merger progresses relatively little from older respondents to younger ones (Gordon 2010). This result complicates the straightforward depiction of the conditional merger presented in *ANAE* and described above.

Gordon and Strelluf (2012) provided acoustic analysis of data from interviews with twenty-two Kansas Citians, which were conducted by Gordon and his students over several years. This limited study generally confirmed the profile of Kansas City's vowel system suggested by *ANAE*, based on data for four interviewees born between 1948 and 1952 (the *ANAE* sample included three speakers born between 1944 and 1954). Gordon and Strelluf (2012) found a male lead over females in the merger of pre-nasal DRESS and KIT and broad participation in the low back merger. The two mergers differed in perception tests. For the pre-nasal merger of KIT and DRESS, speakers who claimed that minimal pairs sounded the same showed acoustic measurements that were indeed suggestive of merger. For the low back merger, by contrast, interviewees who claimed the vowels were the same showed basically the same acoustic measurements as interviewees who claimed to perceive the vowels as distinct. Gordon and Strelluf (2012) also found some surprising movements in the back vowels, GOOSE, GOAT, and MOUTH, which generally fronted in apparent time between the oldest and middle-aged groups of interviewees, but then showed some retraction among the youngest interviewees.

Gordon and Strelluf (forthcoming) also include a small sample of Kansas Citians in their study of recordings of speakers born in the late nineteenth and early twentieth centuries. They study the features characteristic of Midland speech as identified in *ANAE* (and listed above), and find none of them present in speakers born before 1900. One Kansas Citian, a man born in 1902, appears to have the pre-nasal KIT-DRESS merger.

These few works comprise most of the studies of English in Kansas City, at least as far as phonetics and phonology are concerned. A few works in the tradition of lexical dialectology also offer insight. R.L. Weeks's recollections of "rustic speech of Jackson County" in the American Dialect Society's 1896 *Dialect Notes* is probably the earliest focused attestation of features of Kansas City English. Kansas Citians were interviewed for the *Dictionary of American Regional English*, and their lexical outputs contribute to Carver's (1987) Lower North and Upper South boundary, which appears to cut through the center of Kansas City. Observations on Kansas City are sprinkled throughout the works of Donald Lance and Rachel Faries. Their works (e.g., Faries & Lance 1993; Lance & Faries 1997) also offer a number of insights into settlement patterns in Kansas City and in Missouri more generally.

1.4. Summary

The main research goal of this project is to describe the phonetics and phonology of Kansas City English vowels. Settlement patterns suggest that the dialect would have initially been formed by South Midland speakers, with a large population of North Midland (and other northern) speakers entering the speech community shortly after. The area's growth over the last century and, more recently, division into urban and suburban communities suggest that many socioeconomic and cultural ideologies and attitudes shape the landscape of Kansas City, and they likely shape the interactions Kansas Citians have with one another. Previous research suggests, at least, that in today's dialect the low back merger should be advancing and the diphthongal back vowels should be fronting. This set of changes, if indeed present, may be examined in the context of knowledge from sociolinguistic research patterns of on chain shifting and mergers.

This last point will offer opportunities to shape this project's research goals from simply characterizing the dialect of Kansas City to also exploring why the dialect has developed (and is developing) in the ways observed. In examining the vowel system for structural explanations and in examining speaker productions of vowels for social explanations, it may be possible to learn more about language in Kansas City, language change in general, and the Kansas City community itself.

The next chapter will describe the methodology of this study. As necessary, I will introduce additional concepts, procedures, and assumptions from the sociolinguistic approaches employed in this research. Chapters 3 through 6 will move through the vowel system of Kansas City, examining the production of vowels in this data, changes that appear to be occurring in Kansas City, possible structural explanations for those changes, and possible social explanations for those changes. These chapters will focus, in turn, on the vowels of the low back merger, the short front vowels, the back vowels, and the central vowel space. Chapter 7 will attempt to synthesize findings from these chapters into broader claims about the dialect of Kansas City and its implications for the study of sociolinguistic variation and change.

CHAPTER 2

METHOD

This chapter outlines my research goals and the design of my study. It also discusses the use of the Forced Alignment and Vowel Extraction (FAVE; Rosenfelder et al. 2011) suite, which appears to be emerging as a central tool of sociolinguistic research. The particular and important methodological contribution here will be the consideration of best practices for employing FAVE in the study of dialects and dialect features that were not of central interest to FAVE's programmers at University of Pennsylvania. FAVE is an extremely effective tool, but aspects of its architecture will severely affect researchers who use it uncritically.

2.1. Research Goals

My collection goal was to record a large pool of speech suitable for acoustic analysis from native Kansas Citians. I wanted this pool to be balanced by gender so that the patterns for males and females could be compared. I wanted to sample interviewees born during the period Lusk (1976) studied to afford a direct real-time comparison with her results, and to sample a younger group of interviewees to allow an apparent-time analysis of change. Previous studies (especially Lusk 1976 and Labov, Ash & Boberg 2006) drew interviewees primarily from the Kansas side of Kansas City, so I wanted to include a larger portion of Missourians. Previous studies (e.g., Labov, Ash & Boberg 2006; Gordon & Strelluf 2012) also drew largely from suburban subjects, so I hoped to reflect a better balance of subjects from KCMO itself along with subjects who grew up in the suburbs. Finally, I wanted my study to be socioeconomically stratified, so that I could identify potential social correlates of sound change. In particular, since it has regularly been found in US sociolinguistic research that changes operating below the level of conscious awareness are led by interior social groups (e.g., Labov 1966\2006, Labov 2001; Baranowski 2007, 2013), I wanted to include interviewees from the upper working and lower middle classes.

I targeted interviewees who were born either between 1955 and 1975 or during the 1990s. The older group's parameters were set against Lusk (1976). Assuming Lusk (1976) conducted her interviews around 1975, her youngest interviewee would have been born in 1965, and her "Under 20" group would have included fifteen interviewees born between 1956 and 1975. So, my oldest group corresponds to her youngest group, and affords a real-time comparison against her findings. The younger group was designed to correspond, roughly, to the age of the older group's children. I limited the younger group to the 1990s to focus on the youngest children who would be primarily under the linguistic influence of their peers rather than their parents—i.e., in high school (cf. Labov 2001; Eckert 1989, 2000; Johnson 2010). Gordon and Strelluf (2012) also drew largely on interviews with Kansas Citians born in the 1980s, so focusing on people born in the 1990s provides an incremental step forward in apparent time beyond that research. As it happened, several interviews were conducted with parents in the older generation and with their children in the younger generation—including the Z family, which included both the oldest (Robert Z) and youngest (Madison Z) interviewees in this sample. In other words, the time parameters for these groups coincide for practical purposes with two generations of Kansas Citians.

Interviewees had to be native Kansas Citians. I defined Kansas City as the areas included in the Kansas City MSA in the US Census (2013, *Annual Estimates*). I defined "native" as a person being born in Kansas City and living their entire life, with exceptions for brief periods away for college or military service, in Kansas City. Practically speaking, a few interviewees who I ultimately included in the data presented here were born outside Kansas City, but moved to the area prior to entering the speech community (i.e., before elementary school) and had no real memory of living outside Kansas City. I considered these native, too (cf. Labov 2001; Johnson 2010). I did not exclude interviewees whose parents were born outside Kansas City, nor did I exclude interviewees who had moved between different areas of Kansas City during their lives—I'll discuss both issues below. Instead, I noted locations where interviewees' parents were from, where interviewees lived as very young children, where interviewees lived as high school students, and, in the older generation, where interviewees chose to live as adults. These factors are available for exploration against observed patterns.

I treat gender uncritically as male or female. I'll discuss socioeconomic classification below.

2.2. Recruitment

I conducted sociolinguistic interviews in 2012 and 2013. Interviewees were recruited through "snowball sampling" (e.g., Milroy & Gordon 2003:32). I identified areas of metropolitan Kansas City and/or social groups that I hoped to study, then found an initial contact in that community who would introduce me to others in that community. In some cases, I relied on friends and family members to help me make such in-roads through their work contacts, community groups, and other associations. In other cases, through trial and error, I found someone who would listen to me describe my research project and then become sufficiently interested (or sympathetic) to agree to help with subject recruitment.

My initial contact in a given community was rarely also an interviewee. Typically, the first contact who agreed to help would serve as an intermediary. They would propose potential interviewees who met criteria for my study and might be amenable to being interviewed. In many cases, this intermediary would make initial contact with a proposed interviewee to describe my project. I would then contact the proposed interviewee directly to go through details of my survey methods and request participation. At the very least, the intermediaries would allow me to use their names during interview solicitation. This was critical to helping me distinguish myself from the many marketers and campaigners (much of my fieldwork occurred during the 2012 US General Election) whom potential interviewees dealt with regularly and were naturally suspicious of. To continue the snowball sample, the people who agreed to be interviewed often subsequently became intermediaries to additional interviewees. At the conclusion of interviews, I would ask for help meeting other people. Many participants were willing to recruit other participants.

This telephone-chain-style recruitment allowed me to make in-roads in the communities I had hoped to explore, and generally to be several layers of contact removed from whoever my initial contact was. My interviews with Jerry and Mark are typical of the chains that led me to usable data. A family member described my research to a more distantly related family member. That family member allowed me to do interviews at their work. A person I interviewed there introduced me to a police officer working off-duty as security. That police officer introduced me to Jerry. Jerry introduced me to Mark. Jerry and Mark are included in my study.

Through this recruitment, I conducted interviews with more than ninety people. Sometimes during an interview, I would learn that an interviewee did not meet criteria for inclusion—most commonly, this would mean that they moved to Kansas City after starting elementary school. I usually proceeded with these interviews, and have a large pool of data available for future studies of dialect acquisition. I also interviewed African Americans, whose data will be the basis for a future study of African American English in Kansas City. I interviewed several University of Missouri students who are Kansas City natives for future research on dialect convergence. Finally, I over-sampled some demographics, and so have excluded some interviews from groups that are already sufficiently represented in my data. The research that is presented here, then, is drawn from the speech of fifty-one interviewees. The characteristics of these interviewees will be discussed more below.

Before exploring the composition of the pool of interviewees, it’s important to note potential limitations of my recruitment approach. In the broadest terms, for subject recruitment sociolinguists studying large urban areas have traditionally used either carefully structured random sampling informed by sociological surveys (e.g., Labov 1966\2006; Wolfram 1969; Sankoff & Sankoff 1973; Baranowski 2007) or network-driven ethnographic study informed by anthropological field methods (e.g., Labov 1972a; Milroy & Milroy 1978; Milroy 1980; Eckert 1989, 2000). Labov (2001:39) states a clear preference for the former approach in studies of large cities, noting:

> One cannot capture the regular structure of variation within a large community by any procedure that abandons the critical steps of enumeration and random selection. Unfortunately, a number of sociolinguistic studies of urban communities have retreated from this standard. In many studies, any individual who will agree to be interviewed was selected as long as he or she had the social characteristics desired to fill out an even distribution by sex, education, etc.

He further indicates that “studies drawn from representative samples of the community have provided the basic and most reliable findings on sociolinguistic patterns” (Labov 2001:39). An interviewee’s willingness to be interviewed is further problematic from the standpoint of Labov’s (1972a) observation that “lames”—people who are not centrally integrated into the social life of a community—do not participate in the vernacular norms of the community and therefore do not provide representative linguistic data. But lames are the people most likely to agree to participate in an interview for academic research (and, present readers and writers excluded, lames are most likely to become academic researchers) (Labov 1972a:290-292). So, studies designed without rigorous random sampling are convenient for researchers, but may not provide reliable research data. By comparison, for example, with researchers who select specific neighborhoods for study based on specific criteria, and then choose random houses in those neighborhoods from which to solicit interviews, my snowball sample is limited to the areas that the friend-of-a-friend chains I happened to be able to access happened to penetrate.

At the same time, because I did not conduct a deep ethnographic study (especially in the sense of Eckert 1989; Kiesling 1998; Bucholtz 1999), my research is not intended to provide an intensive focused look at a linguistic "community of practice." In other words, if small networks of Kansas Citians are engaging in hyper-local practices, they will not emerge in my data. As such, I can't make claims to exploring the kinds of questions these studies have been successful in elucidating.

So, in the most harshly critical sense, my research goals for understanding the dialect of Kansas City demand a structured random sample, but I am using a fairly non-rigorous version of a more ethnographically driven sampling method. As a result, data from my sample can only be said to apply to the Kansas City community broadly (rather than any specific community of practice), but cannot be definitely argued to be representative of the Kansas City community as a whole. I am, then, potentially using a compromised form of the two research methods that, in a worst-case-scenario, fails to achieve the best possible results that might be derived from either. Indeed, undoubtedly, there is linguistic variation and change operating in Kansas City that I am failing to identify as a result of my recruitment choices.

On the other hand, other practical and methodological goals justify my recruitment approach. A primary purpose of the sociolinguistic interview is to capture natural or vernacular speech. These are notoriously slippery terms (see, e.g., Milroy & Gordon's 2003:49-51 discussion of "vernacular"), but the general idea is that we want to observe how people speak "normally." While that goal will almost never be met when a subject is speaking with an interviewer, if the interviewee periodically suspends their awareness of being interviewed, the researcher can get glimpses in the direction of vernacular speech. Labov (1966\2006, 1972b) famously attempts to overcome the Observer's Paradox—which recognizes that the very behaviors we wish to observe in research perform differently as a result of their being observed—with questions about emotional events, like the "fear of death and dying" question, that distract interviewees from the task of the interview itself. Labov (1966\2006) also makes use of non-interview moments, such as an interviewee pausing to take a phone call or to interact with family members, as speech that is more vernacular than are the answers to his interview questions. A great body of debate has emerged in sociolinguistics over some of these fundamental assumptions about what "natural speech" is and how (if there is such a thing) it can be studied (e.g., Bucholtz 2003; Milroy & Gordon 2003; Schilling-Estes 2004, 2007; Singler 2007; Becker 2013). Indeed, the ethnographic methods that emerged in the 1980s and 1990s developed, in part, to find ways to integrate researchers into researched communities, so that researchers were as much participants as they were observers.

These concerns created by the situation of the sociolinguistic interview itself are magnified by a researcher being a stranger to the people they interview. The issue here is not just the Observer's Paradox, but that people are naturally suspicious of others asking them for time and information. Such solicitations are frequent among marketers trying to lead people into spending money, and the news is rife with stories of personal information being stolen through phishing attacks and then being used to defraud people. Furthermore, the interior social classes that I hoped to highlight in my research are, arguably, most subject to being victimized by such approaches and have perhaps the most at risk from such attacks in terms of their socioeconomic status. Hold on socioeconomic status may be very tenuous for those on class borders. This was particularly true during the time when I was conducting fieldwork, as the US economy was still in a slow recovery from the Great Recession. Several interviewees, indeed, spoke of losing jobs, moving, and even selling homes to avoid foreclosure. Such socioeconomic tenuousness is indeed at the heart of observations on linguistic insecurity (e.g., Labov 1966\2006; Labov 1972b; Preston 2013) in interior social groups. Illustratively, my interview with Joshua K, who lives in the suburb of Claycomo, MO but was visiting family in KCMO, was interrupted by a door-to-door solicitor. Joshua, whose childhood seems to reflect a high degree of economic insecurity as a result of his father's transition from military service to civilian life, was extremely unsettled by the interruption, which he interpreted as a person trying to swindle his family. It led to several charged comments from him about life in KCMO as opposed to in the suburbs.

This is to say that a distrust of strangers is a part of the regular life experiences of the people I hoped to interview. Blind solicitation for interviews would, to a fair degree, be greeted with this suspicion. Moreover, even if people accepted that I was not trying to steal from them, my status as a graduate student engaged in an ostensibly trivial activity of talking to people to study language would likely elicit further resistance to interviews. While people are often interested in many of the types of issues that sociolinguists explore, the study of language does not offer many immediately apparent benefits that would justify giving time and energy that could otherwise be devoted to work and family.

And, if all that weren't enough, a subject who agrees to have their language researched is potentially subjecting something deeply personal to critique. One interviewee (who is not included in this research because he moved to Kansas City after he began elementary school) asked me if I was trying to show “how stupid we sound” in Kansas City.

In short, there are reasonable impediments to the goal of collecting natural speech through sociolinguistic interviews that are exacerbated if interviewees are recruited through a truly random sample. I assessed that it would be difficult to convince people to be interviewed and, once the interview started, there would be a fairly long period of convincing an interviewee that they were really not in some way at risk. Certainly, many researchers have overcome these issues quite successfully. But the primary advantage to snowball sampling is that the researcher is able to use an insider’s status as a shortcut to credibility. Since someone known to the interviewee has vouched for the researcher, the interviewee is potentially able to enter the task with some barriers removed.

I attribute to this methodological decision that, at least from my perspective, most interviews felt comfortable very quickly. Generally speaking interviews moved rapidly from introductory matters to highly engaging conversation, often characterized by a great deal of laughter and sharing of personal information. In the interview with Eddy and Jeremy, who were interviewed together, the task of the interview was sufficiently forgotten that, when I stepped away to take a phone call, Eddy complained of wanting the interview to be finished because she was hungry. When I returned, they both laughed with embarrassment when it seems that they remember she is wearing a microphone and has been recorded complaining. So, I suggest that the speech I collected very frequently consists of relatively un-self-conscious speech, and does so from early in most interviews.

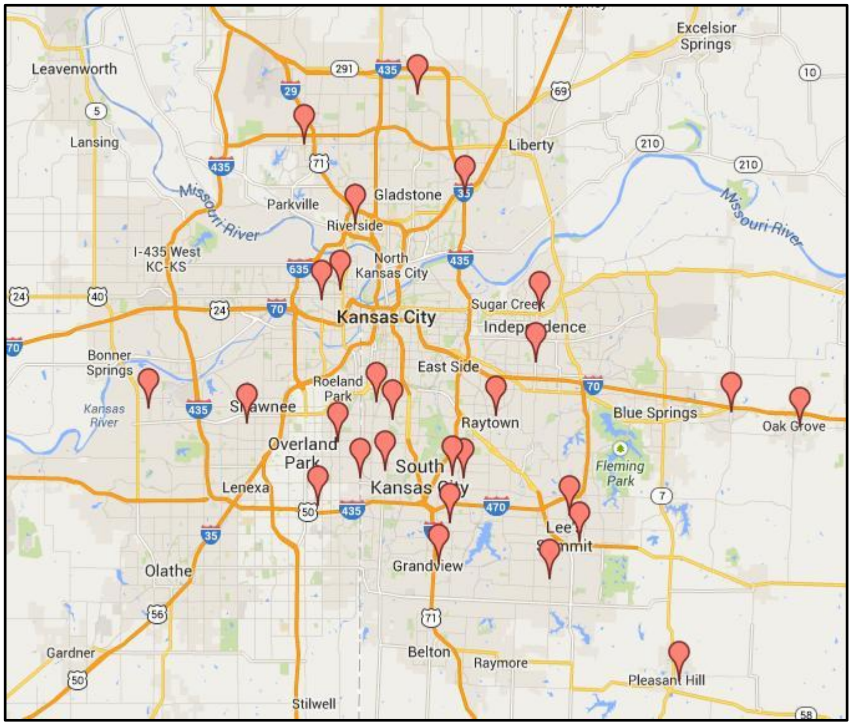
In short, the snowball sample, relative to the truly random sample, compromises representativeness of the entire community in favor of getting better casual speech data from the interviewees who are included. Relative to ethnographic approaches, the snowball sample compromises intensive knowledge of micro-practices in favor of looking more broadly at the larger community. Snowball sampling, then, is not better than either random sampling or ethnography, but reflects a different set of priorities from those approaches. In this case, my priority was on eliciting a large sample of relatively comfortable speech from many Kansas Citians. Snowball sampling was an effective recruitment method to achieve that.

2.3. Interviewee Demographics

Appendix A lists all interviewees and the demographics that will be discussed in this section. Interviewees are assigned pseudonyms. Where interviewees are family, a common last initial is provided. Figure 2.1 maps the locations of high schools attended by the fifty-one interviewees who are included in this research. For overview purposes, I use high school as a proxy for a speaker’s hometown, since adolescence has been shown in a number of studies to be a critical period for a person’s shift away from the language of their childhood caregivers to the language of their community and peer group (e.g., Eckert 1989, 2000; Johnson 2010).

The dispersion of points away from downtown KCMO at the center of the map reflects the demographic realities described in Chapter 1, that the movement of whites to more suburban areas has left primarily African Americans and pockets of other ethnic minorities in the urban core. Because of this dynamic, even white interviewees who grew

Figure 2.1. Locations of high schools attended by all interviewees



up in KCMO interior neighborhoods like Old Northeast and Midtown typically attended private schools farther to the south or in the suburbs. The dispersion also belies the fact, though, that because of KCMO's aggressive annexation policies, KCMO itself has spread to fill much of the space between many of the suburbs. As described in Chapter 1, the city limits of KCMO extend from the intersection of I-29 and I-435 in the northwest corner of the map (where Kansas City International Airport is) to an area between Lee's Summit and Raymore in the southeast. Because of KCMO's sprawl, twenty-three of fifty-one interviewees lived in KCMO while they attended high school.

The importance of school as a social factor in Kansas City cannot be overstated. Like many large US cities, white flight out of the urban core and into the suburbs initiated a period of steady decline in Kansas City schools. A common theme among older interviewees was to discuss the quality of Southwest High School in KCMO, which in the 1950s and 1960s drew its student body from the upper class areas around Ward Parkway and the Country Club District. Several older interviewees referred to Southwest students as “The Silverspoons.” As bussing began in the 1970s, the population became almost exclusively African American. The school closed during the 1990s and is presently operating as a charter school. Interviewees point to Southwest as indicative of the failure of KCMO to provide a viable school district. As I write, the Kansas City School District (KCSD) remains unaccredited, and is attempting to maintain its independence following the announcement of a State of Missouri plan to assume administration of the school district. KCSD was recently relatively relieved when only twenty-three students requested that they be allowed to transfer to accredited suburban schools at KCSD’s expense, following a court’s upholding of a transfer law—the same law prompted more than 2,000 students in unaccredited St. Louis area schools to transfer to suburbs (see, e.g., “Few Kansas City families” 2014). Other school districts within the borders of KCMO—most of which exist from times prior to KCMO’s expansion by annexation when the areas where unincorporated communities—now face similar challenges. The Hickman Mills School District, for example, which serves 6,000 students in South Kansas City, slipped into provisional accreditation status in 2013 and was cited for financial mismanagement issues in a subsequent state audit (Lowe 2014).

White interviewees regularly cited the inadequacy of KCSD schools as a primary reason for moving to the suburbs. For instance, Andrew O and Michael O both grew up in south KCMO and attended elementary and middle school there, but their family moved to Lee’s Summit, MO specifically for access to better high schools. They described frequent moves from then on as periods of unemployment for their father forced them out of houses and they endured a generally tenuous economic situation, but they cited access to quality free schools in Lee's Summit as helping them survive this period. In a more middle-class scenario, I interviewed Nicole P and Seth P one week after they had moved from KCMO to Shawnee, KS. Both grew up and attended high school in south KCMO. Nicole described being distraught over leaving Missouri for Kansas, but cited the pragmatics of being able to plan on sending their son to a public school for free in the Kansas suburbs, rather than to pay for private school in KCMO.

Whites who remain in KCMO—at least, as I found in my interview recruitment—tend to be those who can afford (or find a way to afford) private schools. So, among younger interviewees, all of those who live south of the Missouri River and attend a KCMO school, attend a private school. (The social dynamics are different in north KCMO, which has its own school districts and generally has demographic characteristics more like those of other suburbs—several KCMO interviewees attend KCMO public schools in the Northland.) In other words, schools appear to be an important mechanism driving the social dynamics of Kansas City among whites. Many working class and middle class families move to the suburbs for access to suburban public schools. White families who stay in KCMO, often do so with plans to use private schools, which would be expected to create a different socioeconomic concentration of students than might be typical of the high school experience.

The dynamics that schools drive in Kansas City became apparent early in my interviews, and led me not to require of a given interviewee that they had lived exclusively in a single city. Moves for the purpose of access to schools were simply too frequent among interviewees to make such a parameter tenable, or reflective of the social fabric of the city. Instead, the places where interviewees attended elementary school, high school, and, if they are adults, where they choose to live are all available as factors to correlate against linguistic practice.

It was similarly difficult to limit interviewees to those whose parents were also from Kansas City, which might be required for some especially complex local language patterns (e.g., Payne 1980). However, especially among the older group, many interviewees had one parent from outside Kansas City. In particular, work in the railroads drew many workers from more rural areas to Kansas City. So, I do not take interviewees' parents' status as native Kansas Citians into account.

Beyond those caveats for social undercurrents of place, Figure 2.1 is suggestive of the areally broad scope of my research in Kansas City. This affords observations about Kansas City as a widespread metro area. It will also create opportunities in future research for comparisons of some broad concept such as urban versus suburban, Missouri versus Kansas, etc.

As this discussion suggests, place is intricately bound up with questions of class. In a US paradigm, the concept of class proves to be challenging. (Linkon 2010 provides a very quick discussion of the breadth of popular ideas of what it means to be middle class in America that suggests the problems of such categorization.) At the heart of this challenge is that middle classness is conceptually very closely related to ideas of pursuing the American Dream, of not being aberrantly poor or rich, and of simply being "normal." As such, the idea of middle class is not uniformly connected to income, but is also tied to matters of lifestyle and personal identity. This is an important consideration for the tradition of sociolinguistics that has attempted to correlate language variation and change with socioeconomic factors. Davis (1985), for instance, critiques the practice of dividing study participants into socioeconomic groups, especially in Labov (1966\2006) and Wolfram (1969), and shows that a small change in the number of groups a researcher divides their population into can dramatically change the results of a study. Mallinson (2007:150-152) summarizes more recent challenges to socioeconomic groupings and the scales used to construct them, including that they are often biased toward the norms of white males, that they imply the salient categories exist even though Americans are not necessarily aware of them, and that they have not generally been constructed with an underlying theory for what determines class.

I add to these concerns that class is not necessarily stable over the course of a person's life. In particular, the notion of upward mobility is central to the idea of the American Dream that is potentially conflated with middle-classness, and is often pointed to as a key reason for linguistic change in progress. Labov (2001:409-411), for instance, identifies the leaders of language change as those women who rebel against authority and injustice, but remain upwardly mobile so that they carry language innovations into the broader community. Among the older interviewees in my study, few grew up in obviously middle class families. Heather, for example, described her childhood as subsisting on odd jobs her father did, usually small painting jobs. After high school, she began working on an assembly line in a factory, where she continued to work through her twenties. In her late twenties, she took advantage of the company's support for education to attend night school and eventually earn a bachelor's degree. In her thirties, she used her degree to move to the company's corporate headquarters, where she took advantage of educational benefits again to earn a master's degree. Now in her forties, she works in corporate public relations. So, just in the span of her early adult life, she moved from a solidly working class position to a solidly middle class one, and it seems very likely that her childhood economic situation was closer to the low end of the working class spectrum. As such, the point in her life during which she was interviewed greatly affects her socioeconomic classification.

It is possible to account empirically for this kind of upward trajectory. The socioeconomic scale Labov (2001:60-68) uses to index Philadelphians assigns 0 points for downward mobility, 1 point for stability, and 2 points for upward mobility. However, these scores are dwarfed by the other scaling factors (education, occupation, residence value, and house upkeep), which are based on the person's present adult status. This is potentially problematic, since childhood and adolescence are presumed by the same study to be the times when the linguistic system is developed. It's possible to solve this by simply assigning socioeconomic class to adults according to their socioeconomic class as teenagers. But this is in turn problematized by Eckert's (2000) finding that high school students in Detroit participate in the linguistic patterns of the class toward which their life trajectories are carrying them rather than the linguistic patterns of their parents (i.e., in Eckert's study, Burnouts participate in working class speech patterns, and a middle class student who identities with the Burnouts will talk more like a Burnout than a Jock). So, it's not clear that using an adult's teenage socioeconomic status would accurately reflect the socioeconomic patterns that they were participating in as teenagers.

In short, while correlations between socioeconomic class and linguistic practice have proven extremely important in sociolinguistic research, establishing those correlations is not straightforward. In view of this, I included three separate models for class in my survey.

First, I used a qualitative model to divide speakers into working class and middle class based on occupation. I count working class occupations as those that are primarily based on physical labor and do not require college education, and middle class occupations as those that are primarily based on intellectual work and require some college. While this division is admittedly arbitrary, impressionistically these classifications seem to match the attitudes that interviewees carried for themselves. For instance, Cliff works as a letter carrier, a position that, based on pay, benefits, and quality of retirement plan could quite easily be counted as middle class. However, while working to schedule his appointment, he proudly spoke of not having access to email and similar symbols of office work, and during our interview he identified his labor with that of the utility workers he interacted with while on his mail route. He seemed to think of himself as working class, and that roughly matches the physically laborious nature of his work and that he was able to do it without attending college.

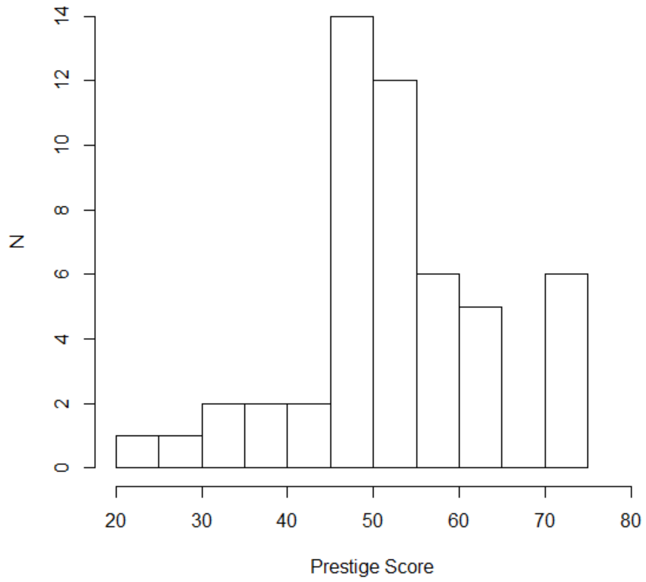
Even this division was problematic in practice, and for the integrity of the data, I felt a need to add a third class, which I label “transitional.” These were interviewees who did not neatly fit the mold of either working or middle class. Typically, these participants met (or nearly met) the criteria for working class, but clearly identified with the middle class. The J family is illustrative. Neither Matt J nor Jessica J attended college. Jessica J does not work outside the house. Matt J is a self-described entrepreneur, who has worked a series of mostly labor-based jobs, including being a handyman, a roofer, a car detailer, a salesman of various products he had developed, and a manager of low-income rental properties. At the time I interviewed him, though, he was working as a loan agent, functioning as an intermediary between prospective home buyers and banks. He moved into this more white-collar position through personality and carefully cultivated friendships. The J family live in a nicely kept house in a middle class neighborhood in KCMO, and their kids attend private school. Matt and Jessica both spoke openly of living month to month throughout their marriage (including while Matt works as a loan agent—the pay is based on commission). However, they valued the quality of life they were providing their children, and were willing to sacrifice in order to live in KCMO where they saw more access to cultural events, a higher value on neighborhoods, and closer proximity to good private schools compared with the suburbs. Such complex interactions made me uncomfortable classifying the J family as either working class or middle class. So I placed them, along with a few others, in the transitional class.

Interviewees born in the 1990s were classified according their parents' socioeconomic classification unless the interviewee was financially independent of their parents. As it turned out, among the younger interviewees it was only those coming from working class families who had achieved financial independence, and they had themselves gone into working class jobs. Younger middle class and transitional class people who were old enough to be financially independent were typically in college. Interestingly, among the younger interviewees, there were hints in career plans among males related to military service that support the three-way division in socioeconomic classifications that I use. Among those interviewees I've labeled working class, several males planned to enlist in the military and then serve for several years as active duty enlisted personnel. Among the transitional class, both young males planned to contract with Reserve Officer Training Corps in order to pay for college, which would result in their commissioning as officers, and they hoped to serve in a reserve component. Among the middle class, no one expressed plans to join the military. This suggests three levels of mobility: one remaining working class, one using working class-style labor to attain middle class credentials, and one having already entered the middle class.

This classification method resulted in a pool of twenty-one working class, twenty-one middle class, and nine transitional class interviewees. This was the basic scheme for determining the balance of my sample.

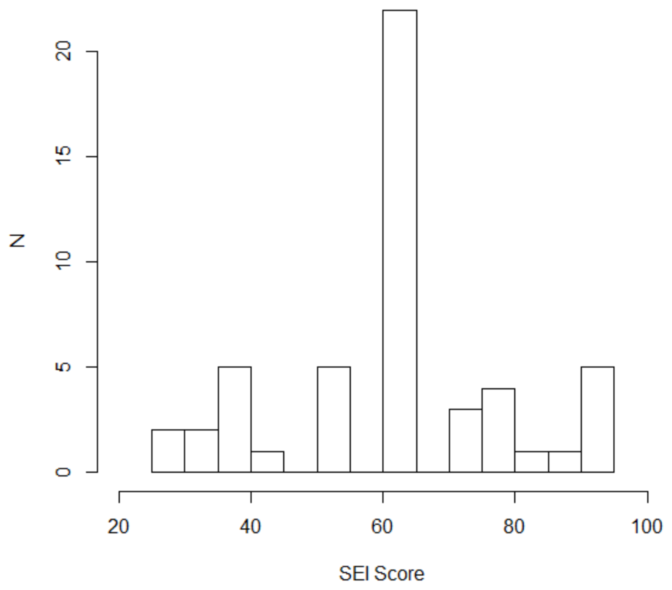
Because I was uncomfortable with the arbitrary nature of these classifications, I added two more objective systems. As a second measure of socioeconomic status, I scored each interviewee according to occupational prestige, based on surveys from the National Opinion Research Center. Labov (2001:477-478) uses this measure based on Nakao and Treas (1990, 1992) in his examination of GOOSE fronting in North America. I used updated ratings from Nakao and Treas (1994). Prestige scores are calculated from surveys that ask people to rank a set of job titles according to relative prestigiousness. In Nakao and Treas (1994:42-69), prestige scores range from a low of 13 for “fortune teller” to a high of 86 for “physician” (median 49.5). Prestige scores in my data range from 21 for Jeff, a parking attendant, to 75 for Kevin M, a lawyer (whose rating is passed to his kids, Emmanuel M, Hayden M, and Timothy M), and Danielle, whose mother is a lawyer. The median prestige score for my interviewees is 51 and the mean is 52.4. The mean and median prestige scores for interviewees fall near the middle of the prestige index. This suggests that my data pool at least partially meets the goal of representing socioeconomically interior groups. Figure 2.2 plots the distribution of prestige scores for interviewees.

Figure 2.2. Distribution of interviewee prestige scores



As a third measure of socioeconomic status, I scored each interviewee according to socioeconomic index (SEI) score. These are recorded for all interviewees in Labov, Ash, and Boberg (2006:30)—the *ANAE* SEI scores are available in the survey's raw data, but are not utilized in the atlas itself. SEI scores focus on income and education, rather than public opinion. Again, I draw my SEI numbers from the updated work in Nakao and Treas (1994). For all occupations, SEI scores range from a low of 20 for "miscellaneous textile machine operators" and "agricultural product graders and sorters" to a high of 96 for "dentist," with a median of 58. SEI scores among my interviewees range from 26 for Maya, a beautician, to 92 for lawyers. The median of my data is 63 and mean is 61.9, skewing slightly higher than the middle of the total SEI scale. Figure 2.3 plots the distributions of SEI scores. It shows a heavy bias for interviewees in the 60- to 65-point range.

Figure 2.3. Distribution of interviewee socioeconomic index (SEI) scores



While I intended for the inclusion of these scales to provide a check against my own three-way classification, these systems are not without their own problems. Hauser and Warner (1996:68), for instance, question the validity of any occupation-based index in the modern workforce, since such scales inherently emphasize income and fail to recognize differences in earnings and education levels that exist between men and women. (They suggest that a simple scale based on education best reflects socioeconomic class [1996:68], a conclusion that contradicts Labov's 2001:188 assumption that occupation is the single best predictor of performance of stable sociolinguistic variables and, therefore, the most important factor in examining class for correlations with linguistic performance.)

More specific to my interviews, though, these rating schemes fail to recognize the potentially meaningful social differences that exist within a single profession. For instance, at the high end of my scale, my inclusion of two families with lawyers in them suggests the high echelons of upper middle class. However, Kevin M is a lawyer for the city of KCMO, which, while undoubtedly a relatively high-prestige job, is different from the popular idea of a corporate attorney. I interviewed the M family at their house, which, while certainly clean and comfortable, was a crowded one-story ranch that did not reflect ostentatious wealth. In fact, Kevin M and his sons talked of a venture they were beginning that involved selling vitamins in an Amway-type arrangement so that they could have spending money. Again, this does not mean that the M family was not of a higher-than-normal socioeconomic status, but it suggests that their SEI score of 92 may be a bit unduly high.

The families of Andrew and Michael O and of Elly and Peyton D are also illustrative of this issue. The father in each family was the primary source of income, and in both cases was a high school graduate who worked in a technical support capacity. I visited each family’s house. The O family’s home and recent history (discussed above), suggested economic instability and periods of unemployment. In fact, when I interviewed them, they were preparing to move and, my impression was, that the move was sudden and out of necessity. The D family, by contrast, reflected a very stable, prototypically suburban lifestyle. The kids had lived in the same house in a planned community for their entire lives, and the house appeared to be something of a gathering spot for friends of the members of the D family. The objective scales of SEI and prestige scores place the O family and D family in the same category and, based on my impressions, those scores belie very different experiences of living in those families.

Finally, accurately categorizing a person's job can be problematic. This was particularly at issue when I interviewed younger adolescents. In the case of the K family, I interviewed five children of Lisa K and her husband. The closest I could get to a description for their father's work was that he was a job counselor. As such, they are all scored 46 in prestige and 63 in SEI. However, based on their description of his education (high school only) and impressions I derived from my interviews with other members of the K family (David, Maria, and Patricia K), the label "job counselor" is somewhat inaccurate in the sense that it is intended in the scales. This impression is supported by the job aspirations of the sons in the K family: Joshua K is independent and working as a mechanic's assistant, Brandon K plans to enlist in Marine Corps infantry, and Tyler K desires a career in landscaping. These vocational aspirations suggest a high valuation on maintaining working class, rather than middle class, lives.

As such, if the prestige and SEI scores offer a check against my three-way impressionistic classifications, my impressionistic classifications also offer a check against these more objective measures. Hartman (1979) notes that sociologists evaluate occupations in basically the same ways as the general population, so I will suggest that my own classificatory biases may at least be useful in reflecting general social classificatory biases.

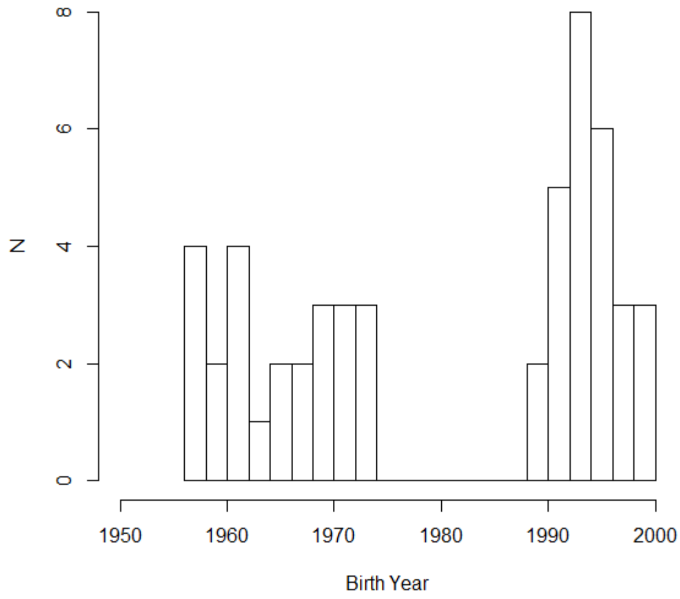
This scheme, then, affords three potential approaches of comparison, both within my data and against some other studies. My three-way impressionistic classification (which I henceforth label "class") will be available for exploring stratification as a discrete function. Typically I will use this impressionistic classification to refer broadly to social classes. Prestige and SEI scores will offer a way to look at class as a continuous variable, which is desirable for trying to identify curvilinear patterns of change. Prestige and SEI scores will also allow comparisons against Labov and his collaborators' more recent work, specifically Labov (2001) and Labov, Ash, and Boberg (2006). Prestige and SEI scores also, importantly, offer some validation that my sample of interviewees represents, a central range of the socioeconomic spectrum within Kansas City, though it is potentially skewed just to the high side of that central range.

As this discussion may suggest, though, I am ultimately uncomfortable treating class as a hard-and-fast factor in my data. As I explore the dialect of Kansas City, I will look for correlations between linguistic practice and class, prestige, and SEI. I will be reluctant, though, to rely on these factors too strongly, and offer the qualification that effects of socioeconomic classifications are suggestive rather than definitive.

I approach gender using the traditional male-female binary. While many sociolinguistic studies have revealed fascinating variation and change by examining the constructedness of gender (e.g., Podesva 2007, 2011; Bigham 2008; Mann 2011), such a nuanced consideration of personal identity was beyond the purview of this dissertation. I interviewed twenty-six females and twenty-five males.

Twenty-four interviewees were included in the older group, born between 1956 and 1974, with a median and mean of 1966. Twenty-seven interviewees were included in the younger group, ranging between 1989 and 1999, with a median and mean of 1994. Figure 3.4 plots the distribution of interviewee birth years.

Figure 2.4. Distribution of interviewee birth years



2.4. The Interview

Interviews were conducted in a quiet location at interviewees' convenience. Most interviews took place in the interviewee's home. I also interviewed a number of people at their workplaces. A few interviews took place in meeting rooms at libraries, at my house, or at the house of an intermediary who had helped arrange the interview.

All interviews began with the interviewee reading the informed consent statement, followed by me verbally summarizing the informed consent statement. For minors, I met with a guardian prior to the interview (typically immediately before) and completed the informed consent process with them. Minors then also signed an informed assent agreement. No person who reached the stage of the informed consent briefing declined to participate in the interview.

Interviews were recorded on a Zoom H4N Handy Recorder and recorded as uncompressed WAV files at 44,100 Hz sampling rate in 16-bit resolution (Thomas

2011:25-26; De Decker & Nycz 2013:119-120). Most interviews took place one-on-one between me and a single interviewee. In these cases, the interviewee wore a Sony ECM-44B lavaliere microphone, connected by XLR directly to the left channel of the Handy. Six people were interviewed in pairs: Elly D and Jasmine, Danielle and Maya, and Jeremy and Eddy. In these cases, a second lavaliere microphone was connected by XLR to the right channel of the Handy. Finally, a few participants were interviewed in larger groups during the casual speech portion of the interview via the Handy's built-in omnidirectional microphones. These groupings were the kids of the K family, the adults of the K family, and the M family. In all cases, the Sony ECM-44B microphone was used for the reading passage, word list, and minimal pairs portions of the interview. During data validation (discussed below), I compared acoustic measurements for the interviewees who were recorded with different equipment between casual speech and more formal tasks. Many more tokens needed to be dropped from casual speech recorded through either the omnidirectional microphones or the backup microphone (which was much more sensitive than the Sony ECM-44B) due to increased atmospheric noise. However, formant measurements for vowels did not appear to be substantially different across the various microphones.

The recorder was placed in view of the interviewee. I did not begin recording until I explicitly confirmed for the interviewee that the interview was beginning. As this description makes obvious, interviewees were fully aware that they were being recorded for the purposes of this research.

The interview instrument is included as Appendix B. Interviews began with the participant counting from one to ten, and stating their name and birth year. I then asked questions aimed at eliciting casual speech. While Appendix B includes a number of questions that reflect topics of interest to my research, the casual speech portion of the interview itself was loosely structured, with a primary goal of building rapport with the participant and encouraging them to talk comfortably. I generally pursued topics that seemed to engage the interviewee rather than follow a set protocol of questions. As conducive to the flow of conversation, I asked questions about personal and socioeconomic background, family, work, education, life in Kansas City, and attitudes about Kansas City. This decision meant that I did not consistently ask the same questions to all interviewees, which precludes comparisons of attitudinal factors against linguistic productions (cf. Bigham 2008). However, it contributed to interviews being characterized, generally, by a high degree of conviviality and engagement. So, as with the choice of recruitment method, the decision to gather casual speech through a loosely structured interview reflects the prioritization of maximizing interviewee comfort and casualness over collecting specific information.

The same priority is reflected by the inclusion of a small set of group interviews. There are many important practical problems to using group interview data. Besides the potential loss of recording quality discussed above, when multiple people participate in an interview, each individual interviewee necessarily talks less than they would if they were being interviewed one-on-one. And among interviewees in a group setting there will be disparities in conversational contributions, as some people tend to emerge as more vocal and others less. On the other hand, in group interviews, the interviewer is able to take advantage of in-group dynamics and knowledge to encourage interaction and conversation. In the cases where I interviewed multiple people together, there were always stretches where I would effectively fade away while interviewees interacted, joked, teased, questioned, and co-constructed stories together. Not surprisingly, family members and friends would raise topics and questions for co-interviewees that would not have arisen in a more standard routine of my questions. So, these group conversations, while less fruitful in terms of outputs of language to measure, potentially offer insights into social meanings and practices that might not emerge in the course of a more traditional interview. They also further foster comfortable conversation on the part of interviewees. So, data from several group interviews are included in my results. Phonetically, their measurements will come with a qualification relative to results from individuals interviewed one-on-one—especially because their casual speech token counts will be lower than those for traditional interviewees. However, their data still offers useful insights.

Following the casual speech portions of interviews, interviewees participated in a series of tasks that would be expected to place more of the interviewee's attention on their speech itself, generally following the model of the classic Labovian sociolinguistic interview (see Labov 1966\2006 for the model; for discussion see Labov 1972b; Milroy & Gordon 2003; Becker 2013). Interviewees completed a perceptual dialectology exercise (see Preston 1989 for the model; for some recent examples see Bucholtz et al. 2008; Campbell-Kibler 2013; Evans 2013) in which they indicated on maps of the United States and of Missouri and Kansas where people "speak different from the way we do in Kansas City." I will explore responses to this exercise in future research.

Interviewees then read passages, which were constructed to include a number of tokens of words with vowels of particular interest in this study—especially those that might be affected by merger of LOT and THOUGHT (see Chapter 3) or the conditional mergers of pre-nasal KIT and DRESS (Chapter 4) and various back vowels with following /l/ (Chapters 5 and 6). The reading passages were written by Matthew Gordon, and were included in the interviews used in Gordon and Strelluf (2012). Most interviewees read the passages labeled “Reading Passage 2” and “Reading Passage 3” in Appendix B. The members of the K family (who were the first people interviewed for this study) read Reading Passage 1, but Lisa K, later called me to voice her concerns that the passage contained the word *thong*, which she found objectionable. (She explicitly allowed me to keep the data from her and her kids in my study.) I switched to the other passages for all other interviewees.

Next, participants responded to a set of ten sentences that contained grammatical features identified by Murray and Simon (2006) as indicative of Midland speech. They were asked to indicate whether each sentence was something they could say, something they had heard, or something they had never heard. These results will also be explored in future research.

Interviewees then read a list of 205 words, selected to show various vowels in a range of phonetic environments. The list also included several tokens of local interest for regional or social variation (e.g., *roof*, *Plaza*, *Missouri*) and several local place names that were included to potentially elicit social commentary (e.g., *Holmes*, *Prospect*, *Wornall*, and *Troost* are major streets in KCMO that run north to south near the boundary between the traditionally African American east part of the city and the historically white west part of the city).

Finally, interviewees read a set of fifteen minimal pairs and were asked to indicate whether the vowels in the words sounded the “same,” “close,” or “different.” These focused especially on potential vowel mergers and conditional mergers. A few pairs—*dew-do*¸ *reed-read*, *know-no*—were included as controls (though there was some variability in *dew-do*). I mean “control” in the sense of Gordon (2006a), that I did not expect these pairs of words to be pronounced differently by most Kansas Citians, so a response that they were perceived as different by an interviewee might indicate that they were responding to expectations about the minimal pairs test rather than actual phonetic/phonemic information (i.e., they believe that the “right” answer to the test is that all pairs sound different). Such responses would offer some qualification of responses of “different” to minimal pairs that actually are under investigation, in the event that I judged them to be pronouncing the minimal pairs the same. Additionally, the pair *hair-her* was included to test for the spread of the conditional merger of SQUARE and NURSE in St. Louis African American English among African Americans in Kansas City, but functioned as another control for white interviewees (in this case, suggesting that some minimal pairs should be pronounced differently, as opposed to a pair like *know-no*). The pair *but-bet* was included to test whether the proposed fronting of STRUT might be infringing on the space of DRESS, but again appeared to serve as a control for most interviewees, who generally perceived them as obviously different. These minimal pairs responses form an important set of data because they can test both perception (i.e., whether a person believes vowels are merged or distinct) and production (i.e., whether I judged their productions to be merged or distinct). They are also the context where speakers are presumed to be paying the most attention to their speech, so they are the most likely interview task for variation to occur as a result of sociolinguistic evaluation of a given variable (so that if people judge the merger of LOT and THOUGHT negatively, they are most likely to pronounce them most distinctly in the minimal pairs test).

In my results below, I try to be explicit about the interview task from which data is being drawn. Ideally, it would be possible to draw all analysis from casual speech (CS), since this is presumed to be the context that most resembles the way people "normally" talk. However, because some phonetic environments occur less frequently than others in my CS sample, it is often necessary to flesh out data by considering the more controlled interview tasks of reading passage (RP), word list (WL), and minimal pairs (MP).

Including these additional contexts is also often necessary for comparisons that take socioeconomic class into consideration. Many of the interviewees whom I have labeled as "working class" were on much more restrictive schedules than those I've labeled "middle class." For instance, I interviewed John (middle class) and Jerry (working class) during lunch breaks at the place where each man worked. John's "lunch hour" was a time he could elect to take depending on his schedule, and was open-ended in terms of how long it lasted (in fact, John and I met for more than an hour and he apparently ate his lunch later). If people walked by the meeting area where we were working, there appeared to be a presumption that John was engaged in some sort of important or worthwhile work. By contrast, Jerry's lunch hour was a set period of about forty-five minutes. He ate quickly during the informed consent briefing and during the perceptual dialectology portion of the interview. He checked in and out with a supervisor and, after our interview was over, cut his break short so that he could fill in for Mark while I interviewed him. In other words, socioeconomic class correlates with personal autonomy at work. In interviews, middle class people could often talk for as long as the conversation interested them, which had the practical effect that they often lasted much longer. Working (and transitional) class people were much more subject to external controls, and often assuming fairly substantial personal inconvenience to accommodate my interview. So, their time was more tightly constrained. As a result, in terms of vowel measurements I was able to collect, the combined output of all working and transitional class speakers is about the same as the combined output of middle class speakers. In my results below, it will frequently be necessary, then, to include more interview tasks in considerations of results to increase the relative balance of working and transitional class interviewees against middle class interviews. When I use CS, RP, WL, and WP speech together, I label it "interview speech."

On average, interviews lasted about one hour. This meant roughly thirty to forty-five minutes for casual speech, and roughly fifteen minutes for the more formal tasks. Some interviews, especially with middle class people, lasted much longer, and often included a great deal of additional talk after the formal tasks. While these segments of conversation would afford interesting comparisons and interesting commentary on the method of the sociolinguistic interview, in this research I include data only up to the final minimal pair.

All interviews were transcribed in ELAN, freely available software from the Max Planck Institute (e.g., Wittenburg et al. 2006). An annotation tier was created for each participant in an interview. Tiers were also created to account for background noise and to mark different interview tasks. Speech was transcribed in "breath units"—typically two to three seconds each, accounting for unbroken periods of speech between breaths and other pauses. All sounds were transcribed, including linguistic utterances, speech errors, false starts, laughs, coughs, etc. Any audible background noise was also marked as {NS} per FAVE documentation (see below).

2.5. Measuring Vowels with FAVE

Vowels from the fifty-one interviews included in this study were measured using the University of Pennsylvania's FAVE suite (Rosenfelder et al. 2011). FAVE works in two stages. First, FAVE-align, based on the Penn Phonetics Lab Forced Aligner (Yuan & Liberman 2008), aligns the acoustic signal with an orthographic transcription (this is "Forced Alignment"). Second, FAVE-extract, based on the work of Evanini (2009) and further developed by Ingrid Rosenfelder and Josef Fruehwald (see Fruehwald 2013:46), measures and normalizes all vowels in the recording based on the aligned file (this is "Vowel Extraction"). Evanini (2009), which first presented and utilized the technology that became FAVE, provides an extensive discussion of the underlying architecture of FAVE. Fruehwald (2013) describes improvements to Evanini's (2009) scripts in the current version of FAVE, which include a speaker-based check on measurements and a more complex method for selecting the measurement point in vowels. Labov, Rosenfelder, and Fruehwald (2013) provide a succinct overview of the suite. Gordon and Strelluf (2012) and Labov (2012b) are early uses of FAVE in research, but its usage is becoming increasingly widespread among sociolinguists. FAVE is available as downloadable scripts which can be run locally, or through the University of Pennsylvania website. I used the web-based version for this research.

Following a practice employed widely in sociolinguistics since Labov, Yaeger, and Steiner (1972), I use measurements in Hertz (Hz) of the first two formants (F1 and F2) taken at a single point in a vowel's duration as acoustic cues of tongue height and backness at the point of maximum inflection. F1 corresponds to height, with lower F1 values reflecting a higher tongue position and higher F1 values a lower tongue position. F2 corresponds to frontness, with higher values reflecting fronter tongue position and lower F2 values reflecting backer tongue position. FAVE-extract allows users to set several parameters related to this tradition of measuring F1 and F2. Probably the most important are maxFormants and measurementPointMethod. MaxFormants sets a Hz value as the upper limit for the Linear Predictive Coding (LPC) window that FAVE-extract will use to identify formants. Following FAVE (and Praat) documentation, I set this at 5000 Hz for males and 5500 Hz for females. MeasurementPointMethod determines the point within a vowel at which measurements will be taken. Again, I used the setting recommended in FAVE documentation, FAAV (Forced Alignment and Automatic Vowel Analysis). FAAV was modified over time from Evanini's (2009) method, which found that in a pool of *ANAE* data, measuring vowels at one-third of their duration best replicated *ANAE*'s hand-coded results. FAAV uses the one-third method for all vowels except PRICE, FACE, MOUTH, GOAT, and GOOSE with coronal onset. For PRICE and FACE, FAAV measures at F1 maximum. For MOUTH and GOAT, FAAV measures halfway between the beginning of the vowel segment and maximum F1. For GOOSE after coronals, FAAV measures at the beginning of the vowel segment. In all cases, measurements of diphthongs reflect the vowel nucleus and not the glide. The FAAV setting for measurementPointMethod is used in recent studies based on FAVE, including Labov, Rosenfelder, and Fruehwald (2013) and Fruehwald (2013).

Rather than repeat technical descriptions provided elsewhere (especially in Evanini 2009 and Labov, Rosenfelder & Fruehwald 2013), in this discussion I will focus on the points of FAVE's architecture that are most likely to cause errors to be introduced into a user's data. I will extol the virtues of FAVE a bit further below, but here note that the growing use of FAVE among sociolinguists is not without potential pitfalls. By design, FAVE has limits to its functionality in terms of how well it works for various dialects of American English and how well it works for different dialect features. Researchers who use it as a blunt tool will get lots of data to work with quickly, but their data will almost surely be flawed in ways that may not be immediately apparent. Researchers need to be cognizant of FAVE design factors that may create bad measurements so that they can build (often study-specific) tools to increase the integrity of their data.

FAVE-align uses the Carnegie-Mellon University (CMU) Pronouncing Dictionary (Lenzo 2013) to align sound files with their orthographic transcriptions. The CMU Dictionary is a machine-readable script, developed primarily to support speech processing and speech recognition software. Users may also upload a custom dictionary written in the CMU Dictionary's ARPABet coding to supplement the CMU dictionary. FAVE-align appears to pull machine-readable transcriptions from this custom dictionary first, and from CMU second. (My custom dictionary grew to 364 words over the course of my research, but I added multiple potential pronunciations for most of the entries, raising the count of custom entries to well over one thousand.)

When the resulting aligned script is processed through FAVE-extract, FAVE-extract measures vowels in the manner selected by the user (e.g., at one-third of vowel duration, at peak F1, etc.). In doing so, it actually generates a set of possible measurements based on manipulations that a human using LPC software might make—for example, changing the number of formants that LPC identifies. It then compares each set of measurements for a given instance of a vowel against all values measured for that vowel in *ANAE*. FAVE-extract determines the single measurement (i.e., the F1 and F2 pair) that, based on *ANAE* distributions, is most likely to be valid. It keeps that measurement and discards others. If, based on *ANAE*, no measurement is likely to be valid, the vowel is discarded. In a second pass, FAVE-extract again looks at each individual vowel measurement, and this time compares each one to the speaker's overall distribution of measurements for that vowel class. Any that are found to be extreme outliers are discarded.

These processes provide measurements for F1 and F2. FAVE-extract then uses the FAVE-align file to mark vowels for a number of environmental factors (which, because they are based on the FAVE-align file, are ultimately again based on the CMU Dictionary renderings). Environments include following manner (free [syllable-final], stop, affricate, fricative, nasal, /l/, /r/), following place (free, bilabial, labiodental, interdental, alveolar, palatal, velar), following voicing (free, voiceless, voiced), preceding segment (free [syllable-initial and /h/], oral labial [/p/, /b/, /f/, /v/], /m/, alveolar and interdental obstruent [/t/, /d/, /s/, /z/, /θ/, /ð/], /n/, palatal [/ʃ/, /ʒ/, /ʤ/, /ʧ/], velar, liquid, obstruent+liquid cluster [/tr/, /gl/, etc.], glide [/j/,/w/]), following segments (the number of syllables occurring after the vowel), and stress (unstressed, primary, secondary). There are additional codings, but this list reflects the elements I use in this research.

FAVE provides this information for every vowel that it determines it has measured accurately. FAVE-extract returns a file of raw data, which also includes measurements for F3 and, in addition to the Hz measurements, Bark values. It also returns a file of data normalized using the Lobanov (1971) transformation. Normalization is necessary to account for the acoustic differences that result from biological differences in vocal tracts—e.g., because adults have physically longer vocal tracts than children, the harmonics formed in an adult's vocal tract for a given vowel will necessarily have lower frequencies than the same vowel being produced in a child's vocal tract (e.g., Thomas 2001, 2011). Moreover, since every human's vocal tract is unique, every human produces vowel harmonics uniquely. Without transforming frequency measurements to account for these physiological differences, vowel measurements for one speaker cannot be compared directly to those of another. Normalization procedures seek to replicate the normalization that a hearer's brain does in processing language. A good normalization routine will eliminate differences in measurements that arise from physiological factors while maintaining differences that are due to sociolinguistic variation (cf. Labov 1994, 2001; Thomas 2001, 2011:160-171; Adank et al. 2004; Labov, Ash, & Boberg 2006:39-40). The Lobanov transformation, which FAVE employs, is a vowel-extrinsic method, meaning that it uses measurements of multiple vowels to calculate a "grand mean" by which each individual vowel may be normalized. Specifically, in the Lobanov method the quotient of the mean and standard deviation of each formant of all vowels is subtracted from each formant of each individual vowel.

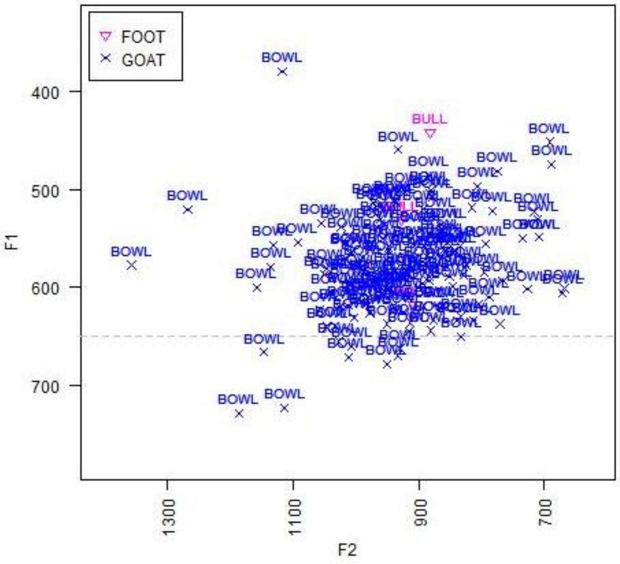
The measurements returned by FAVE can be used with any program that can interact with text worksheets. I wrote scripts in R (R Core Team 2013) to handle all FAVE outputs and generate all calculations and vowel plots in this research. Earlier versions of the same scripts were used in Gordon and Strelluf (2013, forthcoming). I am currently modifying these scripts into less project-specific versions which will be publically available online.

In practical terms, two essential and interrelated aspects of FAVE's architecture introduced errors into my data: alignment based on the CMU Dictionary and the comparison of speaker outputs to the database of F1 and F2 values drawn from *ANAE*. A fairly simple case is the word *twang*. This word occurs several times during interviews, typically during discussions of regional dialects, and interviewees pronounce it [twæŋ] or [tweɪŋ]. CMU's entry for *twang*, however, transcribes it with the vowel in LOT. Because FAVE-align's interface with CMU does not actually evaluate the way something is pronounced, but rather simply delineates boundaries (e.g., a consonant-vowel transition), FAVE-align would return a machine-readable transcription of T W AA1 NG in ARPABet. This corresponds to the pronunciation [twɑŋ], so that this instance of a TRAP vowel would be actually coded as a LOT vowel. In a sense, this is the sort of error that the check against *ANAE* values should catch—it should simply be the case that the measurement is outside the range of existing LOT vowels and would, therefore, be counted as a bad measurement and dropped from the FAVE-extract output. However, because LOT fronts in the direction of TRAP in the Northern Cities Shift, a TRAP-like production of a LOT token is within the range of observed variation in *ANAE*. So, *twang* is marked and measured as an extremely front LOT vowel, when it may actually be a fairly conservative TRAP vowel. This particular case is easily solved by adding an entry for *twang* into the custom dictionary and rerunning FAVE-align and FAVE-extract. But, given the tremendous amounts of data that FAVE returns, the error will be invisible to the researcher without careful checks at the token level (see below).

A similar, but slightly more complicated, issue arises in the case of relatively localized pronunciations. For instance, *poor* is generally pronounced with a FORCE vowel in Kansas City, rather than the CURE vowel that might be used in some other dialects (cf. Wells 1982:162-165). CMU contains only the transcription (albeit, with the GOOSE vowel rather than the FOOT vowel that Wells 1982 uses for CURE) P UW1 R, for [pur]. Two issues emerge here. The first is that phonetically [o]-like productions of *poor* will be marked as members of the GOOSE class, which may not accurately represent their phonemic assignment in Kansas City. The second is that, if the FORCE-like productions of GOOSE are not widely distributed across the United States, *ANAE* will not contain values to suggest that the measurements in the range of FORCE are possible values for GOOSE. These will then simply be dropped, unbeknownst to the researcher.

This can be a significant consequence for data, and unfortunately will most affect sound changes that were not of interest to researchers working on *ANAE*. For instance, during interviews I noted a relatively high degree of conditional merging among younger interviewees between GOAT and FOOT when followed by /l/ (see Chapters 5 and 6 for discussion). Impressionistically, words like *bull* and *pull* are pronounced with something close to [o], so that they are occasionally homophonous with *bowl* and *pole*. This conditional merger was not explored in *ANAE*, which instead explored the conditional merger of GOOSE and FOOT before /l/ (e.g., *pool* and *pull*—cf. Ash 2006:42-43 for notes on pre-/l/ FOOT in *ANAE*). As such, a production of *pool* as [pʊl] and even *bull* as [bul] would be within the range of possible measurements and retained in FAVE outputs, but a production of *bull* as [bol] would appear to be outside the realm of possibility. It would be discarded. During my first round of FAVE analysis on all my interviews, FAVE returned a total of just thirty-seven tokens with pre-/l/-FOOT—minimally, since *bull* and *pull* both occur in RP and MP, even with conservative standards for validating data there should have been around one hundred tokens of these. Figure 2.5 illustrates the problem, plotting all tokens of the minimal pair *bowl* and *bull* prior to error correction.

Figure 2.5. FAVE-measured tokens of *bowl* and *bull* prior to error checking



The dashed horizontal line in Figure 2.5 is plotted at a mid-height of 650 Hz in F1 as a reference point for comparing charts. (This line appears in plots throughout this study, as is a vertical line at a central position of 1550 Hz in F2.) Figure 2.5 visually demonstrates that *bull* was largely omitted from FAVE's analysis. This effectively precludes exploration of a potentially interesting sound change. It also could, potentially, over-represent the presence of the merger of pre-/l/ GOOSE and FOOT, since those tokens would be more likely to pass the FAVE error-check based on *ANAE* exemplars.

This issue for the pre-/l/ merger of GOAT and FOOT, as well as locally specific pronunciations like *poor*, cannot be solved quite as simply as *twang* could. Creating a dictionary entry to force FAVE-align to mark *bull* as B OW1 L would potentially change the direction of the problem so that higher productions (e.g., people who merge *pull* with *pool*) would be rejected. This reassignment would also presume the conditional merger rather than explore it, and without some control to split the classes back out, the potentially infelicitously combined vowel classes could throw off measurements of the actual vowel class (i.e., a measurement of a token of *bull* that is phonemically assigned to FOOT would be measured as a token assigned phonemically to GOAT). Creating multiple entries for FAVE-align to use (e.g., one entry for *bull* assigned to GOOSE, one entry assigned to FOOT, one entry assigned to GOAT) would also not quite be right, because you would then potentially divide the word among the three classes, which could hide a merger—I will discuss this issue with regard to the LOT and THOUGHT classes below.

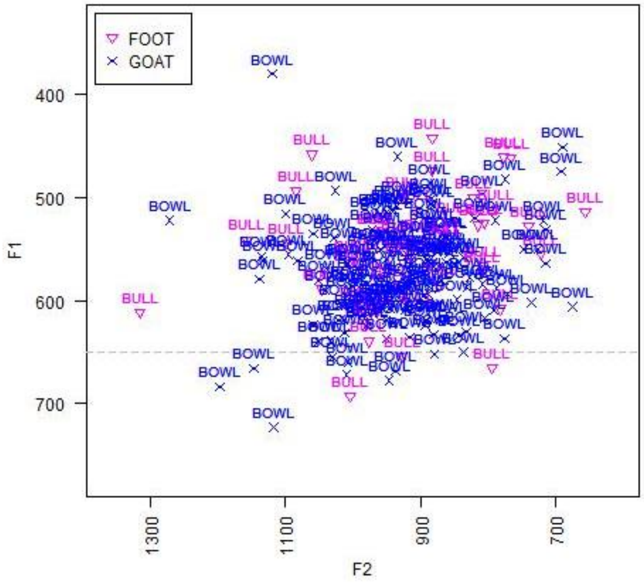
In other words, without controls implemented locally, FAVE will not be maximally effective if a pronunciation under exploration is either not included in the

CMU Dictionary or was not researched in *ANAE*. For me, this required running all my data through FAVE a second time after vetting my initial run of data for errors. Before rerunning my data, I built a custom dictionary entry for every word that appeared to be missed in FAVE analysis in a way that was attributable to the CMU Dictionary or the *ANAE* cross-check. Each entry contained the range of phonetic outputs I had heard in interviews. For example, the entry for *poor* included P UW1 R [pur], P UH1 R [pʊr], and P OW1 R [por]. These entries will then cause FAVE-align and FAVE-extract to consider the vowel in *poor* against productions of all three vowels in *ANAE* data, making it much more likely than the measurements will be included as valid. This approach must be used with restraint—each additional class that is used to consider a vowel potentially decreases the effectiveness of FAVE-extract's built-in error-checking, meaning the erroneous measurements (e.g., FAVE-extract measures F3 as F2) would be introduced. So, the researcher should only expand the custom dictionary to match outputs with a high probability of occurring in data.

I then wrote a script in R that would recode all occurrences of each of these dictionary entries into the vowel class that they are assigned to in Wells (1982). When it was apparent that a regular pattern existed for dropping data within a certain vowel class or environment—e.g., pre-/l/ FOOT—I then went through the entire CMU dictionary and added entries for any word that might be effect by the CMU Dictionary and *ANAE* cross-check. I view this as somewhat critical (and as a point that highlights a pitfall for a researcher using FAVE without careful attention to quality control), because FAVE doesn't provide feedback on words that are dropped. So, unless a researcher looks word-by-word to see what words occurred in a transcription and were subsequently not included in FAVE outputs, the researcher will never know what data has been lost. Scripted interview tasks like RP and WL facilitate this, but it's practically impossible in casual speech. So, the researcher must identify entire classes that might be compromised by FAVE's architecture and plan for as many types within those classes as possible. It is also important to note that the CMU Dictionary is simply a list and, so, is insensitive to morphemes, meaning that adding an entry for *poor* will not address *poorly* and *poorer*; separate entries must be added for each.

Figure 2.6 plots every token of *bowl* and *bull* following my implementation of this error-checking and rerunning all interview data through FAVE.

Figure 2.6. FAVE-measured tokens of *bowl* and *bull* after error checking



Tokens of *bull* are much better represented in Figure 2.6 than they were in Figure 2.5. Where the initial run suggested that space might be closing between the minimal pair *bowl* and *bull* but that much more research would be needed to collect data, Figure 2.6

suggests a conditional merger with enough data to proceed with analysis immediately. Through this process of error-checking, the number of pre-/l/ FOOT tokens measured by FAVE increased from thirty-seven to 236. The number of pre-/l/ STRUT tokens (not discussed above, but also subject to being dropped by FAVE—see Chapter 6 for analysis) grew from 121 to 189.

While these errors are a result of entries and measurements being under-represented in CMU and *ANAE*, over-representation also introduces errors. In other words, if pronunciations that phonetically correspond to several phonemes occur in both CMU and *ANAE*, productions in a user's data can be inadvertently divided among those phonemes. Here it is critical to keep in mind that the CMU Dictionary is designed to facilitate speech recognition, rather than linguistic analysis. As such, a linguistic concept like lexical class is irrelevant to CMU's designers, who are interested in representing likely pronunciations of a word so that sounds can be translated to machine-readable coding. Not surprisingly, then, if a merger is widely attested to, it will make sense for the dictionary to contain multiple entries for types within the affected classes that reflect both merged and non-merged productions. A word like *caught*, then, which may be pronounced as either [kɔt] or [kɑt] for a variety of dialectologically relevant reasons, including the presence or absence of the low back merger and the Northern Cities Shift (not to mention potential raising patterns in cities like Philadelphia and New York City or vowel breaking in the South), is represented in CMU by the entries K AA1 T [kɑt] and K AO1 T [kɔt]. In fact, many words in the LOT and THOUGHT classes are included in the CMU Dictionary with both vowels.

This is desirable in speech recognition, but problematic for dialectologists. The practical effect is that productions of, e.g., *caught* that are LOT-like will be marked by FAVE-align with LOT vowels and included in FAVE outputs accordingly, and productions of *caught* that are THOUGHT-like will be aligned and analyzed as THOUGHT. So, if a speaker is merged in LOT and THOUGHT, but sometimes produces tokens with [ɑ] and sometimes with [ɔ] (see Chapter 3), FAVE will analyze their [ɑ] productions as LOT and their [ɔ] productions as THOUGHT, even though it is the same type being distributed across those two classes. This would have the effect of creating a phonemic distinction where there is none. It is entirely possible for FAVE to generate an analysis that a speaker with a statistically significant distinction between *bought* and *caught* as LOT types and *bought* and *caught* as THOUGHT types.

There are also a number of problematic entries in these classes more nearly related to issues described for, e.g., *poor*, above. For instance, *frog*, is transcribed only with the LOT vowel, though its assignment to LOT and THOUGHT is highly variable across dialects (Labov, Yaeger & Steiner 1972). The word *on* is included with both LOT and THOUGHT, though these phonemic assignments are historically fairly well set in the North (LOT) and South and Midland (THOUGHT) in the United States.

So, language researchers must be aware that the very phenomena that they might wish to study—in this case the widespread merger of LOT and THOUGHT—may cause CMU to introduce problematic phonemic assignments that will make it impossible to study those phenomena in the data FAVE returns. Here, it is critical not to try to solve the problem strictly on the custom dictionary side (i.e., the solution for bad entries in CMU, like *twang*), but to recode entries after they are generated by FAVE. Forcing the dictionary to analyze a historically THOUGHT word as THOUGHT could cause the resulting token to be dropped during FAVE-extract if the production was especially LOT-like. (In practical terms, this specific case is unlikely since there are presumably many LOT-like productions of THOUGHT words in *ANAE*, but I intend for this advice to generalize to mergers that were not being explore closely by Labov, Ash & Boberg 2006.) Instead, FAVE outputs should be recoded before they are analyzed. Again, in the case of my data, I wrote an R script to recode FAVE outputs according to historical classes in Wells (1982). In the case of *on*, I also used this script to code *on* as a THOUGHT word, based on its historical assignment in the Midland (see, e.g., Ash 2006:45) as well as productions by Kansas Citians born in the late nineteenth century studied in Gordon and Strelluf (2013, forthcoming), who were not merged between LOT and THOUGHT and pronounced *on* as [ɔn].

A smaller set of problems may arise with regard to preceding and following segments in FAVE outputs, especially resulting from a lack of sensitivity to meaningful differences in segmental effects on vowels. Cases of following /l/—where following /l/ can have a lowering effect on F2 that may result in a set of backer productions relative to other members of a vowel class (e.g., Thomas 2001, 2011:126)—proved especially important to note in my data. The obvious way to explore this effect is to use the subset of the vowel that FAVE outputs have marked as having a following manner of /l/. However, in the case of pre-/l/ GOOSE, for example, the words *tool* and *truly* would both be marked by FAVE as GOOSE with following manner of /l/. The syllabic boundary between the root and derivational morpheme in *truly* blocks the backing effect of /l/ on the vowel, which means it is not conditioned in the way that the vowel in *tool* is when /l/

is the syllabic coda. The only practical solution I found to this was to add limits based on FAVE-marked following segment in cases where the effect of following /l/ was of central importance to analysis (e.g., for the mergers under consideration in Chapter 5). This solution means that in more general data, there are tokens rolled in that do not belong there. These are unlikely to have much effect as long as sample sizes are large, but should be noted as possible issues.

Finally, it is important to note once more the broader consequence that the CMU Dictionary is intended to be used for speech recognition rather than linguistic analysis. The lexical sets I refer to frequently in the discussion above are linguistically important for understanding language as something that changes diachronically from one production to another. As such, it is useful for a linguist to understand that *force* and *four* were at one time frequently assigned to the GOAT (FORCE) class and *north* and *forty* were at one time assigned to the THOUGHT (NORTH) class, but are now generally all assigned to a single merged class. This historical distinction is irrelevant to speech recognition, and the CMU Dictionary assigns them all to the THOUGHT class (or, more accurately, codes them all as AO1). The solution implemented in Gordon and Strelluf (forthcoming) was to write an R script that recoded types into the lexical sets established in Wells (1982). This solution was expanded for my research here, and scripts now recode hundreds of types into sets like CLOTH, PALM, CURE, and START and corresponding vowels (/ɔ/, /ɑ/, /ʊ/, and /ɑ/, respectively) to reflect my research needs. Other research projects might see similar needs for, e.g., the BATH or SQUARE classes. All such decisions reflect research priorities, and potentially channel data toward certain types of exploration and outcomes.

This is all to say that researchers using FAVE for acoustic analysis must do so with an awareness of how the underlying architecture of the suite, particularly with regard to the composition and aims of the CMU Dictionary and the research focuses of *ANAE*, relate to the communities and features they are studying. Differences between a researcher's specific project and FAVE's design features may limit a researcher's ability to use FAVE to derive meaningful results or, worse, may even lead the researcher toward the wrong conclusion (as in the case of the LOT-THOUGHT merger). Implementing scripts to expand what CMU and *ANAE* measure without undermining FAVE's error-checking, to avoid presupposing the presence or absence of various changes in data, and to maintain the general integrity of data requires a very conscious approach to FAVE.

If such controls are built into a study, it is hard to overstate the potential opportunity that FAVE creates for language researchers. It opens possibilities for researchers to work from tremendous volumes of data. Fruehwald (2013:48), for instance, draws on measurements of 735,408 vowels in his study of Philadelphia. Labov, Rosenfelder, and Fruehwald (2013:37) estimate that FAVE can extract about 9,000 vowel measurements from a fifty-minute interview (elsewhere, 2013:35, they suggest a range of 3,000 to 9,000 measurements). My average for a good interview was nearer to 1,000 vowel measurements per ten minutes of interview speech—in some cases interviewees were more talkative and produced more measurements, in some cases interviewees were less talkative (or I was too talkative) and produced less. Group interviewees also produced fewer tokens. Even so, this yields amounts of data that are an order of magnitude larger than what a single researcher could do by traditional methods (Labov, Rosenfelder & Fruehwald 2013:35 estimate a rate of 300 to 350 measurements per forty hours of hand-coding.)

Perhaps as importantly, the researcher can direct attention away from the mundane task of finding vowels and measuring them, and toward the task of analyzing the psycho-social content of data. In other words, a researcher can let a computer do the work of figuring out the values of F1 and F2 of LOT and THOUGHT in Hz, and instead work through the much more human element of determining whether the interviewee recognizes a difference in productions or whether those productions carry a social meaning for the interviewee. Measuring formants is, in a perfect world, the type of work that a computer should be able to do. Analyzing the sociology of language is a better focus for humans. FAVE, used critically, creates the possibility of establishing that division of labor. This can result in analysis that is both more statistically reliable (because of volume) and more sociologically meaningful (because of analysis).

2.6. Kansas City Data

The fifty-one interviews included in this research resulted in 156,729 FAVE-measured vowels following the error-checking procedures described in Section 2.5. I added a script that allowed me to optionally exclude a subset of words from the data pool. These “stop words” include thirty-three types from Evanini (2009:48) based on their susceptibility to reduction. They also include words that emerged during my error checking as problematic to broader analysis. The final list of my stop words is:

> *a*, *am*, *an*, *and*, *are*, *as*, *because*, *but*, *can*, *da*, *didn't*, *eh*, *er*, *for*, *get*, *gets*, *getting*, *gonna*, *had*, *have*, *has*, *he*, *he'd*, *he's*, *Holmes*, *huh*, *I*, *I'd*, *I'll*, *I'm*, *I've*, *is*, *it*, *it'd*, *it'll*, *it's*, *its*, *like*, *my*, *nah*, *of*, *oh*, *or*, *our*, *ours*, *she*, *she'd*, *she's*, *that*, *that's*, *the*, *them*, *then*, *there*, *they*, *they're*, *this*, *to*, *uh*, *um*, *wanna*, *was*, *wasn't*, *we*, *we'd*, *we're*, *we've*, *well*, *ya*, *yeah*, *you*, *your*, *you're*

A few of these further emphasize the need to do careful error-checking throughout analysis of a huge pool like that created by FAVE. The frequent occurrence of *like* as a discourse marker (DM), for example, makes it one of the most heavily represented types in my data (*n* = 3,285). While it would be possible to rig a code into the transcription process that would allow DM-*like* to be analyzed separately from, e.g., verbal *like*, I did not do so in this research. Impressionistically, though, DM-*like* was frequently produced with a mid-central vowel. In fact, the mean value of all tokens of *like* in all interviewees casual speech (which includes some non-DM-*like*) in F1 is 725.7 Hz, while the mean F1 of *liked*, *likes*, and *likely* is 773.0 Hz. If *like* is included in results, the mean F1 value for all CS tokens of the PRICE vowel with a following /k/ is 728.1 Hz (*n* = 3,308). If *like* is excluded, the mean F1 value of PRICE with following /k/ is 812.8 Hz (*n* = 91). This suggests strongly that DM-*like* has a unique reduced or raised production that distinguishes it from other PRICE types and even from other uses of *like*. If *like* is included in analysis, especially because of its high frequency of occurrence, it suggests that PRICE is being produced higher in vowel space that it actually might be.

The KCMO street name *Holmes* presents a different issue. It is typically pronounced by interviewees as /holmz/, with an F2 in the range of 850 Hz. However, a few productions are more central, with F2 as high as 1297 Hz for one token. These fronter productions come from speakers who call the street /homz/, losing the backing effect of the following /l/. In many cases, it is difficult to judge whether a speaker is producing a reduced /l/ or actually saying /homz/, so the inclusion of this token introduces potential errors into the data if impressionistic coding cannot accurately distinguish whether an interviewee is saying /holmz/ or /homz/. As such, it is safer simply to make *Holmes* a stop word. (Researchers should be aware that similar cases arise with words like *palm* or *folk* that are more widely subject to variable pronunciation of /l/. Such words will typically be included as entries in the CMU Dictionary, so the task for the researcher is generally to assure that FAVE-align marks each pronunciation accurately, and then to write scripts that account for whether or not a following /l/ is marked in a given token.)

Because of the high incidence of words like *I*, *that*, and *like*, removing stop words reduces the size of my pool by 49,123 vowels to 107,603 vowels. They can be reintroduced into the data at any time since a script removes them on the fly, but all research below excludes these stop words.

While Fruehwald (2013:46) notes that the error-checking procedures in FAVE eliminate almost all gross errors in measurement, I still performed a long series of error-checks beyond those described above as general notes on using FAVE. First, to verify that my data were normal in a statistical sense, I checked the data visually by density plot and quantile-quantile (Q-Q) plot. Examples of these are displayed in Figures 2.7 and 2.8, limited to tokens of GOAT in casual speech with following stops (*n* = 773). In Figure 2.7, the dashed lines represents a perfectly normal distribution based on the sample mean. The solid black line shows the actual distribution of F1 and F2. The more the solid lines resemble the dashed lines, the more normal the distribution. In Figure 2.8, the solid line represents a theoretical normal distribution of values. The open circles represent the observed values (the top chart is F1, the bottom is F2). Again, the closer the fit between circles and the solid line, the more normal the distribution. Using these graphical tools, I checked each vowel for normal distributions in the context of each following manner environment.

Figure 2.7. Density plot of GOAT with following stop in casual speech

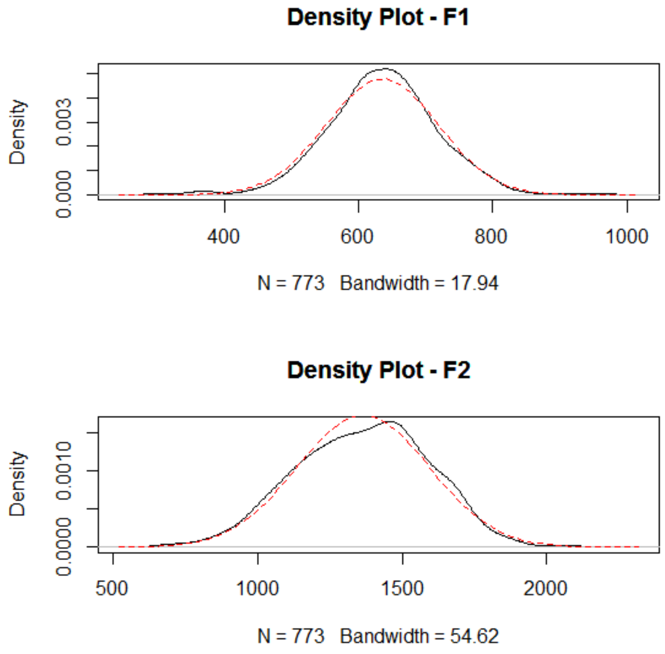
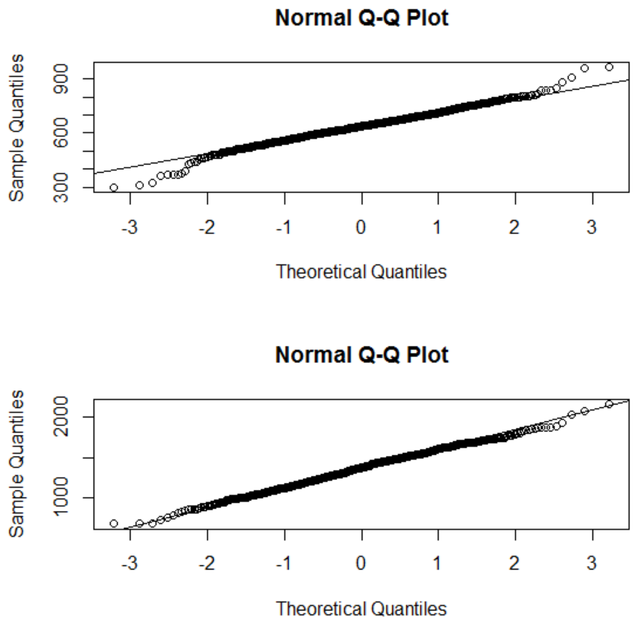


Figure 2.8. Quantile-quantile plot of GOAT with following stop in casual speech



Outliers (for example, the values at the left and right sides of the F1 Q-Q plot) were checked impressionistically by listening to the corresponding tokens to assess whether the outlier value seemed auditorily to be a feasible result. Often, outliers could simply be dismissed as bad measurements because of environmental noise, a sudden change in an interviewee’s volume, or some similar factor. These were simply marked for exclusion. Others weren’t so easily explainable, but were clearly bad measurements (e.g., a vowel would be measured with a high F2 but not sound markedly front). These, too, were marked for exclusion. Finally, some outliers seemed feasible. These were checked in Praat. If the FAVE measurement generally matched the LPC results in Praat, the FAVE measurement was kept. Otherwise, it was marked for exclusion. I wrote a script to automatically exclude all marked tokens from analysis.

After these error checks, I repeated the process to check all tokens with F1 or F2 measurements that were three standard deviations higher or lower than the mean for each vowel and following manner. These outliers were also checked impressionistically as described above and marked for exclusion as necessary.

Then, I randomly checked one vowel and one following manner for each speaker with a Shapiro-Wilk test for normality. For interviewees who were part of group interviews, I did this for both casual speech and formal tasks (though it was sometimes necessary to consider several following manner environments together to create token counts high enough for the Shapiro-Wilk test). If a test returned a significant value, meaning the data appear to be non-normal, I checked that class for outliers as above. I would then check another vowel and following manner for that speaker to determine whether there was a broader problem with the measurements for that speaker. While several speakers' tokens were excluded through this individual-focused step, the process revealed that generally all interviewees' measurements were roughly equally good.

Finally, throughout analysis, I looked at token distributions. As outliers emerged, I checked those impressionistically. Through this, more tokens were excluded.

As time-consuming as this was, this error-checking process only resulted in the exclusion of 169 tokens. This left a final pool of 114,859 vowel measurements, including 82,758 in which the vowel occurs in primary stress position. In terms of interview task, 66,767 of these vowels in primary stress position come from CS, 10,115 from RP, 9,509 from WL, and 1,367 from MP. In terms of class, 40,251 come from middle class interviewees, 15,035 from transitional class, and 27,472 from working class. Males contribute 38,283 vowels and females 44,475. Older interviewees produce 42,989 vowels versus 39,769 for younger interviewees.

Even though the quality-control measures of vetting data, removing stop words, and limiting to primary stress have made this pool of data much smaller than the initial number of 156,729 vowel measurements, this method has still produced a tremendous amount of data to use in the study of the dialect of Kansas City. Undoubtedly, even with error-checking methods built in to FAVE and then added for this study, any given measurement is less accurate than would be the same measurement done by hand. However, in this case, there is statistical safety in numbers. And this large pool of data should provide some assurance about the validity of conclusions about language in Kansas City that emerge.

2.7. Statistical Measures

I use several statistical measures to explore this data. Most frequently, I'll discuss F1 and F2 measurements as mean values. In plots of vowel space, means are generally derived directly from the normalized outputs of FAVE. In other cases, especially as I compare phonetic conditioning effects, stylistic variation in different interview tasks, and social correlations of language change, I estimate means using linear mixed effects regression (lmer) calculated with the {lme4} package (Bates et al. 2014) in R.

Lmer is a type of linear model. All linear models estimate the likelihood of correlations among sets of data. In the simplest form of a linear model, points are plotted in a two-dimensional space, with one vector of data represented on the x-axis and another vector on the y-axis. The best-fitting straight line is drawn through the plotted points. The model then returns a coefficient and intercept for the formula {y = coefficient * x + intercept}, which should allow for a y-value to be predicted based on a known x-value. A traditional linear model also returns a significance value (*p*) for the model, a standard (residual) error that remains after the model is implemented, and a coefficient of determination (R^2) that indicates how much observed variation in data can be accounted for by the model. An R^2 of 1 would indicate absolutely perfect correlation. Traditional linear models also return an adjusted R^2, which is a more conservative estimate of R^2 that takes into account the number of explanatory terms that have been added to a model. When I report R^2 values, I am reporting these more conservative adjusted R^2 scores.

A lmer modifies the traditional linear model by compensating for differences in the relative weights of vectors. In sociolinguistic analysis, the traditional linear model's assumption that all data are equal would mean that a corpus being analyzed should be perfectly balanced in terms of speaker social factors, the number of tokens individual speakers contribute to the corpus, and the phonetic conditioning effects on those tokens. In other words, if a sociolinguist were working with data drawn from a balanced set of speakers reading a word list, a traditional linear model would be basically suitable. However, in general in sociolinguistics, data are not nearly so balanced. Speakers who talk more produce more tokens and, therefore, produce disproportionately large effects on models. Word frequency in naturalistic data further precludes balance. A word that occurs often in speech will have a larger effect on a linear model than a word that occurs less frequently.

Mixed effects models mitigate these concerns by allowing random factors to be added to the linear model. The size of the random factors is taken into account in calculating the coefficients and standard error for each fixed effect, so that they take on roughly the same relative weight in the construction of the model. Johnson (2009, 2010) demonstrated convincingly that mixed effects models were more suitable than fixed effects models for the types of data that sociolinguists collect and mixed effects models have since grown increasingly popular among sociolinguists.

Following Johnson (2010), in lmer models I include "speaker" and "word" as random effects. In cases where I use lmer to estimate mean values for F1 and F2 for a vowel, the intercept can be interpreted as the mixed effects-measured mean for a reference condition (the intercept) and each coefficient can be interpreted as a value that should be added to the intercept to get some other condition. (Strictly speaking, the lmer outputs can be entered into the equation $\{y = \text{coefficient} * x + \text{intercept}\}$ and, where the factor being explored is a category instead of a number, $x = 1$.) To illustrate, Table 2.1 provides a lmer analysis of the effect of following voicing on PRICE F1 for all interviewees in CS. The "fv" before each entry in the first column indicates "following voicing" and the description immediately after (e.g., "Voiced") indicates the environment.

Table 2.1. Mixed effects regression of PRICE F1 for all interviewees in casual speech

Fixed Effects	Estimate	Std. Error	*t* value	Example
fvFree (Intercept)	861.964	6.909	124.75	*pry*
fvVoiced	-16.754	6.963	-2.41	*price*
fvVoiceless	-37.873	8.215	-4.61	*prize*

Here, PRICE in a free position is the intercept and has a mixed effects-measured mean of 862.0 Hz in F1. PRICE with a following voiced consonant has a mixed effects measured F1 mean 16.8 Hz lower at 845.2 Hz. PRICE with following voiceless has an F1 37.9 Hz lower at 824.1 Hz. A stylized R syntax to achieve the results in Table 2.1 would be lmer(PRICE Normalized F1 ~ Following Voicing + (1|Speaker) + (1|Word).

A point of statistical controversy is whether *p*-values can be calculated from mixed effects models. The authors of the {lme4} package that has grown to be the predominant tool for lmer analysis in R explicitly reject including significance calculations in the package, arguing that, because the F ratios used in the model are drawn from the same denominator, significance tests would be largely artificial (Bates 2006). To fill this gap, researchers sometimes use the older mixed effects regression packages {lme} and {nlme} to calculate *p*-values, or a Markov Chain Monte Carlo simulation is applied on top of lmer() using pvals.fnc() or mcmcsamp() from the {languageR} package (see, e.g., Durian 2012). It appears to be growing increasingly controversial, though, among R users whether this is a valid measure in mixed effects models or a case of wanting to report *p*-values for the sake of having *p*-values to report and, in fact, the {languageR} package recently removed *p*-value support (Baayen 2013). Rather than weigh in on this controversy, I am using lmer() straightforwardly as it was designed and not reporting *p*-values. So, the lmer models I present will be useful as analytic tools for calculating the relative effects of factors on changes in vowels, especially as a basis for comparison with visual inspection of vowel plots made from more traditionally derived means.

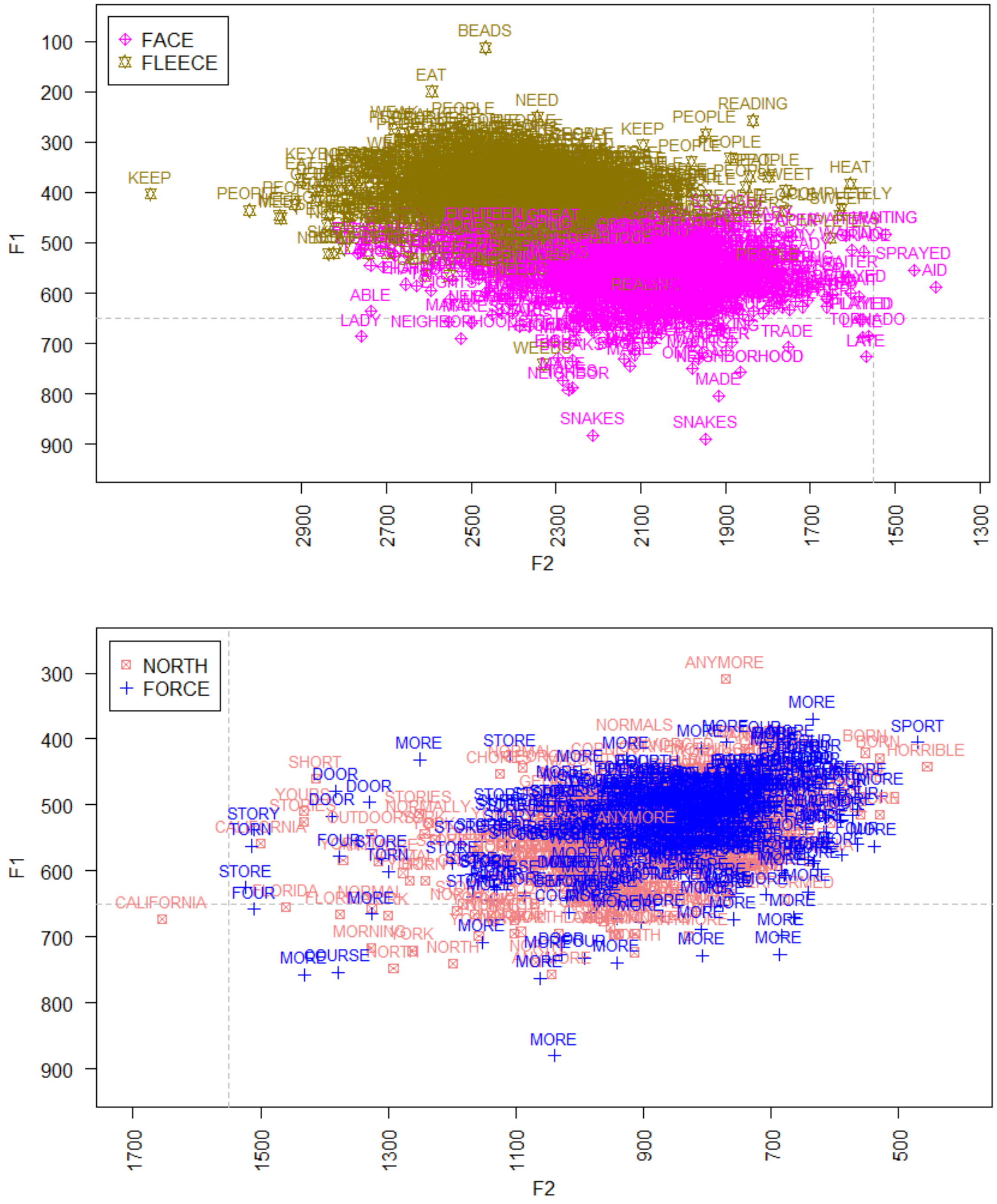
After initial estimates for vowel means are calculated, I'll use a series of other basic calculations and statistical methods to explore relationships and changes. Where sample imbalances are less problematic (e.g., when one interviewee's mean vowel measurements are compared against another interviewee's mean vowel measurements, rather than the two interviewees being combined and averaged), I'll use traditional fixed effects linear models. I'll use such linear models, for instance, to explore correlations between vowel measurements and interviewee birth years as suggestive of change in progress. Linear models will also be useful for exploring possible structural relationships between values—for example, in the case of a chain shift, a linear model might allow us to predict a speaker's productions of Vowel A based on their productions of Vowel B. (In these cases, where one numerical vector is being explored against another numerical vector, the outputs are still entered into the formula $\{y = \text{coefficient} * x + \text{intercept}\}$. However, now a number can be entered for x to estimate a value for y.) Like the mixed effects models, these fixed effects models calculate an R^2 value and residual error, but they also provide a *p*-value that can be reported less controversially.

Where distances between vowels are under exploration—especially in examination of potential mergers—a relatively conventional way to calculate this distance is by Euclidean (or Cartesian) distance. Euclidean distance measures a straight-line distance between the means of two vowels as plotted in a two-dimensional space defined by F1 and F2. These means can also be tested by Welch's Two-Sample *t*-Test to calculate a *t*-score and *p*-value. A low *t*-score suggests little difference between the two samples of measurements, and a non-significant *p*-value ($p > 0.05$) would indicate that the vowel samples are not statistically different. (However, it should be noted that studies of the low back merger, such as Herold 1990 and Johnson 2010, have frequently found statistically significant differences between LOT and THOUGHT even among speakers who they concluded were merged.)

I will also use Pillai scores to compare sets of vowels (Hay, Warren & Drager 2006; Hall-Lew 2010; Gorman 2012). A Pillai score is an output of a multivariate analysis of variation (MANOVA) test. Rather than calculating mean values, the Pillai score takes every data point into account. Given an explanatory factor, it reports how much dispersion exists across data points. More overlap generates a lower Pillai score and more dispersion a higher Pillai score. The MANOVA also returns a *p*-value to estimate whether the samples created by the explanatory factors suggest different populations.

Figure 2.9 provides a visual comparison of two degrees of overlap. On the top half of Figure 2.9, all tokens of FLEECE and FACE with a following stop in primary stress position from the CS of younger interviewees are plotted. The classes are close to one another in vowel space, but only overlap at the edges of their respective ranges and in a few exceptional tokens. On the bottom half of Figure 2.9, all tokens of NORTH and FORCE in primary stress position from the CS of younger interviewees are plotted. They show a great deal of overlap. NORTH-FORCE returns a Pillai score of 0.02465 (Euclidean distance = 45.81 Hz). FLEECE-FACE returns a Pillai score of 0.65887 (Euclidean distance = 310.98 Hz). In both cases, *p*-values are highly significant, which should be noted for future analyses. Likely this is a case of pooling all younger speakers into the MANOVA calculation. In large pools of data, a non-significant *p*-value combined with a low Pillai score should not necessarily be taken to mean that vowels are distinct for interviewees.

Figure 2.9. Casual speech tokens of FLEECE and FACE with following stops (top plot) and NORTH and FORCE (bottom plot) in primary stress position among younger interviewees



These different measures can occasionally be combined. For instance, it will be possible to calculate a Pillai score for two vowel classes for each interviewee, and then to create a linear model of each interviewee's Pillai score by birth year. This would provide an examination of dispersion among vowels as a change in time.

I'll also occasionally use an analysis of variation (ANOVA) test to compare the relative impacts of various factors. Typically, I will use this as an initial examination of social factors. Returning to measurements of PRICE from Table 2.1 above, Table 2.2 shows the output from an ANOVA for the social factors of gender and class in explaining variation observed in F1 and F2 of PRICE followed by a voiceless consonant.

Table 2.2. ANOVA of PRICE F1 and F2 for all interviewees by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	4680.4	4680.4	0.9225
Class	2	4245.3	2122.7	0.4184
Sex:Class	2	7106.8	3553.4	0.7004
F2				
Sex	1	46639	46639	3.0486
Class	2	1137	568	0.0371
Sex:Class	2	17470	8735	0.5710

I use {lme4} to generate mixed effects ANOVA results. These do not return the significance tests familiar from fixed effects ANOVA models, so the most important measure is the *F*-value, with higher scores suggesting that a factor accounts for a higher degree of observed variation in data. Table 2.2 suggests that gender may have the strongest relative impact on the F2 of PRICE.

This overview accounts for most of the approaches I'll take to exploring data in this study. I'll offer additional explanations in-text as necessary.

Chapter 3 begins the presentation of interview data captured and examined by these methods. It starts the study of the dialect of Kansas City by examining the low back vowel space occupied (traditionally) by the vowels in LOT and THOUGHT.

CHAPTER 3

THE LOW BACK VOWEL(S)

This chapter explores the vowels in words like LOT and THOUGHT. The configuration of these vowels is described by Labov, Ash, and Boberg (2006) as one of two key factors in determining the typology North American dialects and in spurring various ongoing sound changes (the other is the configuration of the TRAP vowel, discussed more in Chapter 4). Lusk (1976) suggests that the merger of LOT and THOUGHT was rapidly advancing in Kansas City in her study, especially among speakers born between 1940 and the early 1960s. Gordon (2006a) shows the continued progress toward merger among a younger pool of respondents to a written questionnaire. Gordon and Strelluf (2012), drawing on acoustic evidence, find the merger to be very advanced perceptually in Kansas City, but with lingering differences in the F2 dimension, with several speakers born in the 1980s who produced a distinction but claimed not to recognize one, produced no distinction but claimed to recognize one, or were variable in both production and perception. These observations of an advancing—but as yet incomplete—merger provide a starting point for examining sound change in Kansas City.

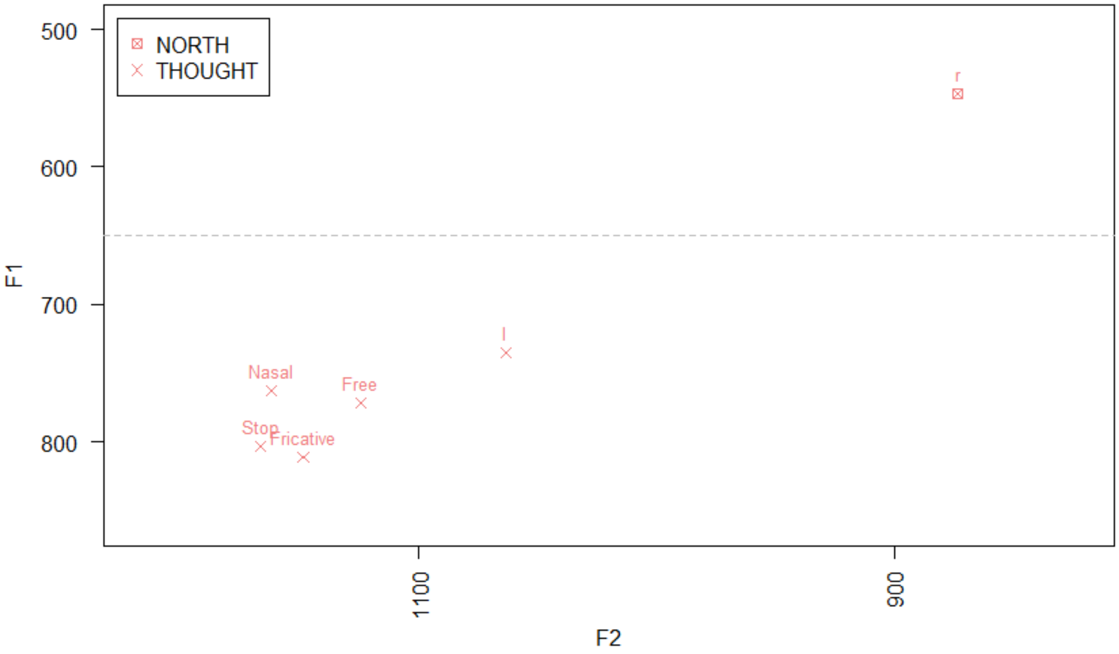
I will begin with a phonetic description of each vowel, exploring F1 and F2 against the FAVE-marked factors of following manner of articulation, following place of articulation, following voicing, preceding segment, and stress. Gordon (2001) shows the value of careful exploration of phonetic conditioning in identifying underlying effects on sound change and in complicating traditional models of chain shifting (e.g., the same conditioning factor might encourage a shift in one vowel while discouraging it in another, problematizing the assumption of a structural connection between the changes). This exploration of conditioning factors is intended to help identify key developments in each vowel, and to isolate specific phonetic environments for closer attention. Isolating environments in this way is particularly important for distinguishing between true diachronic changes and more general conditioning effects on vowels. Appendix C provides a list of general conditioning effects of consonants on the acoustic measurements of vowels.

Phonetic developments will subsequently be examined in the context of interviewees' productions and perceptions of LOT and THOUGHT in minimal pairs tests to evaluate the status of the low back merger in Kansas City. I'll also explore the data for interactions with social factors using a range of analytic approaches.

3.1. THOUGHT – Phonetic Conditioning

THOUGHT words with following /r/ (the NORTH class) will be omitted from this portion of analysis. Figure 3.1 shows the aggregated mean productions of THOUGHT tokens for all interviewees separated by following manner of articulation, which splits following liquids out from other manners. NORTH class words are clearly separated from the rest of the THOUGHT class, produced at a relatively high back position phonetically near [o]. If they are included in a lmer analysis, following /r/ generates a coefficient of -235.0 in F1 and -225.0 in F2. These extreme measurements collapse potentially meaningful differences among the other conditioning factors with no benefit besides giving a numerical value to something that is visually obvious. I will instead explore NORTH briefly in Chapter 5.

Figure 3.1. Distribution of THOUGHT by following manner in interview speech



Following /l/ will also be omitted from the first part of my analysis. Acoustically, /l/ generally results in lower F2 for vowels it follows (e.g., Ladefoged 1993; Thomas 2001). In the case of THOUGHT in this data, this creates a strong backing effect that derives a coefficient of -70.8 when it is included in the model. THOUGHT with following /l/ is also produced with lower F1 with a coefficient of -50.6, resulting in a raised vowel. These effects are particularly important to note because /l/'s classification in FAVE as a voiced alveolar would potentially obscure conditioning effects in place of articulation and voicing. To avoid this potential for skewing, following /l/ will be excluded from this first examination of conditioning effects. For those factors that remain, then, Table 3.1 shows conditioning effects on F1 of THOUGHT.

