Arab American Youth and Sound Change in Southeastern Michigan

by

Mukta Sai Samant

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Doctoral Committee:

Associate Professor Robin M. Queen, Chair
Professor Patrice Speeter Beddor
Associate Professor Anne L. Curzan
Assistant Professor Carmel O'Shannessy

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Chapter 1: Background and Research Questions

1.1 Introduction

This dissertation is an investigation of the spread of several Northern Cities Shift sound change variables to Arab American adolescents in Dearborn, MI. Sociolinguists have offered theories about how sound changes spread across speakers, but these theories often reflect assumptions or generalizations about the effects of social variables (for example, it is widely accepted that women lead men in certain kinds of sound changes). In contrast, ethnographic research has shown that local context and information are crucial to understanding how social factors operate in relation to linguistic variation. Though sociolinguistic research as a whole now includes a significant focus on local ethnography, I argue that longstanding and widely accepted sociolinguistic theories about sound change spread have not kept up with the findings of the numerous studies that have uncovered a remarkable level of distinction and detail in the social patterning of those sound change variables. This dissertation contributes to an ongoing discussion about the importance of local variation in the social realm as it relates to the spread of sound change variables and how that information can contribute in particular to our understanding of mainstream regional sound changes.

The linguistic focus of this dissertation is on four of the six vowels that comprise a set of sound changes known collectively as the Northern Cities Shift (NCS). The NCS is an ongoing shift associated with and documented in speakers in large urban centers from Chicago, IL, to Buffalo, NY. Research on the NCS has its roots in early dialectology studies of the 1950s and it continues to receive attention today in sociolinguistics. Work on the NCS has contributed to sociolinguists' understandings and theories about the nature of sound changes and how they spread across speakers (Labov 1994). Shifts such as the NCS, involving several vocalic variables, are generally viewed as a connected set of sound changes. Though there is dispute on *how* the changes are connected (e.g., Gordon 2001), there is consensus that there is some kind of connection between the variables involved in the shift (see 1.2 below for further discussion).

Several generalizations, many put forth by Labov (1991, 1994), have been proposed about how broad social categories relate to sound change spread (e.g., women lead men in the use of new variables; minority speakers do not participate in sound changes). These generalizations are broadly conceived not only in terms of the groups and categories of speakers they apply to, but also in terms of the sound changes: generalizations about regional shifts are (implicitly?) about a *set* of variables and not about individual elements of a shift. Further, these basic generalizations about the relationship between social variables and sound change spread, which have underlined decades of sociolinguistic research in this area, have been left more or less intact despite a growing body of work that suggests these generalizations need to be re-examined or refined. As I discuss below in section 1.2, the findings of many studies on the NCS, across a diverse range of speakers, suggest that the social patterning of the NCS variables is not uniform and not predictable. Broadly conceived social categories may not provide the information needed to understand patterns of sound change spread and, further, the patterns of spread sociolinguists have been working with may themselves be too vague.

Ethnographically oriented work on the NCS has shown that local contexts and identities provide valuable and necessary information for understanding the patterns of fine-grained phonetic variation found among speakers. This kind of work has shown that within a community or group of speakers, the individual variables within a sound change may pattern differently from one another (Eckert 2000; Gordon 2001; Roeder 2006). That individual variables in a set of sound changes pattern differently from one another complicates generalized predictions about how classes of speakers (e.g., women, ethnic minorities, adolescents) might use a sound change. Once we acknowledge that there is variation among the patterns of individual variables within a shift, the questions about how the shift spreads becomes more complicated, because we must consider individual variables and not just the shift as a whole and we must consider social axes of distinction that go beyond macrosocial categories.

Information gathered through ethnographic work – one of the most successful methods for understanding local meaning and how it relates to sociolinguistic variation – is highly context-specific, so generalizing from a highly localized setting to a broader context is challenging. Eckert's (2000) work on white adolescents at a high school in suburban Detroit, however, offers a means of connecting between the local and macrosocial. She argues that the local identities of speakers impact how different variables within a set of sound changes spread among a local community of speakers. Eckert's hypothesis is that

the newer variables in a set of connected changes carry local social meaning while older variables, that have lost some social saliency, index more general social distinctions. The differences in the kinds of social meaning that variables carry affect how they are transmitted through a community, which suggests that even if the development of a vowel shift like the NCS is coordinated, the spread of it may not be, or at least, we cannot assume it will spread uniformly. Thus, very local variables can have a significant impact on how sound change progresses. This suggests that sound change spread at a community level is complicated, especially while older and newer variables in a sound change are indexical of different kinds of social meaning. Eckert's theory does several things: it offers an explanation for variation in the social patterning of the individual elements of the NCS; it shows how the local social identities of speakers impact the spread of sound change; and it articulates a close relationship between how variables acquire social meaning and how they spread.