In terms of following manner, THOUGHT following nasals is produced highest in vowel space at about 761.4 Hz in F1. THOUGHT in free position is slightly lower, and

Table 3.1. Mixed effects regression of conditioning effects on THOUGHT F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmFree (Intercept)	777.43	11.13	69.85	*saw*
fmFricative	32.89	11.70	2.81	*lost*
fmNasal	-16.02	12.08	-1.33	*dawn*
fmStop	21.22	11.62	1.83	*fraud*
fpAlveolar (Intercept)	794.532	5.718	138.96	*across*
fpFree	-16.055	12.764	-1.26	*draw*
fpLabiodental	18.998	9.200	2.06	*soft*
fpPalatal	-5.622	21.731	-0.26	*wash*
fpVelar	-15.553	7.554	-2.06	*talk*
fvFree (Intercept)	777.677	11.352	68.50	*law*
fvVoiced	-6.124	11.936	-0.51	*cause*
fvVoiceless	27.849	11.489	2.42	*hawks*
psAlveolar or Interdental Obstruent (Intercept)	802.3968	7.1182	112.72	*taught*
psFree	0.7593	8.8440	0.09	*awesome*
psGlide	-29.5083	11.5233	-2.56	*walk*
psLabial (Oral)	-9.1137	12.7977	-0.71	*bought*
psLiquid	-39.9671	10.0242	-3.99	*launch*
psN	-11.7625	46.7875	-0.25	*naughty*
psObstruent+Liquid Cluster	-17.4494	10.9752	-1.59	*brought*
psPalatal	-18.9612	24.3159	-0.78	(*chocolate*)
psVelar	9.9851	11.4088	0.88	*coffee*
stress0 (Intercept)	739.82	47.62	15.537	*authentic*
stress1	52.94	47.62	1.112	*pause*
stress2	42.09	49.50	0.850	*catalog*

THOUGHT with following stops and fricatives is produced acoustically lower still. In following place of articulation, free positions and following velars result in raising, THOUGHT with following alveolars occupies a middle point, and THOUGHT with following labiodentals is produced lower. Vowels with following voiceless consonants are produced low relative to those with following voiced consonants and to THOUGHT in word-final position.

Preceding segment results in a very complex set of conditioning effects. In particular, THOUGHT with preceding liquid or glide is produced high. Preceding /n/, obstruent+liquid clusters, and palatals are also raised, while THOUGHT in word-initial position, with preceding velar, interdental, or alveolar is produced relatively low. Finally, THOUGHT in primary and secondary stress position are both realized at similar levels, articulatorily lower than the few instances of THOUGHT in unstressed position. While most analyses below will include only primary stress, it is useful to know that F1 measurements for secondary stress positions are probably generally similar.

Table 3.2 presents lmer analyses of THOUGHT in the F2 dimension. Many results for frontness appear to mirror those observed in height, with lower F1 readings (articulatorily raised) corresponding to lower F2 readings (backed), and higher F1 readings (lowered) corresponding to higher F2 readings (fronted). THOUGHT appears to condition along a diagonal in vowel space. While this reflects the physical shape of the vocal tract, it is specifically noteworthy in the case of THOUGHT since the combination of lowering and fronting would push tokens toward territory traditionally occupied by LOT. The pattern basically holds for all following manner and voicing factors (following nasals are produced at effectively the same F2 as vowels in free position, rather than backed). It generally holds for place of articulation. Acoustically, the strong backing effect of following palatals and velars is a bit surprising, as it seems to violate general expectations of effects on vowels in those environments (Thomas 2011:101).

The situation is less clear for preceding segments. Preceding glides, liquids, and oral labials have an amplified effect on F2 compared to their effects on F1. Preceding-/n/ has a strong fronting effect, which is somewhat surprising given their slight raising effect. THOUGHT with preceding free position is backed. THOUGHT with preceding palatals is produced fronter (even though the environment also correlates with higher productions) and THOUGHT with preceding velars is produced slightly backer (even though it is slightly lowered). Preceding-/n/ has a strong fronting effect.

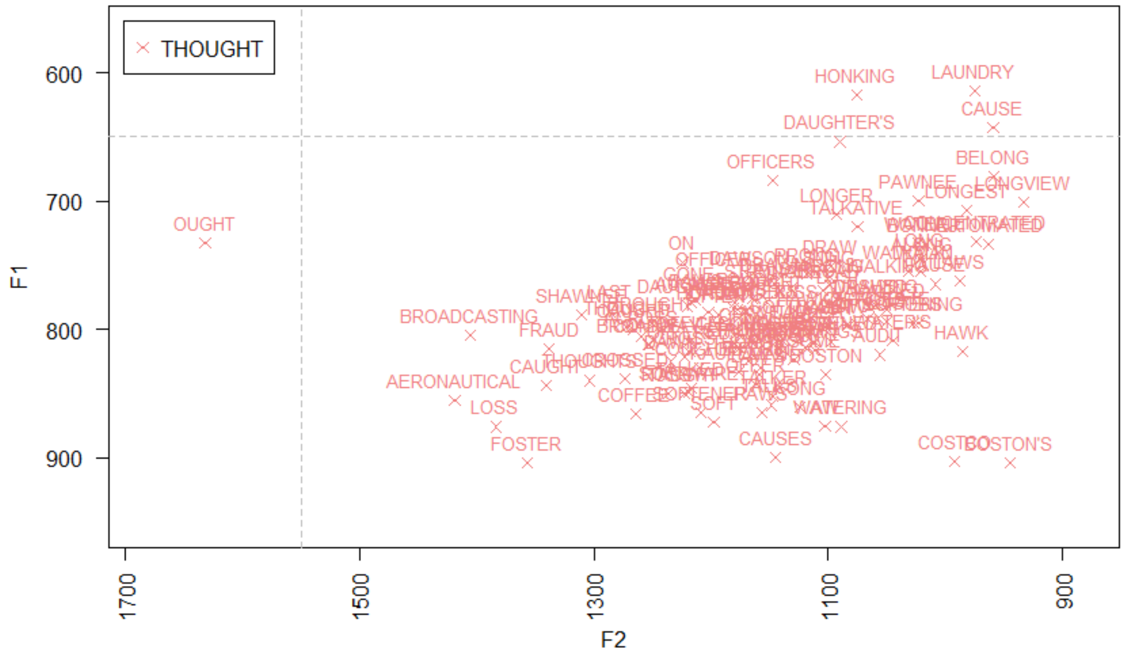
Table 3.2. Mixed effects regression of conditioning effects on THOUGHT F2

Fixed Effects	Example	Std. Error	*t* value	Example
fmFree (Intercept)	1119.414	27.430	40.81	*saw*
fmFricative	41.420	29.023	1.43	*lost*
fmNasal	2.546	30.122	0.08	*dawn*
fmStop	37.036	28.914	1.28	*fraud*
fpAlveolar (Intercept)	1167.559	12.503	93.38	*across*
fpFree	-47.470	27.029	-1.76	*draw*
fpLabiodental	3.162	19.629	0.16	*soft*
fpPalatal	-80.119	47.951	-1.67	*wash*
fpVelar	-57.964	16.204	-3.58	*talk*
fvFree (Intercept)	1119.41	27.46	40.76	*law*
fvVoiced	16.88	28.97	0.58	*cause*
fvVoiceless	37.81	27.98	1.35	*hawks*
psAlveolar or Interdental Obstruent (Intercept)	1187.91	13.54	87.73	*taught*
psFree	-30.59	15.72	-1.95	*awesome*
psGlide	-126.72	20.52	-6.18	*walk*
psLabial (Oral)	-77.722	22.713	-3.42	*bought*
psLiquid	-114.70	17.83	-6.43	*launch*
psN	137.19	81.40	1.69	*naughty*
psObstruent+Liquid Cluster	7.66	19.46	0.39	*brought*
psPalatal	44.54	43.09	1.03	(*chocolate*)
psVelar	-23.764	20.529	-1.16	*coffee*
stress0 (Intercept)	1072.41	88.05	12.179	*authentic*
stress1	72.56	88.02	0.824	*pause*
stress2	114.20	92.14	1.239	*catalog*

The F2 measurement for stress position is noteworthy, with robust coefficients for primary and, even more so, secondary stress. Acoustically, when the vowel is in one of these stressed positions it is realized fronter (and lower), and therefore closer to the canonical position of LOT.

These descriptions may be more meaningful in the context of words. Figure 3.2 shows mean productions for all tokens of THOUGHT (excluding those with following /r/ or /l/) in primary stress position measured from the casual speech of all interviews.

Figure 3.2. Mean productions of THOUGHT tokens from casual speech for all interviewees

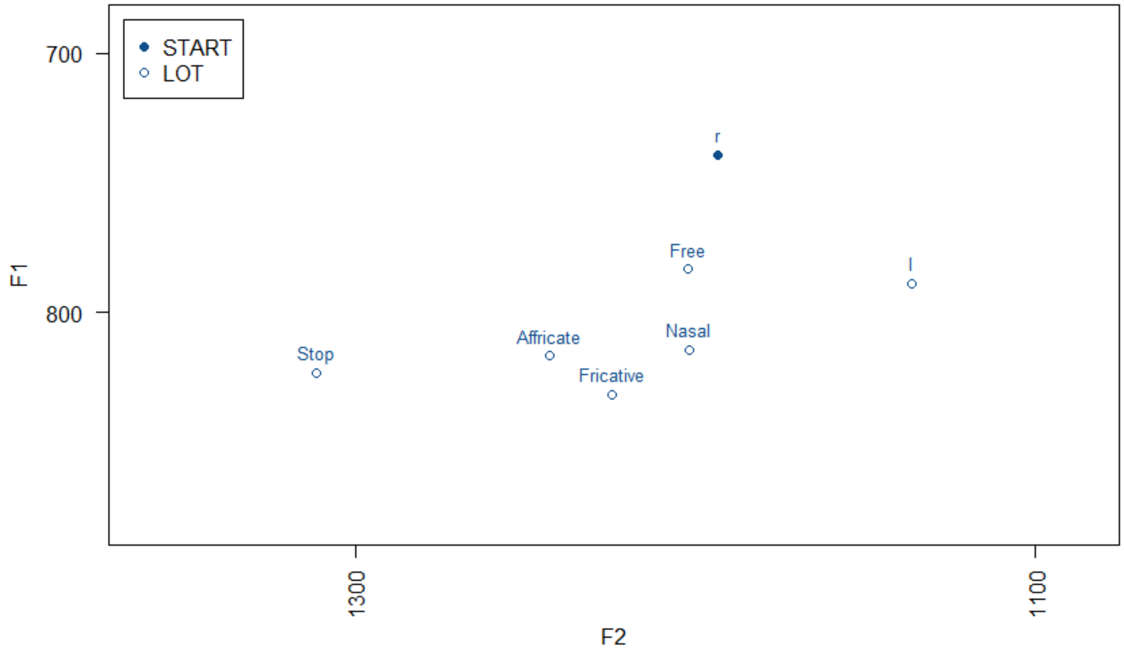


While this central space of the vowel is naturally muddled, tokens on the periphery are useful for making sense of the regression data. Following nasals and velars occur in several higher and backer tokens, including *honking*, *laundry*, and *talkative*. *Pawnee* follows this pattern but the similar Native American name *Shawnee* (F1:789, F2:1311, *n* = 17) does not and measures at a substantially fronter position. *Shawnee* is the name of a suburb in Kansas, and this may facilitate a different pronunciation from *Pawnee*. Syllable-final THOUGHT in *draw* is just visible at the back upper edge of the main cluster. Several following alveolars emerge relatively front, including *broadcasting*, *fraud*, *loss*, and *caught*—though *daughter's* and *cause* violate this pattern. *Coffee* and *caught* show the front position of preceding velars. It should be noted that these token means are especially subject to the type of error that I'm trying to avoid by using mixed effects modeling. The very front realization of *ought* reflects a single token, for instance, while *talk* (buried in the mass at F1:814, F2:1178) is the average 142 tokens. But, the plot is at least useful for providing some visual depiction of the numerical trends the emerge in lmer analysis.

3.2. LOT – Phonetic Conditioning

Figure 3.3 shows the mean distribution of LOT tokens for all interviewees.

Figure 3.3. Distribution of LOT by following manner



Tokens with following /r/ (the START class) appear higher and generally backer than other LOT tokens, though the effect is less dramatic than it is for NORTH. With coefficients of -79.4 in F1 and -78.0 in F2, START is realized acoustically in the range of [ɔ]. Following /l/ again has a raising effect with a coefficient of -39.0 in F1 and a substantial backing effect of -133.6 in F2. This places LOT with following /l/ at the very back edge of the LOT class's acoustic space. As above, START and following /l/ will be omitted from the lmer analysis presented here, but will be explored more below.

Tables 3.3 and 3.4 report regression results for LOT in F1. LOT in free position is included to account for borrowings such as *bra*, *Omaha*, and *Arkansas*, which might be treated as part of the PALM class otherwise (cf. Wells 1982:130). In Figure 3.3, word-final LOT occurs at a higher position than any other conditioning environment (besides the START class), reflected in the negative coefficients in F1 for free position in manner, place, and voicing in Table 3.3. Free position is nearer to the back of LOT's vowel space. This realization nearer to [ɔ] may reflect speakers observing the phonotactic constraint in English which prevents short vowels from occurring in free positions, and therefore reanalyzing these as long.

Effects of following manner on LOT are otherwise subdued, with LOT with following nasals and affricates realized slightly higher, and with following stops and fricatives slightly lower. LOT with following alveolars, interdentals, and palatals is realized lower than LOT in free position, but higher than with following bilabials, labiodentals, and velars. Notably, with the exception of velars, following conditions show the same direction of effects in LOT F1 as they do in THOUGHT F1, and with very similar coefficient values. LOT with following voiced consonant is realized higher than is LOT with following voiceless.

Table 3.3. Mixed effects regression of conditioning effects on LOT F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	817.892	14.440	56.64	*dodge*
fmFree	-27.588	21.097	-1.31	*blah*
fmFricative	10.523	15.847	0.66	*novels*
fmNasal	-8.884	14.956	-0.59	*vomit*
fmStop	10.098	14.600	0.69	*cop*
fpAlveolar (Intercept)	810.046	4.701	172.32	*spots*
fpBilabial	21.549	6.046	3.56	*hobby*
fpFree	-12.882	15.342	-0.84	*grandpa*
fpInterdental	10.357	15.405	0.67	*bother*
fpLabiodental	24.970	16.789	1.49	*profit*
fpPalatal	9.411	12.595	0.75	*posh*
fpVelar	22.562	6.840	3.30	*pocket*
fvFree (Intercept)	789.72	15.30	51.62	*Omaha*
fvVoiced	19.65	15.44	1.27	*modest*
fvVoiceless	46.55	15.49	3.00	*locker*
psAlveolar or Interdental Obstruent (Intercept)	827.533	7.495	110.40	*doctor*
psFree	6.074	9.576	0.63	*odd*
psGlide	-24.361	14.901	-1.63	*quality*
psLabial (Oral)	-17.592	9.328	-1.89	*bond*
psLiquid	-1.596	11.092	-0.14	*lobby*
psM	-33.808	13.732	-2.46	*mom*
psN	23.965	13.764	1.74	*diagnostic*
psObstruent+Liquid Cluster	-10.246	9.555	-1.07	*flock*
psPalatal	5.816	12.466	0.47	*jobs*
psVelar	-9.692	9.373	-1.03	*comedy*
stress0 (Intercept)	798.11	17.24	46.28	*October*
stress1	29.03	17.24	1.68	*exotic*
stress2	-17.42	18.52	-0.94	*mailbox*

Preceding segment again shows a complex set of conditioning effects. Syllable-initial LOT, and LOT with preceding glide, oral labial, and obstruent+liquid cluster basically mirror their counterparts in THOUGHT F1. The effects of preceding liquids, palatals, and /n/ violate the THOUGHT patterns—in the case of preceding palatals and /n/, this would push the vowels in these environments slightly farther apart.

Finally for LOT F1, primary stress encourages a slightly lower acoustic production than does free position, and secondary stress encourages slightly higher productions. In terms of vowel space, this could have the effect of placing LOT farthest away from THOUGHT in primary stress position. On the other hand, the greater lowering effect of primary stress on THOUGHT F1 would somewhat offset this tendency.

Table 3.4 shows conditioning effects on LOT F2. Following manner shows a steady progression from LOT with following nasals and in free position being realized at the back end of the vowel space, LOT with following fricatives and stops being fronter, and LOT with following affricates frontest. This ordering does not cleanly match plotted positions in Figure 3.3, especially in the case of following stops, which appear far front of following affricates visually, but slightly back of them in the regression. This is an effect of mixed effects modeling compensating for the relatively high frequency of stops compared with affricates. Token plots below will reveal the value of providing both lmer analyses and actual means, because the true picture is that following stops occupy so much space that they occur both well front and well back of affricates.

Following interdentals show a strong backing effect, contrary to the expected acoustic effects of the environment (Thomas 2011:101). This measurement, though, is driven almost entirely by just a few types: *father*, *bother*, and *bothers*, which contribute 126 out of 143 tokens of LOT with following interdental. LOT with following palatal, by contrast, is quite front, showing the opposite conditioning of THOUGHT counterparts.

LOT with following alveolars and bilabials is relatively front in F2, and with following velars and labiodentals is slightly back. In this regard, following velars also appear to show some distinction in conditioning between the vowel classes—they encourage backing in THOUGHT, but to a much higher degree.

Table 3.4. Mixed effects regression of conditioning effects on LOT F2

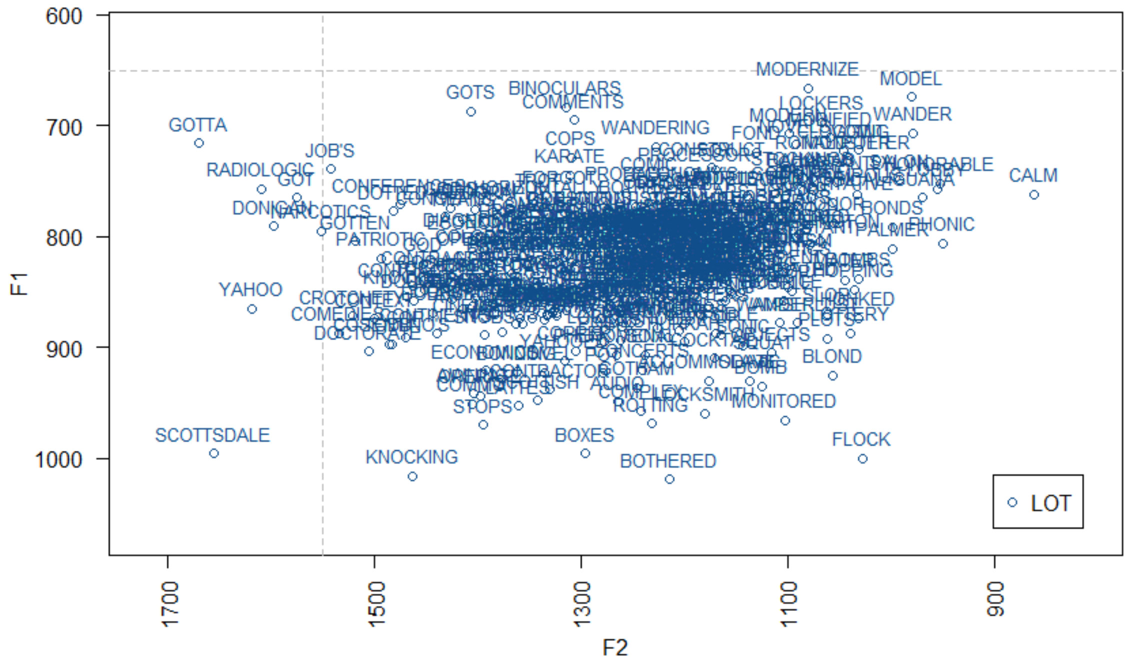
Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	1294.29	33.27	38.90	*dodge*
fmFree	-51.85	50.13	-1.03	*blah*
fmFricative	-43.74	35.89	-1.22	*novels*
fmNasal	-57.57	33.72	-1.71	*vomit*
fmStop	-22.95	33.10	-0.69	*cop*
fpAlveolar (Intercept)	1260.4649	12.2151	103.19	*spots*
fpBilabial	-0.6325	13.7642	-0.05	*hobby*
fpFree	16.7739	37.1402	0.45	*grandpa*
fpInterdental	-68.9962	38.2030	-1.81	*bother*
fpLabiodental	-15.2432	37.7990	-0.40	*profit*
fpPalatal	37.3631	29.0861	1.28	*posh*
fpVelar	-12.8128	15.8015	-0.81	*pocket*
fvFree (Intercept)	1242.404	39.358	31.567	*Omaha*
fvVoiced	3.008	39.183	0.077	*modest*
fvVoiceless	31.502	39.338	0.801	*locker*
psAlveolar or Interdental Obstruent (Intercept)	1286.28	16.99	75.73	*doctor*
psFree	-28.52	19.86	-1.44	*odd*
psGlide	-70.08	30.31	-2.31	*quality*
psLabial (Oral)	-99.98	19.42	-5.15	*bond*
psLiquid	-48.54	22.65	-2.14	*lobby*
psM	-119.02	28.08	-4.24	*mom*
psN	69.43	28.02	2.48	*diagnostic*
psObstruent+Liquid Cluster	-46.53	19.75	-2.36	*flock*
psPalatal	44.15	27.08	1.63	*jobs*
psVelar	34.58	19.22	1.80	*comedy*
stress0 (Intercept)	1278.718	40.019	31.95	*October*
stress1	-23.562	39.535	-0.60	*exotic*
stress2	-1.571	42.378	-0.04	*mailbox*

Voicing effects mirror those for THOUGHT F2, with LOT with following voiceless being realized fronter and with following voiced and in free position backer. In preceding segments, labials correlate with negative coefficients, suggesting backing. Syllable-initial LOT (e.g., *operations*) is realized backer, as is LOT with preceding glide, liquid, or obstruent+liquid cluster. Preceding coronals and velars appear to encourage fronting. These seem to match predicted acoustic effects of consonants on vowels (Thomas 2011:101).

Primary stress results in lower F2 in LOT. This is of potential importance for evaluating merger, since it is directly opposite of the effects of stress on THOUGHT, which resulted in fronting. In other words, in the F2 dimension, LOT and THOUGHT are pronounced more alike in primary stress position than in unstressed position (and much more alike in secondary stress position because of its strong fronting effect on THOUGHT).

Figure 3.4 attempts to provide some context for these numbers through tokens.

Figure 3.4. Mean productions of LOT tokens from casual speech for all interviewees

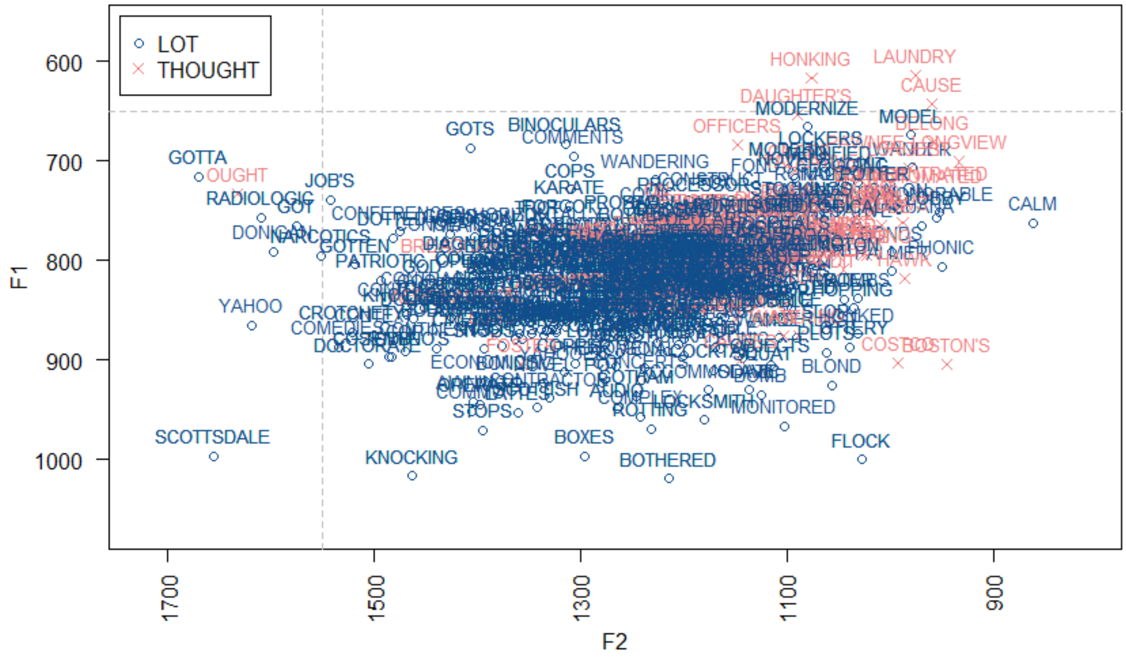


In Figure 3.4 averaged productions are plotted for all LOT tokens (minus those with following /r/ or /l/) in primary stress position for casual speech from interviews. Several instances of following nasals (e.g., *fond*, *wander*) are visible near the top right edge of the vowel space. The bottom edge of the plot appears to be dominated by following voiceless stops, though *cops*, *lockers*, and *binoculars* appear high. The combined effects of preceding /m/ and following voiced stop appears near the top edge of the space in the cases of *model* and *modernize*.

3.3. The Merger of LOT and THOUGHT – Phonetic Conditioning

As an entry point to exploring the merger of LOT and THOUGHT, Figure 3.5 combines Figures 3.2 and 3.4.

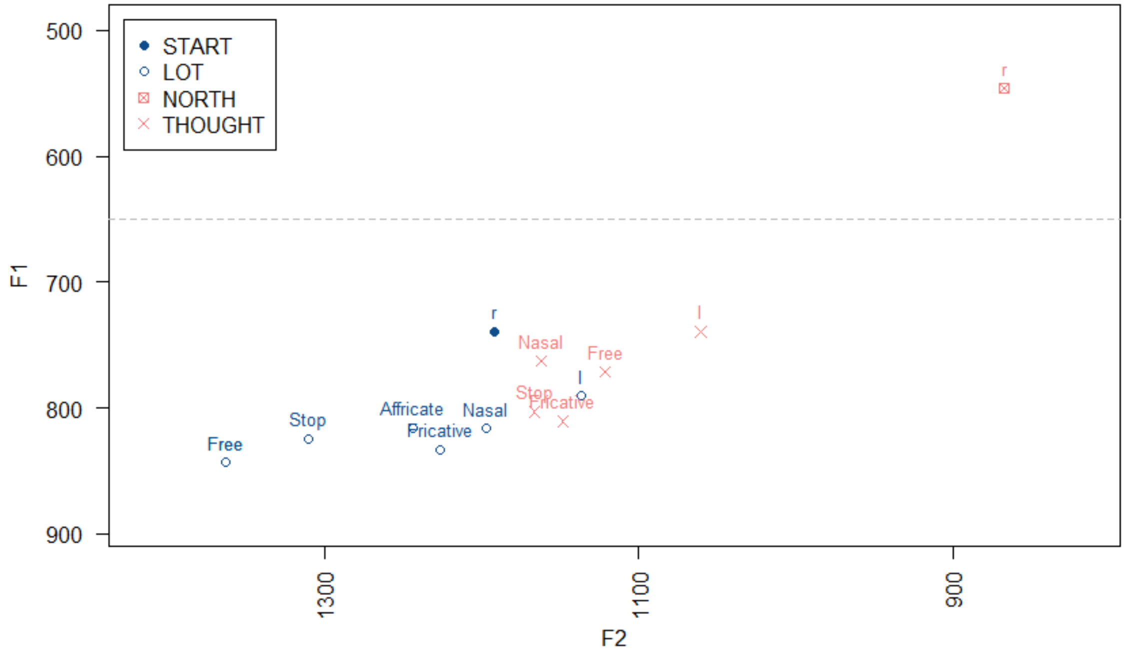
Figure 3.5. Mean productions of LOT and THOUGHT tokens from casual speech for all interviewees



In technical terminology, Figure 3.5 is a mess. And that mess depicts an extreme amount of lexical overlap between the LOT and THOUGHT classes in Kansas City. In this section, I'll explore the extent to which the conditioning effects identified above can help make sense of this overlap. The question to explore will be whether the effects are moving the vowel classes closer together in ways that might break down distinctions (i.e., LOT and THOUGHT with the same conditioning effects are moving toward one another), or in ways that would maintain distinctions even if mean values for the classes as a whole moved closer.

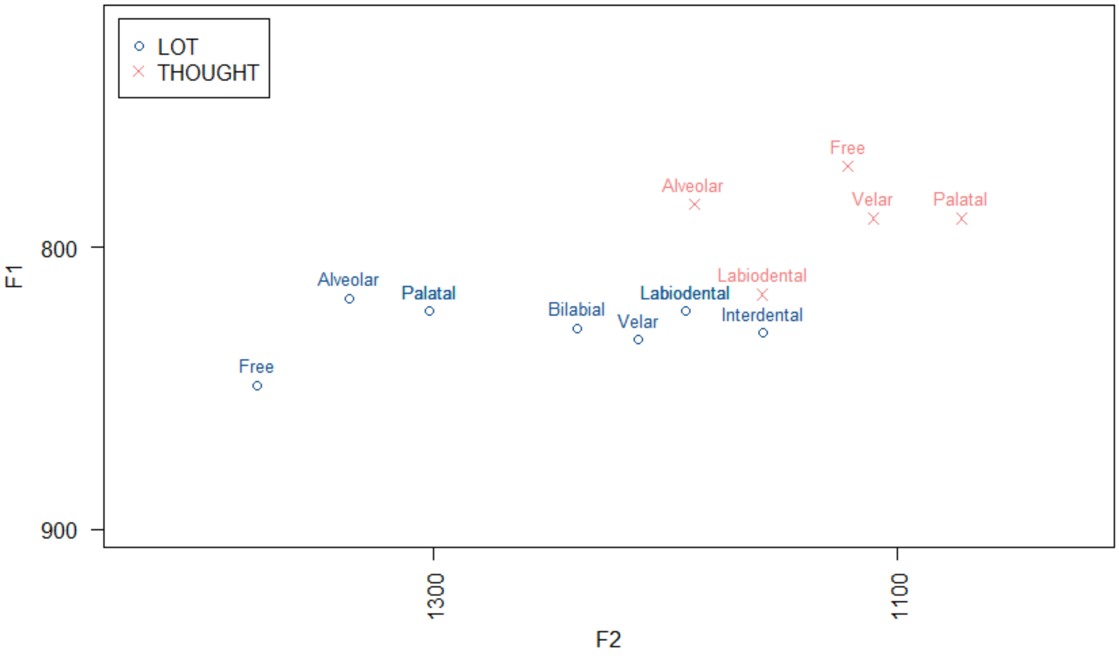
Figures 3.6 and 3.7 show mean production values for all interview speech for LOT and THOUGHT according to following manner and place of articulation, respectively.

Figure 3.6. Distribution of LOT and THOUGHT by following manner in interview speech



Only vowels occurring in primary stress position are included in these figures. Following /l/ and /r/ are included in following manner. They are excluded from following place, as are following nasals. This exclusion is made to avoid artificially high and back measurements on following alveolars, bilabials, and velars, due to the effects of following /l/ and nasals.

Figure 3.7. Distribution of LOT and THOUGHT by following place in interview speech



In these figures, LOT in free position no longer occupies a space near THOUGHT. By selecting only primary stress, backer tokens have been dropped and this has shifted the mean dramatically forward. Elsewhere, differences from initial figures and regressions are less dramatic. LOT followed by /l/ occurs among THOUGHT tokens, though the higher backer position of pre-/l/ THOUGHT keeps the two vowels distinct, at least visually. START occurs with lower F1 than other conditions of THOUGHT, with the exception of the NORTH class. The classes occur close to each other in the context of following fricatives. LOT and THOUGHT with following nasals appear to nearly line up in F2, but show separation in F1. LOT and THOUGHT with following stops, on the other hand, are basically equivalent in F1, but distinct in F2. Table 3.5 quantifies these visual impressions by providing mean values for LOT and THOUGHT F1 and F2 for each following manner condition, and Euclidean distances and Pillai scores for the differences between the classes. The phonetic environments are listed from smallest Euclidean distance to largest. Table 3.6 provides the same data for following place of articulation.

Table 3.5. Distances between LOT and THOUGHT by following manner

		LOT	THOUGHT	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Following nasal	F1	816.1	763.0	63.67	15.8304	< 0.001	0.10538	< 0.001
	F2	1197.1	1162.0		5.2362	< 0.001		
Following fricative	F1	833.0	810.6	80.99	5.5859	< 0.001	0.076844	< 0.001
	F2	1226.2	1148.4		8.7916	< 0.001		
Following /l/	F1	790.4	739.4	91.68	13.1537	< 0.001	0.11766	< 0.001
	F2	1136.7	1060.6		9.314	< 0.001		
Following stop	F1	824.6	802.9	145.98	10.3938	< 0.001	0.12918	< 0.001
	F2	1310.6	1166.3		30.3166	< 0.001		
Free position	F1	831.5	764.5	252.29	2.2642	0.04045	0.24667	< 0.001
	F2	1363.2	1121.4		4.757	< 0.001		

While all differences between means by *t*-test and Pillai score remain highly significant, in practical terms it is difficult to believe that several of these significant differences are actually meaningful. Evanini (2009), for instance, suggests that 100 Hz in Euclidean distance is the threshold under which vowels should be considered merged. By this measure, LOT and THOUGHT with following fricative, nasal, and /l/ should be considered merged for the interview sample as a whole. Pillai scores for these are also quite low. The Pillai score for following stops is just a bit larger than it is for following

/l/, but the Euclidean distance is almost 55 Hz larger. Free position shows a relatively larger distance between the two vowels, but the tiny number of LOT tokens in word final position and primary stress preclude any conclusions about that environment. What seems clear is that following fricative, nasal, and /l/ environments have brought LOT and THOUGHT close to one another across the speech sample. Following stops bear more consideration.

Table 3.6. Distances between LOT and THOUGHT by following place

		LOT	THOUGHT	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Following labiodental	F1	822.7	816.7	33.75	0.4736	0.64	0.0039175	0.3191
	F2	1191.5	1158.3		1.4345	0.1645		
Following velar	F1	833.2	801.6	88.48	9.2096	< 0.001	0.114	< 0.001
	F2	1210.5	1127.8		12.6732	< 0.001		
Following alveolar	F1	819.0	804.3	175.67	5.9086	< 0.001	0.1757	< 0.001
	F2	1359.8	1184.7		28.9935	< 0.001		
Following palatal	F1	822.6	789.7	232.01	3.2489	0.001423	0.36755	< 0.001
	F2	1302.3	1072.6		11.484	< 0.001		

Following place offers the first statistically non-significant differences, in the context of following labiodentals. This is a somewhat interesting case, because there is a major disparity in the number of tokens in either vowel class in this context, with the vast majority of tokens traditionally assigned to THOUGHT (or, more precisely, many of them come from the CLOTH class, which merged into THOUGHT in American English; see Wells 1982:136). Among tokens in this sample, only *profit* is listed by Wells (1982) as belonging to LOT. Other tokens marked as LOT words include *sophomore* and *poverty*. Contrasting with following labiodentals, all tokens with following bilabials in this sample appear to belong to LOT (or PALM) following Wells (1982). This suggests the definition of phonetically conditioned allophones that is familiar to introductory linguistics classes—one sound appears exclusively in a given phonetic environment and therefore does not present a need for speakers to recognize a phonemic distinction. The disparity between the number of LOT and THOUGHT tokens with following labiodentals may lead to a similar allophonic relationship in that environment. The relative scarcity of LOT tokens may discourage the maintenance of a vowel distinction, and following labiodentals might be reanalyzed to THOUGHT based on phonetic conditioning (cf. Labov 2010:99-103).

LOT and THOUGHT with following palatals show a large Euclidean distance and high Pillai score, but the THOUGHT class is entirely represented by forms of *wash*. LOT also appears to be pulled forward by tokens of *gosh*, which appear to be pronounced fairly front. As such, it is difficult to draw much from these numbers. It would be interesting to test the near minimal pair *wash* and *watch* for whether speakers perceive a distinction. (The Euclidean distance between *wash* and *watch* in interviews is 120 Hz, with a Pillai score of 0.23962 [$p = 0.008$]. The difference in F1 is non-significant at $p = 0.6016$, t-score = -0.5348.) LOT and THOUGHT with following velars show significant differences, but relatively small values in Euclidean distance and Pillai score. The environment of following alveolars, like following stops, presents a case of a relatively small dispersion of tokens in terms of Pillai score, but a seemingly large Euclidean distance.

Table 3.7 compares effects of following voicing on the merger of LOT and THOUGHT. Vowels with following voiced consonants appear to show less distance than voiceless ones, especially in Pillai score, which is within a few hundredths of the Pillai score for NORTH and FORCE shown to demonstrate a presumably merged set of vowels in Chapter 2.

Table 3.7. Distances between LOT and THOUGHT by following voicing

		LOT	THOUGHT	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Voiced	F1	815.2	791.1	91.16	5.1319	< 0.001	0.06224	< 0.001
	F2	1221.1	1133.3		9.9218	< 0.001		
Voiceless	F1	828.4	807.7	169.1	10.8776	< 0.001	0.20722	< 0.001
	F2	1329.7	1161.9		38.5095	< 0.001		

The distinction between LOT and THOUGHT in both environments appears to be primarily in F2, with THOUGHT consistently back of LOT.

Finally, Figure 3.8 and Table 3.8 present distances by preceding segment. Visually, the vowel plot gives the impression of generally consistent adherence to LOT and THOUGHT as classes. However, LOT preceded by /m/, obstruent+liquid clusters, liquids, and glides is encroaching into THOUGHT territory. By contrast, LOT preceded by velars appears high and extremely front. Preceding /n/ and /m/ are plotted but not included in Table 3.8, because each contains such a small number of THOUGHT types (*naughty*, *aeronautical*) that a comparison would be of little value. *Naughty*, however, should be noted for behaving in a very THOUGHT-like way at F1:779, F2:1180. Preceding palatals are not included either. Most of preceding palatals classed as THOUGHT words belong to the NORTH class (e.g., *short*, *Georgia*, *majority*) or have a following nasal (e.g., *Shawnee*, which is local and not clearly assigned to THOUGHT in Kansas City). This leaves *chocolate* as the sole type of the class—and, since it is traditionally assigned to THOUGHT in the North and LOT in the South, there is again not a compelling reason to assume it is historically THOUGHT in Kansas City.

Figure 3.8. Distribution of LOT and THOUGHT by preceding segment

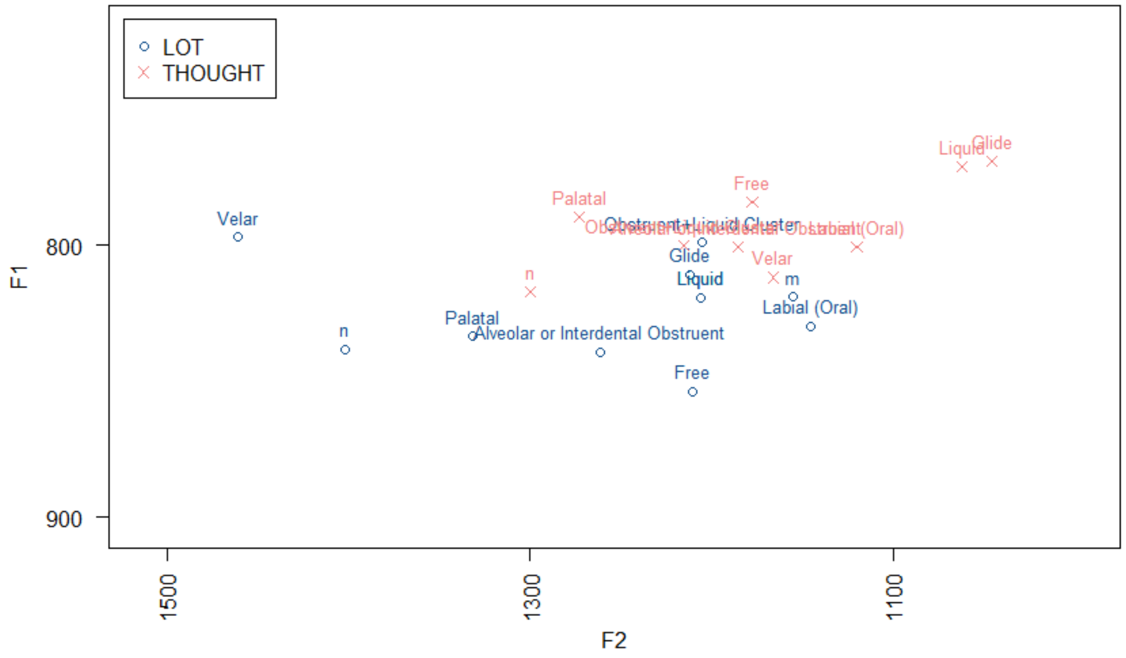
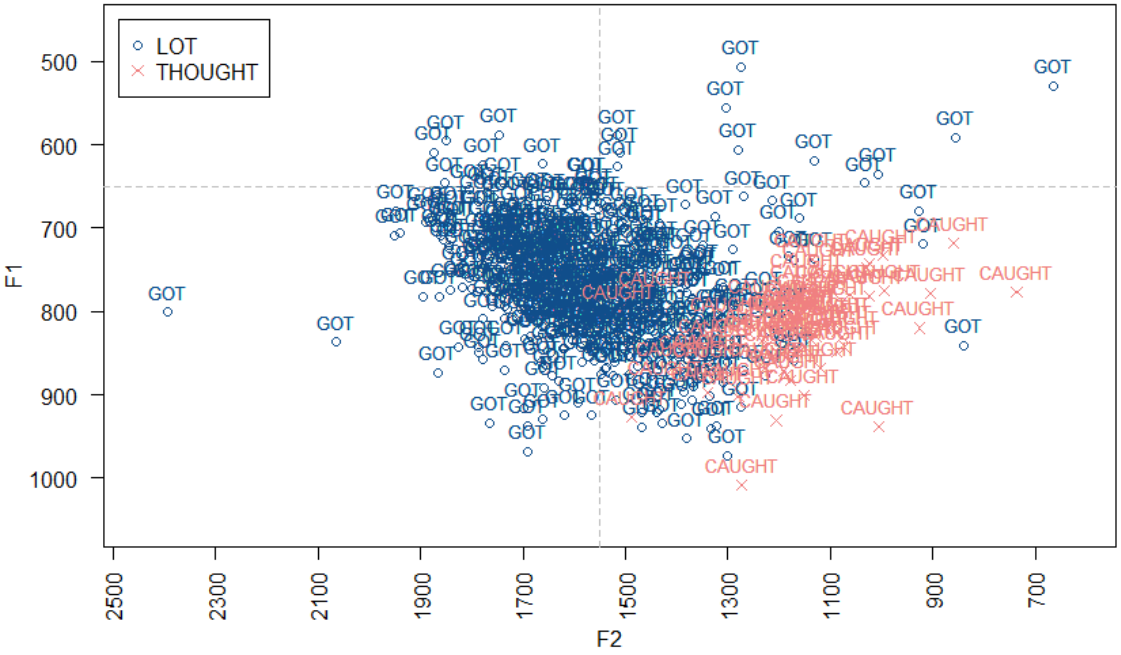


Table 3.8. Distances between LOT and THOUGHT by preceding segment

		LOT	THOUGHT	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Obstruent + Liquid	F1	798.4	806.2	38.07	-1.5383	0.1246	0.018245	< 0.001
	F2	1205.0	1242.3		-3.755	0.000201		
Labial (Oral)	F1	839.9	803.7	53.50	6.0982	< 0.001	0.060467	< 0.001
	F2	1162.7	1123.3		3.4965	0.0005647		
Free	F1	860.2	815.0	85.11	10.3768	< 0.001	0.13759	< 0.001
	F2	1213.1	1141.0		9.0715	< 0.001		
Alveolar or Interdental Obstruent	F1	847.2	802.2	96.97	12.5738	< 0.001	0.14655	< 0.001
	F2	1280.6	1280.5		10.6354	< 0.001		
Liquid	F1	819.6	791.3	123.34	6.6425	< 0.001	0.16834	< 0.001
	F2	1206.4	1086.4		13.9887	< 0.001		
Glide	F1	818.5	769.2	171.31	4.9728	< 0.001	0.27038	< 0.001
	F2	1209.4	1045.3		10.2847	< 0.001		
Velar	F1	793.5	820.7	346.96	-5.3609	< 0.001	0.37023	< 0.001
	F2	1501.2	1155.4		29.4384	< 0.001		

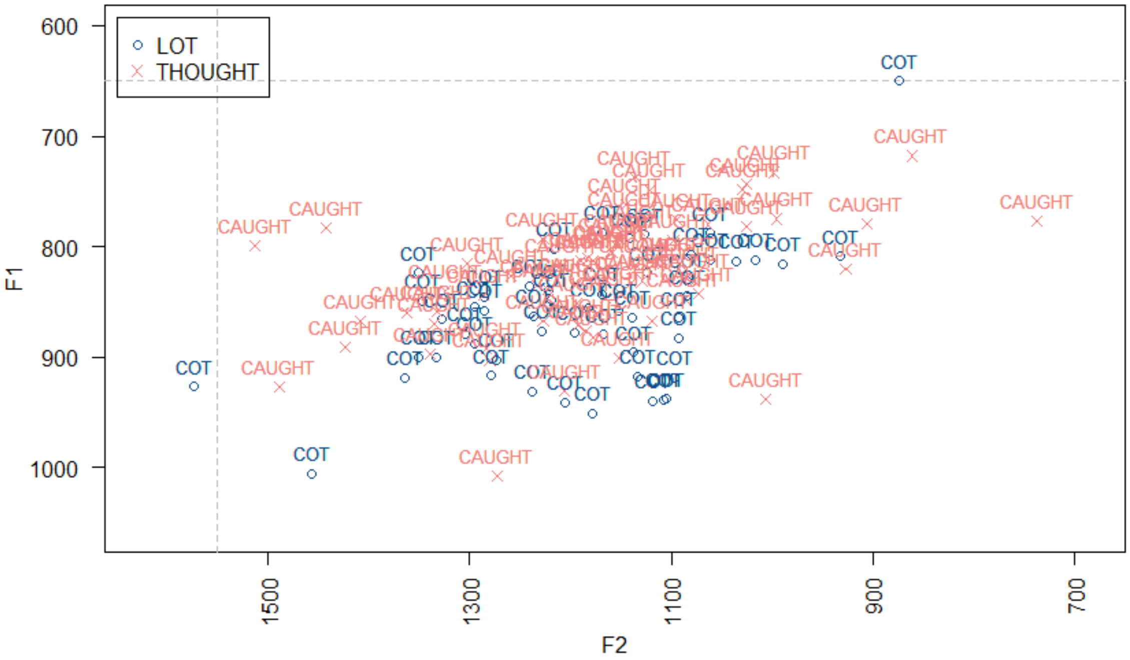
In Table 3.8, almost all measurements again return significant results, the exception being F1 in obstruent+liquid clusters. The Euclidean distance and Pillai scores for that context are extremely small. Distances are also relatively small for LOT and THOUGHT with preceding oral labials and alveolar or interdental obstruents, as well as for syllable-initial LOT and THOUGHT. Preceding liquids and glides seem to disfavor merger. Preceding velars, though, seem to present a major conditioning effect. The vowels are strongly separated in F2 and, interestingly, have switched positions in F1 so that the mean LOT value is lower in Hz (higher in vowel space) than it is for THOUGHT. This appears to be largely an effect of voicing in the preceding velar, with /g/ generating the fronter productions, especially in *got*, and /k/ correlating to backer productions. As a point of illustration, Figures 3.9 and 3.10 compare the distributions of *got* and *caught* (3.9) and *cot* and *caught* (3.10).

Figure 3.9. Distribution of *got* and *caught*



The *got-caught* pair has a Euclidean distance of 398 Hz and Pillai score of 0.352, compared with a Euclidean distance of just 40 Hz and Pillai score of 0.099 for the minimal pair *cot-caught*. So, while the voicing of preceding velars seems to have a substantial conditioning effect on LOT and THOUGHT, it may again create a complementary distribution between the vowels that could facilitate their analysis as belonging to the same vowel class.

Figure 3.10. Distribution of *cot* and *caught*



3.4. Phonetic Conditioning Summary

The preceding sections explore a large amount of phonetic information closely. In a sense, this might be thought of as the vocalic landscape of LOT and THOUGHT that a child learning language in Kansas City would encounter. There appears to be a wide range of productions of the vowels present in the community across the low back vowel space. However, at the level of specific phonetic environments, actual realized space frequently becomes very small. Statistical conclusions suggest that very small but consistent differences between the vowel classes in Kansas City often remain, which matches the notion from Labov, Ash, and Boberg (2006) of the Midland's low back merger as being in a transitional status. However, qualitative analysis recognizes that some of the consistent differences may be so small that they cannot be perceptively real to speakers and auditors. If, as a whole, LOT and THOUGHT are not the same in Kansas City, it is easy to identify specific environments that are much nearer to full merger across this sample than others.

An interesting finding of the isolated lmer analysis of each vowel is that, in many cases, similar phonetic environments are affecting LOT and THOUGHT in similar ways. This appears to be the case especially when vowels are measured by following manner of articulation or following voicing. Where differences appear, they often appear explainable by relatively low representation of words in one of the vowel classes or by ambiguous historical assignment of words to the classes. This is a different result from, e.g., Gordon's (2001) analysis of vowels involved in the Northern Cities Shift, which frequently showed little agreement in the effects of phonetic conditioning from one vowel to the next. This finding suggests several potential explanations. One is that these effects simply represent universal phonetic conditioning effects on vowels. This seems unlikely, though, since several movements appear to violate expected acoustic effects of consonants on vowels (e.g., following velars correlate with lower F2, rather than raised as predicted from Thomas 2011:101). A second is that LOT and THOUGHT are locked in a chain shift so that they are changing co-equally, and maintaining their distinct phonemic status as they do so—a notion that has not been previously observed in a Midland dialect. The third is that LOT and THOUGHT are, in fact, merged, and therefore a single vowel class is being phonetically conditioned in a fairly unified way.

The analysis of LOT and THOUGHT against each phonetic environment offers several points of commentary in favor of this latter possibility, which is a step beyond the characterization of Kansas City as a Midland area in transition with regard to the low back merger. First, a number of contexts show small numerical distinctions. These include following nasal, following labiodentals, preceding obstruent+liquid clusters, and preceding oral labials. Following fricatives, following /l/, following velars, following voiced consonants, word-initial positions, and preceding oral alveolar and interdental obstruents also show arguably small separations.

There are a number of environments in which either LOT or THOUGHT words are dominant. Following bilabials, preceding /n/, preceding /m/, and preceding palatals are almost exclusively LOT. On the other hand, the context of following labiodentals is dominated by THOUGHT, and it appears that LOT types with following labiodentals have been reanalyzed to occur with a THOUGHT vowel. Similarly, there is the case of preceding velar, where the voicing of the preceding segment appears to condition the vowel and the historical LOT-THOUGHT distinction breaks down accordingly. In other words, phonetic productions of [ɑ] and [ɔ] in Kansas City are, on paper, good candidates for being in complementary distribution with one another, and therefore in a textbook sense being allophonic productions of a single phoneme.

A question in exploring the low back merger is what vowel they are becoming. The answer suggested by, for example, Figure 3.5 is that they are becoming both. In

Kansas City, LOT and THOUGHT may be merging into points on a continuum of a single phoneme, along which productions are determined, in part, by a complex set of interactions from phonetic environment. This range of potential productions offers a useful methodological consideration that may explain discrepancies that have occasionally emerged in minimal pairs tests in Kansas City (e.g., Labov, Ash & Boberg 2006; Gordon & Strelluf 2012). In these studies, Kansas Citians have often given incongruous answers to whether vowels sounded the same, close, or different. The phonemic analysis here suggests that perceptual judgments of these pairs might really be that they sound “both” or “either” rather than “same,” “close,” or “different.” In other words, a Kansas Citian will typically say, *Don* with a THOUGHT-like allophone, based on the general conditioning effect of the following nasal . But they may also say it with a LOT-like allophone since it is available for the class. So, asking an interviewee whether *Don* and *dawn* sound the same, close, or different might make the wrong assumption about the phonemic status of the vowels by presuming that the loss of a phonemic distinction also results in a collapse of phonetic space. A model of merger by expansion (e.g., Herold 1990, 1997), by contrast, would account for the entire space of LOT and THOUGHT that would be available to a non-merged speaker remaining available for a merged speaker’s perception and production, even if distinctions within that space aren’t linguistically important. Giving an “either” option in a minimal pairs test may get answers that better describe the state of the low back merger in Kansas City.

My analysis to this point has explored all data from interviews as a massive whole. The intent of this approach was to understand the underlying phonetic quality of the vowels in LOT and THOUGHT from a view of the entire community. While this may help shed light on the types of environments that are more or less amenable to merger or distinction, it also potentially muddies the analytic water, since merged and distinct speakers may be producing the vowels differently and, therefore, may obscure results when they are lumped together. From here, I'll increasingly take different productions among individuals into account, and begin to consider what the productions of LOT and THOUGHT observed to this point indicate in terms of their phonemic status as distinct or merged vowels.

3.5. LOT and THOUGHT – Changes in Apparent Time

The previous sections revealed a number of phonetic environments where LOT and THOUGHT are realized very close to one another in Kansas City. In this section, I'll explore whether those proximities are a result of a static condition or a developing change. Under the concept of apparent time (e.g., Labov 1966\2006, 1972, 1994; Milroy & Gordon 2003), speakers are assumed to be sort of linguistic time capsules of the language that was present in their community during their period of language development. Data from interviewees born in one generation can then be compared with data from interviewees born in another generation to suggest the ways that language has changed over time.

I'll limit this exploration to three phonetic contexts: following /n/, following /l/, and following /t/. While the analysis above suggests that many other environments might reveal interesting results, these contexts offer a useful shortcut to examining the vowel classes as a whole. Since these classes are included in interview minimal pairs tests in the pairs *cot-caught*, *dawn-Don*, and *Polly-Pauley*, findings here may be correlated with interviewee perceptions of the status of LOT and THOUGHT. More immediately, these three contexts present a useful continuum of mergedness in Section 3.3—with following /n/ and /l/ appearing to be relatively favorable contexts for merger and following stop, alveolar, and voiceless each apparently disfavoring merger. I'll explore the position of F1 and F2 of each vowel in each of the three environments for each interviewee. Interviewees will be arrayed in the traditional (fixed effects) linear models according to birth year. The fixed effects models are sufficient here because each speaker is measured independently, meaning that one speaker's high number of token contributions will not wipe out another speaker's small number. The fixed effects linear model provides *p*-values, so those can be provided here. After looking at each vowel separately, I'll compare Euclidean distances and Pillai scores to examine change in the vowels' proximity in time.

Figures 3.11 and 3.12 are linear models of all pre-/n/ LOT and THOUGHT tokens in interview speech. In each figure F1 is graphed as the top plot and F2 as the bottom. Tables 3.9 and 3.10 show the outputs of the models. These models should be understood through the equation {vowel F1/F2 = (year coefficient * year) + intercept}. In other words, in Table 3.9, the measurement of THOUGHT F1 in Hz for a speaker born in, e.g., the year 1950 should be predictable by calculating {pre-/n/ THOUGHT F1 = (0.4409 * 1950) + -105.6524} which returns a measurement of 754 Hz. The coefficient value for year can be read rapidly as the amount of change that occurs each year. In the case of this example (if it were significant), it would predict an increase in F1 of pre-/n/ THOUGHT of 0.44 Hz per year.

Figure 3.11. Linear models of pre-/n/ THOUGHT by interviewee birth year

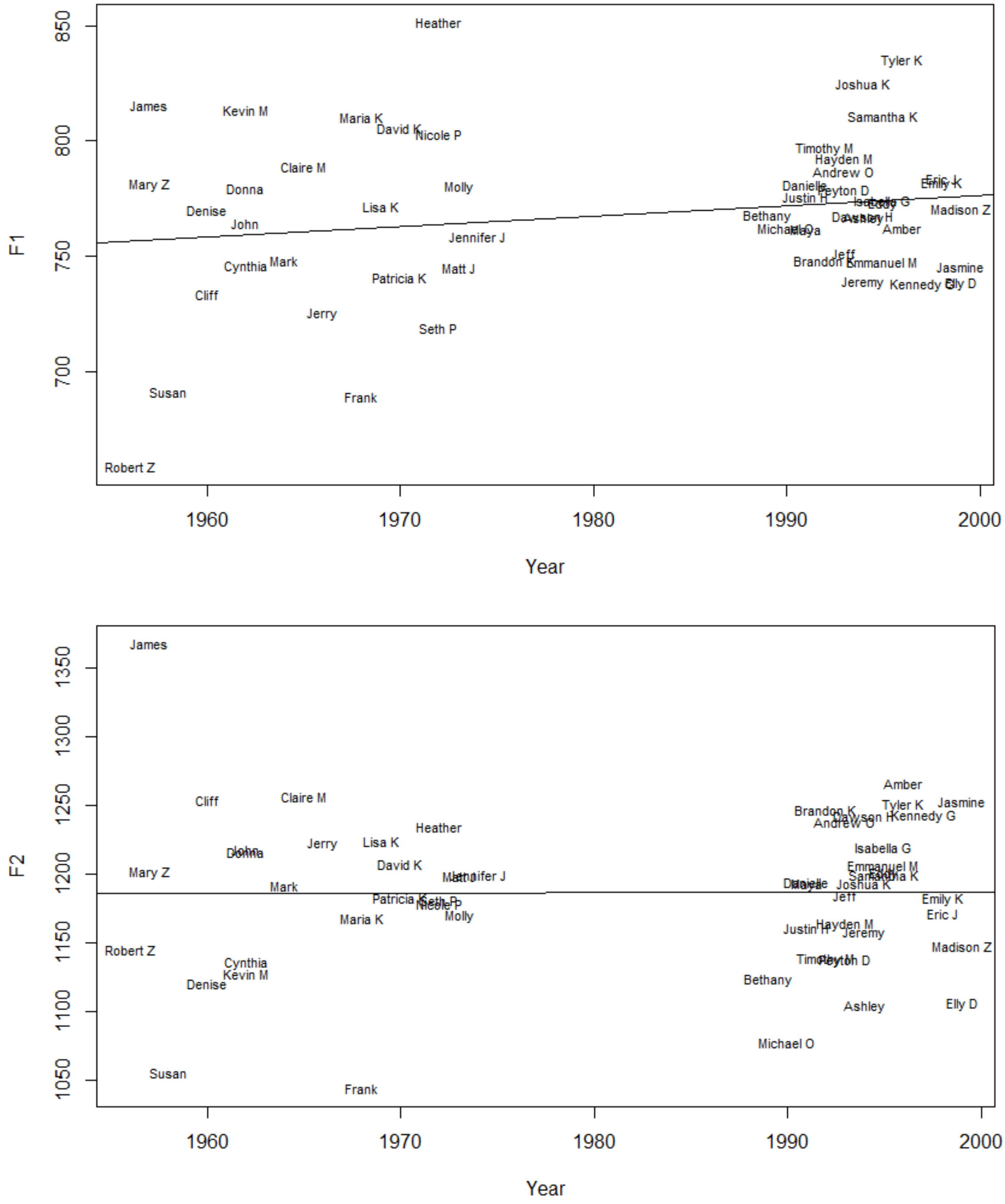


Figure 3.12. Linear models of pre-/n/ LOT by interviewee birth year

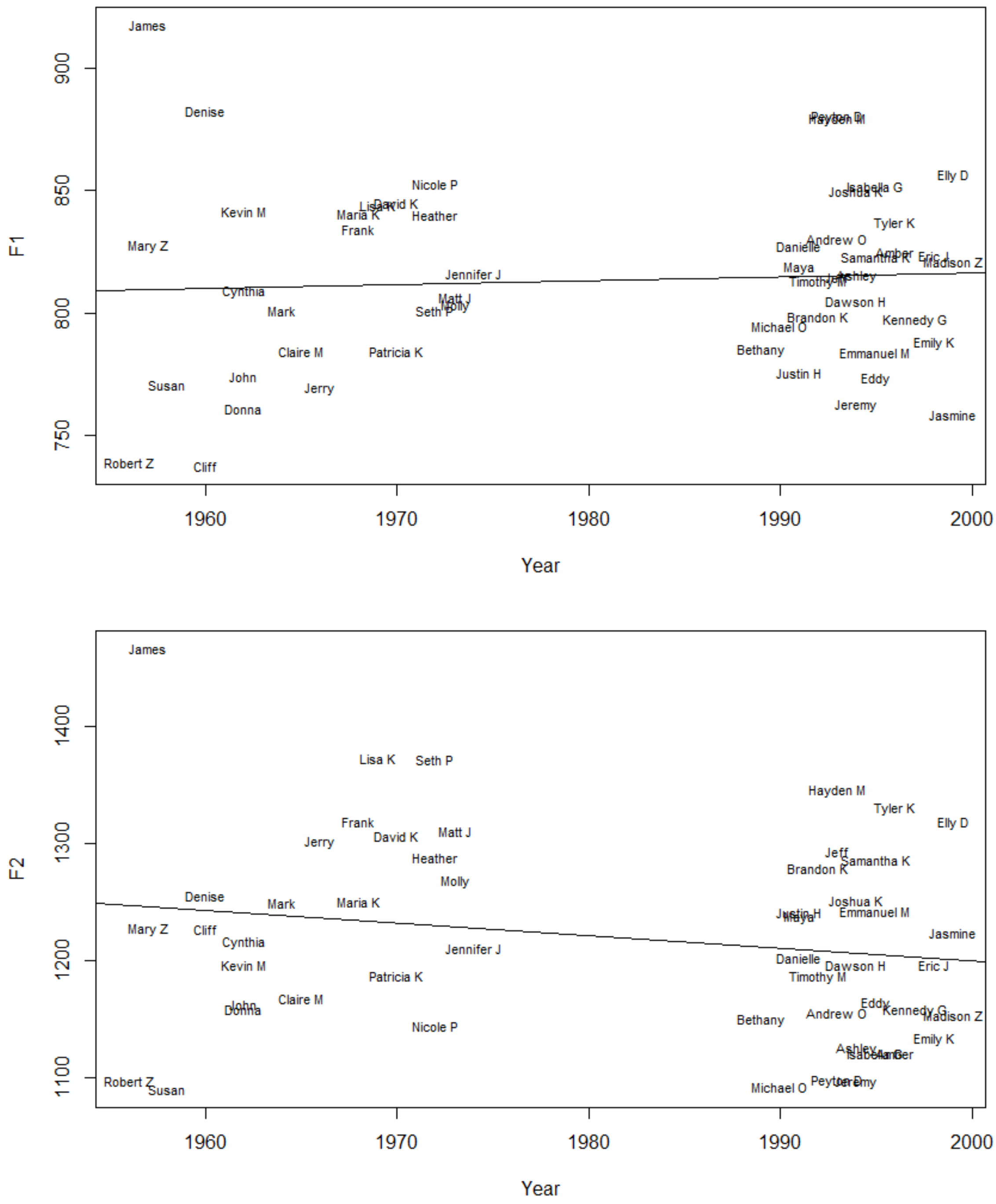


Table 3.9. Linear models of pre-/n/ THOUGHT by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
THOUGHT F1 (Intercept)	-105.6524	659.9563	-0.160	0.873
Year	0.4409	0.3332	1.323	0.192
Residual standard error: 35.76 on 49 degrees of freedom Multiple R-squared: 0.03451, Adjusted R-squared: 0.01481 *F*-statistic: 1.751 on 1 and 49 DF, *p*-value: 0.1918				
THOUGHT F2 (Intercept)	1174.0000	1079.0000	1.088	0.282
Year	0.006426	0.5447	0.012	0.991
Residual standard error: 58.47 on 49 degrees of freedom Multiple R-squared: 0.00000284, Adjusted R-squared: -0.02041 *F*-statistic: 0.0001392 on 1 and 49 DF, *p*-value: 0.9906				

Table 3.10. Linear models of pre-/n/ LOT by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
LOT F1 (Intercept)	505.7260	696.9703	0.726	0.472
Year	0.1552	0.3519	0.441	0.661
Residual standard error: 37.77 on 49 degrees of freedom Multiple R-squared: 0.003954, Adjusted R-squared: -0.01637 *F*-statistic: 0.1945 on 1 and 49 DF, *p*-value: 0.6611				
LOT F2 (Intercept)	3334.0510	1548.7027	2.153	0.0363
Year	-1.0672	0.7819	-1.365	0.1785
Residual standard error: 83.92 on 49 degrees of freedom Multiple R-squared: 0.03663, Adjusted R-squared: 0.01697 *F*-statistic: 1.863 on 1 and 49 DF, *p*-value: 0.1785				

These models suggest very little development in time for pre-/n/ LOT and THOUGHT. Their slopes are mostly flat, R^2 values suggest the models account for little of the observed data, and the models are not statistically significant. (Negative R^2 values are a result of the particular model that the standard R package uses to calculate fixed effects linear models and should simply be thought of as essentially zero scores.) Qualitatively, these results suggest that major movement toward contemporary productions of pre-/n/ LOT and THOUGHT occurred before the speakers I interviewed were born. The slopes suggest slight overall coalescence among interviewees around slightly lower productions of THOUGHT (Figure 3.11 F1) and slightly backer productions of LOT (Figure 3.12 F2). While this may be an effect of speakers being compressed into smaller range of birth years, it appears to suggest less variability in productions. Overall, though, this analysis suggests stability in the late twentieth century for pre-/n/ LOT and THOUGHT in Kansas City.

Figures 3.13 and 3.14 show linear models for pre-/l/ THOUGHT and LOT. Their outputs are in Tables 3.11 and 3.12. Pre-/l/ THOUGHT shows a slight, statistically significant, backing trend in time. The model shows a rate of about -13 Hz in F2 each decade, but only accounts for about 8 percent of observed variation. Pre-/l/ LOT provides a more compelling picture, returning significant results for both raising and backing. The model for pre-/l/ LOT raising shown by F1 decreasing at a rate of 14 Hz per decade accounts for nearly one quarter of variation. Pre-/l/ LOT F2 also decreases, causing LOT to back at a rate of about 24 Hz per decade. The R^2 value for F2 is lower at only about 13 percent, and the dispersion of interviewee productions among the younger groups suggests less coalescence around a norm than was observed for pre-/n/ LOT. This may depict pre-/l/ LOT backing and raising being a more recent development than pre-/n/ LOT backing. These are, again, not dramatic changes, but do suggest a more active pattern than was observed for pre-/n/ LOT and THOUGHT. Pre-/l/ LOT shows a trend of movement in the direction of pre-/l/ THOUGHT. Pre-/l/ THOUGHT shows a small trend toward backing which might maintain some distance between LOT and THOUGHT in F2, but the movement of pre-/l/ THOUGHT is less dramatic than it is for LOT. This means in practical terms that pre-/l/ LOT is closing distance on pre-/l/ THOUGHT in apparent time.

Figure 3.13. Linear models of pre-/l/ THOUGHT by interviewee birth year

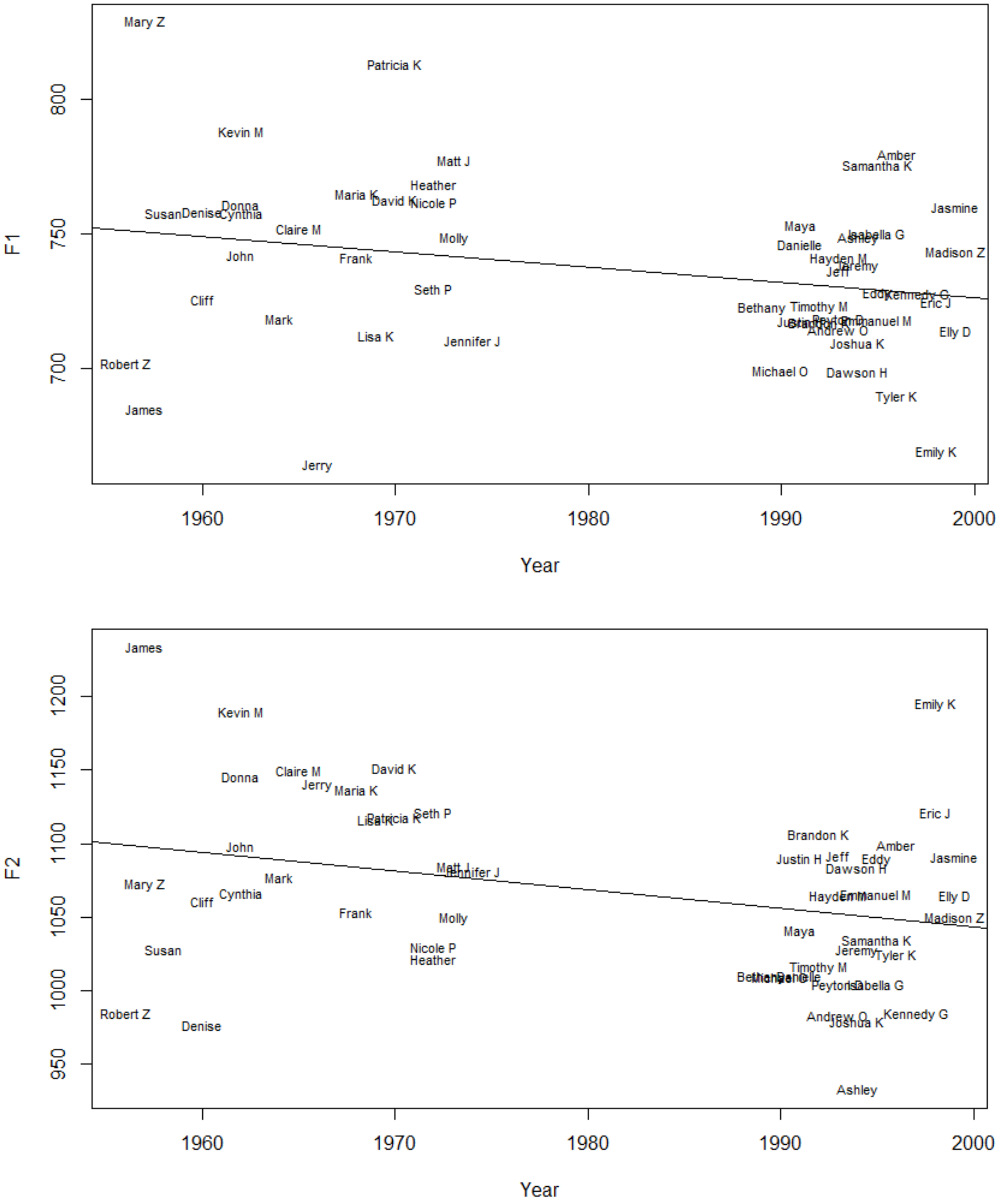


Figure 3.14. Linear models of pre-/l/ LOT by interviewee birth year

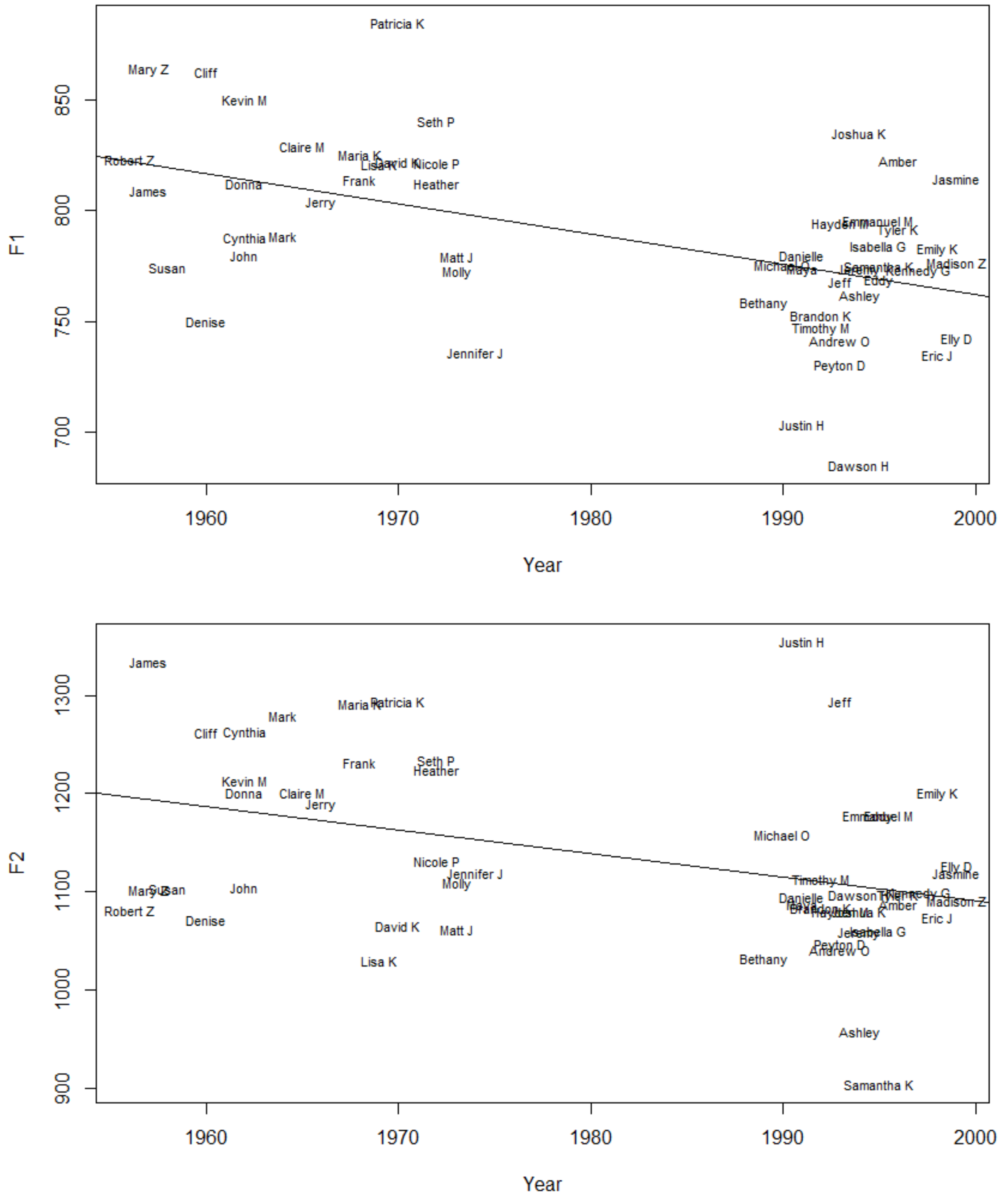


Table 3.11. Linear models of pre-/l/ THOUGHT by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
THOUGHT F1 (Intercept)	1852.0716	587.1575	3.154	0.00275
Year	-0.5629	0.2964	-1.899	0.06347
Residual standard error: 31.82 on 49 degrees of freedom Multiple R-squared: 0.06855, Adjusted R-squared: 0.04954 *F*-statistic: 3.606 on 1 and 49 DF, *p*-value: 0.06347				
THOUGHT F2 (Intercept)	3566.6165	1100.8249	3.24	0.00215
Year	-1.2615	0.5557	-2.27	0.02764
Residual standard error: 59.65 on 49 degrees of freedom Multiple R-squared: 0.09515, Adjusted R-squared: 0.07669 *F*-statistic: 5.153 on 1 and 49 DF, *p*-value: 0.02764				

Table 3.12. Linear models of pre-/l/ LOT by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
LOT F1 (Intercept)	3484.6398	644.2943	5.408	1.88e-06
Year	-1.3613	0.3253	-4.185	0.000118
Residual standard error: 34.91 on 49 degrees of freedom Multiple R-squared: 0.2633, Adjusted R-squared: 0.2483 *F*-statistic: 17.52 on 1 and 49 DF, *p*-value: 0.0001178				
LOT F2 (Intercept)	5891.7659	1637.2962	3.598	0.000744
Year	-2.4006	0.8266	-2.904	0.005507
Residual standard error: 88.72 on 49 degrees of freedom Multiple R-squared: 0.1469, Adjusted R-squared: 0.1295 *F*-statistic: 8.435 on 1 and 49 DF, *p*-value: 0.005507				

Finally, pre-/t/ THOUGHT and LOT are modeled in Figures 3.15 and 3.16. Outputs are presented in Tables 3.13 and 3.14. As has generally been the case, THOUGHT shows almost no movement in its trend line, and nothing of statistical significance. Pre-/t/ THOUGHT F1 appears to show a large amount of variation among younger interviewees, with mean productions ranging across a space of more than 150 Hz.

Figure 3.15. Linear models of pre-/t/ THOUGHT by interviewee birth year

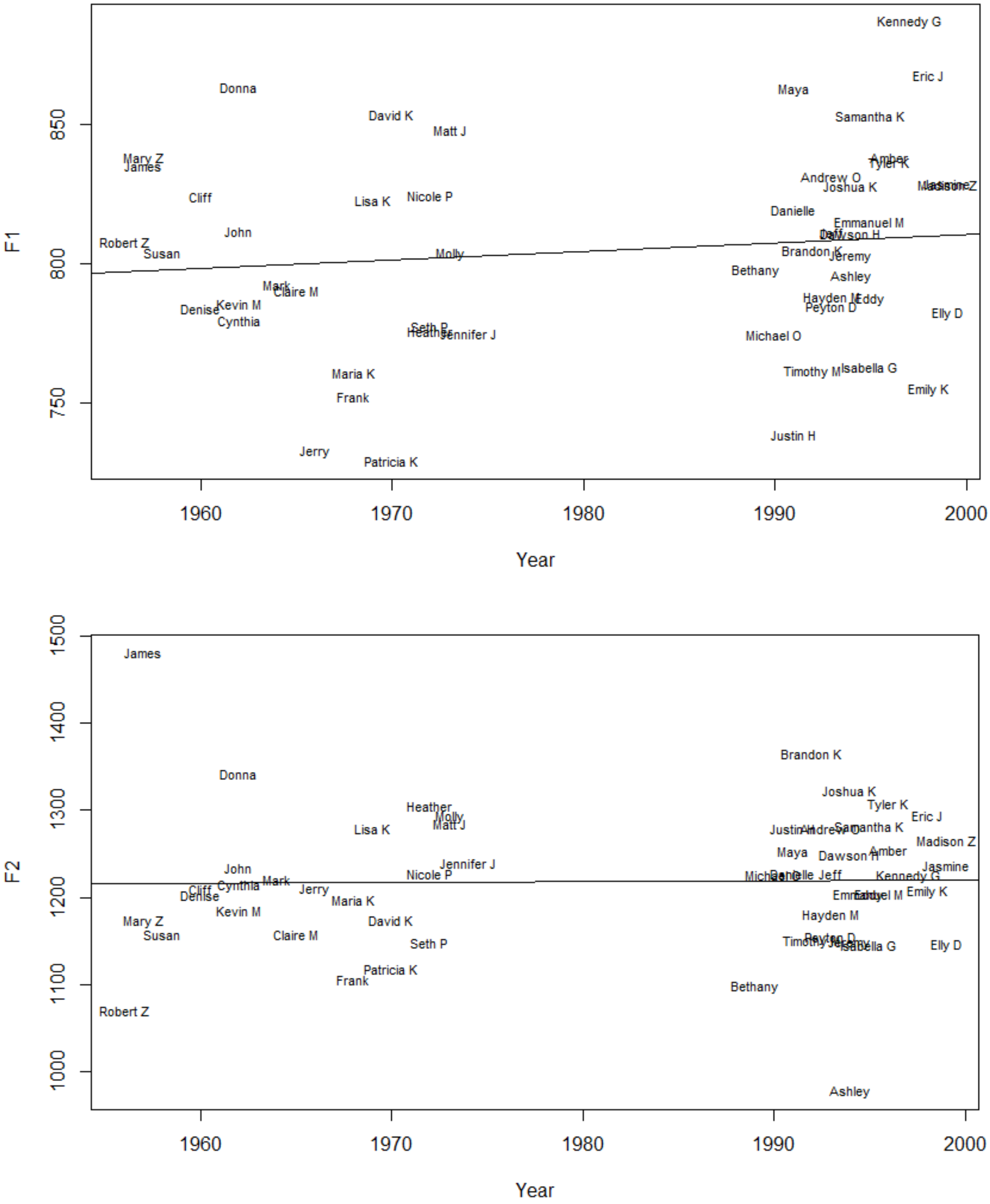


Figure 3.16. Linear models of pre-/t/ LOT by interviewee birth year

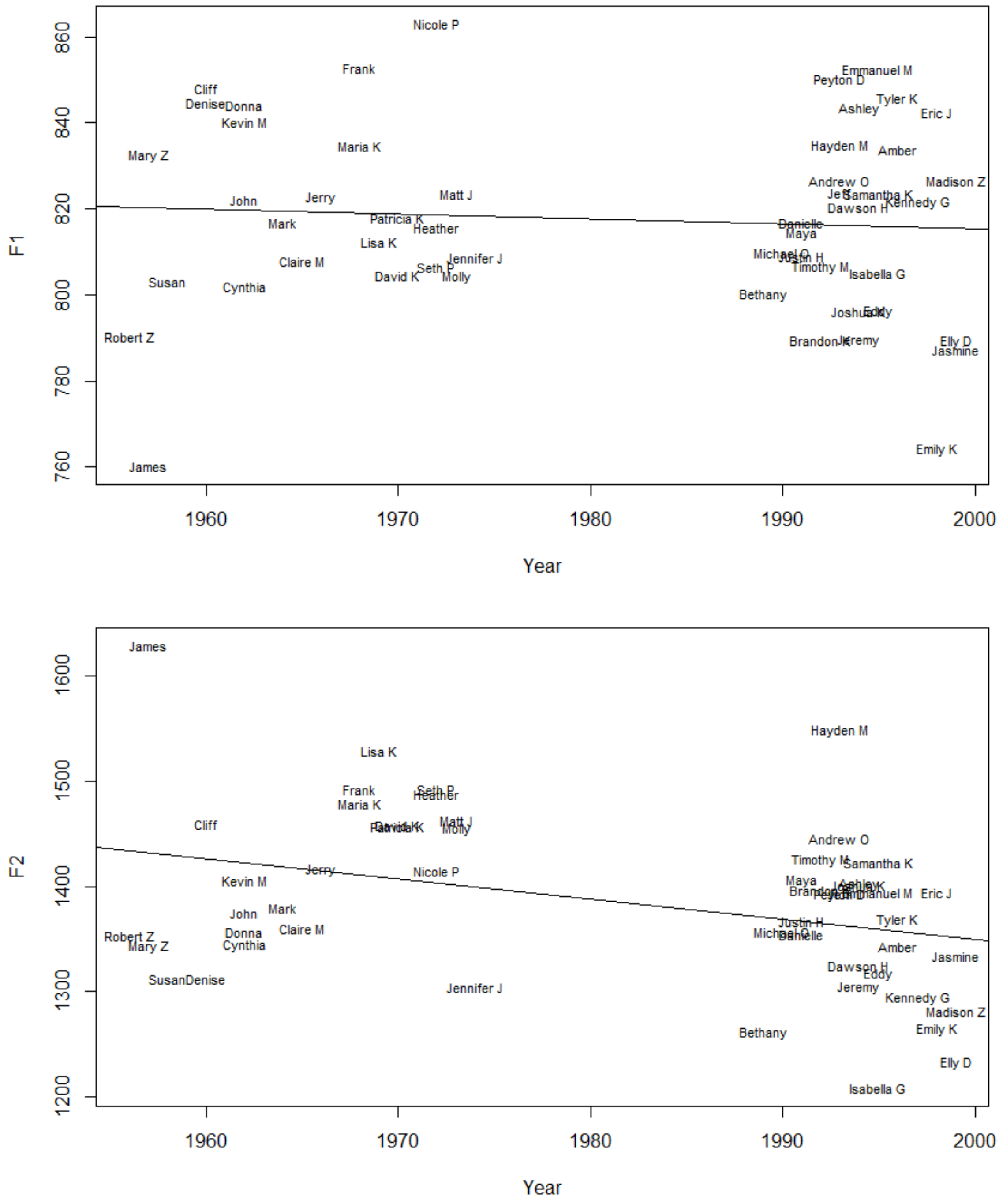


Table 3.13. Linear models of pre-/t/ THOUGHT by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
THOUGHT F1 (Intercept)	205.2796	665.4993	0.308	0.759
Year	0.3025	0.3360	0.900	0.372
Residual standard error: 36.06 on 49 degrees of freedom Multiple R-squared: 0.01627, Adjusted R-squared: -0.003802 *F*-statistic: 0.8106 on 1 and 49 DF, *p*-value: 0.3723				
THOUGHT F2 (Intercept)	994.5551	1520.0061	0.654	0.516
Year	0.1130	0.7674	0.147	0.884
Residual standard error: 82.37 on 49 degrees of freedom Multiple R-squared: 0.0004421, Adjusted R-squared: -0.01996 *F*-statistic: 0.02167 on 1 and 49 DF, *p*-value: 0.8836				

Table 3.14. Linear models of pre-/t/ LOT by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
LOT F1 (Intercept)	1035.7036	414.5584	2.498	0.0159
Year	-0.1101	0.2093	-0.526	0.6012
Residual standard error: 22.46 on 49 degrees of freedom Multiple R-squared: 0.005618, Adjusted R-squared: -0.01468 *F*-statistic: 0.2768 on 1 and 49 DF, *p*-value: 0.6012				
LOT F2 (Intercept)	5171.2993	1424.8487	3.629	0.000677
Year	-1.9108	0.7193	-2.656	0.010631
Residual standard error: 77.21 on 49 degrees of freedom Multiple R-squared: 0.1259, Adjusted R-squared: 0.108 *F*-statistic: 7.056 on 1 and 49 DF, *p*-value: 0.01063				

Pre-/t/ LOT shows little movement in F1 over time, but produces a statistically significant trend accounting for 11 percent of variation in F2. This model predicts a decrease in F2 of 19 Hz each decade. This is a small change at the speaker level, but, since THOUGHT appears to be frozen, the effect suggests a trend toward pre-/t/ LOT closing space relative to THOUGHT. Interestingly, if the older and younger interviewees are considered separately, opposite trends of change are suggested for pre-/t/ LOT F2, with a trend toward fronting LOT among interviewees born before 1975 and toward backing among interviewees born after 1989. The age groups are modeled in Figure 3.17, with older interviewees above and younger interviewees below.

Figure 3.17. Linear models of pre-/t/ F2 LOT for older and younger interviewees

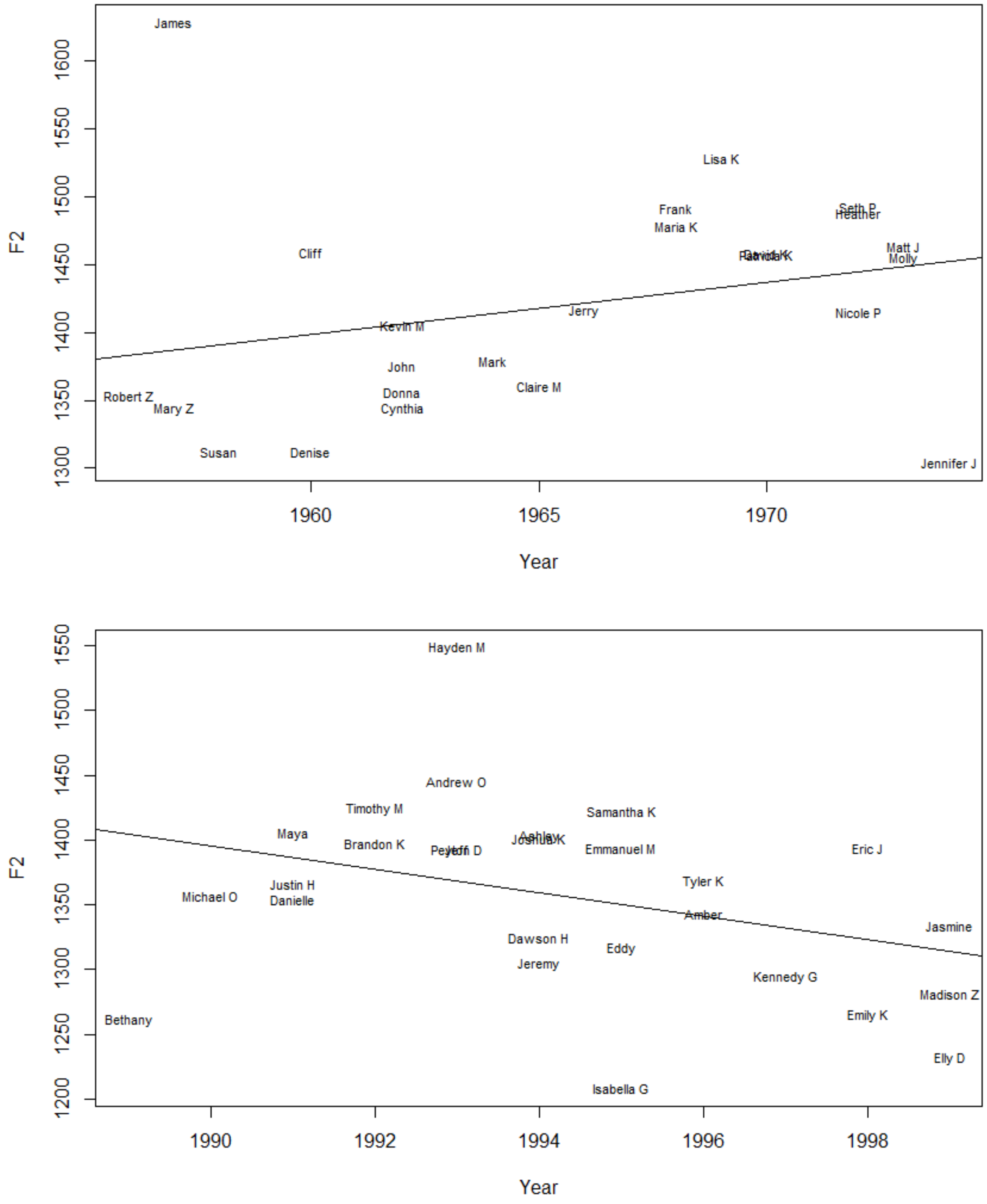


Table 3.15 provides the outputs of the regressions plotted in Figure 3.17. Neither model reaches statistical significance and, if they did, neither R^2 value is large. Nevertheless, the impression created by the trends is interesting. It may be useful at some point to explore speakers born between those included in this study (e.g., those studied in Gordon & Strelluf 2012) to examine whether a discrete change in the trajectory of pre-/t/ LOT F2 can be identified.

Table 3.15. Linear models of pre-/t/ LOT F2 for older and younger interviewees

	Estimate	Std. Error	*t* value	Pr(>|t|)
Older Interviewees				
LOT F2 (Intercept)	-6146.841	5487.412	-1.120	0.275
Year	3.850	2.792	1.379	0.182
Residual standard error: 77.97 on 22 degrees of freedom Multiple R-squared: 0.07956, Adjusted R-squared: 0.03772 *F*-statistic: 1.902 on 1 and 22 DF, *p*-value: 0.1818				
Younger Interviewees				
LOT F2 (Intercept)	19464.936	9677.552	2.011	0.0552
Year	-9.080	4.853	-1.871	0.0731
Residual standard error: 69.59 on 25 degrees of freedom Multiple R-squared: 0.1228, Adjusted R-squared: 0.08776 *F*-statistic: 3.501 on 1 and 25 DF, *p*-value: 0.07307				

Assuming that the low back merger is underway in Kansas City, the gradual trends might be best interpreted according to the S-curve model for the rate at which sound change proceeds (e.g., Chambers & Trudgill 1998; Baranowski 2007). The S-curve predicts that changes will spread slowly at first, rapidly for a time, and the slow again as they near completion. The undramatic measurements here may suggest that Kansas City speakers in my study are in the last step of that curve. Pre-/n/ vowels seem to have progressed through the S-curve earliest, and appear to be stable among Kansas Citians born in the last half of the twentieth century. Pre-/t/ LOT appears to have reached a stable position in F1 among interviewees, and now to be closing remaining distance in F2. Pre-/l/ LOT still shows a pattern of backing and raising, which is moving it in the direction of pre-/l/ THOUGHT.

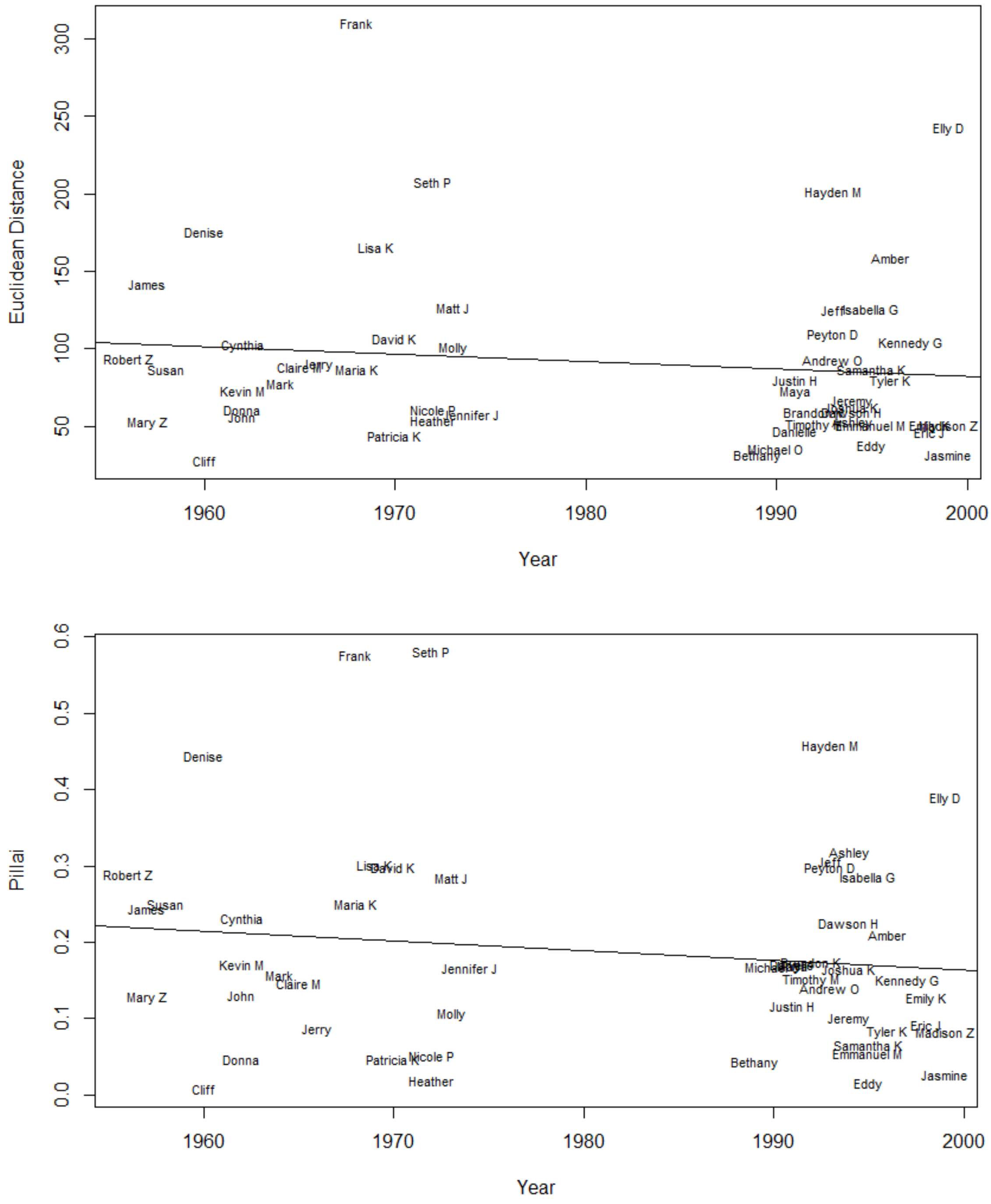
Figures 3.18 through 3.20, and the corresponding Tables 3-16 through 3-18, turn from the independent analyses of the LOT and THOUGHT to the relative distance between them in each phonetic environment. Each figure, shows two fixed effects linear models for the vowels with following /n/, /l/, and /t/ for each interviewee. The top model in each figure shows Euclidean distances and the bottom model shows Pillai scores. Both measures are included in the interest of thoroughness, and to maximize comparability with other studies that have used either measure. The distance measurements are again modeled against interviewee birth year.

Table 3.16 and Figure 3.18 show these results for pre-/n/ LOT and THOUGHT.

Table 3.16. Linear models of pre-/n/ LOT and THOUGHT Euclidean distance and Pillai score by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
Euclidean distance (Intercept)	1032.0073	1058.8351	0.975	0.335
Year	-0.4749	0.5345	-0.888	0.379
Residual standard error: 57.38 on 49 degrees of freedom Multiple R-squared: 0.01585, Adjusted R-squared: -0.004232 *F*-statistic: 0.7893 on 1 and 49 DF, *p*-value: 0.3786				
Pillai score (Intercept)	2.655774	2.483203	1.069	0.290
Year	-0.001246	0.001254	-0.994	0.325
Residual standard error: 0.1346 on 49 degrees of freedom Multiple R-squared: 0.01975, Adjusted R-squared: -0.0002507 *F*-statistic: 0.9875 on 1 and 49 DF, *p*-value: 0.3252				

Figure 3.18. Linear models of pre-/n/ LOT and THOUGHT Euclidean distance and Pillai score by interviewee birth year



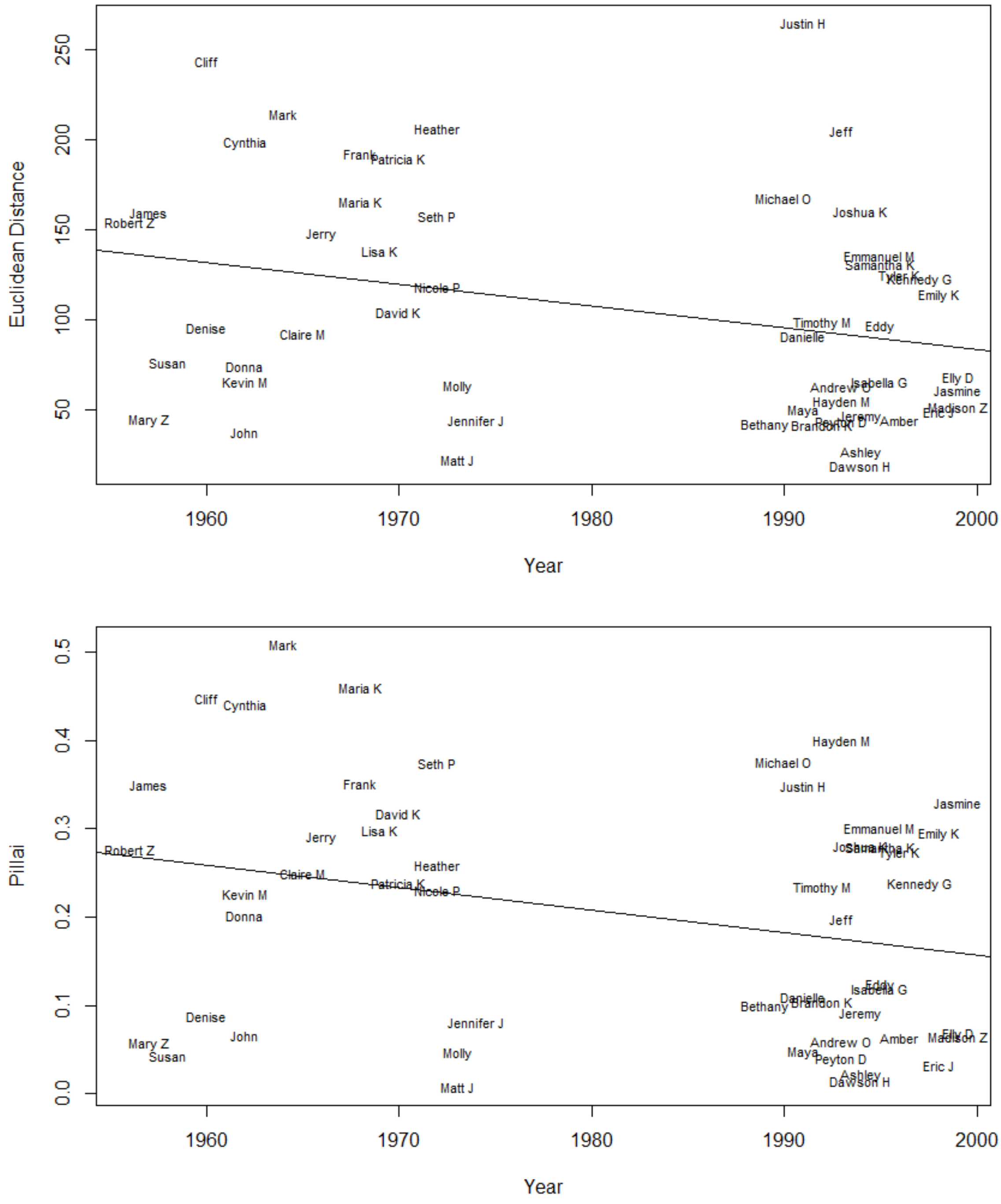
As would be predicted from the independent analysis of pre-/n/ LOT and THOUGHT, the combined measurements show no substantial changes over time. The relative distance and dispersion of the vowel classes remains basically stable across all interviewees. The close proximities of pre-nasal LOT and THOUGHT seen in Section 3.3 seem to reflect completed changes for Kansas City as a whole.

The regressions for pre-/l/ LOT and THOUGHT are shown in Table 3.17 and Figure 3.19. The outputs are numerically small, but reflect the decrease in distance between the vowels that was predicted from LOT’s backing in apparent time. The decrease in Euclidean distance is statistically significant. The decline in Pillai scores just misses significance, depending on how numbers are rounded. Perhaps the more important observation is that the number of interviewees with small distances between vowels appears to become more concentrated in the younger group. Pillai scores also show an interesting break in both groups between speakers with very small vowel dispersions and

Table 3.17. Linear models of pre-/l/ LOT and THOUGHT Euclidean distance and Pillai score by interviewee birth year

<table>
<tr><th></th><th>Estimate</th><th>Std. Error</th><th><i>t</i> value</th><th>Pr(>|t|)</th></tr>
<tr><td>Euclidean distance (Intercept)</td><td>2517.0545</td><td>1125.8539</td><td>2.236</td><td>0.0300</td></tr>
<tr><td>Year</td><td>-1.2168</td><td>0.5684</td><td>-2.141</td><td>0.0373</td></tr>
<tr><td colspan="5">Residual standard error: 61.01 on 49 degrees of freedom
Multiple R-squared: 0.08553, Adjusted R-squared: 0.06687
<i>F</i>-statistic: 4.583 on 1 and 49 DF, <i>p</i>-value: 0.03729</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Pillai score (Intercept)</td><td>5.225567</td><td>2.498465</td><td>2.092</td><td>0.0417</td></tr>
<tr><td>Year</td><td>-0.002534</td><td>0.001261</td><td>-2.009</td><td>0.0501</td></tr>
<tr><td colspan="5">Residual standard error: 0.1354 on 49 degrees of freedom
Multiple R-squared: 0.07611, Adjusted R-squared: 0.05725
<i>F</i>-statistic: 4.036 on 1 and 49 DF, <i>p</i>-value: 0.05005</td></tr>
</table>

Figure 3.19. Linear models of pre-/l/ LOT and THOUGHT Euclidean distance and Pillai score by interviewee birth year



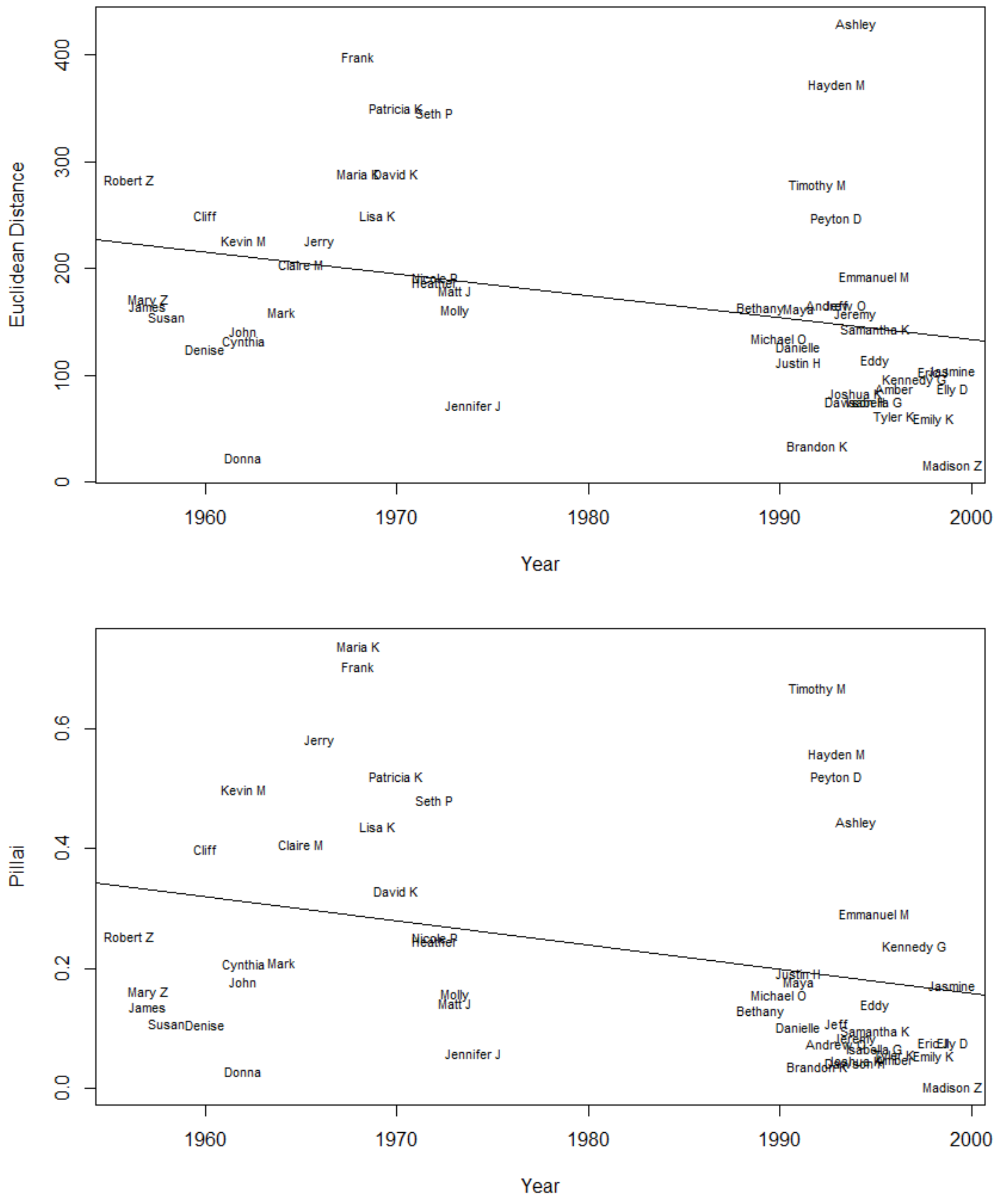
speakers with larger ones. Interestingly, there doesn't appear to be any clear correlation between responses in minimal pairs tests and the speakers on either side of this break. For instance, Mary Z and Denise, who appear among the lowest Pillai scores of older interviewees, both indicated that *Polly* and *Pauley* were different. I judged Denise to be distinct and Mary Z to be close. The connection between the status of these vowels phonetically and phonemically will be explored more below.

The models for pre-/t/ LOT and THOUGHT in Table 3.18 and Figure 3.20 appear to be quite similar to those for pre-/l/ LOT and THOUGHT. Both models reflect a small R^2 of about 8 percent at significant levels. The model for Euclidean distance confirms that the movement of pre-/t/ LOT toward THOUGHT is occurring primarily in F2, as it predicts a decrease in distance of about 21 Hz per decade, very nearly matching the 19-Hz-per-decade backing of pre-/t/ LOT shown in Table 3.14. Visually, these plots again show concentration of productions among younger interviewees. In other words, while

Table 3.18. Linear models of pre-/t/ LOT and THOUGHT Euclidean distance and Pillai score by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
Euclidean distance (Intercept)	4247.5959	1707.6058	2.487	0.0163
Year	-2.0570	0.8621	-2.386	0.0209
Residual standard error: 92.53 on 49 degrees of freedom Multiple R-squared: 0.1041, Adjusted R-squared: 0.08581 *F*-statistic: 5.693 on 1 and 49 DF, *p*-value: 0.02094				
Pillai score (Intercept)	8.226517	3.511775	2.343	0.0233
Year	-0.004034	0.001773	-2.276	0.0273
Residual standard error: 0.1903 on 49 degrees of freedom Multiple R-squared: 0.09558, Adjusted R-squared: 0.07712 *F*-statistic: 5.178 on 1 and 49 DF, *p*-value: 0.02728				

Figure 3.20. Linear models of pre-/t/ LOT and THOUGHT Euclidean distance and Pillai score by interviewee birth year



roughly similar ranges of distances and dispersions exist within each age group, among the younger interviewees fewer people are spread across the entire range. Very close productions of LOT and THOUGHT appear to be the norm among young Kansas Citians, again depicting a change nearing completion. Among younger interviewees, individuals with relatively distinct productions are outliers.

The psychological basis of differences between LOT and THOUGHT can be perhaps best measured through speaker productions (and judgments about their productions) during minimal pairs tests. Figure 3.21 shows the results of interviewee judgments of the minimal pairs *dawn-Don*, *Polly-Pauley*, and *cot-caught*. The numbers of interviewees who judge the pairs same, close, or different are represented by the three colored bands in each bar graph. Judgments are grouped by older and younger interviewees to demonstrate change in the perception of LOT and THOUGHT as phonemically distinct vowels. As the interview task that explicitly demands interviewees focus most closely on their speech, the minimal pairs test would presumably be the task most likely to capture interviewees' conscious perceptions about language.

Figure 3.21 suggests the collapse of a phonemic distinction between LOT and THOUGHT in apparent time. The distinction was already breaking down among older interviewees, with over half judging the vowels the same in all three phonetic environments, and just over one-fifth of older interviewees claiming the vowels to be different in any one context. Among younger interviewees, only Andrew O perceives the vowels as different in any environment. All other younger interviewees claim the vowels are the same or close (with a strong preference for same). Younger interviewees seem to perceive *cot* and *caught* as slightly more distinct than they do the other pairs, potentially reflecting the ongoing backing of pre-/t/ LOT observed above. However this is a relatively small claim to being the most distinct pair. The most plausible conclusion from this data is that interviewees do not recognize a phonemic distinction between LOT and THOUGHT in the context of the minimal pairs test.

Figure 3.21. Interviewee judgments of minimal pairs of *dawn-Don*, *Polly-Pauley*, and *cot-caught* by age group

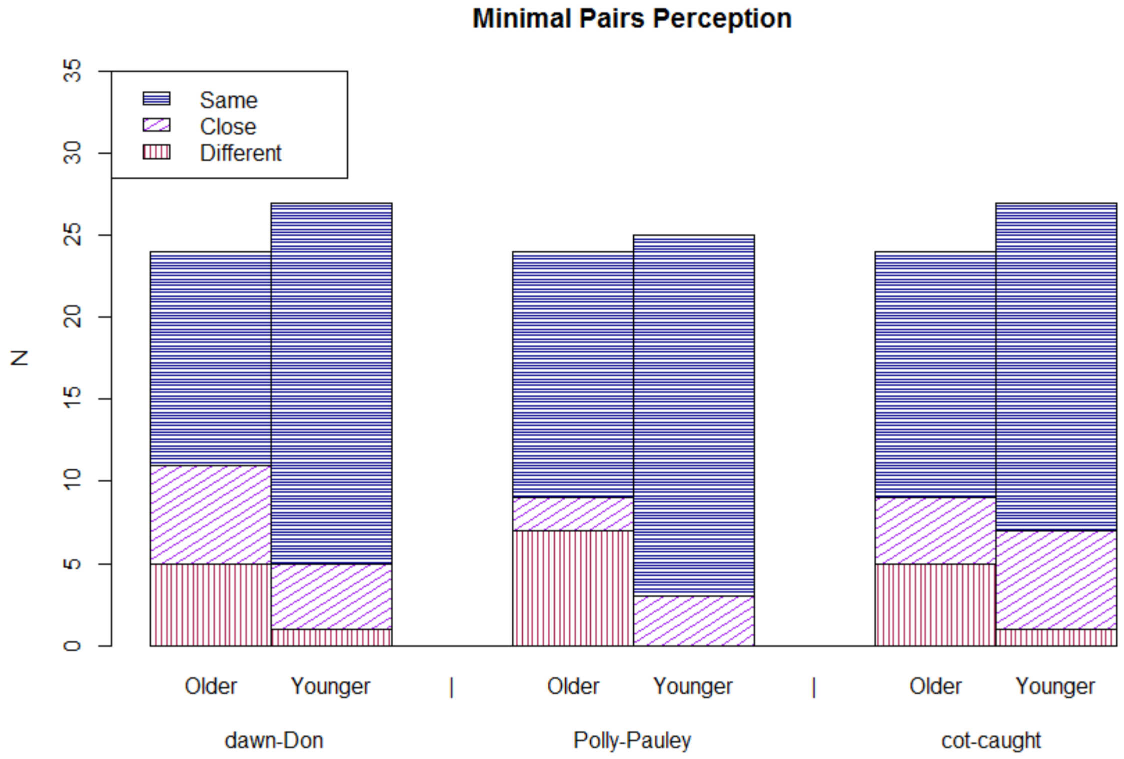
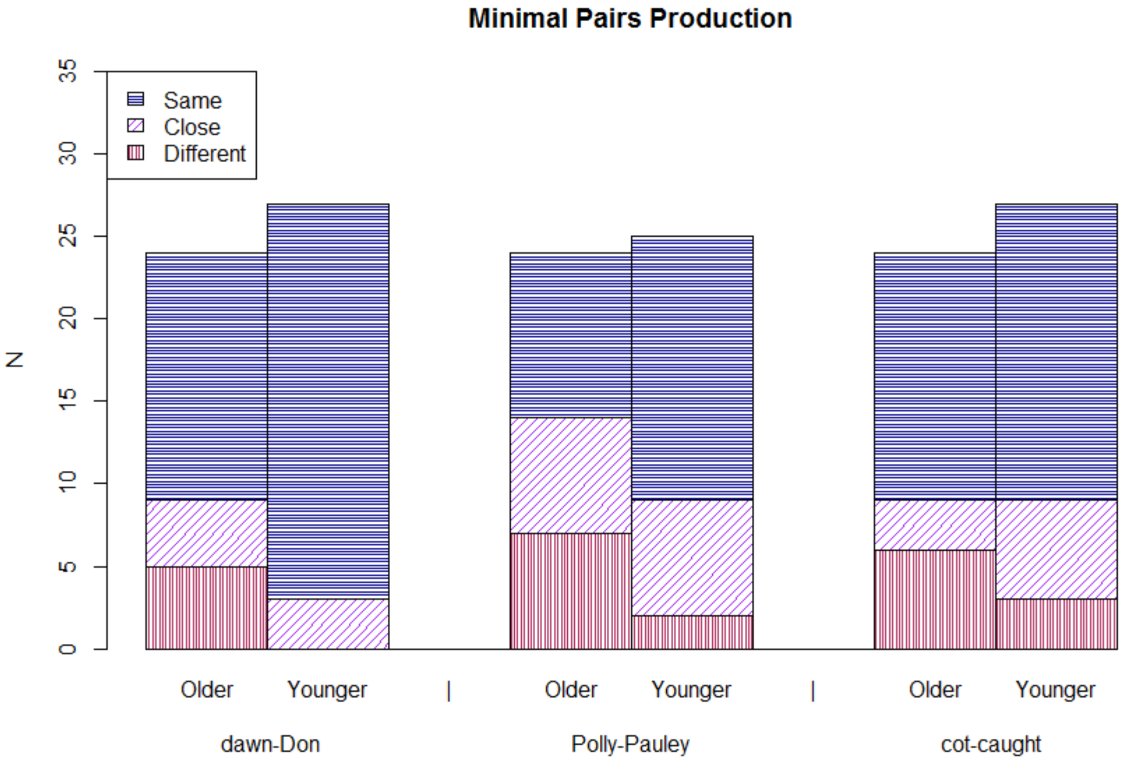


Figure 3.22 replicates the format of 3.21, but depicts my judgments of minimal pairs productions.

Figure 3.22. Interviewee productions of minimal pairs of *dawn-Don*, *Polly-Pauley*, and *cot-caught* by age group



Judgments of these minimal pairs suggest that, impressionistically, older Kansas Citians were approaching a complete phonetic merger of *dawn-Don*, and that younger Kansas Citians are all but fully complete. *Polly-Pauley* shows advance, from two-thirds of older interviewees producing some kind of distinction to two-thirds of younger interviewees producing merged vowels. *Cot-caught* is also nearing complete merger in production, with just nine younger interviewees being judged to have any distinction. It is perhaps noteworthy that, for the two changes that still appear to be in progress in the acoustic analysis above (pre-/l/ and pre-/t/ LOT and THOUGHT), interviewees appear to judge the vowels to be the same at a slightly higher rate than I judge their productions to be the same. In other words, raw counts suggest that the vowels are more merged in perception than production.

Figure 3.23 shows perceptions of the minimal pairs split by gender for the two age groups. Confirming the progress of the perceptual merger in apparent time, this finer division shows a female lead among younger interviewees for *dawn-Don* and *cot-caught*, and a slight male lead for following /l/. The perception results among older speakers are less straightforward. Generally, older females appear to lead males in judgments of same for the minimal pairs, but they also appear slightly more likely than males, especially in the case of *cot-caught*, to claim to perceive the pair as different.

Figure 3.23. Interviewee perceptions of minimal pairs of *dawn-Don*, *Polly-Pauley*, and *cot-caught* by sex

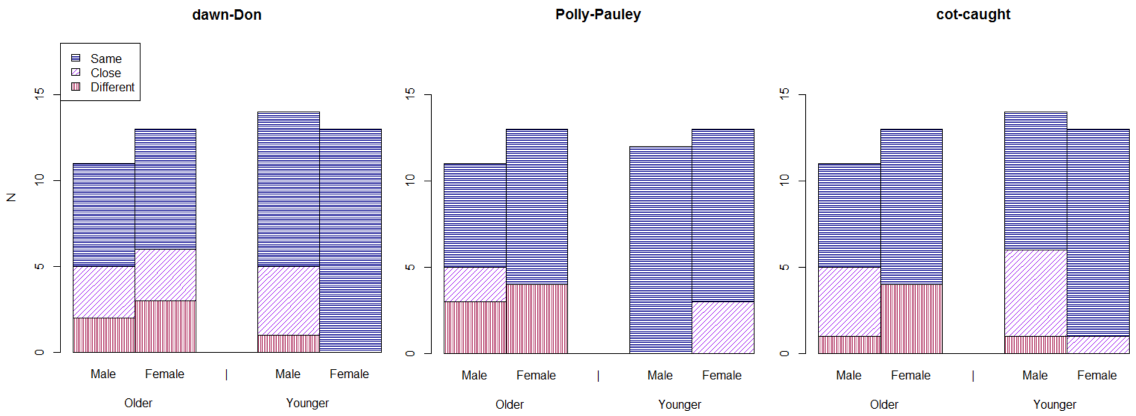
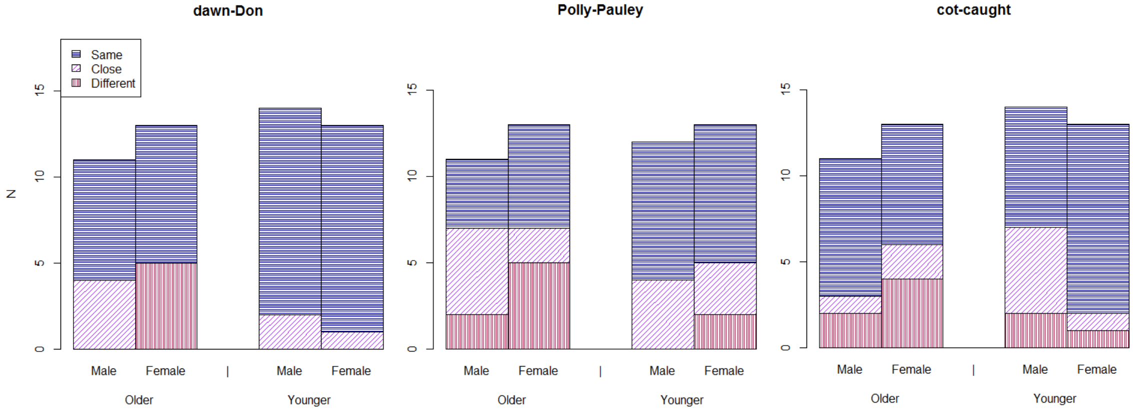


Figure 3.24 shows production of the minimal pairs for the age groups by gender. As seen in the broader examination of age groups above, production of the minimal pairs as merged trails perception. Young females maintain a slight lead over males in merged productions of *cot-caught*, males a slight lead in *Polly-Pauley*, and the sample of young

speakers appears nearly completely merged in production of *dawn-Don*. Among older interviewees, males appear to show a slight lead over females in production. This is a surprising result given the general expectation that women will lead sound change and the slight female lead in the merger among younger speakers. This generational gender difference bears more study.

Figure 3.24. Interviewee productions of minimal pairs of *dawn-Don*, *Polly-Pauley*, and *cot-caught* by sex



Figures 3.25 and 3.26 compare minimal pairs test perception and production by status as working class (WC), transitional class (TC), or middle class (MC). In terms of perception, the Kansas City community is basically unified in perceiving LOT and THOUGHT as same or close. MC interviewees are especially advanced in perceiving the *cot-caught* as merged, with only Mary Z calling them different. TC speakers are advanced in all three perceptual mergers, with none perceives any pair as different. In Figure 3.26, merged productions again trail perceptual merger. Only *dawn-Don*

Figure 3.25. Interviewee perceptions of minimal pairs of *dawn-Don*, *Polly-Pauley*, and *cot-caught* by class

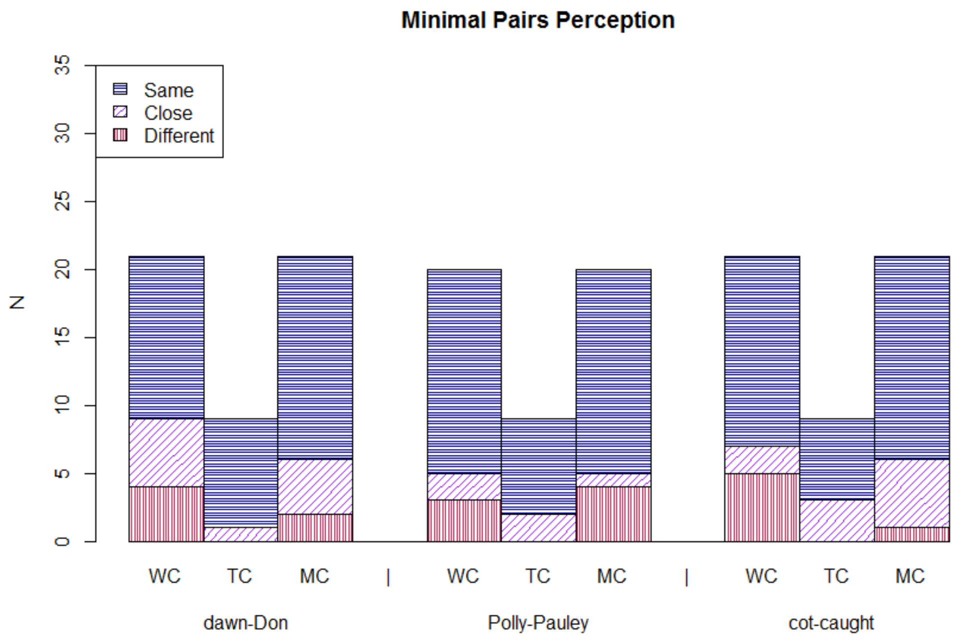
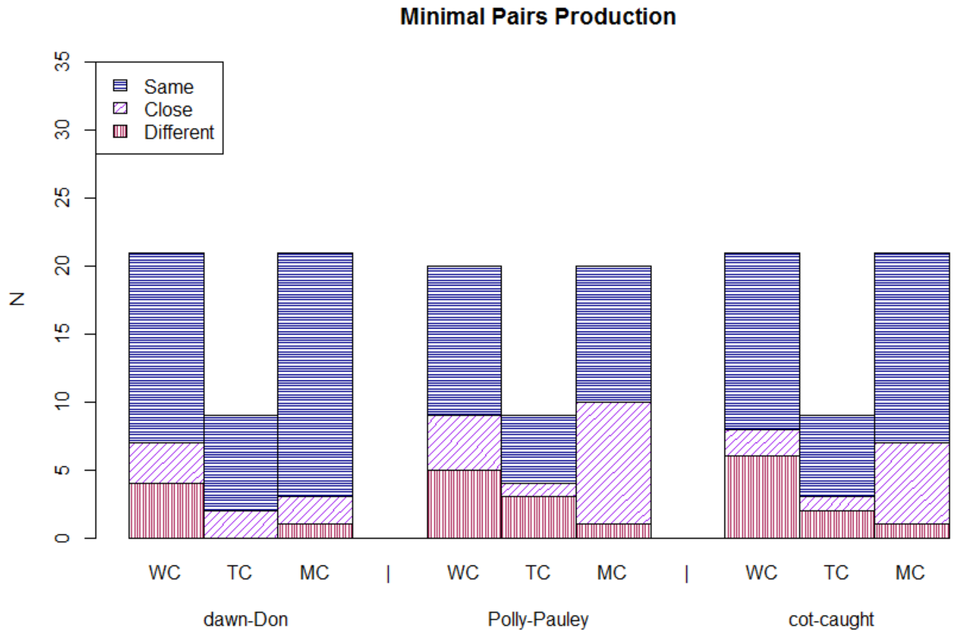


Figure 3.26. Interviewee productions of minimal pairs of *dawn-Don*, *Polly-Pauley*, and *cot-caught* by class



challenges this general trend, with slightly more speakers in all three classes producing the pair as the same than claimed to perceive the pair as the same.

Considerations by age, gender, and class all point to the conclusion that the distinction between LOT and THOUGHT is largely gone from the phonemic inventory of Kansas City English. It is challenging to explain why significant differences in measurements remain between LOT and THOUGHT in these phonetic environments in measurements above given these perceptual and impressionistic results. As noted above, this is a regular occurrence in studies of the low back merger (cf., Herold 1990, 1997; Evanini 2009; Johnson 2010; though Majors 2005 is much more consistent in producing statistical results that reflect merger). Perhaps the relatively small backing of pre-/t/ LOT and the backing and raising of pre-/l/ LOT in apparent time that are noted above reflect the vowels catching up phonetically with their phonemic statuses. While this does not provide a satisfactory explanation for this broader issue of phonetic distinctions being present where phonemic distinctions are absent, for the study of language in Kansas City, minimal pairs test results clearly suggest that phonemically, LOT and THOUGHT are merged, especially for young Kansas Citians, regardless of any lagging phonetic differences.

These observations on minimal pairs responses afford a more fine-grained analysis of phonetic conditioning. Tables 3.19 through 3.21 compare productions of LOT and THOUGHT in interview speech in each of the contexts of following /n/, /l/, and /t/ according to which interviewees claimed each pair was the same, close, or different. Additionally, the tables compare productions for each environment according to my impressionistic judgments of whether interviewees were the same, close, or different. The number of interviewees included under each perception or production result appears in parentheses in each entry in the first column. Two interviewees, Dawson H and Tyler K, misread *Polly-Pauley* and are not included in Table 3.20.

Table 3.19. Distances between pre-/n/ LOT and THOUGHT by perception and production of *dawn-Don* minimal pair

dawn-Don		LOT	THOUGHT	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Perception Same (35)	F1	812.9	770.2	42.73	8.1653	< 0.001	0.065007	< 0.001
	F2	1198.0	1195.4		0.2513	0.8017		
Perception Close (10)	F1	832.3	751.6	158.59	8.7085	< 0.001	0.31597	< 0.001
	F2	1305.5	1169.0		7.092	< 0.001		
Perception Different (6)	F1	794.3	742.5	51.84	4.5114	< 0.001	0.079806	< 0.001
	F2	1193.2	1193.7		-0.0204	0.9838		
Production Same (39)	F1	808.6	763.3	45.97	9.1951	< 0.001	0.068839	< 0.001
	F2	1201.8	1193.6		0.8337	0.4048		
Production Close (7)	F1	828.8	750.6	131.40	6.8388	< 0.001	0.23874	< 0.001
	F2	1290.3	1184.7		4.4977	< 0.001		
Production Different (5)	F1	829.0	776.2	78.62	4.0789	< 0.001	0.12949	< 0.001
	F2	1236.4	1178.2		2.3148	0.02226		

Table 3.20. Distances between pre-/l/ LOT and THOUGHT by perception and production of *Polly-Pauley* minimal pair

Polly-Pauley		LOT	THOUGHT	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Perception Same (37)	F1	782.3	734.7	89.23	11.3165	< 0.001	0.11834	< 0.001
	F2	1135.0	1059.4		7.7606	< 0.001		
Perception Close (5)	F1	797.3	753.8	75.70	4.6356	< 0.001	0.1069	< 0.001
	F2	1139.5	1077.5		2.6572	0.009		
Perception Different (7)	F1	833.6	756.5	124.23	6.0921	< 0.001	0.15819	< 0.001
	F2	1148.9	1051.5		4.3873	< 0.001		
Production Same (26)	F1	784.9	735.8	97.65	9.6788	< 0.001	0.12541	< 0.001
	F2	1140.2	1055.8		7.5031	< 0.001		
Production Close (14)	F1	806.9	750.6	82.50	7.3888	< 0.001	0.11373	< 0.001
	F2	1136.4	1076.0		4.0533	< 0.001		
Production Different (9)	F1	788.7	736.1	104.56	5.8197	< 0.001	0.14414	< 0.001
	F2	1133.0	1042.8		4.1192	< 0.001		

Table 3.21. Distances between pre-/t/ LOT and THOUGHT by perception and production of *cot-caught* minimal pair

cot-caught		LOT	THOUGHT	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Perception Same (35)	F1	815.9	808.2	143.61	2.1802	0.02947	0.10637	< 0.001
	F2	1368.7	1225.3		17.1402	< 0.001		
Perception Close (10)	F1	813.7	800.2	218.71	1.9928	0.04706	0.20351	< 0.001
	F2	1389.1	1170.8		12.5888	< 0.001		
Perception Different (6)	F1	829.6	792.2	196.88	3.8303	< 0.001	0.20206	< 0.001
	F2	1397.6	1204.3		9.5901	< 0.001		
Production Same (33)	F1	811.2	807.7	160.35	0.9067	0.3648	0.1223	< 0.001
	F2	1378.9	1218.6		17.3139	< 0.001		
Production Close (9)	F1	826.0	811.8	138.45	2.1409	0.03322	0.10632	< 0.001
	F2	1363.3	1225.6		9.4323	< 0.001		
Production Different (9)	F1	828.1	787.4	207.72	5.9036	< 0.001	0.22983	< 0.001
	F2	1376.2	1172.4		12.8784	< 0.001		

The striking result of this division is that very little emerges in the way of a clear pattern for the distance between LOT and THOUGHT that correlates with a interviewee perceptions or production of merger or distinction. For all pre-/n/ LOT and THOUGHT tokens, Euclidean distances and Pillai scores are extremely similar for interviewees who perceive the *dawn-Don* pair the same and for interviewees who perceive them different. In fact, speakers who perceive *dawn* and *Don* the same have nearly identical mean values in F2, and so do speakers who perceive *dawn* and *Don* as different. Likewise, those I judged to be merged show basically the same Euclidean distances as those I judged to be distinct. For pre-/l/ LOT and THOUGHT, Pillai scores are almost identical across the different phonemic statuses. Pre-/t/ LOT and THOUGHT Euclidean distances are greater than they are in other contexts, but Pillai scores show very little change.

The most concrete observation to take from this consideration is that all interviewees basically pattern phonetically in these three environments in the ways predicted by the linear regressions in Sections 3.1 and 3.2, regardless of the phonemic status of LOT and THOUGHT for the interviewee. LOT and THOUGHT with following /l/ are both produced high and back. LOT and THOUGHT with following /t/ are produced lower and fronter. LOT and THOUGHT with following /n/ are produced between following /l/ and /t/.

On the other hand, the fact that I impressionistically judged several interviewees to be distinct during minimal pairs (and the lingering presence of separations between the vowel classes in some phonetic environments) continues to raise problems for this analysis. One critical possibility raised by the sociolinguistic interview is that interviewees are speaking differently in the more formal task of the minimal pairs test than they are in casual speech. I will explore that in the following section. The other is that distinctions are being produced on dimensions besides height and frontness, such as lip-rounding, vowel duration, production of an off-glide, or differences over the course of the vowel contour. I will not explore those possibilities in this study. However, it is critical to consider those as caveats since they would potentially undermine any study that relies on steady-state measurements of F1 and F2.

3.6. Stylistic Variation

It is possible to test whether the perceived differences in the productions of LOT and THOUGHT among a small subset of interviewees is a result of the minimal pairs task itself by comparing productions in the four different styles of interview speech that I track in this data. I will use “style” and “stylistic variation” as short-hand for the different levels of attention-to-speech suggested by the four interview tasks of CS, RP, WL, and MP. My examination here will be cursory, focusing only on the broad phonetic category of following stops in primary stress position. I limit this primarily in the interest of time. But the environment of following stops in primary stress position is very appealing for exploration because it is robustly represented by 7,604 LOT and THOUGHT tokens in my data. As such, it allows for a lot of data to be considered for stylistic variation, while still providing a unifying phonetic feature across the many forms. In phonetic analysis in Section 3.3, the context of following stops showed mild resistance to the merger of LOT and THOUGHT.

Stylistic variation will be considered according to interviewees' conscious phonemic status of LOT and THOUGHT as separate vowels—at least to the extent that phonemic status can be determined by perceptions in minimal pairs test. Interviewees who claimed to perceive any distinction in the *cot-caught* minimal pair will be grouped together and compared against interviewees who said that the two words sounded the same. The idea here is that, if speakers are conscious of a distinction between LOT and THOUGHT, they will produce that distinction most definitively in the interview task that calls the most attention to speech. They might have relatively closer productions in styles that demand less attention to speech, especially casual speech. If speakers are not conscious of a phonemic distinction between LOT and THOUGHT, they might be expected to produce the vowels at similar relative distances to one another regardless of interview task.

Table 3.22 provides lmer analyses of productions of F1 and F2 measurements for THOUGHT and LOT with following stop among interviewees who perceive a difference between *cot* and *caught*, divided according to each of the four interview tasks. The tasks are listed from demanding least attention to speech to most. Table 3.23 provides the same for interviewees who perceive that minimal pair as the same. Table 3.24 shows Euclidean distances and Pillai scores for pre-stop LOT and THOUGHT for each perceptual grouping. Since Table 3.24 will provide absolute means for LOT and THOUGHT F1 and F2, the information in Tables 3.22 and 3.23 is somewhat redundant. However, the added precision of the mixed effects model is important as a balance against conclusions that might be skewed by the unbalanced nature of the CS data.

Table 3.22. Mixed effects regression of THOUGHT and LOT with following stop according to interview task among interviewees who perceive *cot-caught* minimal pair as different or close

Fixed Effects	Estimate	Std. Error	*t* value
THOUGHT F1			
styleCS (Intercept)	785.412	11.653	67.40
styleRP	3.007	7.702	0.39
styleWL	-14.905	9.728	-1.53
styleMP	-5.490	23.904	-0.23
THOUGHT F2			
styleCS (Intercept)	1162.88	23.28	49.95
styleRP	-28.74	14.33	-2.01
styleWL	-105.28	18.19	-5.79
styleMP	-154.73	48.96	-3.16
LOT F1			
styleCS (Intercept)	832.545	7.741	107.54
styleRP	15.376	7.569	2.03
styleWL	29.011	12.376	2.34
styleMP	39.942	37.450	1.07
LOT F2			
styleCS (Intercept)	1286.26	21.27	60.46
styleRP	-16.97	14.57	-1.17
styleWL	-83.64	28.17	-2.97
styleMP	-84.47	111.84	-0.76

For interviewees who perceive a difference in *cot-caught,* lmer analysis shows a fairly clear degree of stylistic variation across interview tasks for both LOT and THOUGHT. F1 does not change much for THOUGHT, but in F2 the vowel backs substantially, especially as the interview changes from RP to WL. In MP, THOUGHT with following stop has retracted all the way back to 1008 Hz. Interestingly, LOT also backs, though its decline in F2 is not as dramatic. Again, there is a big jump back as interviewees move from RP to WL. LOT's distance from THOUGHT also increases in an F1 dimension, as LOT lowers across styles. In MP, mixed effects regression places LOT at F1:872 Hz, F2:1202 Hz. This results in a Euclidean distance between LOT and THOUGHT in MP of about 215 Hz (quite a bit bigger than the distance of 115 Hz calculated from absolute means and shown in Table 3.24). The Euclidean distance between LOT and THOUGHT in CS in lmer analysis is 132 Hz. This suggests that the strong backing of THOUGHT and lowering of LOT across styles has the effect of increasing the relative distance between the vowels as speakers increase their attention to speech. This suggests that interviewees who claim that minimal pairs are different may be emphasizing the distinction between the vowels in formal styles. At the same time, it is interesting to note that LOT backs in a pattern similar to THOUGHT as attention to speech increases. While LOT does not match THOUGHT's degree of backing, it does seem that backer productions are associated with more formal styles, even among interviewees who perceive a phonemic distinction.

This backing pattern also appears to be followed by speakers who perceive *cot-caught* as same. In the case of those interviewees, though, LOT and THOUGHT back at roughly equivalent rates as interviewees move through styles. This is shown in Table 3.23.

Table 3.23. Mixed effects regression of THOUGHT and LOT with following stop according to interview task among interviewees who perceive *cot-caught* minimal pair as same

Fixed Effects	Estimate	Std. Error	*t* value
THOUGHT F1			
styleCS (Intercept)	797.481	7.181	111.05
styleRP	17.522	4.903	3.57
styleWL	0.692	6.515	0.11
styleMP	10.380	16.963	0.61
THOUGHT F2			
styleCS (Intercept)	1172.533	19.553	59.97
styleRP	-11.209	9.196	-1.22
styleWL	-72.576	12.247	-5.93
styleMP	-106.646	33.581	-3.18
LOT F1			
styleCS (Intercept)	823.219	4.937	166.74
styleRP	24.440	4.770	5.12
styleWL	13.093	8.961	1.46
styleMP	21.047	29.647	0.71
LOT F2			
styleCS (Intercept)	1272.364	13.202	96.38
styleRP	-16.709	8.312	-2.01
styleWL	-79.564	17.305	-4.60
styleMP	-90.448	67.781	-1.33

The CS lmer measurements for interviewees who are merged in perception of LOT and THOUGHT are really basically the same as are those for interviewees who perceive a difference in the vowels. Merged interviewees even lower LOT somewhat in more formal styles, though the lowering effect is not very strong and they do not show a steady progression of acoustically lower productions as attention to speech increases. Whatever distance they produce between the vowels remains basically the same across styles—the Euclidean distances estimated from mixed effects regression are 103 Hz in CS and 122 Hz in MP.

So, overall, the picture appears to be that in CS all interviewees produce LOT and THOUGHT in roughly the same ways. All interviewees also seem to share an evaluation that backer productions of the vowels correlate with more formal speech styles. The phonemic difference emerges as interviewees who perceive the vowels as the same back LOT and THOUGHT at basically equal rates. By contrast, interviewees who perceive a difference back THOUGHT more dramatically and lower LOT with the effect of increasing acoustic distinction.

These conclusions are not quite so straightforward when real measurements are compared, rather than mixed-effects estimated ones. Table 3.24 does not show the obvious patterning that lmer analysis did for either vowel or perception group. Even so, Table 3.24 still confirms the overall pattern of backing in F2 for both LOT and THOUGHT as attention to speech increases. For interviewees who perceive a difference, LOT F2 in MP is almost the same as THOUGHT F2 in RP. The interviewees who perceive *cot-caught* as same appear to be acoustically merged, especially in MP, where Euclidean distance and Pillai score are extremely small. For them, LOT started at a relatively central position in F2, but backed dramatically to a very low back position, and THOUGHT lowered to meet LOT. So, by these absolute measurements, speakers who perceive LOT and THOUGHT as the same actually produce the vowels more similarly as their attention to speech increases.

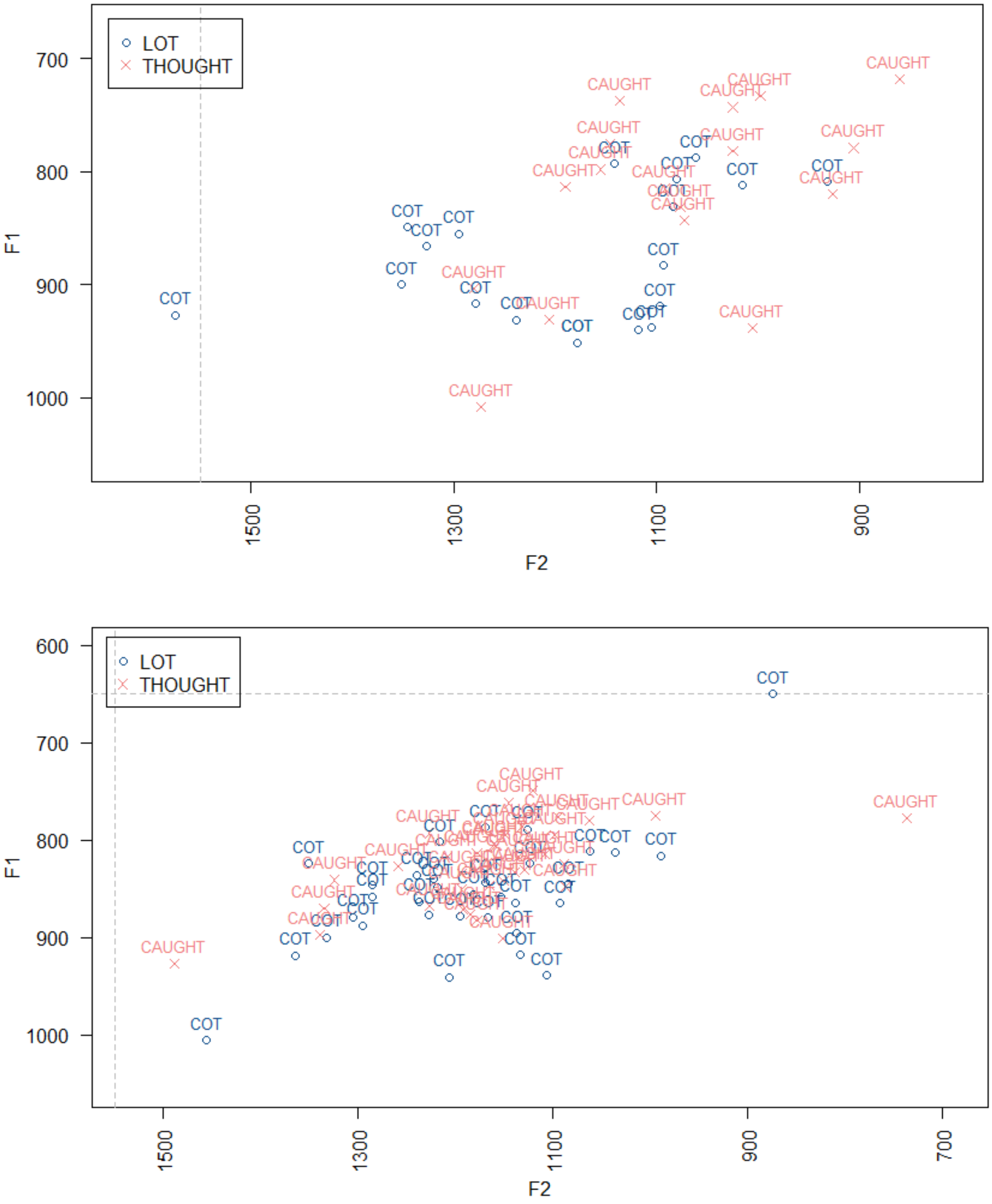
Table 3.24. Distances between THOUGHT and LOT with following stop according to interview task divided by interviewee perception of *cot-caught* minimal pair

		LOT	THOUGHT	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
cot-caught different or close								
styleCS	F1	826.1	793.6	201.76	5.3203	< 0.001	0.15049	< 0.001
	F2	1344.7	1145.6		14.7041	< 0.001		
styleRP	F1	826.5	798.8	118.21	4.3287	< 0.001	0.14342	< 0.001
	F2	1301.7	1186.8		7.5665	< 0.001		
styleWL	F1	869.0	784.7	132.05	7.8604	< 0.001	0.30605	< 0.001
	F2	1176.7	1075.0		7.0805	< 0.001		
styleMP	F1	873.1	821.6	115.47	2.1653	0.03891	0.16408	0.05684
	F2	1184.3	1080.9		2.2005	0.0351		
cot-caught same								
styleCS	F1	815.3	797.4	157.45	4.6112	< 0.001	0.1094	< 0.001
	F2	1335.4	1178.9		19.4299	< 0.001		
styleRP	F1	829.7	815.3	81.90	3.769	< 0.001	0.064327	< 0.001
	F2	1289.4	1208.7		7.4561	< 0.001		
styleWL	F1	851.1	804.1	89.43	8.6798	< 0.001	0.1742	< 0.001
	F2	1162.1	1086.0		8.2705	< 0.001		
styleMP	F1	856.4	827.4	37.94	2.2783	0.02642	0.080736	0.06762
	F2	1187.4	1162.9		0.8561	0.3951		

Figure 3.27 plots these two groups' productions of minimal pairs of *cot* and *caught* to offer some visualization of the numbers above. The interviewees who perceive a difference are plotted above and the interviewees who perceive the pair as the same are plotted below. These plots show that both phonemic statuses result in overlap. However, the group perceiving a difference shows a slight tendency to group LOT and THOUGHT separately. The group that perceives the pair the same shows greater overlap.

The comparisons here of interviewee perceptions of the merger against their productions have continued to make the case that, for most Kansas Citians, LOT and THOUGHT are phonemically merged. A few outliers are still present in the community, and in conscious speech they affect a distinction between the vowels. They may help

Figure 3.27. Distribution of LOT and THOUGHT minimal pairs according to interviewee perception of different/close (above) or same (below)



keep a wide range of phonetic productions of LOT and THOUGHT available to Kansas Citians—i.e., the vowels have not merged in the position of one vowel or the other, but the classes have basically expanded to include the acoustic space of both original classes. That space seems to be used by Kansas Citians to index formality regardless of the phonemic status of the vowels, especially in F2 where fronter productions correlate with more casual speech and backer productions with more careful speech.

The number of outliers who maintain a phonemic distinction are dwindling in apparent time, though. Because they are in such a small minority, I will forgo discussion of correlations between the positions of LOT and THOUGHT and social factors like gender and socioeconomic class. (I modeled those factors, and no differences emerged.) Instead, I'll turn now to productions of LOT and THOUGHT from a few interviewees, who help demonstrate the changes in these vowels in Kansas City since 1956.

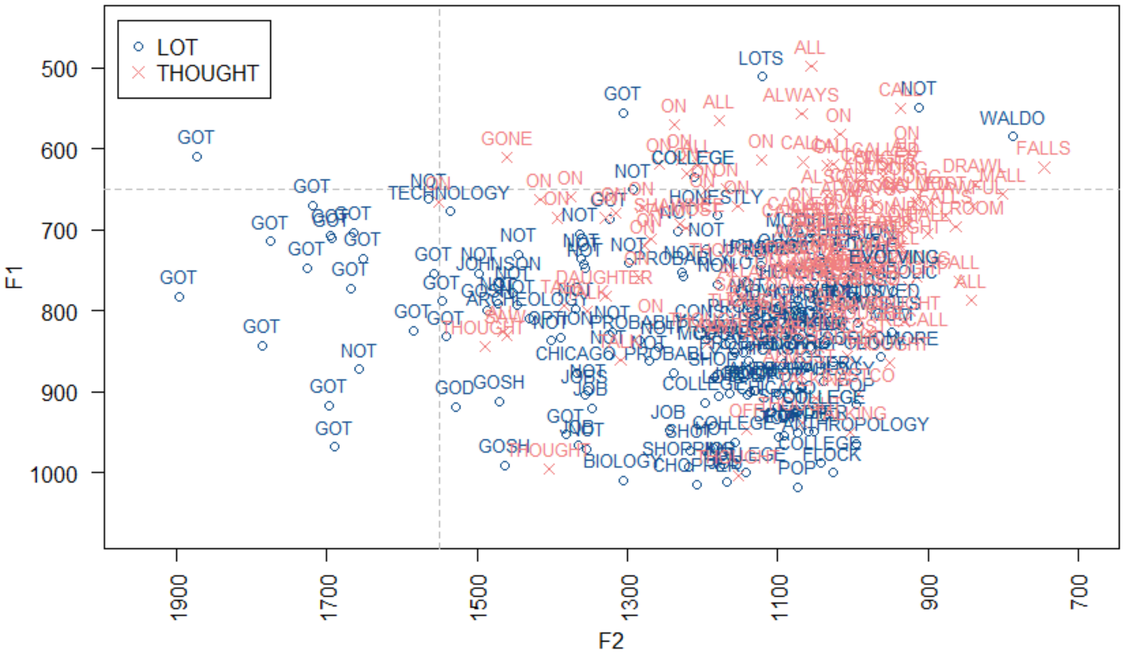
3.7. The Merger of LOT and THOUGHT – Individual Realizations

I select interviewees for closer examination in this section based on those who emerge as noteworthy in Figures 3.18 through 3.20. This exploration begins with Robert Z. Born in 1956, he is the oldest speaker I interviewed for this study. He was born in KCMO and lives there still. Trained as a computer programmer, he is rated socioeconomically as middle class. His wife, Mary Z, and daughter, Madison Z, were also interviewed. Madison Z appears to be among the most merged speakers in production in Figures 3.18 through 3.20, and her vowels are analyzed further below.

Figure 3.28 shows all Robert's CS tokens of LOT and THOUGHT in all environments besides START and NORTH. There is a tendency for THOUGHT and

LOT to cluster in their canonical positions, but also a great deal of overlap. His allophonic distribution appears generally to follow the pattern identified in this chapter. Pre-/l/ LOT and THOUGHT occur back and often high—though height shows variability, as in the case of *college*, which is visible both at the top and at the bottom of the THOUGHT mass. Following nasals and syllable-initial positions also often appear high and back (*Johnson* is an exception). Pre-/t/ LOT and THOUGHT occur lower and fronter—two tokens of *thought* appear safely in LOT territory—and LOT and THOUGHT with preceding /g/ in the case of *got* is generally front.

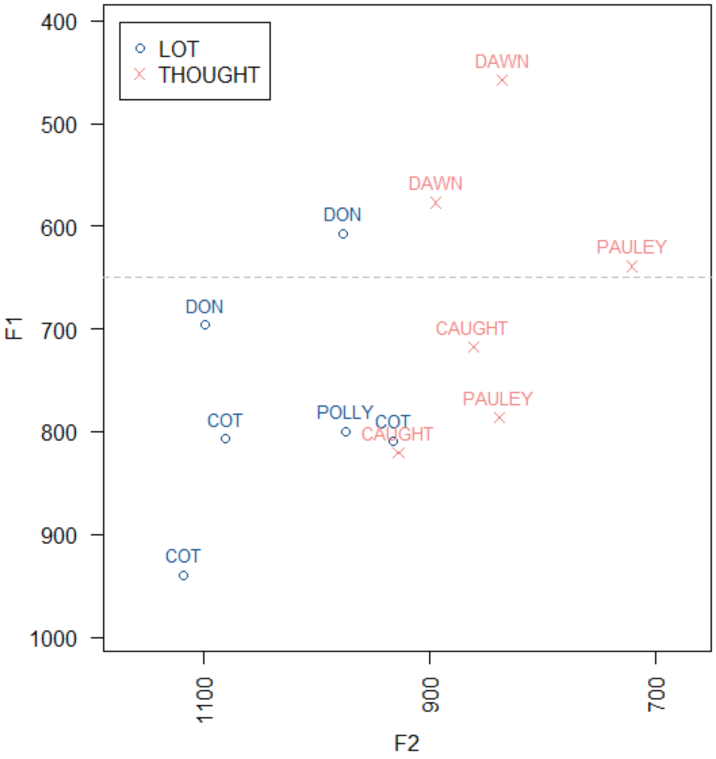
Figure 3.28. Robert Z, b. 1956, KCMO – Casual speech LOT and THOUGHT tokens



Robert is of interest not only because he is the oldest speaker I interviewed, but also because he commented on the low back merger during his minimal pairs test. Figure

3.29 shows measurements for his minimal pairs tokens. In each case, he pronounced the minimal pair multiple times, seeming to search for whether or not they were the same or different and, often, to increase acoustic difference in repetitions. This did not occur with any of his other minimal pairs.

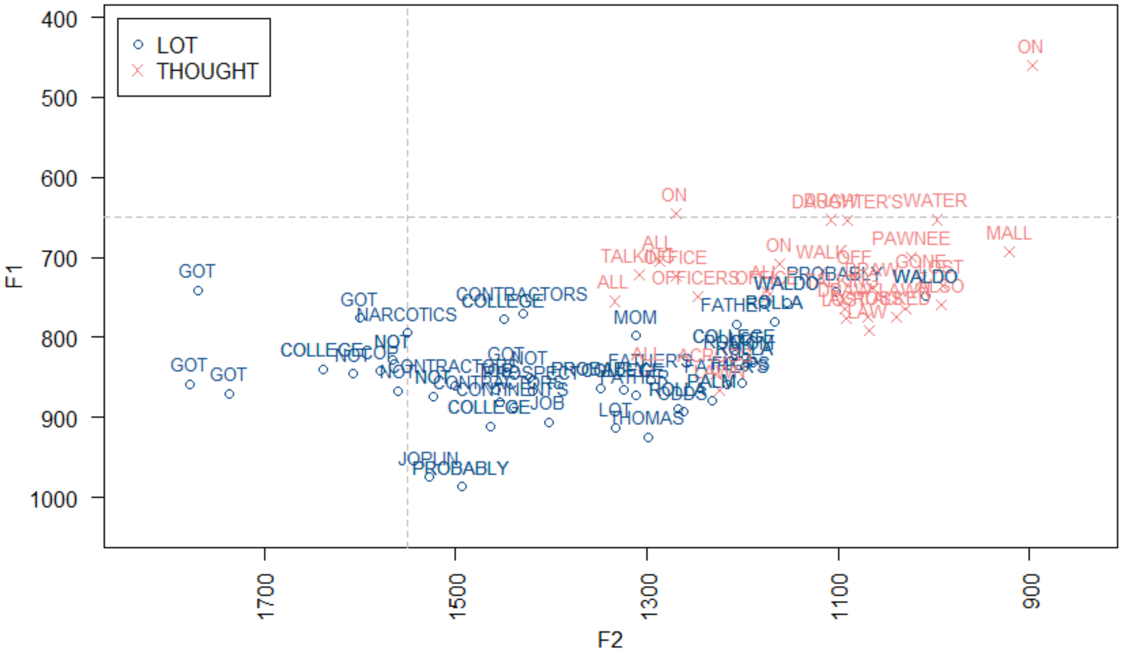
Figure 3.29. Robert Z, b. 1956, KCMO – Minimal pairs LOT and THOUGHT tokens



Robert’s reading of *cot-caught* went, “[kɔt] and c- -- <pause> [kɑt] and [kɔt] Yeah, [kɑt] and [kɔt]. Yeah, those are slightly different.” His first *cot* token production overlaps directly with his final *caught* production. His first repetition of *cot* is then extremely low and relatively front and opposed to a very back *caught*. In his last production, he produces the tokens on the same level in F1 with separation in F2. At the beginning of the timeframe of this study, then, there appears to be a case of a speaker who is losing the phonemic distinction between LOT and THOUGHT, but recognizes that there is “supposed to be” one.

Recognition of that distinction is more clearly demonstrated in the consistently high Euclidean distances and Pillai scores across phonetic contexts shown by Frank. His CS LOT and THOUGHT tokens are plotted in Figure 3.30.

Figure 3.30. Frank, b. 1968, KCMO – Casual speech LOT and THOUGHT tokens



Frank was born in KCMO in 1968 and continues to live there. He is included in the transitional class. His economic background is an interesting mixture of white collar and more blue collar experiences. Growing up, his family owned a successful electrical contracting company, and he worked throughout adolescence as an electrician. As a young adult, he enlisted rather than going to college. He eventually entered law enforcement, and while working enrolled in community college and ultimately did some undergraduate and graduate-level course work. He remains in law enforcement today.

The casual speech plotted in Figure 3.30 shows a fairly reliable distinction between LOT and THOUGHT. Many of the words that make incursions into THOUGHT space are those that would traditionally be assigned to PALM, including tokens of *palm* and *father*. Others are local place names like *Waldo* (a neighborhood in south Kansas City) and *Rolla* (a city in south-central Missouri), that cannot actually be presumed to class with LOT.

Figure 3.31. Frank, b. 1968, KCMO – Minimal pairs LOT and THOUGHT tokens

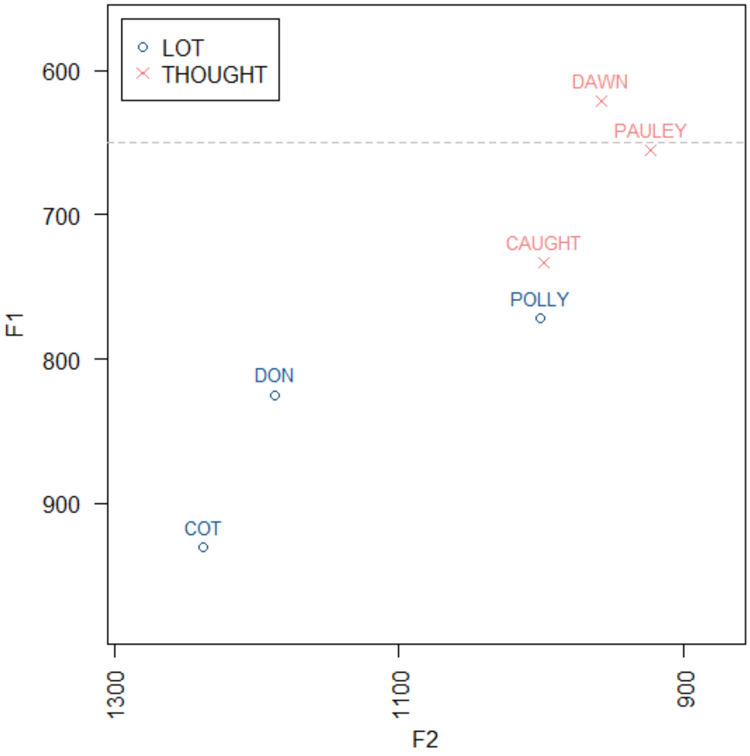


Figure 3.27 shows the clear distinctions Frank maintains in minimal pairs testing. Only *Polly* shows an encroachment into THOUGHT territory. Impressionistically,

Frank’s *dawn* and *Pauley* are accompanied by a great amount of lip rounding. This may provide evidence of an awareness of the phonemic distinction, and a particular articulatory gesture that solidifies that distinction.

It is difficult to propose anything to explain a linguistic outlier like Frank. Of anecdotal interest, he is the youngest speaker in my sample who regularly produces (hw), as in [ʍɪʧ] for *which*. Frank also offered more meta-linguistic comments than most interviewees, talking critically at some length, for instance, about the use of [ɑ] in *Plaza* and of [ə] for the final syllable in *Missouri*. As such, Frank may be more conscious than other speakers of following a particular set of linguistic norms, a trait that could manifest itself as resistance to some innovations.

By contrast, Donna appears to be a relatively early adopter of the low back merger, showing consistently small Euclidean distances and Pillai scores across phonetic environments. She was born in Shawnee, KS in 1962 and, to a degree, mirrors Frank’s socioeconomic progression. From her description of her father’s work as an aircraft engineer, her childhood was solidly middle class. She attended a vocational program for school and became a licensed practical nurse in hospice care, a relatively low-scoring SEI occupation that generally involves less-skilled and less-pleasant work than might other nursing tracks. Her CS LOT and THOUGHT tokens appear in Figure 3. 32.

Her pre-nasal and pre-/l/ tokens occur, for the most part, reliably in the upper and backer portion of the combined vowel space. *Shawnee* is an exception. Following stops generally occur lower and fronter, *probably* being a regular exception. Her *taught* and *thought* are clearly produced with a low central vowel. Her Pillai score is a non-significant 0.056 (*p* = 0.188), and her Euclidean difference in means of 66 Hz is not significant in either F1 (*p* = 0.7842) or F2 (*p* = 0.08012).

Figure 3.32. Donna, b. 1962, Shawnee, KS – Casual speech LOT and THOUGHT tokens

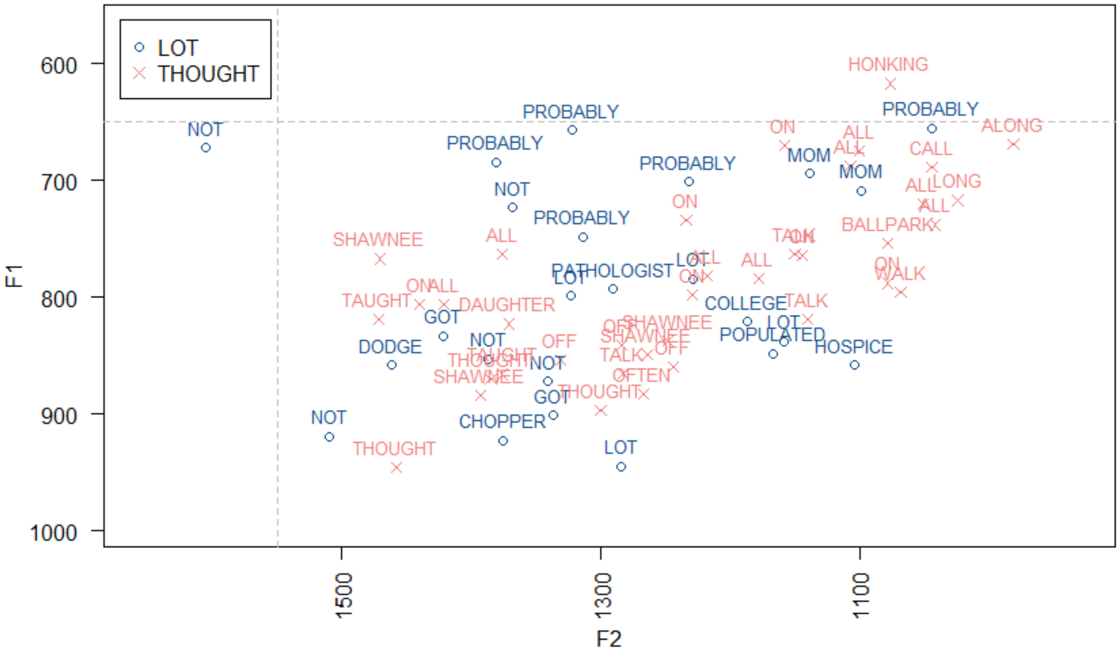
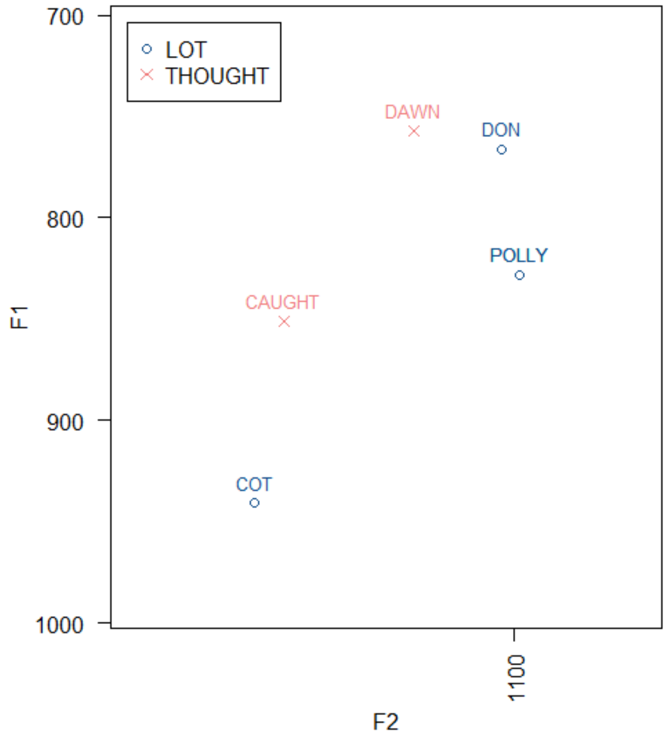


Figure 3.33 depicts her minimal pairs measurements. *Pauley* was not detected by FAVE, but she produced and perceived it as same with [ɔ]. Her *cot* token is at 1206 Hz in F2, compared with *Polly* at 1098 Hz. Interestingly, there is a fair amount of acoustic separation between her *cot* and *caught*, though we both counted them as same. The Euclidean distance between them of 91 Hz suggests that the 100-Hz threshold may indeed be useful for approximating the limits of perceptibility. Also of note, these pre-/t/ vowels are produced far enough back that I impressionistically coded them as [ɔ] (though this plot suggests something more like [ɑ]). These are well back of her casual speech

tokens of *taught* and *thought*, which are in a central position, supporting the claim that formal speech tasks elicit backer productions.

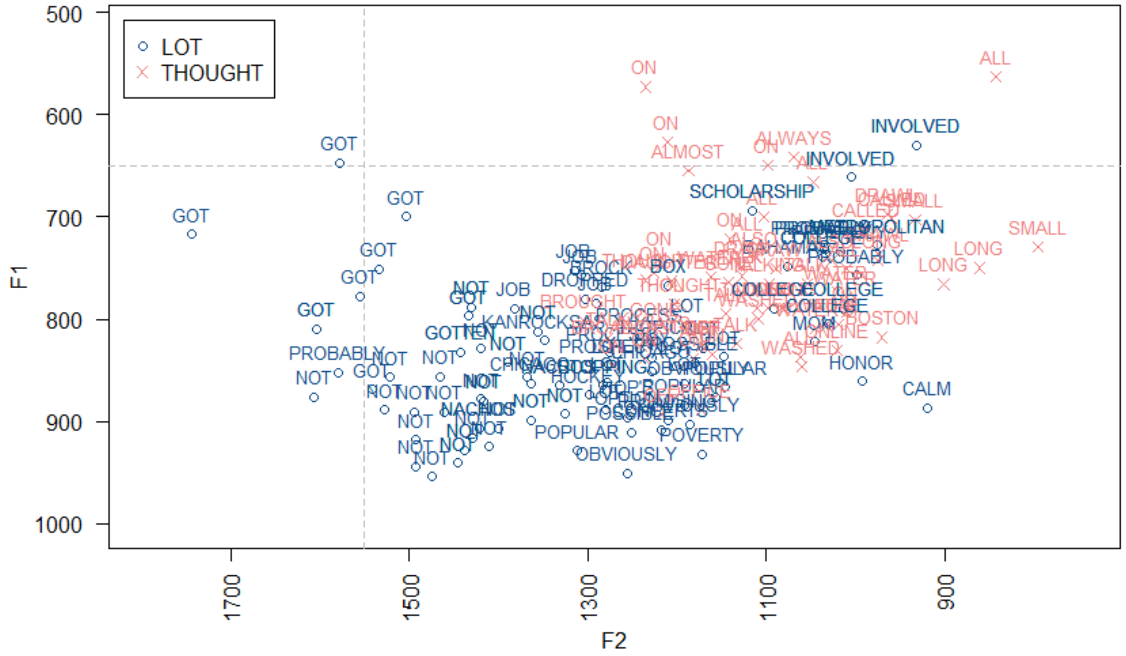
Figure 3.33. Donna, b. 1962, Shawnee, KS – Minimal pairs LOT and THOUGHT tokens



Among younger interviewees, several show some large Euclidean distances and/or Pillai scores, but there is relatively little consistency across phonetic environments. I analyze Peyton D, who shows large Pillai scores in LOT and THOUGHT with following /n/ and /t/. His casual speech tokens are plotted in Figure 3.34.

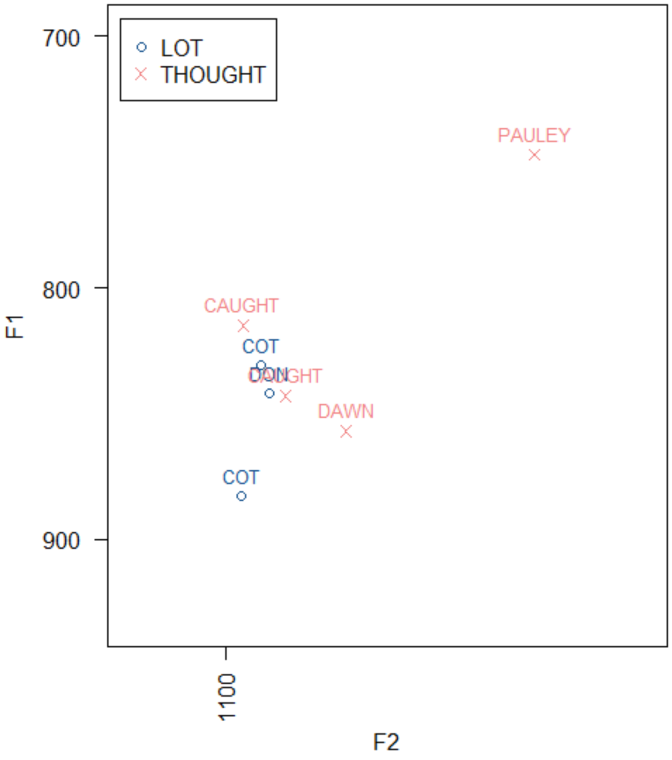
Peyton D, like Frank and Donna, is included in the transitional class. His father provides help desk-type technical support in an office building. At the time I interviewed him, Peyton was taking community college classes with plans to attend a state university eventually. He has lived his whole life in Independence, MO. His parents also both grew up in Independence. The plot in Figure 3.34 reflects a Euclidean distance of 204 and Pillai score of 0.335, both being highly significant.

Figure 3.34. Peyton D, b. 1993, Independence, MO – Casual speech LOT and THOUGHT tokens



However, these distances appear very much to be a case of the phonetic conditioning on LOT and THOUGHT explored above. Pre-/l/ tokens regularly occur in the range of [ɔ], including *college*, which appeared to maintain a lower and fronter position among older speakers in figures above. Following stops generally occur low and front, with *got* and *not* being frontest, as expected. *Probably* occurs throughout the LOT-THOUGHT space. This plot suggests that, in fact, Peyton has merged the classes into a single vowel, but strongly maintains allophonic conditioning.

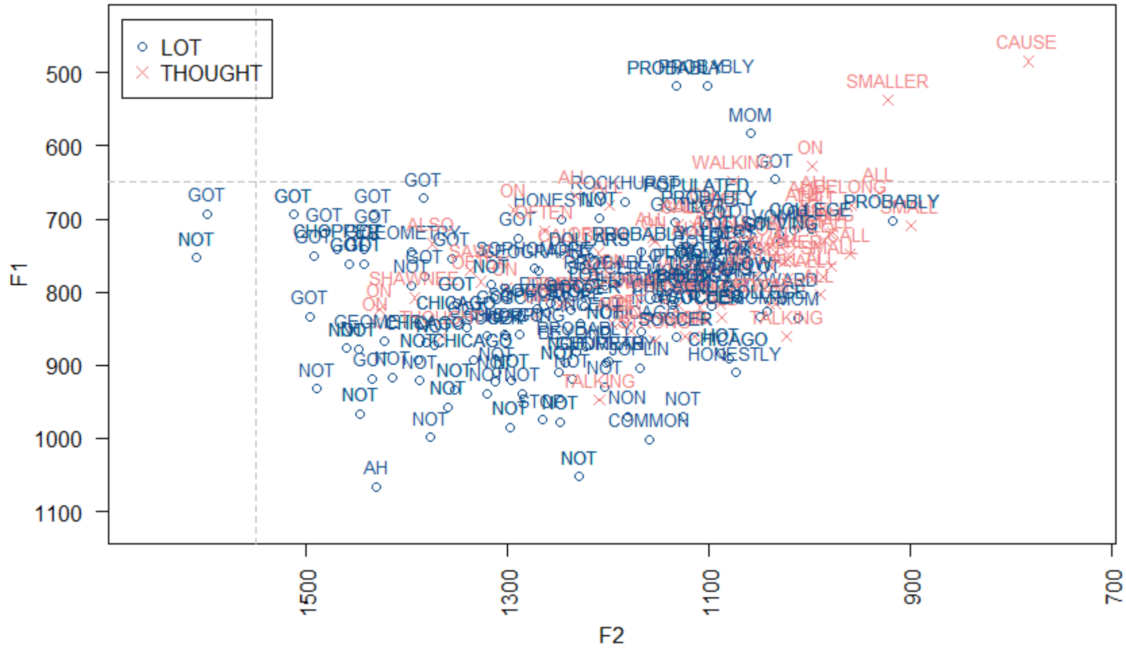
Figure 3.35. Peyton, b. 1993, Independence, MO – Minimal pairs LOT and THOUGHT tokens



The distribution of Peyton’s minimal pairs in Figure 3.35 strongly supports the claim that he is, in fact, merged. *Polly* was not measured by FAVE, but we both judged it to be the same as *Pauley*. (His token of *Pauley* is measured at 962 Hz in F2, compared with *cot* at 1093 Hz.) *Don* and *dawn* occur with a Euclidean distance of just 37 Hz between them. More interesting are *cot* and *caught*, which Peyton pronounced twice. The first time, he identified them as close and I marked them as different. That I scored them as different is somewhat surprising from this plot, since they only show a Euclidean distance of 68 Hz, well below distances that have been perceived as same elsewhere. It appears that a drop in pitch on *caught* may serve to distinguish it in the minimal pair. More importantly, however, after Peyton D completed the minimal pairs test, I told him I had missed his answer to that minimal pair and he repeated it. In doing so, he produced the second pair, which overlaps with *Don* in the plot and has a Euclidean distance of only 16 Hz. He judged these the same. This appears to be the opposite result from that of Robert Z, who repeated tokens to meet a target of separate phonemes. Peyton appears to repeat them to meet a target of a single phoneme.

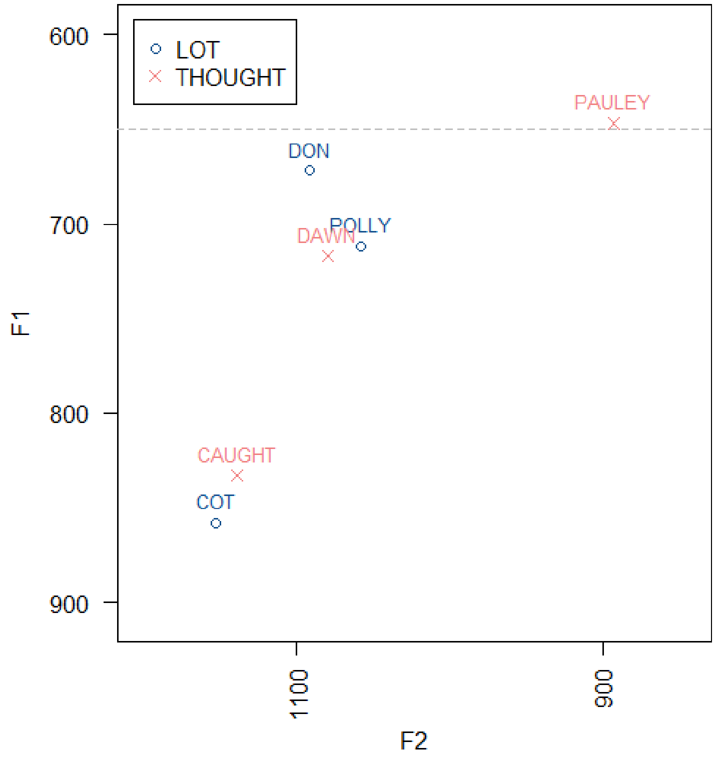
Madison Z offers a final case study as one of the youngest interviewees. Her Euclidean distances and Pillai scores between LOT and THOUGHT are consistently small. She is Robert (and Mary) Z's daughter, and has lived her entire life in KCMO.

Figure 3.36. Madison Z, b. 1999, KCMO – Casual speech LOT and THOUGHT tokens



Her vowel plot in Figure 3.36 shows much overlap between LOT and THOUGHT. Again, there is evidence for the phonetic conditioning effects observed throughout this chapter. There is some evidence of loosening of the conditioning requirements. For example, *on* appears several times in the fronted space of *got* and *not*. *Shawnee* again appears to occupy a front position. On the other hand, the effect of preceding /r/ seems to operate more consistently to cause backing and raising, especially in *probably* and *Rockhurst*. Following-/l/ still appears back and high for LOT and THOUGHT words.

Figure 3.37. Madison Z, b. 1999, KCMO – Minimal pairs LOT and THOUGHT tokens



Her minimal pairs show her to be clearly merged on *cot* and *caught* and *Don* and *dawn*, with the latter pair reversing positions in F1. Madison paused after reading *Don* and *dawn*, before saying, “Same I guess.” There is a bit of separation in F2 between *Polly* and *Pauley*, with a Euclidean distance of 177 Hz. I scored her as close on this pair. She said of the pair, “That’s different to me, but I don’t think it sounds different.” While this is not a straightforward statement to interpret, it is possible that she meant she says them differently but there is not actually a difference in their pronunciation. In linguistic terms, this would seem to describe having a phonetic distinction, but not a phonemic one.

3.8. LOT and THOUGHT – Wrap Up

This chapter has provided a close examination of the vowels involved in, perhaps, the single most studied sound change in American English. Of course, there is still a great deal of ground left uncovered. As noted, my measurements of central tendency leave vowel contour and/or length completely undiscussed, and these could be used to maintain phonemic distinctions. I also focus a good deal analysis on just three phonetic contexts, despite the appearance of influence from several other contexts that have not been thoroughly explored elsewhere, especially the various preceding segmental contexts.

Nevertheless, the detailed discussion identifies many of the changes in LOT and THOUGHT that have taken place in Kansas City. The acoustic space traditionally occupied by LOT and THOUGHT appears to remain available to Kansas Citians, but phonetic conditioning has largely reassigned words into complementary distribution across the classes. Words with preceding velars, /n/, and palatals, along with following alveolars and palatals tend to occupy the LOT range. Words with preceding /m/, liquids, and obstruent+liquid clusters, along with following nasals, /l/, and labiodentals appear to occupy the THOUGHT range. Preceding voicing appears to favor LOT and preceding voiceless THOUGHT, while there seems to be a slight tendency toward the reverse in following segments. Where productions of speakers who perceive a difference between LOT and THOUGHT were compared with productions of speakers who do not, phonetic environments conditioned vowels in roughly the same ways. In other words, conditioning effects of phonetic environment appear to be similar for all Kansas Citians, regardless of their status with regard to the low back merger.

This complex set of conditioning factors offers some explanation for how it is that the LOT and THOUGHT vowels might seem to be the same within a community, but still show regular and statistically significant differences in measurements of production. A complex set of conditioning factors are adhered to, and these can maintain the appearance of a quantitative distinction in the community, when speakers do not actually derive any linguistic meaning from that distinction. That resulting range of allophonic productions produced by such a merger of expansion would potentially create a different situation from the more traditional idea of a merger, where one vowel simply moves into the space of another. In Kansas City's merger of LOT and THOUGHT, it appears that the general vowel space of LOT and THOUGHT remains available. This could, at least, account for the varied responses to questions about the status of these vowels from Kansas Citians that have prevented researchers from defining the area as either clearly merged or distinct. In Kansas City LOT and THOUGHT seem to be mostly the same phonemically, but they allow a range of phonetic productions.

Beyond distinctions that are specifically a result of phonetic context, there is some apparent stylistic variation. Broadly, relatively fronter productions appear to be preferred in casual speech and relatively backer productions appear to be more appropriate for situations that emphasize attention to speech. This is a potentially important finding methodologically, because it suggests that the type of data used to explore the low back merger—at least in Kansas City—might determine where measurements land. Data drawn from CS will present the vowel(s) as fronter, and data drawn from language task-oriented speech will present the vowel(s) as backer. Probably both are important, because connecting a sound to an interview task within the Labovian paradigm may suggest an underlying social evaluation.

It still remains difficult to explain why minimal pairs regularly maintain distinct productions, since they should have the same phonetic conditioning. The acoustic picture of LOT and THOUGHT in Kansas City frequently suggests a near merger (e.g., Nunberg 1980; Labov 1994; Di Paolo 1992; Faber & Di Paolo 1995), wherein speakers create the appearance of a merger between phonemes, but speakers maintain reliable acoustic differences between them. However, it is also impossible to make any claim from my data that speakers in the youngest group actually maintain separate phonemes. In the case of Madison Z in Section 3.7, the phonemic sameness of LOT and THOUGHT led her to report that minimal pairs were the same, even though she perceived her own productions of the vowels as different. The most reasonable analysis of this data is that, among the youngest Kansas Citians surveyed here, the low back merger is phonemically complete.

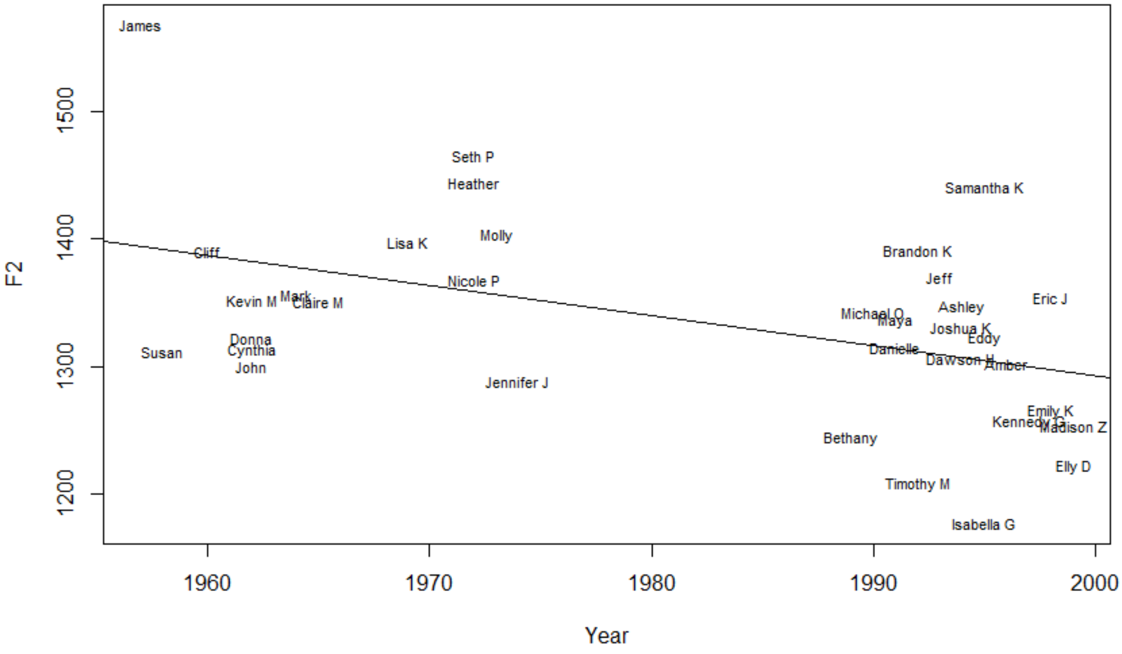
The remaining chapters will operate from the assumption that Kansas City has progressed to phonemic merger between LOT and THOUGHT. The next chapter will build on this analysis to seek correlated changes in the dialect of Kansas City that might be understood as consequences of the low back merger. As proposed by Gordon (2006b) and discussed elsewhere (e.g., Labov, Ash & Boberg 2006; Labov 2010; Durian 2012; Gorman 2012), the low back merger could trigger TRAP retraction as the backward movement of LOT creates a void in the low central area of vowel space. I suggested above that LOT was moving backward in apparent time in Kansas City. With the subsequent analysis of LOT and THOUGHT according to interviewee MP judgments, I can conclude the study of LOT and THOUGHT by checking the relative positions of these vowels specifically among the interviewees who appear to be phonemically merged. Table 3.25 provides fixed effects models for LOT and THOUGHT with following stops in CS among interviewees who judged *cot* and *caught* to be the same.

Table 3.25. Linear models of pre-stop LOT and THOUGHT F1 and F2 in casual speech among interviewees who perceive *cot-caught* the same

	Estimate	Std. Error	*t* value	Pr(>|t|)
THOUGHT F1 (Intercept)	2490.8915	888.6756	2.803	0.00879
Year	-0.8550	0.4484	-1.907	0.06619
Residual standard error: 38.09 on 30 degrees of freedom Multiple R-squared: 0.1081, Adjusted R-squared: 0.07834 *F*-statistic: 3.635 on 1 and 30 DF, *p*-value: 0.06619				
THOUGHT F2 (Intercept)	5416.5636	1913.3842	2.831	0.00821
Year	-2.1354	0.9655	-2.212	0.03476
Residual standard error: 82.02 on 30 degrees of freedom Multiple R-squared: 0.1402, Adjusted R-squared: 0.1115 *F*-statistic: 4.891 on 1 and 30 DF, *p*-value: 0.03476				
LOT F1 (Intercept)	1911.7927	678.7572	2.817	0.00825
Year	-0.5576	0.3425	-1.628	0.11333
Residual standard error: 29.77 on 32 degrees of freedom Multiple R-squared: 0.07649, Adjusted R-squared: 0.04763 *F*-statistic: 2.65 on 1 and 32 DF, *p*-value: 0.1133				
LOT F2 (Intercept)	5994.7485	1601.0226	3.744	0.000714
Year	-2.3510	0.8079	-2.910	0.006528
Residual standard error: 70.22 on 32 degrees of freedom Multiple R-squared: 0.2092, Adjusted R-squared: 0.1845 *F*-statistic: 8.468 on 1 and 32 DF, *p*-value: 0.006528				

The overall trend in Kansas City of LOT backing as a change in progress appears to be operating among Kansas Citians who perceive *cot-caught* as merged, with LOT F2 decreasing by about 24 Hz each decade. The linear model for LOT F2 data in Table 3.25 is plotted in Figure 3.38.

Figure 3.38. Linear model of pre-stop LOT F2 in casual speech among interviewees who perceive *cot-caught* the same by interviewee birth year



At the same time, further complicating the understanding of the low back merger, the regression also identifies a basically concomitant backing in apparent time of THOUGHT, which shows F2 decreasing by about 21 Hz per decade. On this point, my data will simply remain messy. The backing, though, at least makes it clear that speakers who are phonemically merged may be leaving the low central area of the vowel space unoccupied. This points this study in the direction of TRAP and testing whether the backward movement of LOT is affecting TRAP's position in Kansas City vowel space

CHAPTER 4

TRAP AND THE FRONT SHORT VOWELS

This chapter explores potential consequences of the merger of LOT and THOUGHT in Kansas City on the second vowel that Labov, Ash, and Boberg (2006:120) use to define the typology of American dialects: the low front vowel in TRAP. The backing of LOT observed in Chapter 3 has potential structural consequences for TRAP, as LOT's movement backward increases the margin of security between it and TRAP. This could, in turn, causes TRAP to back in a drag chain. Such a pattern was initially (e.g., in Clarke, Elms & Youssef 1995) identified as the "Canadian Shift." Labov, Ash, and Boberg (2006:130) put the threshold for the Canadian Shift at TRAP average F2 below 1825 Hz. TRAP's backing can then pull DRESS lower, which in turn pulls KIT lower, extending the chain shift (cf. Gordon 2006b).

Similar chain shifts among LOT, TRAP, DRESS, and KIT have drawn substantial recent attention from sociolinguists, who have identified it operating widely through the United States. Elements of the shift have been identified (albeit under different labels) in Alaska (Bowie et al. 2012), Arizona (Hall-Lew 2004), California (Eckert 2004; Kennedy & Grama 2012), Columbus, OH (Durian 2012), Illinois (Bigham 2008), Indianapolis (Fogle 2008), and Oregon (Becker et al. 2013). Indeed, Lusk (1976:139) may have identified this shift in Kansas City, as she describes "The raising of /æ/ before nasals, together with less raising than older Kansas Citians in other contexts" as "somewhat less general but nevertheless quite salient among the youngest speakers." If "less raising" is instead presented as "retraction" this seems to describe the pattern expected of the Canadian Shift.

This seems to be what Durian (2012:13) has in mind when he claims that "Lusk in fact identified the inception of the Canadian Shift in Kansas City among her youngest informants." This is a plausible interpretation of her data, though a bit of a reach without more analysis, since Lusk (1976:146-148) used them to suggest that Kansas City was in an incipient stage of the Northern Cities Shift. Furthermore, Gorman's (2012) exploration of the relationship between TRAP and LOT across all *ANAE* data problematizes the claim that TRAP-retraction is structurally linked to the low back merger, as correlations between the vowel positions vary greatly across regions and often break down as areal proximities are taken into account in statistical models. So, here, I'll explore the effects of "less raising" in TRAP in Kansas City—whether TRAP is indeed undergoing retraction and, if so, whether it appears to be part of a systemic change.

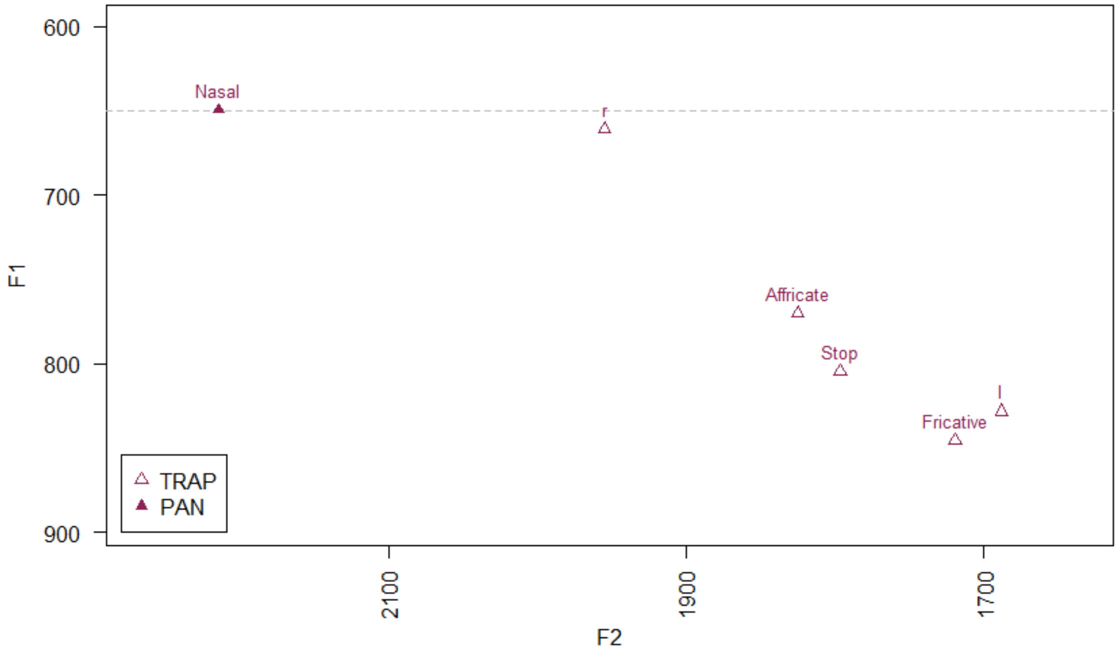
This chapter begins with an exploration of the phonetic conditioning of TRAP to understand its acoustic profile in Kansas City. It then compares productions of TRAP and LOT to explore whether their productions are correlated. TRAP is also explored socially. TRAP is then used to seek further elements of chain shifting in DRESS and KIT.

Finally, this chapter shifts away from changes related to TRAP to the unrelated conditioned merger of pre-nasal DRESS and KIT. This merger is discussed in this chapter as part of building the profile for the front short vowels, and not as part of the potential chain shift that receives most of the attention herein.

4.1. Phonetic Conditioning – TRAP

Figure 4.1 shows the mean distribution of TRAP tokens for all interviewees by following manner. Not surprisingly (and coinciding with Lusk's 1976:139 observation), following nasals have a major effect of raising and fronting TRAP, with lmer coefficients of -121.5 in F1 and 354.3 in F2. These place the mixed effects-measured means for pre-nasal TRAP at 654 Hz in F1 and 2139 Hz in F2, solidly in the range of [e] or [ɛ]. To avoid obscuring other interesting conditioning effects as a result of the extreme influence of following nasals, they will be omitted from lmer analysis in Tables 4.1 and 4.2.

Figure 4.1. Distribution of TRAP by following manner



Following /r/ and /l/ are also excluded from Tables 4.1 and 4.2. The relatively high position of following /r/ in Figure 4.1 suggests the [ɛ]-like production characteristic of the conditional merger of TRAP and DRESS before /r/, which is widespread throughout the United States (e.g., Labov, Ash & Boberg 2006:2006). Following /l/ is a bit more immediately interesting. “Dark” /l/ or [ɫ] is a velarized allophone of /l/ with F2 in the range of 1200 Hz (Ladefoged 1993) and often results in reduced F2 for vowels that it follows (e.g., Thomas 2011:105). In Chapter 3, this effect was observed in the backer positions of LOT and THOUGHT with following /l/. Figure 4.1 shows that this is the case for TRAP, too, with following /l/ being the backest of the following manner environments, but not dramatically so. In lmer analysis (excluding following nasals and /r/), following /l/ has coefficients of 47.2 in F1 and -63.0 in F2. Those measurements leave it relatively high in vowel space and not much farther back of other environments. In other words, there is a backing effect of following /l/ on TRAP, but it appears to be relatively small. As such, there might not actually be a strong phonetic motivation for excluding it from this analysis. Nevertheless, because I am interested in this section in whether the backward movement of LOT appears to be dragging TRAP backward, the general lowering effect that /l/ exerts on F2 could create a false positive result. So, in the interest of approaching this data conservatively, following /l/ is excluded from lmer analyses. It will, however, be checked for correlations with the position of LOT with following /l/ further below.

Table 4.1 shows lmer analysis for F1 of TRAP by following manner, following place, following voicing, preceding segment, and stress position, as coded by FAVE. TRAP with following liquid and nasal is excluded. TRAP with following affricate is realized relatively high, compared with following stops and fricatives, which are realized substantially lower. The environment of following place ranges from following palatals being produced highest to following bilabials and interdentals being produced lowest. Following alveolars, velars, and labiodentals fill out the middle of the continuum. Articulatorily, the alveolar ridge seems to be something of a dividing line in F1—TRAP with following place in front of the alveolar ridge is produced lower, and TRAP with following place at the alveolar ridge or back is produced higher.

Table 4.1. Conditioning effects on TRAP F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	775.60	11.78	65.86	*bachelor*
fmFricative	63.60	12.03	5.29	*laughing*
fmStop	49.81	11.69	4.26	*map*
fpAlveolar (Intercept)	822.780	6.004	137.05	*glad*
fpBilabial	29.051	9.740	2.98	*wrap*
fpInterdental	31.459	16.074	1.96	*math*
fpLabiodental	16.087	10.174	1.58	*cafeteria*
fpPalatal	-20.526	9.838	-2.09	*badge*
fpVelar	4.722	7.015	0.67	*snack*
fvVoiced (Intercept)	806.535	6.913	116.66	*tag*
fvVoiceless	29.133	6.456	4.51	*sack*
psAlveolar or Interdental Obstruent (Intercept)	806.2864	9.4925	84.94	*sassy*
psFree	21.6548	10.5674	2.05	*ad*
psGlide	16.6677	54.6670	0.30	*wagon*
psLabial (Oral)	26.5110	11.1367	2.38	*bath*
psLiquid	52.1857	13.2320	3.94	*latch*
psM	12.8405	13.6049	0.94	*match*
psN	-0.3507	17.8869	-0.02	*napping*
psObstruent+Liquid Cluster	25.9866	10.7415	2.42	*crappy*
psPalatal	8.8114	18.1816	0.48	*jacket*
psVelar	22.3158	13.4251	1.66	*capitalism*
stress0 (Intercept)	704.40	20.86	33.77	*activities*
stress1	128.90	20.68	6.23	*backing*
stress2	73.82	23.05	3.20	*thermostat*

TRAP with following voiced consonants is produced slightly higher than with following voiceless. Preceding segments do not appear to have a dramatic effect on F1, except for preceding liquids, which result in lower productions. Preceding obstruent+liquid clusters have a less dramatic lowering effect, as do preceding oral labials, velars, and free positions. TRAP with preceding /m/, glide, and palatal measures just slightly lower than with preceding alveolars and interdentals. Primary stress position appears to have a strong lowering effect. This means that below, when I limit analysis to vowels in primary stress position, their lowness will be exaggerated relative to vowels in unstressed and secondary stress positions.

TRAP F2 is analyzed by lmer in Table 4.2. Overall, phonetically lower productions (higher F1) correlate with phonetically backer productions (lower F2). This is the case for all contexts of following manner—though, notably, differences in F1 appear to be greater, at least numerically, than in F2. The F2 effect of following voicing also basically parallels the effect of following voicing in F1, with following voiced consonants correlating to fronter TRAP than following voiceless. Stress also acts similarly in F2, with TRAP in primary stress position being realized quite back of TRAP in unstressed position. Secondary stress, on the other hand, is produced at basically the same position in F2 as is TRAP in primary stress position.

In following place, the alveolar ridge again seems to be an articulatory midpoint, with TRAP with following labial and interdental being produced relatively back, and TRAP with following alveolar, palatal, and velar being produced relatively front. These basically reflect expected acoustic influences of following consonants on vowels in F2.

Preceding segments pattern less neatly. Preceding liquids and obstruent+liquid clusters have a strong backing effect. This basically parallels a lowering effect for these environments in F1, though the effect appears to be disproportionately strong in the case of obstruent+liquid clusters. This backing effect matches Labov's (1994:275) general observation that obstruent+liquid clusters reduce F2. Preceding glides, which had only a slight lowering effect in F1, also show a robust backing effect in F2—however, this measurement is based entirely on five tokens of *wagon* (albeit, each one produced by a different speaker), mitigating the importance of this result. On the other hand, preceding velars, which resulted in slightly lower articulation in F1, strongly encourage fronting in F2. Preceding /n/ also results in substantial fronting. Word initial TRAP is produced a bit front of the intercept environment of alveolar and interdental obstruents, though word-initial positions were slightly low in F1. Finally, preceding /m/, palatals, and oral labials in F2 basically pattern like they do in F1, with slight fronting or backing relative to interdentals and oral alveolars.

Table 4.2. Conditioning effects on TRAP F2

Fixed Effects	Estimate	Std. Error	t value	Example
fmAffricate (Intercept)	1789.92	28.00	63.92	*bachelor*
fmFricative	-28.29	26.73	-1.06	*laughing*
fmStop	-11.93	25.89	-0.46	*map*
fpAlveolar (Intercept)	1781.406	16.619	107.19	*glad*
fpBilabial	-36.827	21.569	-1.71	*wrap*
fpInterdental	-10.348	35.253	-0.29	*math*
fpLabiodental	-24.158	22.411	-1.08	*cafeteria*
fpPalatal	-4.990	21.477	-0.23	*badge*
fpVelar	-6.666	15.606	-0.43	*snack*
fvVoiced (Intercept)	1789.94	18.26	98.0	*tag*
fvVoiceless	-23.85	14.44	-1.65	*sack*
psAlveolar or Interdental Obstruent (Intercept)	1794.7641	21.2582	84.43	*sassy*
psFree	9.9392	20.2955	0.49	*ad*
psGlide	-163.3924	104.6371	-1.56	*wagon*
psLabial (Oral)	-5.5957	21.4550	-0.26	*bath*
psLiquid	-116.85271	25.73190	-4.54	*latch*
psM	-6.91386	26.13029	-0.26	*match*
psN	48.2373	34.6625	1.39	*napping*
psObstruent+Liquid Cluster	-110.1600	20.6792	-5.33	*crappy*
psPalatal	0.01972	35.26186	0.00	*jacket*
psVelar	95.57011	26.03031	3.67	*capitalism*
stress0 (Intercept)	1886.81	46.33	40.72	*activities*
stress1	-116.95	44.65	-2.62	*backing*
stress2	-110.61	50.03	-2.21	*thermostat*

These measurements provide several starting points for the exploration of TRAP. First and foremost, the mixed effects mean F2 of TRAP in stressed position for Kansas City is 1771 Hz. (The normalized, as opposed to mixed effects mean, for TRAP is F1:806 Hz, F2: 1783 Hz, *n* = 2841—not dramatically different from mixed effects in F2, but a fair amount higher in vowel space in F1.) The measurement contrasts with Labov, Ash, and Boberg's (2006:83) finding of extreme TRAP fronting in Kansas City, with F2 values between 1955 and 2240 Hz. By the *ANAE* typology, the measurements in this research place Kansas City in the second-lowest of four strata by which TRAP is divided—more consistent with the West—rather than among the most TRAP-fronted areas of North America. In fact, it technically places Kansas City below the Canadian Shift threshold for TRAP of 1825 Hz (Labov, Ash & Boberg 2006:130). The mixed effects mean of F1 at 833 Hz would also place Kansas City in the highest of four *ANAE* strata (lowest in vowel space—the normalized mean of 806 Hz would be in the second highest of four *ANAE* strata) (cf. Labov, Ash & Boberg 2006:82). In other words, I observe TRAP occurring lower and backer in Kansas City than the values reported in *ANAE*.

There also appear to be several strong conditioning effects to consider in exploring the relative position of TRAP. Preceding liquids encourage lower and backer productions than other contexts, and preceding velars encourage fronter productions. In following segments, the alveolar ridge demarcates fronter and higher productions of TRAP from backer and lower ones. TRAP with following voiceless consonants is backer than with following voiced consonants. Following fricatives and stops encourage low and back productions. These observations appear to follow general conditioning effects on

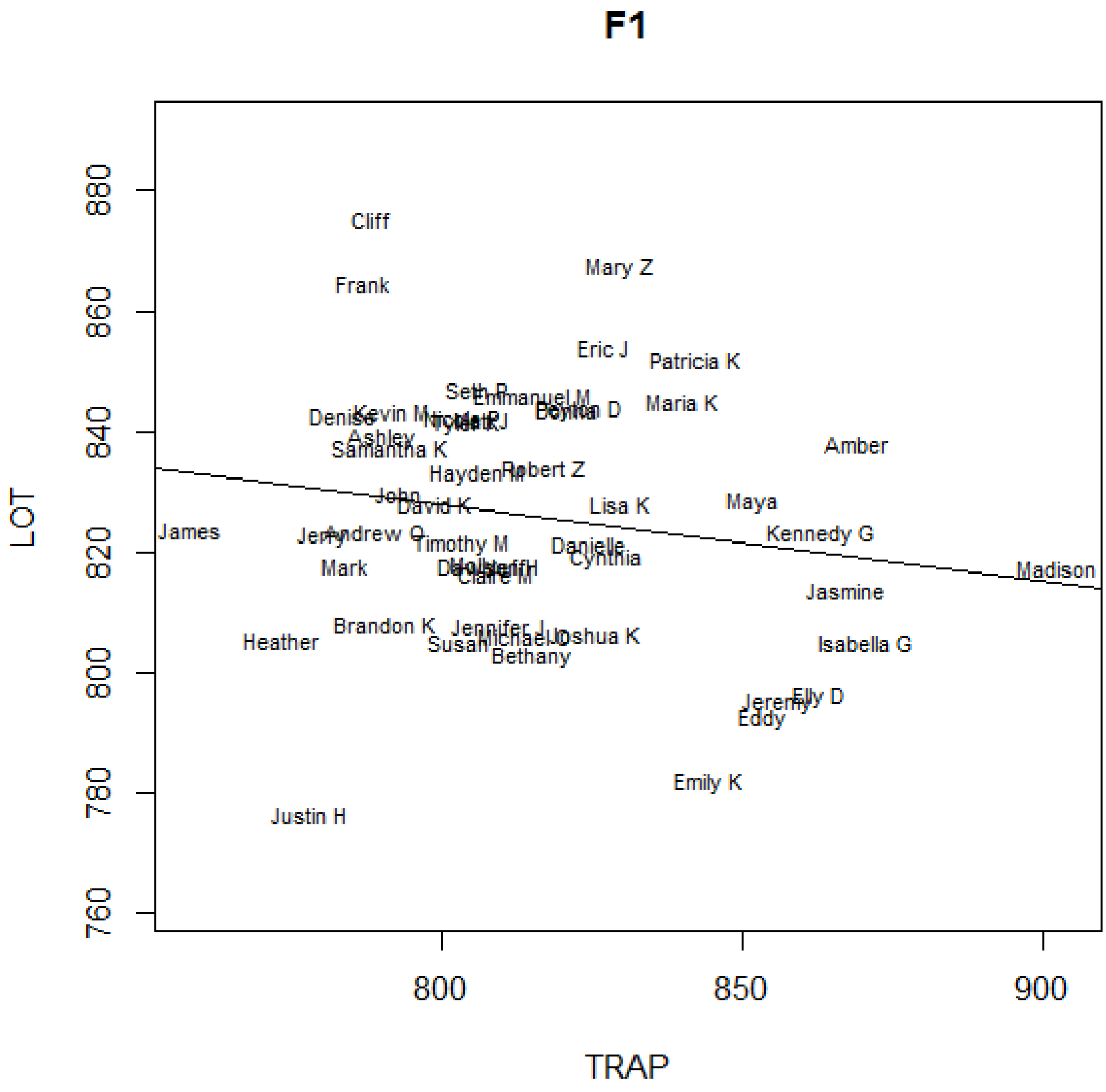
TRAP in the United States (cf. Labov, Ash & Boberg 2006:174, where *glass*, *last,* and *grandfather* are lax for speakers with tense TRAP elsewhere). Labov, Ash, and Boberg (2006:180) describe “following nasals, following voiceless velars, complex codas, and obstruent/liquid onsets” as “the same for almost all North American speakers.” These observations of conditioning effects will allow several points of reference for comparing TRAP’s position in vowel space against LOT’s in order to explore whether there is a structural relationship between them further below.

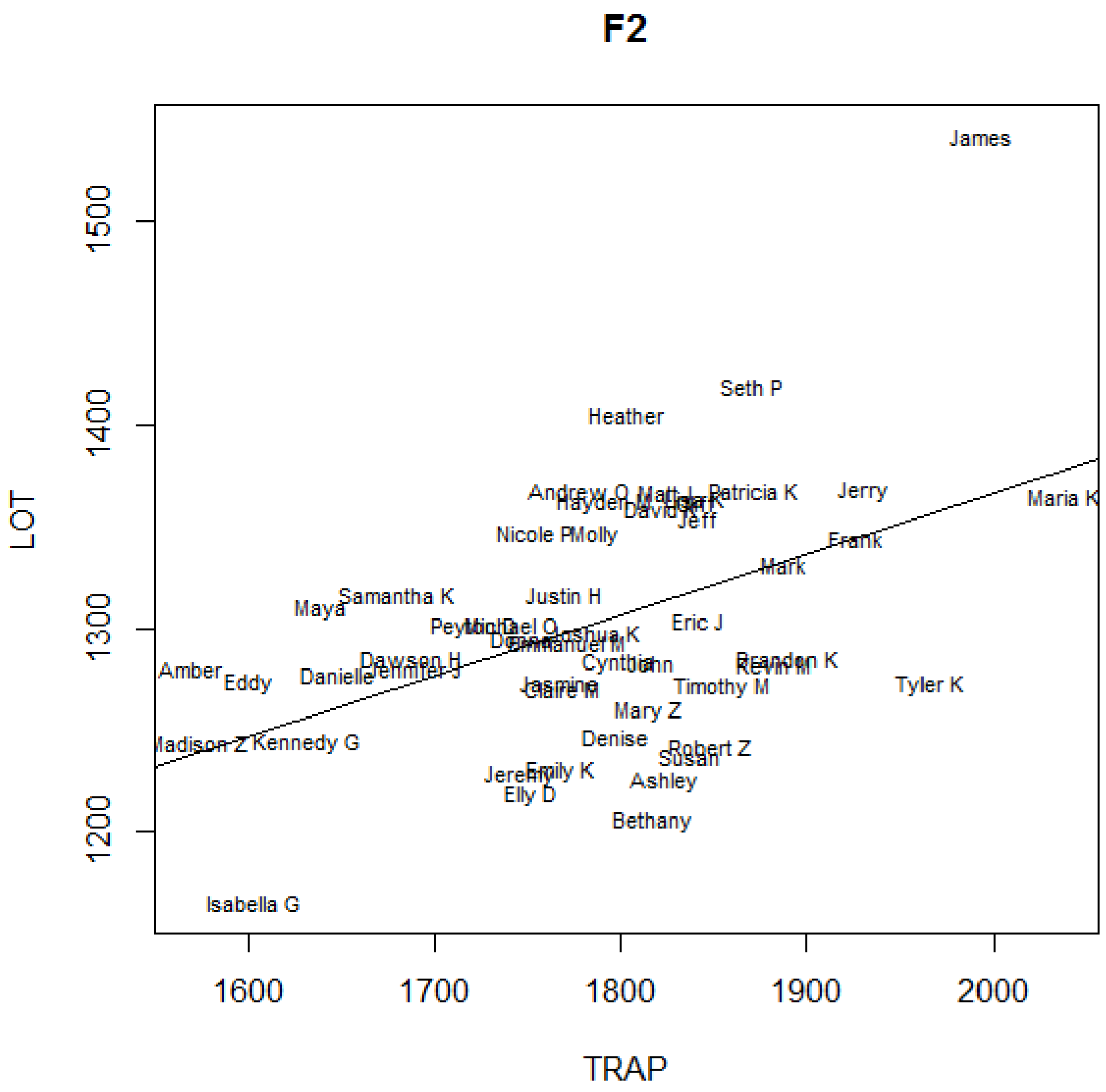
4.2. Structural Relationships – TRAP and LOT

Chapter 3 suggested that LOT is backing in apparent time in Kansas City. This movement potentially creates a void in the low central area of the vowel space (or simply expands the relative distance between LOT and TRAP) and may encourage TRAP to back to fill that space or maintain a certain relative distance between it and LOT. The structural relationship suggested by this account can be tested with fixed effects linear models which explore whether the position of one vowel is predictable by the other. High correlations between the vowels would suggest that speakers with, for example, backer productions of LOT also have backer productions of TRAP. Figure 4.2 shows linear models for each interviewee’s mean F1 and F2 values for TRAP and LOT. Following nasals, /l/, and /r/, and word-final vowels are excluded. Only vowels in primary stress position are included.

The model for F1 is not significant ($R^2 = 0.01126$, $p = 0.2163$). The model for F2, on the other hand, is highly significant ($R^2 = 0.2105$, $p < 0.001$) and accounts for about 21 percent of observed variation. While F1 basically shows most speakers clustering around roughly 800 Hz for both vowels, the F2 model shows a wider range of productions. The speakers at either edge of the F2 continuum tend to pattern in the way that a change in progress would be expected to pattern. On the left side, with lower F2 values of TRAP and LOT, are Madison Z, Amber, Eddy, Isabella G, and Kennedy G—all females born in the 1990s. On the right side, with higher F2 values, are Maria K, James, Frank, Jerry, and Tyler K—with the exception of Tyler, all are in the older group. The

Figure 4.2. Linear model of TRAP and LOT F1 and F2 by interviewee





right side of the F2 plot is generally dominated by males, who may be more linguistically conservative with regard to changes in progress. While the R^2 of the F2 model is not overwhelming in its ability to predict observed data, it still suggests a patterning for a structural relationship between TRAP and LOT. Observations of where interviewees fit into that pattern suggest that both vowels are backing as a change in progress.