Through an investigation of the relationship between Arab American ethnicity and identity and patterns of variation of the NCS variables, I examine how social factors can impact individual variables in a shift of connected linguistic variables. I investigate these questions at a high school in Dearborn, MI. Located in the geographic heart of the Northern Cities Shift region and home to the largest population of Arabs outside of the Middle East, Dearborn provides an opportunity to continue sociolinguistic exploration into issues surrounding an ethnic minority's use of sound changes traditionally associated with white speakers.

Though sociolinguistic research on ethnic minority speakers in the United States continues to grow, the framing of minority speakers' use of mainstream sound change variables has to some extent inhibited the kind of research being done and the questions being asked. A common framing of mainstream sound changes is that they are the purview of white speakers and non-white speakers "participate" in those changes (see e.g. Gordon 2000; Labov 2001; Roeder 2006). But this may obscure more nuanced distinctions that are fundamentally important to understanding sound change spread (see Fought 2006, 143-151, for thoughtful discussion on this topic). Dearborn offers the opportunity to learn more about how participants use English to negotiate and express an ethnic or immigrant identity that is not necessarily defined solely in contrast to mainstream white culture. Arab Americans in Dearborn are at a spectrum of stages of migration and settlement, from students whose parents were born in Dearborn, to students who arrived in the U.S. shortly after birth, to students who have immigrated to the U.S. in

the past few years. These students have a range of linguistic backgrounds: while the majority are dominant in English with some knowledge of (different varieties of) Arabic, students who have come to the U.S. more recently are dominant in Arabic and taking courses through the school's bilingual education program.

The complexity of Arab American identity at a local level in Dearborn also allows for an examination of how ethnicity can impact the social patterning of linguistic variation. Studies on language and ethnicity have often focused on language maintenance and shift and the idea that ethnicity is represented through the use of a particular language. The research in this dissertation, like a growing body of sociolinguistic work on immigrant communities in the United States (and other countries with large and diverse ethnic minority populations), expands the scope of work on language and ethnicity to focus on speakers who are in the process of language shift and explore how variation in the use of English vowels is used to construct Arab American ethnicity.

In this chapter I discuss the theoretical background for the central themes and issues of this research project and present and motivate the research questions and hypotheses. I draw on research on the Northern Cities Shift, sociophonetics, research on language and ethnicity, and research on Arab Americans to situate the present study and inform the hypotheses. In section 1.2, I discuss the Northern Cities Shift. Research on the NCS has provided much of the basis for sociolinguistic theory on the spread of sound changes in general. I also discuss the timeline of the NCS and its role in theories of sound change spread. The next section, 1.3, covers Arab American ethnicity, with a focus on the development of a broad Arab American identity. In section 1.4, I discuss how assumptions in sociolinguistics surrounding ethnic identity and language use have framed how we approach the spread of mainstream sound change in ethnic minority communities. I present the main hypotheses and research questions of the dissertation in section 1.5 and I give an outline of the remaining chapters in section 1.6.

1.2 The Northern Cities Shift

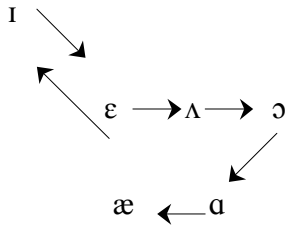
The participants in this study live in a region of the United States where the vowel system has been undergoing a long-term and wide-reaching shift: the Northern Cities Shift. The NCS has a long history of regular study in sociolinguistics, beginning with the dialect studies of the 1950s (Mackwardt 1957; Kurath and McDavid 1961). An understanding of this past research, particularly an examination of the order in which vowels have emerged as part of the shift (as documented by sociolinguistic and dialectology studies), shapes

my decisions about which vowels in the NCS I investigate. Further, understanding the details of the shift as a whole, including its history, informs my hypotheses (see section 1.5) about the relative social meaning of each linguistic variable.

Overview of the shift

The Northern Cities Shift is a set of vocalic sound changes-in-progress that are generally associated with speakers in urban and suburban areas stretching from the Mississippi River to New England. The shift is particularly well studied in the urban centers of Detroit, Buffalo, and Chicago (Labov, Yaeger, and Steiner 1972; Labov 1994; Gordon 2001). Research has also examined the shift in speakers from smaller towns in more rural areas (Gordon 1997; Ito 1999). In general, the shift is well documented among white speakers in urban centers, with increasing research adding pockets of information about minority speakers and speakers in non-urban areas. Figure 1.1, below, shows the six vowels involved in the shift in "un-shifted" positions, with arrows indicating the main direction of their reported changes within a traditional F1-F2 vowel space. As a connected set of variables, the NCS shows a clockwise rotation in the vowel space. Note that this is an idealized representation of the shift; as this dissertation shows, the presence of the shift within the vowel productions of an individual speaker or group of speakers is rarely, if ever, this tidy.