Table 4.3 captures the R^2 and *p* value outputs of linear models for TRAP and LOT in each phonetic environment explored in Table 4.1, with the idea that the case for a

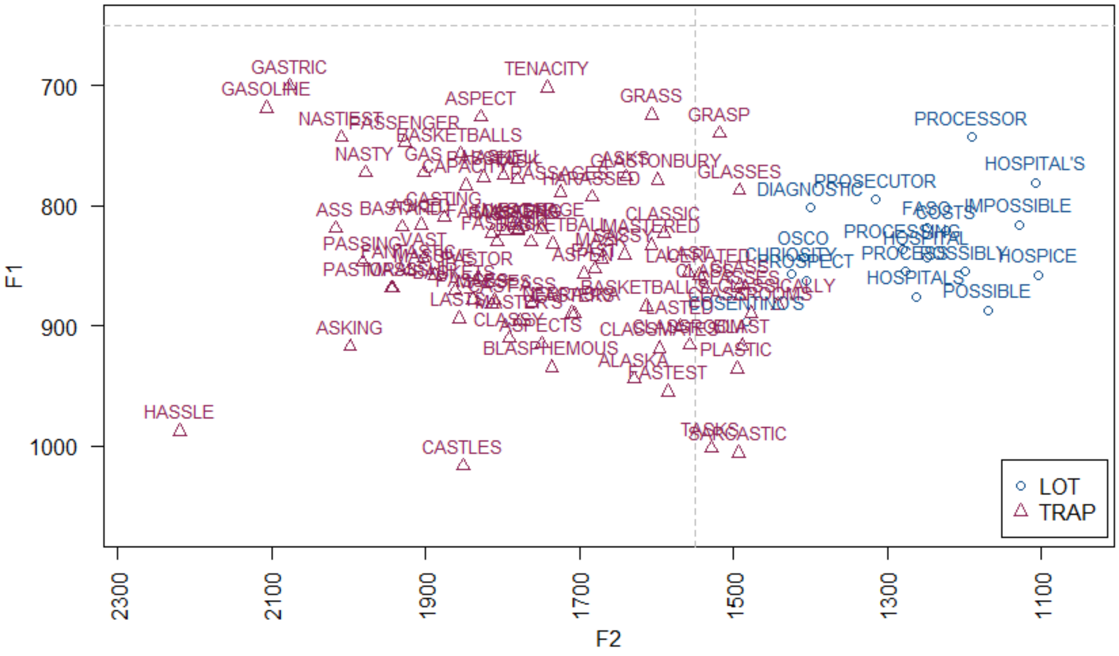
Table 4.3. Outputs of linear models for TRAP and LOT F2

Environment	R^2	*p*
Following affricate	-0.03721	0.751
Following nasal	0.03676	0.1064
Following fricative	0.1124	0.02102
Following stop	0.128	0.006711
Following alveolar	0.1762	0.001569
Following bilabial	0.2227	0.002473
Following interdental	0.2061	0.03839
Following labiodentals	0.01129	0.3011
Following palatal	0.008483	0.2715
Following velar	-0.02098	0.7584
Following voiced	0.2025	0.0007836
Following voiceless	0.1396	0.00475
Preceding oral anterior	-0.01258	0.467
Word-initial	0.09787	0.02327
Preceding glide	-0.1547	0.5446
Preceding oral labial	0.01302	0.2327
Preceding liquid	0.09147	0.02746
Preceding obstruent+liquid	0.04908	0.07751
Preceding /m/	-0.09981	0.5297
Preceding /n/	0.1145	0.0407
Preceding palatal	-0.06612	0.9313
Preceding velar	0.01864	0.2057
Following /p/	0.04558	0.1258
Following /b/	0.3576	0.03057
Following /m/	0.08565	0.04158
Following /f/	-0.006408	0.36
Following /v/	-0.2281	0.647
Following /ð/	0.3409	0.09865
Following /t/	0.02869	0.1341
Following /d/	-0.03708	0.7473
Following /s/	0.3819	0.0007691
Following /z/	-0.04734	0.4321
Following /n/	0.04657	0.08557
Following /l/	-0.03086	0.7517
Following /ʃ/	-0.05103	0.555
Following /ʧ/	-0.05019	0.5067
Following /ʤ/	-0.1225	0.898
Following /k/	-0.007737	0.4177
Following /g/	-0.06809	0.8372
Following /ŋ/	0.07803	0.3311

structural relationship could be made stronger if it was found that phonetic environments that encourage backer (or fronter) productions of LOT also encouraged backer (or fronter) productions of TRAP. For the sake of thoroughness, a number of specific following consonants are also modeled. Contexts with statistically significant scores are shaded.

The most dramatic relationship exists for following /s/. The linear model for following /s/ explains 38 percent of variation at highly significant levels. Figure 4.3 displays mean productions for all TRAP and LOT types with following /s/ in casual speech in primary stress position. The figure illustrates relatively back productions of TRAP, including many behind the vowel space center line marked at 1550 Hz.

Figure 4.3. Mean productions of TRAP and LOT with following /s/ in casual speech by type



Among the specific consonantal phonemes, however, following /s/ and the bilabials /b/ and /m/ are exceptional. No others produce either large correlation or significant ones. This lack of relationship at the consonantal level contrasts with the series of relationships observed in broad categories like following stop or following alveolar, which account for relatively small amounts of variation (but at significant levels), and with even broader categories like following voiced and following voiceless. It appears that when TRAP and LOT are treated abstractly as phonemes, a structural relationship exists between them. This relationship becomes less clear cut as the phonetic environment is more narrowly specified.

This finding is somewhat reminiscent of Gordon's (2001) observations on chain shifting in the NCS, where overall NCS patterns obtained, but individual phonetic contexts created contradictory effects. Then again, results in Kansas City are not quite so contradictory as those that Gordon (2001) observed—there are not obvious cases in Kansas City where LOT is so front and TRAP so back that their distributions strongly overlap throughout the community. Rather, it appears that no single phonemic environment directly correlates to an equivalent retraction in both vowels. As such, data for Kansas City may better reflect Labov's (2010:292-294) observation that in *ANAE* raised and fronted pre-nasal TRAP does not correlate to fronter productions of pre-nasal LOT, which he uses to argue that allophonic chain-shifting does not exist. My findings here suggest that, if indeed a chain shift is underway in Kansas City between LOT and TRAP, then the chain shift operates at the broad phonemic level rather than on a phonetic context-by-context basis.

An important caveat here is that accounts of TRAP retraction as a chain shift typically connect it to the low back merger, rather than LOT backing, per se. Table 4.4 provides outputs of the fixed effects linear model for correlations in F1 and F2 between LOT and TRAP divided by interviewees who perceive *cot-caught* as either different/close against interviewees who perceive them as same (cf. Table 3.25).

Table 4.4. Linear models of TRAP and LOT F1 and F2 divided by interviewee perception of *cot-caught* minimal pair

	Estimate	Std. Error	*t* value	Pr(>|t|)
cot-caught different or close				
LOT F1 (Intercept)	808.70930	186.33526	4.340	< 0.001
TRAP F1	0.03003	0.22884	0.131	0.897479
Residual standard error: 24.46 on 14 degrees of freedom Multiple R-squared: 0.001228, Adjusted R-squared: -0.07011 *F*-statistic: 0.01722 on 1 and 14 DF, *p*-value: 0.8975				
LOT F2 (Intercept)	768.2998	278.3998	2.760	0.0153
TRAP F2	0.3002	0.1523	1.971	0.0688
Residual standard error: 48.09 on 14 degrees of freedom Multiple R-squared: 0.2173, Adjusted R-squared: 0.1613 *F*-statistic: 3.886 on 1 and 14 DF, *p*-value: 0.06879				
cot-caught same				
LOT F1 (Intercept)	957.8149	85.3763	11.219	< 0.001
TRAP F1	-0.1657	0.1043	-1.588	0.122
Residual standard error: 18.78 on 33 degrees of freedom Multiple R-squared: 0.07175, Adjusted R-squared: 0.04363 *F*-statistic: 2.551 on 1 and 33 DF, *p*-value: 0.1198				
LOT F2 (Intercept)	775.92027	175.65120	4.417	< 0.001
TRAP F2	0.29440	0.09894	2.976	0.005437
Residual standard error: 61.89 on 33 degrees of freedom Multiple R-squared: 0.2115, Adjusted R-squared: 0.1877 *F*-statistic: 8.854 on 1 and 33 DF, *p*-value: 0.005437				

Overall, all interviewees follow the pattern that loosely correlates the F2 of TRAP with the F2 of LOT. The only statistically significant model, though, is the F2 model for interviewees who perceive *cot* and *caught* as the same. This suggests that there is a slightly closer connection between perceptual merger in this context and the position of TRAP. The relationship becomes a bit stronger when interviewees are grouped according to my impressionistic judgments of their *cot*-*caught* minimal pairs, as shown in Table 4.5.

Table 4.5. Linear models of TRAP and LOT F1 and F2 divided by interviewee production of *cot*-*caught* minimal pair

	Estimate	Std. Error	*t* value	Pr(>|t|)
cot-*caught* different or close				
LOT F1 (Intercept)	691.0878	186.7703	3.700	< 0.001
TRAP F1	0.1706	0.2293	0.744	0.46768
Residual standard error: 24.93 on 16 degrees of freedom Multiple R-squared: 0.03344, Adjusted R-squared: -0.02697 *F*-statistic: 0.5535 on 1 and 16 DF, *p*-value: 0.4677				
LOT F2 (Intercept)	899.5562	199.6671	4.505	0.00036
TRAP F2	0.2264	0.1108	2.043	0.05783
Residual standard error: 47.08 on 16 degrees of freedom Multiple R-squared: 0.207, Adjusted R-squared: 0.1574 *F*-statistic: 4.176 on 1 and 16 DF, *p*-value: 0.05783				
cot-*caught* same				
LOT F1 (Intercept)	1007.55067	80.82134	12.466	< 0.001
TRAP F1	-0.22515	0.09873	-2.281	0.0296
Residual standard error: 17.77 on 31 degrees of freedom Multiple R-squared: 0.1437, Adjusted R-squared: 0.116 *F*-statistic: 5.201 on 1 and 31 DF, *p*-value: 0.02961				
LOT F2 (Intercept)	699.6478	191.9635	3.645	< 0.001
TRAP F2	0.3377	0.1075	3.142	0.00368
Residual standard error: 62.6 on 31 degrees of freedom Multiple R-squared: 0.2415, Adjusted R-squared: 0.2171 *F*-statistic: 9.873 on 1 and 31 DF, *p*-value: 0.003677				

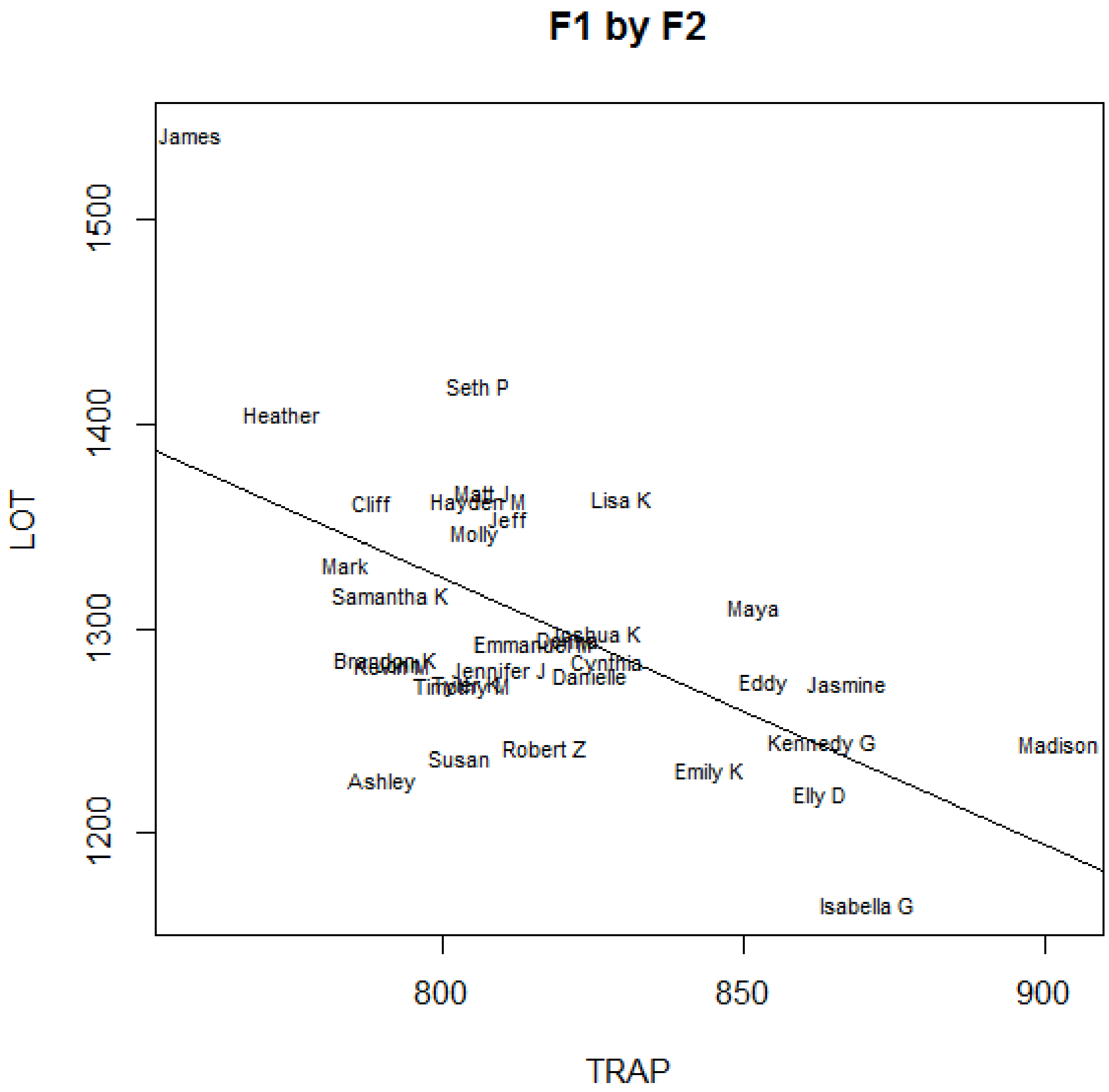
While the F2 model does not quite reach significance at the $p = 0.05$ level for interviewees I rated as close or different on *cot*-*caught*, the linear model for interviewees I rated as merged is significant and accounts for 21 percent of observed variation. The model for F1 is also significant, with low F1 in LOT corresponding to higher F1 in TRAP. This is suggestive of the raising of LOT observed in Chapter 3 as the first stage in the merger of LOT and THOUGHT and points out that TRAP retraction may involve lowering as well as backing. On this point, it is worth testing whether LOT backing corresponds to TRAP lowering. The model for this structural relationship is shown for both interviewee perception and production in Table 4.6.

Table 4.6. Linear models of LOT F2 and TRAP F1 divided by interviewee perception and production of *cot-caught* minimal pair

	Estimate	Std. Error	*t* value	Pr(>|t|)
cot-caught different or close – Interviewee perception				
LOT F2 (Intercept)	1859.2614	387.8273	4.794	< 0.001
TRAP F1	-0.6668	0.4763	-1.400	0.183270
Residual standard error: 50.91 on 14 degrees of freedom Multiple R-squared: 0.1228, Adjusted R-squared: 0.06016 *F*-statistic: 1.96 on 1 and 14 DF, *p*-value: 0.1833				
cot-caught same – Interviewee perception				
LOT F2 (Intercept)	2311.8430	261.0050	8.857	< 0.001
TRAP F1	-1.2399	0.3189	-3.888	< 0.001
Residual standard error: 57.72 on 33 degrees of freedom Multiple R-squared: 0.3142, Adjusted R-squared: 0.2934 *F*-statistic: 15.12 on 1 and 33 DF, *p*-value: 0.0004613				
cot-caught different or close – Interviewee production				
LOT F2 (Intercept)	1754.4388	379.9790	4.617	< 0.001
TRAP F1	-0.5497	0.4665	-1.178	0.255918
Residual standard error: 50.71 on 16 degrees of freedom Multiple R-squared: 0.07984, Adjusted R-squared: 0.02233 *F*-statistic: 1.388 on 1 and 16 DF, *p*-value: 0.2559				
cot-caught same – Interviewee production				
LOT F2 (Intercept)	2372.3343	264.3667	8.974	< 0.001
TRAP F1	-1.3086	0.3229	-4.052	< 0.001
Residual standard error: 58.11 on 31 degrees of freedom Multiple R-squared: 0.3463, Adjusted R-squared: 0.3252 *F*-statistic: 16.42 on 1 and 31 DF, *p*-value: 0.0003159				

The models for TRAP F1 as a result of LOT F2 among interviewees who perceive or are judged to produce *cot-caught* the same are quite strong. The production model accounts for 32 percent of observed variation, with backer LOT correlating with lower TRAP. This model is plotted in Figure 4.4, visually illustrating the connection between higher TRAP F1 and lower LOT F2.

Figure 4.4. Linear model of TRAP and LOT in casual speech by interviewee



Similar results are derived from calculating TRAP's position according to the model Labov, Rosenfelder, and Fruehwald (2013) use for front vowels that move diagonally on peripheral or non-peripheral tracks: {Diagonal = F2 - 2*F1}. This formula attempts to account simultaneously for changes in F1 and F2. When TRAP is measured diagonally, its diagonal measurement falls in relationship to LOT backing at $R^2 = 0.2937$ ($p < 0.001$). The model is much stronger if LOT F2 is used for the correlation rather than by also calculating LOT as diagonal ($R^2 = 0.1184$, $p = 0.028$). This suggests that the important correlation in predicting TRAP's retraction—either in height or in frontness—is the backward movement of LOT.

These models suggest that there is a structural connection in Kansas City English between LOT's position in F2 and TRAP. The correlation holds most strongly for interviewees who show evidence of the low back merger in minimal pairs testing. Based on findings in Chapter 3 that the low back merger is nearing completion in Kansas City and that, as this happens, LOT is backing in apparent time, this structural relationship should result in TRAP retracting in apparent time. The plots above suggest that young females are producing TRAP lower and backer than other interviewees. The next section tests that more thoroughly.

4.3. Change in Time – TRAP

I'll use the findings in Table 4.3 as a basis for exploring the production of TRAP as a change in time. I will explore two environments that show a relatively strong structural relationship between TRAP and LOT: the broad environment of following voiced consonant and the specific environment of following /s/. These two conditions show relatively large effects that are highly significant, are non-overlapping, and are relatively frequent in occurrence. So as not to skew results either by presuming the importance of the TRAP-LOT structural relationship or by only exploring contexts that are overly favorable to backing, I will also explore three that do not show a relationship and would not be likely to show a backing effect: TRAP with following nasals, following velars, and preceding velars. None shows a significant (or substantial) TRAP-LOT relationship in Table 4.3. Following nasals and preceding velars were shown in Section 4.1 to correlate with fronter productions (following nasals are also raised), and following (voiced) velars result in raised TRAP in many US dialects (e.g., areas with a "continuous" TRAP configuration in Labov, Ash & Boberg 2006:180-182; Wisconsin in Zeller 1997; Oregon in Becker et al. 2013). These will serve to offer potential contrast against TRAP with following voiced consonants and with following /s/.

I'll examine each of these five environments against interviewee birth year. For each, I'll use one linear model of TRAP F1 and one of TRAP F2. Figures 4.5 through 4.9 plot the linear models and Tables 4.7 through 4.10 provide the outputs of those models.

The models depicted for following voiced consonants in Figure 4.5 and Table 4.7 show TRAP lowering and backing at highly significant levels. The effect is not terribly dramatic in F1 at only about 17 Hz per decade. However, in F2, TRAP with following voiced is backing at a rate of 41 Hz for every ten years. The relatively high R^2 shown in Table 4.7 suggests that TRAP backing in the context of following voiced consonant is a robust change in progress in Kansas City. This supports Lusk's (1976) identification of less raising as a new innovation among the youngest interviewees in her study—those who would correspond to the oldest interviewees in my study.

Figure 4.5. Linear models of TRAP with following voiced consonant by interviewee birth year

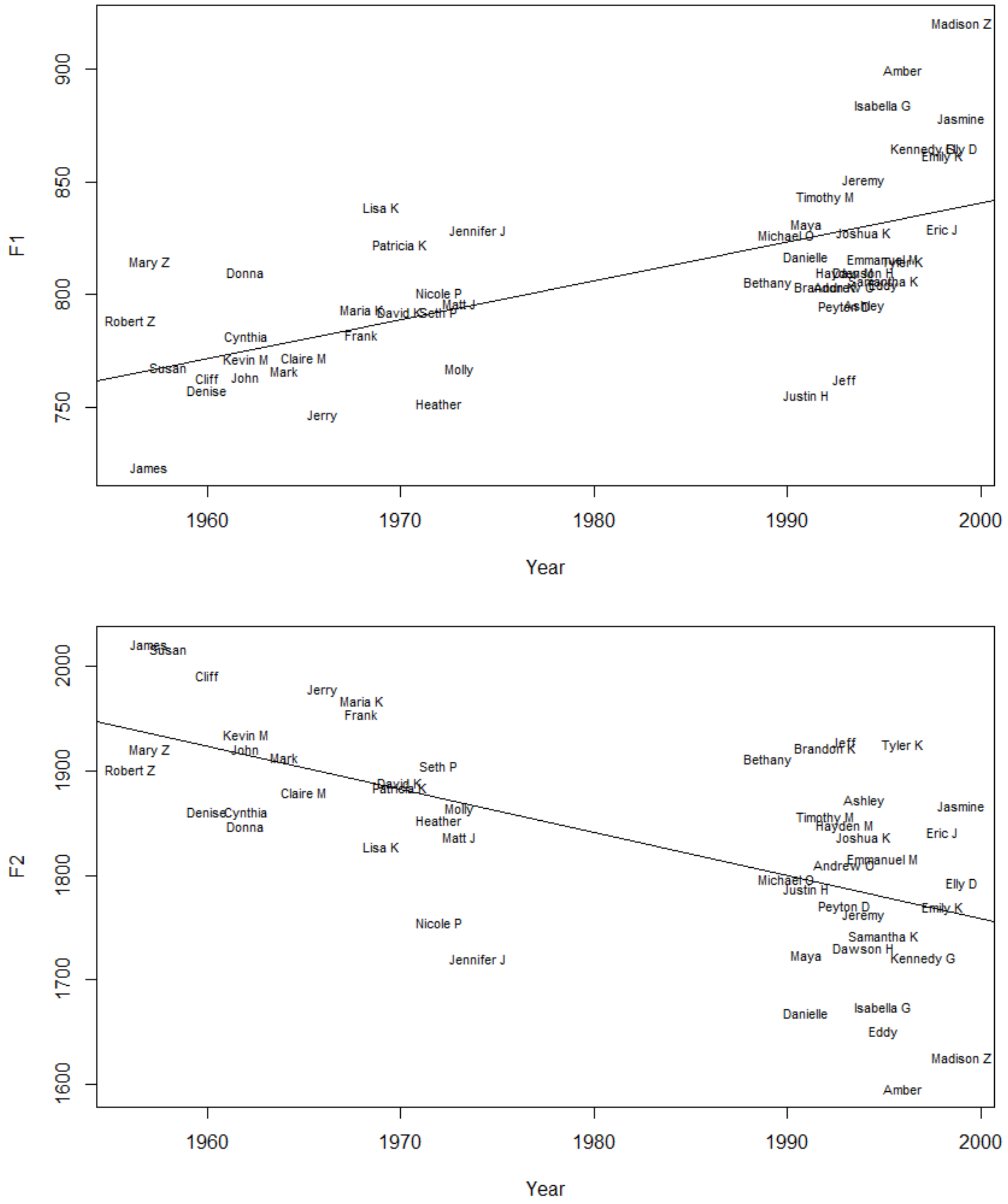


Table 4.7. Linear models of TRAP with following voiced consonant by interviewee birth year

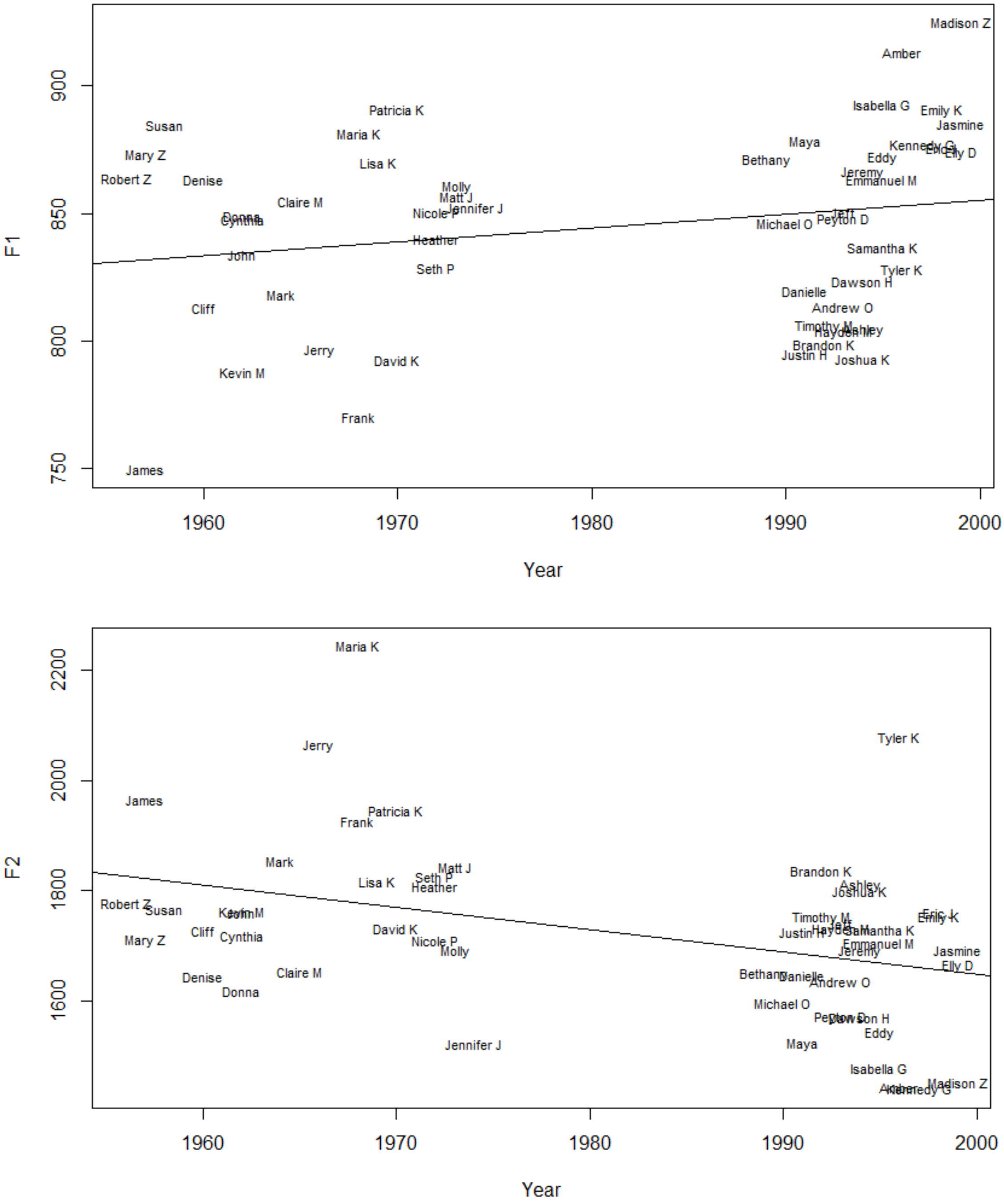
	Estimate	Std. Error	*t* value	Pr(>|t|)
TRAP F1 (Intercept)	-2602.4417	583.9365	-4.457	< 0.001
Year	1.7214	0.2948	5.839	< 0.001
Residual standard error: 31.64 on 49 degrees of freedom Multiple R-squared: 0.4103, Adjusted R-squared: 0.3983 *F*-statistic: 34.1 on 1 and 49 DF, *p*-value: 4.133e-07				
TRAP F2 (Intercept)	9976.5929	1461.2788	6.827	< 0.001
Year	-4.1088	0.7377	-5.570	< 0.001
Residual standard error: 79.19 on 49 degrees of freedom Multiple R-squared: 0.3877, Adjusted R-squared: 0.3752 *F*-statistic: 31.02 on 1 and 49 DF, *p*-value: 1.07e-06				

In the narrower phonetic environment of following /s/, a significant value obtains only for backing as a change in progress. Table 4.8 shows a rate of reduction in F2 of 40 Hz each decade. With an R^2 of 0.1301, the model is not nearly as strong as the model for following voiced. However, the pattern is the same. Figure 4.6 suggests that the underlying pattern for F1 also holds, though not at statistically significant levels.

Table 4.8. Linear models of F1 and F2 of TRAP with following /s/ by interviewee birth year

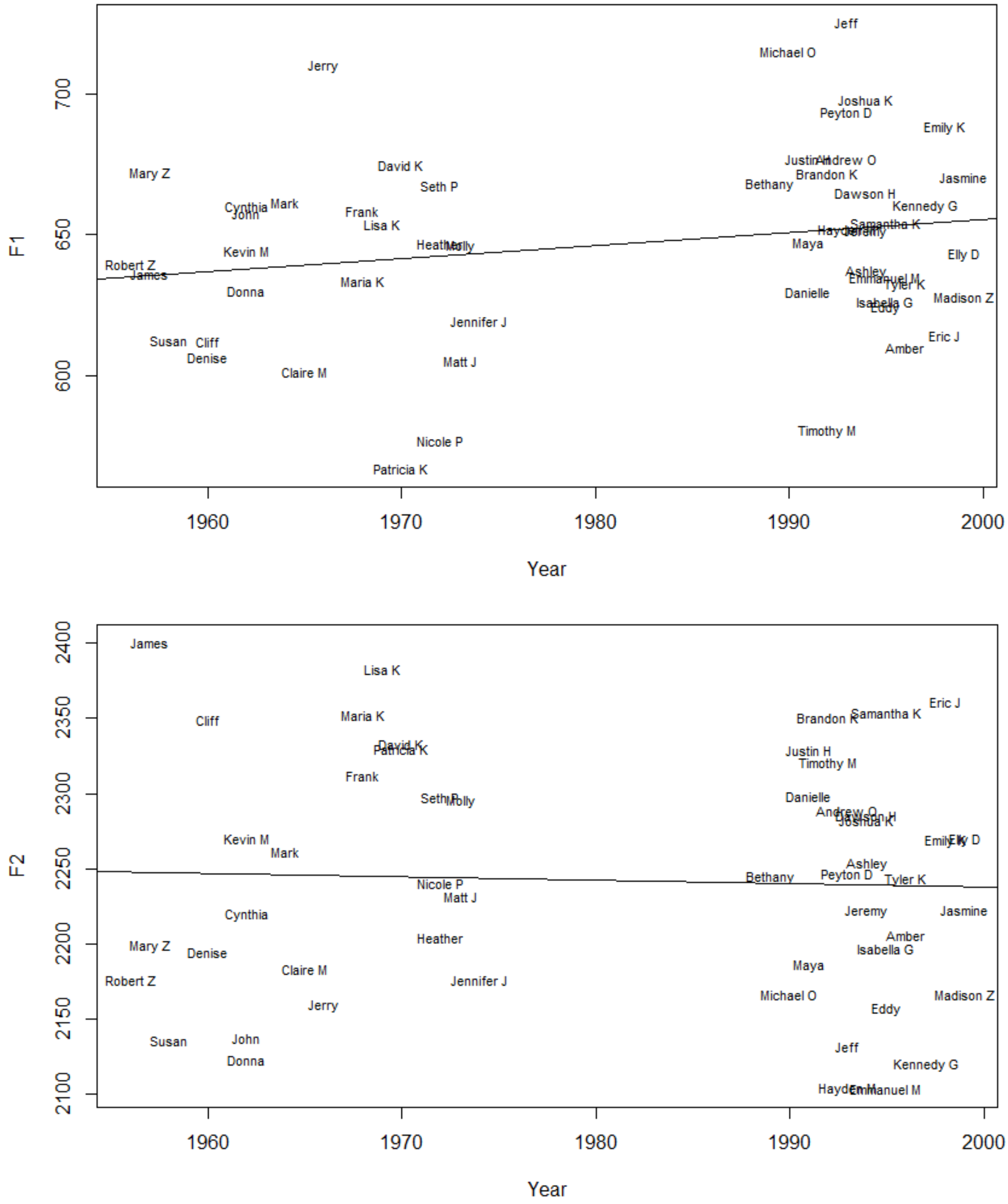
	Estimate	Std. Error	*t* value	Pr(>|t|)
TRAP F1 (Intercept)	-210.5464	683.6938	-0.308	0.759
Year	0.5328	0.3452	1.544	0.129
Residual standard error: 37.05 on 49 degrees of freedom Multiple R-squared: 0.04637, Adjusted R-squared: 0.02691 *F*-statistic: 2.382 on 1 and 49 DF, *p*-value: 0.1291				
TRAP F2 (Intercept)	9722.582	2745.776	3.541	< 0.001
Year	-4.037	1.386	-2.912	0.005394
Residual standard error: 148.8 on 49 degrees of freedom Multiple R-squared: 0.1475, Adjusted R-squared: 0.1301 *F*-statistic: 8.479 on 1 and 49 DF, *p*-value: 0.005394				

Figure 4.6. Linear models of TRAP with following /s/ by interviewee birth year



Following nasals do not adhere to the trend of lowering or backing, as shown by the basically flat lines in F1 and F2 in Figure 4.7 and the apparently scattershot plotting of interviewee measurements.

Figure 4.7. Linear models of TRAP with following nasal by interviewee birth year



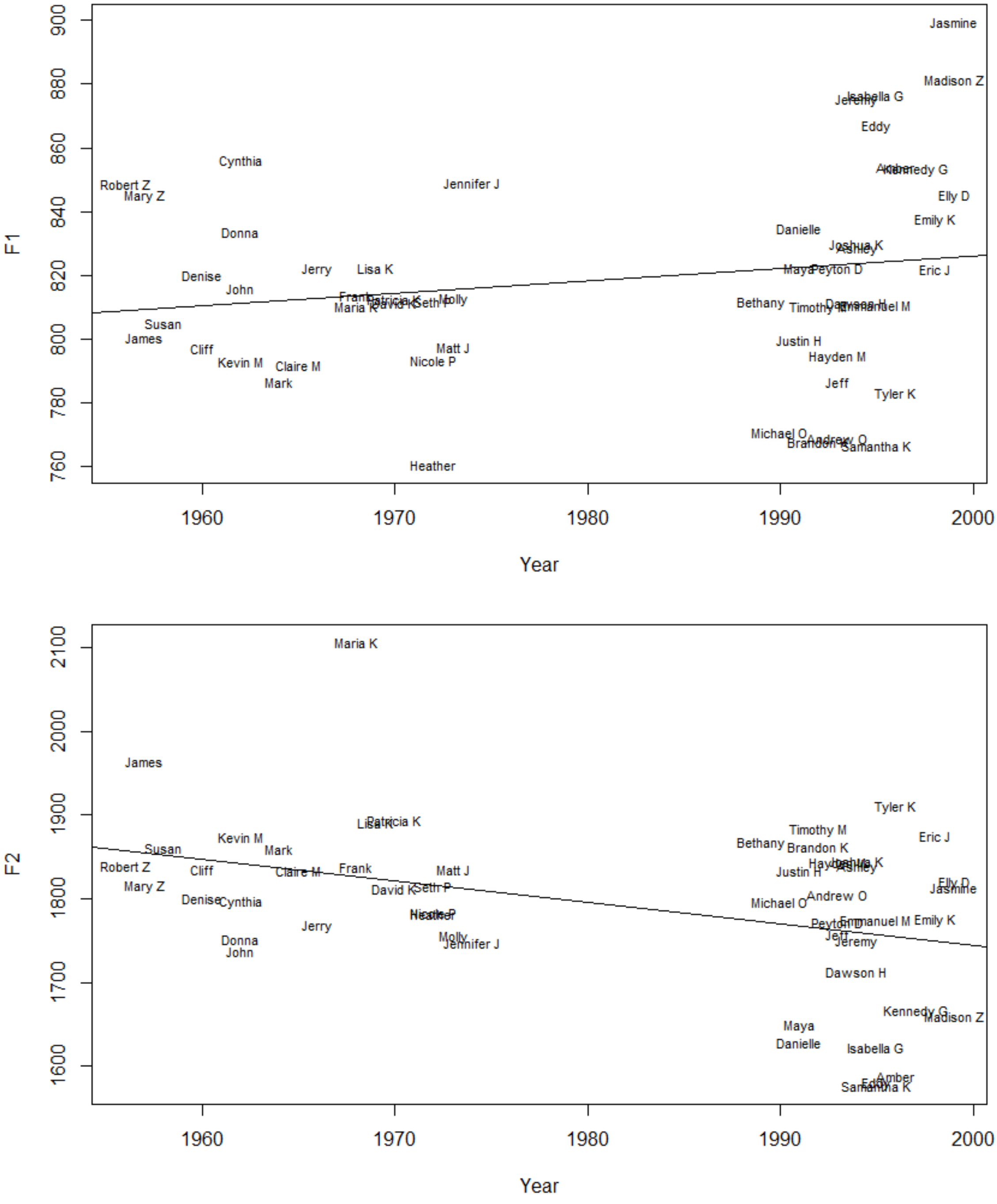
I’ve omitted the outputs of the models for TRAP with following nasals, since they show that there is no explanatory power in the models. Nevertheless, the lack of any movement in following nasals is noteworthy. Lusk (1976) described TRAP with following nasals as raising vigorously in her study of Kansas City. Figure 4.7 suggests that TRAP with following nasal has plateaued. Overall, pre-nasal TRAP has remained basically locked in its present position since at least the 1950s.

Following velars return to the pattern of backing in time. The slope in Figure 4.8 shows F2 decreasing 26 Hz each decade. This number is smaller than for the environments of either following voiced consonant or following /s/. So, while following velars encourage raised and fronted TRAP in many dialects of American English, in Kansas City they seem to participate in the general pattern of backing in apparent time.

Table 4.9. Linear models of F1 and F2 of TRAP with following velar by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
TRAP F1 (Intercept)	42.9035	575.1234	0.075	0.941
Year	0.3915	0.2903	1.348	0.184
Residual standard error: 31.17 on 49 degrees of freedom Multiple R-squared: 0.03578, Adjusted R-squared: 0.0161 *F*-statistic: 1.818 on 1 and 49 DF, *p*-value: 0.1837				
TRAP F2 (Intercept)	6881.9293	1691.3948	4.069	< 0.001
Year	-2.5687	0.8539	-3.008	0.004141
Residual standard error: 91.66 on 49 degrees of freedom Multiple R-squared: 0.1559, Adjusted R-squared: 0.1387 *F*-statistic: 9.049 on 1 and 49 DF, *p*-value: 0.004141				

Figure 4.8. Linear models of TRAP with following velar by interviewee birth year

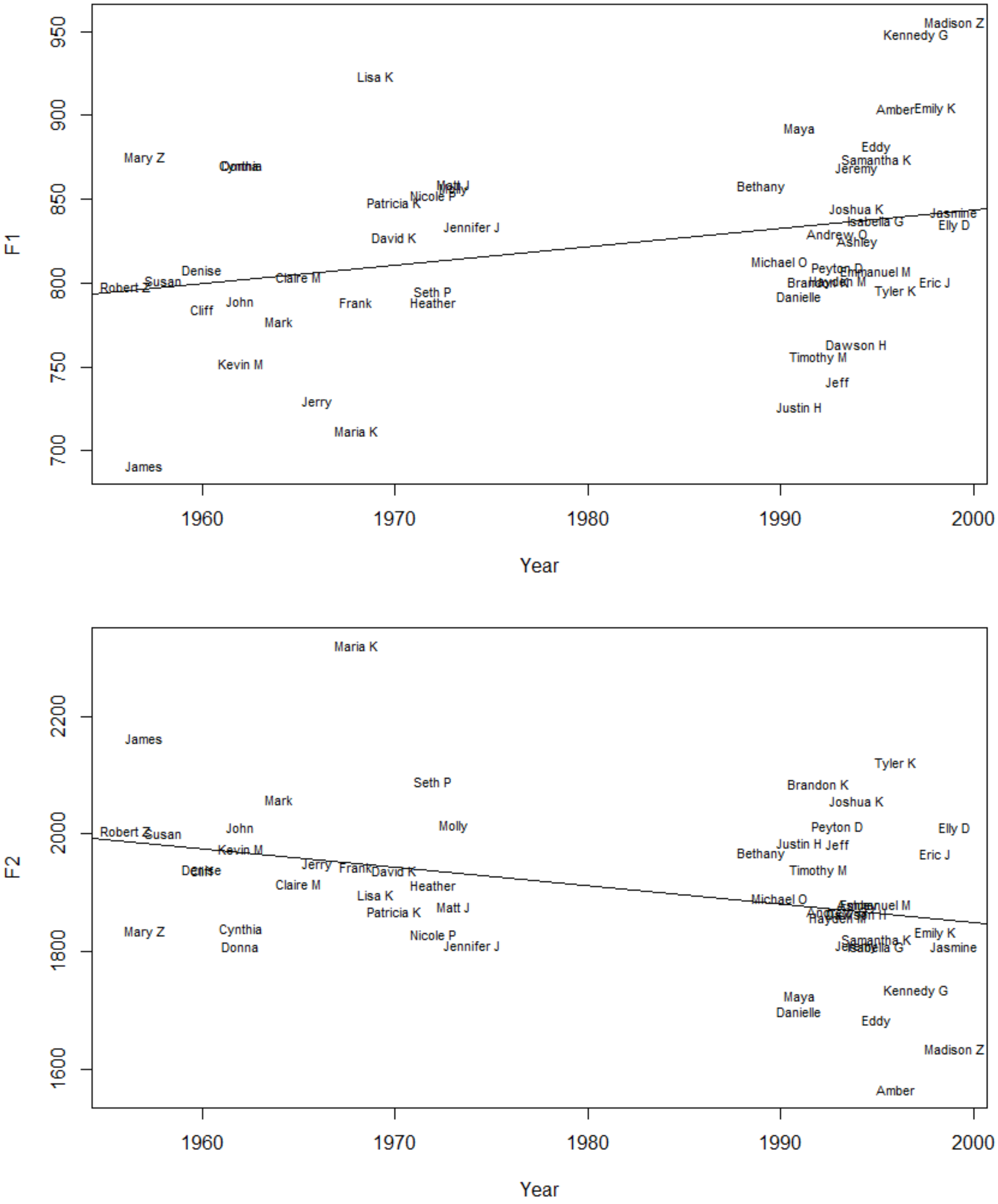


Finally, Table 4.10 and Figure 4.9 show backing continuing to occur in the context of preceding velar, an environment that correlated with relatively front productions of TRAP in section 4.1. In fact, while Table 4.10 shows that this model is limited in its explanatory power due to its R^2 of just 0.104, the slope it generates predicts F2 decreasing by 31 Hz every ten years, which is basically in line with predictions for TRAP with following /s/, following voiced consonant, and following velar. In other words, the preceding velar context which was shown to correlate with a fronter TRAP still seems to participate in backing at roughly the same rate as most other phonetic environments explored here.

Table 4.10. Linear models of F1 and F2 of TRAP with preceding velar by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
TRAP F1 (Intercept)	-1331.8979	1020.9515	-1.305	0.198
Year	1.0876	0.5154	2.110	0.040
Residual standard error: 55.33 on 49 degrees of freedom Multiple R-squared: 0.0833, Adjusted R-squared: 0.06459 *F*-statistic: 4.453 on 1 and 49 DF, *p*-value: 0.03998				
TRAP F2 (Intercept)	8079.236	2366.984	3.413	0.0013
Year	-3.114	1.195	-2.606	0.0121
Residual standard error: 128.3 on 49 degrees of freedom Multiple R-squared: 0.1217, Adjusted R-squared: 0.1038 *F*-statistic: 6.792 on 1 and 49 DF, *p*-value: 0.0121				

Figure 4.9. Linear models of TRAP with preceding velar by interviewee birth year



Combined, these results suggest a change in time for the production of TRAP. In pre-nasal environments, the pattern of TRAP raising appears to have reached its conclusion. In other environments, TRAP is retracting. In particular, that retraction is realized as backing. At the phonemic level, there appears to be, at least, a statistical relationship between TRAP backing and the backward movement of LOT as it merges with THOUGHT. However, within specific phonetic environments, TRAP is backing regardless of the position of LOT in corresponding phonetic environments. The backwards shift appears to occur at the phonemic level for TRAP, so that almost the entire class is backing in appearing time.

4.4. Stylistic Variation – TRAP

Table 4.11 shows the lmer analysis of TRAP in different interview tasks. For the sake of brevity, I'll limit exploration to two environments analyzed for change in progress in the previous section: TRAP with following voiced consonant and TRAP with following nasal. No TRAP tokens were included in the minimal pairs tests, so only casual speech (CS), reading passage (RP), and word list (WL) are shown. Casual speech is the intercept value.

Across both phonetic environments in Table 4.11 there is a trend for increasingly formal interview tasks to correlate with lower and fronter productions of TRAP. F2 values in WL are especially high, suggesting very front productions in the highest-attention-to-speech style. So, generally speaking, CS favors backer and higher productions compared with more formal tasks.

Table 4.11. Mixed effects regression of TRAP by interview task

Fixed Effects	Estimate	Std. Error	*t* value
Following Voiced F1			
styleCS (Intercept)	805.677	7.652	105.29
styleRP	29.128	17.867	1.63
styleWL	20.484	7.415	2.76
Following Voiced F2			
styleCS (Intercept)	1774.93	18.93	93.76
styleRP	46.77	40.28	1.16
styleWL	96.41	16.82	5.73
Following Nasal F1			
styleCS (Intercept)	652.872	5.781	112.94
styleRP	17.910	7.066	2.53
styleWL	9.382	6.057	1.55
Following Nasal F2			
styleCS (Intercept)	2153.54	15.67	137.40
styleRP	50.27	20.25	2.48
styleWL	118.65	17.81	6.66

These style patterns suggest that, though no interviewee commented on back productions of TRAP, there may be some degree of social evaluation to TRAP's height and frontness. At the very least, there seems to be a correlation between careful speech and a low front target for the vowel.

4.5. Social Factors – TRAP

With TRAP retraction, especially in the dimension of backing, established as a change in progress, this section seeks social correlations for that change. I will explore gender and class. I include all environments in these models except following nasal, /l/, and /r/.

Tables 4.12 shows the outputs of an ANOVA test for the weight of sex and class as factors predicting observed variation. Table 4.13 provides outputs of the lmer models of sex and class as factors. The *F*-values in both ANOVA models suggest that sex offers the most explanatory power. In lmer analysis, females produce TRAP 30 Hz lower and 85 Hz backer than males, leading in the direction of the change in progress. Transitional and middle class speakers show backer productions in F2 than working class speakers.

Table 4.12. ANOVA model of TRAP F1 and F2 by gender and class

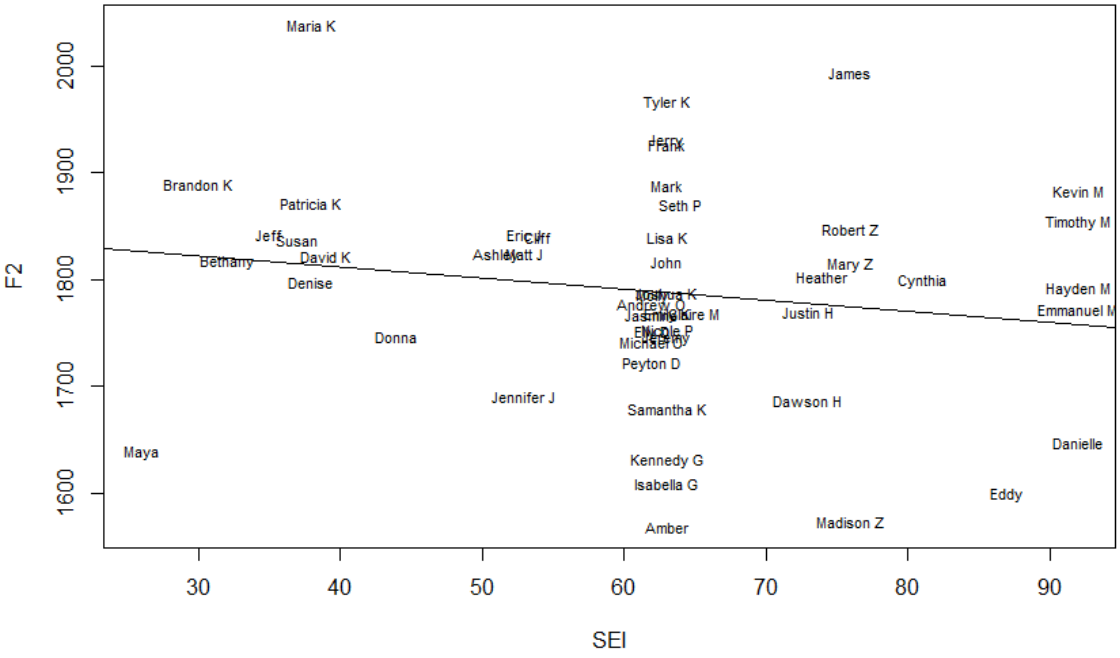
Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	98747	98747	17.7441
Class	2	11598	5799	1.0420
Sex:Class	2	8037	4018	0.7221
F2				
Sex	1	298322	298322	12.8147
Class	2	112188	56094	2.4096
Sex:Class	2	34714	17357	0.7456

While the regression shows a difference in F2 as a result of class, mixed effects regressions of job prestige scores and SEI scores show no statistical correlation with backing (or lowering). The SEI linear model is provided as Figure 4.10 for reference. While there are outliers, the overall trend is that the lowest F2 values belong to females born in the 1990s regardless of SEI score. The eight lowest F2 values in Figure 4.10—Maya, Samantha K, Kennedy G, Isabella G, Amber, Madison Z, Eddy, Danielle—are all younger females. Their distribution offers the possibility that higher SEI scores among younger females correlate with backer productions of TRAP (with Maya being an outlier), but the correlation between lower F2 values and younger speakers is convincing.

Table 4.13. Mixed effects regression of TRAP F1 and F2 by gender and class

Fixed Effects	Estimate	Std. Error	*t* value
F1			
sexFemale (Intercept)	847.943	5.596	151.53
sexMale	-30.044	7.096	-4.23
classMC (Intercept)	835.046	6.875	121.46
classTC	6.860	11.532	0.59
classWC	-7.590	9.054	-0.84
F2			
sexFemale (Intercept)	1729.45	18.05	95.81
sexMale	85.13	24.27	3.51
classMC (Intercept)	1749.452	21.585	81.05
classTC	1.935	37.655	0.05
classWC	52.412	29.340	1.79

Figure 4.10. Linear model of TRAP F2 by interviewee SEI score



Figures 4.11 and 4.12 explore TRAP backing in time as a factor of gender. The model for females is shown in 4.11. Males are shown in 4.12. Models for F1 appear above and F2 below. Males and females appear to participate in TRAP retraction.

Figure 4.11. Linear models of TRAP F1 and F2 among females by birth year

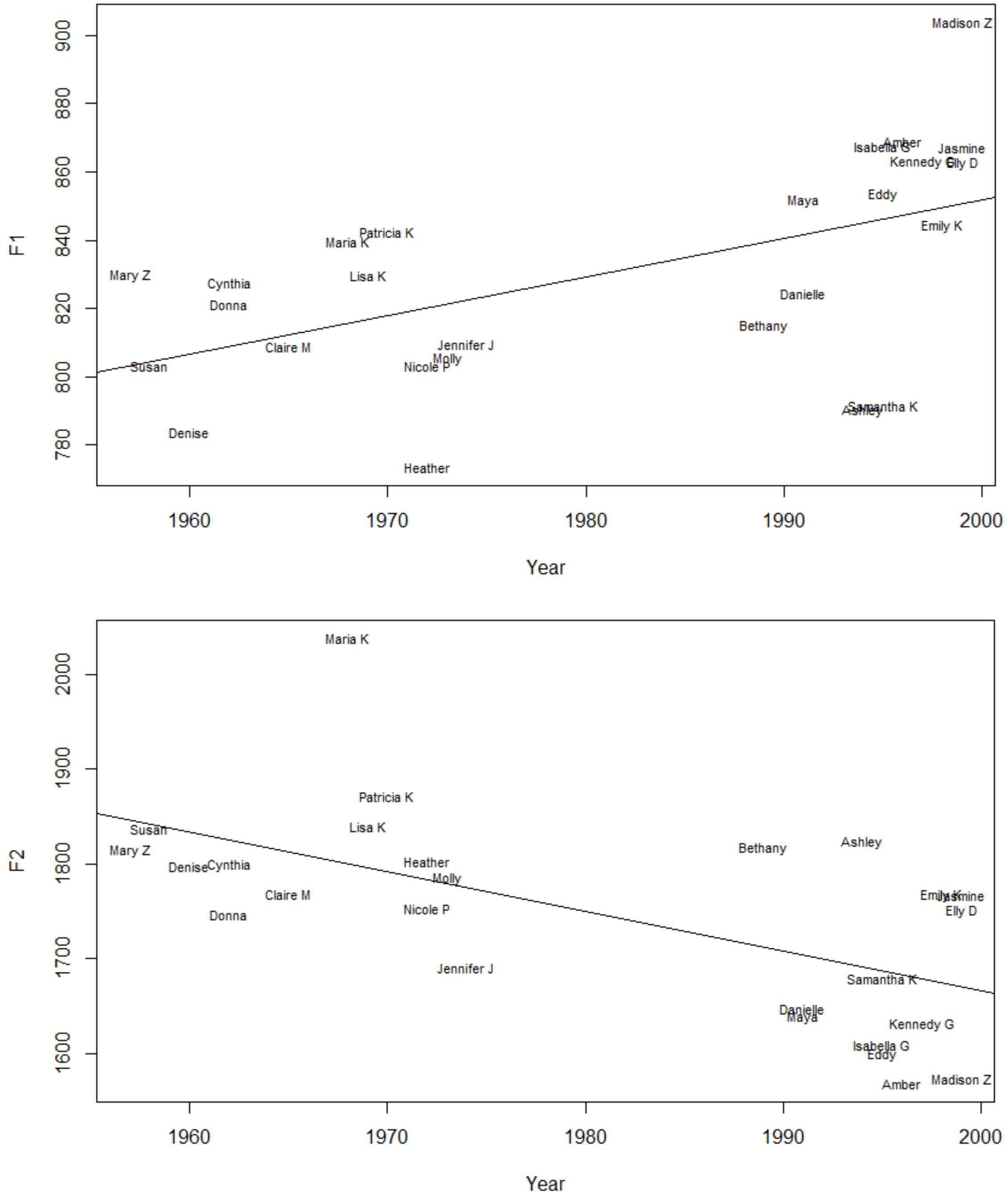


Figure 4.12. Linear models of TRAP F1 and F2 among males by birth year

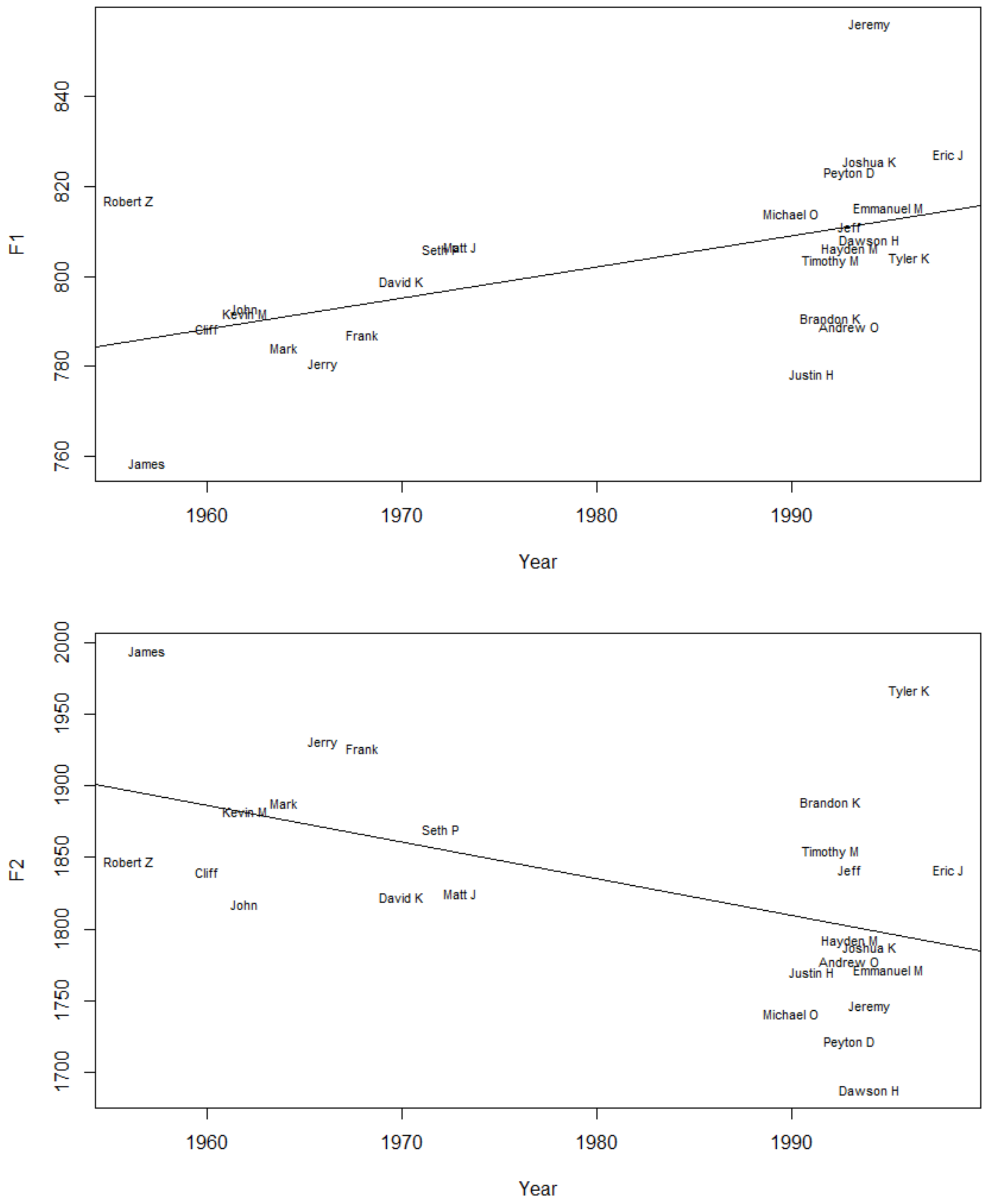


Table 4.14 captures the outputs of the regressions shown in Figures 4.11 and 4.12. All models are statistically significant overall, though the intercept values for F1 fall

short of statistical significance. This suggests that the inter-speaker variance within each gender is relatively high. F2 models more neatly, with females backing TRAP at a rate of 42 Hz per decade and males at 26 Hz. This confirms not only the broader trend of backing in apparent time, but also the female lead in the trend suggested by visual analysis of TRAP backing in the models for various phonetic conditioning effects.

Table 4.14. Linear models of TRAP F1 and F2 by gender by birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
Females				
TRAP F1 (Intercept)	-1402.1274	688.6082	-2.036	0.05291
Year	1.1269	0.3476	3.242	0.00347
Residual standard error: 26.92 on 24 degrees of freedom Multiple R-squared: 0.3045, Adjusted R-squared: 0.2755 *F*-statistic: 10.51 on 1 and 24 DF, *p*-value: 0.003472				
TRAP F2 (Intercept)	10044.913	2232.946	4.499	0.000149
Year	-4.189	1.127	-3.716	0.001076
Residual standard error: 87.28 on 24 degrees of freedom Multiple R-squared: 0.3653, Adjusted R-squared: 0.3388 *F*-statistic: 13.81 on 1 and 24 DF, *p*-value: 0.001076				
Males				
TRAP F1 (Intercept)	-577.7174	455.9246	-1.267	0.21779
Year	0.6969	0.2302	3.028	0.00599
Residual standard error: 17.11 on 23 degrees of freedom Multiple R-squared: 0.285, Adjusted R-squared: 0.2539 *F*-statistic: 9.166 on 1 and 23 DF, *p*-value: 0.00599				
TRAP F2 (Intercept)	6887.3070	1768.6593	3.894	0.000732
Year	-2.5516	0.8929	-2.858	0.008905
Residual standard error: 66.38 on 23 degrees of freedom Multiple R-squared: 0.262, Adjusted R-squared: 0.2299 *F*-statistic: 8.166 on 1 and 23 DF, *p*-value: 0.008905				

Of note, these regression results also allow for comparison of males and females across generations. Labov (2010:198-199) provides a model for this in noting that “language learners acquire their first language from close contact with a female” with the result that “girls and young women advance” a given sociolinguistic change “while males do not participate further in the change but remain at the base level they acquired from their mothers.” Choosing an arbitrary F2 value of 1775 Hz as a target, the regressions in Table 4.14 predict that a female with this mean TRAP production value would be born in 1968 (1775 = -4.189 * 1968.23 + 10044.913). A male with F2 at 1775 Hz would be born in 1994 (1775 = -2.5516 * 1993.77 + 6887.3070). The twenty-six year difference between these predicted birth years roughly corresponds to one generation, and neatly matches Labov’s model for boys acquiring the language of their mothers while girls advance the language forward. Of course, the greater rate of backing shown by females would quickly render this model incorrect, but the corresponding prediction would be that the next generation of males will acquire their mothers’ accelerated rate of backing and begin their portion of the faster section of the S-curve.

4.6. Summary – TRAP

The discussion of TRAP has shown it to be retracting—and, in particular, backing—in vowel space in apparent time. This appears to be a vigorous change led by females. There are not clear interactions with class.

It appears that TRAP’s retraction is structurally related to the low back merger. More specifically, TRAP appears to retract as a result of LOT’s movement backward. Chapter 3 suggested that LOT is backing in Kansas City in general, but in particular it is backing for speakers who are perceptually merged in a *cot-caught* minimal pair. Likewise, while TRAP retraction is occurring in general in apparent time, speakers who are perceptually merged for *cot-caught* appear to lead the change. So, there is a fair amount of support for understanding the positions in vowel space of TRAP and LOT as structurally linked, and there is interpretive support for understanding TRAP’s position as structurally linked to the low back merger.

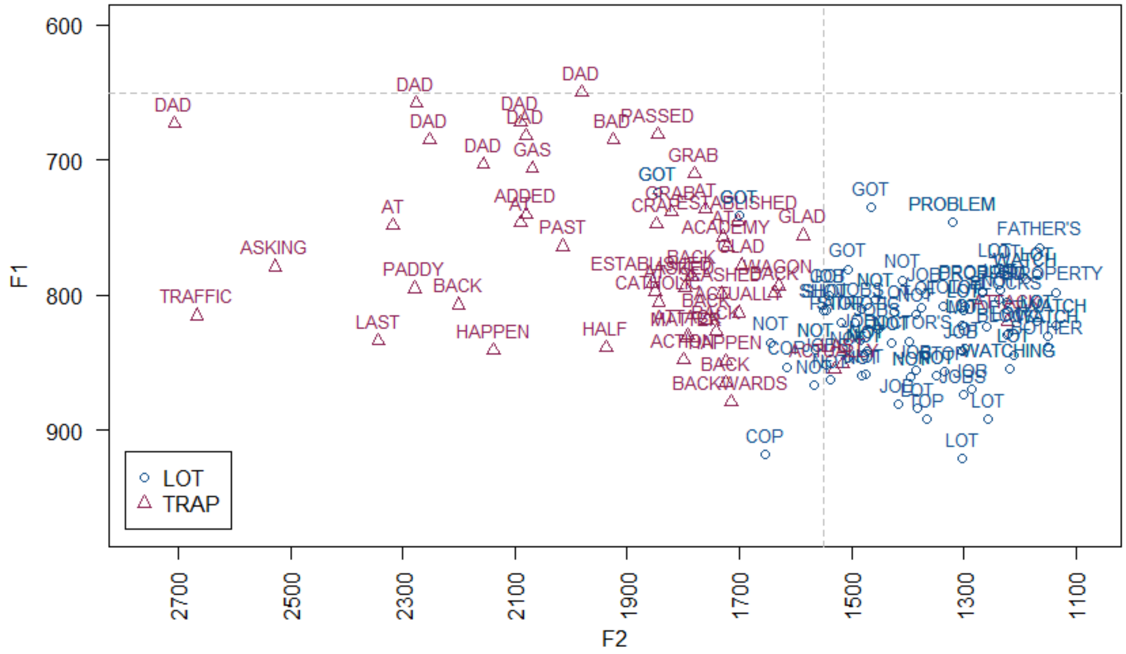
Figure 4.2, which compared the positions of TRAP and LOT as linear models, illustrated this relationship as an effect of time and gender. In F2 especially, lower vales (the left side of the model) belong to females born in the 1990s—Jennifer J, born in KCK in 1974, is the first member of the older group to follow the emerging TRAP-LOT pattern, and Dawson H, born in KCMO in 1994, is the first male. Higher F2 values (the right side of the model) belong primarily to older interviewees, and in general males tend to produce these fronter TRAP values.

Jerry displays this older, particularly male pattern of fronted TRAP and LOT. Jerry was born in KCMO in 1966 and continues to live there—albeit on a suburban edge of the city, rather than in the urban core where he grew up and attended high school. He has been in law enforcement most of his adult life. Socially, Jerry has a fairly high job prestige and SEI score, since police officers tend to be rated highly in job status surveys and are paid relatively well. However, he identifies strongly as working class, describing his role as a police officer as that of a “foot soldier,” who is able to physically defend members of the community. He is a high school graduate and has spent his law enforcement career on patrol status.

Figure 4.13 displays Jerry’s TRAP (mean F1:774 Hz, F2:1915 Hz) and LOT (F1:825 Hz, F2:1379 Hz) tokens in casual speech. Following nasals, /l/, and /r/ and excluded from both vowel classes. The vowel classes largely coalesce around the center line with a small degree of overlap among the backest TRAP and frontest LOT tokens.

The distributions are separated by a Euclidean distance of 538 Hz and Pillai score of 0.598 (*p* < 0.001).

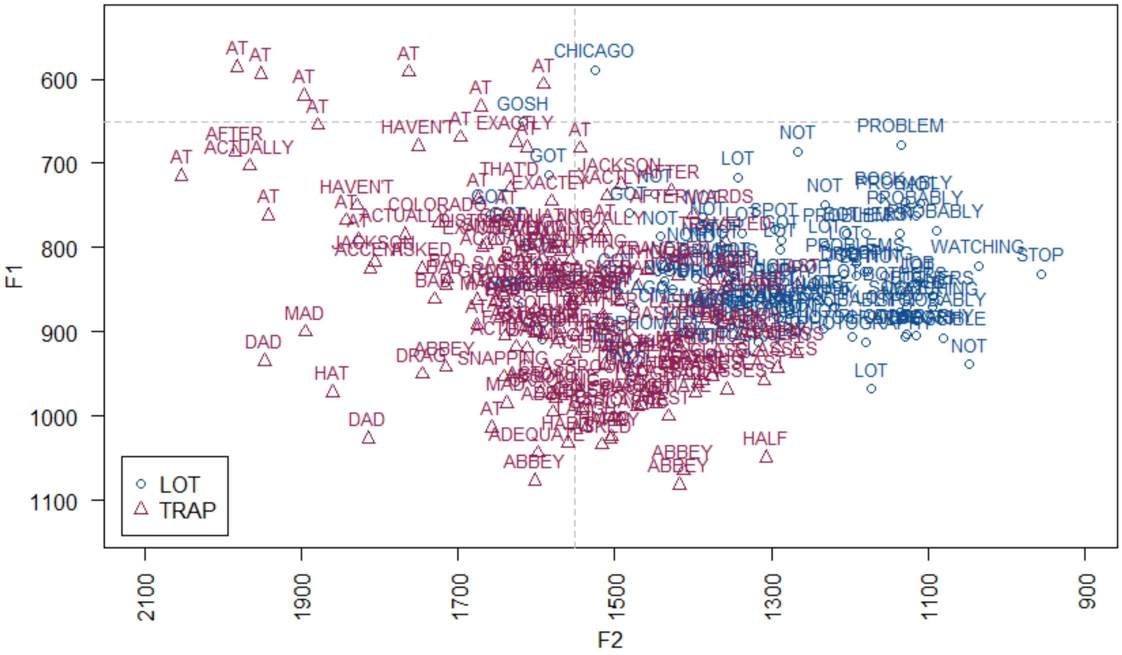
Figure 4.13. Jerry, b. 1966, KCMO – Casual speech TRAP and LOT tokens



Jerry's TRAP with following /d/ is especially high and front and, impressionistically, sounds tense. It appears from this that Jerry may have developed a continuous system for TRAP with following /d/ tense and other TRAP lax. Even tokens with following fricatives, though—a context that is typically phonetically back—appear among his fronter TRAP tokens. These include *traffic*, *asking*, and *past*. His LOT class is correspondingly low and front. Impressionistically, his *got* and *not* are [a].

Amber, born in KCMO in 1996, contrasts Jerry's pattern. Her casual speech tokens of TRAP and LOT are plotted in Figure 4.14. Amber's family is middle class. She grew up in KCMO and, like most white people I interviewed who were born in the 1990s and grew up in KCMO, she has always attended private school. She seems to feel a relatively strong connection to the urban core, though, including working in a predominantly African American area of the city and maintaining friendships with her coworkers there. She plans to attend college and is especially drawn to Chicago. At the time I interviewed her, she hoped to work in an arts-related profession like photography or acting.

Figure 4.14. Amber, b. 1996, KCMO – Casual speech TRAP and LOT tokens



Amber’s LOT (F1:838 Hz, F2:1291 Hz) has clearly shifted back and up relative to her TRAP (F1:870 Hz, F2:1567 Hz), which has correspondingly moved back toward the center of her vowel space. The Euclidean distance between the classes remains robust at 269 Hz, as is her Pillai score of 0.480 ($p < 0.001$). She strongly follows the pattern in which TRAP with preceding liquid and/or following fricative is backest. Her mean F2 for tokens of *last* and *class* is 1384 Hz, and impressionistically some sound as far back as [ɑ]. Syllable-initial TRAP is often fairly high and front—though *Abbey* is an exception. Her LOT tokens also often show [ɔ] distributions—especially those with preceding /r/ like *rock* and *probably*.

Bethany, born in Lee's Summit, MO in 1989, is illustrative of something of a midpoint between these patterns. Her TRAP and LOT casual speech tokens are plotted in Figure 4.15. Bethany was working as a waitress at the time I interviewed her. She was attending college at the time, but, as a single mother, has since had to suspend her education. She plans to continue living in Lee's Summit because of its public schools.

Figure 4.15. Bethany, b. 1989, Lee's Summit, MO – Casual speech TRAP and LOT tokens

Bethany’s TRAP (F1:799 Hz, F2:1800 Hz) and LOT (F1:810 Hz, F2: 1244Hz) Euclidean distances are similar to Jerry’s at 556 Hz, with a Pillai score of 0.66681 ($p < 0.001$). These distances may suggest that her LOT has already moved backward and up, but her TRAP has not yet followed. Her LOT distribution for these tokens is basically characteristic of the development of the merger of LOT-THOUGHT in Kansas City, with *got* and *not* generally appearing low and front in [ɑ] space, words with preceding liquids being produced as [ɔ], and other phonetic contexts falling in between. While her overall TRAP class remains relatively front, by comparison with Jerry, she does not appear to have a strong conditioning effect from following /d/, with the exception of a single token of *dad* (similarly, one following /g/ token of *bag*). Overall, TRAP appears to be in the process of backing, and this has brought the following fricative context (e.g., *laugh*, *class*, and *rather*) back of the center line. So, these tokens that generally occupy the back of TRAP’s distribution are advanced in the overall process of retraction, and may represent the initial inroads of the change.

These speakers potentially represent three points on the continuum of a chain shift. The relationship between TRAP and LOT in that shift is complicated, though. It seems to advance at the phonemic level so that TRAP moves as an entire class. The conditions that reach back positions first do not appear generally to be related between the two vowel classes. This generalization is further supported by the observation that TRAP is currently backing rapidly, while LOT’s backing is relatively slow. If the two are shifting together, they are not doing so at parallel rates.

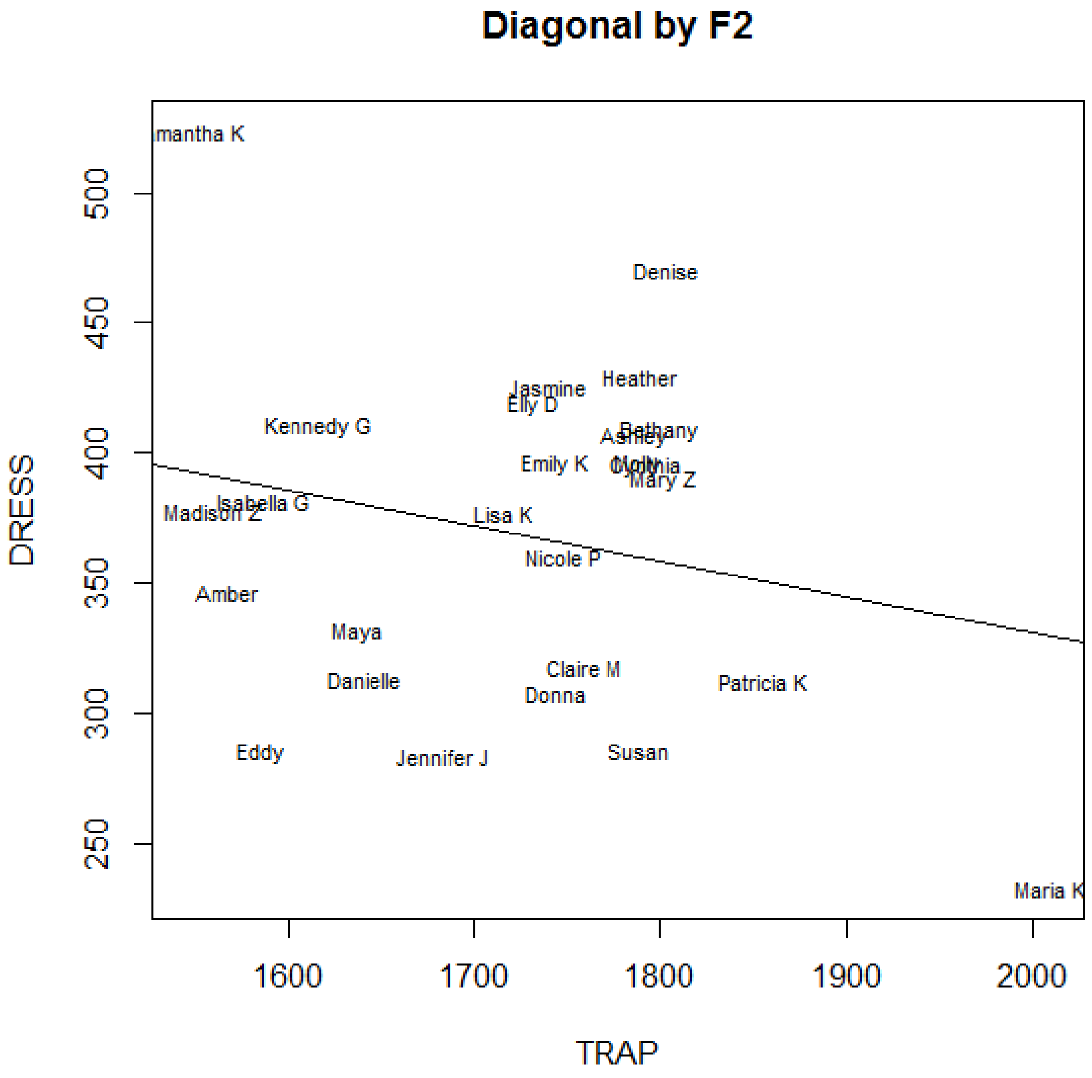
So, there is quantitative and qualitative evidence of a chain shift between TRAP and LOT, but with a fair amount of qualification. To explore that concept more, I will explore whether the retraction of TRAP appears to affect the vowels in front of it. I turn briefly to the short vowels in DRESS and KIT, which are identified as chain shifting down in vowel space in relation to a backing TRAP in a number of dialects (e.g., Eckert 2004; Bigham 2008; Durian 2012). Exploration of potential chain shifts occurring in these vowels will also afford a segue into the study of another merger—that between the conditioned merger of pre-nasal DRESS and KIT.

4.7. Change in Time – DRESS

I will move through my analysis of (non-pre-nasal) DRESS relatively quickly, focusing primarily on its production among women. I will also skip the close phonetic conditioning analysis given to THOUGHT, LOT, and TRAP. This may be an unfortunate choice. If a chain shift is underway in Kansas City, the analysis above suggests: in Step 1, LOT raised to the position of THOUGHT in F1, and this happened before 1955; in Step 2, LOT backed toward THOUGHT in F2; in Step 3, LOT's backing and caused TRAP to retract, and this became a vigorous change in the last quarter of the twentieth century; in Step 4 (if there is one), DRESS and/or KIT might undergo retraction, and the timeline would suggest that such change could be incipient among the youngest interviewees.

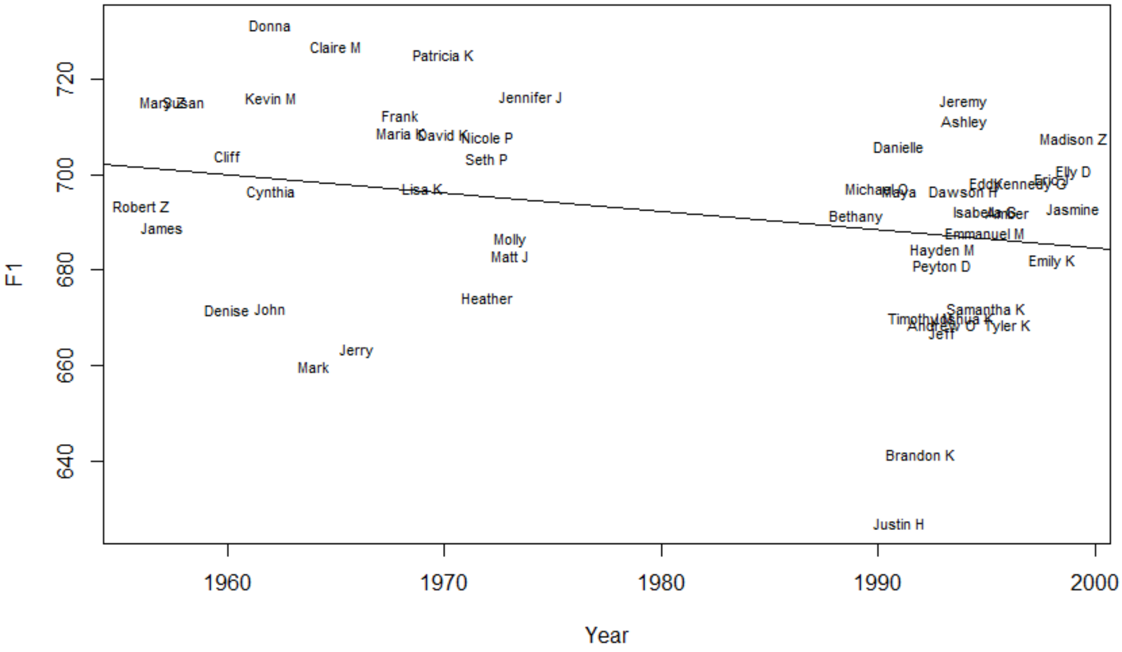
As a potentially new change, DRESS could be more sensitive to phonetic conditioning than would be vowels in more advanced changes. Ignoring close analysis may overlook the opportunity to discover the first movements in a new change. With that caveat in mind, though, the data for DRESS don't suggest much potential to observe a change occurring in DRESS among interviewees in this study in ways that would be relevant to a potential chain shift. Figure 4.16 attempts to create the best possible conditions to observe DRESS retracting as a result of a chain shift with TRAP's retraction: it is limited to casual speech among females, and correlates TRAP F2 against the diagonal measure of DRESS {F2 - 2 * F1}, which would capture retraction either by backing or lowering (or both). Vowels with following nasals, /l/, and /r/ are excluded.

Figure 4.16. Linear model of DRESS diagonal measurement against TRAP F2 in casual speech among females by birth year



The model returns no significant correlations ($R^2 = 0.05076$, $p = 0.2685$). Models for DRESS F1 and F2 also reveal no significant structural correlations between TRAP retraction and DRESS's position. Similarly, models for DRESS as a change in apparent time show no significant patterns emerging. Figure 4.17 shows the model that comes nearest to statistical significance, which is DRESS F1 (following nasal, /l/, and /r/ are excluded) for all interview speech by interviewee birth year.

Figure 4.17. Linear model of DRESS F1 by birth year



This model is not quite significant ($p = 0.05108$) and has an R^2 of just 0.057. More importantly, though, it predicts raising of 4 Hz per decade—a movement in the opposite direction from the one that would indicate a chain shift with TRAP.

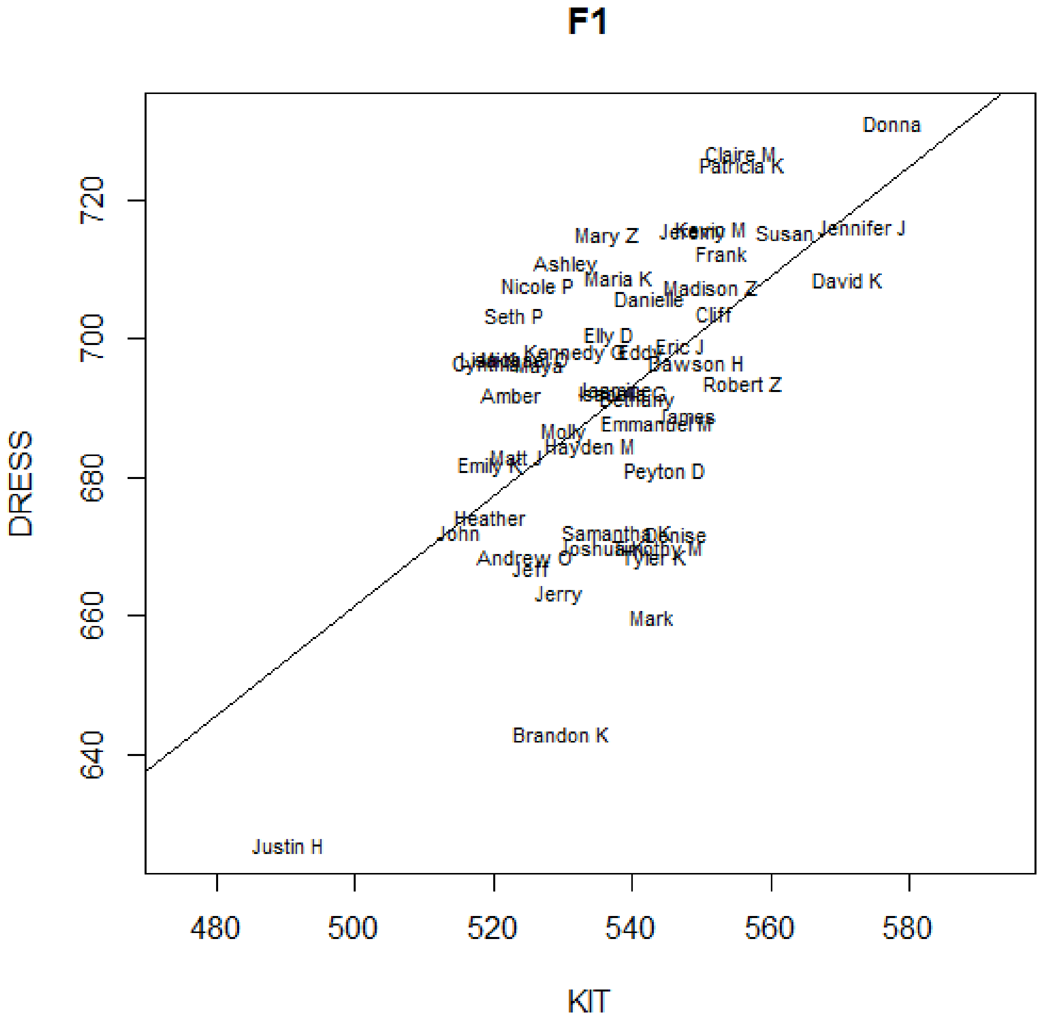
Figure 4.17 also does not suggest any obvious social stratification for DRESS productions, and no clear patterns emerge for linear models according to prestige score or

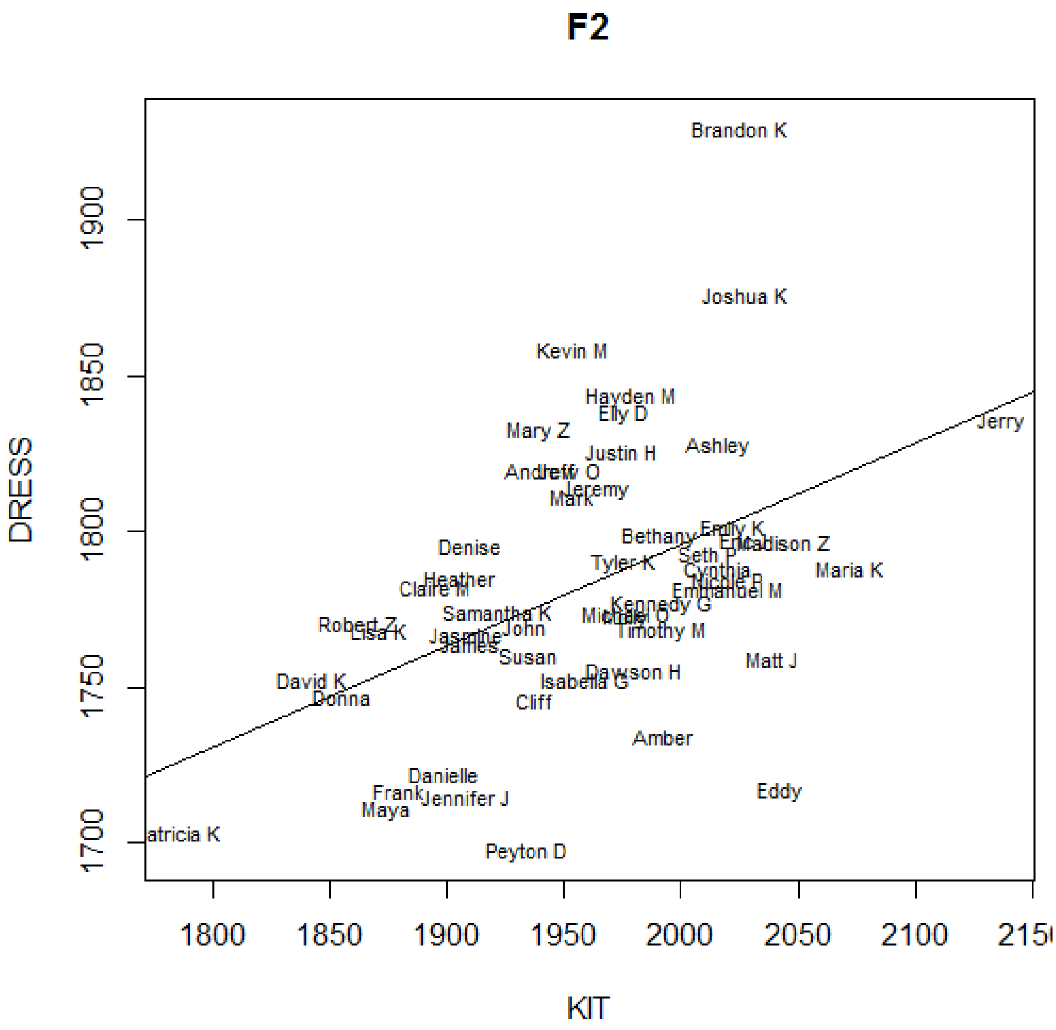
SEI score. In other words, while this cursory examination may gloss over subtle changes that may reveal themselves as important in the future, nothing stands out to motivate looking more closely at DRESS in this data with regard to a chain shift in Kansas City.

4.8. Change in Time – KIT

As with DRESS, I limit my exploration of non-pre-nasal KIT. Figure 4.18 shows linear models for KIT F1 and F2 in relation to DRESS F1 and F2.

Figure 4.18. Linear models of KIT and DRESS F1 and F2

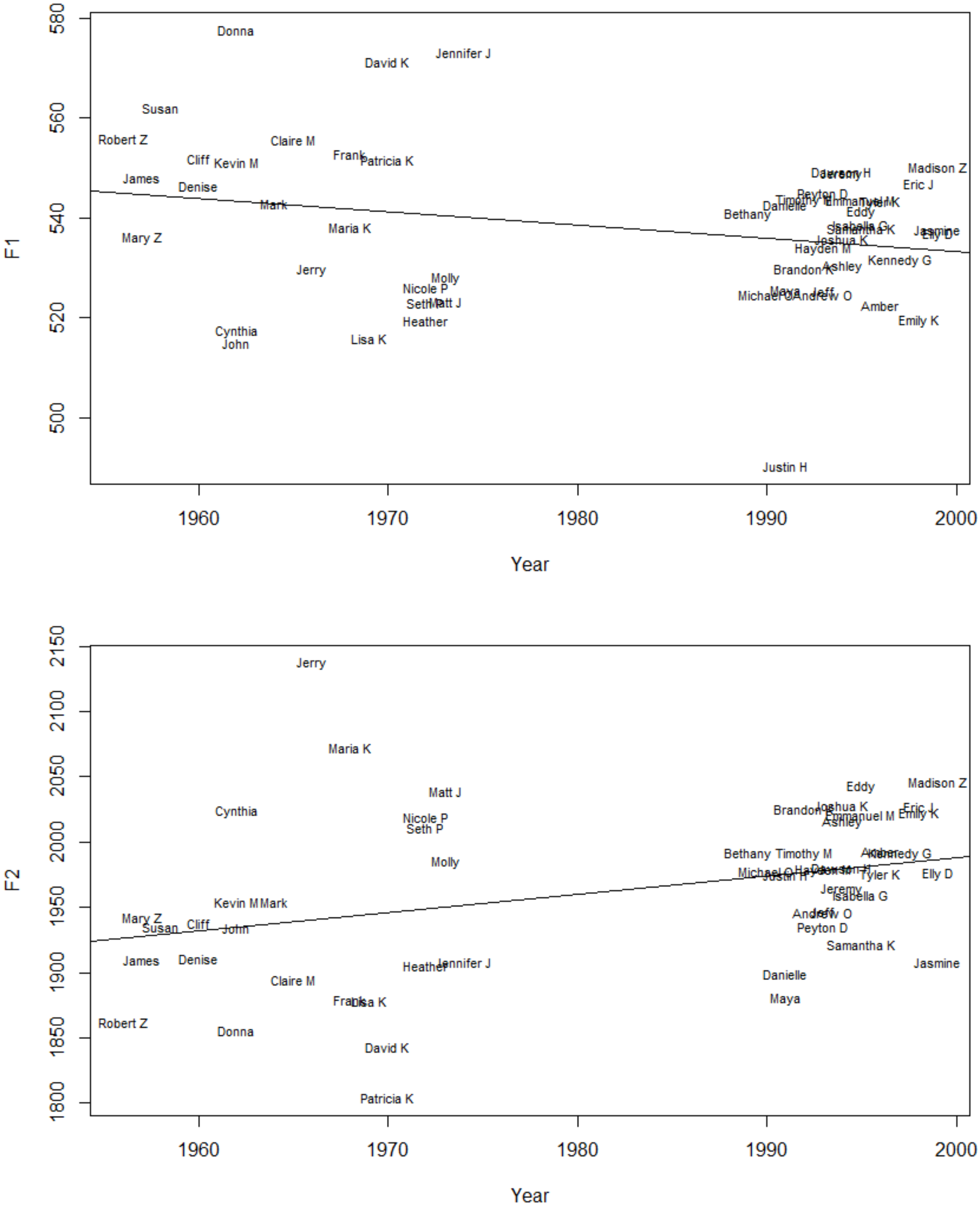




These models suggest a structural relationship between KIT and DRESS in both F1 ($R^2 = 0.3480$, $p < 0.001$) and F2 ($R^2 = 0.2046$, $p < 0.001$). Since DRESS appears to be stable, this suggests that KIT is also stable.

Figure 4.19 checks KIT F1 and F2 as a correlation with interviewee birth year. The model for F2 actually does return a significant result ($R^2 = 0.09041$, $p = 0.0182$), predicting KIT fronting at 14 Hz per decade. This is again the opposite direction from that of the proposed chain shift. KIT also does not pattern in relationship to TRAP backing (i.e., the KIT diagonal measurement does not show any correlation with TRAP F2).

Figure 4.19. Linear models of KIT F1 and F2 by birth year



While this exploration of KIT is again cursory, the results suggest no motivation for pursuing continued signs of a chain shift with TRAP. The front short vowels, DRESS and KIT, appear to be quite stable in Kansas City.

At least that's the case in non-pre-nasal (and non-pre-liquid) environments. The next section examines the possibility of conditioned merger between them.

4.9. Change in Time – PEN and PIN

Lusk (1976:75) notes DRESS raising to the position of KIT in pre-nasal environments among "low-status" speakers in Kansas City—in fact, in her study, all low-status informants raise pre-nasal DRESS. She seems to be describing the development of the conditioned merger between pre-nasal DRESS (PEN) and pre-nasal KIT (PIN) in Kansas City. Labov, Ash, and Boberg (2006:68) show the PIN-PEN merger as widespread throughout the South, but also very advanced in Kansas City, with all informants either merged or close.

I will limit exploration to DRESS and KIT with a following /m/ or /n/. KIT with following /ŋ/ is known in many dialects (e.g., Eckert 2004; Bigham 2008) to tense to an [i]-like position and seems to do so in Kansas City, so it is unlikely to be subject to merger with PEN.

Figure 4.20 models Euclidean distances and Pillai scores by interviewee birth year. Table 4.15 provides the outputs from the two models. The models reveal no progress toward the PIN-PEN merger in apparent time in Kansas City. A closer analysis of the distribution of names affords a slightly more nuanced perspective: in particular, among younger interviewees, males tend to show lower separations between PIN and

PEN than do females. Dawson H and Peyton D, for example, appear to have very small measurements in both Euclidean distance and Pillai score.

Figure 4.20. Linear models of Euclidean distances and Pillai scores for PEN and PIN by interviewee birth year

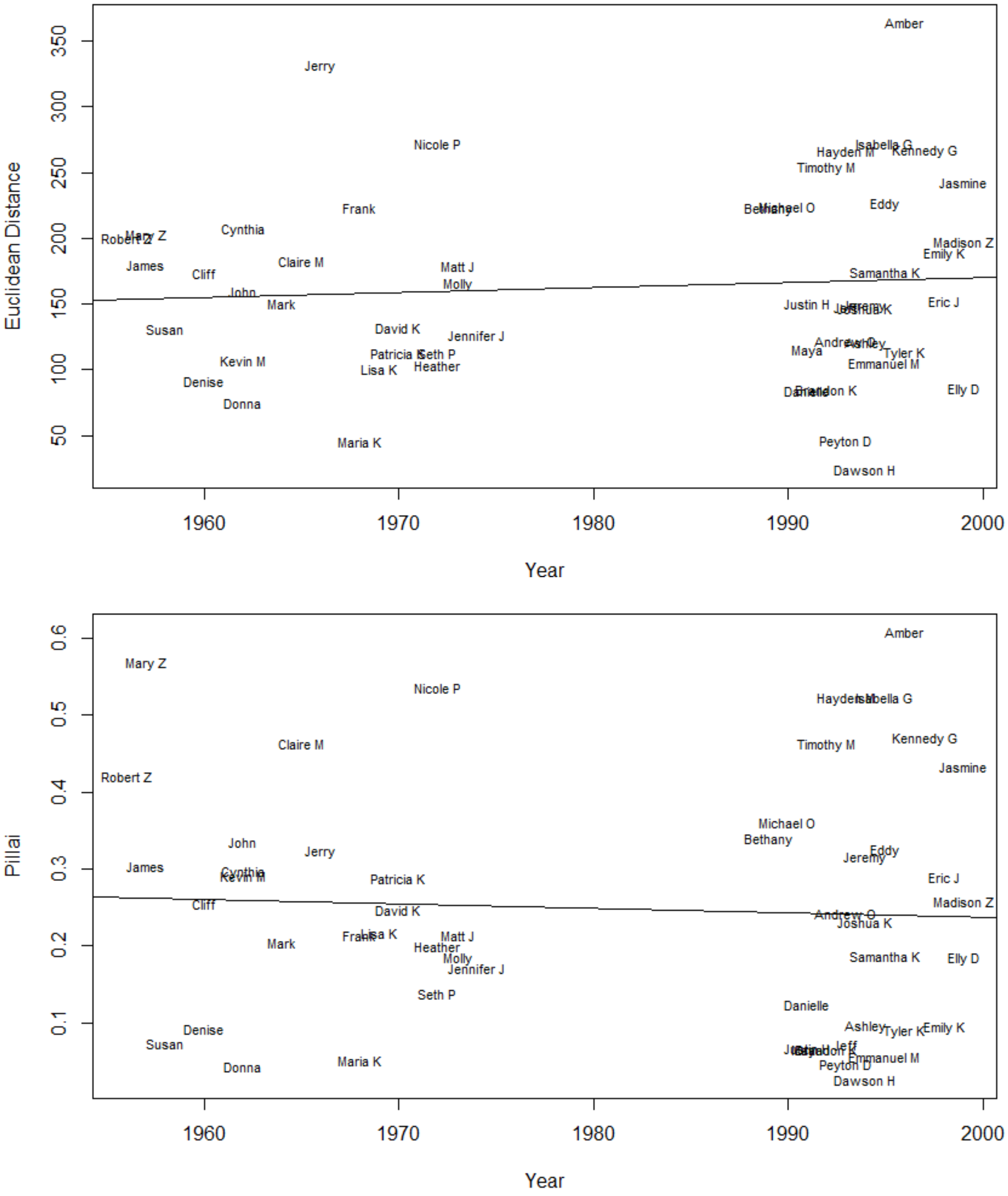


Table 4.15. Linear models of Euclidean distances and Pillai scores for PEN and PIN by interviewee birth year

<table>
<tr><th></th><th>Estimate</th><th>Std. Error</th><th><i>t</i> value</th><th>Pr(>|t|)</th></tr>
<tr><td>Euclidean distance
(Intercept)</td><td>-579.9085</td><td>1341.6498</td><td>-0.432</td><td>0.667</td></tr>
<tr><td>Year</td><td>0.3750</td><td>0.6773</td><td>0.554</td><td>0.582</td></tr>
<tr><td colspan="5">Residual standard error: 72.7 on 49 degrees of freedom
Multiple R-squared: 0.006218, Adjusted R-squared: -0.01406
<i>F</i>-statistic: 0.3066 on 1 and 49 DF, <i>p</i>-value: 0.5823</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Pillai score (Intercept)</td><td>1.3568582</td><td>2.9364023</td><td>0.462</td><td>0.646</td></tr>
<tr><td>Year</td><td>-0.0005596</td><td>0.0014824</td><td>-0.377</td><td>0.707</td></tr>
<tr><td colspan="5">Residual standard error: 0.1591 on 49 degrees of freedom
Multiple R-squared: 0.0029, Adjusted R-squared: -0.01745
<i>F</i>-statistic: 0.1425 on 1 and 49 DF, <i>p</i>-value: 0.7074</td></tr>
</table>

Two minimal pairs included in the MP portion of the interview afford explorations of the PIN-PEN merger against interviewee perceptions of the vowels: *pin-pen* and *gym-gem*. Figure 4.21 plots interviewee judgments of these two pairs by age group. While Figure 4.21 confirms that many Kansas Citians are PIN-PEN merged, it also suggests that the number of merged Kansas Citians is not changing much as a result of time. Certainly, more young interviewees perceive the two minimal pairs as same than did the older group of interviewees, but the increase is relatively slight.

Figure 4.22 graphs my impressionistic judgments of interviewee minimal pairs, and shows basically the same trend. Especially in the case of the pair *pin-pen,* Only slightly more younger interviewees are merged compared with the older group.

Figure 4.21. Interviewee judgments of minimal pairs of *pin-pen* and *gym-gem* by age group

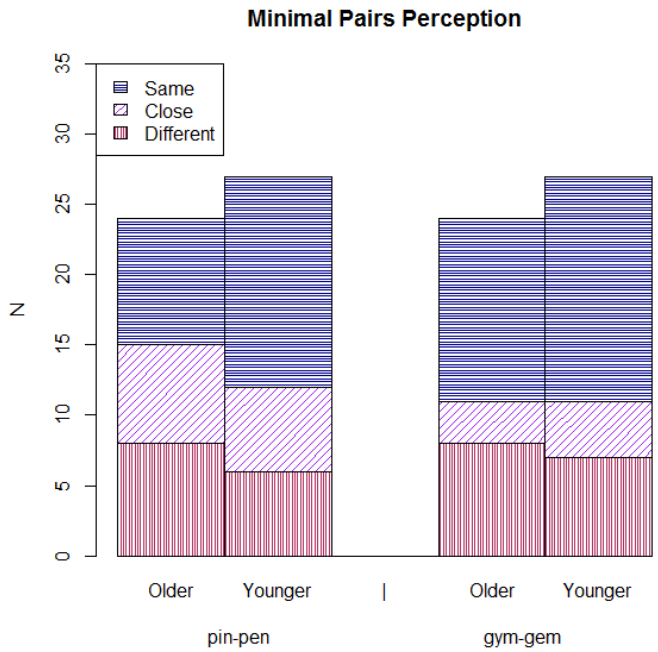
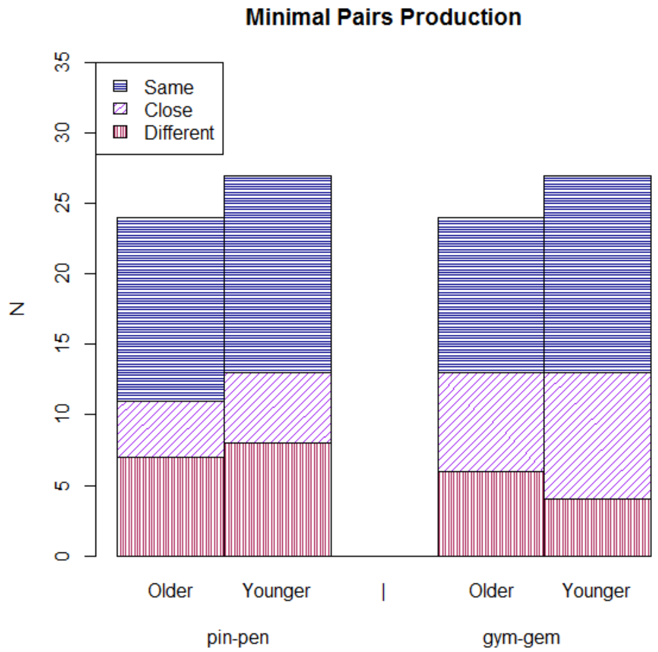
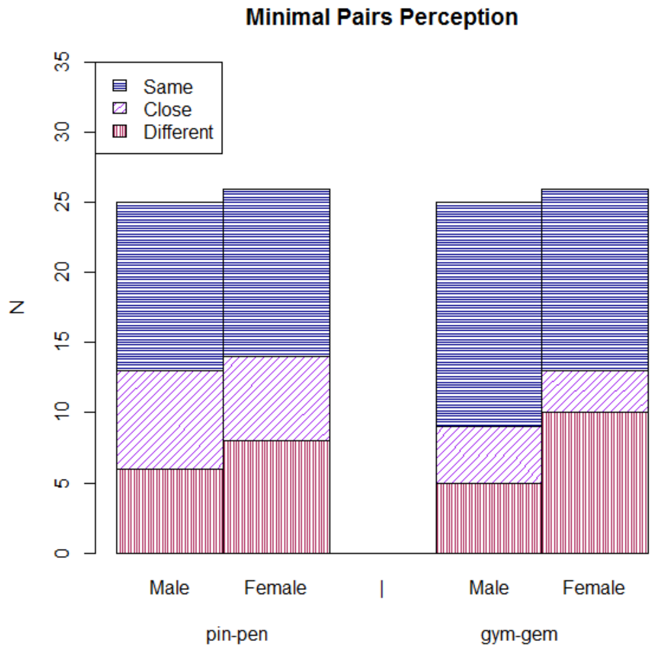


Figure 4.22. Interviewee productions of minimal pairs of *pin-pen* and *gym-gem* by age group



These perception and production results for the minimal pairs reflect the basically flat lines in Figure 4.20 that suggested that the relative positions of PIN and PEN were not changing as a function of time. Figures 4.23 and 4.24 reproduce the graphs of perception and production results for the minimal pairs, this time divided by gender.

Figure 4.23. Interviewee perceptions of minimal pairs of pin-pen and gym-gem by sex



These figures suggest a male lead in the condition merger of PIN and PEN. While interviewee perception results are basically the same for males and females in the case of *pin-pen*, males are more likely than females to indicate that *gym* and *gem* sound the same. In my impressionistic judgments, in both pairs I judged more males than females as same. In *gym-gem*, I judged sixteen males as the same compared with nine females. Females showed even more resistance to the pair *pin-pen*, for which I rated ten females as different. Perhaps because of lexical frequency (*pin* and *pen* are presumably more commonly encountered words than *gym* and *gem*), *pin-pen* seemed to draw especial resistance to merger among females.

Figure 4.24. Interviewee productions of minimal pairs of *pin-pen* and *gym-gem* by sex

Figures 4.25 and 4.26 split minimal pairs perception and production responses along class lines. In all cases, transitional class interviewees appear to lead in the PIN-PEN merger, followed by working class, followed by middle class. This suggests a lead among speakers in the most interior socioeconomic group examined in this study.