Figure 1.1 Diagram of the Northern Cities Shift (following Labov 1994)



1.2.1 Past research as a timeline of elements' emergence in the NCS

The ubiquity of the NCS in sociolinguistics over the years may seem disadvantageous—what else is there to learn or discover about this shift?—but in fact, the wealth of past findings provides substantial and important grounding for this study. Beginning with older studies of the NCS and moving forward to very recent work highlights information about the progress of the shift over time. Generally, as the name indicates, the Northern Cities Shift is thought to have progressed from speakers in urban centers outward to

suburban and more rural regions, a fairly typical geographical pattern of language spread. Taken together, the body of work on the Northern Cities Shift provides an overview of an ongoing, widespread regional language shift. As I discuss further below, having a timeline of the NCS – knowing which vowels changed first and which changed later – may inform our understanding of the relationship between the spread of sound change and speakers' social identities, by providing a means for distinguishing the kinds of social meaning variables carry within a community. Though the NCS is one of the most widely studied set of linguistic variables in sociolinguistics, our understanding of the shift is by no means comprehensive, especially considering both the diversity of sociolinguistic patterning that has been found to date, and the diversity of speakers whose NCS patterning has not yet been examined.

Past research on the NCS

Labov (1994, 178) credits an unpublished (1969) paper by Ralph Fasold as the first to explicitly recognize the Northern Cities Shift as a set of related vowel changes. Fasold analyzes the vowel productions of 24 Detroit speakers (from 1966 recordings taken by Shuy, Wolfram, and Riley) and finds patterned variation in the form of /æ/-fronting and raising, /ɑ/-fronting, and /ɔ/-fronting, all of which are variations associated with the NCS. Dialect studies of the 1950s and 1960s (Mackwardt 1957; Kurath and McDavid 1961) also provide early documentation of some of the NCS variation (/æ/-raising and /ɑ/-fronting), recognizing them as characteristic of a Northern dialect region, but these early dialect studies do not present the entire shift as a connected set of sound changes.

In a later study, Labov, Yaeger, and Steiner (1972) conduct a sweeping investigation of vowel systems and sound change in the United States (and the United Kingdom), including a sample of speakers from Buffalo, Detroit, and Chicago, all urban centers in the NCS region. Labov *et al*, use instrumental techniques to analyze all the vowels reported to be involved in the NCS at the time (/æ/, /ɑ/, /ɔ/, /ɛ/, and /ɪ/)[1], and their discussion focuses on internal linguistic factors affecting the shift (Gordon 2001, 14). Labov *et al*'s work confirms that past impressionistic research on the NCS is generally accurate with regards to the presence of a systematic vocalic shift, but also shows that acoustic methods of data analysis are able to reveal systematic, patterned differences in the acoustic correlates of auditory coding that went unnoticed in impressionistic research, particularly variation in F2 measures (4). Though the methodological point here does not

[1] /ʌ/ was not recognized as part of the Northern Cities Shift until several years after this 1972 study.

speak to the overall sociolinguistic patterns of the NCS, it does provide early confirmation that the acoustic methods of later studies are also valid.

After Labov *et al*, come many studies that each have a somewhat narrower focus, either looking at fewer vowels or a narrower social dimension. Callary (1975) investigates /æ/-raising in the speech of 18 young women, each from a different county in Northern Illinois, and finds a correlation between /æ/-raising and the size of the speaker's community – the larger the community, the more raised a speaker's vowel realizations are, suggesting that these changes spread out from larger urban centers to smaller towns (see also Eckert 2000; Gordon 2001; Labov 2001, 436).

Herndobler's (1993) sociolinguistic study of /æ/- and /ɑ/-variation in the speech of working-class speakers in Chicago shows that, among these Chicagoans, women lead men in the use of raised variants of /æ/ and fronted variants of /ɑ/. Herndobler argues that the higher occurrence of NCS variants of /æ/ and /ɑ/ in the women's speech is connected to the community's working-class gendered norms and expectations, including differing interests between men and women in preserving cultural norms. Use of NCS variants is locally indexical of sophisticated and cosmopolitan culture, which women in this community are exposed to through their jobs in more affluent towns nearby.

Knack (1991) investigates the production of /ɔ/ among 33 middle-aged non-Jewish and Jewish speakers in Grand Rapids, MI. Knack finds a strong correlation between the Jewish participants' network ties to New York City and their use of backed variants of /ɔ/, which Knack identifies as an index of Jewish (New York City) identity. The non-Jewish participants, who don't have ties to New York City, have more fronted /ɔ/ in their speech, which follows the pattern of the NCS. Knack's study shows that the participants' ethnic identity, constructed in part through ties to a geographically-distant, ethnically like community, can play a role in whether or not speakers use variants associated with a local shift. (See Chapter 6 for further discussion.) These studies identify most of the vowels involved in the shift (/ʌ/ is notably absent; see below for discussion). Though no comprehensive pattern emerges from all of the various studies, we find that speakers utilize variation associated with the NCS to index a range of social characteristics from global categories, such as sex and age, to identity parameters that emerge from specific local contexts.

Even more recently, several studies (mostly by graduate students at universities in the Midwest) have focused on the spread of the NCS; these studies confirm that while NCS variables show a great deal of social variation, that variation is linked to the specific social dynamics and contexts of the local community. Roeder's (2006) research investigates the extent to which speakers from a community of Mexican Americans in Lansing, MI, use NCS-variants in their speech. Roeder uses word-list recordings to examine the variation in four vowels: /ɔ, æ, ɑ, ɛ/; her findings show that NCS-variants of /æ/ are used by the young female Mexican American participants, while patterns for the other three vowels in the speech of the Mexican American participants do not follow NCS-like variation. Roeder argues that local norms of pronunciation distinct from the NCS have developed within this community (2006, 79-80). Evans's (2001) study of Appalachian migrant speakers in Ypsilanti, MI, shows that use of NCS-variants of /æ/ is linked to speakers' identification with Appalachian identity as measured through social network scores. Participants with strong ties to Appalachia/Appalachian identity showed less /æ/-fronting and –raising. In his (2000) study of three NCS elements – /æ/-raising, /ɑ/-fronting, and /ɛ/-backing and lowering – in the speech of white, Mexican American, African American, and mixed-ethnicity college-aged participants in Northwestern Indiana, Gordon concludes that the NCS is not very well-established in this region, and that the extent to which it is present is still generally restricted to the white speakers in his study (but see Fought 2006, 145-146, for detailed discussion that challenges this conclusion). In many of these more recent studies, speakers' ethnicity, migration history, and socioeconomic class are factors that relate to the degree of use of the NCS, though these studies, taken together, do not suggest an easy generalization about the relationship between ethnicity and use of NCS variables.

Sociolinguistic research continues to show that variation in the Northern Cities Shift is tied to a variety of social factors, including gender, geographical location, community size, race, and ethnicity, though research to date is by no means comprehensive in any of these regards. Though I focus on social variation that is tied to the students' ethnic identity because of its social salience in Dearborn, it will be important in my research to consider the effect of other social factors as well, since it is often difficult or problematic to cleanly separate these issues. Ethnicity is but one aspect of an individual's identity, which cannot be considered discretely or in a vacuum separate from all other facets of an identity. Further, much research has shown that characteristics such as ethnicity often get filtered through local distinctions. Thus, though the goal here is to consider what role ethnicity plays in the social patterning of NCS variables, it may be that the social factors

most relevant to NCS variation relate to ethnicity only indirectly. In my statistical analysis I include social variables related to gender, ethnicity, religion, and language, as informed by my ethnographic findings (see Chapter 4 for further discussion).

1.2.2 Ordering of elements in the NCS (Eckert's hypothesis) and its relevance to this dissertation

Relative chronology of the NCS

As I discussed above, past studies on the NCS tell us something about the ordering of the elements in the shift, which, according to Eckert's hypothesis, can tell us something about the potential for social salience of particular linguistic variables. Collectively, studies provide some documentation of which vowels show what kind of variation over time. Many of the early studies (Mackwardt 1957; Kurath and McDavid 1961; Fasold 1969; Callary 1975) report on up to three of the six variables of the NCS: /æ/-raising, /ɑ/-fronting, and /ɔ/-fronting.[2] Based on the findings of these and other studies (as reported in Labov 1994 and Gordon 2001), the first three elements of the shift, which underwent change first, are proposed to be /æ/, /ɑ/, /ɔ/. There is dispute about the order of these elements relative to each other (Labov 1994; Gordon 2001; Eckert 2001; Roeder 2006). Labov proposes that the NCS is a chain shift initiated by the raising and fronting of /æ/, triggering a series of shifts that move clockwise within the vowel space. Gordon argues, based on the findings of his research on speakers in two small towns in Michigan, that the first element that triggered the shifts in the NCS is the lowering of /ɔ/. Since both of these theories are based on single community studies, it is difficult, if not impossible, to decide which one is more compelling. At present, the most prudent conclusion is that /æ/, /ɑ/, and /ɔ/ are the first three variables in the NCS and we cannot conclusively say which came first.