Responses and ratings from MP speech present a picture of the PIN-PEN merger as much more static than the LOT-THOUGHT merger. Most importantly, the PIN-PEN merger does not appear to be advancing in apparent time. It also appears that males participate in the merger more than females, and that transitional and working class

Figure 4.25. Interviewee perceptions of minimal pairs of *pin-pen* and *gym-gem* by class

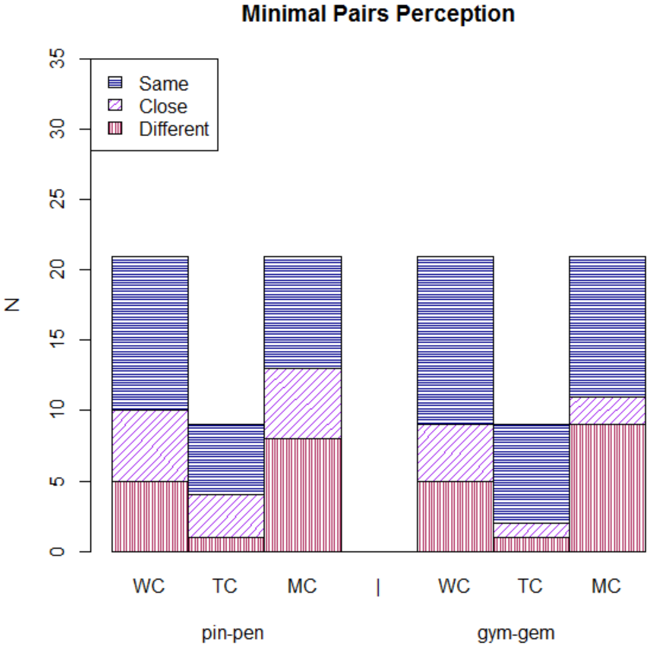
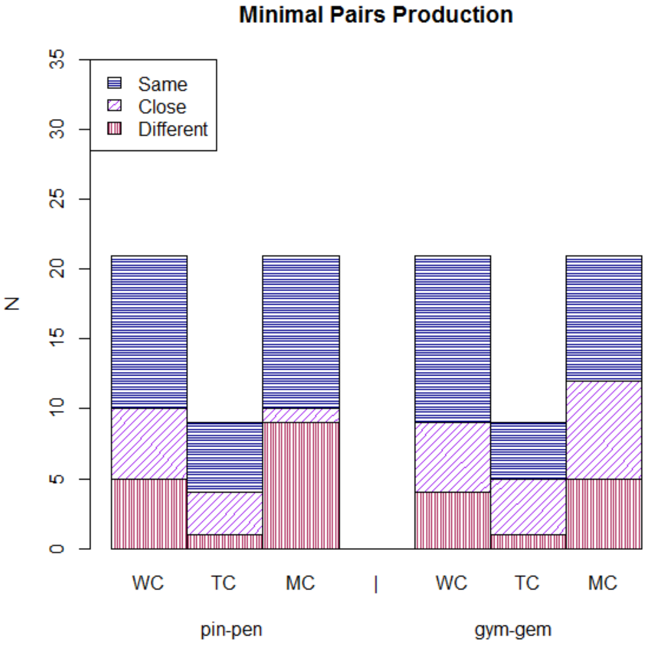


Figure 4.26. Interviewee productions of minimal pairs of *pin-pen* and *gym-gem* by class



speakers participate more than middle class speakers. The presumably less common pair *gym-gem* appears to be more subject to merger than the more common pair *pin-pen*.

Table 4.16 draws on minimal pairs perceptions and productions to understand the acoustic correlates of PIN and PEN with their merger. It provides mean values for PIN and PEN and Euclidean distances and Pillai scores according to interviewees who rated the minimal pair *pin-pen* as the same, close, or different.

Table 4.16. Distances between PIN and PEN by perception and production of *pin-pen* minimal pair

pin-pen		PIN	PEN	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Perception Same (24)	F1	598.2	643.4	114.09	-11.024	< 0.001	0.11263	< 0.001
	F2	2001.9	1897.1		9.1359	< 0.001		
Perception Close (13)	F1	575.3	659.8	193.88	-15.908	< 0.001	0.27369	< 0.001
	F2	2046.9	1872.4		11.5984	< 0.001		
Perception Different (14)	F1	581.1	685.3	227.09	-26.116	< 0.001	0.37849	< 0.001
	F2	2036.7	1834.9		17.8147	< 0.001		
Production Same (27)	F1	592.4	644.1	132.02	-13.674	< 0.001	0.14436	< 0.001
	F2	2028.5	1907.1		11.327	< 0.001		
Production Close (9)	F1	586.5	654.1	148.45	-10.352	< 0.001	0.17888	< 0.001
	F2	2004.2	1872.0		6.9504	< 0.001		
Production Different (15)	F1	578.1	687.1	238.27	-27.841	< 0.001	0.40952	< 0.001
	F2	2035.4	1823.6		19.3599	< 0.001		

Compared with similar sets of calculations for LOT and THOUGHT in pre-/n/, -/l/, and -/t/ contexts, the PIN-PEN merger patterns much more neatly according to the phonemic status of the vowels for interviewees. Interviewees who perceive *pin* and *pen* as the same show closer productions of PIN and PEN in interview speech than do interviewees who judge the pair as close. They, in turn, show closer productions than do interviewees who judge the pair as different. Production shows the same patterning.

Acoustically, speakers who are PIN-PEN merged produce PEN higher and fronter, and also show productions of PIN that are backer or lower.

4.10. Stylistic Variation – PEN and PIN

This section explores PIN and PEN by interview task, with speakers grouped according to those who claim *pin* and *pen* sound the same versus those who claim they sound close or different. Tables 4.17 and 4.18 show lmer analyses for mean productions according to interview task.

Table 4.17. Mixed effects regressions of F1 and F2 of PEN and PIN by style among interviewees who perceive *pin-pen* as different or close

Fixed Effects	Estimate	Std. Error	*t* value
PIN F1			
styleCS (Intercept)	573.904	6.574	87.30
styleRP	17.696	7.249	2.44
styleWL	9.414	13.070	0.72
styleMP	-6.813	15.737	-0.43
PIN F2			
styleCS (Intercept)	2026.85	22.02	92.06
styleRP	-29.16	21.70	-1.34
styleWL	70.67	38.51	1.84
styleMP	96.25	45.46	2.12
PEN F1			
styleCS (Intercept)	658.496	7.336	89.76
styleRP	15.435	5.429	2.84
styleWL	-5.958	12.523	-0.48
styleMP	57.399	14.678	3.91
PEN F2			
styleCS (Intercept)	1841.31	16.99	108.41
styleRP	23.69	12.22	1.94
styleWL	39.87	28.60	1.39
styleMP	-10.08	33.67	-0.30

Table 4.18. Mixed effects regressions of F1 and F2 of PEN and PIN by style among interviewees who perceive *pin-pen* as same

Fixed Effects	Estimate	Std. Error	*t* value
PIN F1			
styleCS (Intercept)	584.792	8.960	65.27
styleRP	31.595	8.164	3.87
styleWL	14.774	14.542	1.02
styleMP	31.592	18.570	1.70
PIN F2			
styleCS (Intercept)	1985.03	25.22	78.72
styleRP	19.17	22.19	0.86
styleWL	88.47	38.97	2.27
styleMP	46.02	48.37	0.95
PEN F1			
styleCS (Intercept)	629.684	6.702	93.96
styleRP	10.021	5.923	1.69
styleWL	-2.399	12.343	-0.19
styleMP	23.921	15.567	1.54
PEN F2			
styleCS (Intercept)	1894.22	21.34	88.78
styleRP	37.54	16.41	2.29
styleWL	143.54	34.08	4.21
styleMP	73.81	43.52	1.70

For perceptually merged interviewees, more formal interview tasks appear to correlate with lower, fronter productions of both vowels (though there is not an obvious progression, e.g., from CS to MP). Perceptually distinct interviewees, by contrast, appear to increase the relative distance between PIN and PEN as attention to speech increases. Their PIN F2 increases, emphasizing the frontness of that vowel, and their PEN F1 increases, resulting in relative lowering for that vowel.

Table 4.19 compares PEN and PIN by Euclidean distance and Pillai score as a function of interview task by MP judgments. Generally, the patterns observed in Tables

4.17 and 4.18 hold for calculations of Euclidean distance and Pillai scores in Table 4.19. In particular, interviewees who claim to perceive a difference between *pin* and *pen* greatly increase distances between the classes in MP. Interviewees who are perceptually merged are included for comparison, and they maintain basically the same distances across interview tasks.

Table 4.19. Distances between PIN and PEN by style according to perception judgments

		PIN	PEN	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
pin-pen different or close								
styleCS	F1	569.3	667.8	235.66	-25.587	< 0.001	0.3721	< 0.001
	F2	2043.6	1829.5		19.0199	< 0.001		
styleRP	F1	604.6	680.9	151.45	-10.595	< 0.001	0.18491	< 0.001
	F2	1985.7	1854.8		6.3191	< 0.001		
styleWL	F1	607.7	694.0	154.63	-6.369	< 0.001	0.26309	< 0.001
	F2	2093.6	1965.3		3.9675	< 0.001		
styleMP	F1	585.9	721.4	236.17	-10.370	< 0.001	0.50596	0.05684
	F2	2126.2	1932.7		6.051	< 0.001		
pin-pen same								
styleCS	F1	575.9	638.6	129.88	-10.973	< 0.001	0.16498	< 0.001
	F2	1984.5	1870.8		6.5965	< 0.001		
styleRP	F1	625.2	643.8	99.19	2.6252	0.00913	0.051444	< 0.001
	F2	1995.3	1897.9		5.229	< 0.001		
styleWL	F1	628.2	659.9	84.11	-2.8514	0.00535	0.12209	0.00115
	F2	2086.3	2008.4		2.5852	0.01159		
styleMP	F1	627.8	660.7	82.40	-2.4348	0.01706	0.12902	0.00263
	F2	2050.8	1975.3		3.1592	0.00218		

These measurements suggest that Kansas Citians who perceive a difference between PIN and PEN emphasize that difference when paying close attention to speech. The shift from RP and WL to MP brings with it a substantial increase in Euclidean distance and Pillai score between productions. On the other hand, the distances in RP are very similar to those in MP for interviewees who perceive a PIN-PEN distinction. This could be a result of phonetic conditioning on tokens in RP, or simply suggest that speakers who maintain a PIN-PEN distinction indeed maintain a firm distinction.

4.11. Social Factors – PEN and PIN

Table 4.20 shows ANOVA models of PIN-PEN Euclidean distances and Pillai scores by the factors of gender and class. Because separations between the vowel classes are calculated for each speaker, meaning that differences in the numbers of tokens speakers contribute will not throw off averages, the ANOVA can be calculated from a fixed effects model and generate significance scores.

Table 4.20. ANOVA model of PIN-PEN distances by sex and class

Factor	Df	Sum Sq	Mean Sq	*F* value	Pr(>|t|)
Euclidean Distance					
Sex	1	1484	1483.8	0.3010	0.5860
Class	2	17835	8917.6	1.8088	0.1756
Sex:Class	2	19458	9729.0	1.9734	0.1508
Residuals	45	221849	4930.0		
Pillai Score					
Sex	1	0.01423	0.014233	0.7224	0.399853
Class	2	0.26158	0.130788	6.6381	0.002977
Sex:Class	2	0.08186	0.040932	2.0775	0.137092
Residuals	45	0.88662	0.019703		

The ANOVA models suggest that class strongly accounts for Pillai scores. Reflective of the perception and production results in minimal pairs tests, which showed TC interviewees to be most merged, TC interviewees as a social class have a PIN-PEN Pillai score of just 0.14769 ($p < 0.001$). WC interviewees' Pillai score is just larger at

0.15987 ($p < 0.001$). MC interviewees' Pillai score is more than twice as large at 0.35447 ($p < 0.001$).

Mixed effects regression means in Table 4.21 suggest that TC interviewees produce PIN lower and backer than other classes, and PEN higher and fronter relative to

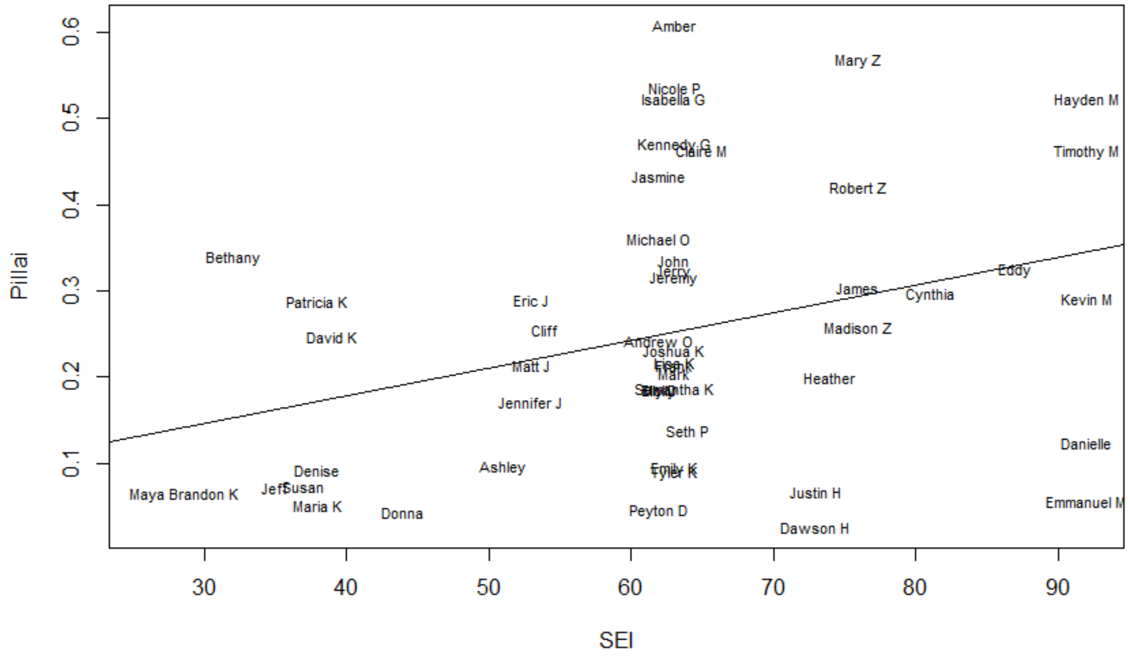
Table 4.21. Mixed effects regressions of F1 and F2 of PIN and PEN by sex and class

Fixed Effects	Estimate	Std. Error	*t* value
PIN F1			
sexFemale (Intercept)	585.650	6.689	87.55
sexMale	-7.955	6.230	-1.28
classMC (Intercept)	578.307	6.857	84.34
classTC	12.769	8.319	1.53
classWC	3.285	6.910	0.48
PIN F2			
sexFemale (Intercept)	1988.86	20.24	98.28
sexMale	73.75	21.23	3.4
classMC (Intercept)	2017.75	22.39	90.12
classTC	-17.48	31.91	-0.55
classWC	24.93	25.99	0.96
PEN F1			
sexFemale (Intercept)	659.737	6.545	100.80
sexMale	-23.750	8.142	-2.92
classMC (Intercept)	659.826	7.269	90.77
classTC	-18.648	11.859	-1.57
classWC	-20.794	9.364	-2.22
PEN F2			
sexFemale (Intercept)	1838.76	15.49	118.73
sexMale	64.47	15.57	4.14
classMC (Intercept)	1854.306	17.436	106.35
classTC	9.907	24.631	0.40
classWC	35.301	19.548	1.81

MC interviewees. Such productions would push the vowels closer together in acoustic space (the TC Euclidean distance based on mixed effects means is 145 Hz, compared with 183 Hz for MC). WC interviewees produce PIN fronter than other classes, but also raise and front PEN more than other classes. This has the effect of making WC interviewees' PIN-PEN classes closer than they are for MC interviewees (WC Euclidean distance based on mixed effects means is 163 Hz), but not as close as TC interviewees.

Figure 4.27 plots a linear model of Pillai scores according to interviewee SEI scores. (The model for prestige scores does not reach statistical significance.) As noted in Chapter 2, SEI and impressionistic social class codings are not measuring social class in exactly the same ways, but SEI gives an objective measure that is much more finely gradable than is my three-way class division.

Figure 4.27. Linear model of PIN-PEN Pillai scores by SEI



While there is a great amount of variance in Figure 4.27, the model does show some small explanatory power from a statistical sense ($R^2 = 0.09925$, $p = 0.0139$). It predicts that Pillai scores will increase by 0.003 for every one-point increase in SEI. Probably the more striking observation is that an SEI of 60 appears to mark off a border. To the left of it, interviewee Pillai scores are in the lower range of observed values. To the right of it, interviewees range across the full continuum of Pillai scores.

This discussion of class as an interaction with the PIN-PEN merger does not present straightforward solutions, but does point in the direction of a correlation between the merger and social class. Probably, this is best described as a middle class resistance to the merger.

The ANOVA in Table 4.20 does not suggest that sex will offer additional explanatory value, but observations of interviewee Pillai scores and Euclidean distances, as well as results from minimal pairs tests, indicate that the factor of sex may at least be worth exploring. In particular, the distribution of names among younger interviewees in Figure 4.20 suggests that males may lead that age group in the spread of the PIN-PEN merger.

Figure 4.28 reproduces the Pillai scores in of Figure 4.20 for males only. (The model for Euclidean distances is very similar—I use Pillai here for consistency with discussion in this section.) The model is not significant ($p = 0.1307$) and would only account for a small amount of the data ($R^2 = 0.05722$) if it were. There is an interesting change, though, in the distribution of values between older and younger interviewees. Older interviewees appear to show a steady progression toward smaller Pillai scores. The older males are modeled in Figure 4.29.

Figure 4.28. Linear model of PIN-PEN Pillai scores for males by birth year

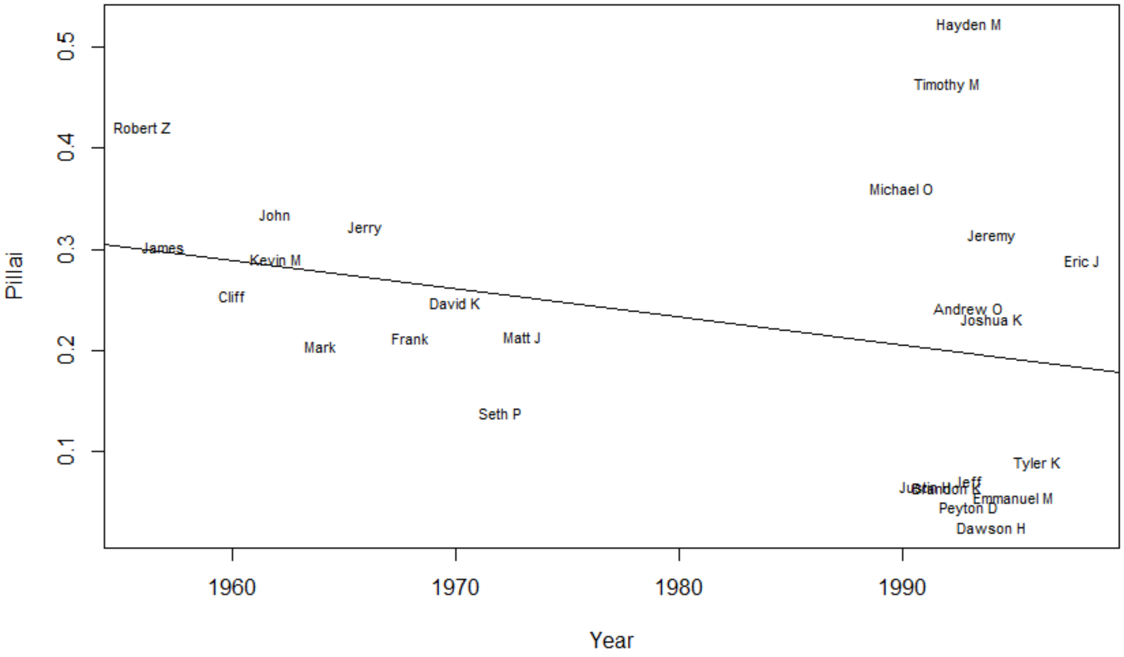
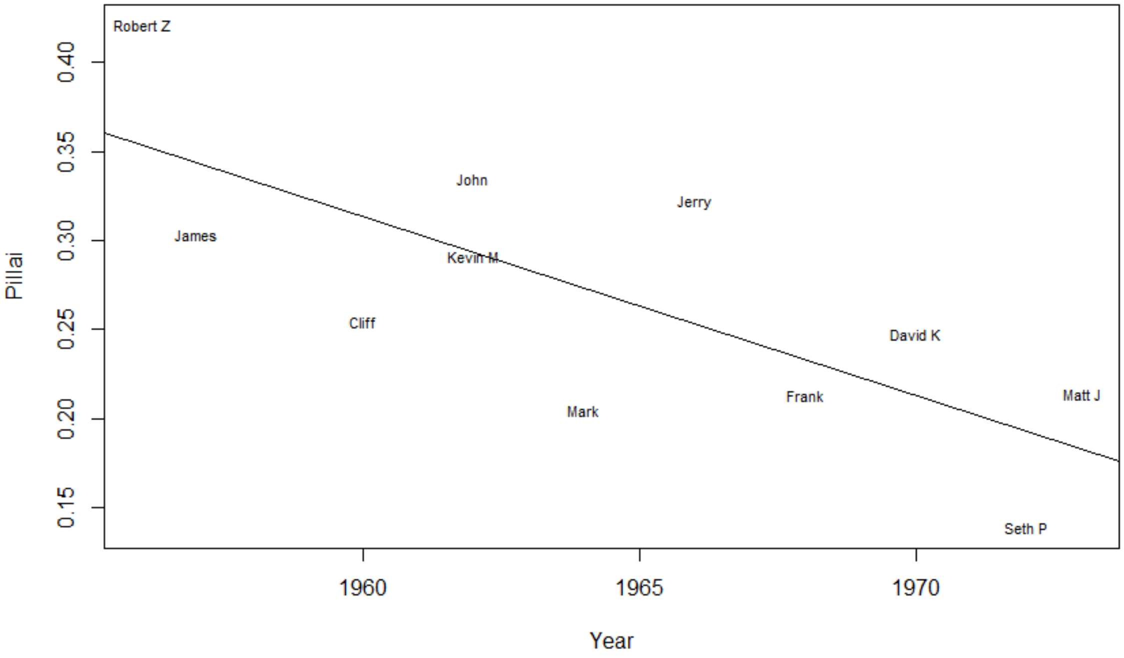


Figure 4.29. Linear model of PIN-PEN Pillai scores for males born 1955-1975

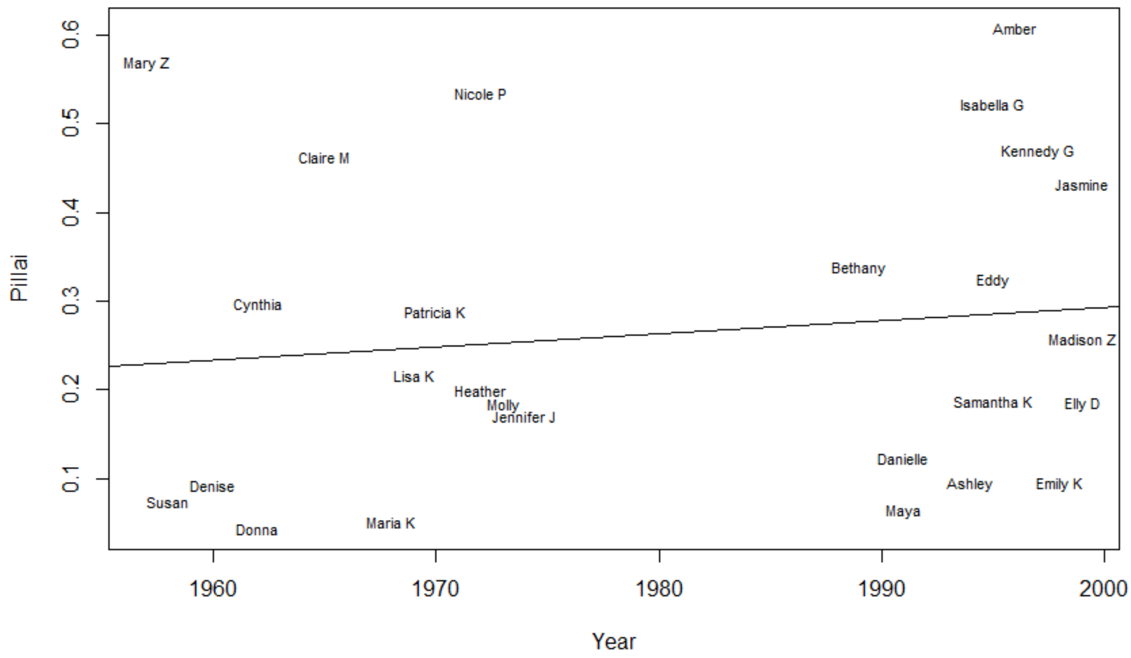


The model in Figure 4.29 shows a dramatic change in time toward the merger. It has high explanatory power with an R^2 of 0.5122 ($p = 0.007985$). The model predicts a decline in Pillai score of 0.10014 every ten years, which would result in a Pillai score of zero in 1991. As Figure 4.28 shows, half the males born in the 1990s appear to have Pillai scores very near zero. The other half, however, maintain larger Pillai scores. These include two brothers from the M Family, Hayden and Timothy (though a third brother, Emmanuel M, is merged), two from the O Family, Andrew and Michael, and one brother from the K family, Joshua (but his two younger brothers, Brandon and Tyler K, both appear merged). They are dispersed across middle class, transitional class, and working class. It is difficult to detect an immediate social explanation, but it appears that participation in the PIN-PEN merger is diverging among younger males.

Figure 4.30 shows the linear model for females' Pillai scores. The flat line through the widely dispersed values in Figure 4.30 has no statistically explanatory value ($R^2 = -0.02377$, $p = 0.5233$). It helps show visually, though, that among the older group of females, those who are most merged tend to be working class, including Denise, Susan, and Maria K. I classify Donna as transitional (see discussion of her in Chapter 3). By contrast, the most distinct women, Claire M, Mary Z, and Nicole, are middle class. This trend is less clear among younger women—though the three highest Pillai scores, Amber, Isabella G, and Kennedy G, are middle class, and among the lower scores, Maya and Emily K are working class and Ashley is transitional.

The interaction between the PIN-PEN merger and gender is, then, not straightforward either. It appears to be the case that the merger was progressing in Kansas City in the period between 1955 and 1975. Among males, the advance of the merger seemed to correlate straightforwardly with an advance in apparent time. Among females, there was not an obvious pattern, with some females showing a wide range of productions of PIN and PEN relative to one another. Among younger males, a divide has developed between males who continued to progress toward complete merger and those who resisted it. Younger females continue to show a broad range of realization and resistance to the PIN-PEN merger.

Figure 4.30. Linear model of PIN-PEN Pillai scores for females

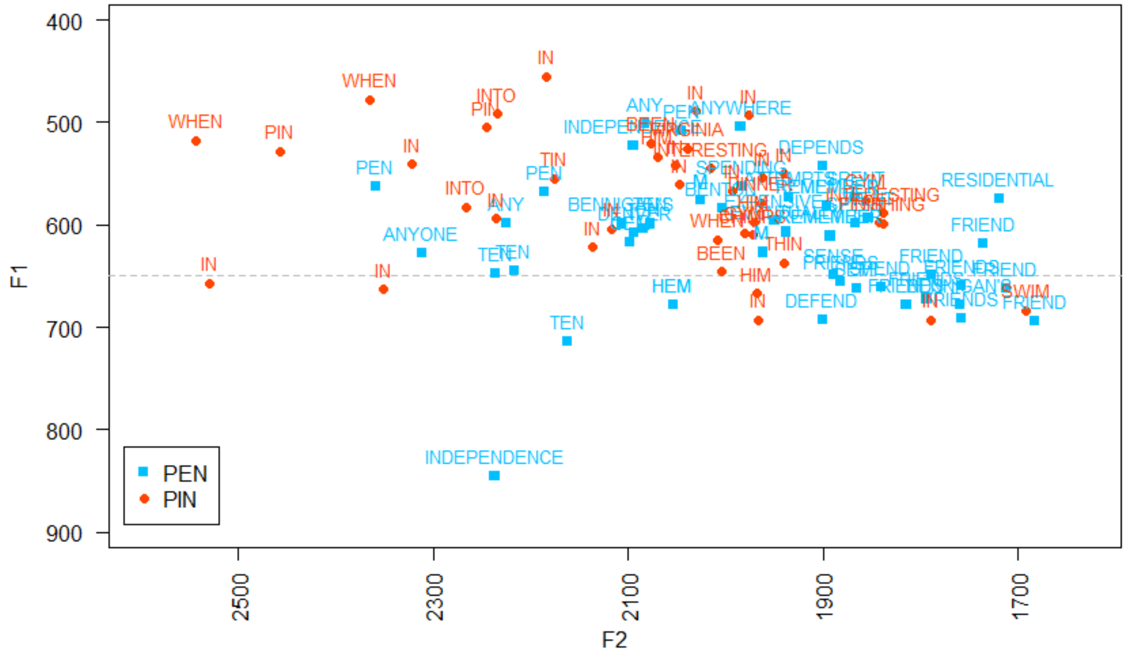


4.12. The Merger of PEN and PIN – Case Studies

Seth P and Nicole P offer useful comparisons of different patterns in PIN and PEN. They are married and had just moved from KCMO to Shawnee, KS at the time I interviewed them. They had moved for access to better schools. Both grew up in a working class neighborhood in KCMO. They dated in high school, went to different colleges, and reconnected in their twenties. They are now middle class. Seth is a home appraiser. Nicole is a corporate writer and editor.

Seth P's PIN and PEN vowels are plotted in Figure 4.31. All styles are included in a single plot.

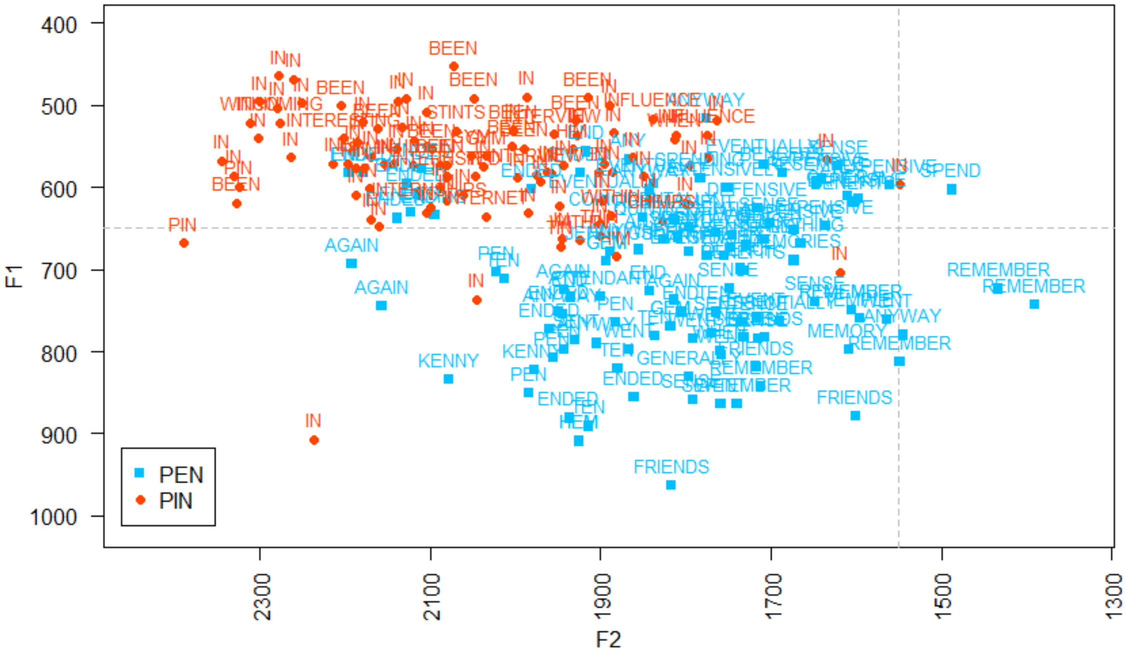
Figure 4.31. Seth P, b. 1972, KCMO – PIN and PEN tokens



He shows a great deal of overlap between the classes, suggesting merger. In casual speech (CS), he maintains a Euclidean distance between PIN of 143 Hz (F1:577 Hz, F2:2069 Hz) and PEN (F1:626 Hz, F2:1935 Hz). His Pillai score is smaller and reflects the merger even more at 0.18617 ($p = 0.003$). In minimal pairs (MP), his Euclidean distance collapses to 46 Hz. This is in part due to his production of *gym* as backer than *gem*. While I impressionistically judged him same on both pairs, for *pin* and *pen* he claimed, "To me they sound different." The hedge of "to me" is noteworthy.

Nicole P maintains a much clearer distinction. Figure 4.32 shows all her tokens of PIN and PEN, which certainly overlap in some cases, but overall plot much more uniformly as two separate classes.

Figure 4.32. Nicole P, b. 1972, KCMO – PIN and PEN tokens

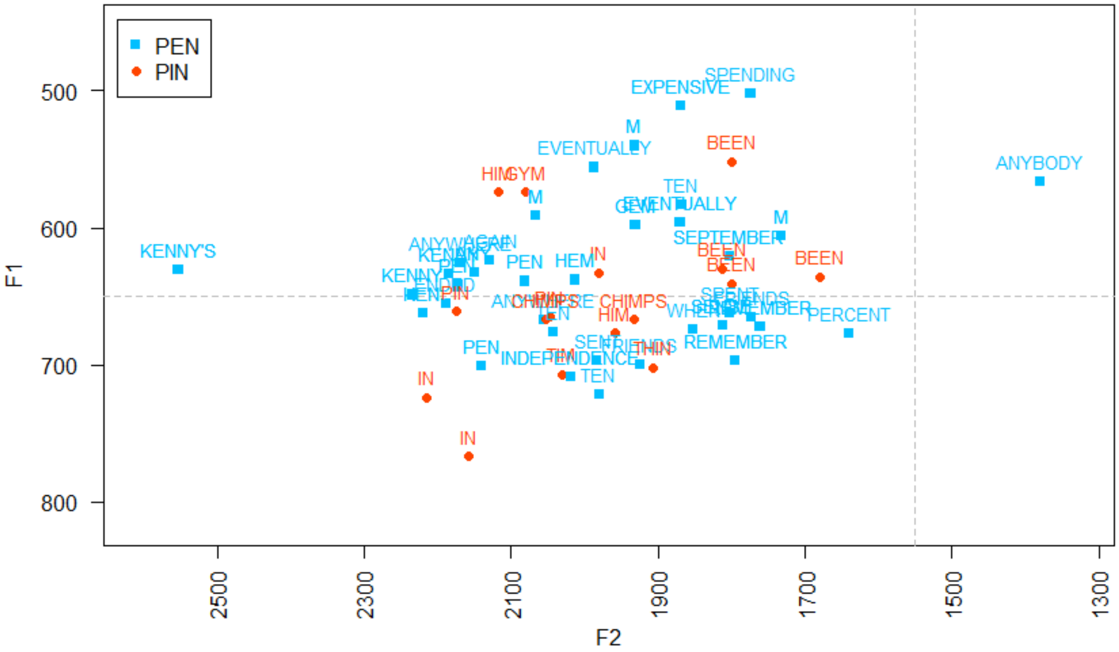


In CS, she shows a large Euclidean distance of 285 Hz, based on PIN at F1:567 Hz, F2:2057 Hz and PEN at F1:700 Hz, F2: 1804 Hz. Her Pillai score is a robust 0.522 ($p <$ 0.001). In MP, her Euclidean distance increases to 349 Hz. She perceives them as different, and they sound different.

Seth and Nicole P display the overall pattern suggested by the data for the merger, which is that among older males the merger was advancing rapidly. It is interesting that Seth seems to misjudge his production of *pin* and *pen* as distinct (at least, compared to my impressionistic coding), because, while Nicole's perception of her PIN-PEN productions is accurate, she misjudged her productions of *cot* and *caught*. In that case, she claimed they were the same, even though there was a slight impressionistic distinction in the direction of the traditional LOT and THOUGHT classes. So, in the case of a mistaken judgment in LOT-THOUGHT, a female is more merged in perception than production. In the case of a mistaken judgment in PIN-PEN, a male is more merged in production than perception.

Dawson H, born in KCMO in 1994, displays the completed conditional merger. He lives in an upscale neighborhood in KCMO and attends private school. His parents both work in management at large companies. Figure 4.33 shows his merged PIN and PEN vowels.

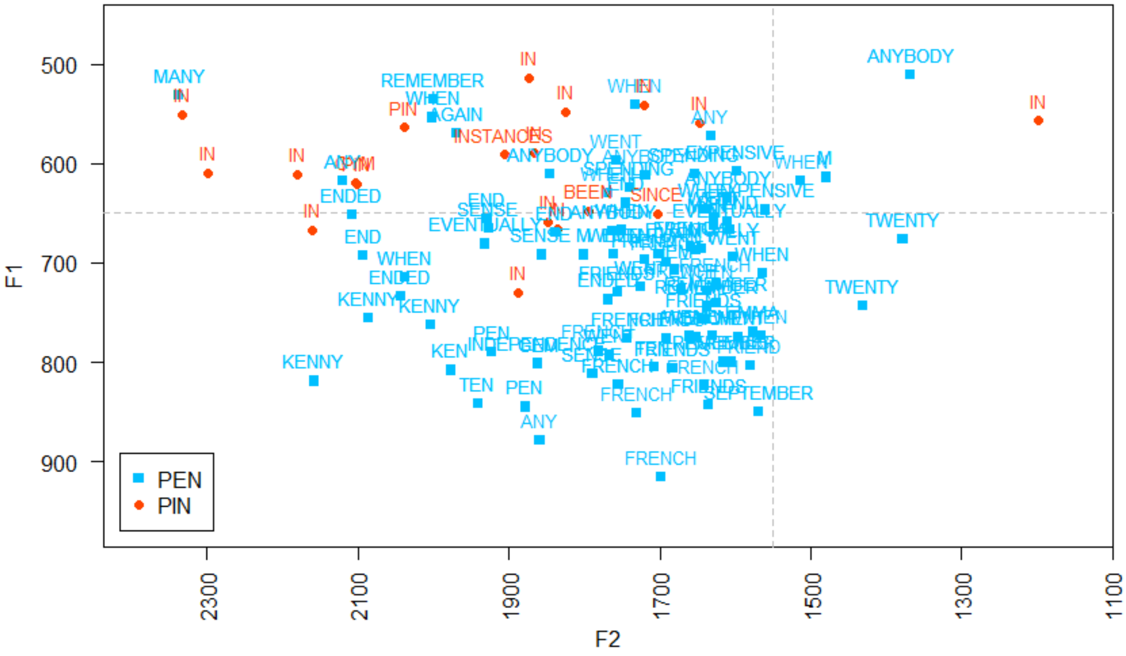
Figure 4.33. Dawson H, b. 1994, KCMO – PIN and PEN tokens



His token counts are somewhat small, especially for PIN words, but the overlap is obvious. For all productions, he shows a Euclidean distance of just 24 Hz and a non-significant Pillai score of 0.025 (*p* = 0.532). He judges both minimal pairs to be the same.

By contrast, Madison Z (who was also discussed with regard to LOT and THOUGHT), born in KCMO in 1999, shows the female maintenance of distinction in Figure 4.34. While she is not the most distinct among young females, I include her because she commented explicitly that it bothered her when people pronounce *pin* and *pen* the same. After reading the minimal pair as different, she said, “I have a friend whose name is *Emma*, and I hear people say [ɪmə]. And it bothers me for some reason.”

Figure 4.34. Madison Z, b. 1999, KCMO – PIN and PEN tokens



Again, her token count for PIN (F1:606 Hz, F2:1871 Hz in CS) is small, and there is obvious overlap with PEN (F1:703 Hz, F2:1714 Hz). But her CS Euclidean distance is fairly large at 185 Hz. Her Pillai score in CS of 0.205 reflects the high degree of overlap ($p < 0.001$). In MP, her Euclidean distance opens to 272 Hz. Correlated with her explicit acknowledgement of merged productions of PIN and PEN, her productions suggest a conscious avoidance of the PIN-PEN merger.

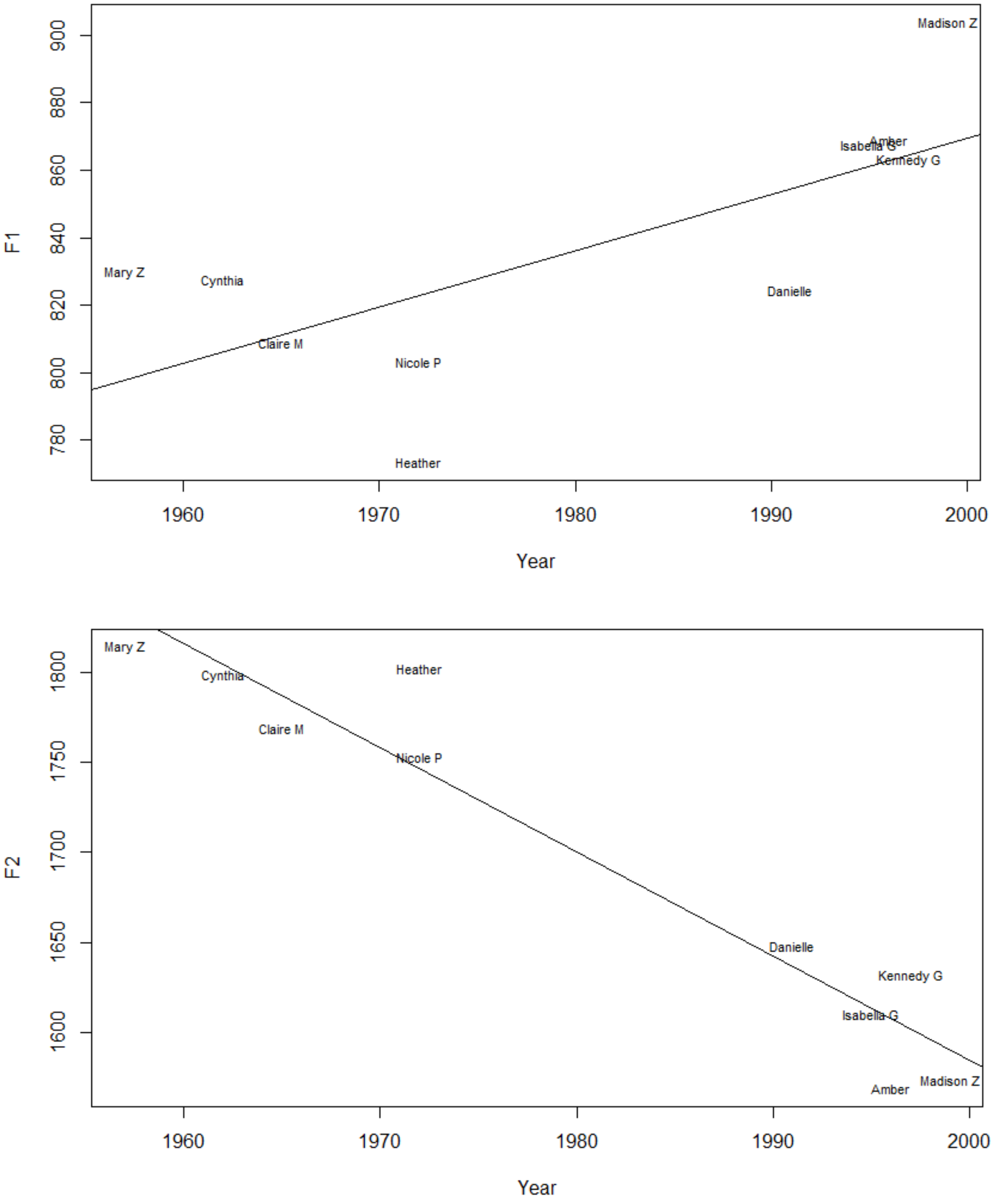
These observations combine to show a very different picture for the PIN-PEN merger in Kansas City from that of the LOT-THOUGHT merger. The latter appears to have progressed rapidly to completion without drawing conscious attention. The former appears to have emerged into some degree of social awareness. While many males have progressed toward completion, women have generally maintained stable ratios of merged-to-distinct speakers over time.

4.13. TRAP – Redux

Anecdotally speaking, as I began presenting preliminary results from this research, I began hearing comments from audiences about the PIN-PEN merger similar to Madison Z's. My general impressions of the commenters were that they were middle-class females, and the tenor of comments was that failing to distinguish between PIN and PEN was indicative of low-status speech. These socially marked comments raise the possibility that the resistance to the PIN-PEN merger among Kansas City females and among some younger males could be a result of social evaluation.

The possibility of a linguistic evaluation connected with middle-class females recalled results for TRAP presented above, in which young middle-class females appear to lead TRAP retraction. To be clear, the PIN-PEN merger should have no structural relationship with TRAP—but there is nothing precluding a coincidence of social evaluations. Figure 4.35 models the apparent time change of TRAP for middle-class females.

Figure 4.35. Linear model of TRAP F1 and F2 among middle-class females by birth year



A highly cohesive model appears that describes an exaggerated version of the overall change that is taking place in Kansas City for TRAP. The model for F1 accounts for nearly 45 percent of observed variation ($R^2 = 0.4473$, $p = 0.02057$), predicting an increase in F1 of 17 Hz per decade. The F2 model accounts for 92 percent of the data ($R^2 = 0.9155$, $p < 0.001$), predicting a decrease in F2 of 58 Hz every ten years. In terms of backing, middle class females are participating in the emerging pattern dramatically and with extreme uniformity.

The same model for F2 among working class women falls just short of statistical significance and accounts for less data ($R^2 = 0.2578$, $p = 0.06354$), predicting a decline of 38 Hz per decade. F1 is worse ($R^2 = 0.1189$, $p = 0.1597$). Working class females trail middle class females, both in their starting point for TRAP and in their rate of backing. However, all females are moving in the direction of retraction. That direction seems to be set by middle-class women.

The same model for middle class males shows them, too, following the lead of middle-class females for TRAP F2. They back TRAP at a rate of 40 Hz per decade ($R^2 = 0.4975$, $p = 0.009202$) (very near the rate of retraction observed among working class women). Working class males, by contrast, show no correlations in TRAP F2, but are lowering TRAP in F1 at a very modest rate of 6 Hz per decade ($R^2 = 0.331$, $p = 0.04777$). This could represent working class males trailing all females (i.e., the first step in retraction is lowering and the second step is backing), or simply observing a different pattern from other groups.

In any case, this reconsideration of previous data for TRAP suggests that the social picture for the change in progress in Kansas City is more nuanced than initially suggested. Specifically, middle-class females appear to lead the change. Similarly, an unrelated innovation, the PIN-PEN merger, is resisted by middle class and female interviewees, and draws some explicit criticism from middle-class females. These two developments appear to hold in common the suggestion that middle class female practices may have especially strong influence in determining the evolution of English in Kansas City.

4.14. TRAP, DRESS, and KIT – Summary

This chapter has covered a tremendous amount of territory among the front short vowels. Starting with the merger of LOT and THOUGHT as a potential effect on the position of TRAP, it identified a robust retraction of TRAP in time—especially in the dimension of backing—that appears to be loosely correlated with the backing of LOT and the low back merger. The change is led, in particular, by middle class females. This chapter also showed that the tensing of pre-nasal TRAP appears to have reached a steady state. It then sought other effects of TRAP retraction among the short vowels, but did not find them—DRESS and KIT do not appear to be undergoing change as a response to TRAP's retraction. (In light of Section 4.12, I re-examined DRESS and KIT specifically for changes among middle-class females, and no new results emerged.) This is not to say that DRESS and KIT won't retract. Different generations may implement this chain shift incrementally, so children born in the 2000s may start initiate the retraction of DRESS and/or KIT. As far as this study is concerned, though, this part of the shift proposed to be operating in many dialects in the United States is not taking place in Kansas City.

This chapter concluded with an examination of the conditioned merger involving two of the front short vowels, pre-nasal DRESS and KIT. The merger does not appear to be progressing, broadly speaking, in Kansas City. While the merger is well established among transitional class interviewees and many working class interviewees, there is anecdotal evidence that it is becoming socially marked. This makes it very different from the low back merger that was the focus of Chapter 3. It will serve as another touchstone for examining a third set of mergers in Chapter 5: the conditioned mergers of back vowels with following /l/.

Chapter 5 will draw on the observations of this chapter to shift exploration from the front portion of vowel space to the back. Its starting point will be the backing of TRAP, which potentially carries that vowel through the nucleus of MOUTH.

CHAPTER 5

THE BACK(?) VOWELS

Very generally speaking, the single most defining characteristic of Midland speech might be the fronting of the nuclei of the back upgliding diphthongs GOOSE, GOAT, and MOUTH (Labov, Ash & Boberg 2006:103, 105, 107). The Midland is not unique in fronting any of these vowels, which, in particular, are fronted throughout the Southeast super-region of which the Midland is a part (e.g., Labov, Ash & Boberg 2006:139). Nevertheless, the extreme front realizations of all three back diphthongs observed in the Midland together help mark the area as a distinct dialect region (Labov, Ash & Boberg 2006:263-266).

This chapter will explore developments in these three vowels in Kansas City, as well as the short back vowel in FOOT. Exploration will necessarily be more constrained for each vowel than it was for LOT, THOUGHT, or TRAP. But generally I'll look briefly at phonetic conditioning, changes in apparent time, and social factors in relation to observed productions for each. I do not explore stylistic variation with regard to MOUTH, GOAT, and GOOSE because I did not design the minimal pairs task to elicit comment on these vowels; however, I'll explore variation among different interview tasks in future research. I'll conclude by examining the potential conditional merger of three of these vowels—GOOSE, FOOT, and GOAT—in the context of a following /l/. (Treated as classes, I label these POOL, BULL, and BOWL, respectively.)

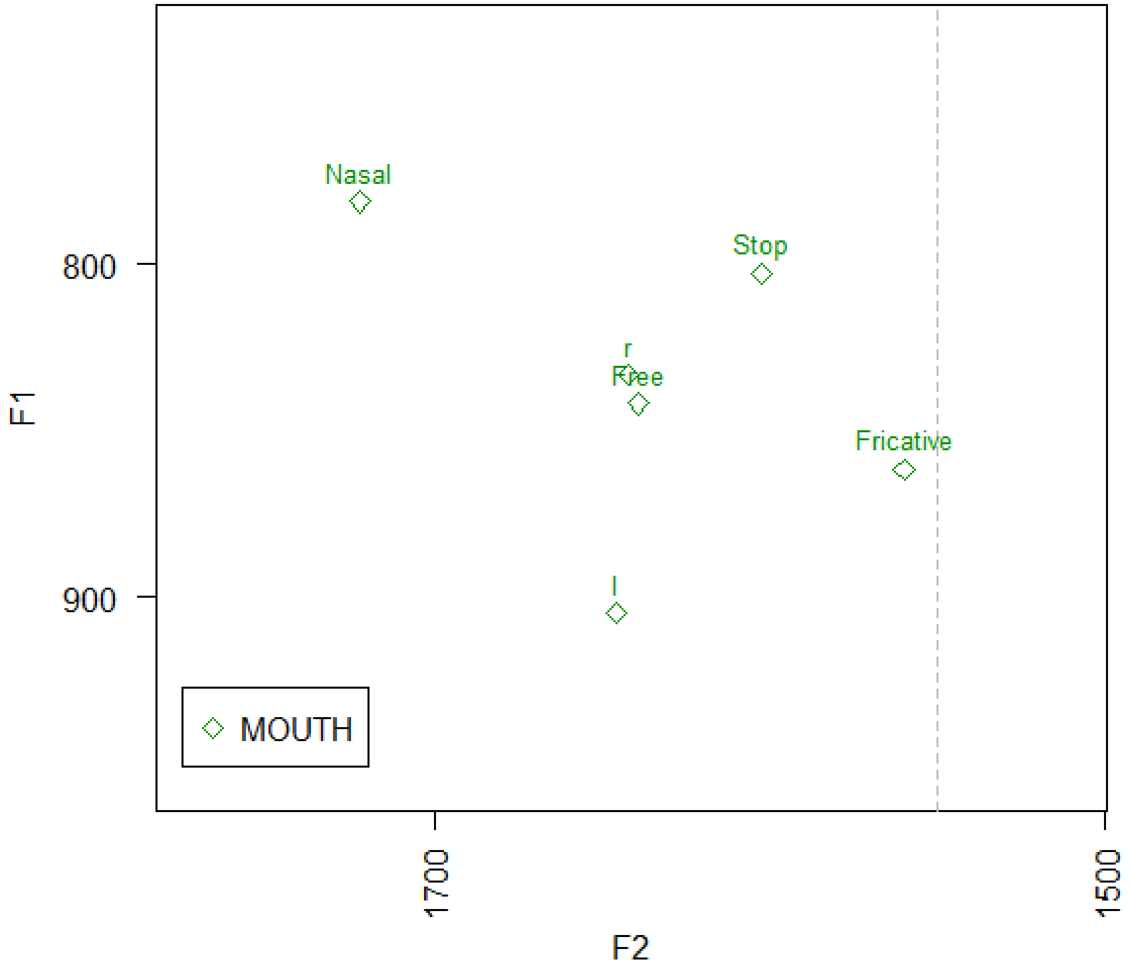
I begin this chapter at the bottom of vowel space with MOUTH. This affords a potential transition from the previous chapter, since the observed backing of TRAP would conceivably push that vowel into the canonical nuclear space of MOUTH.

5.1. MOUTH

Canonically, MOUTH is a diphthong with a low-central nucleus and high-back glide. The phonetic realization of either the nucleus or glide could be subject to change, but the nucleus has been most frequently studied and many regions show relatively front productions of the nucleus (e.g., Labov, Ash, and Boberg 2006:159). Especially front productions of MOUTH are characteristic of the Midland and South in *ANAE*. Labov, Ash, and Boberg (2006:271) suggest that "extreme fronting and raising of [MOUTH] is characteristic of Kansas City, which shows even stronger [MOUTH] fronting than southern cities, and leads other Midland communities in this respect." Raising, in this context, appears to occur along a peripheral track, as MOUTH fronts to such an extreme that it begins moving up along the front vowel space. The effect appears to be particularly strong with following nasals. Labov, Ash, and Boberg (2006:267) plot all Kansas City speakers with mean MOUTH F2 exceeding 1750 Hz. Lusk (1976:87) explores MOUTH only briefly, but describes fronting as "clearly widespread in all phonological environments" with following nasals being "especially conducive to fronting." Her transcriptions show 78 percent of Kansas Citians with a nucleus in the impressionistic range of [æ] (1976:86-87).

All discussion in this section of MOUTH refers to the nucleus. Figure 5.1 displays normalized means for MOUTH by following manner. It suggests relatively little effect on MOUTH's production as a result of following manner. Perhaps this is not phonetically surprising, since the glide might be expected to intervene between the nucleus and phonetic conditioning effects of the following environment. Nevertheless, following nasals (e.g., Lusk 1976:86-87 in Kansas City; Labov, Ash & Boberg 2006 generally) and following /l/ (e.g., Dinkin 2011 in Philadelphia) have been observed to affect the nuclear production of MOUTH in other studies, so the lack of major conditioning effects from those environments in Figure 5.1 is noteworthy. It appears that in mean values, MOUTH with following nasals is only a bit higher and fronter than other contexts, and MOUTH with following /l/ is just a bit lower.

Figure 5.1. Distribution of MOUTH by following manner in interview speech



Tables 5.1 and 5.2 recast these normalized means through lmer outputs for F1 and F2 of MOUTH, respectively.

Table 5.1. Mixed effects regression of conditioning effects on MOUTH F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmFree (Intercept)	859.64	11.97	71.83	*now*
fmFricative	-14.53	18.02	-0.81	*lousy*
fmL	35.66	27.25	1.31	*owl*
fmNasal	-66.94	13.76	-4.87	*sound*
fmR	-44.22	18.23	-2.43	*hour*
fmStop	-26.36	15.43	-1.71	*pout*
fpAlveolar (Intercept)	815.320	6.235	130.76	*loud*
fpBilabial	96.828	54.771	1.77	*cowboys*
fpFree	41.107	11.374	3.61	*allow*
fpInterdental	8.677	24.297	0.36	*south*
fvFree (Intercept)	855.58	11.21	76.31	*how*
fvVoiced	-42.98	11.54	-3.72	*housing*
fvVoiceless	-28.35	14.95	-1.90	*household*
psAlveolar or Interdental Obstruent (Intercept)	793.902	10.844	73.21	*thousands*
psFree	68.761	15.722	4.37	*outcast*
psGlide	65.335	37.783	1.73	*wow*
psLabial (Oral)	39.183	17.023	2.30	*pound*
psLiquid	46.774	19.441	2.41	*loud*
psM	19.780	23.716	0.83	*mouse*
psN	-7.325	26.241	-0.28	*now*
psObstruent+Liquid Cluster	32.264	18.819	1.71	*crowded*
psPalatal	-22.137	54.778	-0.40	*shout*
psVelar	9.184	18.522	0.50	*counted*
stress0 (Intercept)	899.70	14.10	63.83	*foundation*
stress1	-74.89	12.77	-5.86	*rowdy*
stress2	-98.49	21.08	-4.67	*southeastern*

The lmer analysis for following manner confirms that MOUTH with following nasal occurs higher than all other contexts, and with following /l/ lower. MOUTH with following alveolars and interdentals is realized high compared to MOUTH in free position, and following bilabials have a strong lowering effect. MOUTH with following voiced and voiceless consonants is realized higher than in free position. In preceding contexts, the alveolar ridge appears to demarcate lower productions, which are favored by preceding places of articulation front of the alveolar ridge, from higher ones. Preceding liquids, however, violate this pattern and favor lower productions. Primary and secondary stress both appear to correlate with raised productions.

Table 5.2. Mixed effects regression of conditioning effects on MOUTH F2

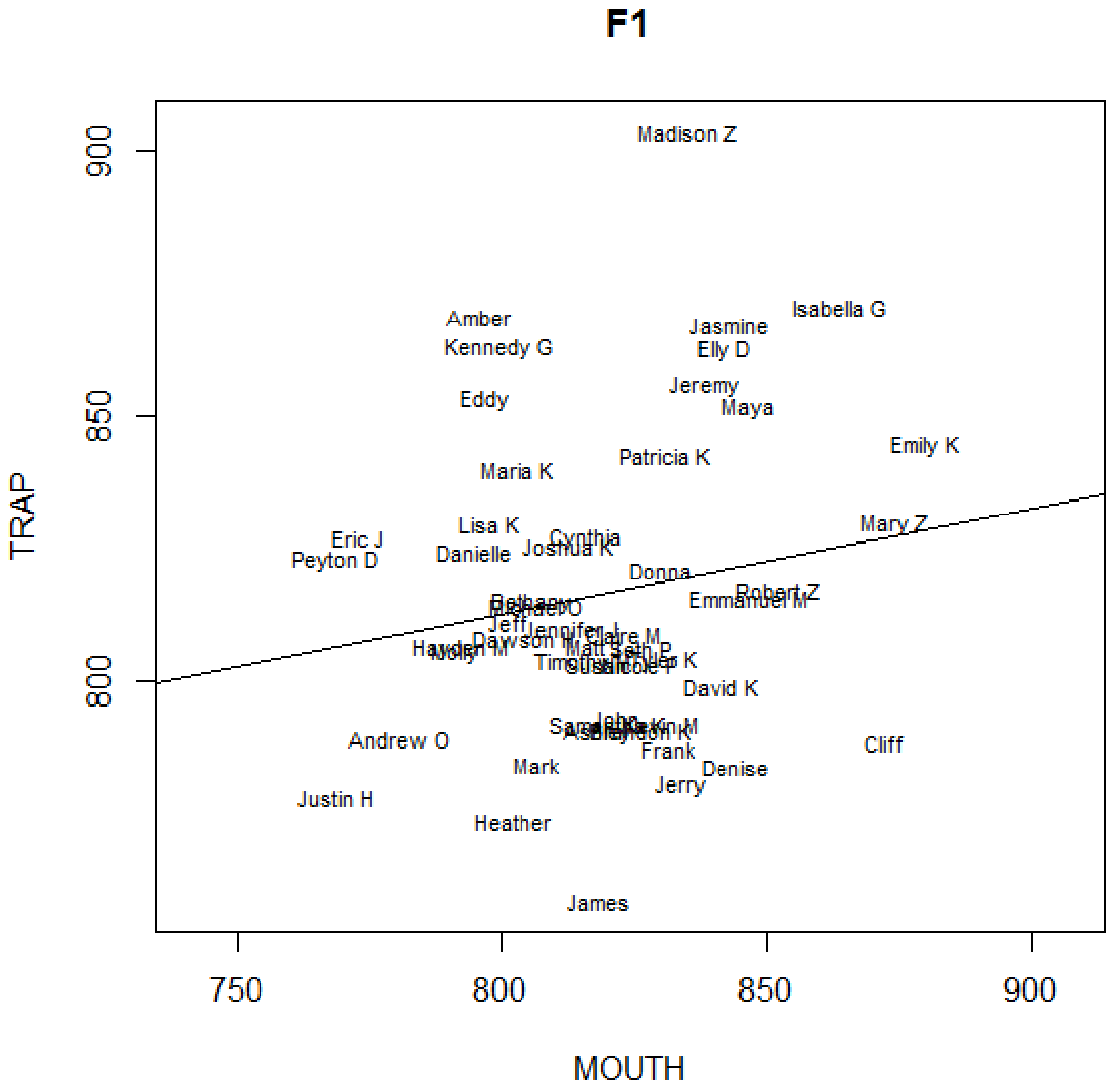
Fixed Effects	Estimate	Std. Error	*t* value	Example
fmFree (Intercept)	1586.07	26.53	59.79	*now*
fmFricative	-43.87	38.76	-1.13	*lousy*
fmL	23.93	58.30	0.41	*owl*
fmNasal	130.81	29.54	4.43	*sound*
fmR	57.02	57.02	1.53	*hour*
fmStop	30.01	33.03	0.91	*pout*
fpAlveolar (Intercept)	1662.79	15.07	110.34	*loud*
fpBilabial	-41.70	116.84	-0.36	*cowboys*
fpFree	-70.94	24.29	-2.92	*allow*
fpInterdental	-100.83	53.78	-1.87	*south*
fvFree (Intercept)	1597.79	24.52	65.15	*how*
fvVoiced	81.57	24.18	3.37	*housing*
fvVoiceless	2.86	31.65	0.09	*household*
psAlveolar or Interdental Obstruent (Intercept)	1678.83	20.69	81.13	*thousands*
psFree	-108.41	28.51	-3.80	*outcast*
psGlide	-254.42	67.97	-3.74	*wow*
psLabial (Oral)	-57.19	30.71	-1.86	*pound*
psLiquid	-94.56	35.95	-2.63	*loud*
psM	-79.50	42.80	-1.86	*mouse*
psN	69.05	47.40	1.46	*now*
psObstruent+Liquid Cluster	-49.82	35.27	-1.41	*crowded*
psPalatal	49.32	105.82	0.47	*shout*
psVelar	149.99	34.02	4.41	*counted*
stress0 (Intercept)	1412.91	29.69	47.58	*foundation*
stress1	246.52	26.01	9.48	*rowdy*
stress2	169.13	43.99	3.85	*southeastern*

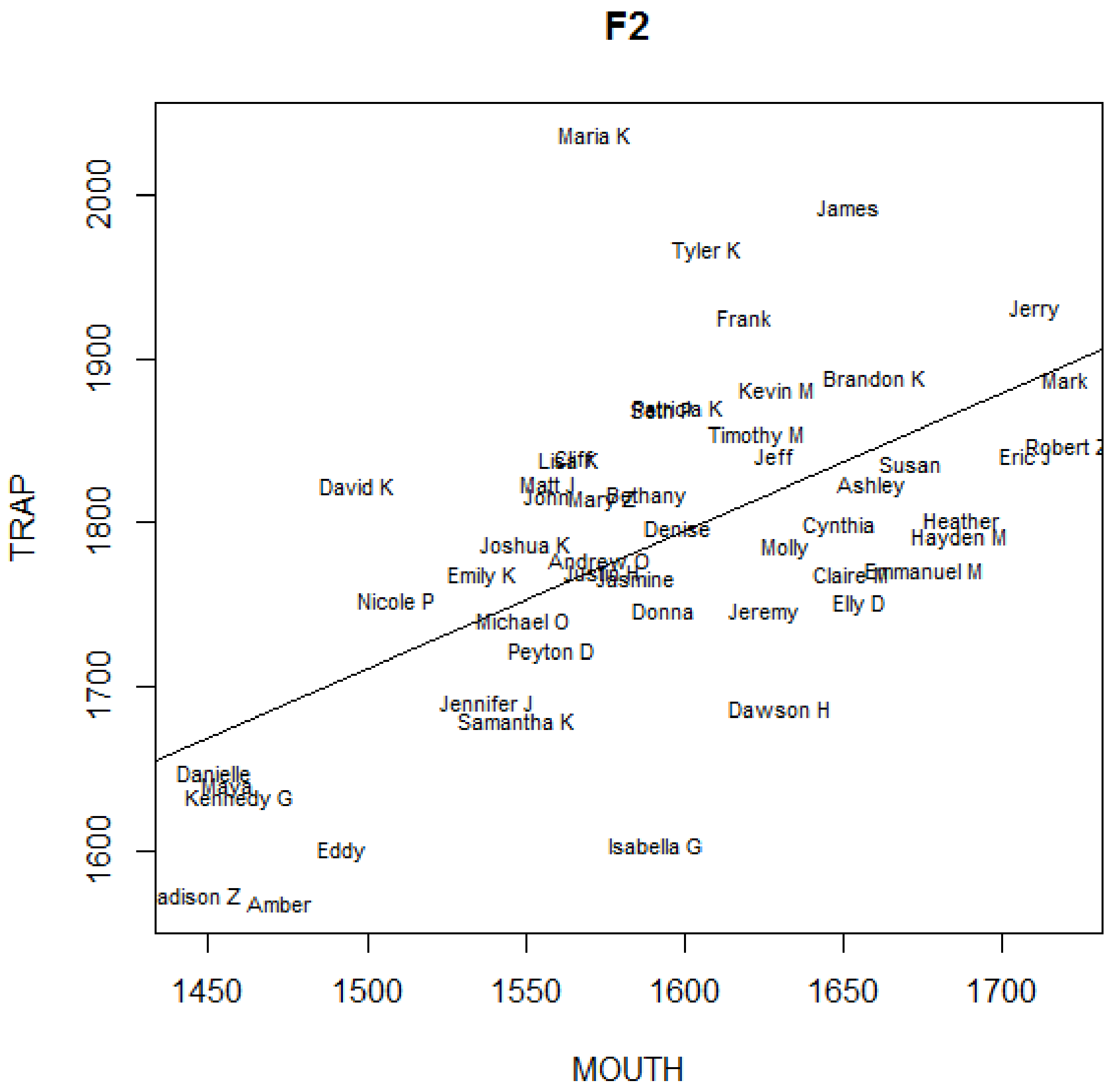
The fronting effect of following nasals on MOUTH is more apparent in lmer analysis than in normalized means. Following /r/ also appears to encourage fronter productions, but that context is represented primarily by forms of *hour* (*our* is excluded as a stop word). Despite the lowering effect that following /l/ often has in F2 (which will be explored more in GOAT, GOOSE, and FOOT), for MOUTH it appears to favor fronting slightly, at a level similar to following stops. MOUTH in free position and, especially, with following fricatives is realized relatively back. In following place of articulation, following alveolars encourage fronter MOUTH, while following interdentals, bilabials, and free position encourage backer MOUTH. These effects appear to be generally consistent with expected acoustic influences of these environments on vowels (Thomas 2011:101). Following voiced consonants appear to have a fairly strong fronting effect relative to either following voiceless or MOUTH in free position. Preceding segments show a wide range of effects on MOUTH F2, with preceding velars strongly encouraging fronting and preceding glides strongly encouraging backing. The latter context is dominated by tokens of *wow*, though. Generally, preceding contexts that encourage lowering also encourage backing and those that encourage raising also encourage fronting. With the exception of preceding velars, preceding coronals tend to correlate with fronter productions and preceding non-coronals with backer productions, which resembles more general expectations for the behavior of the back vowels GOOSE and GOAT (e.g., Labov 2001; Labov, Ash & Boberg 2006; discussed below). The movements are also suggestive of movement along a diagonal path, rather than backing strictly speaking. MOUTH in primary stress position is produced much fronter than in secondary or unstressed position. Forty-three of forty-six vowels counted for unstressed position are the second syllable in *downtown*.

The distribution of MOUTH in lmer analysis is remarkably similar to the distribution of TRAP seen in Chapter 4. Figure 5.2 explores the possible structural relationship between TRAP and MOUTH as a linear model. For comparability with

Figure 4.2, which explored the structural relationship between LOT and TRAP, the model in Figure 5.2 excludes MOUTH and TRAP with following nasals, /l/, and /r/.

Figure 5.2. Linear model of MOUTH and TRAP F1 and F2 by interviewee





The model for F1 is not significant ($R^2 = 0.009471$, $p = 0.2299$). The correlation between TRAP and MOUTH in F2 is highly significant ($R^2 = 0.3375$, $p < 0.001$), suggesting some structural relationship between TRAP and MOUTH. In fact, the lack of correlation in F1 was also observed in the linear model of LOT and TRAP, and the correlation between TRAP and MOUTH F2 is quite a bit stronger than it was for LOT and TRAP. The distribution of interviewees also suggests patterning similar to TRAP in terms of social characteristics, with younger females (Amber, Danielle, Eddy, Kennedy

G, Madison Z, Maya) appearing at the left of the scale with low F2 values, and older males (Eric J, Jerry, Mark, Robert Z) at the right with high F2 values. Figure 5.3 and Table 5.3 explore whether this suggested trend constitutes a change in apparent time.

Figure 5.3. Linear models of MOUTH F1 and F2 by interviewee birth year

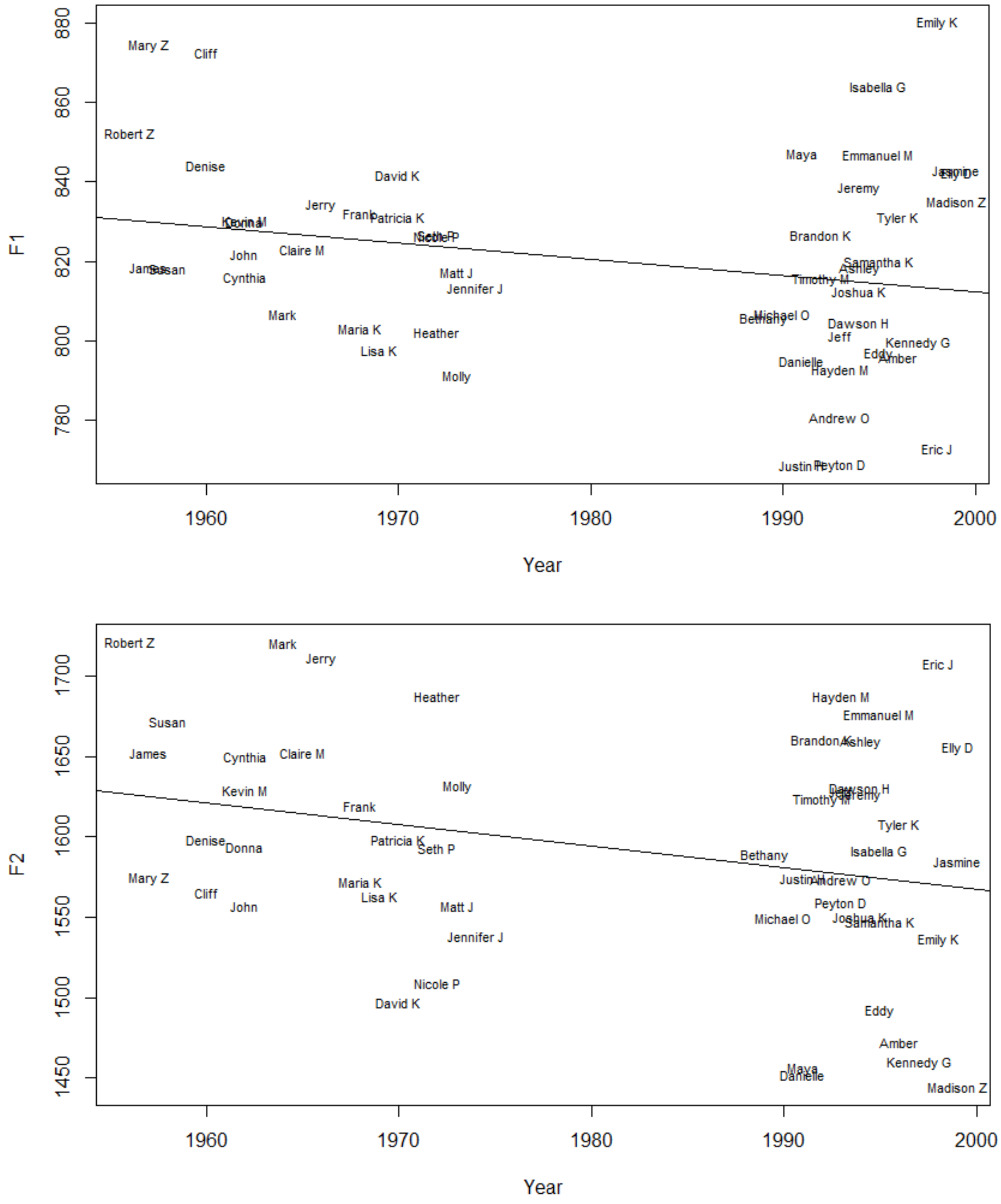


Table 5.3. Linear models of MOUTH F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
MOUTH F1 (Intercept)	1624.7495	460.5785	3.528	< 0.001
Year	-0.4061	0.2325	-1.747	0.086957
Residual standard error: 24.96 on 49 degrees of freedom Multiple R-squared: 0.05861, Adjusted R-squared: 0.0394 *F*-statistic: 3.051 on 1 and 49 DF, *p*-value: 0.08696				
MOUTH F2 (Intercept)	4258.1124	1289.1658	.303	0.00179
Year	-1.3454	0.6508	-2.067	0.04402
Residual standard error: 69.86 on 49 degrees of freedom Multiple R-squared: 0.08021, Adjusted R-squared: 0.06144 *F*-statistic: 4.273 on 1 and 49 DF, *p*-value: 0.0440				

The apparent time analysis reveals very little in terms of a cohesive change in progress. Only in F2, with a trend of backing by 13 Hz each decade, does a model reach statistical significance, and only at a level accounting for 6 percent of observed variation. The models show some curious developments on closer inspection. For example, among older interviewees, there appeared to be a fairly robust pattern of raising at 19 Hz per decade in the F1 model ($R^2 = 0.2468$, $p = 0.007899$), but this trend clearly dissipated among younger interviewees. In F2, of the six younger females who show the lowest F2 measurements, four are from KCMO (Amber, Danielle, Madison Z, Maya). In the future it may be of interest to explore different home towns as an explanatory social factor, but males from KCMO don’t appear to exhibit a similar pattern. So, despite the appearance of a structural relationship between TRAP and MOUTH in F2, the evidence for MOUTH changing in apparent time is not nearly as strong as it is for TRAP.

On the other hand, while MOUTH does not appear to be retracting at a rate commensurate with TRAP, it is noteworthy that MOUTH is certainly not fronting. This suggests, at least, that the front realization of MOUTH that *ANAE* cited as characteristic of Kansas City has reached a point of stability. Possibly, it may even be reversing, though the evidence for that is limited here for MOUTH as a broad phonemic category.

A much more dramatic case for change can be made in the specific environmental context of following nasals. Normalized means and mixed effects regressions suggested that MOUTH is realized higher and fronter in this environment. Figure 5.4 and Table 5.4, however, suggest that particular context is undergoing a fairly dramatic change in time. Table 5.4 provides linear model outputs for F1 and F2 as a consequence of interviewee birth year. I also added a regression for the diagonal measurement {F2 – 2 * F1}, since both F1 and F2 show significant changes. Figure 5.4 plots the linear model for the diagonal movement, which has the highest R^2 value.

Figure 5.4. Linear models of MOUTH F1 and F2 with following nasal by interviewee birth year

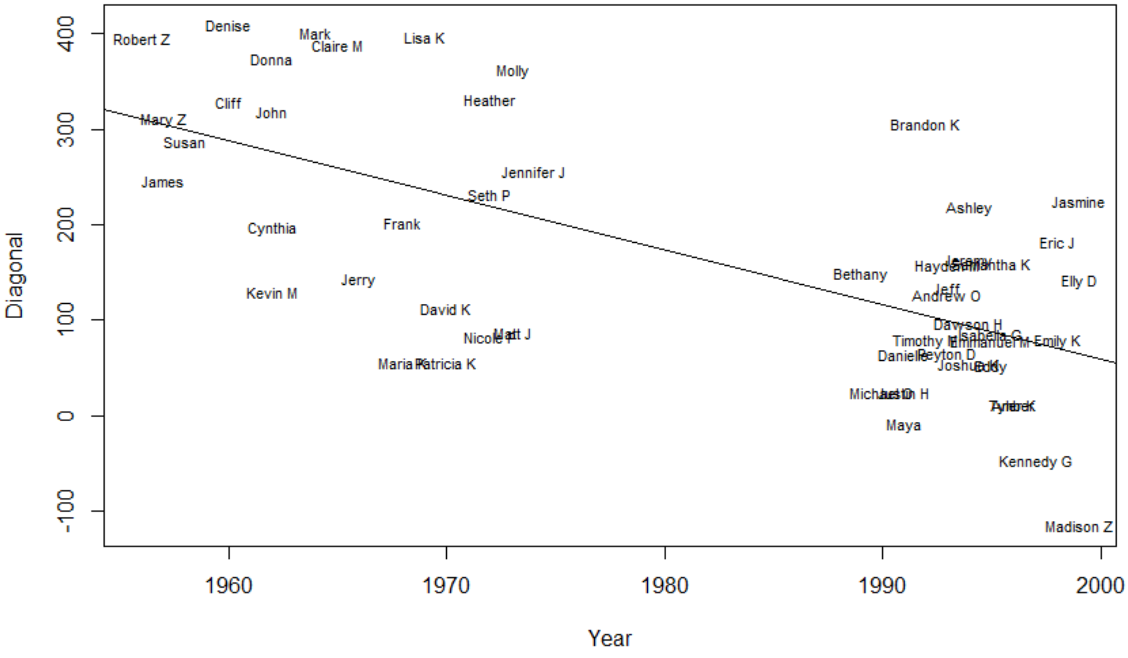


Table 5.4. Linear models of MOUTH F1 and F2 with following nasal by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
MOUTH F1 (Intercept)	-1841.100	526.799	-3.495	0.00102
Year	1.324	0.266	4.978	< 0.001
Residual standard error: 28.55 on 49 degrees of freedom Multiple R-squared: 0.3358, Adjusted R-squared: 0.3223 *F*-statistic: 24.78 on 1 and 49 DF, *p*-value: 8.348e-06				
MOUTH F2 (Intercept)	7808.831	1390.586	5.615	< 0.001
Year	-3.068	0.702	-4.371	< 0.001
Residual standard error: 75.36 on 49 degrees of freedom Multiple R-squared: 0.2805, Adjusted R-squared: 0.2658 *F*-statistic: 19.1 on 1 and 49 DF, *p*-value: 6.429e-05				
MOUTH Diagonal (Intercept)	11491.0311	1868.6944	6.149	< 0.001
Year	-5.7161	0.9434	-6.059	< 0.001
Residual standard error: 101.3 on 49 degrees of freedom Multiple R-squared: 0.4283, Adjusted R-squared: 0.4167 *F*-statistic: 36.71 on 1 and 49 DF, *p*-value: 1.898e-07				

These models suggest substantial retraction of pre-nasal MOUTH, at a rate of 13 Hz per decade in F1 and 31 Hz per decade in F2. The dispersion of names suggests that the change was incipient among older interviewees, who show a wide range of productions across the time span of their group, and then became well established by the time the younger interviewees were born, since they generally show a greater coalescence around the regression line. No obvious social explanations in terms of gender or class emerge in Figure 5.4. Table 5.5 explores sex and class as factors against pre-nasal MOUTH productions by ANOVA, and confirms this observation.

Table 5.5. ANOVA model of pre-nasal MOUTH F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	3589.7	3589.7	0.8924
Class	2	6565.9	3282.9	0.8161
Sex:Class	2	8743.3	4371.6	1.0868
F2				
Sex	1	2793.2	2793.2	0.1449
Class	2	9835.3	4917.7	0.2551
Sex:Class	2	15983.1	7991.5	0.4146

The low *F* values for all factors suggest that all interviewees are performing fairly uniformly for pre-nasal MOUTH. It appears that the retraction of pre-nasal MOUTH is a robust pattern that is general among Kansas Citians. By contrast, Table 5.6 explores the broader context of MOUTH with following stops and fricatives (as in Figures 5.2 and 5.3) for social factors by ANOVA.

Table 5.6. ANOVA model of MOUTH F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	870.2	870.2	0.1688
Class	2	11631.0	5815.5	1.1278
Sex:Class	2	2614.2	1307.1	0.2535
F2				
Sex	1	144343	144343	5.8399
Class	2	1722	861	0.0348
Sex:Class	2	51262	25631	1.0370

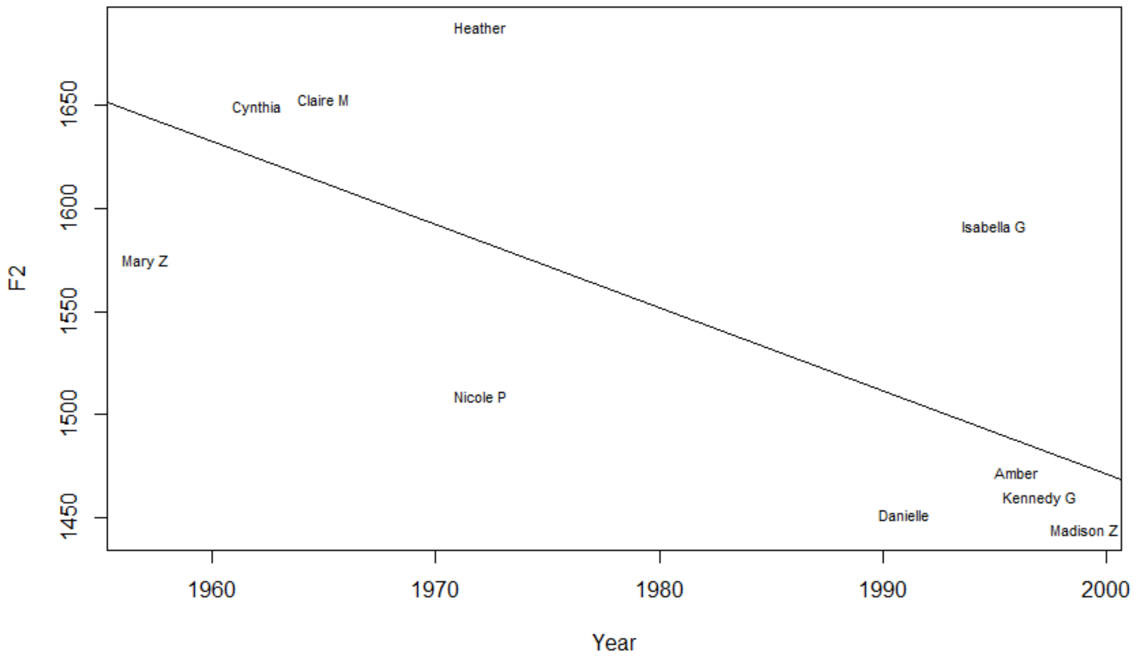
In this broader phonetic context, a large effect appears in F2 for sex. This is suggestive of the qualitative interpretation of Figure 5.3 as a change in progress, based on the fronter productions of older males and backer productions of younger females. Table 5.7 shows the lmer analysis of MOUTH F2 by gender.

Table 5.7. Mixed effects regression of MOUTH F2 by gender

Fixed Effects	Estimate	Std. Error	*t* value
F2			
sexFemale (Intercept)	1569.52	21.41	73.30
sexMale	45.02	18.26	2.47

Females are calculated to produce MOUTH about 45 Hz back of males. If it is assumed the females lead change, this may suggest that the long-term pattern for MOUTH in Kansas City will be backing. Support for this notion is found by limiting this linear model to the group that appeared to lead all others in TRAP retraction: middle class females. Figure 5.5 shows the linear model for that group for MOUTH F2.

Figure 5.5. Linear model of MOUTH F2 for middle-class females by birth year

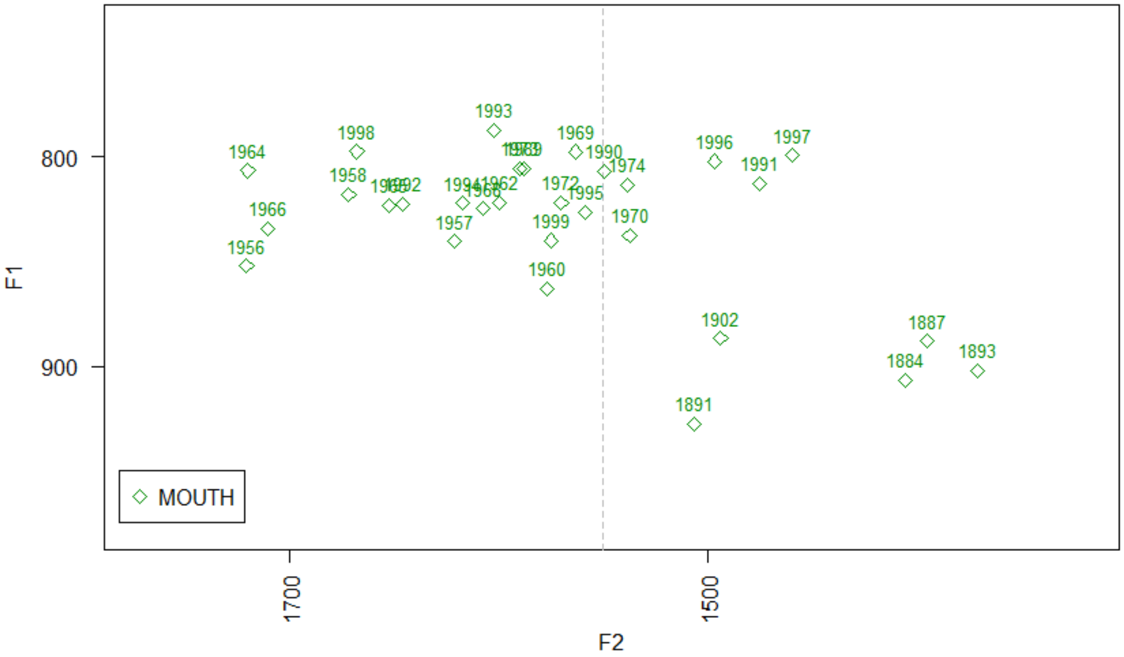


The very similar, very back productions of Amber, Danielle, Kennedy G, and Madison Z are striking in this model. It predicts backing at a rate of 40 Hz per decade ($R^2 = 0.4483$, $p = 0.02042$). While this change has clearly not taken hold throughout Kansas City, the backing of MOUTH may reflect an incipient change in the city. The suggestion of a structural relationship between TRAP and MOUTH F2, indicates that this pattern could develop as a third step in a chain shift. In fact, such a pattern could represent a broader trend in Midland speech. Durian (2012:332), for example, notes “retraction of the nucleus of [MOUTH], likely as a result of its being involved in a low vowel reversal chain shift with [TRAP] and [LOT]” that would move MOUTH back from the fronted position previously observed in Columbus, OH.

In light of this suggestion, a data point from Gordon and Strelluf (2013) can be reevaluated to depict the broader development of this pattern. Figure 5.6 includes acoustic measurements from Kansas Citians born between 1884 and 1902, which were used for the studies in Gordon and Strelluf (2013, forthcoming). Normalized F1 and F2 values are averaged by birth year from MOUTH in primary stress position. MOUTH in free position and with following nasals, /l/, and /r/ is excluded.

In Figure 5.6, the lowest, backest values are for those speakers born in the 1800s. Measurements generally move front and upward to the area where speakers born in the 1950s and 1960s are found. This movement places their values in the extreme front range identified for MOUTH in *ANAE*. Values then back on a basically horizontal line and, generally, the backest measurements belong to birth years in the 1990s. This patterning is suggestive of Labov’s (1994; also Labov, Yaeger & Steiner 1972) descriptions of vowels raising and fronting along a peripheral track in vowel space and lowering and backing along a non-peripheral track. This longer time period visually shows MOUTH raising and fronting along a peripheral track, shifting into a non-peripheral track, and then backing.

Figure 5.6. Progression of MOUTH by birth year from 1884 to 1999



As far as the description of Kansas City English goes, this change in MOUTH potentially represents a shift away from a pattern that *ANAE* noted as characteristic of the city. While many interviewees clearly have front productions of MOUTH, the pattern of MOUTH fronting appears to have reached its conclusion. In pre-nasal contexts, MOUTH is retracting robustly. Among middle-class females, MOUTH generally appears to be backing, and this may represent that first step in an emerging change in the dialect of Kansas City.

These observations also lend support to one of the more surprising observations in Gordon and Strelluf (2012), which was that several of the back vowels showed a "boomerang effect" in which they fronted among speakers born in the late 1960s and early 1970s and then retracted among speakers born in the 1980s. The larger pool of research here depicts such a boomerang effect slightly differently, but certainly suggests that Gordon and Strelluf (2012) may have identified an incipient development of MOUTH backing in their pilot work in Kansas City.

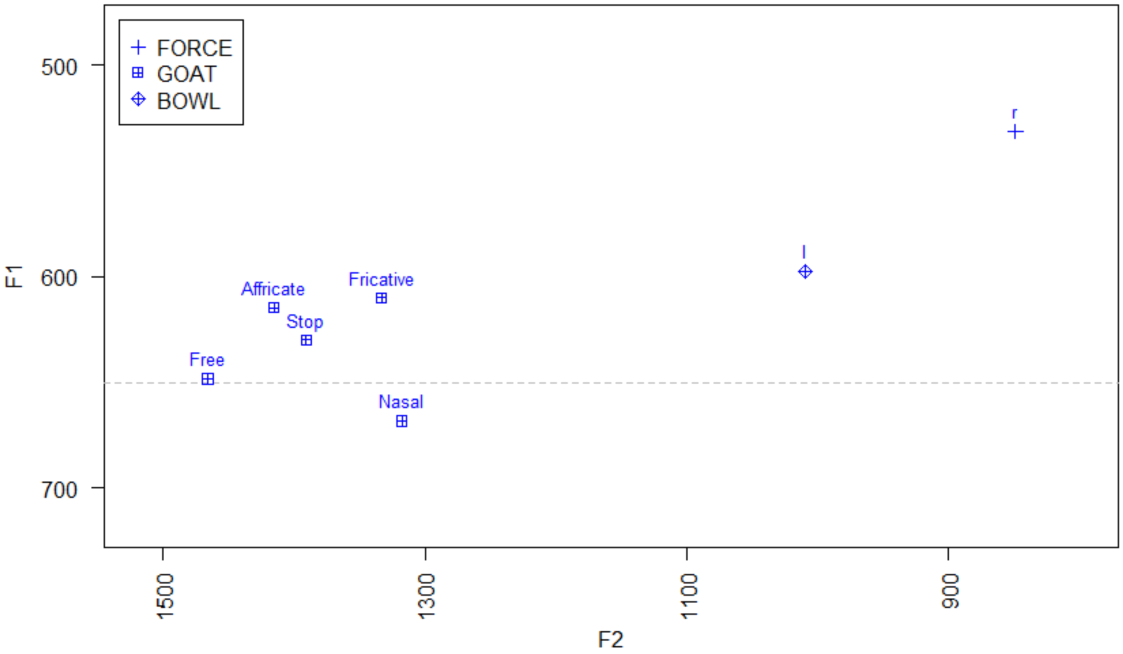
5.2. GOAT

Labov, Ash, and Boberg (2006:263-264) describe the extreme fronting of the nucleus of GOAT, defined as mean F2 greater than 1550 Hz, as general throughout the Midland. Kansas City appears to be less advanced in this pattern than some other Midland cities, with speakers generally between 1200 and 1400 Hz (cf. Labov, Ash & Boberg 2006:265, 271). Allophones of GOAT before /l/ (BOWL) and /r/ (FORCE) do not participate in fronting (Labov 1994, 2001, 2010; Thomas 2001; Labov, Ash & Boberg 2006). Lusk (1976:120) identified the centralization of GOAT as an incipient change "among young people, especially in the highest status group." She noted the greatest increase in centralization occurring among interviewees born between approximately 1935 and 1945 (1976:121), and transcribed uses among speakers born since 1955 as [ɵʊ]. She notes that following stops encourage fronting, while following nasals and /l/ discourage fronting (1976:85). Generally speaking, her description for GOAT matches the findings of *ANAE* for Kansas City.

Fronted GOAT is another key variable in distinguishing the Southeast super-region from the North and West. GOAT F2 in the West remains a point of controversy, and a number of researchers have identified vigorous GOAT fronting in the West, especially among young Californians (e.g., Eckert 2004; Hall-Lew 2010; Kennedy & Grama 2012). But, its status in the Midland as an innovation appears to be clear.

Figure 5.7 plots mean distributions for GOAT among interviewees by following manner. It basically matches the expected distribution based on *ANAE*, with BOWL realized back and most other contexts being realized fronter. FORCE is also produced backer and higher.

Figure 5.7. Distribution of GOAT by following manner



In lmer analysis, BOWL is measured at F1:602 Hz, F2:1039 Hz. FORCE is measured at F1:534 Hz, F2:890 Hz. Since BOWL and FORCE are clearly behaving in a different way from GOAT in other environments, they are excluded from the mixed effects regressions in Tables 5.8 and 5.9.

Table 5.8. Mixed effects regression of conditioning effects on GOAT F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	617.990	22.190	27.850	*coaches*
fmFree	20.453	22.386	0.914	*mow*
fmFricative	-6.463	22.454	-0.288	*both*
fmNasal	41.791	22.658	1.844	*loan*
fmStop	2.689	22.366	0.120	*smoke*
fpAlveolar (Intercept)	626.375	4.475	139.98	*coding*
fpBilabial	7.301	7.245	1.01	*hopes*
fpFree	11.913	5.539	2.15	*ago*
fpInterdental	-14.572	25.921	-0.56	*growth*
fpLabiodental	5.039	12.021	0.42	*grove*
fpPalatal	-21.465	12.539	-1.71	*social*
fpVelar	-7.649	7.901	-0.97	*choked*
fvFree (Intercept)	637.788	4.956	128.68	*blow*
fvVoiced	-2.253	5.446	-0.41	*cozy*
fvVoiceless	-22.407	5.582	-4.01	*ghosts*
psAlveolar or Interdental Obstruent (Intercept)	626.7772	5.7821	108.40	*tone*
psFree	10.7352	7.2593	1.48	*open*
psGlide	14.8747	19.9074	0.75	*quote*
psLabial (Oral)	4.4919	8.7212	0.52	*pony*
psLiquid	0.4152	8.8357	0.05	*lowered*
psM	10.6430	10.8180	0.98	*moat*
psN	26.3386	9.3716	2.81	*know*
psObstruent+Liquid Cluster	-12.6550	8.1678	-1.55	*growing*
psPalatal	-5.2378	11.7304	-0.45	*joke*
psVelar	-10.7508	8.8736	-1.21	*goal*
stress0 (Intercept)	621.206	6.696	92.78	*window*
stress1	8.044	6.672	1.21	*donate*
stress2	22.865	10.082	2.27	*motivation*

Table 5.8 shows GOAT in free position and GOAT with following nasals being produced lower than GOAT with other following manners. Unchecked GOAT is also produced lower than GOAT with other following places of articulation. Following palatals and interdentals appear to encourage slightly higher productions. The lowering effect of free position also applies in following voicing, where GOAT in free position and with following voiced consonants is realized slightly lower than GOAT with following voiceless. Preceding segments appear to have relatively little effect on GOAT's height,

though preceding /n/ encourages lower productions. The stress position of GOAT also appears to have little effect on height; secondary stress appears to result in slightly higher F1 (lower in vowel space).

Table 5.9. Mixed effects regression of conditioning effects on GOAT F2

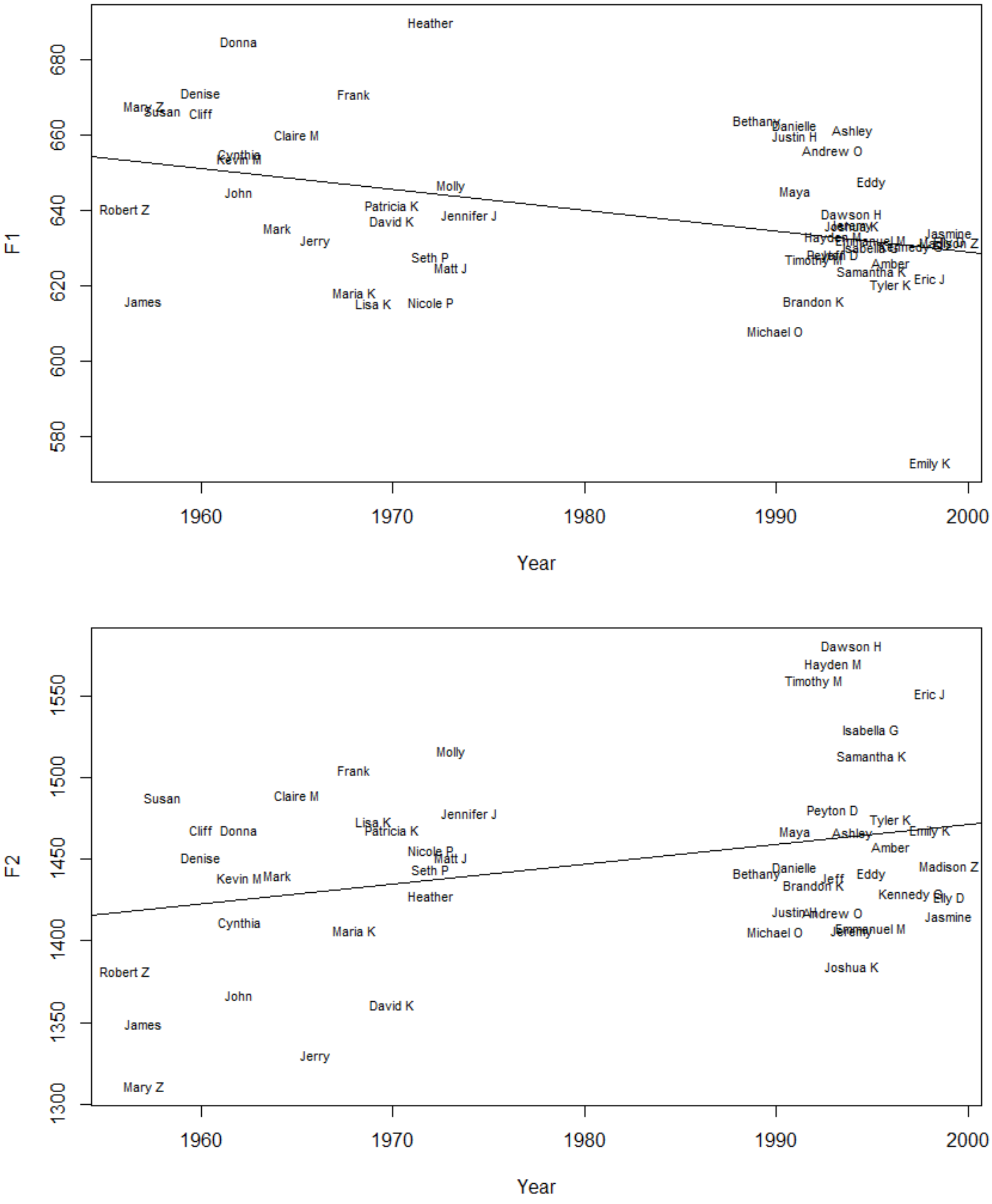
Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	1479.5	103.2	14.338	*coaches*
fmFree	-115.1	104.3	-1.103	*mow*
fmFricative	-129.5	104.5	-1.240	*both*
fmNasal	-192.9	105.1	-1.836	*loan*
fmStop	-141.4	104.1	-1.358	*smoke*
fpAlveolar (Intercept)	1350.562	15.794	85.51	*coding*
fpBilabial	-61.582	28.085	-2.19	*hopes*
fpFree	12.776	21.414	0.60	*ago*
fpInterdental	-2.051	101.754	-0.02	*growth*
fpLabiodental	-48.449	44.698	-1.08	*grove*
fpPalatal	55.172	45.074	1.22	*social*
fpVelar	-52.968	29.354	-1.80	*choked*
fvFree (Intercept)	1363.24	18.43	73.95	*blow*
fvVoiced	-27.84	21.19	-1.31	*cozy*
fvVoiceless	-33.60	21.66	-1.55	*ghosts*
psAlveolar or Interdental Obstruent (Intercept)	1460.48	17.82	81.96	*tone*
psFree	-153.95	22.79	-6.75	*open*
psGlide	-287.61	58.77	-4.89	*quote*
psLabial (Oral)	-220.69	26.91	-8.20	*pony*
psLiquid	-207.50	26.50	-7.83	*lowered*
psM	-274.90	32.70	-8.41	*moat*
psN	70.89	29.62	2.39	*know*
psObstruent+Liquid Cluster	-224.27	25.35	-8.85	*growing*
psPalatal	87.72	36.10	2.43	*joke*
psVelar	-22.07	27.76	-0.80	*goal*
stress0 (Intercept)	1379.08	23.29	59.23	*window*
stress1	-52.61	24.14	-2.18	*donate*
stress2	17.85	35.61	0.50	*motivation*

As Table 5.9 indicates, GOAT shows much more variation in production in the F2 dimension. The lmer analysis projects following affricates to have a greater fronting effect on GOAT than normalized means suggested. This appears to occur because the class is represented entirely by twenty-five tokens of *approach*, which have a mean F2 around 1393 Hz, and five tokens of *coach(es)*, which have a mean F2 around 1530 Hz. The calculation of word as a random intercept weighs these tokens more evenly and estimates the F2 for the class at a higher value. Following nasals appear to inhibit fronting relative to following stops, fricatives, and free position (this concurs with observation for conditioning effects on GOAT F2 in Labov 2010:279-284).

Following labials and velars encourage backer productions and following palatals encourage fronter productions. Following free position appears to encourage fronting relative to either following voiced or voiceless consonants. Preceding coronals, to include preceding /n/ and palatals, strongly encourage fronting relative to other environments, as described for the general pattern of American dialects that front GOAT (e.g., Labov 2001:486). Preceding velars present a bit of a complication since they are realized fairly front, as they were for MOUTH above. No obvious explanations emerge from examining tokens in this environment, which is well represented in interview data, that explain why the preceding velars would be produced with F2 near preceding alveolars and interdentals, rather than with other non-coronals, though it may simply reflect normal acoustic correlates of velars.

Figure 5.8 examines productions of GOAT F1 and F2 as changes in apparent time. GOAT with following nasals, /l/, and /r/ is excluded. Table 5.10 provides the outputs from these linear models. The model for GOAT F1 shows a very slight pattern of raising over time, but by just 5 Hz per decade. The model for GOAT F2 predicts fronting of 12 Hz per decade. Both models have low R^2 scores, suggesting they don’t hold a great deal of explanatory power. Impressionistically, the model for F1 appears to suggest a

Figure 5.8. Linear models of GOAT F1 and F2 by interviewee birth year



decrease in the range of productions among younger interviewees relative to older interviewees, with most younger interviewees clustering fairly tightly around the regression line. The F2 model is a bit more complicated. Here, each age group appears to have a main cluster of production values and a set of outliers. In the case of older interviewees, these outliers (e.g., James, Jerry, Mary Z) have relatively backer productions, while in the case of younger interviewees, the outliers (e.g., Dawson H, Eric J, Hayden M, Timothy M) have fronter productions.

Table 5.10. Linear models of GOAT F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
GOAT F1 (Intercept)	1724.7610	365.2122	4.723	< 0.001
Year	-0.5478	0.1844	-2.971	0.00459
Residual standard error: 19.79 on 49 degrees of freedom Multiple R-squared: 0.1527, Adjusted R-squared: 0.1354 *F*-statistic: 8.828 on 1 and 49 DF, *p*-value: 0.004587				
GOAT F2 (Intercept)	-957.0183	1002.8395	-0.954	0.3446
Year	1.2143	0.5063	2.398	0.0203
Residual standard error: 54.34 on 49 degrees of freedom Multiple R-squared: 0.1051, Adjusted R-squared: 0.0868 *F*-statistic: 5.753 on 1 and 49 DF, *p*-value: 0.02032				

An interesting side note here is that Dawson H, Eric J, Hayden M, and Timothy M all attend the same high school. Hayden and Timothy are brothers, but there is no indication of any acquaintance among Dawson and Eric. So, there is at least the possibility of a highly localized norm of extreme GOAT fronting, which might be examined in the future. For the broader population, it seems best to suggest that GOAT is not undergoing much change in Kansas City in either F1 or F2. A slightly more nuanced picture is available by modeling preceding coronals separately from preceding non-coronals. Commensurate with the findings described above, in this closer look, GOAT with preceding coronals offers little evidence of change in progress (F1 coefficient: -

0.4987, $R^2 = 0.0797$, $p = 0.02522$; F2 coefficient: 1.2497, $R^2 = 0.08375$, $p = 0.0223$). GOAT with preceding non-coronals offers a better case for change in progress (F1 coefficient: -0.5348, $R^2 = 0.116$, $p = 0.008321$; F2 coefficient: 2.4234, $R^2 = 0.159$, $p = 0.002191$). The regression for F2 of GOAT following non-coronals predicts fronting at 24 Hz per decade in a model that accounts for about 16 percent of observed variation. So, perhaps a better description of GOAT fronting in Kansas City is that it has slowed greatly for GOAT following coronals, but shows some change in progress in the direction of fronter productions for GOAT following non-coronals.

These slight changes do not show strong social correlations. Table 5.11 provides ANOVA analyses for F1 and F2 of GOAT following a coronal versus non-coronal.