The inclusion of the other three elements, /ɛ /, /ɪ/, and /ʌ/, in NCS studies is less frequent. Labov, Yaeger, and Steiner (1972) include /ɛ / and /ɪ/ in their 1972 survey, the earliest study I found to do so. In Labov's (1994) discussion of the NCS, he reports on data collected in Chicago in the late 1960s. Data from these findings suggest the backing of /ɛ/ and /ɪ/ is present in the speech of NCS speakers. Penelope Eckert's work on the speech of adolescents at a high school in suburban Detroit is the first to identify /ʌ/ variation as part of the NCS (Eckert 1988, 1989, 1991, 2000; Labov 1994). Because of a lack of evidence of the backing and lowering of /ʌ/ in data from the 1950s and 1960s, Labov suggests that

[2] The exception is Labov, Yaeger, and Steiner 1972, who include /ɪ/ and /ɛ/ in their analysis.

the variation in /ʌ/ that Eckert discovered is a very new stage of the NCS that emerged in the 1970s and 1980s (1994, 191). To summarize, based on the evidence gained from prior research, there are two stages to the NCS. The first involves the raising of /æ/, the fronting of /ɑ/, and the fronting of /ɔ/. The second stage involves the /ɛ/-backing and -lowering, /ɪ/-lowering, and /ʌ/-backing.[3] Below, I discuss the relationship between the spread of the NCS and the social meaning that variables carry.

Spread of the NCS and the social meaning of variables

Labov argues that the NCS follows a cascade model of diffusion (2001, 285) whereby the sound changes involved in the NCS begin in urban centers and then proceed to smaller towns (see also Trudgill 1974; Callary 1975). Work on models of sound change spread seem to be oriented to the goal of figuring out rules for how a sound change progresses – who picks it up first (e.g., adolescents or adults, men or women, working class or middle class speakers), and which phonetic or lexical features inhibit or promote a sound change – that may be generalized to all sound changes. In the case of the NCS, for example, researchers look to the relative chronology of NCS elements to understand (or predict) which elements would be picked up in a new community (e.g., Ito 1999; Gordon 2001; Roeder 2006,).

In Gordon's alternate proposal about the ordering of the NCS elements, we still find a distinction between the upper half and the lower half of the shift. Though Gordon questions the ordering that Labov proposes (and thus some of the assumed principles of chain shifts), Gordon's alternative solution still rests on a presumption that the NCS is a set of sound changes that are connected to one another. So, in order for a speaker to have /ʌ/-backing, they must have all the changes previous in the shift (/ɛ / -backing and -lowering, /ɪ/-lowering and so forth); this is the reasoning he uses to argue for an alternative ordering of the NCS variables. If we are to presume that the NCS is a connected set of sound changes and that to have shifting in the newest variable means you have shifting in oldest variable – and all those in between -- then how do we reconcile it with a theory such as Eckert's, in which the social patterning of variables is posited to be such that we may not find all of the variation implied by a theory such as Gordon's? Some of the difficulty in reconciling these theories is that the one supported by Gordon and Labov seems to take a view in which the rules that govern how the

[3] Gordon (2001:53) notes that the later three vowels show a wider range of variation, along multiple trajectories, than the early NCS variables, which generally vary across one trajectory (though see chapter 4 for further discussion).

variables of the shift progress in relation to one another are internal (i.e. not social) and that social factors that may bear on the progress of the shift apply to all the variables consistently.

Eckert's hypothesis, on the other hand, relies on individual variables in a shift being affected differently (if at all) by the same social factor. In Eckert's view, internal properties of the shift (i.e., which variables are older or newer) play a role, but these properties work in concert with very local and context-social factors. At Belten High, the site of Eckert's ethnographic research on adolescent social and linguistic practices, the burnouts, a group of students oriented towards a local, working-class lifestyle and culture, introduced newer "urban" variables (backed variants of /ʌ/ and /ɛ/) to other Belten students through their network ties with adolescents from Detroit (or from suburbs closer to Detroit than where they lived). The jocks' use of these "urban" variables was one symbolic resource that allowed them to construct a locally-oriented identity that contrasted with the jocks, a group of students who oriented to the institutional order and culture of the high school. Over time, Eckert predicts, the backed variants will lose their urban associations and spread through the school, getting picked up first by girls and then later by boys (2000, 226). Unlike the newer variables, the older variables in the NCS had a regional meaning associated with Detroit and the surrounding area, and were not used to construct social identity that was based on contrast between jocks and jocks. Rather, students could use the variability of the three older vowels as a tool in stylistic expressiveness (225). Eckert (2000) hypothesizes that the social meaning of a variable may be tied to how long that variable has been part of the shift and available to take on social meaning. Thus, variables that have been around a long time are more stable and will show less socially-patterned variation than a variable that is newer and thus more sociolinguistically salient. I return to Eckert's hypothesis in section 1.5, where I discuss the central research questions and hypotheses of this dissertation.

1.3 Arab American ethnicity

Made up of about 1.2 million people, the Arab American communities in the United States are longstanding and hugely diverse, tracing roots back across the entire Arab world. This section provides an overview of these communities and of Arab American identity, nationally and in Dearborn, the site of this research project. Dearborn's geographic location, in the heart of the NCS region, and demographic makeup, with a high concentration of Arab Americans in one area, make it an ideal place for studying the spread of the NCS to Arab Americans in Michigan.

1.3.1 *Ethnicity* in sociolinguistic research

A focus of this dissertation is examining the extent to which participants' identification as Arab Americans relates to the sociolinguistic patterns of NCS variables. To that end, it is important to understand what is meant by *Arab American*. Discussing Arab American ethnicity (like discussing any sort of ethnicity in the U.S.) immediately raises the question of what is meant by *ethnicity* and *identity*. I join the ranks of social science and humanities researchers who take the position that ethnicity, like all other facets of social identity, is a process, located in the social actions and interactions of people (Bucholtz & Hall 2005, 2008; Irwin 2009; Del Torto 2008). Actions and interactions cover an infinite range of practices (e.g. clothing, hair, food, domicile, or music) but for sociolinguists, the social interaction of interest is language – how people talk, what they say, and what they say about how they and others talk. Uncovering the relationship between linguistic practices and social identities requires attention to both broad macrosocial identity categories and local social information (Eckert 2001; Bucholtz and Hall 2005; Fought 2006). Thus, sociolinguists' approach to identity has evolved to look beyond macrosocial categories to the locally-constructed realities, but ethnicity remains a tricky concept. Fought's (2006) volume *Language and Ethnicity* discusses several definitions of ethnicity that have come out of the social sciences and humanities literature and can bear on discussion of socially patterned linguistic variation. Fought concludes that defining ethnicity is a muddy task, but the definitions she covers provide a reasonable starting point for understanding ethnicity. In Barth's (1969) definition, a mainstay in studies on ethnicity, an ethnic group:

> (1) is largely biologically self-perpetuating; (2) shares fundamental cultural values; (3) makes up a field of communication and interaction; (4) has a membership which identifies itself, and is identified by others, as constituting a category distinguishable from other categories of the same order (as quoted in Fought 2006, 9).

Cohen (1978) offers another definition of ethnicity:

> Ethnicity, then, is a set of descent-based cultural identifiers used to assign persons to groupings that expand and contract in inverse relation to the scale of inclusiveness and exclusiveness of the membership (Cohen 1978, 387, quoted in Fought 2006, 8).

In these definitions, ethnicity is based on one's ancestry, social networks, and daily practices. Contrast is also critical to defining ethnicity – it matters most (or, perhaps, only matters) when creating opposition between groups (Fought 2006, 12). These boundaries

are not universal, but, rather, "creatively invoked and negotiated by individuals and groups in response to their evolving social roles and circumstances" (De Fina 2007, 373). Thus, even the boundaries themselves are flexible and accommodate to the needs of the moment.

Another component of these definitions of ethnic identity is that it is "descent-based," passed on across generations. As Gabaccia (2006) notes, external forces reinforce the idea that ethnicity is inherited. U.S. census takers' practice of recording information about citizens' ancestries allowed "discussions of 'second' and 'third' generation immigrants to become common by the 1930s; like race, this suggests nationality and ethnicity could be transmitted across the generations—it was inherited" (21). The idea that ethnicity is at once inherited and constructed highlights how even locally-constructed identities exist against a backdrop of existing ideas and stereotypes about social categories. The push-and-pull between the macrosocial and the local creates a space in which ethnic identity can be created and challenged.

The view of ethnicity in this dissertation is ultimately how the participants perceive and define it for themselves and others, and, in Chapter 2, I discuss in greater detail the ethnographic findings that help me incorporate students' ethnic identity (and views and ideologies about their ethnicity) into my analysis of the sociolinguistic patterning of several NCS variables. This approach, following a social constructionist paradigm, "is based on the primacy of interactants' local construction of social reality, on the centrality assigned to the concept of practice, and on the close observation of social behavior in real contexts of interaction" (De Fina 2006, 372). But the participants' ethnic identity, however local it may seem to them, is rooted in a broader history and is part of larger discourses that go beyond the walls of Mercer High School, the research site, and the boundaries of Dearborn.[4] An overview of the development of Arab American as an ethnicity shows that it is dynamic, broad, and persistent. The larger sociopolitical, cultural, and media contexts of the United States impact what Arab American means, how Arab Americans are perceived, and how they perceive themselves. The macrosocial context provides grounding and a means through which to understand the local circumstances that produce Arab American identity at Mercer High School. Below, I provide an overview of how Arab American as an ethnic identity and category developed in the United States.