Table 5.11. ANOVA model of F1 and F2 for GOAT with preceding coronal versus non-coronal by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
Preceding Coronal F1				
Sex	1	16583.4	16583.4	4.1202
Class	2	701.2	350.6	0.0871
Sex:Class	2	7963.6	3981.8	0.9893
Preceding Coronal F2				
Sex	1	6850.5	6850.5	0.2976
Class	2	17292.3	8646.1	0.3756
Sex:Class	2	20033.4	10016.7	0.4351
Preceding Non-Coronal F1				
Sex	1	10.2	10.16	0.0039
Class	2	6216.6	3108.29	1.1898
Sex:Class	2	4092.2	2046.10	0.7832
Preceding Non-Coronal F2				
Sex	1	1801	1801	0.0717
Class	2	61320	30660	1.2210
Sex:Class	2	110545	55272	2.2012

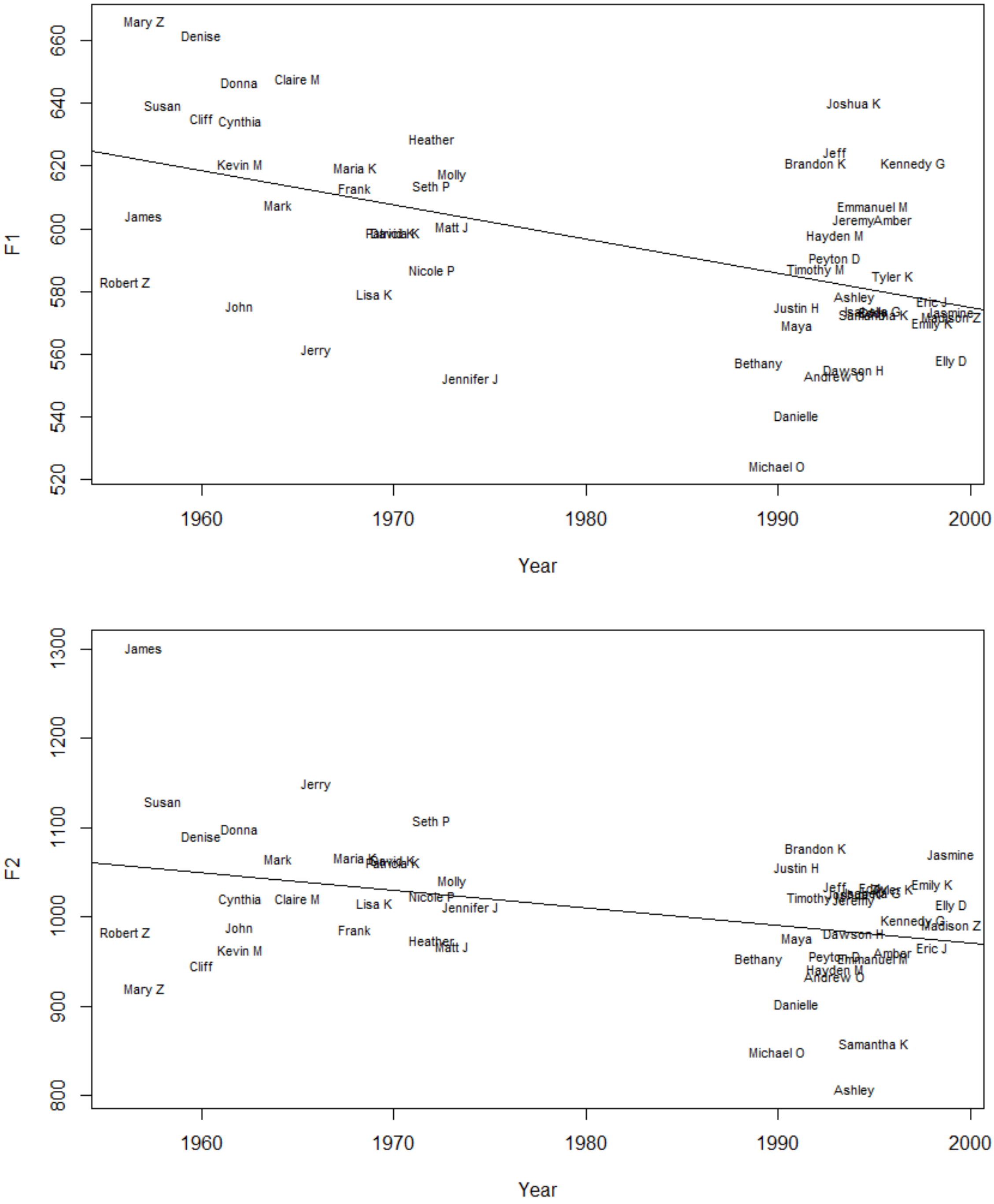
The low *F* values across the board suggest little in the way of social explanations for observed variation. In F1 of GOAT after coronals, sex seems to offer some hint of a social effect, but in mixed effects regression this amounts to a difference of just 13 Hz lower F1 for males. If there is a difference, it doesn't seem likely that it is an important one. Similarly, linear models for prestige and SEI scores show no discernible social correlations. On the whole, GOAT appears to have become fairly stable and uniform in its realization in Kansas City.

By contrast, linear modeling of BOWL suggests a more active change in progress. Table 5.12 and Figure 5.9 show developments in this particular subset of GOAT. BOWL appears to be raising at a rate of 11 Hz per decade and backing at a rate of 20 Hz per decade. The raising trend has a fairly large R^2 value, accounting for 25 percent of observed variation. This suggests that, while GOAT in general appears to be slowing in its pattern of fronting, BOWL appears to be pushing farther away from it by moving back and up in vowel space.

Table 5.12. Linear models of BOWL F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
BOWL F1 (Intercept)	2760.242	510.993	5.402	< 0.001
Year	-1.093	0.258	-4.235	< 0.001
Residual standard error: 27.69 on 49 degrees of freedom Multiple R-squared: 0.268, Adjusted R-squared: 0.253 *F*-statistic: 17.94 on 1 and 49 DF, *p*-value: 0.0001001				
BOWL F2 (Intercept)	4904.5268	1375.0389	3.567	< 0.001
Year	-1.9665	0.6942	-2.833	0.006679
Residual standard error: 74.51 on 49 degrees of freedom Multiple R-squared: 0.1407, Adjusted R-squared: 0.1232 *F*-statistic: 8.025 on 1 and 49 DF, *p*-value: 0.006679				

Figure 5.9. Linear models of BOWL F1 and F2 by interviewee birth year



The ANOVA analysis for interactions of gender and class with BOWL are printed in Table 5.13. These estimates suggest that BOWL's patterning is general in Kansas City, with few differences between males and females, or among middle, working, and transitional class speakers.

Table 5.13. ANOVA model of BOWL F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	399.6	399.62	0.1541
Class	2	3229.4	1614.71	0.6227
Sex:Class	2	2087.5	1043.73	0.4025
F2				
Sex	1	7761	7761	0.4787
Class	2	25921	12960	0.7994
Sex:Class	2	49468	24734	1.5257

Gordon and Strelluf (2012) observed a gender difference for BOWL, in which females strongly backed the conditioned vowel while males showed fronting. No such effect emerges in this study. Linear models for job prestige score and SEI also show no clear patterns.

As a community, then, Kansas City shows a high degree of conformity over the treatment of the vowel in GOAT in the phonetic contexts explored. GOAT appears to have reached a fairly front position, and that change appears to be nearing completion, especially when GOAT follows a coronal. While that position is front relative to, e.g., the position observed for the vowel in the North, it is backer than productions observed in several other Midland cities, including Columbus and Cincinnati, OH, Indianapolis, and Pittsburgh (cf. Labov, Ash & Boberg 2006:265).

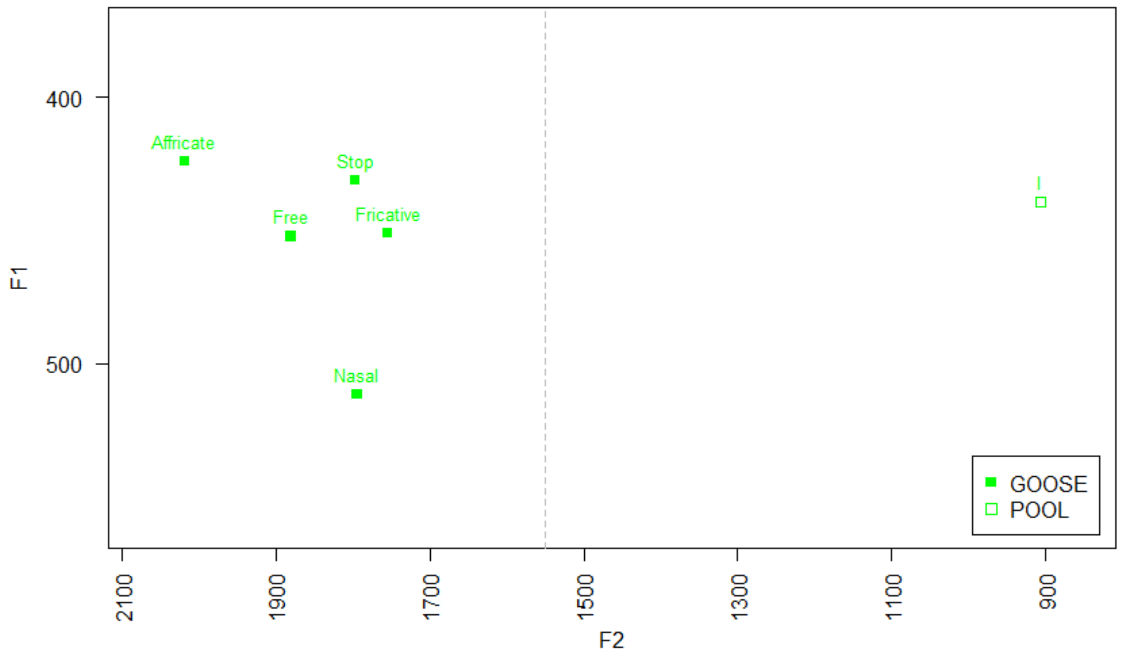
BOWL shows more innovation, but is again treated with remarkable consistency throughout the population. It appears to have reached an extreme back position, and is now raising. The mechanism driving this is unclear. But a practical consequence of BOWL raising will be to push it in F1 toward the canonical space of the higher back vowels of FOOT and GOOSE. This will be explored further below.

5.3. GOOSE

The nucleus of GOOSE is fronting to some extent in most US dialects (Labov, Ash & Boberg 2006:154). Generally, in the South, GOOSE fronts in all phonetic contexts (Labov, Ash & Boberg 2006:152). Elsewhere, GOOSE with following /l/ (POOL) remains in a back position, and GOOSE with a preceding coronal fronts more than other phonetic contexts (e.g., Labov 2001:490-496). Labov, Ash, and Boberg (2006:154) mark Kansas City for extreme fronting, with F2 exceeding 2000 Hz after coronals, and for values fronter than 1550 Hz in F2 after non-coronals. Lusk (1976:76-77) did not explore preceding environment, so her brief discussion of GOOSE may underestimate fronting effects since preceding coronals and non-coronals are considered together. Nevertheless, she finds 25 percent of GOOSE vowels (when not followed by /l/) being strongly centralized to [ʉ] (1976:76). POOL is only slightly centralized. Following stops most encourage centralization of GOOSE, and centralization is correlated with lower socioeconomic status (1976:77).

Figure 5.10 shows the distribution of GOOSE normalized means in Kansas City interviews by following manner. It confirms the back position of POOL and the strongly fronted positions of other following manner environments. The relatively low position of following nasals also marks that category as slightly different from other following manners. The lower backer mean suggests a similar distribution for GOOSE with following nasals as was observed for GOAT with following nasals.

Figure 5.10. Distribution of GOOSE by following manner



Tables 5.14 and 5.15 show the mixed effects regression values for phonetic conditioning in F1 and F2. POOL, which lmer measures at F1:445 Hz, F2:1143 Hz, is excluded from the inputs. Potential GOOSE types with following /r/ (e.g., *sure*, *poor*, *tour*) are considered below as part of the CURE class and are plotted with FOOT. They are excluded from Figure 5.10 and from Tables 5.14 and 5.15.

Following nasals indeed encourage acoustically lower productions. In following place, following labials and GOOSE in free position appear to correlate with lower productions relative to other following place environments. GOOSE with following voiceless consonants is produced slightly higher acoustically than with either following voiced or free position. Preceding segments don't appear to have a great effect on height; preceding /n/ appears to encourage lower productions. Stress position also shows little variation across unstressed, primary, and secondary stress positions.

Table 5.14. Mixed effects regression of conditioning effects on GOOSE F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	420.39	23.53	17.869	*huge*
fmFree	45.83	23.76	1.929	*Mizzou*
fmFricative	18.96	21.71	0.874	*lose*
fmNasal	87.55	22.19	3.946	*soon*
fmStop	15.90	21.65	0.734	*root*
fpAlveolar (Intercept)	445.454	4.648	95.84	*dude*
fpBilabial	24.652	7.666	3.22	*tube*
fpFree	20.969	5.802	3.61	*grew*
fpInterdental	-21.214	26.425	-0.80	*youth*
fpLabiodental	18.265	10.488	1.74	*movie*
fpPalatal	-20.980	14.956	-1.40	*future*
fpVelar	-9.259	19.617	-0.47	*fluke*
fvFree (Intercept)	466.917	5.043	92.59	*chew*
fvVoiced	-7.177	6.088	-1.18	*news*
fvVoiceless	-28.927	6.582	-4.39	*juice*
psAlveolar or Interdental Obstruent (Intercept)	450.861	5.947	75.81	*tunes*
psFree	-7.896	11.551	-0.68	*hoot*
psGlide	-7.830	7.575	-1.03	*puke*
psLabial (Oral)	11.785	12.334	0.96	*foodies*
psLiquid	20.990	9.550	2.20	*loop*
psM	25.143	14.237	1.77	*moot*
psN	36.084	12.378	2.92	*neutral*
psObstruent+Liquid Cluster	26.674	8.696	3.07	*groups*
psPalatal	-4.806	9.511	-0.51	*shootings*
psVelar	11.989	14.458	0.83	*google*
stress0 (Intercept)	467.743	7.393	63.27	*fruition*
stress1	-13.513	7.145	-1.89	*cartoon*
stress2	8.688	12.244	0.71	*attitude*

Table 5.15 shows F2. As was the case with GOAT, GOOSE shows much more variation in this dimension as a result of phonetic conditioning than it did in F1.

Table 5.15. Mixed effects regression of conditioning effects on GOOSE F2

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	2094.4	192.1	10.901	*huge*
fmFree	-484.6	194.3	-2.494	*Mizzou*
fmFricative	-208.9	195.1	-1.071	*lose*
fmNasal	-291.8	197.9	-1.474	*soon*
fmStop	-261.9	194.4	-1.347	*root*
fpAlveolar (Intercept)	1936.60	28.86	67.10	*dude*
fpBilabial	-233.29	49.75	-4.69	*tube*
fpFree	-325.16	39.18	-8.30	*grew*
fpInterdental	-112.10	163.14	-0.69	*youth*
fpLabiodental	-363.10	75.11	-4.83	*movie*
fpPalatal	118.11	98.86	1.19	*future*
fpVelar	-279.52	116.80	-2.39	*fluke*
fvFree (Intercept)	1608.65	32.71	49.18	*chew*
fvVoiced	249.96	40.99	6.10	*news*
fvVoiceless	216.12	46.54	4.64	*juice*
psAlveolar or Interdental Obstruent (Intercept)	1999.826	34.905	57.29	*tunes*
psFree	-518.609	75.375	-6.88	*hoot*
psGlide	-168.583	45.359	-3.72	*puke*
psLabial (Oral)	-454.324	72.956	-6.23	*foodies*
psLiquid	-448.906	60.382	-7.43	*loop*
psM	-486.569	91.638	-5.31	*moot*
psN	-9.956	74.812	-0.13	*neutral*
psObstruent+Liquid Cluster	-312.080	55.592	-5.61	*groups*
psPalatal	-315.881	57.574	-5.49	*shootings*
psVelar	-472.439	82.109	-5.75	*google*
stress0 (Intercept)	1597.95	44.08	36.25	*fruition*
stress1	197.92	44.71	4.43	*cartoon*
stress2	159.54	77.85	2.05	*attitude*

Table 5.15 confirms a relatively back position for following nasals, but also projects GOOSE in free position as being much farther back than suggested by the normalized mean in Figure 5.10. It appears that this is a consequence of mixed effects regression balancing against the heavy representation of *two*, *do*, and *new* in this class, which are all preceded by coronals that would weight the normalized mean frontward. In following place, following coronals appear to encourage much fronter production than following non-coronals. GOOSE with following voiced tokens is produced fronter than

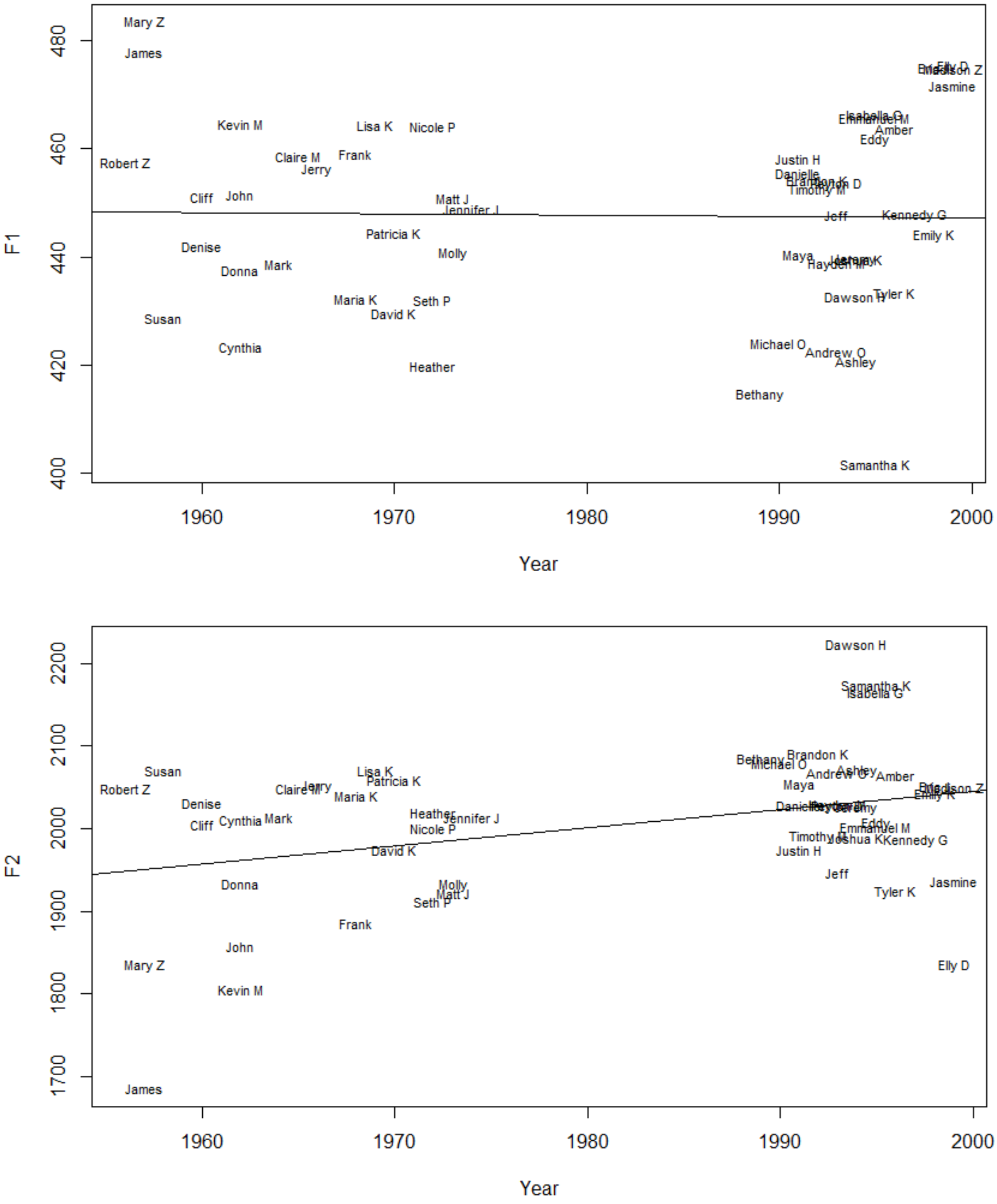
GOOSE with following voiceless, and both are estimated well front of GOOSE in free position. Preceding segment shows the expected division between preceding coronals, which are extremely front—roughly at 2000 Hz—and non-coronals. Preceding palatals violate this pattern in lmer analysis, but this appears to be an effect of a distribution between checked tokens (e.g., *chooses*, *shoots*, *juniors*) which are very front, and unchecked tokens with the vowel in a non-primary-stress position (e.g., *situation*, *graduation*, *perpetual*), which are in the range of 1100 Hz. Increased stress, indeed, correlates with increased fronting.

The phonetic conditioning of GOOSE in interviews neatly matches data in *ANAE*. Table 5.16 and Figure 5.11 look at the frontest environment, GOOSE after coronal, as a change in apparent time. These linear models only include vowels in primary stress position, so the backing effect of types like *graduate* should be eliminated to make preceding palatals affect GOOSE more like other coronals.

Table 5.16. Linear models of post-coronal GOOSE F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
GOOSE F1 (Intercept)	502.72343	337.33316	1.490	0.143
Year	-0.02779	0.17030	-0.163	0.871
Residual standard error: 18.28 on 49 degrees of freedom Multiple R-squared: 0.0005432, Adjusted R-squared: -0.01985 *F*-statistic: 0.02663 on 1 and 49 DF, *p*-value: 0.871				
GOOSE F2 (Intercept)	-2399.5695	1637.2821	-1.466	0.14915
Year	2.2226	0.8266	2.689	0.00977
Residual standard error: 88.72 on 49 degrees of freedom Multiple R-squared: 0.1286, Adjusted R-squared: 0.1108 *F*-statistic: 7.231 on 1 and 49 DF, *p*-value: 0.009768				

Figure 5.11. Linear models of post-coronal GOOSE F1 and F2 by interviewee birth year



These model suggests no change for F1 GOOSE after coronal. The F2 model reaches significance predicting fronting of 22 Hz per decade, albeit with a relatively low R^2 value.

Table 5.17 replicates these models for GOOSE following non-coronals. Since neither model suggests any pattern of change, the linear models are not plotted here.

Table 5.17. Linear models of post-non-coronal GOOSE F1 and F2 by interviewee birth year

<table>
<tr><th></th><th>Estimate</th><th>Std. Error</th><th><i>t</i> value</th><th>Pr(>|t|)</th></tr>
<tr><td colspan="5"></td></tr>
<tr><td>GOOSE F1 (Intercept)</td><td>830.5366</td><td>480.6540</td><td>1.728</td><td>0.0903</td></tr>
<tr><td>Year</td><td>-0.1878</td><td>0.2427</td><td>-0.774</td><td>0.4427</td></tr>
<tr><td colspan="5">Residual standard error: 26.05 on 49 degrees of freedom
Multiple R-squared: 0.01208, Adjusted R-squared: -0.008085
<i>F</i>-statistic: 0.599 on 1 and 49 DF, <i>p</i>-value: 0.4427</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>GOOSE F2 (Intercept)</td><td>2401.2200</td><td>4033.4560</td><td>0.595</td><td>0.554</td></tr>
<tr><td>Year</td><td>-0.4645</td><td>2.0363</td><td>-0.228</td><td>0.821</td></tr>
<tr><td colspan="5">Residual standard error: 218.6 on 49 degrees of freedom
Multiple R-squared: 0.001061, Adjusted R-squared: -0.01933
<i>F</i>-statistic: 0.05203 on 1 and 49 DF, <i>p</i>-value: 0.8205</td></tr>
</table>

These models suggest a basically static position for GOOSE after non-coronals in both F1 and F2. So while post-coronal GOOSE may be continuing to front in apparent time, other phonetic environments appear to have reached a point of relative stability.

Table 5.18 uses ANOVA to explore social interactions for GOOSE following coronals. Class shows a stronger effect in F1 than either gender or the combined factor of gender and class. In linear modeling, SEI and prestige scores both show a small correlation between lower socioeconomic status and lower F1 (SEI appears to be a slightly better model, with decrease or increase of 0.33 Hz in F1 for each point in SEI; R^2

= 0.0799, *p* = 0.02506). In mixed effects regression, this correlates to working class interviewees producing GOOSE with F1 13 Hz lower than either transitional or middle class. Given the likely imperceptible acoustic differences, this appears to be a statistically significant model that is practically unimportant.

Table 5.18. ANOVA model of post-coronal GOOSE F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	28.0	28.0	0.0090
Class	2	20354.5	10177.2	3.2764
Sex:Class	2	3912.7	1956.3	0.6298
F2				
Sex	1	90697	90697	1.3490
Class	2	149603	74802	1.1126
Sex:Class	2	40052	20026	0.2979

The ANOVA model for GOOSE after non-coronals shows similarly little variance in the population according to social factors. I have not reproduced it here. The overall picture for GOOSE, then, is one of conformity among Kansas Citians. GOOSE following non-coronals appears to have reached a point of relative stability. GOOSE following coronals is well front of other contexts and still shows some continued fronting.

Figure 5.12 and Table 5.19 examine POOL F1 and F2 as a change in apparent time. I have not split these by preceding segment. The model for POOL F1 falls just short of statistical significance. This is not terribly surprising since, presumably, POOL would occur at the top back corner of vowel space and have very little room to raise, as the coefficient value for year calculates. POOL F2 appears to be backing at a strong rate of 33 Hz per decade, a rate even more rapid than that observed for BOWL. This suggests that, in apparent time, the allophones of POOL and post-coronal GOOSE are increasing their relative distance from one another in Kansas City.

Figure 5.12. Linear models of POOL F1 and F2 by interviewee birth year

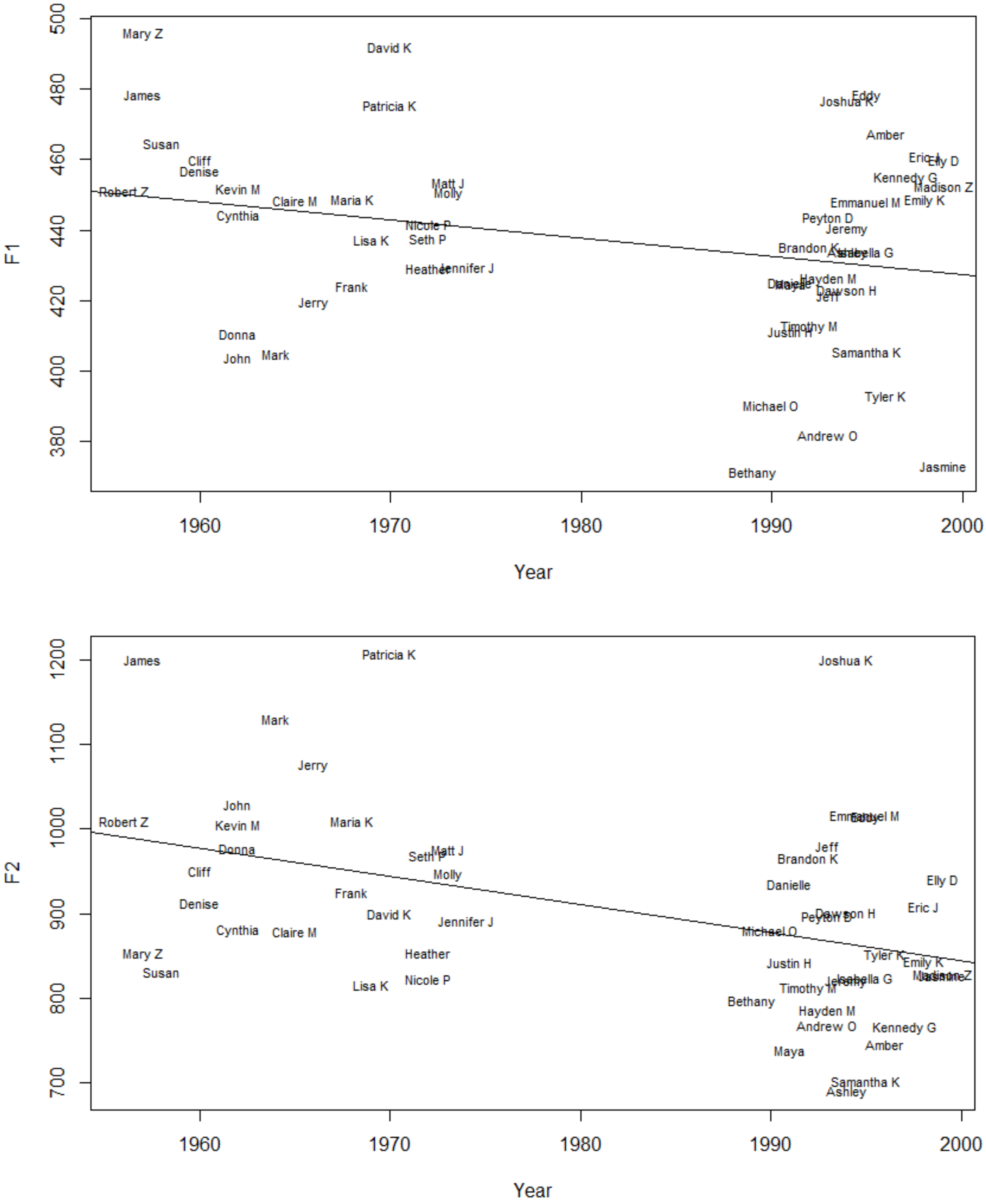


Table 5.19. Linear models of POOL F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
POOL F1 (Intercept)	1463.1274	512.9617	2.852	0.00634
Year	-0.5179	0.2590	-2.00	0.05107
Residual standard error: 27.8 on 49 degrees of freedom Multiple R-squared: 0.07547, Adjusted R-squared: 0.0566 *F*-statistic: 4 on 1 and 49 DF, *p*-value: 0.05107				
POOL F2 (Intercept)	7495.519	2043.378	3.668	< 0.001
Year	-3.326	1.032	-3.224	0.002253
Residual standard error: 110.7 on 49 degrees of freedom Multiple R-squared: 0.175, Adjusted R-squared: 0.1581 *F*-statistic: 10.39 on 1 and 49 DF, *p*-value: 0.002253				

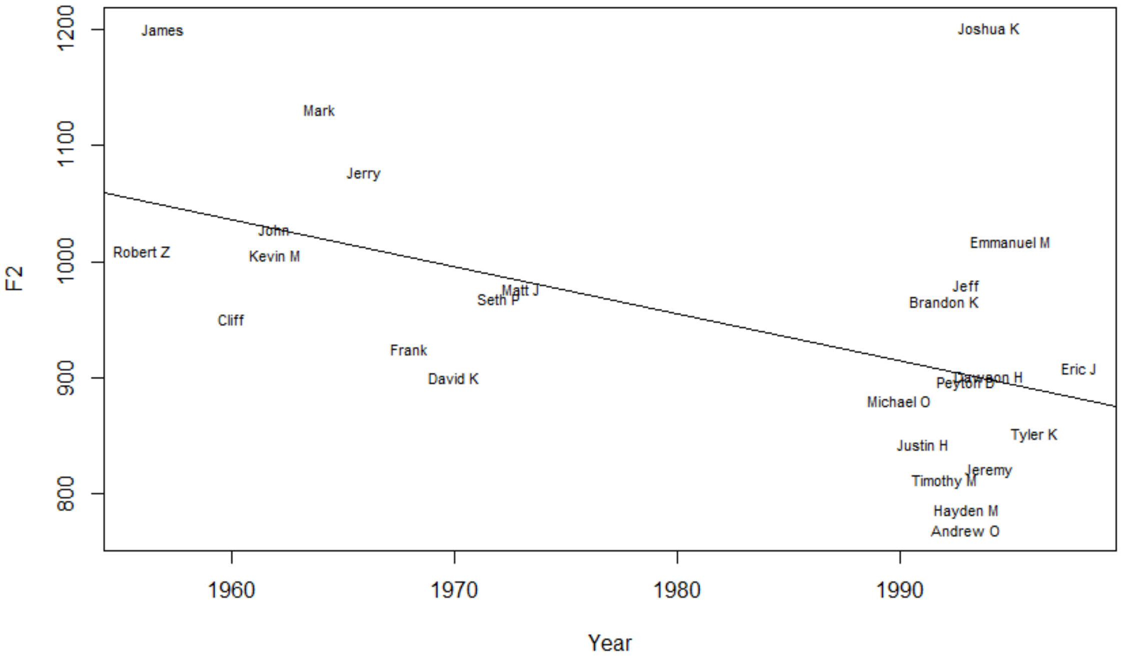
Table 5.20 provides ANOVA outputs for POOL F1 and F2 according to gender and class.

Table 5.20. ANOVA model of POOL F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	1719.50	1719.50	1.2432
Class	2	1134.99	567.49	0.4103
Sex:Class	2	225.92	112.96	0.0817
F2				
Sex	1	129813	129813	5.6763
Class	2	22843	11422	0.4994
Sex:Class	2	43144	21572	0.9433

The ANOVA outputs suggest some effect from interviewee gender, especially in F2. In lmer analysis, females produce POOL 73 Hz backer than males (female F2:1119 Hz; male F2:1192 Hz). Linear models for female productions of POOL do not reach statistical significance. The model for male productions of POOL F2, does. Male F2 productions are modeled by birth year in Figure 5.13.

Figure 5.13. Linear model of POOL F2 among males by interviewee birth year



This fixed effects regression of Figure 5.13 predicts backing at a substantial rate of 40 Hz per decade ($R^2 = 0.2451$, $p = 0.006933$). Given the backer productions of females, this may represent a later stage of a change in progress of POOL. It is feasible that females led a change toward backer productions of POOL and that younger generations of males are backing to the target that females set.

Generally, the picture painted of GOOSE in this data matches that depicted by *ANAE*. GOOSE following coronals is very front in Kansas City. POOL is very back. GOOSE in other contexts occupies a position roughly between those two extremes, and its position in these contexts has stabilized. Post-coronal GOOSE may still be undergoing some fronting. POOL is still backing, especially among males.

5.4. FOOT

FOOT fronting is noted in some descriptions of Southern (Fridland 1998; Thomas 2001; Fridland & Bartlett 2006) and Western (Eckert 2004; Fridland 2008) dialects. Lusk's (1976:77-78) brief discussion of FOOT appears to be the only information on the vowel in Kansas City. She notes older and lower-status speakers using tense [u] before [ʃ] (e.g., *push*). She also identifies a centralized production used by 56 percent of speakers younger than twenty years old, but by only 26 percent of speakers older than twenty (Lusk 1976:78). The vowel doesn't receive much additional attention, but it is again possible that she discovered an incipient change.

Figure 5.14 shows the distribution of FOOT productions in interview speech by following manner. The distribution of normalized means is tightly constrained in F1, with all following manner environments occurring within 100 Hz of each other. FOOT with following /l/ (BULL) appears back in F2. In lmer analysis, BULL is measured at F1:569 Hz, F2:986 Hz. BULL is excluded from mixed effects regressions in Tables 5.21 and 5.22. FOOT with following nasal is represented entirely by one token of *woman*, and will be excluded from analysis here as a singleton. FOOT with following /r/ (CURE) is discussed below and also excluded from consideration in this section. The CURE class is built from Wells's (1982:164) classification of words like *poor, tour, your,* etc. as /ʊ/. This assignment is imperfect; there is a good deal of variability in American dialects in the phonemic assignment of words that Wells (1982) places in this class. For instance, the

CMU Dictionary transcribes *poor* with a GOOSE vowel, *tour* with a FOOT vowel, and *your* with THOUGHT, FOOT, and (the reduced form) NURSE. Collecting these in a CURE class as laid out by Wells (1982) represents a desire to capture productions according to the same objective list as is followed for other word classes in this dissertation, rather than a judgment on their phonemic assignments in Kansas City English. Indeed, as will be seen, in Kansas City the types grouped into the CURE class have been generally redistributed into the NURSE and FORCE classes, so their being marked as CURE is merely notational.

Figure 5.14. Distribution of FOOT by following manner

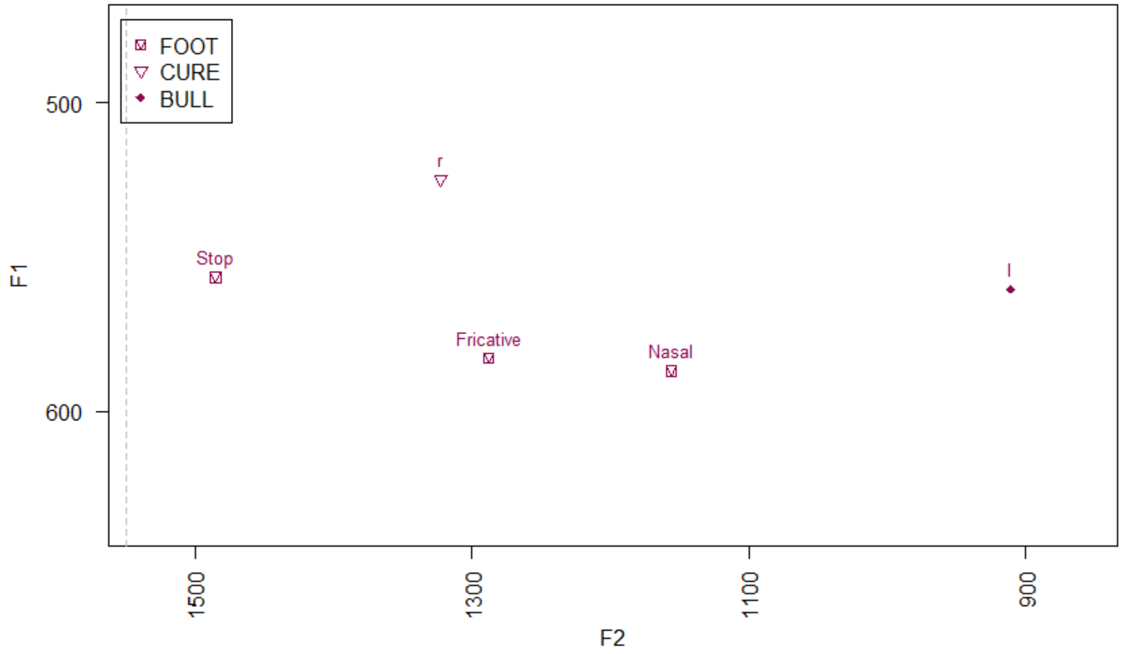


Table 5.21 shows lmer analysis for F1 of FOOT. The regression shows effectively no difference in height between FOOT with following stops and with following fricatives. Following coronals encourage slightly higher productions than following

velars, which in turn encourage higher productions than following labiodentals. Following voiced consonants encourage slightly higher productions than following voiceless. FOOT with preceding free position (FAVE marks the preceding context of /h/ as free, and this captures types like *hook* and *neighborhood*) is realized lower than with other preceding segments. Preceding glides, velars, and obstruent+liquid clusters encourage raising (obstruent+liquid clusters are represented primarily by tokens of *Brookside*, the name of a Kansas City neighborhood). Primary stress encourages higher productions in vowel space than does secondary stress position.

Table 5.21. Mixed effects regression of conditioning effects on FOOT F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmFricative (Intercept)	567.21	16.43	34.52	*push*
fmStop	-10.11	17.31	-0.58	*foot*
fpAlveolar (Intercept)	549.300	7.629	72.00	*put*
fpLabiodental	46.844	23.102	2.03	(*hoof*)
fpPalatal	-4.241	27.352	-0.16	*Busch*
fpVelar	17.230	11.041	1.56	*sugar*
fvVoiced (Intercept)	540.963	8.278	65.35	*goodness*
fvVoiceless	29.174	10.154	2.87	*rookies*
psAlveolar or Interdental Obstruent (Intercept)	557.67	18.36	30.382	*took*
psFree	44.46	22.14	2.008	*hooked*
psGlide	-28.59	20.56	-1.390	*wood*
psLabial (Oral)	19.95	19.71	1.012	*books*
psLiquid	-5.85	20.98	-0.279	*look*
psObstruent+Liquid Cluster	-24.91	33.97	-0.733	*Brookside*
psPalatal	-12.71	23.72	-0.536	*shook*
psVelar	-24.81	20.98	-1.183	*cook*
stress1 (Intercept)	554.332	6.249	88.71	*football*
stress2	22.549	13.990	1.61	*octopus*

Table 5.22 provides the lmer analysis of FOOT F2. As has been the case for other back vowels, the frontness dimension appears to show much more variation in

productions than does height. Following stops encourage fronting relative to following fricatives. Following alveolars encourage much fronter productions than other following manner environments. FOOT with following palatals is realized front compared with FOOT with following non-coronals, but is represented only by forms of *push* and *Busch*. Following voiced consonants strongly encourage fronting relative to following voiceless. Preceding coronals and velars also strongly encourage fronting, while preceding labials and liquids strongly encourage backing. FOOT in primary stress position is fronted relative to FOOT in secondary stress position.

Table 5.22. Mixed effects regression of conditioning effects on FOOT F2

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmFricative (Intercept)	1367.29	78.71	17.372	*push*
fmStop	75.00	83.02	0.903	*foot*
fpAlveolar (Intercept)	1525.69	34.22	44.58	*put*
fpLabiodental	-235.72	109.73	-2.15	(*hoof*)
fpPalatal	-125.87	116.14	-1.08	*Busch*
fpVelar	-182.87	49.37	-3.70	*sugar*
fvVoiced (Intercept)	1591.64	33.00	48.24	*goodness*
fvVoiceless	-249.02	40.35	-6.17	*rookies*
psAlveolar or Interdental Obstruent (Intercept)	1634.49	80.00	20.430	*took*
psFree	-232.58	99.03	-2.349	*hooked*
psGlide	-175.61	97.24	-1.806	*wood*
psLabial (Oral)	-322.91	91.48	-3.530	*books*
psLiquid	-315.88	97.70	-3.233	*look*
psObstruent+Liquid Cluster	-190.15	141.57	-1.343	*Brookside*
psPalatal	15.89	109.04	0.146	*shook*
psVelar	36.13	98.13	0.368	*cook*
stress1 (Intercept)	1440.82	31.18	46.21	*football*
stress2	-34.12	65.17	-0.52	*octopus*

Figure 5.15 and Table 5.23 show outputs of linear models of FOOT F1 and F2 as a change in apparent time. They reveal no changes in apparent time in either F1 or F2.

The high F2 values of two very young speakers, Madison Z and Samantha K, are interesting, but not suggestive in this data of a larger trend.

Figure 5.15. Linear models of FOOT F1 and F2 by interviewee birth year

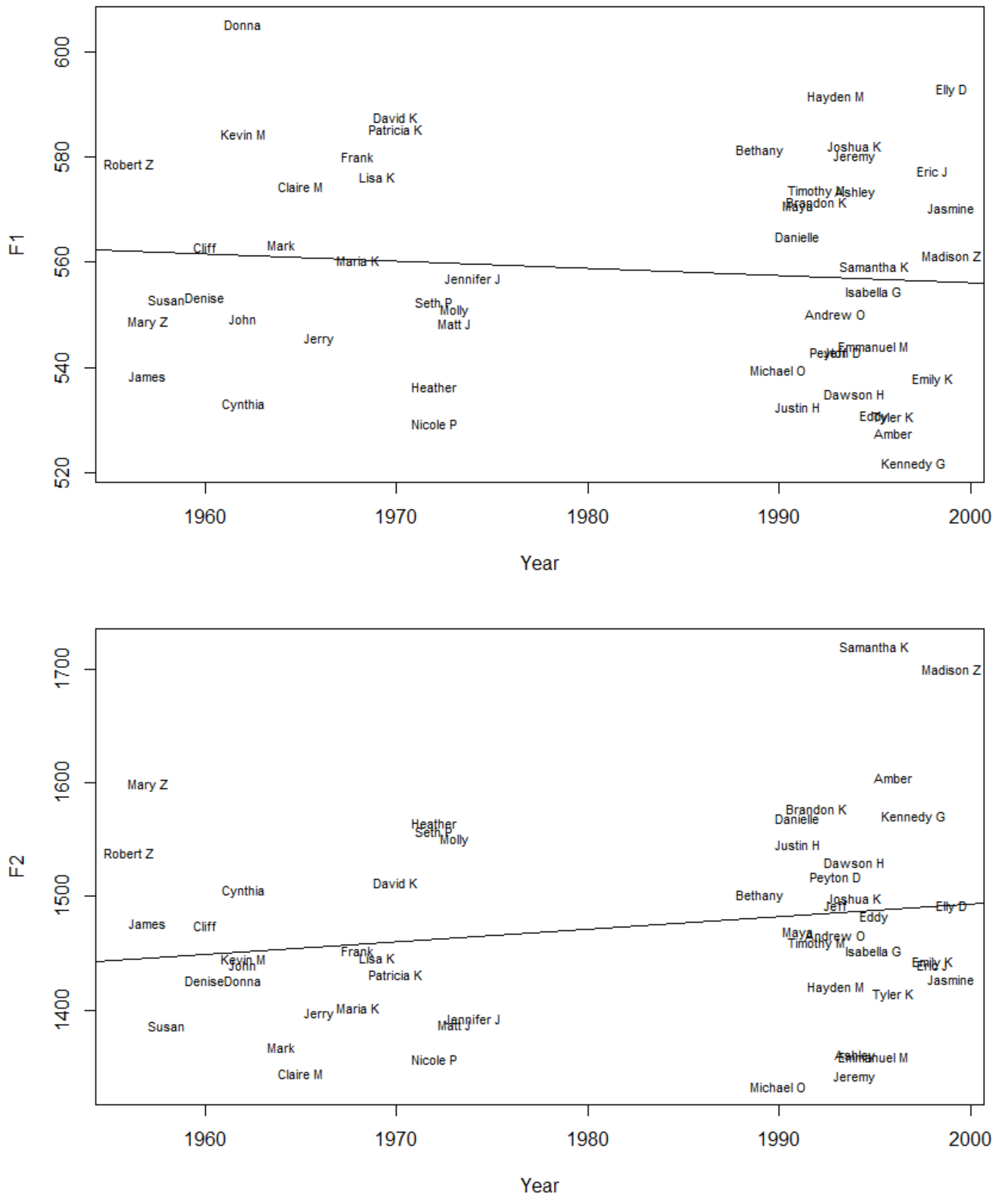


Table 5.23. Linear models of FOOT F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
FOOT F1 (Intercept)	830.9436	376.9678	2.204	0.0322
Year	-0.1374	0.1903	-0.722	0.4737
Residual standard error: 20.43 on 49 degrees of freedom Multiple R-squared: 0.01053, Adjusted R-squared: -0.009665 *F*-statistic: 0.5214 on 1 and 49 DF, *p*-value: 0.4737				
FOOT F2 (Intercept)	-695.5408	1578.9732	-0.441	0.662
Year	1.0943	0.7971	1.373	0.176
Residual standard error: 85.56 on 49 degrees of freedom Multiple R-squared: 0.03703, Adjusted R-squared: 0.01738 *F*-statistic: 1.884 on 1 and 49 DF, *p*-value: 0.1761				

The ANOVA analysis in Table 5.24 also suggests that there are few differences in FOOT production based on social factors.

Table 5.24. ANOVA model of FOOT F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	1080.4	1080.4	0.3634
Class	2	4600.9	2300.4	0.773
Sex:Class	2	3480.4	1740.2	0.5854
F2				
Sex	1	5416	5416	0.1551
Class	2	78131	39065	1.1186
Sex:Class	2	29845	14923	0.4273

While no *F* value in this calculation is high, it is worth noting that mixed effects regression calculates working class productions of FOOT F2 being about 25 Hz back of middle class FOOT F2, and transitional class FOOT F2 being 44 Hz back of middle class FOOT.

Figure 5.16 and Table 5.25 explore the specific environment of BULL for change in apparent time. They reveal no patterns of change for either F1 or F2.

Figure 5.16. Linear models of BULL F1 and F2 by interviewee birth year

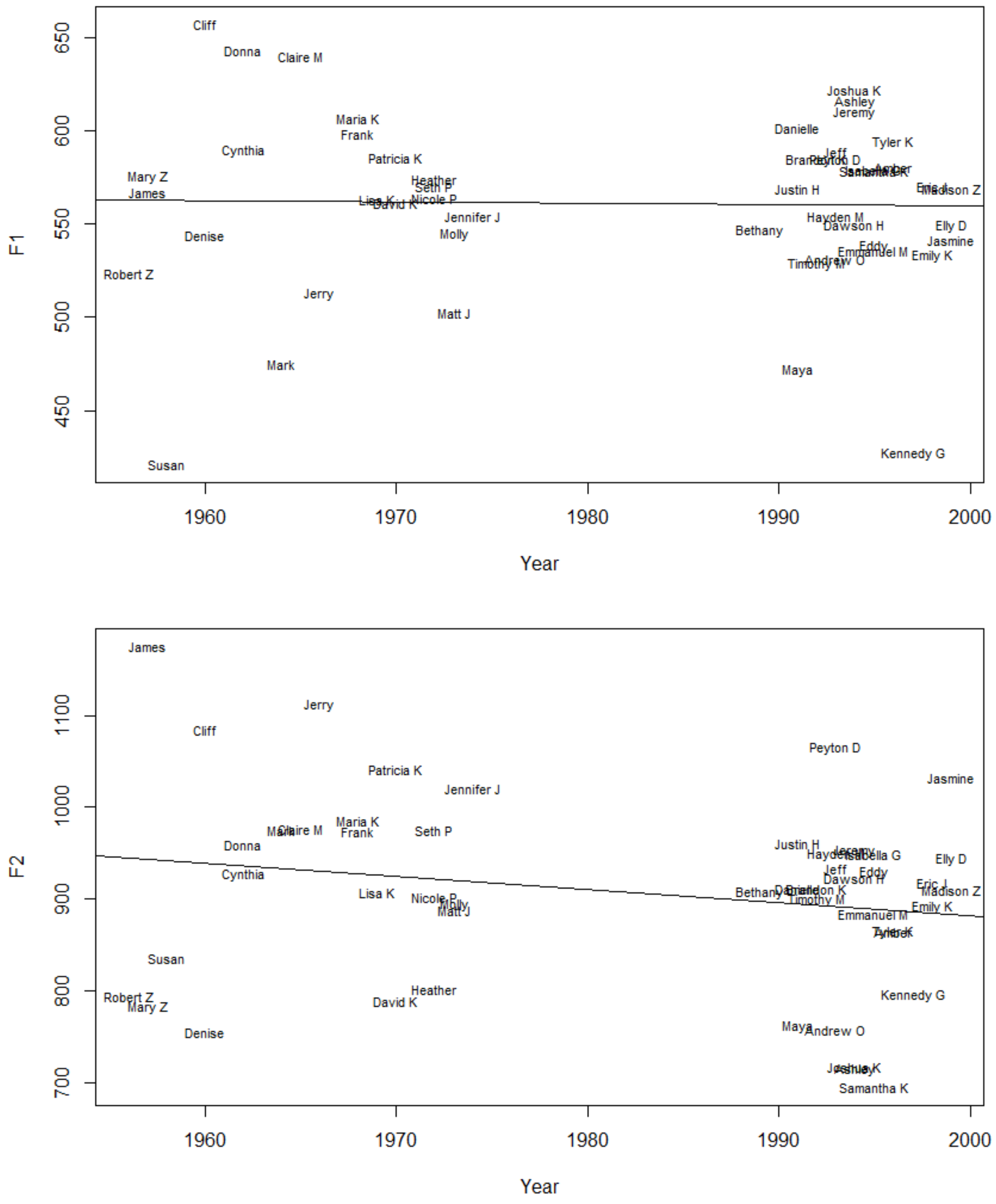


Table 5.25. Linear models of BULL F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
BULL F1 (Intercept)	718.56696	927.53736	0.775	0.442
Year	-0.07953	0.46812	-0.170	0.866
Residual standard error: 48.46 on 46 degrees of freedom Multiple R-squared: 0.000627, Adjusted R-squared: -0.0211 *F*-statistic: 0.02886 on 1 and 46 DF, *p*-value: 0.8658				
BULL F2 (Intercept)	3700.453	1986.674	1.863	0.0689
Year	-1.409	1.003	-1.405	0.1666
Residual standard error: 103.8 on 46 degrees of freedom Multiple R-squared: 0.04117, Adjusted R-squared: 0.02033 *F*-statistic: 1.975 on 1 and 46 DF, *p*-value: 0.1666				

A minor qualitative observation from Figure 5.16 is that, among the younger interviewees, those with the backest productions (Andrew O, Ashley, Maya, Joshua K, Samantha K) are all working class or transitional class. While this is an interesting note for consideration, the ANOVA shown in Table 5.26 does not suggest that class is an important factor in accounting for variation in BULL F2.

Table 5.26. ANOVA model of BULL F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	3.9	3.9	0.0014
Class	2	0539.8	5269.9	1.8262
Sex:Class	2	10780.5	5390.2	1.8678
F2				
Sex	1	34442	34442	2.6710
Class	2	7768	3884	0.3012
Sex:Class	2	1020	510	0.0396

In lmer analysis, females produce BULL F2 about 49 Hz back of males. Neither gender shows a significant pattern of change in time in linear modeling, though, when they are examined in isolation. Like FOOT, BULL appears to be rather static among Kansas Citians.

It is a bit surprising that more obvious trends do not emerge for BULL, because impressionistically BULL, BOWL, and POOL appear to be undergoing several different patterns of merger. The lack of a clear direction of change here complicates the explanation of those observed patterns. They will be explored in Section 5.7 for an underlying order.

For now, it is sufficient to say that FOOT does not show a pattern of change in Kansas City. Its realization is fairly high and near-back or central except in the case of BULL. BULL is back, and appears to have been there longer than the data in this study can account for.

5.5. Summary – MOUTH, GOAT, GOOSE, and FOOT

The analysis of the back vowels to this point has shown that older interviewees have relatively front productions for all four vowels. For younger interviewees, four relatively distinct patterns emerge.

MOUTH appears to have reached the end of its fronting. In the specific case of pre-nasal MOUTH, that fronting has reversed and the vowel is retracting; several young females also show backer productions of MOUTH in other contexts, which may represent the beginning of an incipient change.

GOAT is still fronting, but the process seems to be slowing. GOAT with preceding coronal seems to have stopped fronting, while GOAT with other preceding segments continues to front. Likely, GOAT fronting is a change nearing completion.

GOOSE is also still fronting. But here it is GOOSE with preceding coronal that continues to front, while other preceding segments appear to have stopped fronting. GOOSE fronting may also be a change nearing completion.

FOOT does not appear to be changing in time. It appears in this data to be stable.

It is difficult to make general conclusions from these phonetic observations. The fronting of the back vowels—at least, GOOSE, GOAT, and MOUTH—is often treated as a case of parallel shifting (e.g., Labov 1994, 2010; Labov, Rosenfelder & Fruehwald 2013; Fruehwald 2013). It is difficult to make a case that parallel changes are occurring among these vowels in Kansas City. MOUTH shows some parallel conditioning in F2 from preceding segments relative to GOOSE or GOAT synchronically, but diachronically it appears to be taking on a different trajectory.

GOOSE and GOAT F2 make a better case for structural relatedness. Table 5.27 and Figures 5.17 and 5.18 model GOOSE and GOAT F2 against one another for all interviewees by preceding coronal and non-coronal. Both models show a fair amount of agreement. So, even though the continuing apparent time changes in GOOSE and GOAT seen in this study occur in different environments, (preceding coronals for GOOSE; preceding non-coronals for GOAT), there is still a case to be made for GOOSE and GOAT fronting in parallel.

Table 5.27. Linear model of GOOSE and GOAT F2

	Estimate	Std. Error	*t* value	Pr(>|t|)
Preceding coronal				
GOOSE F2 (Intercept)	1054.1835	330.0000	3.194	0.00245
GOAT F2	0.6368	0.2213	2.877	0.00593
Residual standard error: 87.91 on 49 degrees of freedom Multiple R-squared: 0.1445, Adjusted R-squared: 0.127 *F*-statistic: 8.277 on 1 and 49 DF, *p*-value: 0.005932				
Preceding non-coronal				
GOOSE F2 (Intercept)	463.2292	338.5730	1.368	0.17750
GOAT F2	0.8852	0.2538	3.488	0.00104
Residual standard error: 122.5 on 49 degrees of freedom Multiple R-squared: 0.1989, Adjusted R-squared: 0.1825 *F*-statistic: 12.16 on 1 and 49 DF, *p*-value: 0.001039				

Figure 5.17. Linear model of F2 of GOOSE and GOAT following coronals

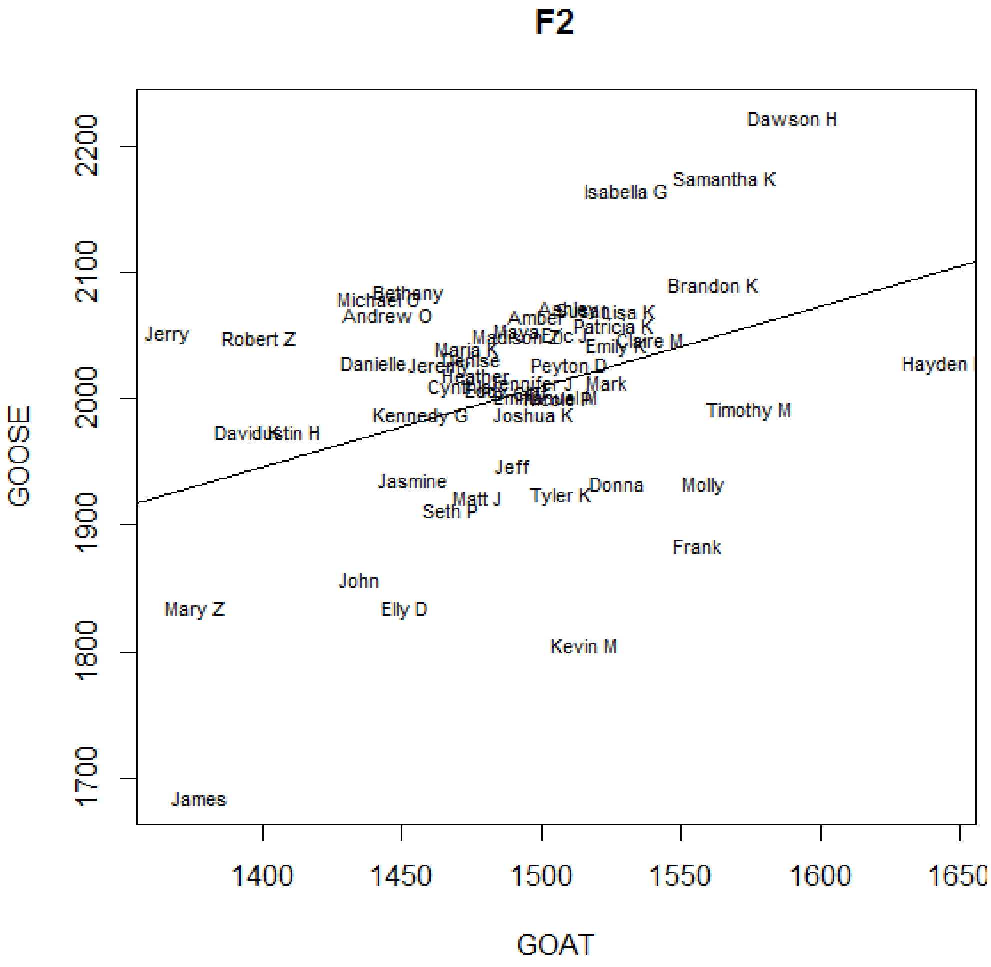
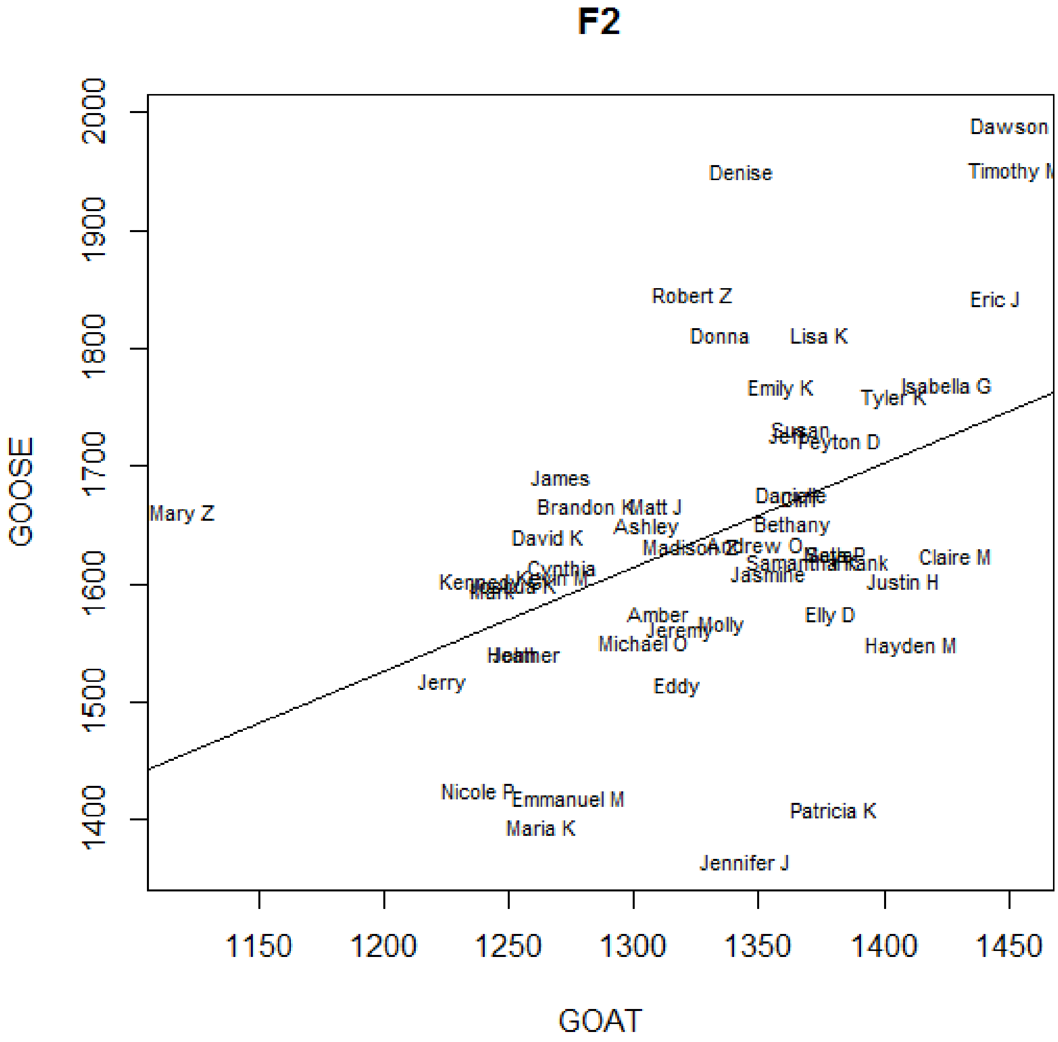


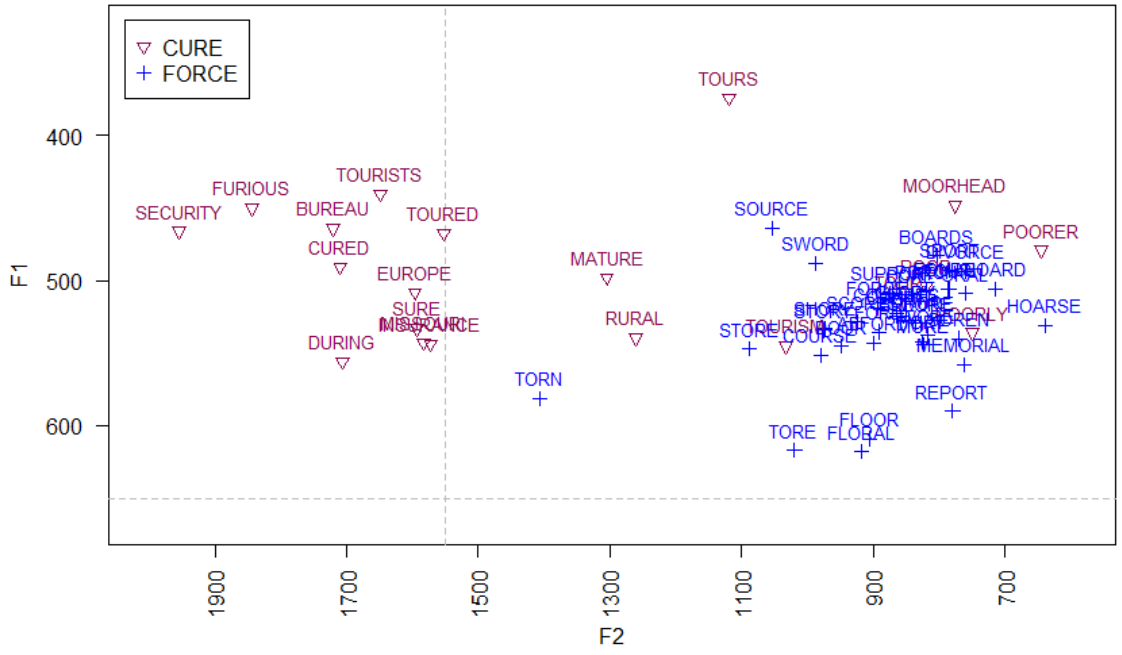
Figure 5.18. Linear model of F2 of GOOSE and GOAT following non-coronals



5.6. CURE, NURSE, FORCE, NORTH, and START

To this point, discussion of vowels preceding /r/ has been extremely limited. The back vowels offer an opportunity to discuss effects of that phonetic context. Figure 5.19 plots mean values for tokens of CURE and FORCE. Ideally, NURSE would also be plotted, but that class is heavily represented casual speech and visually obscures the CURE tokens when plotted here.

Figure 5.19. Mean values of tokens of CURE and FORCE in casual speech



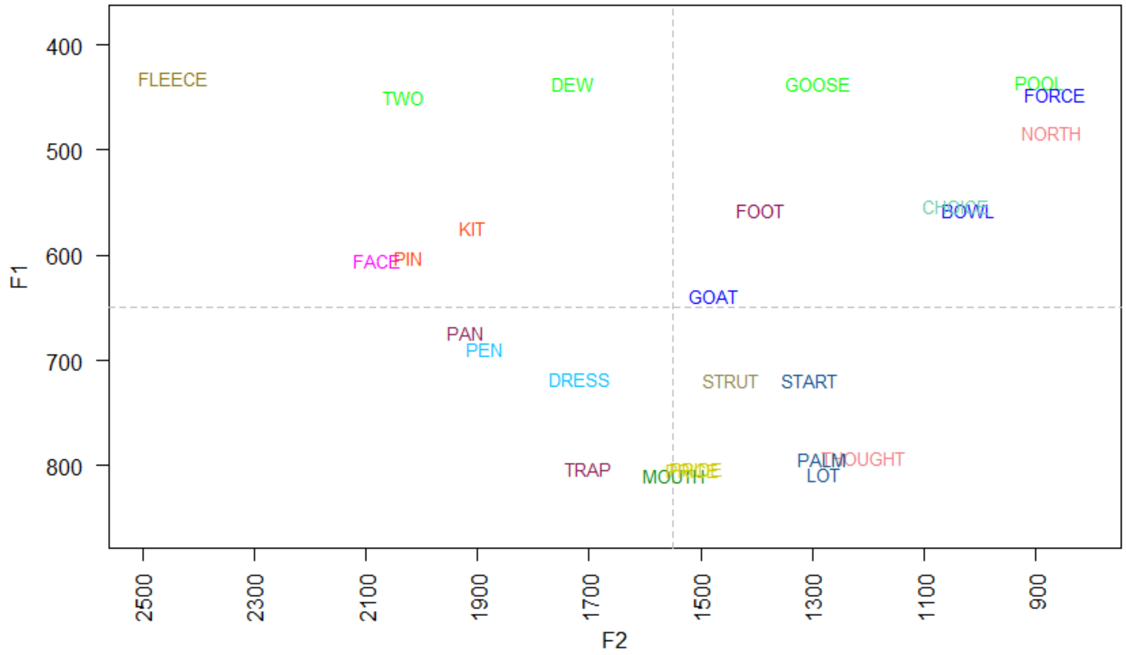
Roughly half the CURE tokens overlap with FORCE. The other half distribute as NURSE. CURE has undergone a split, and the two resulting classes have merged with either NURSE or FORCE.

There seems to be some potential for social marking for the assignment of types to these sets. Derivations of *tour* may be a useful point of future exploration. Three productions of *tour* show up in Figure 5.19, as *tourist* and *tourism* with [o] produced near *store*; *tourists* and *toured* produced with [ɝ] near *bureau* (here [bjɝo]) in a central position; and *tours* produced disyllabically as [tuɝ], which plots in a high position as [u] in Figure 5.19. During public presentations of early findings from my research, a number of people expressed dislike for the pronunciation [tor], seemingly prompted by discussion of the (unrelated) mergers among POOL, BULL, and BOWL. I did not recognize this as a potential site for social evaluation during my research, but note it as a possible area for future work. There are only a few tokens of derivations of *tour* that occur in interviews. It happens that NURSE-like productions occur among young interviewees who grew up in Independence, MO and FORCE-like productions occur among interviewees who grew up in KCMO, but that is only anecdotal at this time.

The more general observation is that CURE appears to have merged completely into NURSE and FORCE, but some lexical differences in assignment may lead to sociolinguistic differences that merit future study. It is also noteworthy that, structurally, the dissolution of a CURE class has left open the high back space in contexts of following /r/, which is typically discussed with regard to back vowel shifts (e.g., in the Southern Shift in Labov, Yaeger & Steiner 1972 and Labov 1994; in Philadelphia in Labov 2001). In my data, a number of speakers show high back realizations of FORCE (and CURE). The vowel system of Jennifer J, who was born in 1974 and grew up in KCK, is plotted in Figure 5.20 illustratively, but Susan (Independence, b. 1958), Cynthia (Independence, b. 1961), Frank (KCMO, b. 1968), Matt J (Pleasant Hill, MO, b. 1973), Molly (KCMO, b. 1973), and Madison Z (KCMO, b. 1999) show similar configurations. A locally specific pattern of raising may be of future interest, but no clear patterns emerge in gender, class, or apparent time when all interviewees are taken into consideration. For now, I note that the potential for raising among FORCE (which has merged with NORTH) and CURE exists in Kansas City for future study.

Linear modeling suggests a slight structural relationship between FORCE and START F1 for the formula {START F1 = 0.2704 * FORCE F1 + 588.008} ($R^2 = 0.072$, $p = 0.032$). So, the underpinnings for a following-/r/-conditioned back vowel chain shift may be in place in Kansas City. Continued real time study is needed to see whether this materializes.

Figure 5.20. Vowel system of Jennifer J, born in KCK in 1974, illustrating a high back configuration of NORTH and FORCE



5.7. POOL, BULL, and BOWL

Analyses above place mean values of POOL, BULL, and BOWL in relatively close proximity in Kansas City. Each is very back, and POOL and BOWL appear to be continuing to back. Figure 5.21 shows mean productions for back vowels with following /l/ (plus STRUT, to be discussed in Chapter 6). The plot window shows the entire vowel space to help make visual sense of the small phonetic differences that have resulted from various backing trends. As shown here, these collapse the difference between POOL and BULL in F2. The F1 distance between BOWL and BULL (and pre-/l/ STRUT—GULL) is also negligible. Euclidean distances and Pillai scores among these vowels are provided in Table 5.28 (all Pillai scores are highly significant at $p < 0.001$). LOT and THOUGHT with following /l/ are also provided for comparison against a set that I have already argued is phonemically merged in Kansas City.

Figure 5.21 Mean distributions of back vowels before /l/ in interview speech

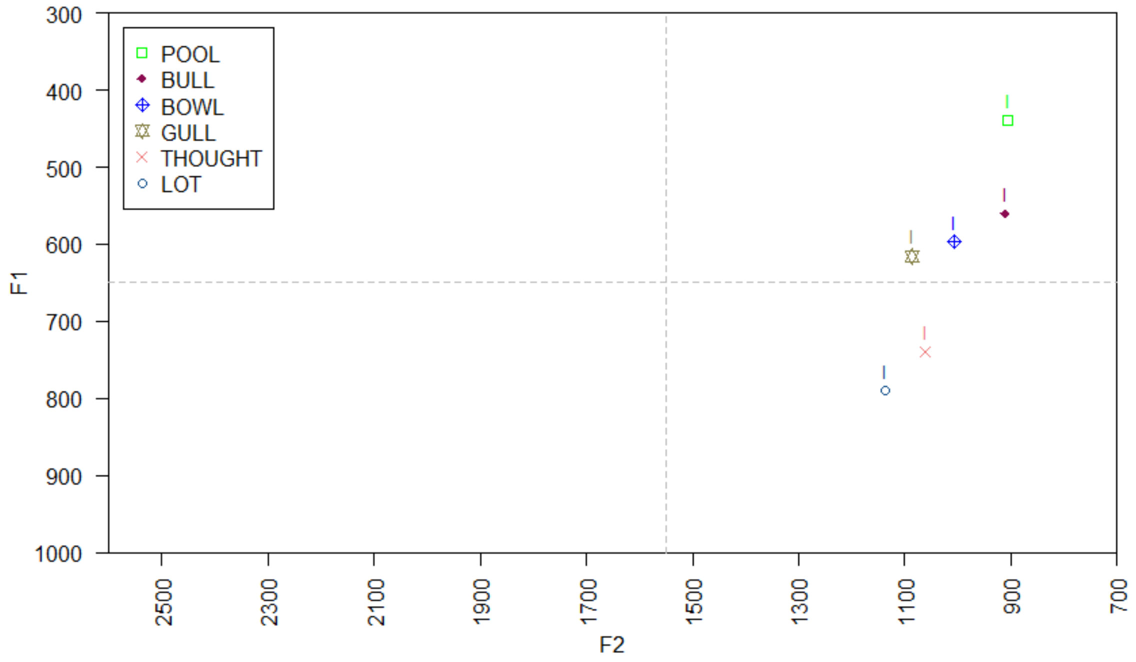


Table 5.28. Euclidean distances and Pillai scores among POOL, BULL, BOWL, and GULL in interview speech

	POOL	BOWL	BULL
BULL	Euclidean: 121.68 Pillai: 0.52507	Euclidean: 103.57 Pillai: 0.089604	
BOWL	Euclidean: 188.25 Pillai: 0.68046		
GULL	Euclidean: 252.13 Pillai: 0.63979	Euclidean: 79.84 Pillai: 0.033467	Euclidean: 183.05 Pillai: 0.28926

In Chapter 3, I pointed to 100 Hz as a potential threshold in Euclidean distance below which vowels might be considered merged. By this standard, BOWL appears to be merged with GULL. I will return to GULL in Chapter 6. BOWL also appears very likely to be merged with BULL. BULL is also very near this threshold with POOL—though obviously the Pillai score shows a much greater dispersion of these two sets.

Conditioned mergers in these phonetic contexts are widespread across the United States. Labov, Ash, and Boberg (2006:70) identify one Kansas Citian as merged between POOL and BULL. Ash (2006:42-43) notes that data on the potential merger of BULL and BOWL is limited in *ANAE*, because it was added to the interview schedule later in the survey, but recognizes that weakening in that distinction is actually more advanced in the Midland than is the weakening of the distinction between POOL and BULL.

Among interviewees, both patterns of merger are present—though, as my lexical set labels suggest, I analyze the merger of BOWL and BULL to be more important. Figure 5.22 displays Euclidean distances Pillai scores for POOL and BULL by interviewee as an effect of time. Table 5.29 provides outputs of the models. The models are not significant, but reflect the wide range of realizations of POOL and BULL, from speakers whose measurements suggest merger (e.g., Maya and Kennedy G) to others whose measurements suggest strong distinctions (e.g., the K family, Donna, Heather). No trends in either plot are immediately apparent. Among older interviewees, the Pillai scores that are plotted above the regression line belong to women, though several women also appear below the regression line. This could be a gender effect for higher Pillai scores among older interviewees, but this is not a strong finding. Prestige and SEI scores show no clear effects in linear models.

Figure 5.22. Linear models of distances between POOL and BULL by interviewee according to birth year

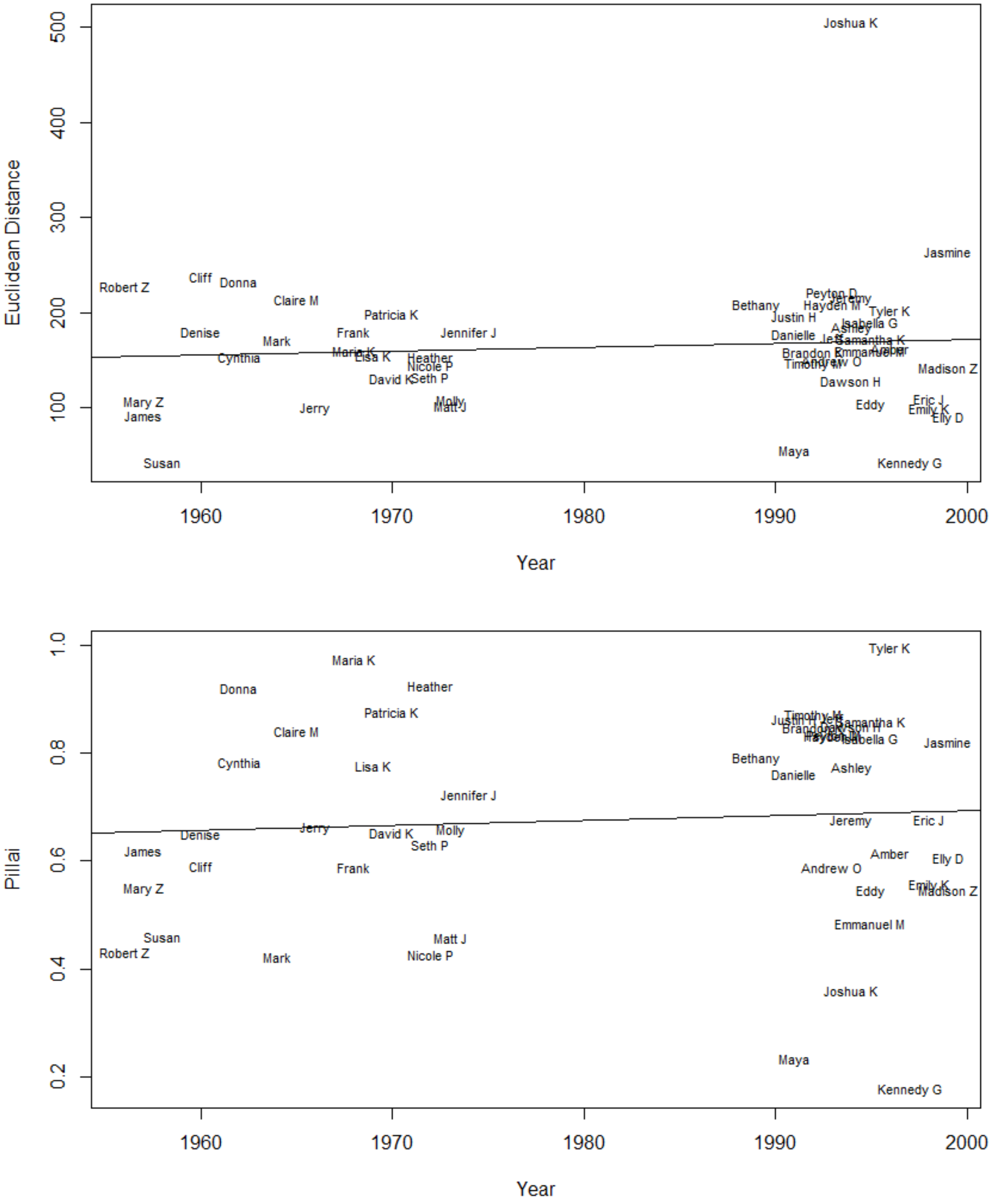


Table 5.29. Linear models of distances between POOL and BULL by interviewee according to birth year

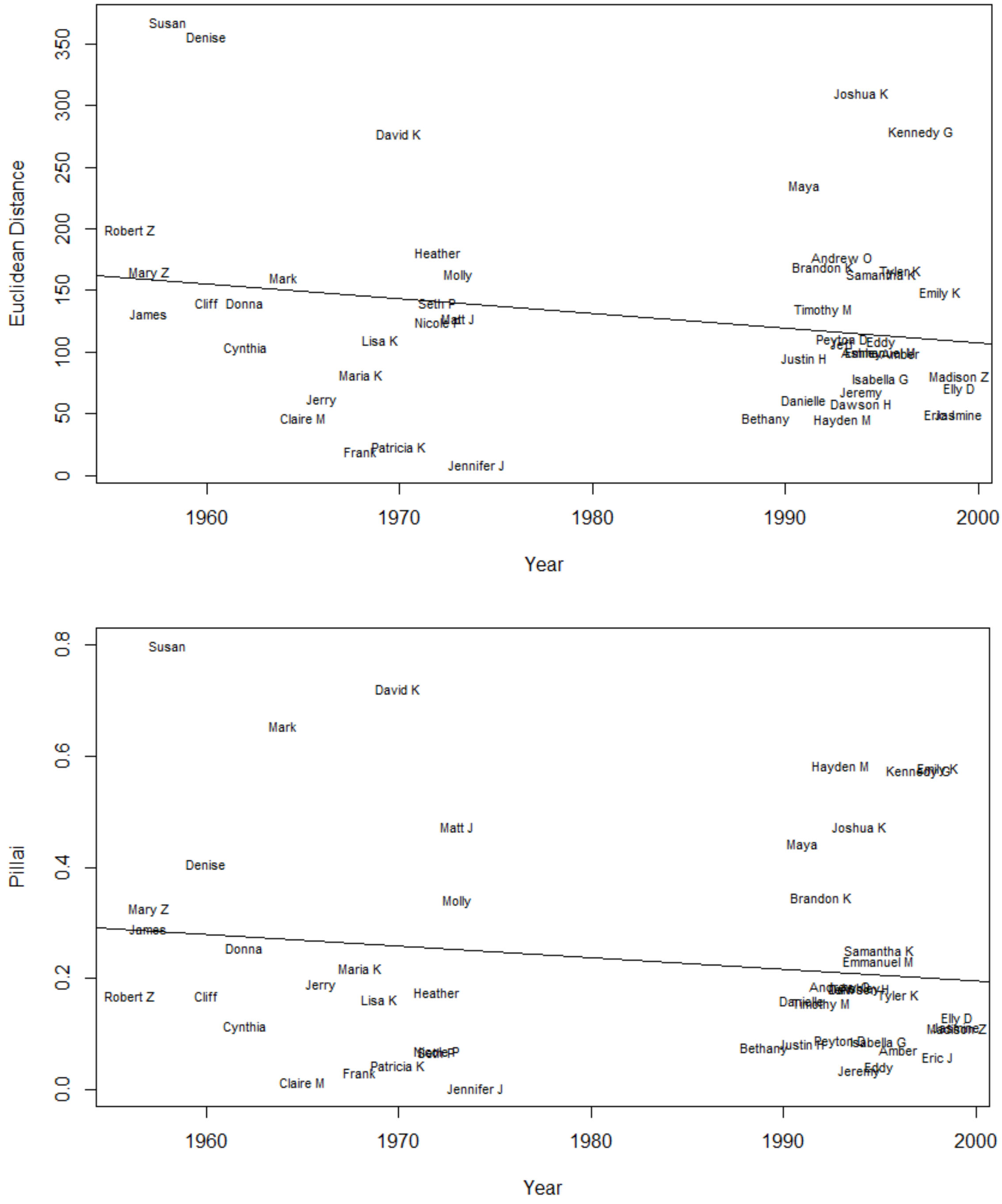
	Estimate	Std. Error	*t* value	Pr(>|t|)
Euclidean distance (Intercept)	-647.7667	1384.5151	-0.468	0.642
Year	0.4097	0.6988	0.586	0.560
Residual standard error: 72.34 on 46 degrees of freedom Multiple R-squared: 0.007419, Adjusted R-squared: -0.01416 *F*-statistic: 0.3438 on 1 and 46 DF, *p*-value: 0.5605				
Pillai score (Intercept)	-1.1100141	3.6644183	-0.303	0.763
Year	0.0009015	0.0018494	0.487	0.628
Residual standard error: 0.1915 on 46 degrees of freedom Multiple R-squared: 0.005139, Adjusted R-squared: -0.01649 *F*-statistic: 0.2376 on 1 and 46 DF, *p*-value: 0.6282				

Table 5.30 and Figure 5.23 model Euclidean distances and Pillai scores for BOWL and BULL.

Table 5.30. Linear models of distances between BULL and BOWL by interviewee according to birth year

	Estimate	Std. Error	t value	Pr(>|t|)
Euclidean distance (Intercept)	2501.7860	1558.2150	1.606	0.115
Year	-1.1971	0.7864	-1.522	0.135
Residual standard error: 81.41 on 46 degrees of freedom Multiple R-squared: 0.04795, Adjusted R-squared: 0.02726 *F*-statistic: 2.317 on 1 and 46 DF, *p*-value: 0.1348				
Pillai score (Intercept)	4.320317	3.807801	1.135	0.262
Year	-0.002062	0.001922	-1.073	0.289
Residual standard error: 0.1989 on 46 degrees of freedom Multiple R-squared: 0.02441, Adjusted R-squared: 0.003205 *F*-statistic: 1.151 on 1 and 46 DF, *p*-value: 0.2889				

Figure 5.23. Linear models of Euclidean distances and Pillai scores between BOWL and BULL by interviewee according to birth year



The models are still non-significant, but lend themselves a bit more comfortably to analysis. Several interviewees (e.g., Claire M, Frank, Jennifer J, Patricia K) plot near the bottom of each graph, showing extremely close productions of the sets. Younger interviewees show a smaller range of Pillai scores than do older interviewees, and on balance they cluster nearer the lower end of scores in both plots. Despite the lack of model significance, qualitatively, these values suggest that BOWL and BULL are more merged in Kansas City than are POOL and BULL.

There is a fair amount of correspondence between higher distance measurements in the model for one of the mergers and lower distance measurements in the model for the other merger. This suggests that, rather than individual interviewees showing a three-way merger between POOL, BULL, and BOWL, there are two separate mergers. For example, Kennedy G has a low Pillai score in Figure 5.22 and a high Pillai score in Figure 5.23. Claire M has a high Pillai score in Figure 5.22 and a low Pillai score in Figure 5.23. There are exceptions to this that bear exploration—e.g., Robert Z’s Pillai scores are fairly low for both vowels. But, overall, this suggests that speakers are moving toward either one merger or the other.

The minimal pairs portion of the interview included three pairs intended to test interviewee perceptions and productions of these vowels directly: *pull-pool, full-fool, bowl-bull*. I’ll explore results from *pull-pool* and *bowl-bull* here. (I exclude *full-fool* in order to focus on a direct comparison of responses to one minimal pair versus the other, rather than on different responses to different pairs testing the same potential merger.) Figure 5.24 plots interviewee judgments of the two pairs for older and younger interviewees.

Figure 5.24. Interviewee judgments of minimal pairs of *pull-pool* and *bowl-bull* by age group

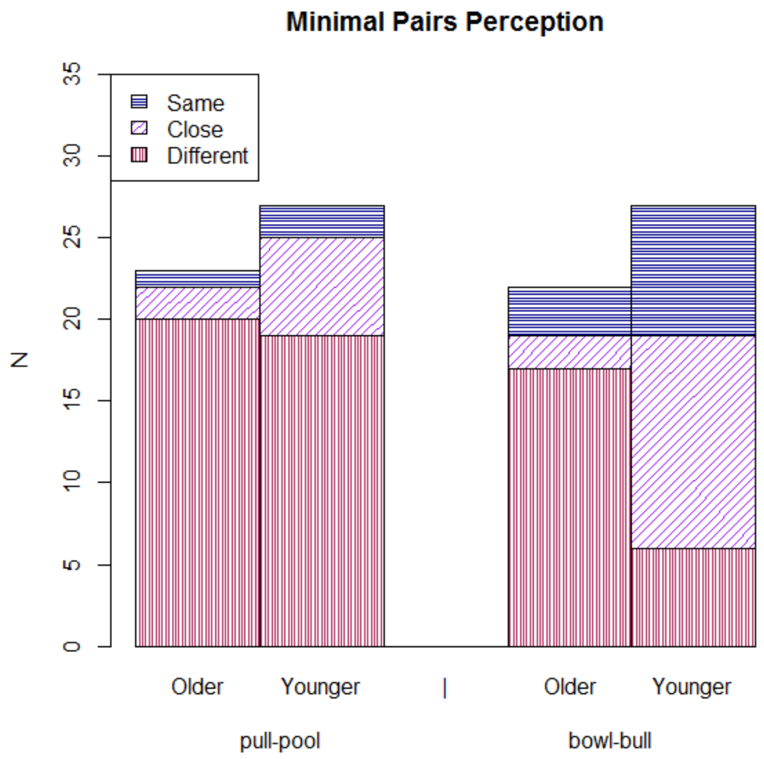
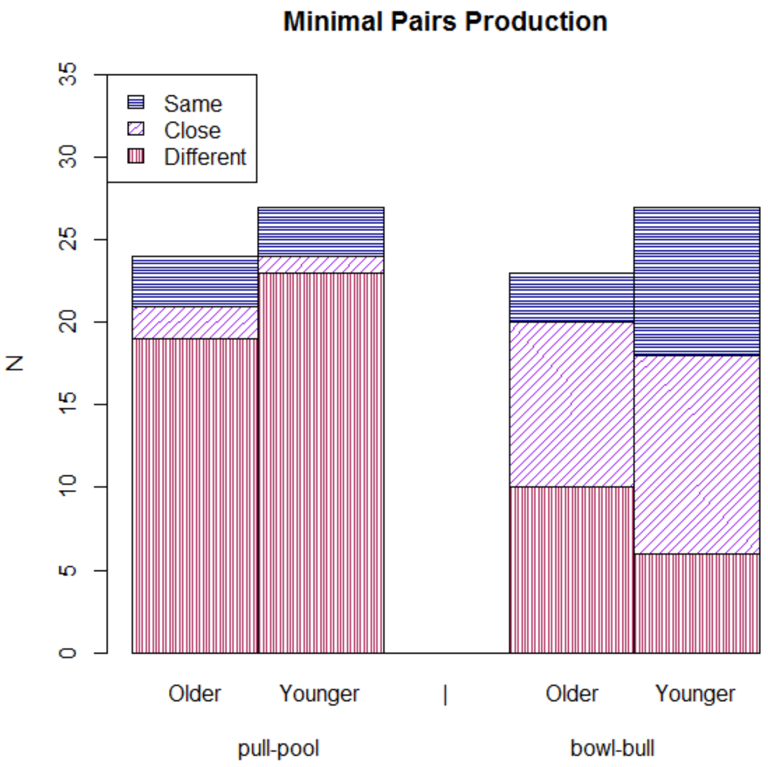


Figure 5.24 shows a dramatic increase among younger interviewees in the perception of *bowl-bull* as the same or close. While eighteen older interviewees label the pair different, just six younger interviewees label them different. The most striking increase is in the number of people who perceive the pair as close. The number of interviewees who perceive *pull-pool* as same or close also increases in apparent time, but to a smaller degree. Most of the growth is in perceptions of close, which increase from three older interviewees to six younger interviewees. One younger interviewee, Kennedy G, calls both pairs the same. Five younger interviewees, Amber, Ashley, Emmanuel M, Samantha K, and Timothy M, indicate both pairs are close. No older interviewees perceive both pairs as the same or close. These responses suggest a rapid closing of the

perceptual space between *bowl* and *bull*, but also a possible incipient weakening of the perceptual distance of *pool* from *pull* and (potentially) *bowl*.

Figure 5.25 graphs my judgments of interviewee minimal pairs.

Figure 5.25. Interviewee productions of minimal pairs of *pull-pool* and *bowl-bull* by age group



Interviewee productions lead to a different understanding of the progress of these mergers. My impressionistic codings of *pull-pool* in particular, show an opposite trend from that suggested by interviewee perceptions, with a relative increase in the number of young interviewees who produce *pull* and *pool* differently. Production results also suggest that older interviewees are much more merged for *bowl-bull* than they perceive themselves to be. I code eleven older interviewees as close in *bowl-bull*, compared with twelve younger interviewees. This suggests that, rather than the merger of *bowl* and *bull* suddenly exploding among younger interviewees, it was actually well underway among older interviewees. The increase in productions of the pair as the same or close has been rather gradual. The dramatic increase, instead, appears to be in the perception that *bowl* and *bull* are close rather than different. It seems that the older generation produced *bowl-bull* as close but perceived them as different, and that the younger generation more accurately matched the pair's phonemic status to the phonetic productions they inherited. On the other hand, with *pull-pool* it appears that all interviewees produce the pair slightly more phonetically different than they perceive them to be phonemically.

Figures 5.26 and 5.27 reproduce the graphs of perception and production results for the minimal pairs, this time divided by gender. The different response level between the two pairs results from Lisa K's misreading the *bowl-bull* pair, so that neither her judgment of the pair nor my judgment of her production can be included. Donna's responses to the phonemic status of both pairs are unclear, too, however her reading still affords a production judgment.

Between the two figures, the pair *pull-pool* mirrors the slight difference in perception versus production seen above. More interviewees perceive themselves as close than I impressionistically code as close. There appears to be a slight female lead in both perception and production of the pair as same or close. Interestingly, males seem to be worse at correctly describing the status of these vowels—I score more males as different than do male interviewees, but when I score them as something besides different, I score them as same while they perceive themselves to be close. The pair *bowl-bull* suggests a slight male lead in both perception and production. Males appear slightly more likely to

Figure 5.26. Interviewee perceptions of minimal pairs of *pull-pool* and *bowl-bull* by sex

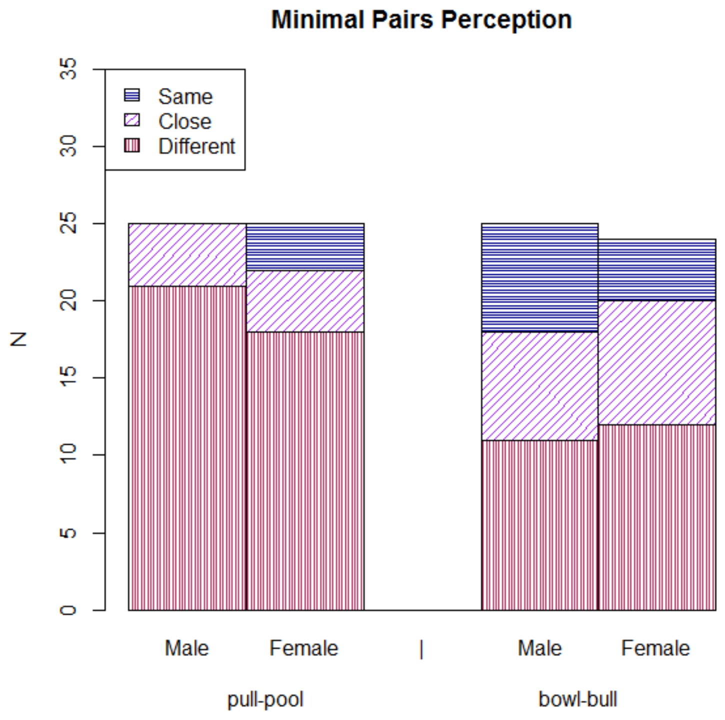
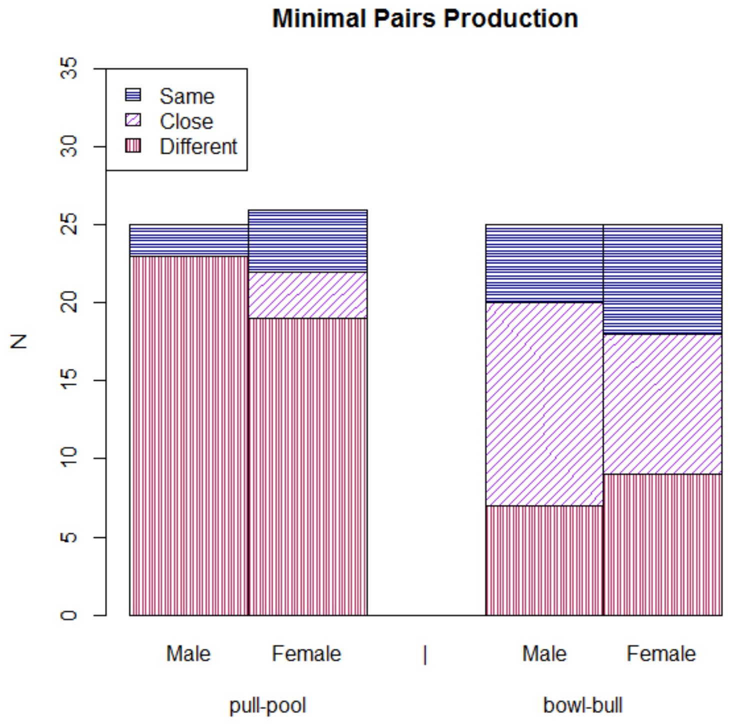


Figure 5.27. Interviewee productions of minimal pairs of *pull-pool* and *bowl-bull* by sex



perceive the pair as the same, while females appear slightly more like to produce the pair as the same.

Figures 5.28 and 5.29 split minimal pairs perception and production responses along class lines. For *pull-pool,* there is again an increase in the number of productions as same rather than close, particularly among transitional and working class interviewees. Middle class interviewees actually perceive themselves as more merged than I perceive them to be in production. For *bowl-bull* all classes are judged to be more merged in production than they judge themselves to be in perception. Middle class interviewees in particular, seem to claim to perceive the pair as distinctly different at higher rates than they actually produce them. Actual production values are fairly similar across classes, though working class speakers are judged to be fully merged in *bowl-bull* at higher rates

Figure 5.28. Interviewee perceptions of minimal pairs of *pull-pool* and *bowl-bull* by class

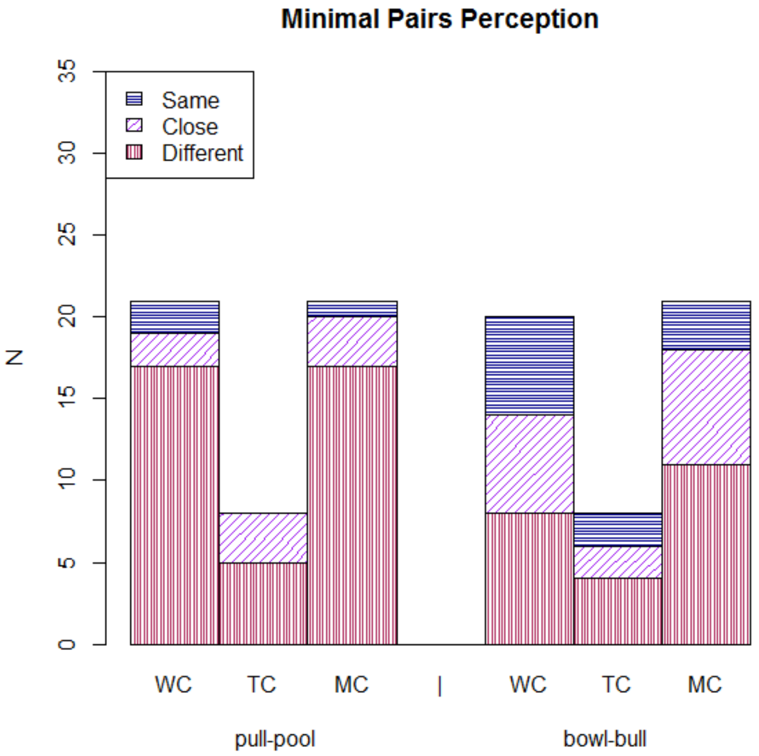
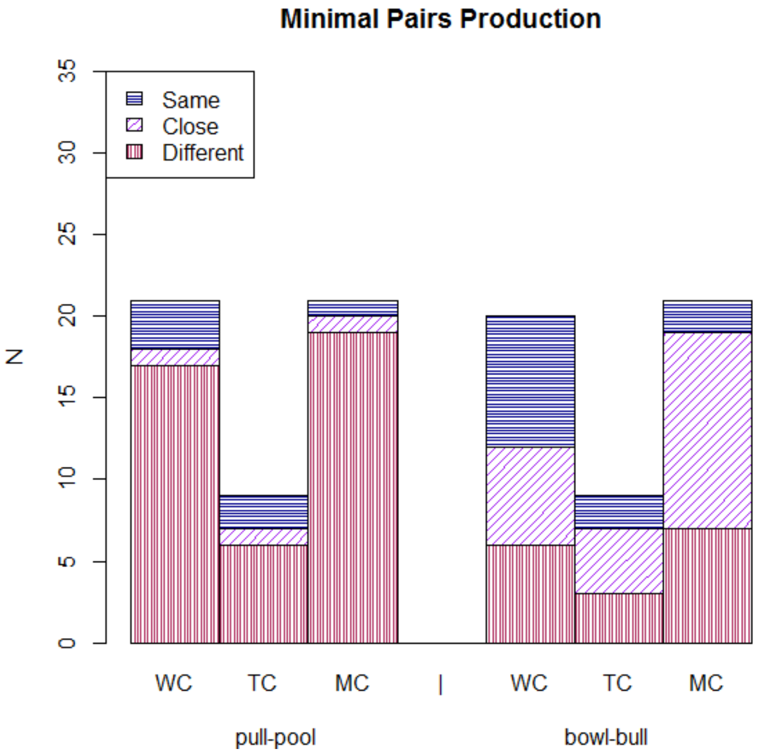


Figure 5.29. Interviewee perceptions of minimal pairs of *pull-pool* and *bowl-bull* by class



than are other classes. This suggests a slight working class lead for the merger of BULL and BOWL.

Interpretation of these results is not easy, and does not mesh neatly with observations on either the LOT-THOUGHT merger or the PIN-PEN merger. The former seemed to progress rapidly in perception and production in apparent time. The latter seemed to be progressing among older interviewees, but then to split into two trajectories, with a set of (especially male) interviewees moving to completion and a set of (especially female) interviewees maintaining a distinction. POOL-BULL was present in the community but has receded slightly in production in apparent time, though not in perception. BOWL-BULL is well established in Kansas City in production, and perception is rapidly catching up in apparent time. PIN-PEN and BOWL-BULL appear to show similar social correlates, with slight leads in production among non-middle class speakers and males.

Tables 5.31 and 5.32 measure distances among all productions in the POOL, BOWL, and BULL sets according to perception and production during minimal pairs tests. Table 5.31 shows results for *pull-pool*. Table 5.32 shows results for *bowl-bull*. Numbers of interviewees for each judgment appear in parentheses in the first column. These do not always add up to fifty-one (the total number of interviewees), because there were a few cases where responses were not interpretable or where no vowels for a given lexical set were correctly measured in FAVE.

Table 5.31. Distances between POOL and BULL by perception and production of merger

pull-pool		POOL	BULL	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Perception Same (3)	F1	447.7	461.1	14.68	-0.6144	0.557	0.021967	0.7166
	F2	778.1	784.0		-0.1639	0.8731		
Perception Close (8)	F1	449.5	556.8	107.28	-9.8597	< 0.001	0.51043	< 0.001
	F2	840.9	842.0		-0.0387	0.9692		
Perception Different (39)	F1	435.8	565.9	130.77	-25.2301	< 0.001	0.53287	< 0.001
	F2	908.6	921.9		-0.9114	0.3628		
Production Same (6)	F1	503.0	441.0	69.08	4.386	< 0.001	0.26223	< 0.001
	F2	882.3	912.9		-1.1176	0.268		
Production Close (3)	F1	408.3	579.4	193.57	-9.0209	< 0.001	0.7359	< 0.001
	F2	852.3	942.8		-1.7319	0.09277		
Production Different (42)	F1	439.2	569.2	129.77	-26.0665	< 0.001	0.5381	< 0.001
	F2	892.7	896.9		-0.2959	0.7674		

Interviewee judgments of the status of the POOL and BULL merger in their own speech appear to predict the presence of the merger reliably. In Euclidean distances and in Pillai scores for vowel, dispersion increases as perception judgments move from same to close to different—though the productive difference between judgments of close and different appear to be relatively small. This is not so clearly the case in my production judgments, as the measurements for speakers judged different are smaller than for those speakers judged close. However, in all cases, the key measurement appears to be in F1. F1 *t*-scores for both perception and production increase dramatically in moving from same to close to different. This is emphasized by the *t*-Test result for F1 in perception judgments of same, which is non-significant. In the case of production judgments of same, speakers who are heard as merged have flipped the vowels in F1, so that POOL is lower in vowel space than BULL. Measurements for POOL for these speakers show an F1 mean at 503 Hz—roughly in the middle of the F1 space of POOL and BULL measured for interviewees judged to be close or different.

Table 5.32. Distances between BOWL and BULL by perception and production of merger

bowl-bull		BOWL	BULL	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Perception Same (11)	F1	592.7	570.6	86.43	1.8023	0.07692	0.083518	0.0268
	F2	994.8	911.2		2.5556	0.01269		
Perception Close (15)	F1	578.0	557.5	59.97	2.1939	0.03028	0.058832	0.004816
	F2	922.3	865.9		2.6634	0.008666		
Perception Different (23)	F1	595.3	556.8	53.86	4.8772	< 0.001	0.084075	< 0.001
	F2	955.3	917.7		2.1302	0.03461		
Production Same (12)	F1	585.7	590.5	100.26	-0.4403	0.6607	0.11579	0.001149
	F2	938.8	838.6		3.9643	< 0.001		
Production Close (22)	F1	590.1	559.4	65.81	3.7017	0.000331	0.069103	< 0.001
	F2	963.4	905.2		2.9225	0.004122		
Production Different (16)	F1	593.2	545.1	49.59	5.1973	< 0.001	0.13016	< 0.001
	F2	944.3	932.5		0.5768	0.5649		

Dispersion measurements for BOWL and BULL in Table 5.32 are surprising, since there appears to be a negative correlation between Euclidean distances and, in several cases, Pillai scores and judgments of same, close, and different. As was the case in Table 5.31, F1 seems to be the key measurement of distance. In both perception and production, *t*-scores increase steadily in moving from judgments of same to close to different. F1 differences are non-significant in both perception and production among speakers for whom the vowels are the same in minimal pairs testing. Nevertheless, all these measurements suggest that BOWL and BULL are very close for Kansas Citians, at least as measured by a single point based on nuclear central tendency. In one sense, this may explain the rapid advance in the perception of BOWL and BULL as merged among young Kansas Citians. In another sense, it suggests that the measure of central tendency under-determines the phonetic information in productions of BOWL and BULL that Kansas Citians cue to in producing or perceiving a distinction in these sets. This is not a startling observation, since a merger between canonically diphthongal POOL and/or BOWL with canonically monophthongal BULL would presumably require glide reduction or glide development on the part of one vowel or the other. At this time, I simply note this as a weakness in the current study and leave other phonetic matters that may account for the maintenance or loss of vocalic distinction for future work.

The combined findings for developments of POOL, BOWL, and BULL show that both mergers are present in Kansas City, though BOWL-BULL is clearly better established and spreading more rapidly at the phonemic level. While, overall, interviewees appear to show apparent time changes for backing POOL and BOWL, these conditional mergers seem to be spreading in an F1 dimension rather than F2 (at least, as far as can be determined from the central tendency measurements I'm studying). Figure 5.30 shows a linear model for BOWL F1 in apparent time among interviewees whose *bowl-bull* minimal pair I judged to be the same or close. Table 5.33 provides outputs for the linear models BOWL F1, as well as BOWL F2 which does not reach significance.