[4] Mercer High School is a pseudonym.

1.3.2 Overview of Arab American migration and identity at a national level

The development of Arab American identity is built upon migration that has spanned the past 150 years and continues to this day. At the same time that generations of Arab American families have settled into life in the United States, Arab immigrants continue to arrive in the United States, as a result of political upheaval in the Middle East from the Gulf War of 1990 to 1991, the 2003 invasion and occupation of Iraq that continues to the present-day, and ongoing unrest in Israeli-Palestinian relations. Chain immigration, through which immigrants sponsor family members to join them in the U.S., also continues. Thus, the Arab American community continues to grow and develop, and Arab American identity and ethnicity encompasses people from widely varied religious, national, and linguistic backgrounds. Arabs have settled throughout the United States and Canada, but Southeastern Michigan, and Dearborn in particular, has played a prominent role in Arab migration, as a site of settlement and as a center for Arab American social and political activism.

Early Arab migrants to the U.S., a wave beginning in the 1870s and continuing through the First World War, were from Greater Syria, which included present-day Syria, Lebanon, the Palestinian territories, Egypt, Jordan, and Iraq. Early immigrants to the U.S. were primarily from present-day Lebanon and mostly Christian and thus a relatively homogeneous group, in terms of social and religious practice (Suleiman 1999; Abraham and Shryock 2000; Naber 2000). Economic opportunity motivated many of these early immigrants to the U.S.; several political and economic events in Greater Syria, including the building and opening of the Suez Canal, significantly altered the economics of the region. Religious persecution of Christians in Greater Syria under Ottoman rule also influenced some Arabs to migrate (Suleiman 1999, 2-3).

Arab migration to the United States follows a common pattern of chain migration. The first wave of migration is characterized by assimilation, economic motivation and opportunity, and an absence of a unified Arab identity. The early group of Arab immigrants to the U.S., who often worked as merchants and peddlers, sought to assimilate to American society and culture: they anglicized names, replaced Arabic and other home languages with English, and downplayed their cultural heritage (Naber 2000, 40). Suleiman, in his 1999 volume *Arabs in America*, writes that "by World War II, Arabs in America were, for all practical purposes, an indistinguishable group from the host society" (9), suggesting a high level of assimilation. Labeling of early Arab

immigrants suggests a somewhat more complicated picture. U.S. officials classified early Arab immigrants as first Turks and later as Syrians, but they were also labeled white (and/or Caucasian), though they were not always afforded the same privilege and position as white Americans whose ancestors were European. Arab "whiteness" in the U.S. was tenuous – it could allow Arabs to blend in and escape discrimination suffered by more visible minority groups, or it could be substandard to European "whiteness" when it came to questions of citizenship and employment (Naber 2000).

The development of a specifically Arab American identity emerged with another wave of Arab immigrants to the U.S. beginning in the 1960s, who brought along with them a different set of motivations and reasons for coming the United States. They came from a broader swath of the Arab world, including Palestine, Egypt, and Iraq, and were often motivated by sociopolitical reasons as much as by economic ones. This second wave was overall more educated and more Muslim than the first wave. Attendant with these shifts in the political and demographic make-up of the immigrants were specific forms of Arab nationalism tied to the new autonomy of Arab nations. Whereas the first wave of immigrants was assigned the label Syrian by U.S. government officials, immigrants in the second wave often came with a self-identification as "Arab", asserting an identity that did not easily assimilate with mainstream U.S. society. The 1967 Arab-Israeli War serves as a watershed moment in the development of Arab American identity (Suleiman 1999; Naber 2000). As Abraham and Shryock write about Arabs in Detroit:

> Arab American identity, as expressed in Detroit today, seldom refers to an ancient regional heritage or even a shared culture. It emerged quite recently as part of a complex (and now largely forgotten) reaction to the 1967 Arab-Israeli War. America's pro-Israel stance in the wake of that conflict increasingly turned 'the Arabs' into a problem, both in Detroit and in the Middle East. Arab American identity evolved as a way of dealing with that problematic status (39).

In the aftermath of the 1967 War, Arab Americans experienced social, political, and cultural marginalization (Naber 2000, 41). A broad and unified Arab American identity, which had not existed in the U.S. before this time, served as a strategic tool for gaining social and political rights and re-defining the meaning of "Arab." The emergence of an Arab American identity is largely a sociopolitical act in response to a global discourse of declining and threatened U.S.-Arab relations, rather than an act of cultural preservation or a response to pressures of assimilation within the context of the U.S. cultural melting pot. This contributes to the popular notion that Arab American identity, at a national level, is more about politics than it is about food or family or other non-threatening cultural tropes

(i.e., contrast with popular images of Italian Americans or Greek Americans). Though an imagined shared heritage underlies popular conceptions of Arab Americans within and without the community itself, as Abraham and Shryock argue there is no "essential Arabness" (39) that unifies Arab Americans. Arab American identity, in the 1960s and now, like many other ethnic identities, is a social and political construction whose boundaries are flexible and accommodate to the needs of the moment.