Figure 5.30. Linear model of BOWL F1 by interviewee birth year among interviewees who produce *bowl-bull* the same or close

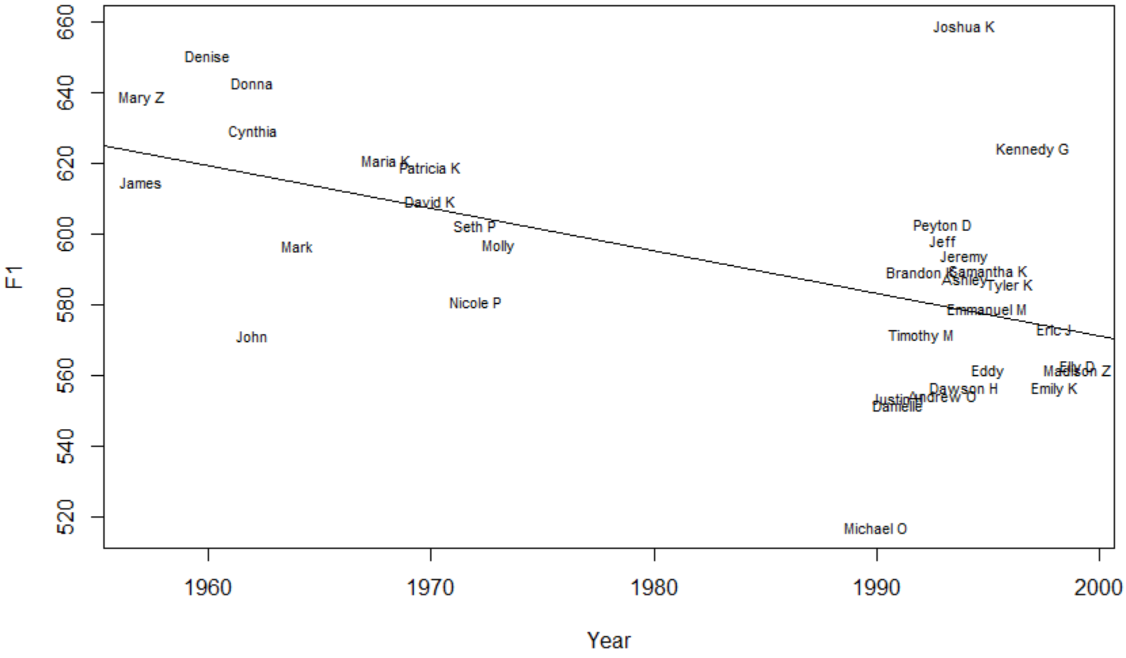


Table 5.33. Linear models of BOWL F1 and F2 by interviewee birth year among interviewees who produce *bowl-bull* the same or close

	Estimate	Std. Error	*t* value	Pr(>|t|)
BOWL F1 (Intercept)	2994.618	632.704	4.733	< 0.001
Year	-1.212	0.319	-3.799	< 0.001
Residual standard error: 27.35 on 32 degrees of freedom Multiple R-squared: 0.3108, Adjusted R-squared: 0.2892 *F*-statistic: 14.43 on 1 and 32 DF, *p*-value: 0.0006147				
BOWL F2 (Intercept)	4512.1169	1873.6300	2.408	0.0220
Year	-1.7865	0.9447	-1.891	0.0677
Residual standard error: 80.98 on 32 degrees of freedom Multiple R-squared: 0.1005, Adjusted R-squared: 0.07242 *F*-statistic: 3.576 on 1 and 32 DF, *p*-value: 0.06769				

The results for F1 suggest a strong correlation between being judged as not-different and raising BOWL in apparent time. Since so few older interviewees indicate the *bowl-bull* pair sounds the same or close, it is difficult to model perception as cleanly as production. The same model for BULL shows no significant changes in apparent time. Impressionistically, this is a bit surprising, because many interviewees produced BULL tokens with [o]-like vowels. The spreading merger of BOWL and BULL clearly bears more study. So does the much more limited merger of POOL and BULL, which, because relatively few interviewees perceive or produce *pull-pool* as the same, does not lend itself to linear modeling in the way the *bowl-bull* does.

Tables 5.34 and 5.35 seek additional explanation in differences in production according to interview task. For consistency with similar presentations of measurements of LOT-THOUGHT and PIN-PEN, the tables show values for interviewees who perceive a difference between *pull-pool* and *bowl-bull* (either different or close).

Table 5.34. Distances between POOL and BULL by style among interviewees who perceive a distinction

pull-pool		POOL	BULL	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Casual speech (41)	F1	455.6	569.6	119.86	-8.5295	< 0.001	0.23071	< 0.001
	F2	951.4	914.2		1.0321	0.3163		
Reading Passage (43)	F1	434.7	568.1	156.54	-11.6384	< 0.001	0.55267	< 0.001
	F2	848.6	930.5		-3.1091	0.003079		
Word List (45)	F1	410.0	560.2	164.88	-15.6694	< 0.001	0.6815	< 0.001
	F2	824.9	892.7		-3.4345	< 0.001		
Minimal Pairs (45)	F1	563.1	398.7	182.05	19.3868	< 0.001	0.70005	< 0.001
	F2	896.2	818.0		3.1457	0.001972		

Among speakers who claim to perceive a difference in the minimal pairs test between POOL and BULL, there is a slight increase in the phonetic distinction they produce as attention to speech increases. Euclidean distances and Pillai scores increase as interview tasks demand more attention to speech. Most importantly from the discussion above, *t*-scores for F1 increase with each increase in the interview task's formality. This suggests that speakers who claim a distinction between POOL and BULL increase phonetic distance in productions as they focus more on their productions, with the effect of moving the sounds farther away from merged productions.

Table 5.35 shows distances between BOWL and BULL by interview task for speakers who perceive the *bowl-bull* minimal pair as close or different. Compared with results for POOL and BULL, it is more difficult to interpret Table 5.34.

Table 5.35. Distances between BOWL and BULL by style among interviewees who perceive a distinction

bowl-bull		BOWL	BULL	Euclidean Distance	*t*-score	*p*	Pillai score	*p*
Casual speech (31)	F1	583.7	565.5	18.26	1.193	0.2474	0.012528	0.5426
	F2	927.9	929.4		-0.0418	0.9671		
Reading Passage (32)	F1	570.5	561.9	10.27	0.6909	0.4934	0.005466	0.7479
	F2	924.2	929.9		0.8337	< 0.001		
Word List (38)	F1	550.2	609.7	113.29	-5.3378	< 0.001	0.2405	< 0.001
	F2	879.1	975.6		-3.6117	< 0.001		
Minimal Pairs (37)	F1	557.2	585.9	57.54	-2.4798	0.01513	0.065119	0.0369
	F2	881.8	931.7		-1.9045	0.06043		

Distances between the vowels in CS and RP are tiny, suggesting a high degree of merger even among speakers who claim to recognize a distinction. The distinction becomes larger in WL, but then shrinks again in MP. It seems most reasonable to suggest that there may be a slight degree of effort to avoid merged productions of BOWL and BULL that compels some interviewees to emphasize the phonetic distinction between them when paying greater attention to speech. But the merger is sufficiently advanced (or free of negative social evaluation) that even the speakers who claim to maintain a distinction maintain only a small one, and appear able to do so only when reading isolated words.

These findings for style offer further support for the claim that the BOWL-BULL merger is advancing in Kansas City, especially relative to the POOL-BULL merger. If the merger draws any social attention that might cause speakers to avoid it, it is only very slight attention at this time.

Tables 5.36 and 5.37 show ANOVA models for the social factors of gender and class. These model Euclidean distances and Pillai scores for all interviewees. Because separations between the vowel classes are calculated for each speaker so that differences in the numbers of tokens speakers contribute will not throw off averages, the ANOVA can be calculated from a fixed effects model with significance scores.

Table 5.36. ANOVA model of POOL-BULL distances by sex and class

Factor	Df	Sum Sq	Mean Sq	*F* value	Pr(>|t|)
Euclidean Distance					
Sex	1	9837	9836.7	1.8517	0.1808
Class	2	3430	1715.1	0.3229	0.7259
Sex:Class	2	6118	3059.0	0.5758	0.5666
Residuals	42	223113	5312.2		
Pillai Score					
Sex	1	0.00064	0.000636	0.0160	0.8998
Class	2	0.00185	0.000925	0.0234	0.9769
Sex:Class	2	0.02821	0.014103	0.3559	0.7026
Residuals	42	1.66413	0.039622		

While no significant differences are calculated for POOL-BULL, the model for BOWL-BULL selects class as a significant predictor of both Euclidean distances and Pillai scores in Table 5.37.

Table 5.37. ANOVA model of BOWL-BULL distances by sex and class

Factor	Df	Sum Sq	Mean Sq	*F* value	Pr(>|t|)
Euclidean Distance					
Sex	1	7	7.5	0.0012	0.97278
Class	2	50737	25368.3	3.9877	0.02596
Sex:Class	2	2306	1153.0	0.1812	0.83488
Residuals	42	267189	6361.6		
Pillai Score					
Sex	1	0.01136	0.011356	0.3061	0.5830
Class	2	0.29674	0.148371	3.9999	0.0257
Sex:Class	2	0.00018	0.000088	0.0024	0.9976
Residuals	42	1.55794	0.037094		

Table 5.38 provides lmer regressions for BOWL and BULL F1 and F2 by social class.

Table 5.38. Mixed effects regressions of F1 and F2 of BOWL and BULL by class

Fixed Effects	Estimate	Std. Error	*t* value
BOWL F1			
classMC (Intercept)	605.178	8.241	73.43
classTC	-14.228	12.796	-1.11
classWC	-5.048	10.048	-0.50
BOWL F2			
classMC (Intercept)	1030.852	24.129	42.72
classTC	-33.162	30.045	-1.10
classWC	4.644	23.625	0.20
BULL F1			
classMC (Intercept)	568.372	9.945	57.15
classTC	5.793	15.703	0.37
classWC	-20.191	13.148	-1.54
BULL F2			
classMC (Intercept)	908.59	23.21	39.15
classTC	23.07	40.16	0.57
classWC	-10.47	33.06	-0.32

These values suggest that transitional class interviewees lead the BOWL-BULL merger, with a Euclidean distance of just 68 Hz between vowels. They are followed by middle class with a Euclidean distance of 128 Hz and working class with a Euclidean distance of 147 Hz. Modeling by prestige and SEI scores does not reveal significant patterns.

5.8. Summary

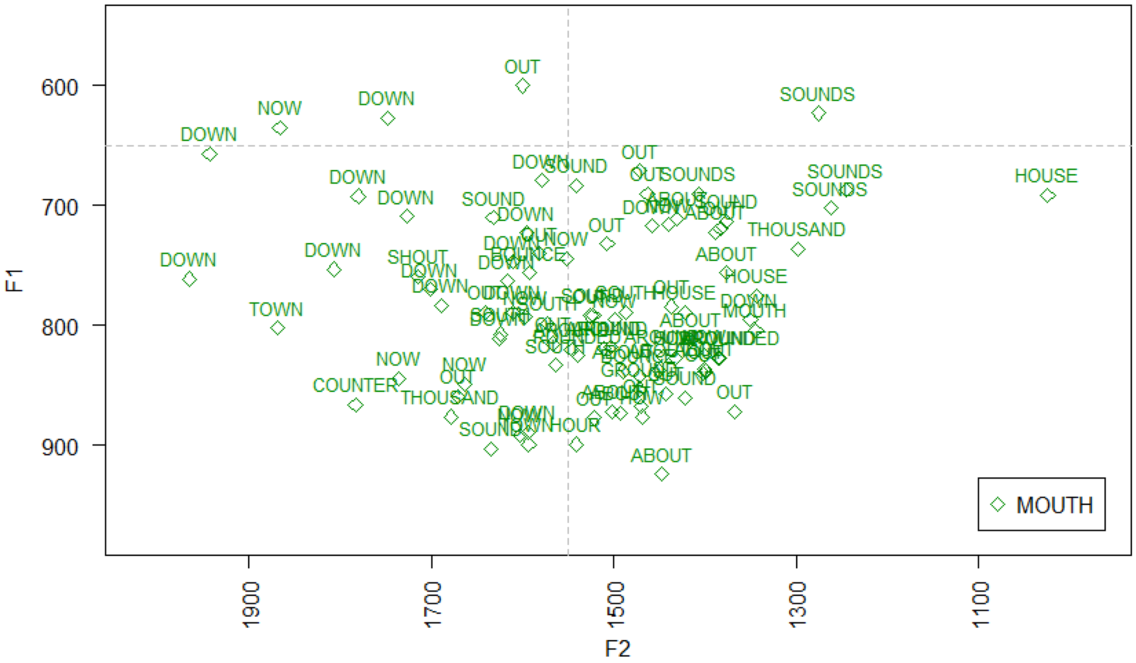
The chapter has attempted to characterize a large portion of the Kansas City vowel system. A few new developments were identified. MOUTH appears to be retracting when it is followed by a nasal, and the distribution of speaker MOUTH F2 measurements is suggestive of an incipient pattern of more general retraction. These changes would reverse a pattern identified as typical of Kansas City speech in *ANAE*. There is some structural evidence for interpreting these emerging patterns as related to the retraction of TRAP. This would potentially create a chain shift among LOT, TRAP, and MOUTH.

In other cases, previously identified developments in Kansas City vowels were confirmed, but our understanding of them as changes in progress has been revised. Specifically in the case of GOOSE and GOAT, both were seen to be quite front. In general, though, the fronting process appears to be moving toward completion, and appears to be limited to specific phonetic contexts.

The allophones of GOOSE and GOAT with following /l/, POOL and BOWL, are undergoing change as they push further back in vowel space. In this backer position, some Kansas Citians merge FOOT’s pre-/l/ allophone, BULL, with POOL. The growing community norm, however, is to merge BOWL and BULL. CURE has also undergone merger, having being divvied up between the NURSE and FORCE classes. Some speakers raise the new CURE-NORTH-FORCE class into the range of [u], suggesting a potential future development of a high back vowel chain shift.

A few plots are provided here to illustrate some of these new patterns. They are presented in roughly the order in which these vowels were discussed in this chapter. The CS MOUTH tokens of Eddy, born in 1995 in Shawnee, KS, are plotted in Figure 5.31.

Figure 5.31. Eddy, b. 1995, Shawnee, KS – Casual speech MOUTH tokens

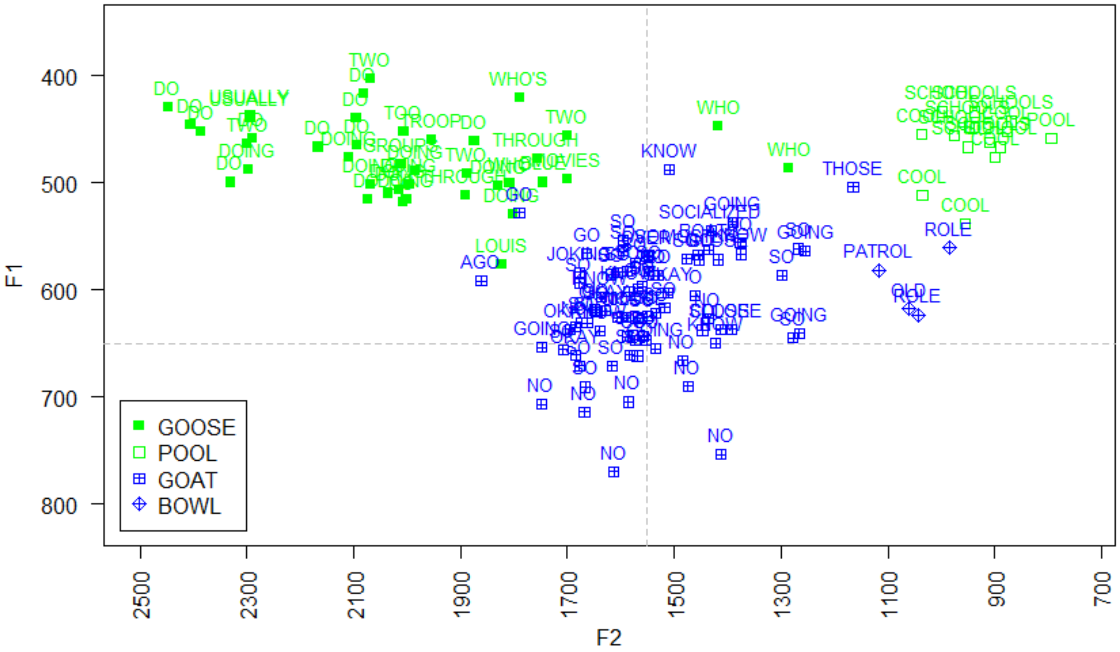


Eddy is classified as transitional class, but her lifestyle is today clearly middle class. When she was born, her mother was in the Army working in an unglamorous and relatively low-skill enlisted position. Her mother used the military to access training to become a chiropractor, though, and by the time Eddy reached high school, her mother had left the military and begun working as a chiropractor. So, Eddy's transitional classification represents her transition from working class to middle class from early childhood to adolescence.

Her MOUTH tokens are backed consistent with the emerging change in Kansas City. A large proportion appear back of the center line and show a nucleus in the range of [ɑ]. While a few tokens of MOUTH with a following nasal (e.g., *down*) occur near [ɛ], others like *sound* and *ground* occur among the backest tokens—some even in the range of [ɔ]. There is no evidence of a voiced-voiceless split in conditioning, which would be characteristic of Canadian Raising for the MOUTH vowel.

The established innovations of fronted GOOSE and GOAT are illustrated by Eric J, born in KCMO in 1998. His distributions for both vowels in CS are plotted in Figure 5.32. Following nasals are excluded for readability. Following /l/ is included. The vowel system of Eric's mother, Jennifer J, was plotted in Figure 5.20 to display a high back position for NORTH-FORCE-CURE. Their family lives in a middle class neighborhood in KCMO, just west of Troost Avenue, the historic line of racial segregation in Kansas City. The neighborhood is primarily white and serves as a de facto economic transition zone between the rich old money areas in the South Plaza and Ward Parkway neighborhoods and the poor African American neighborhoods east of Troost. The J family is coded as transitional class. Neither of Eric's parents attended college. His mother stays at home and is very involved in the local neighborhood council. His father, Matt J, is a self-described entrepreneur. At the time I interviewed them, Matt was working as a loan agent. But, he had recently been self-employed in a range of positions including car detailer, handyman, and rental property manager. Eric attends an elite all-male private school and both his parents commented on the challenges they faced in affording tuition and the importance they placed on the school for assuring Eric's future success. Eric is extremely involved in Boy Scouts. He plans to attend college and is considering military service to make college affordable.

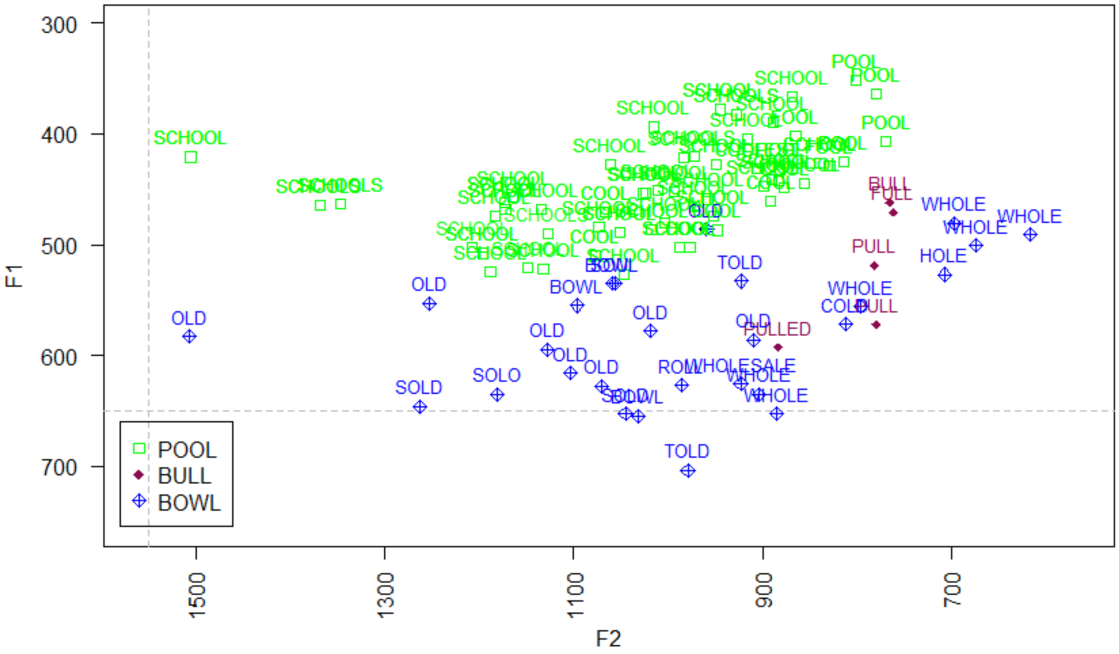
Figure 5.32. Eric J, b. 1998, KCMO – Casual speech GOOSE and GOAT tokens



Eric J's GOOSE and GOAT distributions are characteristic of the front realizations seen among young Kansas Citians. GOOSE shows an obvious break between POOL allophones and allophones in other phonetic environments. Many GOOSE tokens with preceding coronals have nuclei in the range of [i]. There are a limited number of GOOSE tokens that occur after non-coronals (e.g., *who*, *movies*, *through*), but they distribute between the GOOSE with preceding coronals and POOL. GOAT's split between BOWL and other environments is predictably less stark, but still clear. The bulk of GOAT nuclei occur front of the F2 center line at [ə]. A few, including *ago*, take on an [ɛ]-like quality. Low *no* tokens reflect an pronunciation like *nah*, and do not appear to be indicative of anything broader occurring in the GOAT class. Data above suggests that Eric J’s speech may represent an end point in the Kansas City vowel system, with limited continued fronting of GOOSE after coronals and GOAT after non-coronals.

Robert Z, born in KCMO in 1956, was discussed above as exception for showing small Pillai scores in both POOL-BULL and BOWL-BULL. Figure 5.33 displays his tokens for all three lexical sets. Robert Z was introduced in Chapter 3, so his background information will not be repeated here.

Figure 5.33. Robert Z, b. 1956, KCMO – Interview speech POOL, BOWL, and BULL tokens

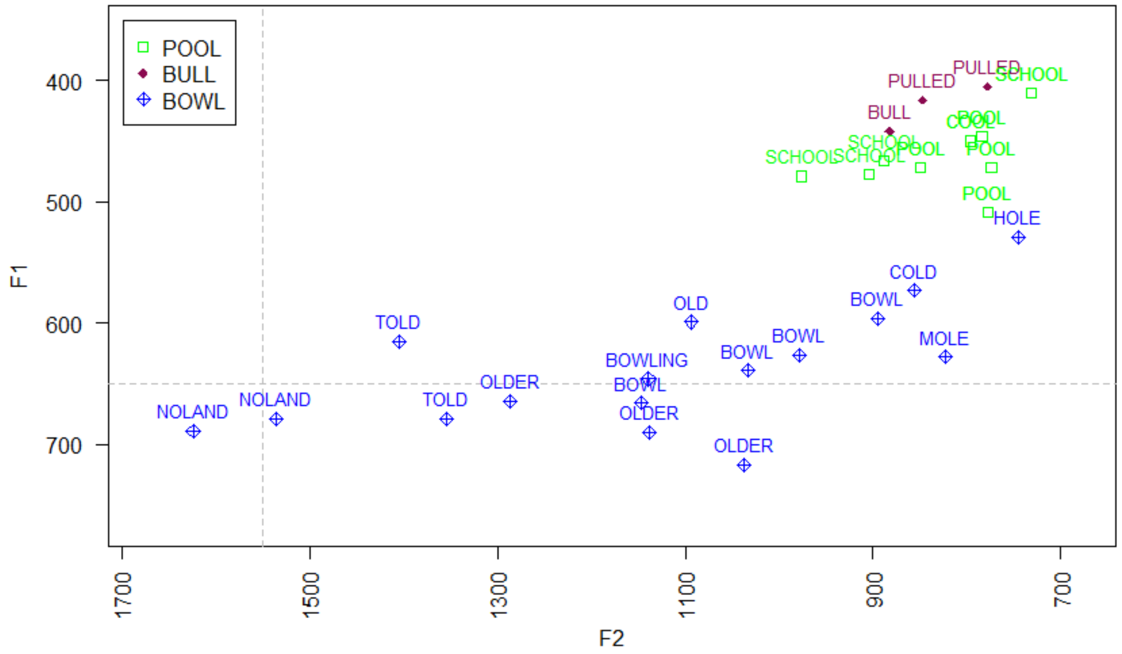


The closer examination afforded by Figure 5.33 suggests that, contrary to distance measurements, Robert Z is following the majority pattern in Kansas City of moving toward the BOWL-BULL merger. His POOL tokens are fairly front compared to those of younger speakers, but they do not actually overlap with his BULL tokens. BOWL, while generally front of BULL, shows several backer tokens that overlap with BULL. (Depending on syllabic boundaries, the token of *solo* may or may not condition as back. Any tokens with a syllabic segment occurring after /l/ are excluded from the merger analysis above.) So, Robert is probably best understood as showing a state just before the rapid advance in the perception of BOWL and BULL as close or merged.

Susan, born in Independence, MO in 1958, shows the contrasting pattern of the POOL-BULL merger. Susan is working class. Her preferred profession is childcare, but at the time I interviewed her she was working seasonally as a receptionist at a tax preparation office. Her life is tightly oriented to the historical areas of Independence near the historic Square, which served as the starting point for the Santa Fe, Oregon, and California Trails, and where Harry Truman's house is. She grew up within a few blocks of the Square and today lives in a different house a few blocks away from the Square. On Friday nights, she enjoys walking to the Square and listening to music and attending other activities, which have begun to occur regularly as some new business development has begun to revitalize the previously derelict area.

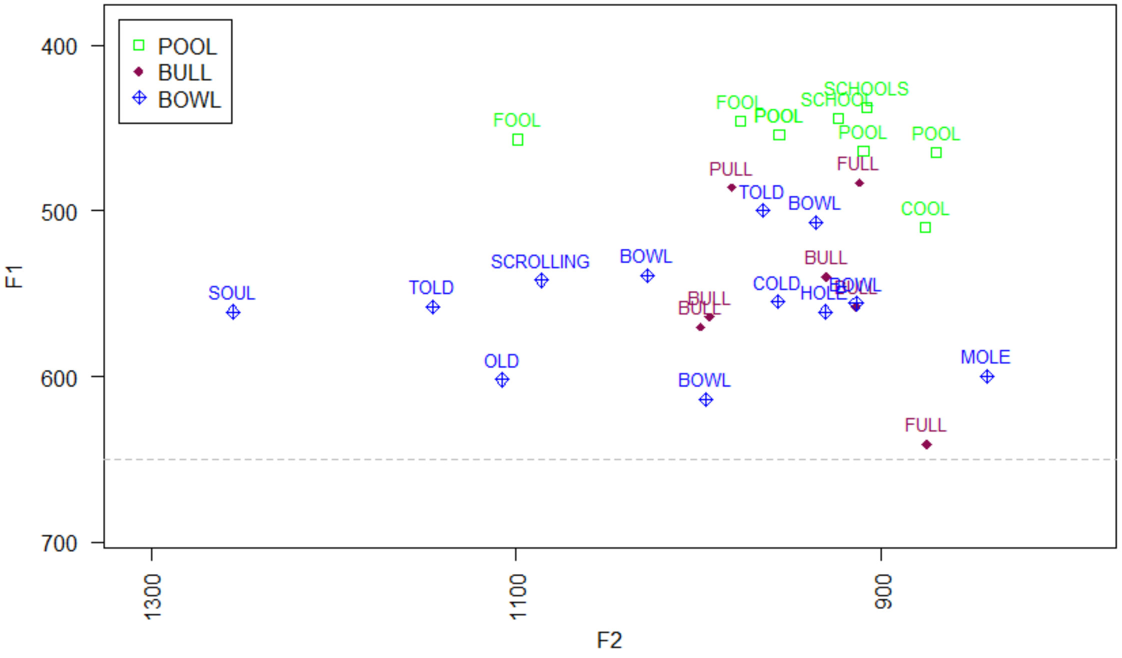
Susan's BULL tokens actually occur at the highest range of her POOL tokens. In particular, *bull* was heavily stressed as [bul] during the minimal pairs test to distinguish it from *bowl*. (*Noland* is caveated as was *solo* above, though Susan appears to place the syllabic boundary at [nəᵒl·ənd].)

Figure 5.34. Susan, b. 1958, Independence, MO – Interview speech POOL, BOWL, and BULL tokens



Elly D, born in 1999 in Independence, MO, contrasts Susan by showing a complete overlap in BOWL and BULL in Figure 5.35. Elly is a transitional class speaker. Her parents did not go to college when they were young, but attended some classes through community college while in their twenties. Her mother earned an associate's degree in this way. She works part-time in a bank. Her father works in IT-related services in a large company, providing help desk-type functions. He began working with computers as they were first being implemented in corporate environments, and has managed stay in the industry through hard work, despite limited formal training in the field. Their transitional class label, again, reflects an upward movement from working class to middle class lifestyles over the course of about twenty years. They live in a planned community in Independence that, at the time it was built, reflected the shift of wealth away from KCMO and toward the burgeoning suburbs of Blue Springs, MO and Lee's Summit, MO. Elly's brother, Peyton D, is discussed in Chapter 3. Elly is involved in sports at the public high school she attends in Independence. She and her friends spend as much free time as possible at Worlds of Fun, the Kansas City area amusement park.

Figure 5.35. Elly D, b. 1999, Independence, MO – Interview speech POOL, BOWL, and BULL tokens



While Elly's BULL tokens distribute in the space of her BOWL tokens, she also shows some POOL lowering. Tokens of *pull* and *full* occur at the edge of POOL. One token of *cool* also occurs in the GOAT range. (*Cool* also distributes low for Eric J in Figure 5.32, so this may be a specific lexical effect.) So, phonetically, the possibility of an eventual weakening of the distinction between POOL and BOWL is visually apparent. Perceptively, Elly judges *pull* and *pool* different, and *bowl* and *bull* close.

These speakers illustrate several of the patterns observed to be present and/or emerging in the dialect of Kansas City. The ambitious nature of this chapter has, naturally, left a great range of innovative possibilities unexplored. Of particular note, most of the vowels explored here are canonically diphthongal, and the many possibilities for realizations of the glides (or for monophthongization) create many sites for variation and innovation. Looking solely at single measurements of nuclear vowels dramatically limits the scope of this chapter. More thorough explorations of the back vowels in Kansas City is unquestionably merited.

Nevertheless, from the starting point of one change in the dialect of Kansas City, this chapter has identified a series of other changes. None of these appears to be individually unique to Kansas City. But, in total, they represent substantial changes to the characterization of the dialect there.

Chapter 6 will complete the analysis of the vowel system of Kansas City. Chapter 6 will begin by looking at the center of vowel space—into which GOAT, PRICE, and MOUTH have moved—to explore the statuses of PRICE and STRUT.

CHAPTER 6

CENTRAL(?) VOWEL SPACE

This chapter concludes the primary exploration of Kansas City's vowel system by examining the lexical sets PRICE and STRUT. The vowel in the former is canonically a diphthong with a low central nucleus in the range of /a/ or /ɑ/. The vowel in the latter is a mid or mid-low, central or back-central short vowel represented by /ʌ/ and phonetically similar to [ə] in American English (e.g., Wells 1982:131-132; Ladefoged 1993:76).

These are examined as complements to the preceding chapters, which have closely examined low vowels, front vowels, and back vowels. While central vowel space has not received direct attention yet, the analyses of the preceding chapters have depicted this space as a relatively volatile vocalic region, as TRAP and, potentially, MOUTH back across it, and GOOSE and GOAT front through it. Beyond simply filling in understanding of a portion of the vowel space, examining PRICE and STRUT is necessary to understand the structure of Kansas City vowel system overall as changes in adjacent vowels may have consequences for the vowels in this space.

After looking at PRICE and STRUT in turn, I'll briefly examine STRUT with following /l/ (GULL). This was noted in Chapter 5 as an additional potential site of conditional merger with BOWL and other back vowels with following /l/.

This chapter will be structurally similar to Chapter 5. Each vowel will be examined for phonetic conditioning, change in apparent time, and social factors. Examinations of change in apparent time and social factors will focus on phonetic factors that emerge as seemingly important (either in this research or in works like *ANAE*).

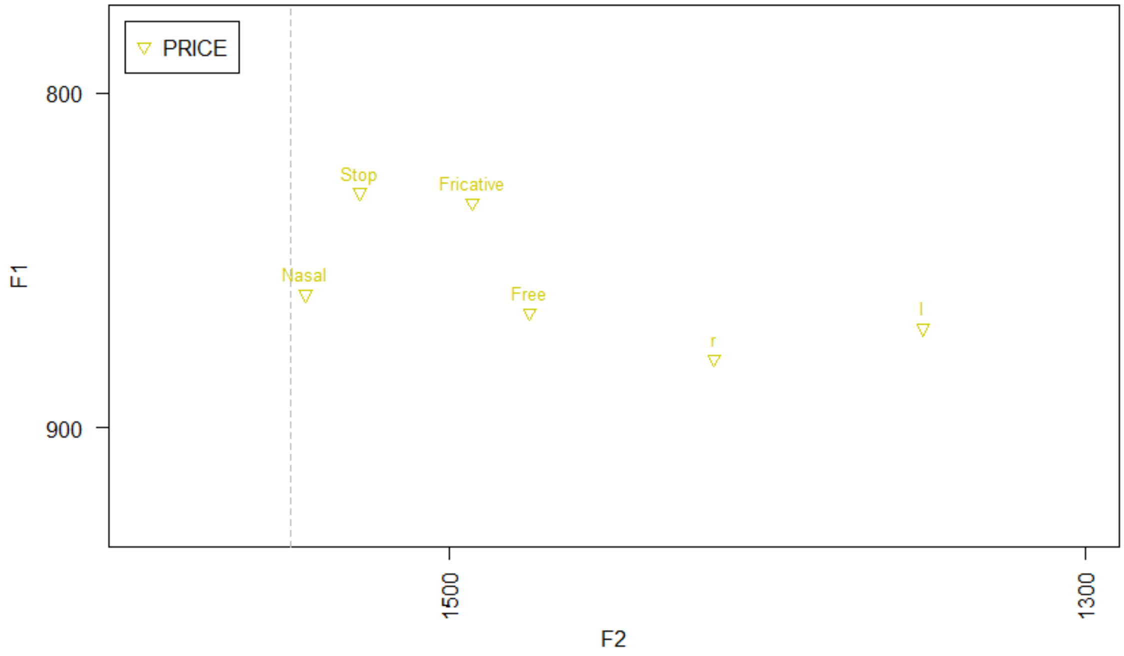
Neither vowel will receive the degree of focus that was given to THOUGHT, LOT, and TRAP, and analysis will likely overlook interesting change as a result of this haste.

6.1. PRICE

Lusk (1976:87) notes PRICE varying in Kansas City by the “reduction of the glide (‘flattening’), fronting of the nucleus, and backing of the nucleus.” She indicates that following /r/ and /l/ are most favorable to monophthongal productions, followed by following nasals and voiced consonants (1976:88). She correlates more monophthongal PRICE with lower social status (1976:132-133) and with males (1976:133-134). Her data does not yield clear patterns of change based on age. She does not explore the relative fronting or backing of the nucleus. Labov, Ash, and Boberg (2006:266, 268) also focused primarily on glide deletion, and found one Kansas Citian, Roger W, who deleted the glide in PRICE before obstruents (a pattern more consistent with the South than the Midland). By contrast, I will only explore the nucleus, and leave the glide for future work. Impressionistically, the glide seems to have great potential for marking social factors, with increased monophthongization among older and more working class speakers.

Figure 6.1 plots mean productions for the nuclei of all tokens of PRICE by following manner. The plot suggests relatively little difference among productions in an F1 dimension, and generally back productions in F2, with the entire class plotting back of the central line at 1550 Hz. PRICE with following liquids plots backer than other following manners, but the separation between tokens in this environment appears relatively small.

Figure 6.1. Distribution of PRICE by following voicing



Tables 6.1 and 6.2 show outputs of lmer analyses for PRICE F1 and F2. In Table 6.1, the following manners of stops and fricatives appear to have the largest conditioning effects, resulting in raised productions of PRICE. Conditioning effects from following place are fairly muted; following labiodentals appear to encourage slight raising and following bilabials and free position appear too encourage slight lowering. PRICE with following voiceless consonants is produced higher in vowel space than PRICE with voiced consonants or in free position. Preceding segments appear to show a fairly wide range of phonetic influences with, in particular, preceding liquids encouraging raising and preceding free segments encouraging lowering. Primary stress position appears to correlate to slight lowering.

Table 6.1. Mixed effects regression of conditioning effects on PRICE F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmFree (Intercept)	868.497	6.264	138.64	*die*
fmFricative	-42.863	7.788	-5.50	*wife*
fmL	8.086	11.229	0.72	*tile*
fmNasal	-13.050	7.926	-1.65	*kind*
fmR	-4.612	15.940	-0.29	*aspire*
fmStop	-32.417	7.087	-4.57	*pipe*
fpAlveolar (Intercept)	842.414	4.686	179.75	*night*
fpBilabial	18.138	10.720	1.69	*fiber*
fpFree	22.466	6.618	3.39	*guy*
fpInterdental	7.147	41.404	0.17	*tithing*
fpLabiodental	-14.396	9.238	-1.56	*rival*
fpVelar	-8.039	11.748	-0.68	*bike*
fvFree (Intercept)	865.599	6.473	133.73	*apply*
fvVoiced	-16.328	6.600	-2.47	*ride*
fvVoiceless	-37.593	7.605	-4.94	*right*
psAlveolar or Interdental Obstruent (Intercept)	848.019	6.110	138.79	*Tigers*
psFree	49.354	9.691	5.09	*ivy*
psGlide	-6.190	10.368	-0.60	*wipe*
psLabial (Oral)	11.105	8.180	1.36	*vitamin*
psLiquid	-37.283	8.600	-4.34	*light*
psM	19.480	11.319	1.72	*Mike*
psN	-17.260	12.899	-1.34	*Nike*
psObstruent+Liquid Cluster	-26.146	8.740	-2.99	*striving*
psPalatal	3.949	20.532	0.19	*shy*
psVelar	18.446	14.433	1.28	*guide*
stress0 (Intercept)	829.774	13.773	60.25	*idyllic*
stress1	21.936	13.726	1.60	*driver*
stress2	-8.684	15.412	-0.56	*advertising*

Table 6.2, confirms the back positions for PRICE with following liquids showing the backing effect observed in other vowels. It also shows PRICE in free position (the intercept value) being backed relative to following stops, fricatives, and nasals. Following interdentals appear to be particularly favorable to fronting, but this context is limited to just fourteen tokens of *either* and one token of *tithing*, the latter of which is produced with an [æ]-like nucleus by Matt J that weights the class forward in lmer analysis. Following labiodentals make a broader claim to encouraging fronting, and PRICE in free

position is, again, favorable to backing. Following voiceless consonants appear to encourage fronting, especially compared with PRICE in free position. Preceding coronals appear to encourage fronting, as do preceding velars. Preceding labials strongly encourage backing (the category of preceding glide is represented exclusively by preceding /w/). These preceding environment influences appear to follow general acoustic effects of consonants on vowels (Thomas 2011:101), and fairly neatly mirror the

Table 6.2. Mixed effects regression of conditioning effects on PRICE F2

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmFree (Intercept)	1472.35	11.95	123.24	*die*
fmFricative	44.16	13.70	3.22	*wife*
fmL	-40.93	19.18	-2.13	*tile*
fmNasal	22.06	14.08	1.57	*kind*
fmR	-31.54	26.94	-1.17	*aspire*
fmStop	41.17	12.49	3.30	*pipe*
fpAlveolar (Intercept)	1498.050	9.271	161.58	*night*
fpBilabial	22.014	17.966	1.23	*fiber*
fpFree	-23.267	11.470	-2.03	*guy*
fpInterdental	61.562	75.602	0.81	*tithing*
fpLabiodental	34.088	15.731	2.17	*rival*
fpVelar	-8.632	20.193	-0.43	*bike*
fvFree (Intercept)	1474.92	12.16	121.30	*apply*
fvVoiced	20.34	11.36	1.79	*ride*
fvVoiceless	43.36	13.19	3.29	*right*
psAlveolar or Interdental Obstruent (Intercept)	1538.565	10.801	142.44	*Tigers*
psFree	-29.507	14.957	-1.97	*ivy*
psGlide	-139.376	15.126	-9.21	*wipe*
psLabial (Oral)	-100.162	12.752	-7.85	*vitamin*
psLiquid	-66.153	13.385	-4.94	*light*
psM	-99.545	16.426	-6.06	*Mike*
psN	107.184	18.572	5.77	*Nike*
psObstruent+Liquid Cluster	-28.443	12.733	-2.23	*striving*
psPalatal	-6.252	31.685	-0.20	*shy*
psVelar	87.641	22.271	3.94	*guide*
stress0 (Intercept)	1560.23	24.04	64.91	*idyllic*
stress1	-68.31	23.50	-2.91	*driver*
stress2	-50.41	25.22	-2.00	*advertising*

preceding segment influences observed for MOUTH. Stress, on the other hand, correlates with backer productions for PRICE, compared with fronter productions of MOUTH.

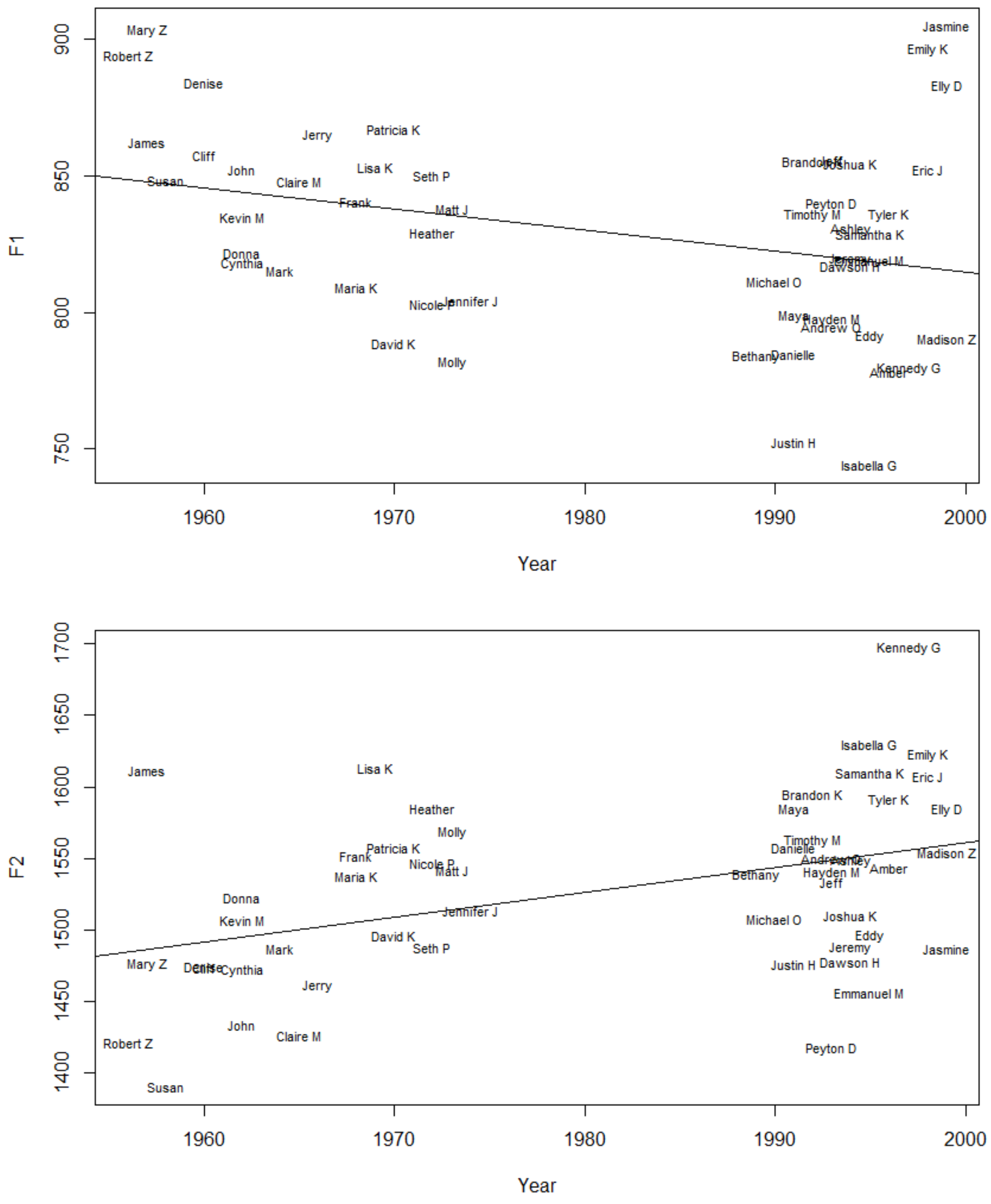
While there may be many potentially interesting patterns in the PRICE data, the pattern of PRICE with following voiceless consonants being produced higher than other following voicing contexts is consistent with PRICE's phonetic conditioning in "Canadian raising." This pattern has been found throughout much of the US North, New England (Labov, Ash & Boberg 2006), and Philadelphia (Labov 2001; Fruehwald 2013). The slightly fronted position of PRICE before voiceless consonants suggested by Table 6.2 is also characteristic of women in Philadelphia (Labov 2001:468). At the risk of missing other interesting conditioning factors, I will focus my exploration on the effect of following voicing.

Table 6.3 and Figure 6.2 plot linear models of pre-voiceless PRICE F1 and F2 in apparent time.

Table 6.3. Linear models of F1 and F2 of PRICE with following voiceless consonants by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
PRICE F1 (Intercept)	2365.7320	666.2644	3.551	< 0.001
Year	-0.7756	0.3364	-2.306	0.02540
Residual standard error: 36.1 on 49 degrees of freedom Multiple R-squared: 0.09788, Adjusted R-squared: 0.07947 *F*-statistic: 5.317 on 1 and 49 DF, *p*-value: 0.0254				
PRICE F2 (Intercept)	-1913.2622	1069.9722	-1.788	0.0799
Year	1.7373	0.5402	3.216	0.0023
Residual standard error: 57.98 on 49 degrees of freedom Multiple R-squared: 0.1743, Adjusted R-squared: 0.1575 *F*-statistic: 10.34 on 1 and 49 DF, *p*-value: 0.002303				

Figure 6.2. Linear models of F1 and F2 of PRICE with following voiceless consonants by interviewee birth year



The linear models show statistically significant changes in apparent time in the direction of raised and fronted PRICE nuclei. The effects calculated are not overwhelmingly large in either dimension—8 Hz per decade in F1 ($R^2 = 0.079$) and 17 Hz per decade in F2 ($R^2 = 0.158$). In part, this appears to result from very different patterns of productions for older versus younger interviewees. Linear models limited to older interviewees suggest a fairly regular and dramatic pattern of raising and fronting in apparent time. Among older interviewees F1 decreases by 37 Hz per decade ($R^2 = 0.3592$, $p = 0.001169$) and F2 increases by 51 Hz per decade ($R^2 = 0.2145$, $p = 0.01314$). Among younger interviewees, particularly in F1, the dispersion of F1 measurements appears to increase. This seems to have some correlations with socioeconomic status: many of the lowest F1 measurements belong to middle class speakers (e.g., Amber, Isabella G, Justin H) and the lowest F1 measurements belong to working class (Emily K and Jasmine) and transitional (Elly D) speakers. Correlations between productions and class will be explored more below.

Figure 6.3 shows linear models for F1 and F2 of PRICE followed by voiced consonants. Table 6.4 shows outputs of the models. These models suggest that pre-voiced PRICE is not raising, but is fronting at a rate very similar to that observed for pre-voiceless PRICE. Together, these models suggest that PRICE is fronting generally in apparent time. Pre-voiced PRICE does not show any change in apparent time in height. Pre-voiceless PRICE appears to have been undergoing a pattern consistent with Canadian raising among older interviewees, and may still be raising among some younger interviewees.

Figure 6.3. Linear models of F1 and F2 of PRICE with following voiced consonants by interviewee birth year

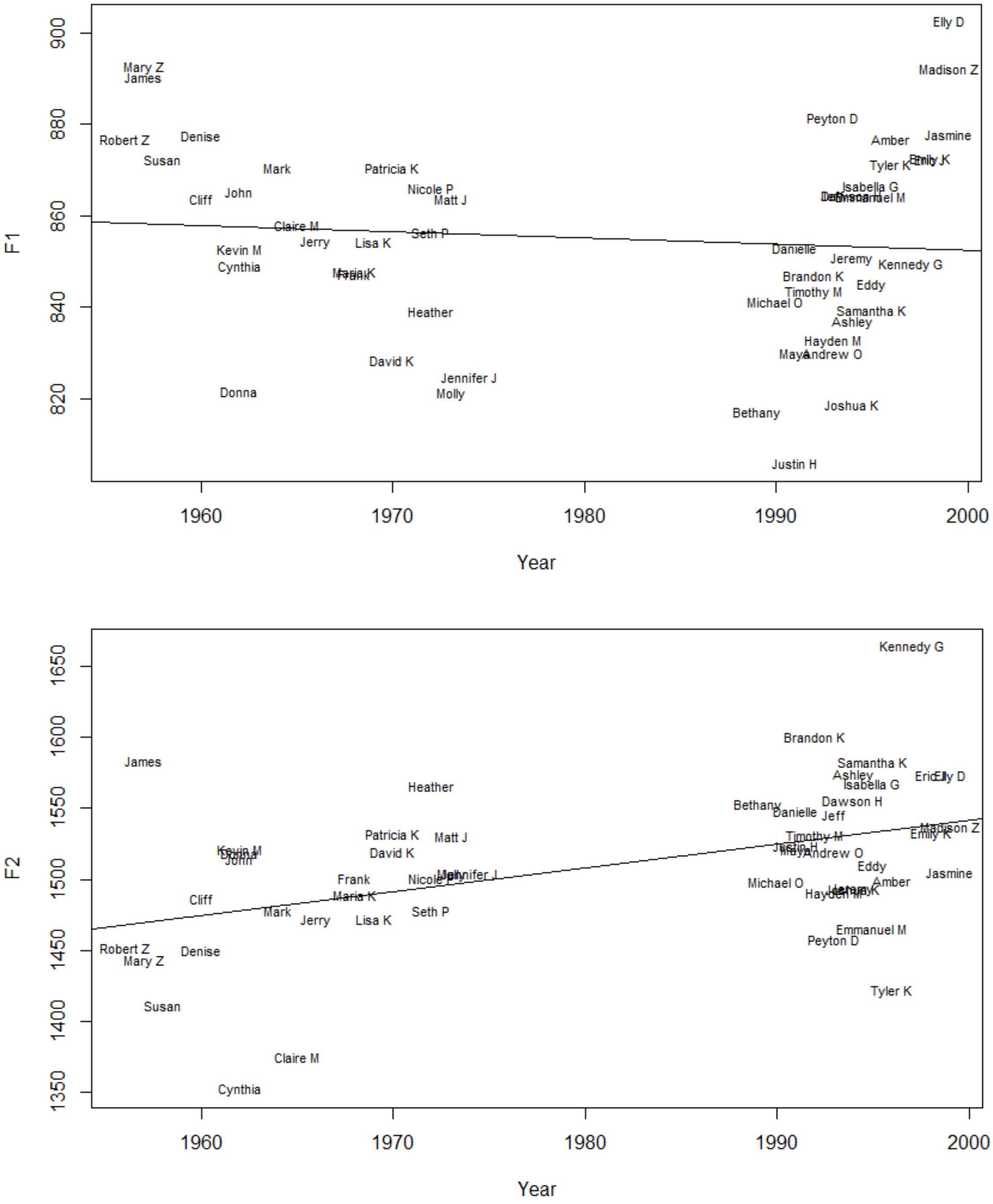


Table 6.4. Linear models of F1 and F2 of PRICE with following voiced consonants by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
PRICE F1 (Intercept)	1120.6247	405.0769	2.766	0.00797
Year	-0.1341	0.2045	-0.656	0.51517
Residual standard error: 21.95 on 49 degrees of freedom Multiple R-squared: 0.008694, Adjusted R-squared: -0.01154 *F*-statistic: 0.4298 on 1 and 49 DF, *p*-value: 0.5152				
PRICE F2 (Intercept)	-1804.986	923.110	-1.955	0.056260
Year	1.673	0.466	3.591	0.000762
Residual standard error: 50.02 on 49 degrees of freedom Multiple R-squared: 0.2083, Adjusted R-squared: 0.1922 *F*-statistic: 12.89 on 1 and 49 DF, *p*-value: 0.0007618				

Table 6.5 shows the outputs of an ANOVA model for the social factors of gender and class for PRICE followed by voiceless consonants. It models F1 and F2.

Table 6.5. ANOVA model of pre-voiceless PRICE F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	4680.4	4680.4	0.9225
Class	2	4245.3	2122.7	0.4184
Sex:Class	2	7106.8	3553.4	0.7004
F2				
Sex	1	46639	46639	3.0486
Class	2	1137	568	0.0371
Sex:Class	2	17470	8735	0.5710

Despite the class effect suggested above based on the dispersion of names in F1 measurements, the only factor that seems to stand out as having some explanatory value is sex in F2. By mixed effects regression, females appear to produce the PRICE nucleus at about 1523 Hz in F2, roughly 31 Hz fronter than males. The gender difference in F1 is just 10 Hz (with PRICE produced higher by females). Class differences in F1 and F2 are marginal.

Table 6.6 replicates the ANOVA model for pre-voiced PRICE.

Table 6.6. ANOVA model of pre-voiced PRICE F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	42.8	42.8	0.0068
Class	2	26790.2	13395.1	2.1408
Sex:Class	2	18535.7	9267.9	1.4812
F2				
Sex	1	6561.3	6561.3	0.4677
Class	2	628.9	314.4	0.0224
Sex:Class	2	10287.7	5143.8	0.3667

The ANOVA for following voiced consonants in Table 6.6 seems to present a mirror image of Table 6.5. In Table 6.6 the factor that seems to offer the most explanation of observed variance is class in F1. In actuality, though, the effect is quite small, with working class interviewees producing pre-voiced PRICE just 13 Hz higher in vowel space than middle and transitional class interviewees. Differences for sex in F1 and sex or class in F2 are negligible. So, for both following voicing environments, ANOVA modeling suggests relatively uniform behavior among Kansas Citians. Linear models for prestige and SEI scores show no clear-cut patterns.

Despite the statistical findings that sex and class do not correlate to changes, the suggested observation of a middle class lead among younger interviewees in raising PRICE before voiceless consonants justifies closer exploration of class as an explanatory factor. Figure 6.4 and Table 6.7 model F1 and F2 of pre-voiceless PRICE strictly among middle class interviewees.

Figure 6.4. Linear models of F1 and F2 of PRICE with following voiceless consonants among middle class interviewees by birth year

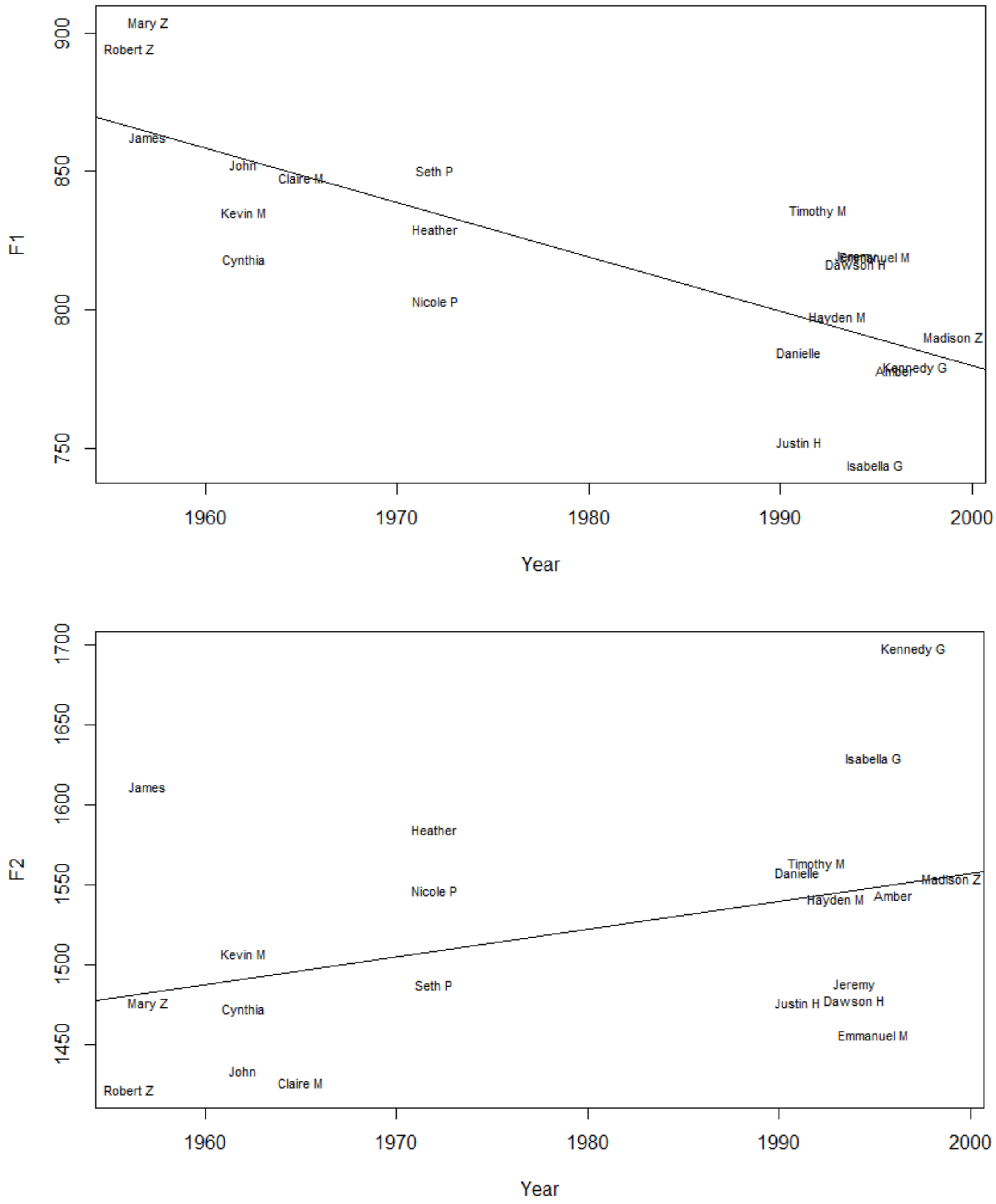


Table 6.7. Linear models of F1 and F2 of PRICE with following voiceless consonants among middle class interviewees by birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
PRICE F1 (Intercept)	4709.2279	728.6790	6.463	< 0.001
Year	-1.9647	0.3681	-5.338	< 0.001
Residual standard error: 26.86 on 19 degrees of freedom Multiple R-squared: 0.5999, Adjusted R-squared: 0.5789 *F*-statistic: 28.49 on 1 and 19 DF, *p*-value: 3.758e-05				
PRICE F2 (Intercept)	-1921.9500	1825.6522	-1.053	0.3057
Year	1.7393	0.9221	1.886	0.0747
Residual standard error: 67.29 on 19 degrees of freedom Multiple R-squared: 0.1577, Adjusted R-squared: 0.1134 *F*-statistic: 3.558 on 1 and 19 DF, *p*-value: 0.07466				

When modeled in isolation, middle class speakers generally follow the norm of PRICE fronting (though the model is not significant). However, they strongly participate in raising pre-voiceless PRICE, showing a decrease in F1 of 20 Hz per decade, with an R^2 value that accounts for more than half of observed variation. Linear models for PRICE with following voiced consonants and in free position for middle class interviewees are not nearly as strong. F1 shows a non-significant intercept for year of 0.3529 (R^2 = 0.02871, p = 0.2224). F2 shows fronting at 18 Hz per decade (R^2 = 0.1477, p = 0.04802).

Figure 6.5 and Table 6.8 show linear models for PRICE with voiceless consonants among working class speakers. In contrast to middle class interviewees, working class interviewees show no pattern of PRICE raising. However, working class interviewees show a significant pattern of PRICE fronting, with F2 measurements increasing by 23 Hz per decade. Like middle class interviewees, PRICE vowels with following voiced consonants show no significant pattern for change in apparent time in F1 (year coefficient

= -0.3567, $R^2 = 0.01531$, $p = 0.2665$). Working class interviewees show a significant pattern of fronting pre-voiced PRICE at 16 Hz per decade ($R^2 = 0.2252$, $p = 0.0172$).

Figure 6.5. Linear models of F1 and F2 of PRICE with following voiceless consonants among working class interviewees by birth year

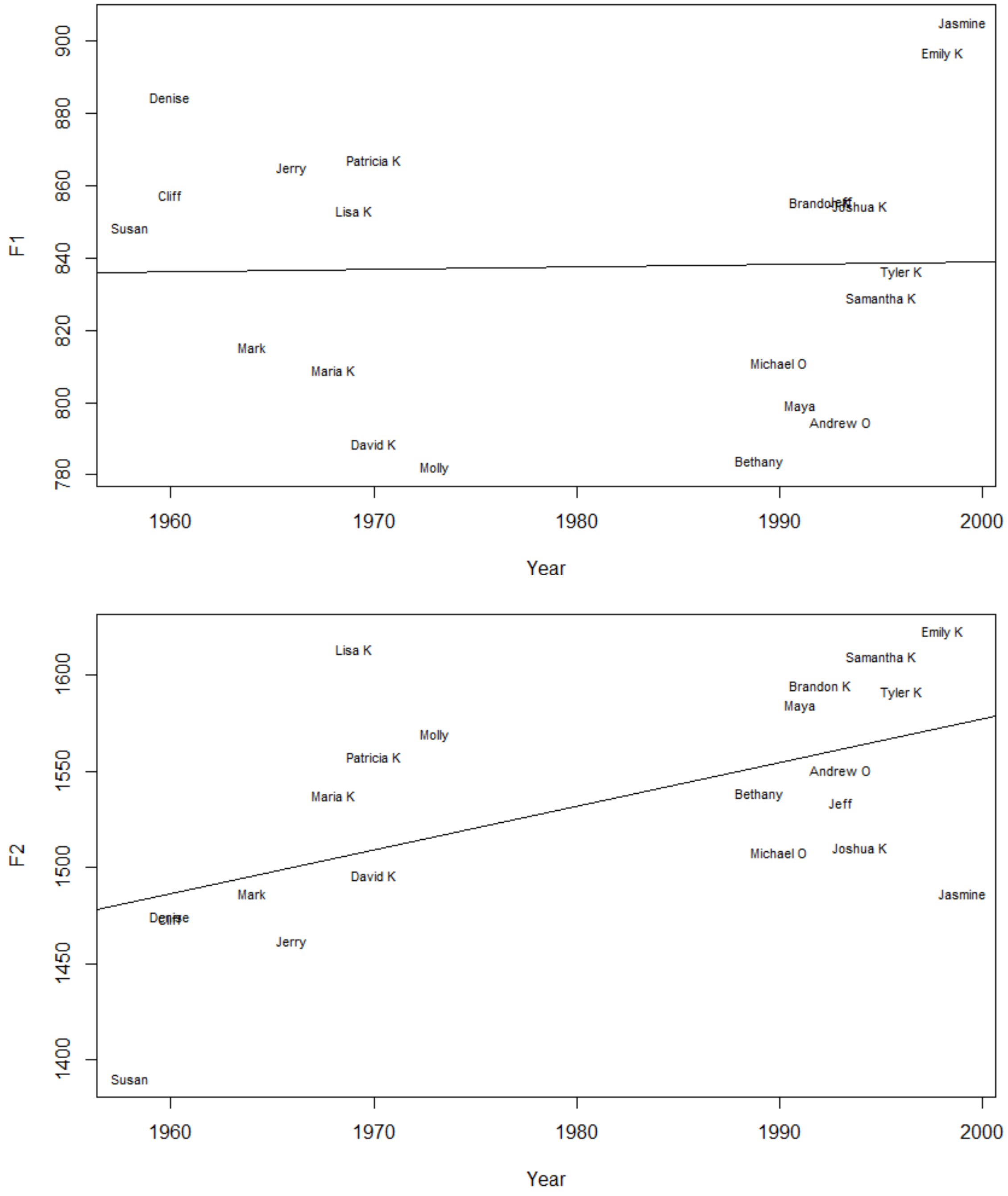


Table 6.8. Linear models of F1 and F2 of PRICE with following voiced consonants among working class interviewees by birth year

<table>
<tr><th></th><th>Estimate</th><th>Std. Error</th><th>*t* value</th><th>Pr(>|t|)</th></tr>
<tr><td colspan="5"></td></tr>
<tr><td>PRICE F1 (Intercept)</td><td>705.1000</td><td>1132.0000</td><td>0.623</td><td>0.541</td></tr>
<tr><td>Year</td><td>0.06692</td><td>0.5717</td><td>0.117</td><td>0.908</td></tr>
<tr><td colspan="5">Residual standard error: 37.89 on 19 degrees of freedom
Multiple R-squared: 0.0007206, Adjusted R-squared: -0.05187
F-statistic: 0.0137 on 1 and 19 DF, *p*-value: 0.908</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>PRICE F2 (Intercept)</td><td>-2977.0307</td><td>1515.2237</td><td>-1.965</td><td>0.06424</td></tr>
<tr><td>Year</td><td>2.2773</td><td>0.7651</td><td>2.976</td><td>0.00776</td></tr>
<tr><td colspan="5">Residual standard error: 50.71 on 19 degrees of freedom
Multiple R-squared: 0.318, Adjusted R-squared: 0.2821
F-statistic: 8.859 on 1 and 19 DF, *p*-value: 0.007756</td></tr>
</table>

This brief analysis of PRICE suggests two developments in the vowel in Kansas City. All Kansas Citians appear to be fronting the nucleus of PRICE generally. There is also what appears to be a vigorous change emerging among middle class speaker to raise the nucleus of PRICE before voiceless consonants. The pattern for middle class speakers is consistent with Canadian raising.

6.2. STRUT

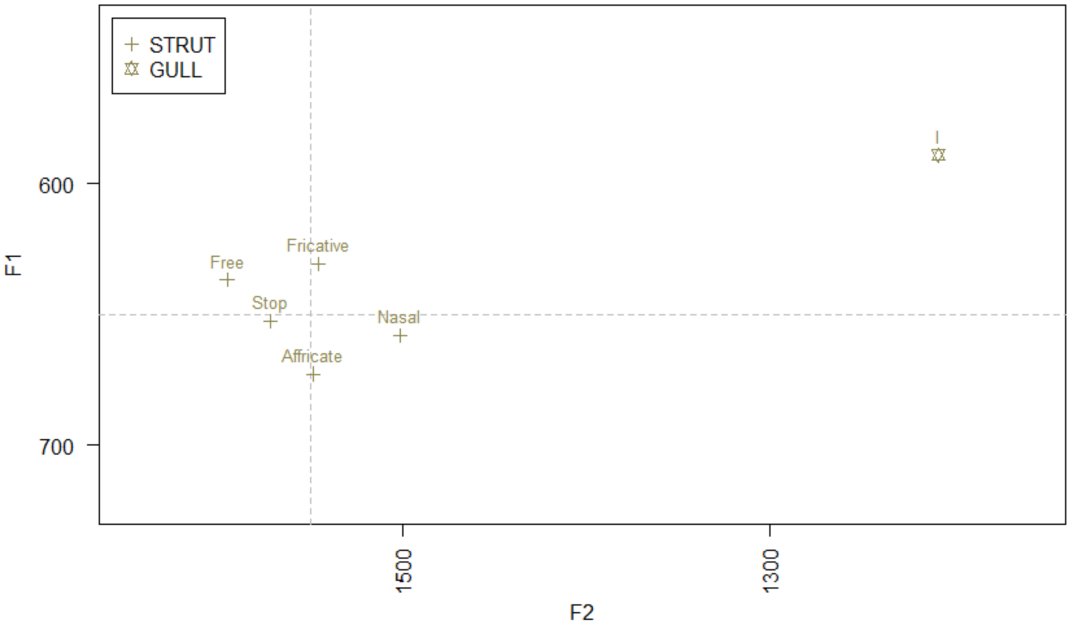
Labov, Ash, and Boberg (2006:266, 269) identify STRUT fronting in Kansas City and other large Midland cities, with F2 values exceeding 1650 Hz for some speakers. This is an important point in *ANAE* analysis not only as a change in and of itself, but also because the observed fronting of STRUT in the Midland directly contrasts with the backing of STRUT in the adjacent North, making the vowel a potential site of oppositional dialect change between the two regions.

Lusk (1976:79) describes STRUT as “generally slightly behind the mid-central position, although it may also be raised and/or fronted.” She notes a small incidence of off-gliding diphthongs in the context of following nasals and in the specific type *brush*. She does not go into further detail on STRUT, but in contrast to Labov, Ash, and Boberg (2006), she indicates that STRUT is one of the most stable vowels in Kansas City that reflects “the least variation of any kind” (1976:143).

Though it was not the focus of the research, Gordon and Strelluf (2012) examined STRUT specifically in the context of this difference of findings between Labov, Ash, and Boberg (2006) and Lusk (1976). In that research, STRUT was found to be at a central position in vowel space and did not show evidence of change in apparent time. The present study, then, aims to provide a more definitive picture of STRUT in Kansas City.

Figure 6.6 shows the distribution of STRUT in Kansas City by following manner. STRUT with following /r/ (NURSE) is not plotted.

Figure 6.6. Distribution of STRUT by following manner



Chapter 5 noted that STRUT with following /l/ (GULL) plotted near BOWL, and Figure 6.6 confirms this very back realization compared with other following manner environments. Mixed effects regression places GULL at F1:573 Hz, F2:1310 Hz. This set will be explored further below. Following /l/ is excluded from the lmer analysis in Tables 6.9 and 6.10.

Table 6.9. Mixed effects regression of conditioning effects on STRUT F1

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	568.55	16.19	35.13	*budget*
fmFree	74.99	18.38	4.08	*algebra*
fmFricative	55.48	16.69	3.32	*stuff*
fmNasal	62.54	16.39	3.81	*son*
fmStop	34.35	16.44	2.09	*sucks*
fpAlveolar (Intercept)	598.145	3.465	172.63	*putt*
fpBilabial	55.173	5.500	10.03	*cup*
fpFree	54.465	9.272	5.87	*pizza*
fpInterdental	86.883	16.230	5.35	*southern*
fpLabiodental	96.173	11.883	8.09	*tough*
fpPalatal	-4.742	14.531	-0.33	*such*
fpVelar	80.734	8.816	9.16	*duck*
fvFree (Intercept)	650.891	9.563	68.06	*Zelda*
fvVoiced	-34.171	9.565	-3.57	*guzzled*
fvVoiceless	-29.789	10.022	-2.97	*bussing*
psAlveolar or Interdental Obstruent (Intercept)	592.692	4.421	134.06	*thugs*
psFree	47.028	7.025	6.69	*updated*
psGlide	75.295	10.841	6.95	*yuppie*
psLabial (Oral)	41.713	7.153	5.83	*public*
psLiquid	57.282	8.192	6.99	*lucky*
psM	4.305	7.409	0.58	*mucky*
psN	43.267	8.578	5.04	*nuts*
psObstruent+Liquid Cluster	48.428	10.436	4.64	*slugger*
psPalatal	-4.077	9.596	-0.42	*shut*
psVelar	53.493	8.839	6.05	*gut*
stress0 (Intercept)	578.067	2.739	211.06	*ambitious*
stress1	140.499	3.230	43.50	*productive*
stress2	146.308	11.828	12.37	*publication*

In terms of height, following affricates appear to encourage higher productions than other contexts. In actuality, most of the STRUT vowels that occur in this context are in unstressed position (e.g., *usage*, *Anchorage*, *passage*), which the lmer analysis of stress suggests is produced at a position near [ɪ]. STRUT with following alveolars and palatals is produced higher in vowel space than STRUT with other following places of articulation. Following voicing appears to have little effect on the vowel's height. Preceding oral coronals and /m/ appear to correlate with higher productions than all other preceding segments.

In Table 6.10, estimated F2 measurements show a relatively strong difference in the conditioning effect of following stops compared with following fricatives and nasals. Stops encourage fronter productions. STRUT with following free position is noted as being backer than STRUT with following stops but fronter than STRUT with following fricatives and nasals. But, again, this context consists primarily of vowels in unstressed positions (i.e., the COMMA class in Wells 1982:167), and is not explored further in this analysis. Following alveolars and palatals encourage fronter productions than other contexts. Following voiced consonants encourage backer productions than following voiceless consonants. Preceding glides strongly encourage backing, but these too occur with STRUT in unstressed positions (e.g., *unions*, *languages*, *regular*). More generally, preceding labials and liquids appear to correlate with backer productions, and preceding coronals, velars, and /m/ correlate to fronter productions—again, though, preceding /n/ segments often occur with STRUT in unstressed position (e.g., *Minnesota*, *inefficient*, *opportunity*) and are phonetically [ɪ]. For the study of fronting, the single most important line in lmer analysis, then, is probably the F2 value for STRUT in primary stress position, which estimates STRUT F2 at 1435 Hz.

Table 6.10. Mixed effects regression of conditioning effects on STRUT F2

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	1707.11	37.88	45.06	*budget*
fmFree	-62.87	43.04	-1.46	*algebra*
fmFricative	-138.18	39.06	-3.54	*stuff*
fmNasal	-150.29	38.36	-3.92	*son*
fmStop	-47.50	38.47	-1.23	*sucks*
fpAlveolar (Intercept)	1646.010	8.022	205.19	*putt*
fpBilabial	-191.017	12.759	-14.97	*cup*
fpFree	6.683	21.375	0.31	*pizza*
fpInterdental	-120.385	36.837	-3.27	*southern*
fpLabiodental	-167.140	27.318	-6.12	*tough*
fpPalatal	32.609	33.308	0.98	*such*
fpVelar	-148.152	20.079	-7.38	*duck*
fvFree (Intercept)	1671.57	22.35	74.78	*Zelda*
fvVoiced	-83.34	22.37	-3.73	*guzzled*
fvVoiceless	-59.42	23.42	-2.54	*bussing*
psAlveolar or Interdental Obstruent (Intercept)	1623.05	10.27	158.02	*thugs*
psFree	-26.79	16.18	-1.66	*updated*
psGlide	-264.72	25.09	-10.55	*yuppie*
psLabial (Oral)	-134.00	16.56	-8.09q	*public*
psLiquid	-143.28	18.99	-7.54	*lucky*
psM	41.58	17.27	2.41	*mucky*
psN	128.73	19.85	6.48	*nuts*
psObstruent+Liquid Cluster	-110.21	24.07	-4.58	*slugger*
psPalatal	29.71	22.12	1.34	*shut*
psVelar	61.13	20.31	3.01	*gut*
stress0 (Intercept)	1671.828	7.356	227.28	*ambitious*
stress1	-236.468	8.689	-27.21	*productive*
stress2	-205.827	32.192	-6.39	*publication*

To isolate the effects of stress, Tables 6.11 and 6.12 reproduce lmer analysis for STRUT in only primary stress position. Following /l/ is still excluded.

Table 6.11. Mixed effects regression of conditioning effects on STRUT F1 in primary stress position

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	694.37	17.69	39.25	*budget*
fmFricative	25.53	18.35	1.39	*stuff*
fmNasal	36.36	17.76	2.05	*son*
fmStop	29.75	18.13	1.64	*sucks*
fpAlveolar (Intercept)	723.8615	4.4906	161.19	*putt*
fpBilabial	0.4549	6.4591	0.07	*cup*
fpInterdental	-11.8949	11.9105	-1.00	*southern*
fpLabiodental	6.4253	10.9883	0.58	*tough*
fpPalatal	-9.0803	14.1041	-0.64	*such*
fpVelar	10.8979	7.4266	1.47	*duck*
fvVoiced (Intercept)	720.247	3.737	192.72	*guzzled*
fvVoiceless	15.424	5.424	2.84	*bussing*
psAlveolar or Interdental Obstruent (Intercept)	718.812	5.364	134.02	*thugs*
psFree	8.542	9.081	0.94	*updated*
psGlide	-19.053	10.528	-1.81	*yuppie*
psLabial (Oral)	14.362	8.399	1.71	*public*
psLiquid	22.247	10.669	2.09	*lucky*
psM	20.331	11.050	1.84	*nuts*
psN	18.196	12.829	1.42	*slugger*
psObstruent+Liquid Cluster	-11.606	9.790	-1.19	*mucky*
psPalatal	-7.116	13.775	-0.52	*shut*
psVelar	20.058	8.601	2.33	*gut*

Under these lmer analyses, following affricates are still produced higher and fronter than other following contexts, but the range of measurements becomes smaller. Now the outlier appears to be STRUT with following nasals, which correlates with much backer productions than other environments. Following place shows little effect in F1, while in F2 following coronals appear to correlate with fronter STRUT than other following segments. Following voiceless consonants encourage fronter productions. Preceding segments appear to have little effect in F1, and correlate with backer productions when the place of articulation is front of the alveolar ridge. The effects on F2 of preceding segments appear to be generally predictable from expected acoustic influences on consonantal segments (Thomas 2011:101).

Table 6.12. Mixed effects regression of conditioning effects on STRUT F2 in primary stress position

Fixed Effects	Estimate	Std. Error	*t* value	Example
fmAffricate (Intercept)	1516.97	44.89	33.79	*budget*
fmFricative	-64.98	46.64	-1.39	*stuff*
fmNasal	-117.95	45.75	-2.58	*son*
fmStop	-73.46	45.97	-1.60	*sucks*
fpAlveolar (Intercept)	1442.02	11.74	122.80	*putt*
fpBilabial	-33.13	16.84	-1.97	*cup*
fpInterdental	25.38	32.83	0.77	*southern*
fpLabiodental	-50.67	28.74	-1.76	*tough*
fpPalatal	54.04	35.99	1.50	*such*
fpVelar	-24.87	18.76	-1.33	*duck*
fvVoiced (Intercept)	1416.256	9.924	142.7	*guzzled*
fvVoiceless	36.374	13.986	2.6	*bussing*
psAlveolar or Interdental Obstruent (Intercept)	1488.738	12.436	119.72	*thugs*
psFree	-19.598	20.291	-0.97	*updated*
psGlide	-123.655	24.452	-5.06	*yuppie*
psLabial (Oral)	-178.420	18.615	-9.58	*public*
psLiquid	-136.449	23.304	-5.86	*lucky*
psM	-126.311	25.390	-4.97	*nuts*
psN	25.995	29.091	0.89	*slugger*
psObstruent+Liquid Cluster	-93.762	21.674	-4.33	*mucky*
psPalatal	-5.899	30.010	-0.20	*shut*
psVelar	11.085	19.717	0.56	*gut*

Figure 6.7 and Table 6.13 show fixed effects linear model results for STRUT as a change in apparent time. STRUT with following /l/ (as well as NURSE) is excluded. In F2, only a few speakers approach the central value of 1550 Hz, suggesting that interviewees are backer in their productions of STRUT than were the speakers interviewed for *ANAE*. More importantly, not only is STRUT backer in this data than it was seen to be in *ANAE*, there is a change in progress in the direction of backing, with F2

decreasing by 14 Hz per decade. Following nasals appear especially important in driving this backing—when modeled in isolation, STRUT with following nasals backs at 19 Hz per decade (R2 = 0.2692, *p* < 0.001).

Figure 6.7. Linear models of STRUT F1 and F2 by interviewee birth year

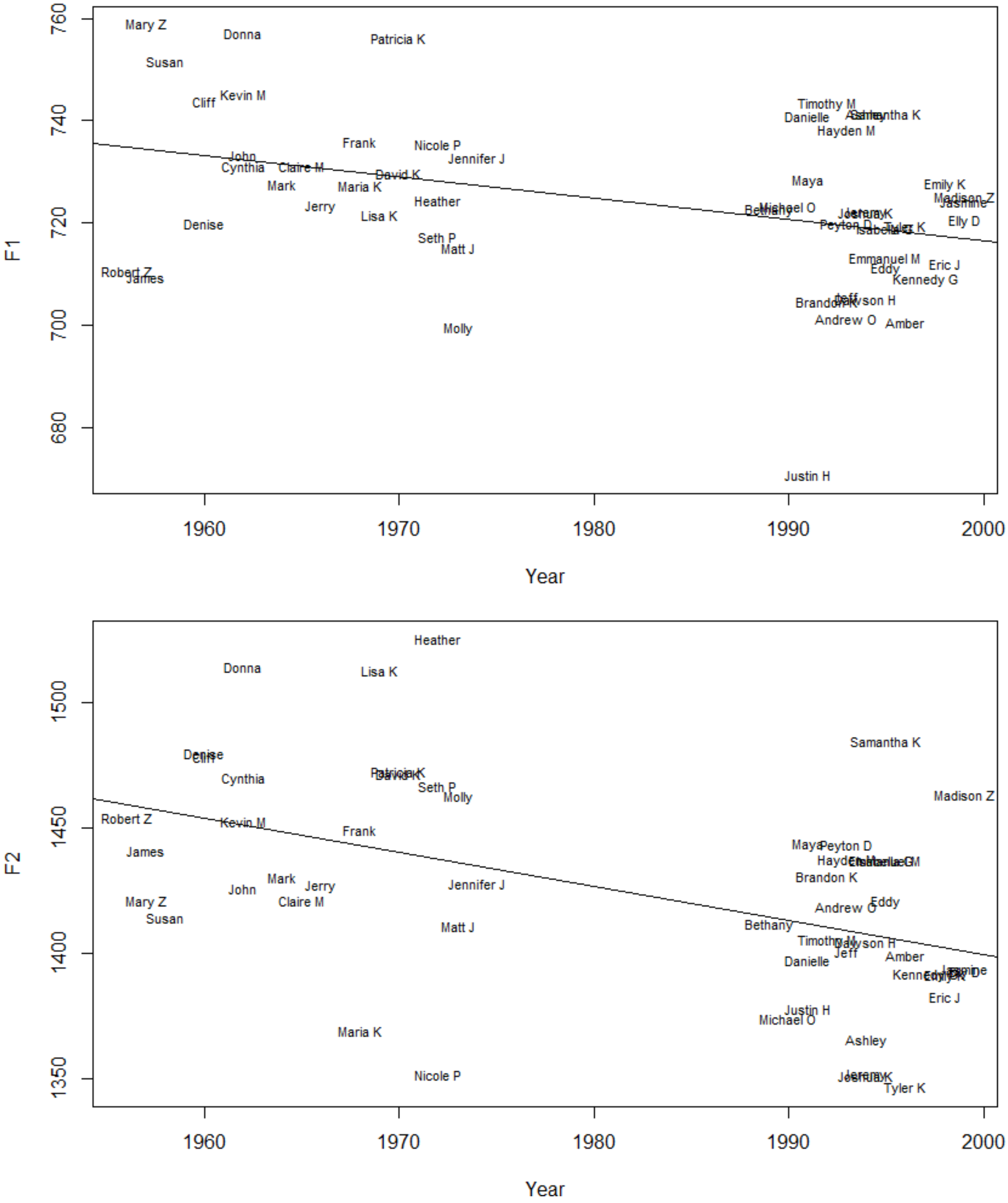


Table 6.13. Linear models of STRUT F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
STRUT F1 (Intercept)	1557.5474	287.1376	5.424	< 0.001
Year	-0.4206	0.1450	-2.901	0.00555
Residual standard error: 15.56 on 49 degrees of freedom Multiple R-squared: 0.1466, Adjusted R-squared: 0.1292 *F*-statistic: 8.417 on 1 and 49 DF, *p*-value: 0.005553				
STRUT F2 (Intercept)	4116.0623	705.8695	5.831	< 0.001
Year	-1.3584	0.3564	-3.812	< 0.001
Residual standard error: 38.25 on 49 degrees of freedom Multiple R-squared: 0.2287, Adjusted R-squared: 0.213 *F*-statistic: 14.53 on 1 and 49 DF, *p*-value: 0.000386				

In addition to the correlation between birth year and decrease in F2, Table 6.13 also shows a small, but statistically significant, change in progress in F1. STRUT F1 decreases by 4 Hz (raising in vowel space) per decade.

Table 6.14 looks to social factors to account for observed variation. F1 and F2 are explored by ANOVA for sex and class.

Table 6.14. ANOVA model of STRUT F1 and F2 by sex and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	32715	32715	6.7260
Class	2	417	208	0.0428
Sex:Class	2	2812	1406	0.2891
F2				
Sex	1	74127	74127	4.4755
Class	2	2923	1461	0.0882
Sex:Class	2	25754	12877	0.7775

In both F1 and F2, ANOVA values suggest that sex best accounts for observed variation. In mixed effects regressions, males produce STRUT 12 Hz higher and 24 Hz backer in vowel space than females. Class differences are negligible in both F1 and F2.

Figure 6.8 shows change in apparent time in STRUT F2 for males. Table 6.15 provides the lmer outputs for both F1 and F2.

Figure 6.8. Linear model of STRUT F2 among males by interviewee birth year

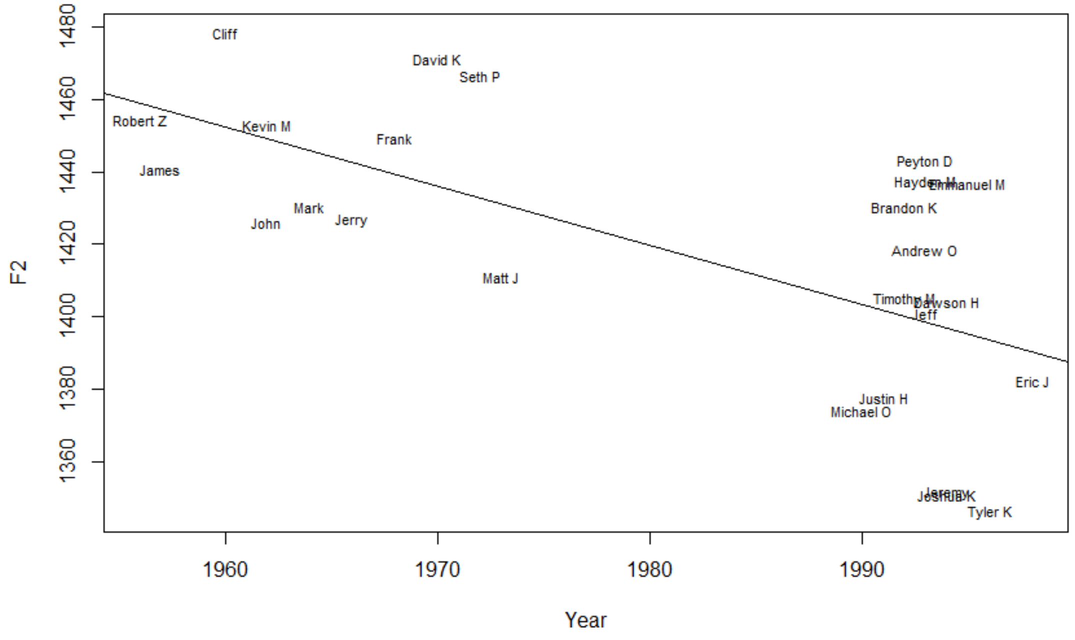


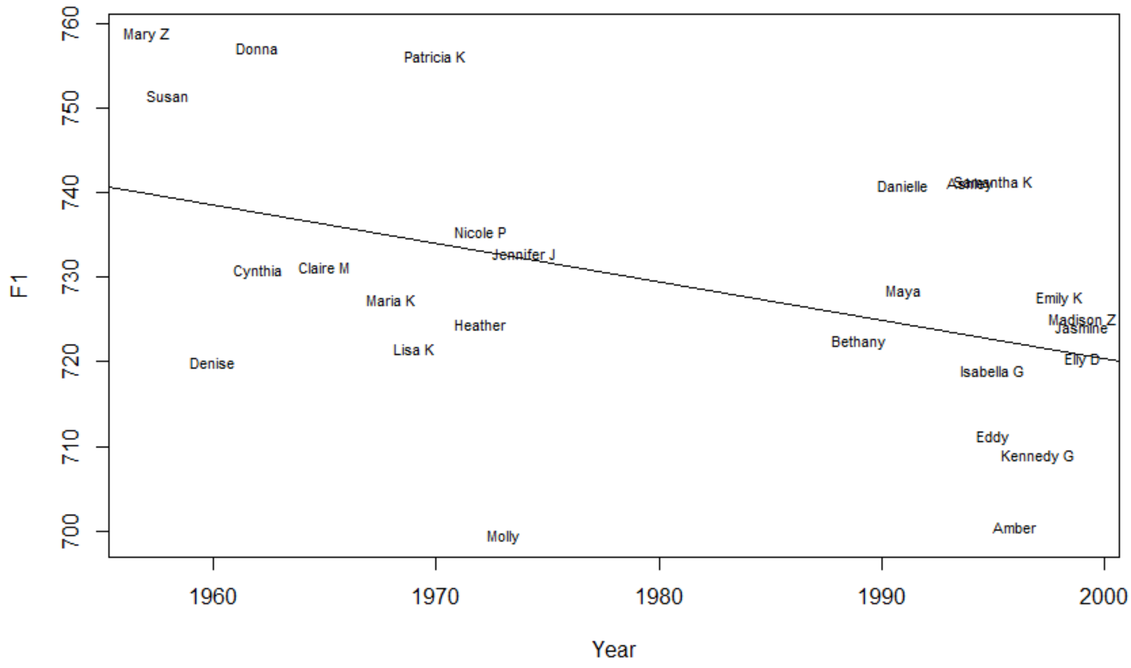
Table 6.15. Linear models of STRUT F1 and F2 among males by interviewee birth year

	Estimate	Std. Error	t value	Pr(>|t|)
STRUT F1 (Intercept)	1479.7950	418.1793	3.539	0.00175
Year	-0.3838	0.2111	-1.818	0.08215
Residual standard error: 15.7 on 23 degrees of freedom Multiple R-squared: 0.1256, Adjusted R-squared: 0.0876 *F*-statistic: 3.304 on 1 and 23 DF, *p*-value: 0.08215				
STRUT F2 (Intercept)	4653.6122	773.6122	6.015	< 0.001
Year	-1.6332	0.3906	-4.182	< 0.001
Residual standard error: 29.04 on 23 degrees of freedom Multiple R-squared: 0.4319, Adjusted R-squared: 0.4072 *F*-statistic: 17.49 on 1 and 23 DF, *p*-value: 0.0003579				

The plot for males' STRUT F1, which does not reach significance, is not shown. The relatively high R^2 of 0.407 in F2 in Table 6.15 suggests relative consistent productions among all males in this pattern of backing.

The linear model for STRUT F1 among females is provided as Figure 6.9. The model for STRUT F2 among females does not reach significance. Outputs of both models appear in Table 6.16. The R^2 values for females are not nearly as high as R^2 was for males in F2. Females do, however, show a significant (if small) level of STRUT raising. They also participate at non-significant levels in the pattern of STRUT backing.

Figure 6.9. Linear model of STRUT F1 among females by interviewee birth year



The analysis of STRUT presented here suggests a different characterization of STRUT than was presented in either Lusk (1976) or Labov, Ash, and Boberg (2006). Contrary to Lusk's description of the vowel as stable and *ANAE*'s description of the

Table 6.16. Linear models of STRUT F1 and F2 among females by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
STRUT F1 (Intercept)	1631.3994	370.4070	4.404	< 0.001
Year	-0.4555	0.1870	-2.436	0.022653
Residual standard error: 14.48 on 24 degrees of freedom Multiple R-squared: 0.1982, Adjusted R-squared: 0.1648 *F*-statistic: 5.934 on 1 and 24 DF, *p*-value: 0.02265				
STRUT F2 (Intercept)	3623.4757	1158.5612	3.128	0.00457
Year	-1.1064	0.5849	-1.892	0.07067
Residual standard error: 45.28 on 24 degrees of freedom Multiple R-squared: 0.1297, Adjusted R-squared: 0.09349 *F*-statistic: 3.578 on 1 and 24 DF, *p*-value: 0.07067				

vowel as fronted, this research suggests that STRUT is backing in apparent time. There is also a meager pattern of STRUT raising. Males appear to lead females fairly strongly in STRUT backing.

6.3. GULL

Chapter 5 showed that STRUT followed by /l/ (GULL) is produced by Kansas Citians at a back position near BOWL. I did not study GULL as part of a minimal pair, and so my exploration of it here will be something of an afterword to the consideration of POOL, BOWL, and BULL in the last chapter.

Table 6.17 shows linear models for Euclidean distance and Pillai scores for separations between GULL and BOWL. Neither model shows any change whatsoever in the proximity of GULL and BOWL in apparent time. In other words, the relative distance of GULL and BOWL appears to be stable in Kansas City.

Table 6.17. Linear models of distances between GULL and BOWL by interviewee according to birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
Euclidean distance (Intercept)	-1149.7332	1620.0853	-0.710	0.481
Year	0.6466	0.8177	0.791	0.433
Residual standard error: 86.4 on 48 degrees of freedom Multiple R-squared: 0.01286, Adjusted R-squared: -0.007707 *F*-statistic: 0.6253 on 1 and 48 DF, *p*-value: 0.433				
Pillai score (Intercept)	0.9873159	3.4863780	0.283	0.778
Year	-0.0003856	0.0017598	-0.219	0.827
Residual standard error: 0.1859 on 48 degrees of freedom Multiple R-squared: 0.0009994, Adjusted R-squared: -0.01981 *F*-statistic: 0.04802 on 1 and 48 DF, *p*-value: 0.8275				

Table 6.18 shows ANOVA models for Euclidean distances and Pillai scores for all interviewees by the social factors of gender and class. Because these are created from fixed effects models, significance scores can be calculated in these ANOVA models.

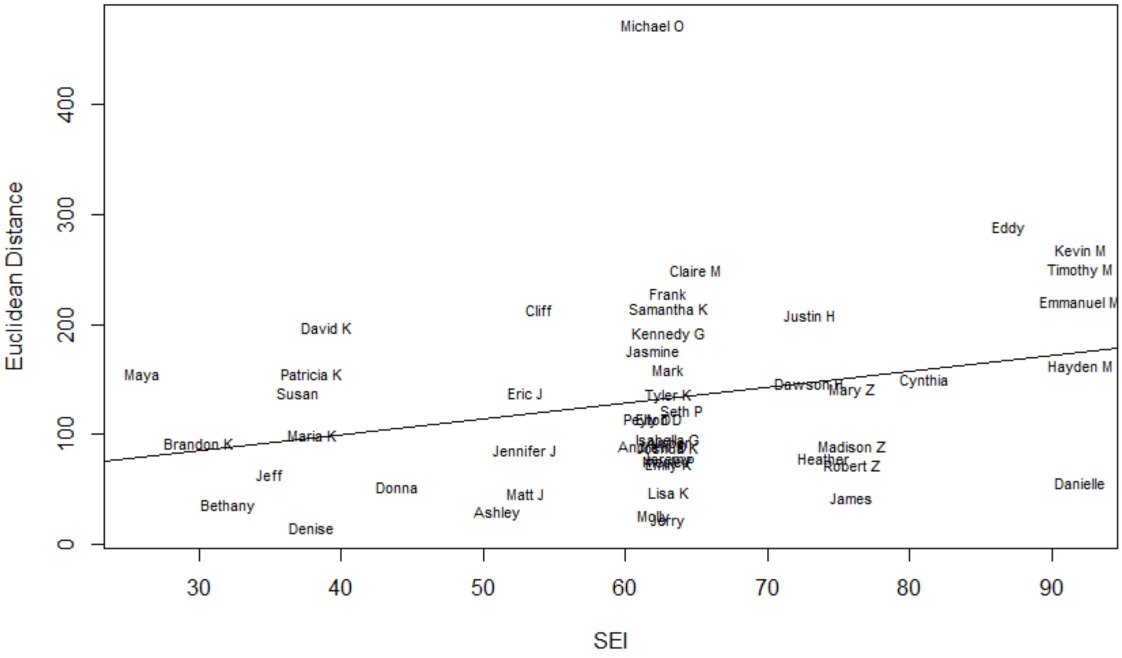
Table 6.18. ANOVA model of GULL-BOWL distances by sex and class

Factor	Df	Sum Sq	Mean Sq	*F* value	Pr(>|t|)
Euclidean Distance					
Sex	1	18709	18709.0	2.4173	0.1272
Class	2	2082	1041.1	0.1345	0.8745
Sex:Class	2	1646	822.9	0.1063	0.8994
Residuals	44	340543	7739.6		
Pillai Score					
Sex	1	0.07245	0.072450	2.0576	0.1585
Class	2	0.03586	0.017930	0.5092	0.6045
Sex:Class	2	0.00342	0.001708	0.048	0.9527
Residuals	44	1.54928	0.035211		

No social factors account for observed variation in distances between GULL and BOWL. This suggests that, not only are the distances between GULL and BOWL not changing in time in Kansas City, but that all speakers participate in basically the same norms.

Slightly contradicting this, linear models for Euclidean distances according to prestige and SEI scores do show a slight correlation between higher socioeconomic status and higher Euclidean distances. The model for SEI scores is plotted as Figure 6.10 (intercept = 41.5875, coefficient = 1.4501, R^2 = 0.06352, p = 0.04295).

Figure 6.10. Linear model of Euclidean distances between GULL and BOWL by SEI



This is a small correlation, though, and no such correlation emerges by Pillai score. The better understanding of the data, then, is that the relative distance between GULL and BOWL is not changing in apparent time in Kansas City. Given that BOWL was seen to be backing in apparent time, it would be expected that GULL is also backing. Figure 6.11 and Table 6.19, however, show that this is not the case.

Figure 6.11. Linear models of GULL F1 and F2 by interviewee birth year

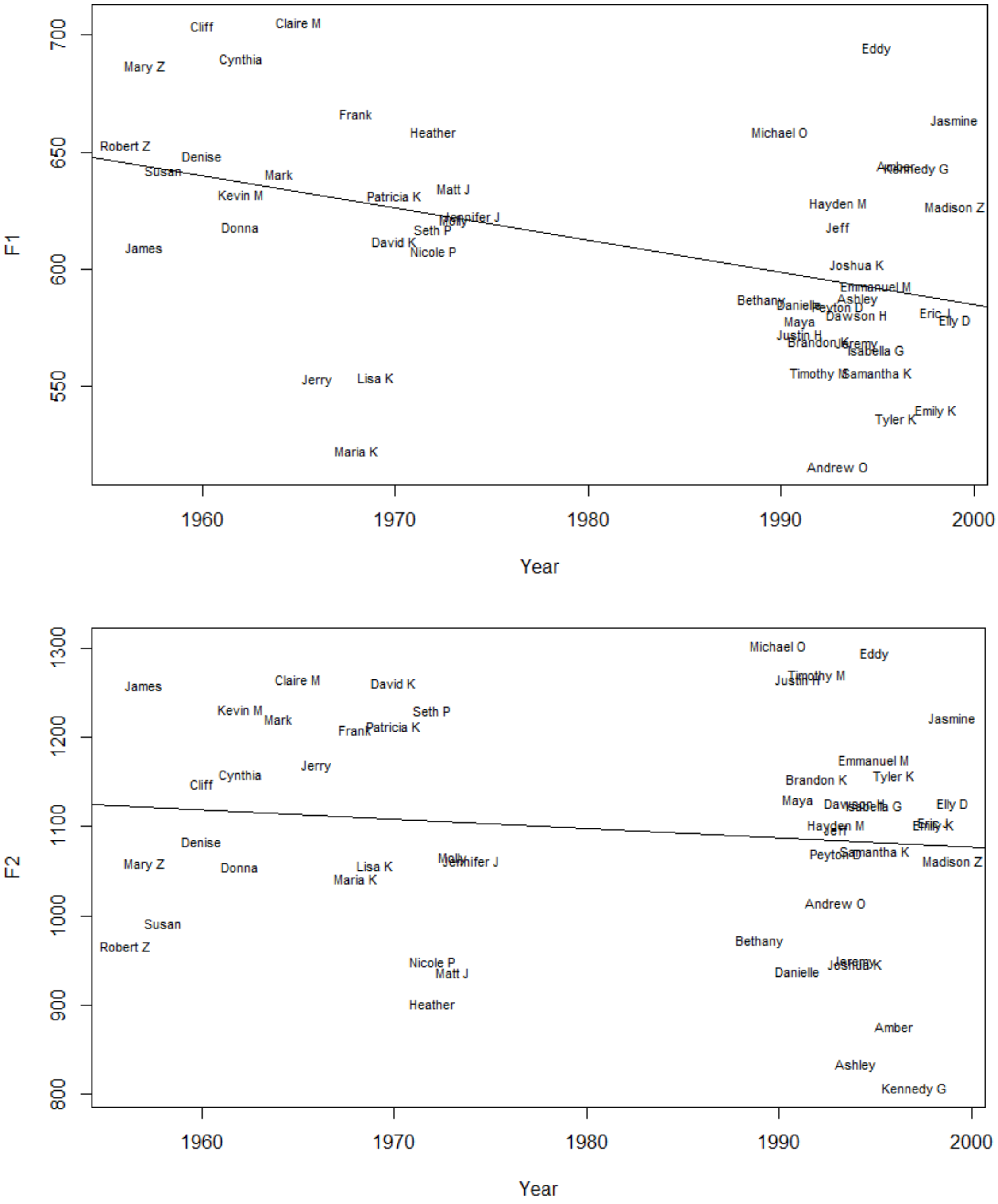


Table 6.19. Linear models of GULL F1 and F2 by interviewee birth year

	Estimate	Std. Error	*t* value	Pr(>|t|)
GULL F1 (Intercept)	3350.2755	810.1522	4.135	0.000142
Year	-1.3828	0.4089	-3.381	0.001442
Residual standard error: 43.21 on 48 degrees of freedom Multiple R-squared: 0.1924, Adjusted R-squared: 0.1756 *F*-statistic: 11.43 on 1 and 48 DF, *p*-value: 0.001442				
GULL F2 (Intercept)	3177.130	2345.350	1.355	0.182
Year	-1.050	1.184	-0.887	0.379
Residual standard error: 125.1 on 48 degrees of freedom Multiple R-squared: 0.01613, Adjusted R-squared: -0.004367 *F*-statistic: 0.787 on 1 and 48 DF, *p*-value: 0.3794				

For GULL, the change in apparent time occurs in F1. At a modest R^2 of 0.176, F1 decreases by 14 Hz per decade. These measurements suggest that GULL has been produced quite back for many Kansas Citians for more than a half century, but has undergone a relatively recent change in the direction of raising. Phonetically speaking, this suggests that older Kansas Citians might produce GULL more like pre-/l/ THOUGHT, and younger Kansas Citians would produce GULL more like BOWL. This possibility would be of interest for future minimal pairs testing in Kansas City.

Table 6.20 provides ANOVA outputs for GULL F1 and F2 by the social factors of gender and class. These are calculated from mixed effects models, so significance scores are not provided. The ANOVA of GULL suggests a strong interaction between F2 and gender. In mixed effects regression, males produce GULL 83 Hz fronter than the female intercept of 1034 Hz. Males also produce GULL 13 Hz higher than the female F1 measurement of 631 Hz. Transitional class speakers produce GULL 12 Hz higher and 30 Hz backer than the middle class intercepts of F1:636 Hz, F2:1077 Hz. Working class speakers produce GULL 24 Hz higher and just 7 Hz fronter than middle class speakers.

Table 6.20. ANOVA model of GULL F1 and F2 by gender and class

Environment	Df	Sum Sq	Mean Sq	*F* value
F1				
Sex	1	2136.2	2136.2	1.0710
Class	2	5914.1	2957.1	1.4826
Sex:Class	2	6788.3	3394.1	1.7017
F2				
Sex	1	86769	86769	6.8483
Class	2	7554	3777	0.2981
Sex:Class	2	15263	7632	0.6023

This analysis suggests that GULL and BOWL are produced close together in Kansas City. It appears that GULL is in a relatively back position for all Kansas Citians. For Kansas Citians whose productions of GULL and BOWL are acoustically close, this appears to result from GULL raising in apparent time. If this analysis is correct, then a secondary consequence should be an increase in the distance between GULL and THOUGHT with following /l/ in apparent time. Figure 6.12 depicts Euclidean distances and Pillai scores for these two classes as a correlation with interviewee birth year. Table 6.21 provides the outputs from these models.

These models show that, among the oldest interviewees there are several (e.g., Robert Z, James) whose productive differences in these contexts are very small. It would be interesting to study minimal pairs like *haul-hull* or *gall-gull* to see if there is a change in time in their perceptions or productions as merged or distinct. Suggesting a change in apparent time, younger interviewees trend toward larger distances between these sets than older interviewees.

Figure 6.12. Linear models of distances between GULL and pre-/l/ THOUGHT by interviewee according to birth year

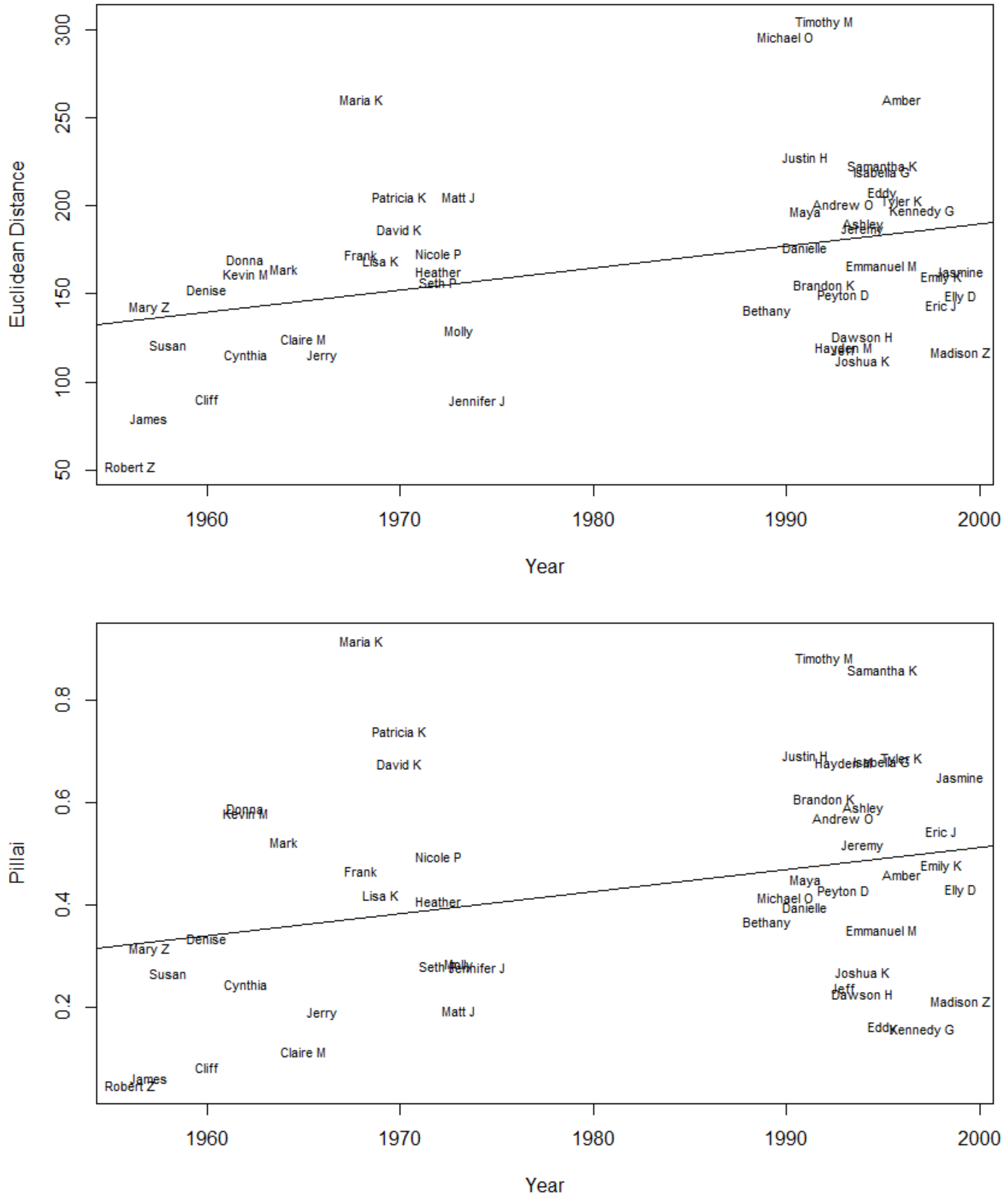


Table 6.21 confirms the significant scores for these models—though each has a low R^2 value. Even so, they offer some confirmation for the observed raising of GULL in apparent time.

Table 6.21. Linear models of distances between GULL and pre-/l/ THOUGHT by interviewee according to birth year

	Estimate	Std. Error	t value	Pr(>|t|)
Euclidean distance (Intercept)	-2334.5146	910.7065	-2.563	0.01355
Year	1.2622	0.4597	2.746	0.00847
Residual standard error: 48.57 on 48 degrees of freedom Multiple R-squared: 0.1358, Adjusted R-squared: 0.1178 *F*-statistic: 7.54 on 1 and 48 DF, *p*-value: 0.008468				
Pillai score (Intercept)	-8.115872	3.945722	-2.057	0.0452
Year	0.004313	0.001992	2.166	0.0353
Residual standard error: 0.2104 on 48 degrees of freedom Multiple R-squared: 0.08902, Adjusted R-squared: 0.07005 *F*-statistic: 4.691 on 1 and 48 DF, *p*-value: 0.03532				

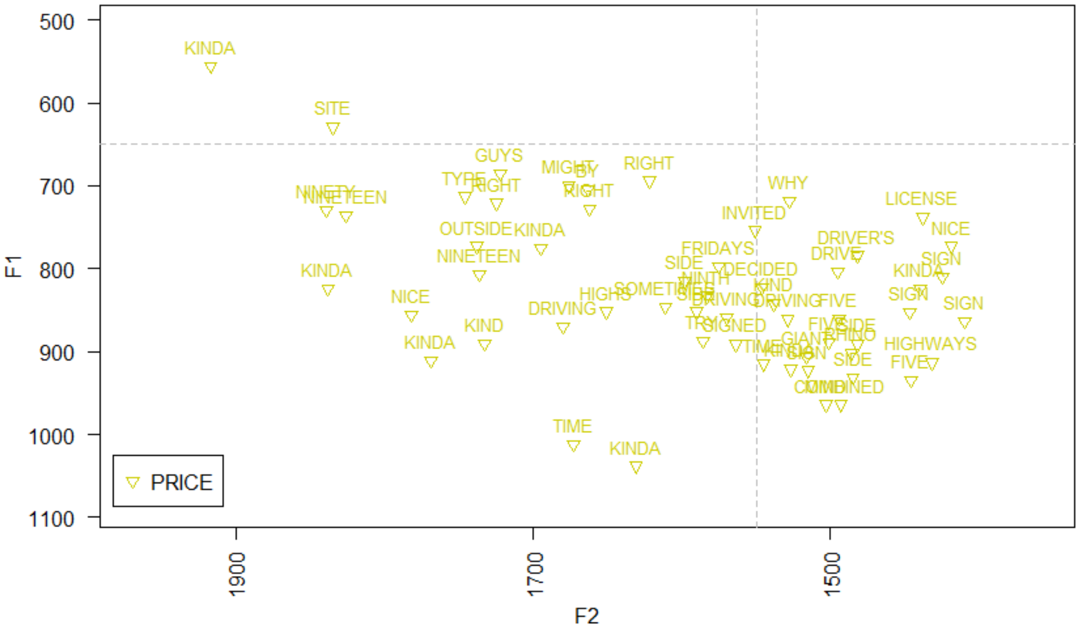
6.4. Summary – PRICE and STRUT

This chapter identified several incipient changes in the dialect of Kansas City that, to my knowledge, were previously undocumented in the city. The first is a general fronting of the nucleus of the vowel in PRICE, as well as raising of PRICE before voiceless consonants among middle class interviewees. Second is a backing of STRUT, especially in pre-nasal contexts. This change shows a male lead and, if it continues, moves Kansas City English away from the extreme front articulation of STRUT that *ANAE* identified as a key marker of Midland speech. The third is a raising of the vowel in

GULL, which may encourage a conditioned merger between GULL and BOWL (and potentially BULL).

To illustrate the emerging middle class pattern of Canadian raising in PRICE, Isabella G's casual speech (CS) PRICE tokens are plotted in Figure 6.13. Isabella was born in 1995 and grew up in the upper-middle-class suburb of Shawnee, KS, just across the Kansas border from KCMO. The public school district in the area is regularly cited by Kansas Citians as a reason for living on the Kansas side of State Line Road. Her family is middle class. Her mother does graphic work for a corporation, and her father stays at home and does some freelance art work. Isabella is herself active in the arts and in performance, and these interests draw her to downtown KCMO more than is typical of white kids in the suburbs. She dances in a troop in downtown KCMO, and regularly attends First Fridays, a trendy monthly art event in the Crossroads District at the southern edge of downtown.

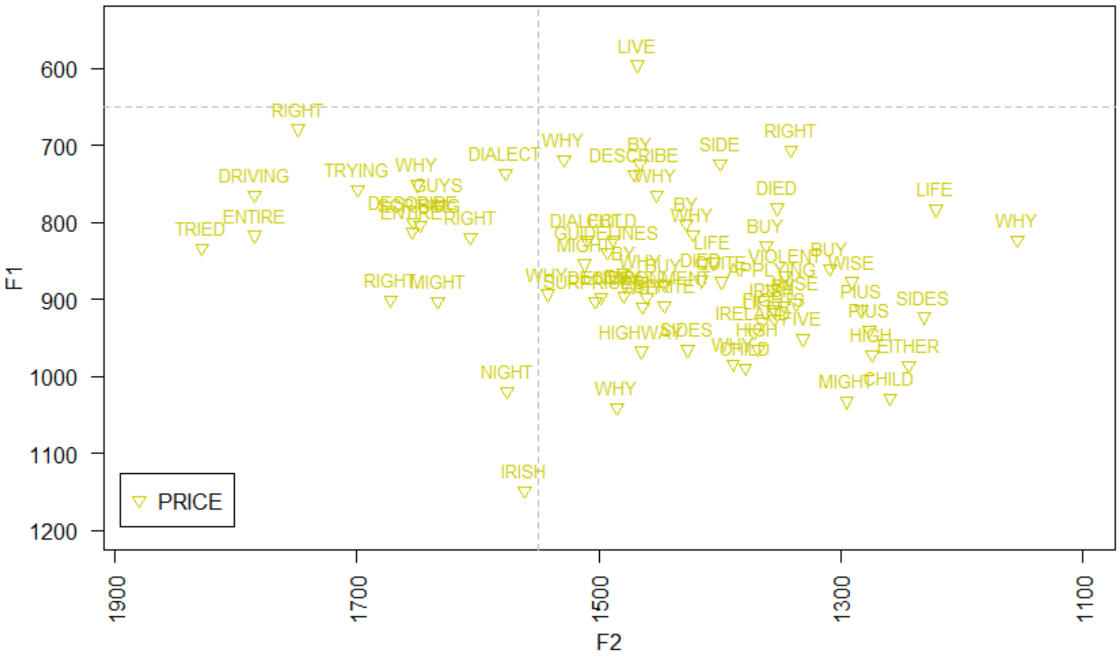
Figure 6.13. Isabella G, b. 1995, Shawnee, KS – Casual speech PRICE tokens



Her PRICE tokens generally show allophonic conditioning for following voicing. While several tokens with a following nasal plot higher and fronter than would be expected from the analysis above (e.g., *kinda*, *ninety*, *nineteen*). There is roughly a diagonal break between her higher, fronter tokens with following voiceless consonants and her lower, backer tokes with following voiced consonants. Her pre-voiceless tokens show mean productions of F1:731 Hz, F2:1646 Hz, compared with a mean of F1:849 Hz, F2:1588 Hz for pre-voiced PRICE (Euclidean distance of 131 Hz). The difference in F1 of 118 Hz is almost double the threshold value that *ANAE* uses to mark Canadian raising in the North (Labov, Ash & Boberg 2006:205-206). Two apparent exceptions to the voicing rule, *guys* and *invited*, are actually confirmations. The /t/ in *invited* is flapped and plots with other voiced tokens. The plural morpheme in *guys* is devoiced—part of a broader pattern of devoicing that I noticed among younger interviewees, but have not yet examined. So, her production of PRICE with Canadian raising appears to be completely phonetically conditioned. This contrasts, e.g., with Fruehwald's (2013) finding that Canadian raising in Philadelphia applies phonemically rather than phonetically, so that PRICE with following flaps raises according to the underlying /t/ rather than the produced [ɾ]. At this time, I simply acknowledge the difference in the application of the raising rule.

Denise's casual speech tokens offer a contrasting pattern. Denise was born in 1960 and grew up in the KCMO area known as Old Northeast. The area was dominated by Italian immigrants for most of the twentieth century, but demographics shifted to the area being dominated by African Americans and Latino immigrants during Denise's childhood. She started high school at Northeast High School, but was moved (unhappily) by her parents to a private school in Independence after her freshman year, because of the perception that Northeast was growing unsafe. Today she works as an administrative assistant in KCMO and lives in the suburb of Lee's Summit, MO. Her vowels are plotted in Figure 6.14. Tokens with following nasals are excluded to make the plot easier to read.

Figure 6.14. Denise, b. 1960, KCMO – Casual speech PRICE tokens

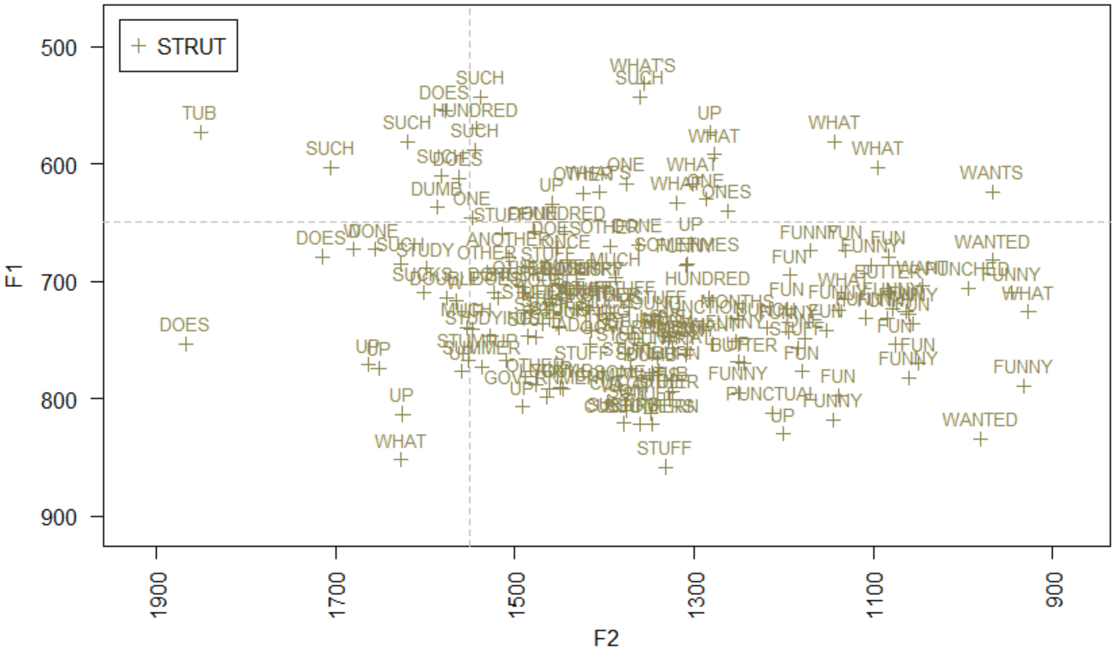


Compared with Isabella G, the bulk of Denise's tokens occur farther back in vowel space. They don't show a distinction in allophonic conditioning based on following voicing. Tokens of *might*, *life*, and *fights* are intermingled in the cluster of tokens between 1300 and 1500 Hz in F2. Tokens with following voiced consonants and in free position (e.g., *driving*, *live*, *why*) occur front and/or high. Her mean value of pre-voiceless PRICE is F1:870 Hz, F2:1470 Hz against a pre-voiced PRICE mean of F1:881 Hz, F2:1444 Hz. This Euclidean distance is just 28 Hz—and only 11 Hz in F1. As such, her PRICE tokens are not split according to voicing, and the entire class is backer than it is for younger interviewees.

These plots show that the difference between the older pattern of backer PRICE tokens, and the newer pattern of fronting PRICE and (for middle class speakers) raising pre-voiceless PRICE, is a perceptually nuanced difference. Nevertheless, it appears that Kansas Citians are fronting PRICE generally, and there appears to be an incipient split among some speakers that is consistent with Canadian raising.

The incipient backing of STRUT, especially pre-nasally, among young Kansas Citians is depicted by a plot of Jeremy’s casual speech STRUT tokens in Figure 6.15. Jeremy was born in 1994 and grew up in Shawnee, KS. He was interviewed with Eddy, whose MOUTH tokens are plotted in Chapter 5 to demonstrate MOUTH backing. Jeremy lives in a new development on the western edge of the Kansas suburb of Shawnee. While Jeremy technically lives in the same middle class suburb as Isabella G, in practical terms they live in very different parts of Kansas City. Physically, the older area of the suburb where Isabella lives is about fifteen miles from the newer part where Jeremy lives. Not only do they attend different high schools, but their high schools are in different school districts. They also seem to have very different cultural orientations with regard to Kansas City; while Isabella’s social life frequently takes her into downtown KCMO for activities related to fine arts, Jeremy’s social life revolves high school sports, suburban shopping areas, and natural activities like camping and fishing in eastern Kansas. While such differences are not necessarily relevant, it is important to note that simple demographic labels for interviewees may belie large cultural differences among them.

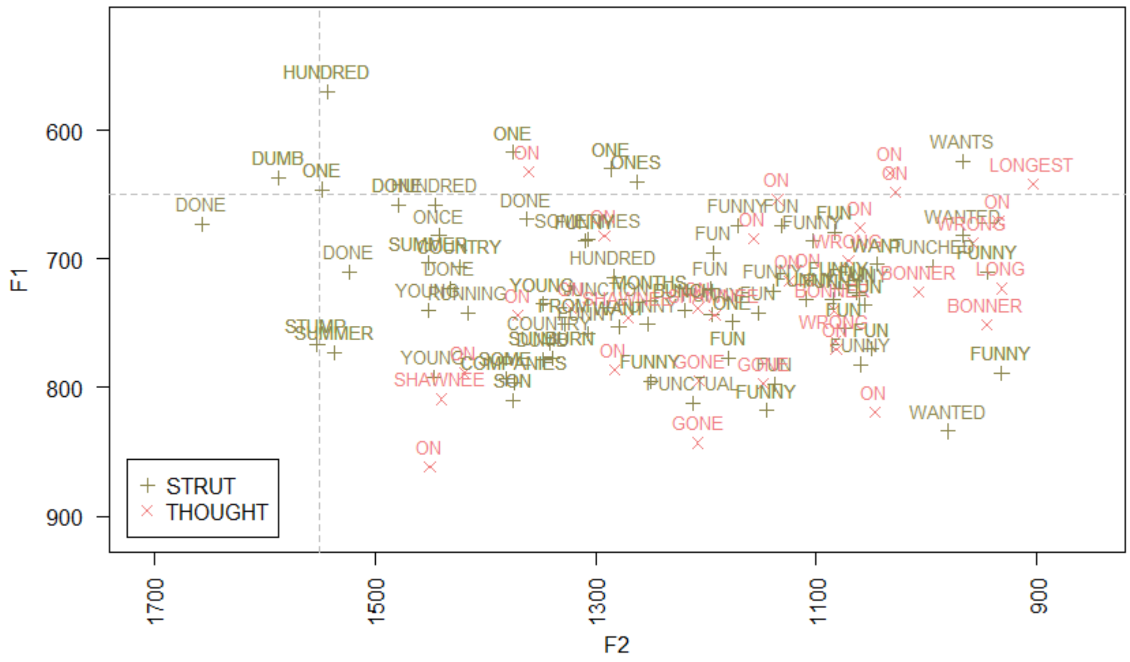
Figure 6.15. Jeremy, b. 1994, Shawnee, KS – Casual speech STRUT tokens



The bulk of Jeremy's STRUT tokens occur both lower and backer than the mid and central reference lines of 650 Hz (F1) and 1550 Hz (F2). STRUT with following affricates (primarily *such*) occurs generally higher and fronter, as suggested by lmer analysis of phonetic conditioning. While a few tokens of STRUT with following nasals plot in the area of these higher fronter tokens (*hundred*, *dumb*), generally tokens with following nasals dominate the lower, backer area of his distribution. Derivations of *fun* are especially well represented. In fact, many of Jeremy's pre-nasal STRUT tokens distribute in the range of pre-nasal THOUGHT tokens, as shown in Figure 6.16.

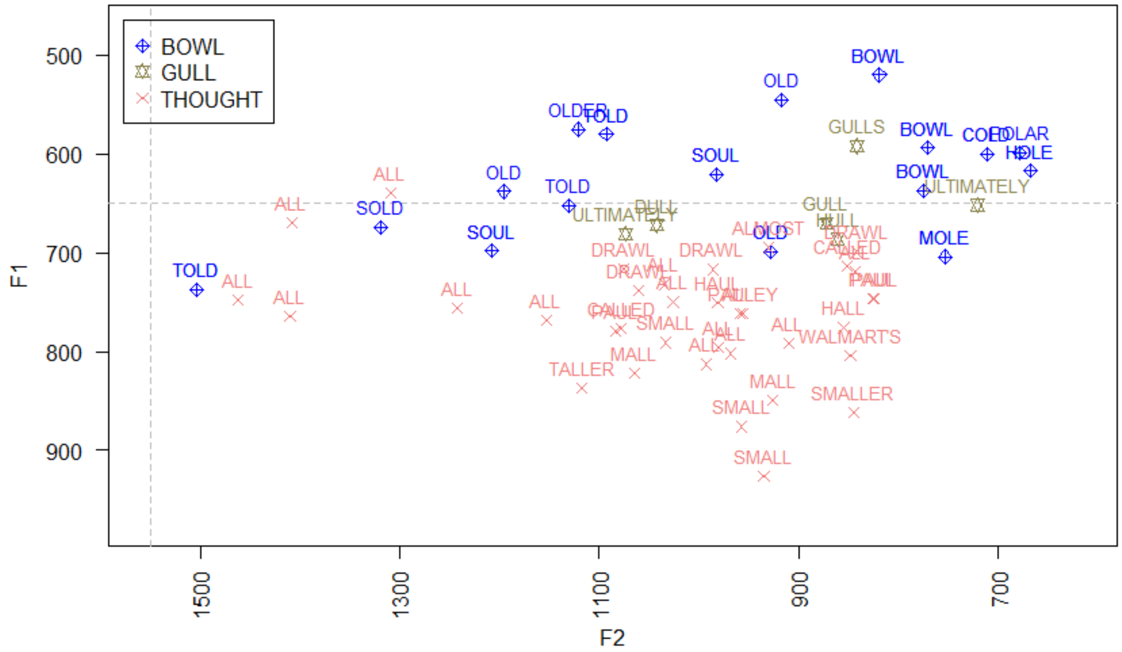
This occasional coincidental phonetic distribution of STRUT and THOUGHT tokens is surprising because it marks a radical departure from the front productions of STRUT found in Kansas City by *ANAE*. In a broader sense, STRUT backing is characteristic as a last stage of the Northern Cities Shift and is used as one of the major contrasts between the North and Midland (e.g., discussion of the UD line in Labov, Ash & Boberg 2006:202). If the suggested incipient backing of STRUT in Kansas City becomes general in the city, it would potentially reduce this point of regional dialect difference.

Figure 6.16. Jeremy, b. 1994, Shawnee, KS – Casual speech pre-nasal STRUT and THOUGHT tokens



Finally, in the narrow pre-/l/ context, Figure 6.17 plots Heather's productions of GULL and BOWL in interview speech to illustrate the sets' largely overlapping distributions for many Kansas Citians. Tokens of THOUGHT with following /l/ are also plotted for reference. Heather was born in KCK in 1972 and lived there through adolescence. Today she live in the Kansas suburb of Merriam. Notes on her background are included in Chapter 2, but Heather grew up in a working class family and neighborhood. She went to work in a factory after high school and spent her early adulthood working on an assembly line. By completing course work at night, she eventually earned bachelors and masters degrees and today works in a solidly white-collar position. Based on her current status, she is coded as middle class.

Figure 6.17. Heather, b. 1972, KCK – Interview speech BOWL, GULL, and pre-/l/ THOUGHT tokens



GULL occurs relatively infrequently in interviews. Nevertheless, the few tokens in Heather's interview are illustrative of patterning among Kansas Citians. GULL tokens (including *gulls*) occur near—or in overlapping distribution with—BOWL tokens. GULL tokens also plot near THOUGHT with following /l/. In fact, GULL visually almost forms a border between BOWL and pre-/l/ THOUGHT. This specific distribution is suggestive of the change in time observed for Kansas City in general—GULL has been acoustically back for some time. It has recently begun a change in raising, which could push GULL from a position in F1 near [ɔ] to a position in F1 near to [o].

No structural explanations are offered in this chapter for the observed changes. At this time, it is simply noted that PRICE and STRUT represent two areas of potentially dynamic change in Kansas City English. The former is fronting and, for middle class speakers, raising in a manner consistent with Canadian raising. The latter shows indications of backing and, in a pre-/l/ context, may be variably subject to merger with either pre-/l/ THOUGHT or BOWL. These changes appear to be new—or at least previously unrecognized—developments in the dialect of Kansas City.

CHAPTER 7

THE NEW SOUND IN KANSAS CITY

To this point, a large amount of data has been discussed in very close detail. This chapter attempts to summarize the observations about English in Kansas City that have emerged from this exploration. I also attempt to contextualize these observations against other studies of language in Kansas City, as well as within the broader field of sociolinguistics. Finally I offer some potential direction for future study.

I have not included an analysis of the attitudes of interviewees toward language in Kansas City in this dissertation. However, a cursory examination of meta-linguistic responses from interviewees suggests that Kansas Citians believe in the "neutrality" of their community's dialect. For instance, Mary Z, born in 1957 in Raytown, MO and living in KCMO, asked during her interview whether, when a news network was hiring reporters, "Do they try to get them from the Midwest cause people can understand them?" James, born in KCMO in the same year, similarly indicated that most reporters were from Missouri, Kansas, Nebraska, and Indiana for the same reason. Their ideas mimic very nearly the responses from Michiganders reported in Niedzielski and Preston (2000), in which the "correctness" of a Michigan dialect was attested to by the claim of linguistically secure respondents that people on the news talked like them.

Jeremy, born in 1994 in Shawnee, KS, revealed a similar attitude in explaining how it was that he was recognized as being from Kansas during a trip to California:

> I was in California and I was just talking. And [someone asked], "You from Kansas?" And I'm like, "Yeah, how'd you know?" It's like you—

> they [can] just tell. It’s like—I guess it’s cause, like, we have such a normal, like, non-accented voice, I think it’s just kind of like a giveaway.

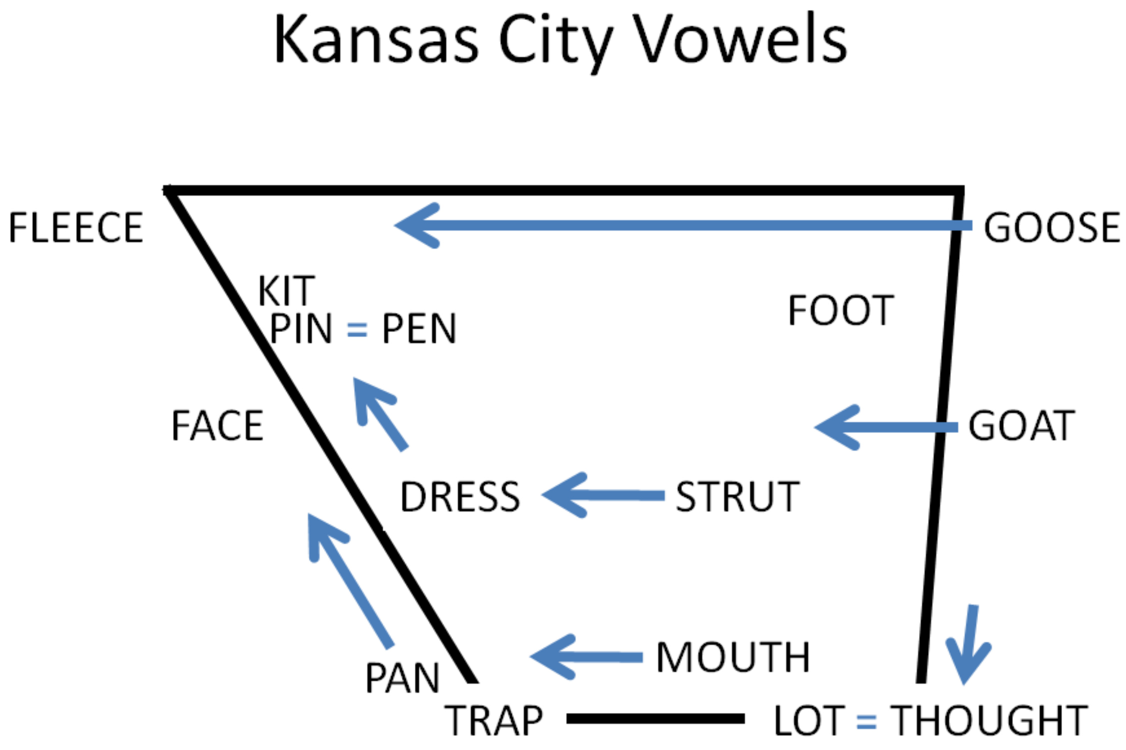
Of course, perceptual dialectology studies (e.g., Preston 1989, 1999) suggest that it is unlikely that strangers would identify a person as being from a specific place based on their lack of an accent. (Jeremy also indicated a few seconds later that most international call centers were located in Missouri, Nebraska, and Kansas, because “we’re pretty easy to understand.”) His comments reflect a deeply held ideology of dialect neutrality in Kansas City—and the ways that Kansas Citians will bend logic to match that ideology. (The ideology is also reflected in looking at postings on YouTube of the “Accent Tag” meme, for instance the description, “Hailey and Alicia doing the accent tag with their very borring [sic] Kansas City talk!”)

Such attitudes are certainly not uncommon in the Midwest. Preston (1989) and Niedzielski and Preston (2000) have regularly observed it in Michigan and Campbell-Kibler (2012) found similar perceptions in Ohio. My experience working with college students at three Missouri universities has suggested that the attitude is fairly widespread throughout the state, especially among students from Kansas City and St. Louis.

From a linguist’s perspective it is anything but surprising that the research presented here has shown that the dialect of Kansas City is neither normal nor boring—at least, if normal and boring are taken to mean static. Language in Kansas City has changed dramatically over the course of the community’s existence, and continues to do so. This research generally confirms the findings of Lusk (1976) and Labov, Ash, and

Boberg (2006) for the characterization of the dialect around the 1950s, as described in Chapter 1 and depicted in Figure 1.6 (reprinted here as Figure 7.1).

Figure 7.1. Proposed Model of the Kansas City Vowel System (from Figure 1.6)



That is, for speakers studied in this research who were similar in age to the people surveyed for Labov, Ash, and Boberg (2006) and included in Lusk's (1976) youngest group of interviewees, this research generally achieved a similar picture of Kansas City vowel space. Like earlier research, I found that GOOSE, GOAT, and MOUTH have fronted for these speakers, LOT and THOUGHT are rapidly progressing toward merger, and pre-nasal TRAP is high and front. In other cases, the picture was a bit more nuanced. For instance, I found STRUT to be more front than Lusk's (1976) characterization of the vowel as stable might suggest, but not as front as indicated by *ANAE*. Among older males, I found PIN and PEN to be moving toward merger, rather than almost completely merged as in *ANAE* or completely merged among lower status informants as in Lusk (1976).

In studying a new generation of Kansas Citians, though, it is clear that Figure 7.1 represents a snapshot of language in Kansas City and not an endpoint. This research has shown that the changes of the previous generations have indeed continued to change, and new developments have been detected in the dialect. These include changes approaching completion, as well as brand new changes emerging. Table 7.1 attempts to summarize the changes observed in this research, according to their progress.

Table 7.1. Changes in Kansas City English according to Progress

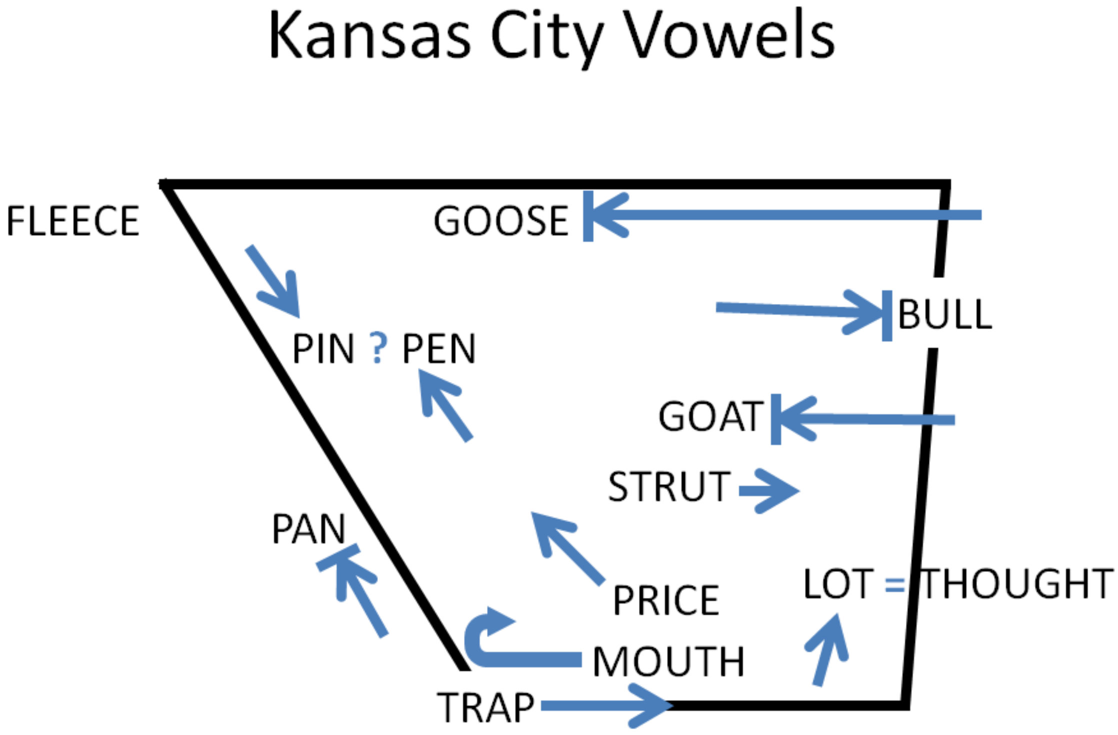
Complete	Nearing completion	In progress	New and vigorous	Incipient
• MOUTH fronting • Pre-nasal TRAP raising • BULL backing • GULL backing and lowering	• Phonemic merger of LOT and THOUGHT • GOOSE fronting • GOAT fronting	• LOT backing • PIN-PEN merger • POOL backing • BOWL backing • PULL-BULL merger • BOWL-BULL merger • PRICE fronting	• TRAP retraction • Pre-nasal MOUTH retraction • BOWL-GULL merger	• MOUTH retraction • PRICE raising • STRUT backing

The boundaries between the labels of “complete,” “nearing completion,” etc. in Table 7.1 are somewhat arbitrary, but attempt to reflect the relative newness of changes observed as well as levels of participation. “New and vigorous” changes, for instance, are those that have appear to be spreading rapidly among younger Kansas Citians, while “incipient” changes are those that are identified among young Kansas Citians but do not appear to have become general among the age group as a whole. It is best to think of these labels as descriptions of a continuum rather than discrete categories.

Some of the changes described in one stage of progress directly conflict with changes described in other stages of progress. For instance, Table 7.1 suggests that MOUTH fronting is complete and that MOUTH retraction is an incipient change. These opposite movements should be interpreted as potential emerging reversals of a diachronic sound change. Elsewhere, especially in the category of “changes in progress,” it is not straightforward from this research that changes in progress will continue to completion. The cases of the POOL-BULL and BOWL-BULL mergers are especially noteworthy, with some evidence pointing to increased participation in the latter and resistance to the former.

I attempt to visualize the new state of Kansas City English in Figure 7.2, which recasts Figure 7.1 in light of this new research. Figure 7.2 obviously does not represent a simplification of the stylized vowel space. But it attempts to more accurately reflect complete and nearly completed changes (like the fronting of GOAT or backing of BULL), changes that appear to be deviating from their earlier trajectories (like MOUTH F2 and the PIN-PEN merger), and newly identified changes (like PRICE raising and STRUT backing). It also offers different conceptual characterizations of some changes (like the phonetic target of the merged LOT-THOUGHT vowel). At the least, it makes visually clear that the dialect of young Kansas Citians is diverging from the dialect of older Kansas Citians, and that the dialect of tomorrow’s Kansas Citians is likely to continue to diverge.

Figure 7.2. Revised Model of the Kansas City Vowel System



The developments in Kansas City's dialect do not lend themselves to easily summarizable conclusions about either causation in the specific cases of these observations, or more broadly about language and language change. Nevertheless, I'll try to propose a few potential interpretations of the data presented to this point. I'll discuss several of the important areas of exploration in this dissertation in the specific context of principles of sound change. For some historical depth to this discussion, I'll also integrate some data collected for Gordon and Strelluf (2013, forthcoming).

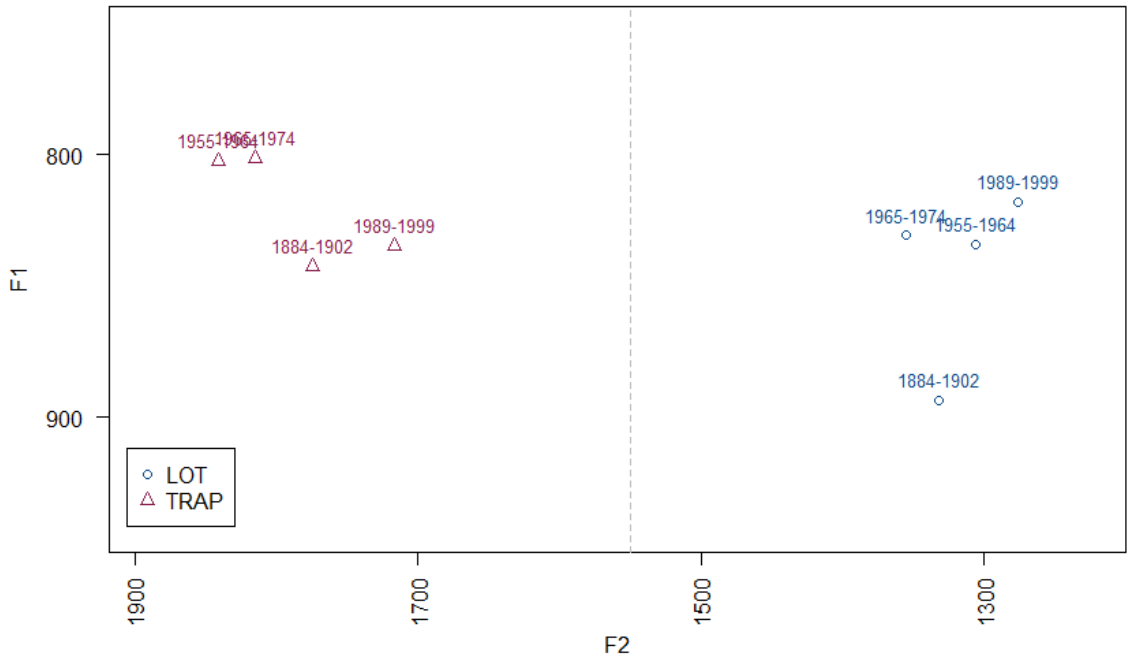
7.1. Chain Shifting in Kansas City

Several changes observed in Kansas City appear potentially to be results of chain shifts, at least in terms of statistical significance. In particular, the retraction of TRAP in connection with LOT's merger with THOUGHT—specifically with LOT's movement backward in F2 in apparent time—is particularly interesting as a potential chain shift in Kansas City. The impressionistic evidence of Kansas City provided by Lusk (1976) for the first half of the twentieth century suggests that TRAP was beginning to retract during the time that LOT and THOUGHT were rapidly undergoing merger. The acoustic evidence presented in this study shows that TRAP's retraction has become a vigorous change in progress. In this research, linear models show statistically significant relationships between the position of TRAP and LOT in F2. The conclusion that this relationship may be the result of a TRAP-LOT chain shift is bolstered because such a shift has been observed elsewhere (e.g., Canada in Clarke, Elms & Youssef 1995; California in Eckert 2004; Columbus, OH in Durian 2012; others listed in Chapter 4) and because it has been structurally predicted by Gordon (2005) and others.

The chain shift here is suggestive of a drag chain. Labov (2010:141-144) offers a revised model of the process governing such a shift (see also Labov's 1994:580-599 discussion of probability matching and its relationship to language change, which is the foundation for the account in Labov 2010). In this account, prior to any change, Vowel 1 (V1) and Vowel 2 (V2) occupy adjoining positions in vowel space. A language learner would naturally encounter productions of V1 that were V2-like (e.g., a V1 token produced at the phonetic edge of V1's space would sound like a production of a V2 token). The language learner would be less likely to interpret these outliers as productions of V1, and would therefore assign less weight to such phonetic productions in shaping the acoustic target of V1. However, when V2 moves away from the space that it previously occupied next to V1 in a way that increases the acoustic space between the vowels, this check against outliers would be lost. Now when a language learner encounters an outlier of V1 that is in the phonetic space vacated by V2, it is reliably understood as a production of V1. The outlier production can now factor into the language learner's calculation of a target value for V1, and this would shift the V1 mean in the direction of V2's previous position.

Figure 7.3 attempts to depict a relationship between TRAP and LOT in Kansas City using data collected for this dissertation, as well as for Gordon and Strelluf (2013, forthcoming). Speakers are divided into four roughly similar groups by birth year, with the oldest being speakers born 1884 to 1902 (from Gordon and Strelluf 2013, forthcoming), and the others are divided as 1955-1964, 1965-1974, and 1989-1999. The figure plots mean productions of TRAP and LOT (excluding those followed by a nasal, /l/, or /r/, as well as members of the PALM class).

Figure 7.3. TRAP and LOT in Kansas City by age group



In terms of the account of a drag chain described above, in their initial state in Kansas City, LOT is a low back vowel and TRAP a low front vowel. LOT vacates its low back space and moves toward THOUGHT. This increases the possibility that language-learning Kansas Citians will understand low back productions of TRAP as actual productions of TRAP (rather than simply discarding them as outliers or mishearing them as LOT), and this should facilitate TRAP backing toward the position that has been vacated by LOT.

This particular set of data requires several qualifications prior to interpretation. Probably most important is that results from Gordon and Strelluf (2013, forthcoming) are based on a much more limited sample of speech from five Kansas Citians drawn from very old recordings and, as such, are less reliable than my newer interview data. It is also important to note that the 1955-1964 and 1965-1974 age groups include eleven and thirteen interviewees, respectively, compared with twenty-seven interviewees in the 1989-1999 age group. Nevertheless, if taken with these grains of salt, Figure 7.3 sheds some interesting light on the theoretical account of the chain shift. First, LOT vacates its initial position before the retraction of TRAP begins. LOT moves from a relatively low position in vowel space up to a higher position between the oldest group and all others; at the same time TRAP is in a front and relatively high position among the interviewees born between 1955 and 1975 before retracting among the youngest interviewees. This is a two-step process led by the vacating of LOT (V2) from its space, making it possible for outlier productions of TRAP (V1) as low and back to be interpreted as TRAP. These could cause the calculation of the mean for TRAP productions to be pulled lower and backer.

Visual inspection of Figure 7.3 still problematizes this straightforward explanation. In particular, it offers no explanation for the raising and fronting of TRAP that appears to occur between the 1884-1902 age group and the 1955-1974 age groups. This pattern of movement also conflicts with Lusk's (1976) description of TRAP lowering outside of pre-nasal environments in apparent time. So, it may be that the low-front position of TRAP measured for the oldest group is simply wrong. As noted, this value is based on a small sample measured from old recordings. On the other hand, while the sample is small in the context of this dissertation, the measurement of TRAP in Figure 7.3 is still based on 236 vowel measurements. And, while the acoustic measurements taken from old recordings may be problematic, generally speaking measurements achieved by this method for Gordon and Strelluf (2013, forthcoming) are plausible (and subject to the same quality controls as outlined in Chapter 2). So, there is no reason to dismiss the values for this oldest group out of hand. Figure 7.3 then fails to convincingly show that there is an inherent relationship between the positions of TRAP and LOT in Kansas City, or perhaps that, if there is a relationship between them, it has not necessarily always existed.

Moreover, like Gordon (2001), interview data for Kansas City suggests relatively little relationship between LOT and TRAP in terms of which phonetic environments encourage backer or fronter (or raised or lowered) productions. For instance, following /t/ correlates with relatively low front productions of LOT and relatively low back productions of TRAP, including among the youngest Kansas Citians, who clearly participate in TRAP retraction (this accounts for the non-significant relationship between these conditions shown Table 4.3). As such, in the actual phonetic experience of Kansas

City language learners, it would theoretically be easy, for instance, to mistake an especially low back utterance of *cat* for a normal production of *cot*. This should presumably limit the inclusion of such low-back TRAP tokens in the calculation of the target mean of TRAP, and effectively slow TRAP retraction. On the other hand, following /g/ correlates with relatively higher and fronter TRAP and higher and backer LOT, creating a large margin of security for the vowels in this phonetic environment. As such, it is very unlikely that a token of *lag* would be mistaken for a token of *log* (assigned to LOT in Labov 2010:100), and this should encourage TRAP retraction, specifically by freeing *lag* to be produced in lower and backer positions. This doesn't appear to happen. The response to this concern is that retraction is occurring at the level of the phoneme rather than the specific phonetic context (and Chapter 4 supports this argument), but nevertheless the phonetic experience of language learners would not intuitively encourage the probability matching as outlined above.

Finally, this complication is reified by interview data through the observation that not all Kansas Citians participate in the proposed LOT-TRAP chain shift in the same way. In particular, TRAP retraction, as structurally predicted by the position of LOT in vowel space, is a middle class, female phenomenon. Other groups more or less follow their lead. Considered in isolation, it seems just as possible that social factors lead to TRAP retraction as it does that a vowel-system-internal relationship is driving this change.

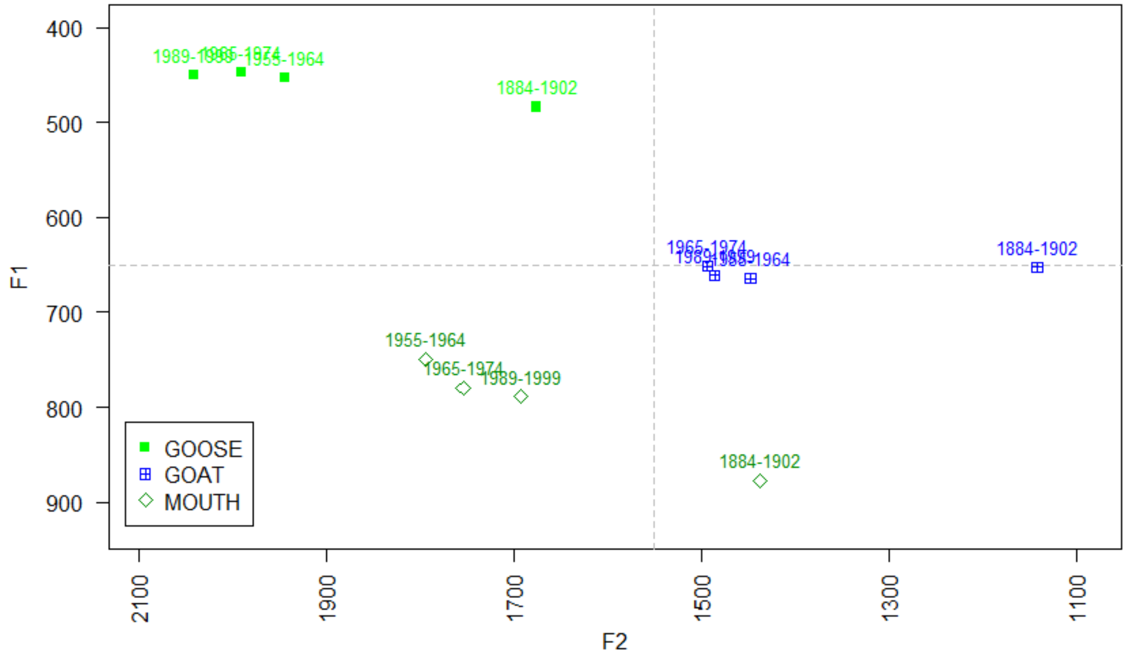
Ultimately, then, the chain shift between LOT and TRAP proposed in this dissertation for Kansas City must be left as a possibility rather than a conclusion. Indeed Occam's Razor supports the likelihood of a chain shift, simply because TRAP retraction has occurred in so many areas where the low back merger has occurred. A structural explanation dependent on a single linguistic system-internal factor is more appealing than the possibility that the same change would take place independently across a wide swath of North America. The chain shift explanation might become stronger in future research if DRESS and KIT lowering also appear in Kansas City, as they have in other areas undergoing Canadian Shift-like patterns.

In short, the examination of TRAP and LOT presented in this research shows that a chain shift may be occurring between the vowels in Kansas City. More research is needed, however, to establish that the correlations between their positions is indeed a matter of causation.

A similar set of complications arises for the front positions of GOOSE, GOAT, and MOUTH. While these are not proposed as chain shifts in the sense described above, these parallel frontings are often considered as interrelated (e.g., Durian 2012; Fruehwald 2013). Chapter 5, indeed, showed structural relationships in Kansas City between the F2 of GOOSE and GOAT. Figure 7.4 uses data collected for Gordon and Strelluf (2013, forthcoming) again to consider a broader apparent time purview for the interrelatedness of these vowels. It plots post-coronal GOOSE, GOAT, and MOUTH, with following liquids excluded, according to age groups.

An important caveat in considering Figure 7.4 is that it presumes a merger between /ɨu/ (/iw/ in *ANAE*) and the /u/ of GOOSE. I have assumed these to be merged in all previous discussion based on interview data, responses to the minimal pair *dew-do*, the finding of Labov, Ash, and Boberg (2006:55) that the classes are completely merged in Kansas City, and the historical precedent of Kurath and McDavid (1961) finding the vowels to be merged in their Midland. Gordon and Strelluf (forthcoming) find that these are not merged in the oldest Kansas Citians they studied, meaning that, strictly speaking, the GOOSE class for the 1884-1902 sample should be backer than it is in Figure 7.4. Likely, post-coronal GOOSE would be in the 1300 to 1400 Hz range for these speakers and the position plotted for GOOSE in Figure 7.4 would more nearly reflect /ɨ/ tokens.

Figure 7.4. GOOSE, GOAT, and MOUTH in Kansas City by age group



Even with that caveat, though, it is overwhelmingly clear that GOOSE, GOAT, and MOUTH have leapt forward in vowel space in apparent time in Kansas City between the 1884-1902 speakers and all others. To that point, an explanation of phonetic analogy (e.g., Durian 2012) or introduction of a phonemic rule (e.g., Fruehwald 2013) seems plausible. These explanations become less convincing, though, when data from interviewees is examined more closely. Most prominently, if MOUTH was fronting in a parallel or analogous relationship with GOOSE and GOAT, it is not anymore. Beginning with the 1955-1964 age group, each age group shows an incremental retraction of MOUTH. Meanwhile, in the post-coronal context of Figure 7.4, GOOSE continues to front incrementally in apparent time, but GOAT has frozen. However, as Chapter 5 showed, in the context of other preceding segments, it is GOAT that continues to front and GOOSE that has frozen. As such, it is difficult to explain the nuclear fronting of the back upgliding vowels in Kansas City—at least as observed in the youngest generation of Kansas Citians—by accounts of either analogy or phonemic rule.

In short, correlated changes are observed in Kansas City. This research raises more questions than conclusions about those changes. I will have to leave for future projects more exploration of actuation.

7.2. Mergers

Each chapter in this dissertation included examination of a potential merger in Kansas City. One, the merger of BOWL and GULL, was only explored phonetically (rather than by the phonemic status of the sets, and will not be discussed further here. The others—the LOT-THOUGHT, PIN-PEN, POOL-BULL, and BOWL-BULL mergers—each revealed a different account of progress in Kansas City.

For all intents and purposes, the low back merger appears to be phonemically complete among young Kansas Citians, though some speakers sometimes maintain phonetic distinctions. This result generally mirrors the findings of Di Paolo (1992) for Utah English, where speakers produced phonetic distinctions between LOT and

THOUGHT in casual speech but produced LOT and THOUGHT as more merged during higher attention-to-speech tasks. Among older interviewees, a few hold out claims for a distinction between LOT and THOUGHT, but they are a minority, and in a few cases they get the distinction wrong (cf. Hall-Lew 2013). Apparent time data suggests that the mean production of LOT raised in vowel space to a THOUGHT-like value before 1955 and the mean value of LOT has been backing in F2 since. This differs from accounts of LOT and THOUGHT merging at [ɑ] in American dialects, as in Wells (1982) or Bailey (1985), and places the merged production of LOT-THOUGHT more in line with productions observed in Canada and western Pennsylvania (e.g., Wetmore 1959; Labov, Ash & Boberg 2006). More generally, though, in Kansas City the entire phonetic space of LOT and THOUGHT appears to be available for productions of the merged vowel, and stylistic variation suggests that productions near [ɑ] might be associated with casual registers and productions near [ɔ] with formal. The availability of the entire vowel space phonetically suggests a merger by expansion, as described by Herold (1990, 1997) in northeastern Pennsylvania.

The low back merger is, of course, advanced throughout much of North America. Its presence in Kansas City raises the question of its source. A map of the merger in *ANAE* (e.g., Labov, Ash, & Boberg 2006:66) suggests an eastward diffusion of a pattern from the West. Similarly, Gordon’s (2006a) finding that the low back merger appears to be spreading across Missouri from the Northwest and out to the east and south supports the idea of an eastward expansion. An underlying rationale for such an account is that when areas are in contact and a merger exists in one of them, the merger will tend to expand geographically (Herzog's Corollary—from Herzog 1965 and discussed in Weinreich, Labov & Herzog 1968; Labov 1994, 2010). A possibility then, is that the low back merger has spread from the West across the continent and now has Kansas City as its eastern extent.

While nothing in this dissertation negates that explanation, I would, at least, like to complicate it by challenging whether the history of contact in Kansas City at the time the low back merger appears to have taken hold in the area would likely derive this result. By contact, I mean that the eastward expansion of the merger would be a more convincing explanation if it could be shown that, especially during the first half of the twentieth century, people were coming from the West to Kansas City and bringing the low back merger with them, or that Kansas Citians were in frequent interaction with areas to the west that had the merger.

While neither can be disproven in the brief settlement history of Kansas City offered in Chapter 1, it's also not obviously clear that either contact situation occurs in Kansas City's history. Generally, the migration pattern in the United States has been east to west. Kansas City was indeed established to facilitate such migration and, in one sense, the community would have been put into contact with westerners through this role. The settlement during this early period of contact, though, was decidedly South Midland, followed by an infusion of North and North Midland settlers during the last half of the nineteenth century and early twentieth century. The first half of the twentieth century (and, indeed, the twentieth century in general) also brought settlers from rural Missouri and Kansas into Kansas City. Neither migration pattern makes it clear that the West could have been a source for the low back merger. Even in the case of immigrants to Kansas

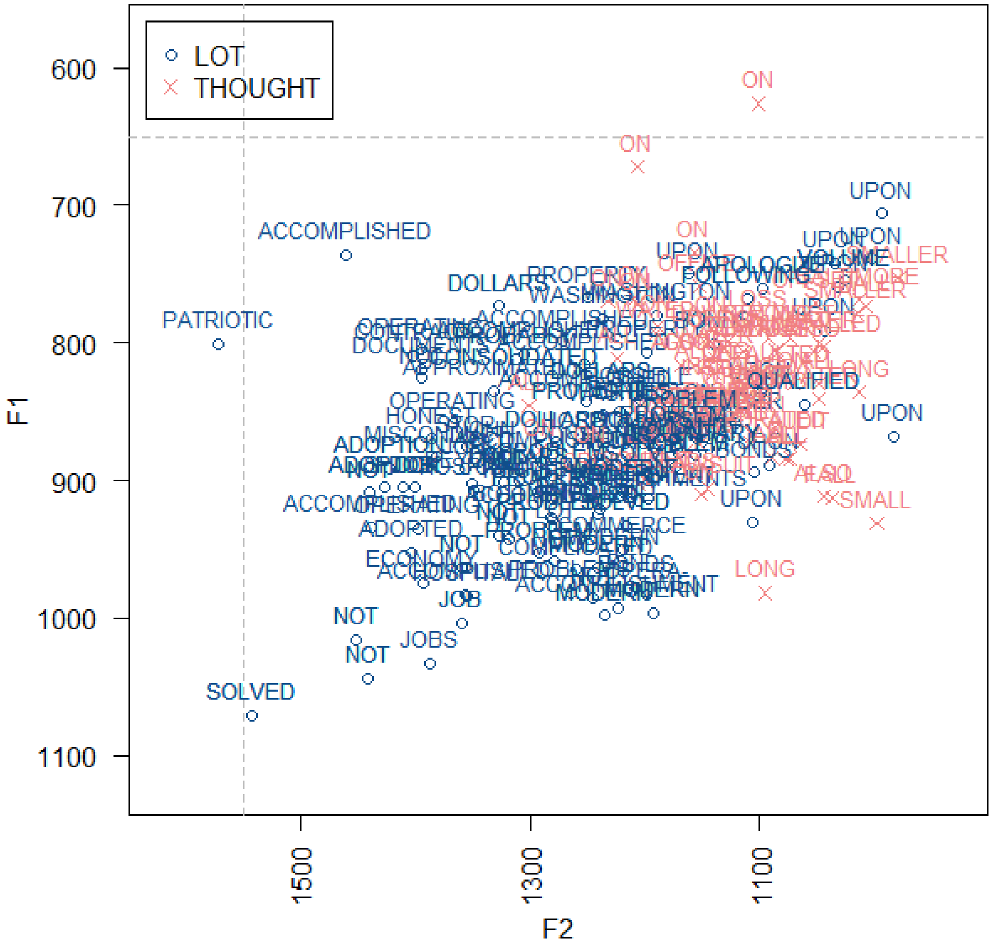
City from Kansas—literally to the west of the city—there's not an obvious history of movements from western areas, per se. Among interviewees, for instance, many indicated that their grandparents had come to Kansas City from rural Missouri and many described visiting relatives in rural Missouri. By contrast, most interviewees regarded the state of Kansas west of the Kansas City area as terra incognita. Only one interviewee, Nicole P, whose father moved to western Kansas after his divorce from Nicole's mother, indicated having visited Kansas outside of the Kansas City area or the large state universities of University of Kansas and Kansas State University. This is only anecdotal, of course, and cannot be representative of the settlement history of the city. However, it suggests that the frequent contact with areas just west of the city is not widespread in the way that might be suggested by the idea of the low back merger spreading into Kansas City from the West. (See Irons 2007 for an analogous challenge to diffusion as an explanation for the low back merger's spread in Kentucky in small isolated communities that are unlikely to be in frequent contact with merged areas or with in-migrations from merged areas.)

An alternative account might be provided by the early years of Kansas City's expansion, when South Midland dialect patterns that maintained the LOT-THOUGHT distinction were brought into contact with North Midland and North dialect patterns that maintained the LOT-THOUGHT distinction in different ways (or were merged, in the case of North Midlanders from western Pennsylvania—e.g., Kurath & McDavid 1961; Evanini 2009). Herold (1990:5-7) and Labov (2010:99-101) detail the haphazard assignment of words to either LOT or THOUGHT, especially in the transition from Middle English /ŏ/. These result not only in a lop-sided assignments of the vowels according to phonetic environments (Labov 2010:100), but also to variable assignments across regional dialects on a word-by-word basis, for instance in the assignment of /ɑ/ after /w/ or in types like *on* and *off* (Herold 1990:6—see also Labov, Yaeger & Steiner 1972 for discussion of LOT and THOUGHT assignments; and Marckwardt 1940, 1942 illustrates the high variability of assignment specifically within the "General American" region just east and northeast of Missouri in Illinois, Indiana, Ohio, Michigan, and Wisconsin). With this diachronic history, it is easy to imagine that the different dialect regions that sent settlers to Kansas City would have caused the area to be populated with competing assignments of words to LOT and THOUGHT. Weeks's (1896:237-242) account of rustic speech in Kansas City gives some anecdotal evidence of this. For instance, he transcribes *bob, bog, ma, pa,* and *Tom*—all of which might be expected to be assigned to either LOT or PALM—with [ɔ]. (He also counts *calm* and *psalm* [PALM], and *faucet* and *haunt* [THOUGHT] as [æ] in Kansas City, illustrating the complicated range of productions present in these vowels in the early history of Kansas City.)

Gordon and Strelluf (2013, forthcoming) examined Kansas Citians born between 1884 and 1902 for presence of the low back merger. While they concluded in general that their sample maintained a solid distinction between LOT and THOUGHT, one Kansas Citian, John Gage, showed hints of the merger to come. Gage was born in KCMO in 1887, and became mayor of KCMO in 1939. His tokens of LOT and THOUGHT from an annual civic address are plotted in Figure 7.5.

Overall, Gage maintains a distinct distribution of LOT and THOUGHT, but there is certainly overlap in the classes. (The type *upon* is marked as LOT by FAVE, but is likely assigned to THOUGHT in the Midland, and should probably be disregarded from analysis. I don't recode it here because it doesn't occur in interviews.) Pre-/l/ LOT tokens, especially, encroach into THOUGHT territory, among them *apologize*, *following*, and *volume*. Pre-nasal LOT in *bonds* also appears among THOUGHT tokens.

Figure 7.5. John Gage, b. 1887, KCMO – LOT and THOUGHT tokens



This potentially emergent breakdown between LOT and THOUGHT in given phonetic environments was noted in Chapter 3 (e.g., Section 3.3.) and proposed as an encouraging factor in the phonemic merger of LOT and THOUGHT in Kansas City. As the proposal went, the historic assignment of tokens to LOT or THOUGHT is such that there are a number of phonetic environments where only one of the vowels is represented, and a number of other environments where the distribution is heavily skewed. Even more to the point, Labov (2010:99-100) suggests that contrastive relationships exist between LOT and THOUGHT only in the contexts of following /t/, /d/, /s/, /n/, /l/, /k/ (and /r/) (moreover, all the types that Labov 2010:100 lists with following /s/, e.g., *cost*, *loss*, *toss*, are listed as CLOTH words by Wells 1982:136-137 and therefore likely merged into THOUGHT in American Englishes, potentially reducing potential contrastive relationships even more). Indeed, this is the case in Kansas City, where the problem of skewed distributions was often solved among interviewees by the reassignment tokens from vowel classes that are only lightly represented in a given context to vowel classes that are more robustly represented (e.g., tokens of LOT with a following labiodental like *novel* or *sophomore* have been reassigned to THOUGHT in Kansas City). This reassignment process might have been encouraged during Kansas City's period of rapid expansion in the late nineteenth century by the regionally competing vowel class assignments of incoming North Midland, North, and South Midland speakers, which could have further blurred assignment of types to classes.

Herold (1990, 1997) argues that, in eastern Pennsylvania coalmining communities, the influx of large numbers of immigrants who did not maintain a LOT-THOUGHT distinction encouraged speakers with a distinction to abandon it. Their social motivation would be communicative efficiency—all members of the community would rely on semantic context rather than phonemic distinction to disambiguate whether another speaker said, e.g., *cot* or *caught*. This resulted in the merger of expansion she described, wherein a token of either class could occur in the phonetic space traditionally available to either vowel. Kansas City's rapid expansion resulting from waves of South

Midland, North Midland, and North speakers could have laid a similar groundwork for the community to abandon a LOT-THOUGHT distinction as communicatively important. The breakdown in phonemic status accounts for the similar result of the merger of expansion observed in Kansas City, as well as the extremely rapid advance of the merger observed by Lusk (1976) during the first half of the twentieth century. It would also allow for comparison to a precedent of speakers who produce a phonetic distinction between LOT and THOUGHT, but appear not to maintain one phonemically, as seems to happen among some interviewees in this data (i.e., the Bill Peters effect, as discussed briefly in Chapter 1).

This is to say that the combination of settlement history in Kansas City, the increased incidence of merger in specific phonetic environments, the linguistic history of LOT and THOUGHT, and the similarity of the description of the low back merger in Kansas City to the merger in places as disparate as Utah and northeastern Pennsylvania may point to a different mechanism for the advancement of the merger in Kansas City than might be suggested by the low back merger isogloss in *ANAE*. Rather than the merger spreading into Kansas City geographically from West areas with the merger, the low back merger might have arisen organically within Kansas City from contact between different linguistic systems that may have eliminated the usefulness of traditional vowel class assignments and thereby encouraged the reassignment of types to vowels according to phonetic conditioning.

A small but potentially useful methodological innovation was noted in Chapter 3 for exploring the phonemic status of LOT and THOUGHT in Kansas City. This is to test interviewee perceptions by giving interviewees the option to say that a minimal pair can sound either same or different, as opposed to forcing a choice between the two. Such an approach might create a way to test whether interviewees are calling tokens of LOT and THOUGHT phonemically different or simply indicating that they hear an allophonic difference. It could also confirm or refute the claim that, in a merger of expansion, any production across the combined vowel space is available. Such a test could also probe interviewee perceptions of appropriateness of productions—for instance, utilizing some of Labov's (1966\2006) linguistic insecurity methods to test whether someone who produced a token with a THOUGHT-like vowel sounded like a newscaster or should try some other line of work.

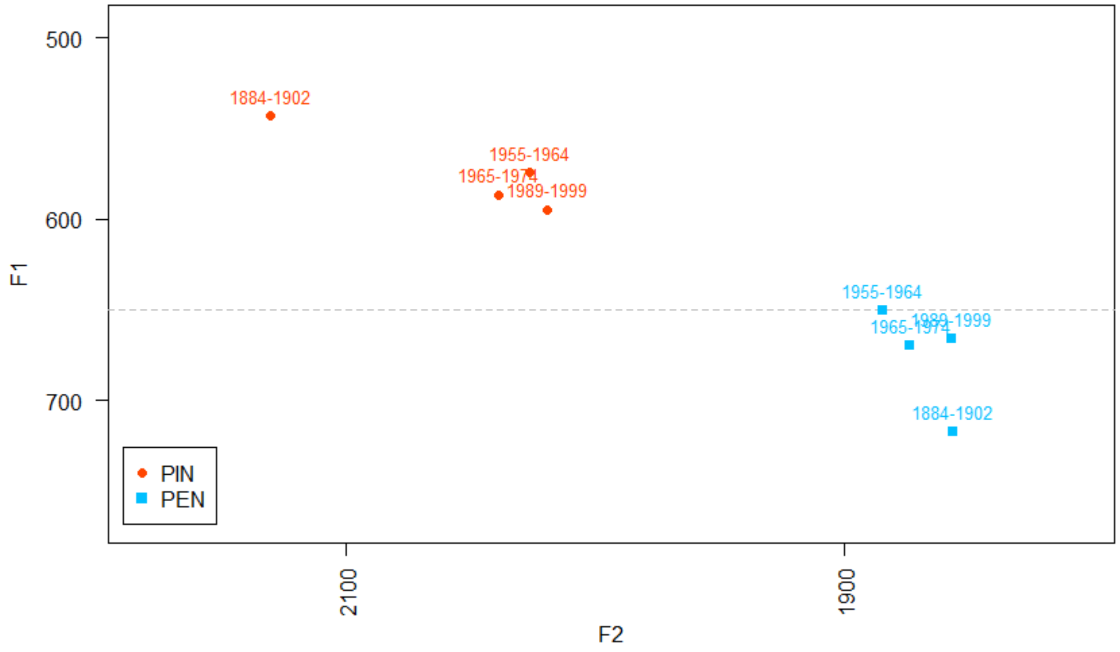
The PIN-PEN merger presents a different set of analytic challenges. Like Gordon (2010), the research in this dissertation finds the PIN-PEN merger present in Kansas City, but not as advanced in the city as depicted by *ANAE* (e.g., Labov, Ash & Boberg 2006:68). In particular, its classification as a change in progress is made problematic by data from younger interviewees, who, overall, maintain a larger distinction between PIN and PEN than do older interviewees. More precisely, a number of younger interviewees follow the pattern of rapid progress that appeared to be emerging among older interviewees, and this subset of younger interviewees is fully PIN-PEN merged. Others, though, maintain a clear distinction, and even commented negatively on the merger during interviews. Bucking a general trend in sociolinguistic research (e.g., Labov 2001), males appear to lead in adoption of the merger—or, perhaps, if this resistance represents a change in progress, then females lead in resistance to the merger.

The geographical distribution of the PIN-PEN merger in *ANAE* gives the clear impression that the merger's presence in Kansas City is a result of its spread northward from the South, where it is well established. The settlement history described for the city makes this geographic spread at least intuitively plausible, in particular as influxes into the city during the first half of the twentieth century brought many people from rural Missouri, including its undeveloped southern areas. Even before this period, Gordon and Strelluf (2013, forthcoming) identified one man born in KCMO in 1902 as likely merged in productions of PIN and PEN. The social history this Kansas Citian describes in his short interview does not reveal anything to suggest that he might have acquired the merger outside of Kansas City—he grew up in what is today downtown KCMO, earned money as an exhibition boxer in KCMO and Chicago, attended business school at the University of Missouri, and eventually took over his father's bedding company in KCMO. He provides limited evidence, then, of the presence of the conditional merger at the turn of the century. Weeks (1896:241) also gives evidence of competing forms of PIN and PEN in early Kansas City history as he transcribes both *rinse* and *since* with the vowel [ɛ] in rustic Kansas City speech.

Figure 7.6 shows changes in PIN and PEN by age group, combining data from this dissertation with data collected for Gordon and Strelluf (2013, forthcoming). It includes all speakers, rather than just those who are merged, so it should be understood as an averaged set of productions for the community rather than a depiction of progress toward merger, strictly speaking.

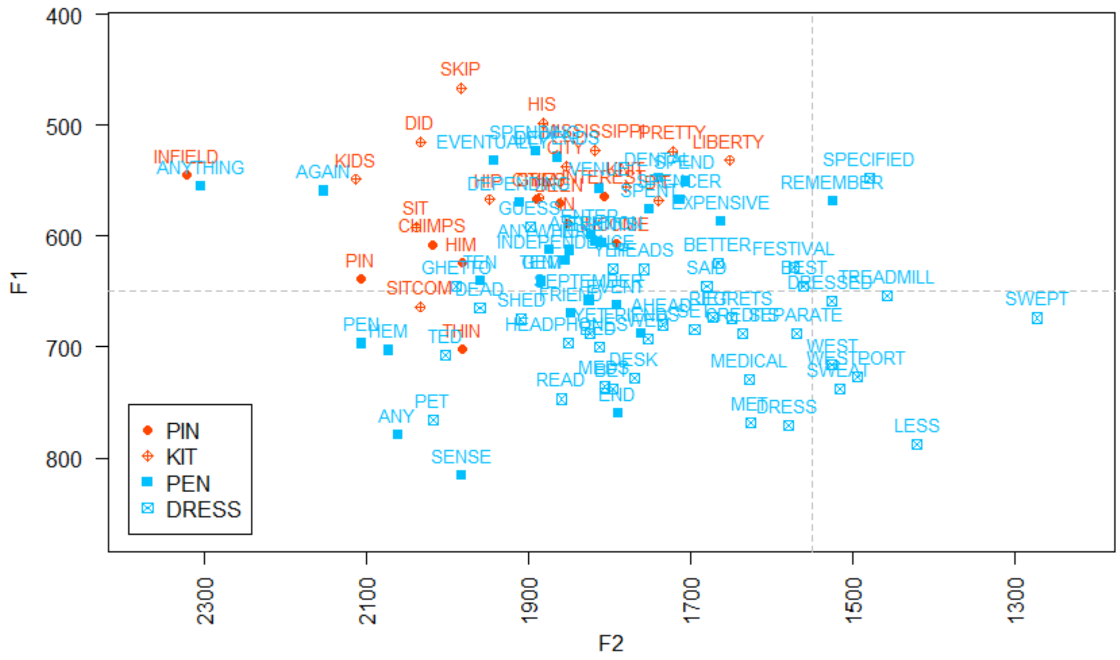
In this view of apparent time, the distance between PIN and PEN closes between the 1884-1902 age group and all others. This seems to be a result of a change away from tensed productions of PIN and [æ]-like productions of PEN that are more characteristic of data from the oldest speakers. Among dissertation interviewees, no overall trend of change in production emerges in apparent time.

Figure 7.6. PIN and PEN in Kansas City by age group



For those speakers who are merged, data presented in Chapter 4 suggests a merger by approximation—specifically that merged speakers' PIN mean was produced slightly backer than their KIT mean, and their PEN mean was produced higher than their DRESS mean, which placed their PIN-PEN productions in the same space. This is somewhat acoustically surprising, since the merger is typically expected to result from PEN being produced with [ɪ] without a change in PIN (e.g., Brown 1990). The occurrence of the merger at [ɪ] is consistent with Lusk's (1976) description of changes occurring among low-status informants' productions of PEN in her data, and is consistent with my impressionistic transcriptions of merged speakers in interview data from this dissertation. In my own productions of PEN (which are merged with PIN), I produce and perceive the vowel in PEN as /ɪ/. It is possible that the F1 dimension is simply the salient one perceptually in this context, and this may be an area for further study to inform the psychological and perceptual processes by which mergers progress. On the other hand, it may be the case that the backer measurements of PIN among merged speakers reflect that, once the PIN-PEN merger is complete, it takes on the characteristics of a merger of expansion, in that the entire range of PIN-PEN vowel space becomes available for productions. Mean values of Peyton D's merged productions of PIN and PEN are shown illustratively in Figure 7.7, along with productions of KIT and DRESS followed by oral alveolars and bilabials for reference.

Figure 7.7. Peyton D, b. 1993, Independence, MO – Mean KIT and DRESS tokens with following nasal or oral alveolar or bilabial



Peyton’s mean productions of PIN and PEN show the tendency for them to be grouped near the back edge of his KIT class. However, a number of PEN types appear well into DRESS territory (e.g., *end*, *event*, *friend*), and a few PIN tokens are produced with relatively high F1 placing them in the range of DRESS (e.g., *him* and *thin*). Perhaps, then, phonemically PIN-PEN merges at the position of PIN, but phonetically leaves open the possibility of the larger combined vowel space. This will remain an open question for future research, and might again be addressed by introducing an “either same or different” option into minimal pairs testing.

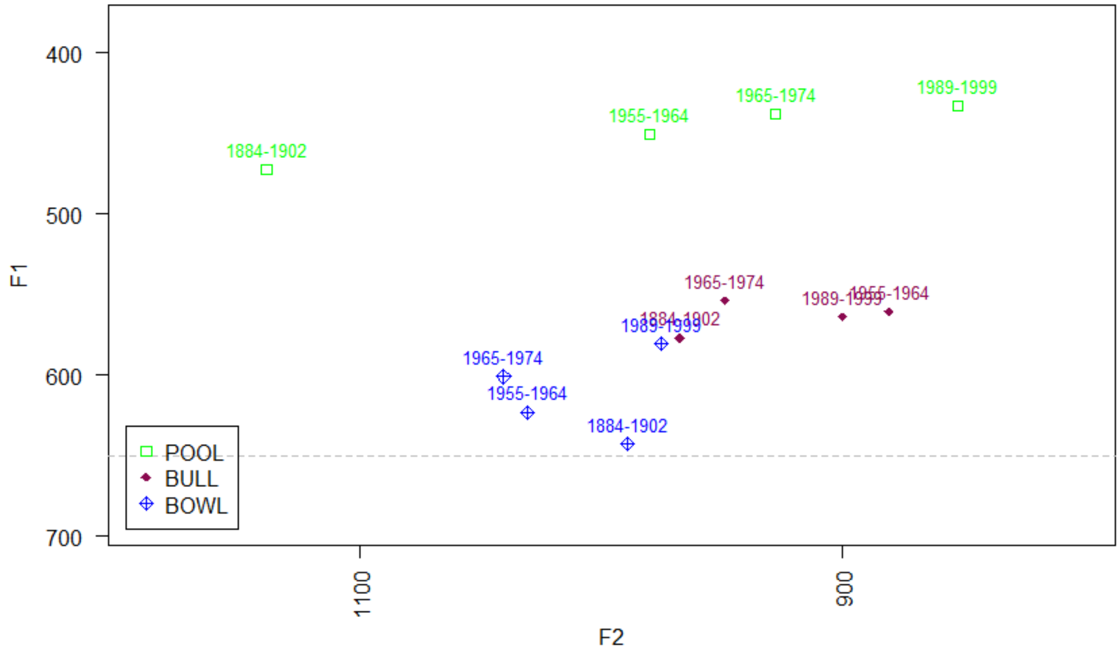
By far, though, the most important area for future exploration with regard to the PIN-PEN merger in Kansas City is that its trend of progress appears to be changing. Labov (2010:130-132) describes the PIN-PEN merger’s rapid spread throughout the Southeast super-region (which includes the Midland and other areas abutting the South) and notes that it “is not as socially marked as many other Southern features are” (2010:132). The resistance to the PIN-PEN merger that appears to have developed recently in Kansas City runs contrary to these observations. It is not clearly the case that the merger is spreading in Kansas City, and it is not clearly the case that it operates below the level of consciousness. (As a noteworthy analogy, Baranowski 2007:140-141 describes the PIN-PEN merger as nearing completion in Charleston, SC, except among upper-class speakers, who also comment overtly on the merger.) Given the geographical history of the PIN-PEN merger, it is tempting to see this developing resistance as an expansion of the resistance to Southern features noted elsewhere (e.g., Labov, Ash & Boberg 2006; Labov 2010; Labov, Rosenfelder & Fruehwald 2013). In this case, younger females, in particular, might be assigning a stigma to the merger (which has typically gone unnoticed in other areas) and thereby introduce resistance.

Two types of study will be necessary in Kansas City to understand this better. The first is continued study of even younger speakers to explore progress of the merger. In this regard it will be particularly interesting to note the female lead in resistance to the merger observed in this data. Johnson (2010), for example, finds that, even though a child's peers are the strongest influences on the child's acquisition of a vowel merger, the child's mother's participation or resistance to that merger also has a strong effect. If the resistance introduced among young interviewees is sufficiently strong, it is possible that the female lead in resistance may reverse the expansion of the PIN-PEN merger in Kansas City. The second area of study will focus on social reactions to the PIN-PEN merger to elicit more comment and probe the underlying psychology that may be governing adoption of or resistance to the merger.

Developments in the mergers of BULL with either POOL or BOWL present yet another set of complicated data. Figure 7.8 shows productions of these three sets combining data from this dissertation with data collected for Gordon and Strelluf (2013, forthcoming). These narrow phonetic contexts occur relatively infrequently, so these measurements are based on much more limited data than are comparable progressions for other lexical sets. BULL, in particular, is infrequent, and in the 1884-1902 age group is represented by just three tokens, so these values should be seen as suggestive rather than definitive.

Despite these caveats, the measurements paint generally the same picture of these prospective mergers as was observed in Chapter 5. They suggest that allophonic conditioning pushed BULL back in Kansas City vowel space very early in the city's history. POOL has shown steady backing across apparent time. BOWL backs among the youngest interviewees. Acoustically, the backward movement of POOL carried it through the range of BULL productions among interviewees born between 1955 and 1974, but then carried POOL past the back edge of BULL among the youngest interviewees. As a community, the lowering of POOL characteristic of POOL-BULL-merged areas (e.g., Pittsburgh) did not take place. On the other hand, the backing of BOWL among the youngest interviewees placed those productions in the range of BULL. BOWL and BULL appear to occur at similar heights, which may further encourage (or reflect) their merger. It is probably, then, simplest to say that POOL-BULL developed as a near merger in Kansas City, but continued changes in apparent time prevented the merger from moving to completion. BOWL-BULL, however, appears to be merging rapidly.

Figure 7.8. POOL, BOWL, and BULL in Kansas City by age group



If the BOWL-BULL merger is considered in isolation, the combined results of acoustic productions and perception tests allow for a fairly simplistic process to account for the merger's progression over time. In the specific allophonic context of following /l/:

1. Generation 1 acquires two phonemes during language learning. An allophonic conditioning rule emerges that, by happenstance, pushes productions of tokens from the two phonemes into a similar phonetic range (in the specific phonetic environment relevant to the conditioning rule). As a result, their productions of the vowels are close, though they maintain distinct perceptions.
2. Generation 2 acquires two close phonemes, based on the data learned from Generation 1. They also acquire the allophonic conditioning rule and apply it. (In the case of the mergers under discussion here, the initial positions of BOWL and BULL would be farther back based on the baseline set by Generation 1 and then would be backed further still by the application of the rule by Generation 2.) Generation 2's productions may be close or same. Their perceptions of the vowels are close.
3. Generation 3 acquires one merged phoneme from Generation 2. Their productions may be close or same. Their perceptions are same.

The simplistic account offers a system-internal description by which BOWL-BULL might be progressing toward merger in Kansas City, especially with data presented in Chapter 5 that the dramatic change in progress is in the perception of BOWL and BULL as close, rather than in their production per se. The process clearly suggests a merger by approximation. It also offers a rubric by which the near merger of POOL-BULL might be understood to have failed to progress—during Step 2, linguistic or social factors may have been introduced to discourage close productions from being reinterpreted as same. In fact, given the description of LOT and THOUGHT's merger above, each allophonic environment of LOT and THOUGHT might be analyzed as an independent expansion by approximation, with the effect across the vowel class of achieving a merger by expansion.

Unfortunately, as tempting as such a formulation might be, the hypothetical discussion does not offer a tidy explanation for the PIN-PEN merger. Nor does it account for outliers observed in interviews, even in the specific cases of the POOL-BULL and BOWL-BULL mergers. For example, Figures 7.9 and 7.10 plot tokens of POOL, BOWL, and BULL tokens from two sisters, Isabella and Kennedy G, born in Shawnee, KS in 1995 and 1997, respectively. Unfortunately, FAVE only coded one instance of BULL from Kennedy G, so this discussion must rely generally on responses to minimal pairs tests.

Phonetically, Isabella G appears to produce BULL as BOWL. However, in minimal pairs testing, she differentiates *bull* from both *pool* and *bowl*, judging and being judged to be distinct for both pairs. On the other hand, her sister, born two years after her, judges *pool* and *bull* and *bowl* and *bull* to be the same. I score her *pool* and *bull* as the same and her *bowl* and *bull* as close. Her POOL and BOWL sets do not sound the same—suggesting that she is adjusting her BULL production to fit into either set without exacting a three-way merger. As is often the case, actual observed linguistic production

Figure 7.9. Isabella G, b. 1995, Shawnee, KS – POOL, BOWL, and BULL tokens

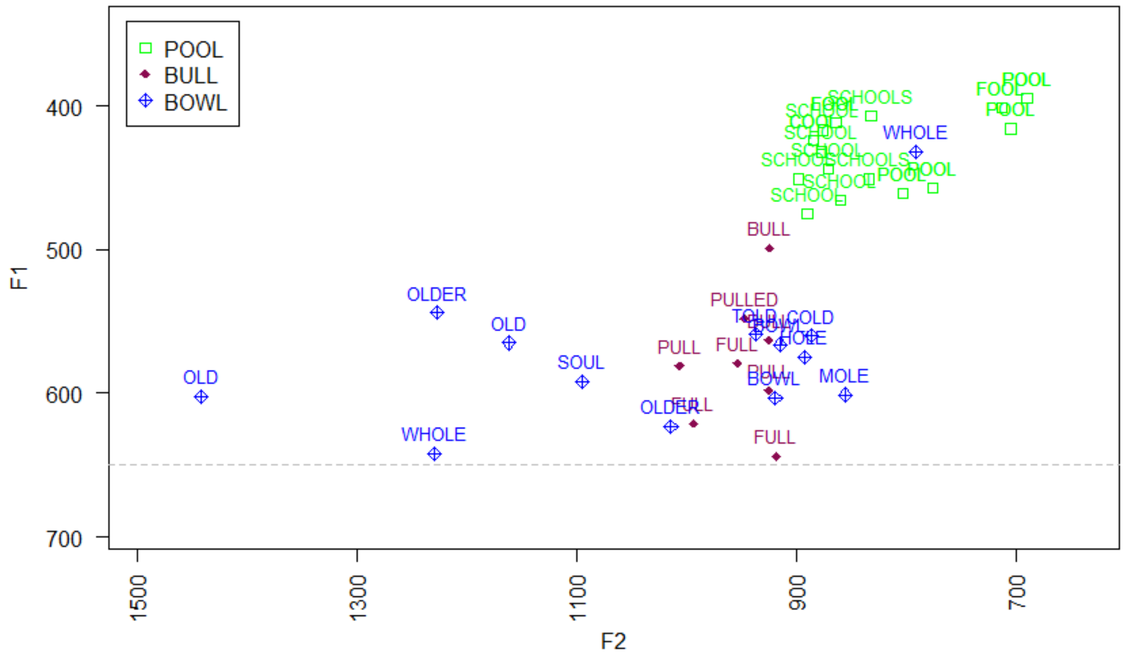
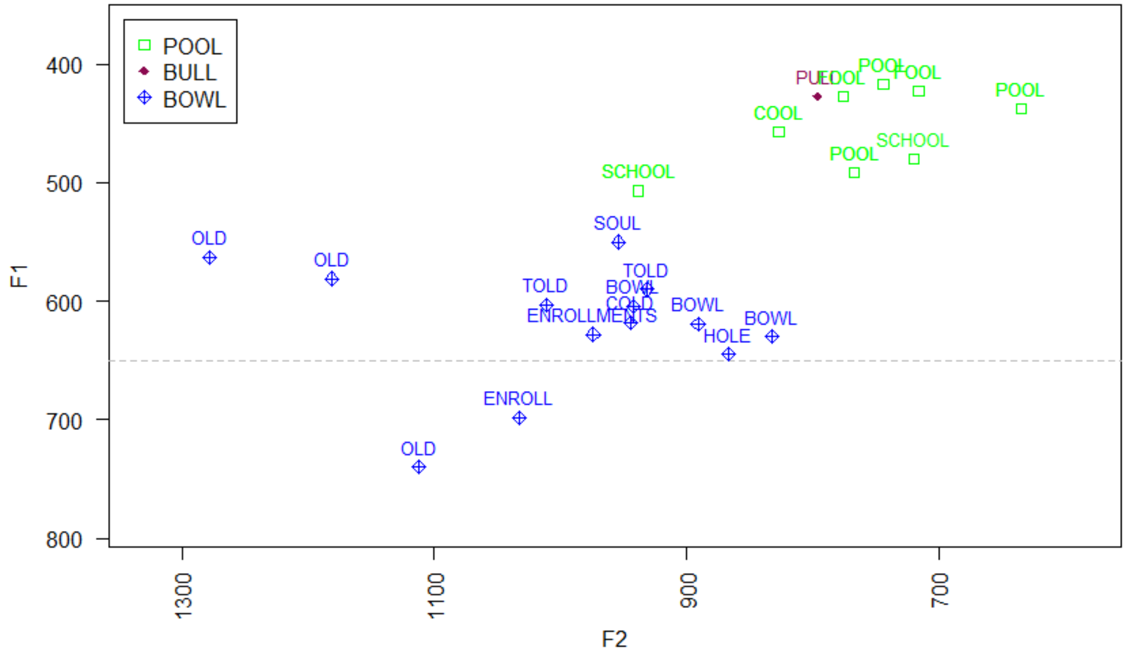


Figure 7.10. Kennedy G, b. 1997, Shawnee, KS – POOL, BOWL, and BULL tokens



defies easy explanation according to a theoretical model. Again, it appears that new research will be needed to achieve more understanding of these mergers in Kansas City, and it will likely be necessary to more directly probe social evaluations of productions of these mergers to understand some of the factors governing these changes.

7.3. More Questions for Kansas City

This research into Kansas City's language has both confirmed previously identified sound changes and revealed new ones. In *ANAE*, Kansas City is exemplified as a prototypical Midland city, especially for its fronted productions of back upgliding vowels and the transitional status of the low back merger. This research has refined knowledge of those particular characteristics and, in the case of the back upgliding vowel MOUTH, has suggested a new trajectory for the change. Likewise, the fronting of STRUT that characterized Kansas City's Midland dialect in *ANAE* may be reversing course, and a new norm of Canadian Raising of PRICE may be emerging in the community's language. Continued research in Kansas City will be of interest not only for witnessing how these changes play out in the city, but also for examining how continued developments in the dialect of Kansas City will inform our understanding of the Midland as a dialect region and the relationship of that region to other US dialects.

Strictly within the scope of research conducted for this dissertation, a great deal of information remains to be gleaned from Kansas City. This includes studies of changes in grammar and, of particular interest, studies of attitudes toward Kansas City and other areas of the United States drawn from the perceptual dialectology portion of the interview and from qualitative interview data. I note this latter point as particularly interesting in hopes that such data might provide information on the social aspects of this sociophonetic study of language in Kansas City. An area of personal interest at the outset of this research was understanding whether changing dynamics in Kansas City (e.g., the redevelopment of downtown KCMO, patterns of migration between KCMO and the surrounding suburbs) correlated with linguistic change. It was necessary as a first step to document the language of Kansas City before trying to make sense of it in terms of social practices and ideologies. Doing so has provided a fascinating baseline of language and change in Kansas City. However, doing so has also raised many more questions than it has answered. For example, no purely linguistic explanation accounts for the data presented just above for Isabella G and Kennedy G who—despite being born two years apart, having the same parents, living in the same house, and attending the same schools—differ strongly from one another in phonemic statuses among POOL, BOWL, and BULL. I hope that turning to more focused explorations of specific results from this dissertation in correlation with specific social attitudes or practices might help explain those results.

Attitudinal and ideological correlates to language practice might be further explored in the many interviews that were not included in this dissertation. I am especially interested in a set of interviews that I conducted over the course of a day in the small exburb of Garden City, MO, located about 50 miles south-southeast of downtown KCMO. Members of the community described a divide between the farmers who worked the lands surrounding the town and the commuters who worked in KCMO and Johnson County, KS. Among my interviewees were several members of a family that had lived in Garden City for seven generations. They identified themselves as Kansas Citians and spoke positively of traveling to the city for cultural, social, and sports events. I also interviewed locals who had grown up within KCMO and its immediately surrounding suburbs, but had moved to Garden City specifically to be away from the city. They identified themselves as being from “Missouri,” and explicitly rejected being labeled as “Kansas Citians.” Impressionistically, the Garden City natives with positive predilections toward Kansas City generally participated in the language productions described in this dissertation for Kansas City, while the Kansas City emigrants followed a different set of norms—for instance, merging FLEECE and KIT before /l/, a conditional merger that occurred very rarely among interviewees in the more central areas of Kansas City. A study of such a small area—particularly one grappling between its traditional identity as a farming community and a new identity as a bedroom community might reveal many interrelationships between language change, attitudes, geography, and contact.

In addition to focused studies of specific areas of Kansas City, the language of African Americans in Kansas City also clearly demands attention. Beyond simply documenting the local dialect of African American English, understanding the community’s linguistic practices is critical to describing the language of Kansas City. Data will also have important implications for social questions, given Kansas City’s history of segregation and white flight, as described in Chapter 1. Among the interesting themes that emerged during interviews with African Americans was the very different experience of the city for males and females because of racial attitudes in Kansas City. Specifically, interviewees often suggested that females were able to be successful in Kansas City, in terms of educational and career opportunities, but that few opportunities existed for males, compelling them to leave Kansas City for cities like Atlanta. Such experiences of the social undercurrents of the city may create fascinating ripples in language practices.

In short, this research has revealed much about the dialect of Kansas City, but there is much more to be discovered. In its relatively short history, Kansas City has emerged from a conglomeration of trading posts into a major metropolitan center. Today it continues to grow and change, and its language grows and changes, too. These developments are fascinating in their own right, and important for the ways that they inform our broader understanding of the functioning of language and language change.

APPENDIX A

LIST OF INTERVIEWEES

Name	Birth Year	Occupation	Social Class	Prestige Score	SEI Score	Childhood City	High School City	Adult City
Amber	1996	Father is a graphic artist	Middle	52	63	KCMO	KCMO	NA
Andrew O	1993	Father is tech support	Working	51	62	KCMO	Lee's Summit, MO	NA
Ashley	1994	Father is in sales	Transitional	44	51	KCMO	KCMO	NA
Bethany	1989	Server	Working	28	32	Lee's Summit, MO	Lee's Summit, MO	Lee's Summit, MO
Brandon K	1992	Mechanic's assistant	Working	33	30	Oak Grove, MO	Claycomo, MO	Claycomo, MO
Claire M	1965	Legal record keeping	Middle	52	65	KCMO	Indep., MO	KCMO
Cliff	1960	Letter carrier	Working	47	54	KCMO	Raytown, MO	KCMO
Cynthia	1961	Radiology teacher	Middle	74	81	Indep., MO	Indep., MO	Indep., MO
Danielle	1991	Mother is a lawyer	Middle	75	92	KCMO	KCMO	NA
David K	1970	Locksmith apprentice	Working	39	39	KCMO	KCMO	KCMO
Dawson H	1994	Mother is an office manager	Middle	59	73	KCMO	KCMO	KCMO
Denise	1960	Admin. assistant	Working	46	38	KCMO	Indep., MO	Lee's Summit, MO
Donna	1962	LPN	Transitional	60	44	Shawnee, KS	Shawnee, KS	KCK
Eddy	1995	Mother is a chiropractor	Transitional	57	87	Shawnee, KS	Shawnee, KS	NA
Elly D	1999	Father is tech support	Transitional	51	62	Indep., MO	Indep., MO	NA
Emily K	1998	Father is a job counselor	Working	46	63	Oak Grove, MO	Claycomo, MO	NA
Emmanuel M	1995	Father is a lawyer	Middle	75	92	KCMO	KCMO	NA
Eric J	1998	Father is a loan agent	Transitional	48	53	KCMO	KCMO	NA
Frank	1968	Law enforcement	Transitional	62	63	KCMO	KCMO	KCMO
Hayden M	1993	Father is a lawyer	Middle	75	92	KCMO	KCMO	NA
Heather	1972	Public relations	Middle	48	74	KCK	KCK	Merriam, KS
Isabella G	1995	Mother is a graphic artist	Middle	52	63	Shawnee, KS	Shawnee, KS	NA
James	1957	Accountant	Middle	65	76	KCMO	KCMO	KCMO
Jasmine	1999	Father is a sound mixer	Working	45	62	Indep., MO	Indep., MO	NA
Jeff	1993	Parking attendant	Working	21	35	Indep., MO	Indep., MO	NA
Jennifer J	1974	Husband is a loan agent	Transitional	48	53	KCK	KCK	KCMO
Jeremy	1994	Father is a copy writer	Middle	52	63	Shawnee, KS	Shawnee, KS	NA
Jerry	1966	Law enforcement	Working	60	63	KCMO	KCMO	KCMO
John	1962	Commercial artist	Middle	52	63	Overland Park, KS	Overland Park, KS	Overland Park, KS

Joshua K	1994	Father is a job counselor	Working	46	63	Oak Grove, MO	Claycomo, MO	NA
Justin H	1991	Mother is an office manager	Middle	59	73	KCMO	KCMO	NA
Kennedy G	1997	Mother is a graphic artist	Middle	52	63	Shawnee, KS	Shawnee, KS	NA
Kevin M	1962	Lawyer	Middle	75	92	Grandview, MO	Grandview, MO	KCMO
Lisa K	1969	Husband is a job counselor	Working	46	63	Oak Grove, MO	Oak Grove, MO	Claycomo, MO
Madison Z	1999	Father is a software engineer	Middle	61	76	KCMO	KCMO	NA
Maria K	1968	Admin. assistant	Working	46	38	KCMO	KCMO	KCMO
Mark	1964	Law enforcement	Working	60	63	KCMO	Lee’s Summit, MO	KCMO
Mary Z	1957	Husband is a software engineer	Middle	61	76	KCMO	Raytown, MO	KCMO
Matt J	1973	Loan agent	Transitional	48	53	Pleasant Hill, MO	Pleasant Hill, MO	KCMO
Maya	1991	Beautician	Working	32	26	KCMO	KCMO	KCMO
Michael O	1990	Father is tech support	Working	51	62	KCMO	Lee’s Summit, MO	NA
Molly	1973	Child care	Working	29	31	Excelsior Springs, MO	KCMO	Grandview, MO
Nicole P	1972	Corporate writer	Middle	52	63	KCMO	KCMO	Shawnee, KS
Patricia K	1970	Administrative assistant	Working	46	38	KCMO	KCMO	KCMO
Peyton D	1993	Father is tech support	Transitional	51	62	Indep., MO	Indep., MO	NA
Robert Z	1956	Software engineer	Middle	61	76	KCMO	KCMO	KCMO
Samantha K	1995	Father is a job counselor	Working	46	63	Oak Grove, MO	Claycomo, MO	NA
Seth P	1972	Real estate appraiser	Middle	50	64	KCMO	KCMO	Shawnee, KS
Susan	1958	Receptionist	Working	39	37	Indep., MO	Indep., MO	Indep., MO
Timothy M	1992	Father is a lawyer	Middle	75	92	KCMO	KCMO	NA
Tyler K	1996	Father is a job counselor	Working	46	63	Oak Grove, MO	Claycomo, MO	NA

APPENDIX B

INTERVIEW INSTRUMENT

Part A – Casual Speech

[Part A shows the types of questions that were asked during the loosely structured, conversational portion of interviews. These questions were not followed as a formal schedule, but demonstrate the types of questions that were asked.]

Demographic questions:

When were you born?
Where were you born?
(If not in KC,) When did you move to Kansas City?
Have you ever lived anywhere besides Kansas City?
(If yes,) When did you live there?
(And) What did you live there for? (e.g., college, military, parents' job, etc.)
(Adults) Why did you come back to Kansas City?
(Adults) What do you do for a living? (follow-up questions include, Where do you work? How long does it take you to drive there? How do you like that? etc.)
(Teens) Who do you live with? (e.g. both parents, mom, grandparents, etc.)
(Teens) What do they do for a living?
(Adults) Where did you go to high school? (follow-up questions include, How did you like it? What activities did you do? Do you still talk to any anybody you went to high school with?, etc.)
(Teens) You're in school at ___________? (follow-up questions include, How do you like it? What activities do you do? What are the students there like?, etc.)
What neighborhood do you live in?

KC Attitude questions

How do you like living in ___________?
How has the area changed since you were a kid/since you moved there?
What do you do for fun?
Where do you like to go out for dinner? ...to shop? ...for entertainment?
Do you like sports? (What about the Chiefs and Royals? What do you think about Mizzou moving to the SEC?)
Do you ever go downtown?
Have you ever been to the Sprint Center? (Follow any conversations that result about the Independence Events Center; Lee's Summit's efforts to get a minor league baseball team, strong opposition to initiatives like downtown revitalization, etc.)
Have you been to the Power and Light District?
Have you ever been to the Speedway?
Kansas City is trying hard to get an NBA or an NHL team to play in the Sprint Center. Would you support one of those teams?

How do you feel about (the interviewee's community) compared with (KC for suburban interviewees, suburbs for KC interviewees)?

Kansas City has spent a lot of money trying to get people to come back downtown. What do you think of those efforts?

The Kansas City area has grown by more than 10 percent over the last decade. Would you encourage someone to move to Kansas City? (Why?)

(If so) Are there any communities in the area where you would encourage them to move or discourage them from moving?

Do you plan to stay in this area? (For how long? Why?)

KC-Regional Interaction questions

Do you ever travel outside of Kansas City? (What for? How often? Where else do you have a lot of family?)

How do you like those places compared with Kansas City?

Where do you tell people you're from when you're outside of this area?

How do people who aren't from here think of Kansas City? (Do you feel like that's right or wrong?)

How do people who aren't from here think of Missouri and Kansas? (Do you feel like that's right or wrong?)

Do you ever notice differences in the way we talk in Kansas City compared with the way people outside this area talk? (Like what?)

Have people ever said anything about people in Kansas City having an accent?

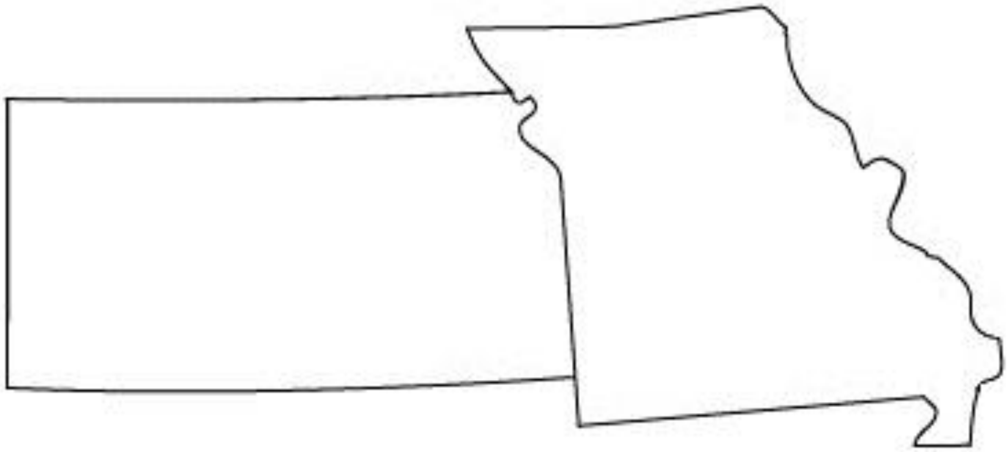
Where do you think Kansas City stops and the country starts (e.g. Is Harrisonville still KC? Is Oak Grove still KC? Is Olathe still KC?)

Is Overland Park part of the Kansas City area the same way that (for suburb residents, insert their suburb; for KC residents, insert “Independence or Lee's Summit”) is part of the Kansas City area?

Part B – Regional Judgments

On this map of the United States, please draw lines to show where people speak different from you. Write labels that describe different areas on the map.

Please do the same thing on this map of Missouri and Kansas.



Part C – Reading Passages

Passage 1

When I was a boy, I used to love going to my Aunt Penny and Uncle Donald's house. Their place was not some grand home or mansion, but they lived in a cool old house on the west end of Chicago near the intersection of Dawson Drive and South Everson Street. What I especially liked is that they always bought lots of candy and other presents as special treats for me and my sisters, Jenny and Dawn, for whenever we would spend the night at their place. We always had a fantastic time. In the winter and fall, we had fun racing around their house, flying up and down the stairs as we played hide-and-seek. When the weather was nice, we'd play tag on the back lawn. I was the fastest and never got caught. When it rained, Jenny and Dawn used to play dress up and would pass the whole afternoon trying my aunt's special clothes and shoes on.

I remember one particular December afternoon that my sisters and I were spending with Aunt Penny and Uncle Don. In fact, my aunt had taken Dawn and Jenny to some store where they were having a sale. I was told to stay behind and help my uncle walk his dog, Rocky, and start to get dinner on. I was feeling a little sad and depressed, and I asked my Uncle Don why I had been left back while my sisters got to go to the sale. He turned his head and looked straight at me and smiled. Then, he asked,

"Do you know what that store sells?"

I bashfully shook my head, and then he laughed.

"It's not a trip for little boys like you. That's a special store for girls like your sisters and your Auntie. It's not a shop for men, unless..." He caught himself and stopped mid-sentence.

"Unless, what?…Uncle Don, tell me!" I begged him.

"Well…unless those men like to put on fancy underwear, like tall stockings and thongs, and take long, hot bubble baths with expensive soaps and oils."

After he told me that, I felt like a fool for sounding so selfish, but now I understand. That was the first I had ever heard of Victoria's Secret.

Passage 2

In September of 1912, the news photographer, Paul Robinson, was sent into an African jungle to get pictures of rare wildlife. He quickly got lost. Eventually, he fell into a pool of quicksand. As he was sinking, a band of chimps happened along. Paul was pretty thin, and the chimps were quite strong. To his amazement, the chimps formed a chain and stretched out across the pool. They pulled and pulled and finally brought him to the shore of the mucky pool. He ended up spending ten months with his new chimp friends. They taught him a lot. Even after he got back to civilization, Paul thought about all the time he had spent lost in that tropical forest.

Passage 3

In my Missouri hometown, there was a “special” boy named Ken Johnson. Kenny loved his tunes. He brought his walkman with him everywhere and he used to wear the headphones down around his collar. He didn’t talk a lot, and when he did, he barely made any sense. I remember that he used to catch frogs down at the pond. He’d put them in a big bowl made of aluminum or tin. When the bowl was full, he’d feed the poor frogs to birds like gulls and hawks. He thought that was cool. Still, some kids didn’t care what he thought. To them, it was wrong. They thought he should stop. I remember one time when a gang of boys tried to wrestle Kenny’s bowl away from him. Kenny was strong as a bull, and he tossed the guys into the pond.

I decided to take a more economic approach. I called Kenny over to me and offered him a trade. I brought out this new pen and pencil set that my mom had bought me at the office shop in town. He wasn’t interested. But, he did say that he’d stop killing frogs for a couple of baseball cards and my hockey mask. I was shocked at his trading skills but I eventually coughed up the stuff.

Part D – Grammatical Judgments

Please read each sentence out loud. Some will sound grammatical and some will sound bad. After you read each one, please tell me whether it’s [1] something you could say, [2] something you couldn't say but you have heard other people say, or [3] something you've never heard.

1. I can't afford to drive a big car anymore.

2. I want off the bus.

3. The car needs washed.

4. Anymore, movies are too expensive.

5. The dog wants out.

6. We're going to the mall. Do you wanna come with?

7. There's plenty to do downtown anymore.

8. I'm fixin' to leave.

9. We might could go to the game this weekend.

10. Remember those one kids we saw last week?

Part E – Word List

Please read the words off this list.

pop
toy
bell
Ted
sock
pan
towel
two
hook
get
Missouri
duck
new
Prospect
shirt
pay
bother
peel
cold
love
Lee's Summit
mountain
town
gum
dollar
dead
hole
talk
so
term
began
jet
toe
still
Independence
hock
bad
bought
fail
Kansas
house
often

time
book
while
cow
box
on
pin
sound
sag
tie
boot
node
steel
bed
fear
hanger
gag
bit
Holmes
odd
Mary
dare
awed
Troost
mole
did
goat
rice
egg
gut
shed
pea
bang
putt
south
tuck
stale
door
take
pew
should
soda

soul
dog
pull
roof
taller
gel
pool
father
dawn
button
there
window
launch
hawk
hurt
Tuesday
married
gull
bomb
open
day
might
less
set
him
dome
pout
bear
hull
go
about
horse
really
off
told
joy
fell
sea
fool
fair
merry
pound

honey
hop
how
pet
home
hoe
put
car
tide
cash
born
sell
know
sad
mush
palm
Plaza
could
hoot
numb
potato
rude
coupon
catch
move
cast
dew
hoarse
gate
bum
third
full
dude
bat
tight
feel
tic-toc
garden
dull
hut
coffee
sit

barn
Dan
tell
hoof
Wornall
feet
pen
pants
fill
spice
fog
Kansas City
stay
boat
calm
last
my
cute
Don
cut
cause
pill
dumb
dear
down
fountain
dope
mad
jail
bet
man
hem
side
do
shoe
sight
tea
bag
law

Part F – Minimal Pairs

Please read each pair of words below, and think about the way the vowel in each word sounds when you say them. Say whether the words sound the same to you, or whether they sound close but not quite the same, or whether they sound different.

1.	dew	do
2.	but	bet
3.	reed	read
4.	pin	pen
5.	full	fool
6.	pill	peel
7.	cot	caught
8.	sell	sale
9.	dawn	Don
10.	.know	no
11.	hair	her
12.	pull	pool
13.	bowl	bull
14.	gym	gem
15.	Polly	Pauley

APPENDIX C

SOME CONDITIONING EFFECTS ON FORMANT MEASUREMENTS

From Thomas (2011:101):

Place of articulation	F1	F2
Bilabial	Lowered	Lowered
Labiodental	Lowered	Lowered
Interdental	Lowered	Raised next to back rounded vowels, lowered next to high front vowels
Alveolar	Lowered	Raised next to central and back vowels, lowered next to mid and high front vowels
Retroflex	Lowered	Raised next to back vowels, lowered next to front vowels
Palatal	Lowered	Raised
Velar	Lowered	Raised

From Labov (1994:275):

Following /r/ contracts vowel space (i.e., lower F2 for front vowels and raise F2 for back vowels).

Following nasals expand vowel space (i.e. raise F2 for front vowels and lower F2 for back vowels).

Preceding obstruent+liquid clusters lower F2.

From Thomas (2011:126):

Following “dark” /l/ ([ɫ]) lowers F2.

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