The flexibility of the boundaries makes defining Arab Americans somewhat difficult. The groups of people who are collectively labeled as (and many of whom self-identify as) Arab American today come from diverse religious, cultural, geographic, and linguistic backgrounds. In a 2003 U.S. Census report on Arab Americans, "most people with ancestries originating from the Arabic-speaking countries or areas of the world are categorized as Arab" (1). El-Badry's (1994) report on the demographics of Arab Americans notes that despite variation in tradition and culture in these nations, their "common ground is an 'Arabic heritage' and the Arabic language" (22). These kinds of categorizations are somewhat vague and can be overly broad. They do not address people from Arab countries who are not Arab (e.g. Berbers and Kurds, both groups that do not identify as Arab, were included as Arab in the 2003 U.S. Census report); people who identify as Arab but do not speak Arabic; the common conflation of Arab, Middle Eastern, and Muslim backgrounds; or the many distinct varieties of Arabic that have specific geographic, political, and religious ties. Despite all these difficulties, *Arab American* persists as a term of ethnic identification, encompassing a diverse group of people. Below, I discuss Arab Americans in Southeastern Michigan and examine some of the specific issues of Arab American identity in that region.

1.3.3 Arab Americans in Southeastern Michigan

The suburbs surrounding Detroit are "home to the largest, most highly concentrated population of Arabs in North America" (Abraham and Shryock 2000, 20). Roughly 200,000 people of Arab descent live in Southeastern Michigan, mostly in the western and northern suburbs surrounding Detroit. Like broader patterns of Arab immigration to the United States, Arabs have been coming to the Detroit area since the late 1800s. In the early to mid-20th century, the rapidly rising auto industry was a source of jobs for many Arab (and other) immigrants. Despite the recent decline of the auto industry and job losses in that sector, Arabs have continued to come to the greater Detroit region to join family members and enter into the well-established Arab American community.

The 2004 Detroit Arab American Study (DAAS), a large-scale survey of the adult Arab population in greater Detroit designed to assess the experience of Arab Americans in metropolitan Detroit after the terrorist attacks of September 11th, 2001, provides some of the most comprehensive demographic information available about Arab Americans in Southeastern Michigan. According to the DAAS, the vast majority of Arabs in Southeastern Michigan are from Lebanon, Palestine, Yemen, and Iraq, though they also come from other parts of the Arab world. Slightly over half of Arabs in Southeastern Michigan are Christian and just under half are Muslim. While the Arab population in the greater Detroit area is quite diverse, the DAAS and other research (e.g. Suleiman 1999; Abraham and Shryock 2000) suggest that patterns of residence and interaction serve to create and maintain boundaries among Arab Americans along lines of kinship, nationality, and religion. Abraham and Shryock note, for example, that "Lebanese Shia in Dearborn have little contact with Palestinian Christians in Livonia [another Detroit suburb]: the two groups do not socialize together, they rarely intermarry, and their Arabic dialects are different enough to cause confusion" (2000, 39). The picture of Arab Americans in Southeastern Michigan suggests that the differences among Arab Americans can be just as salient as differences at an inter-ethnic level.

1.3.4 Research setting: Dearborn, Michigan

Dearborn, the research site, is a suburb directly adjacent to the western edge of Detroit, and serves as a hub for the Arab American community in Southeastern Michigan. The pattern of migration and settlement of Arab Americans in greater Detroit has contributed to the community's growth and establishment. Arabs initially arrived in Dearborn and Detroit's inner suburbs, often to work at the Ford Motor Company's River Rouge automobile plant. Though no longer the primary place of employment for Arab Americans, Dearborn still continues to serve as a point of entry for Arab immigrants arriving in Metro Detroit. Initially, immigrant families gained social and economic footholds and then settled out in the more affluent northern and western suburbs of Detroit (Abraham and Shryock 2000). This pattern of mobility has been traced over repeatedly by different groups of Arab immigrants. In some instances, as families left for more prosperous suburbs, new arrivals would move into the newly vacant houses, take up the same jobs, and attend the same mosques. Additionally, newly arriving sponsored family members would often move into the same neighborhoods and streets, and immigrants could at least partially transplant old family networks to their newly adopted homeland (Rignall 2000).

According to a 2003 U.S. Census report on Arab Americans, about 30% of Dearborn's population identifies as being of Arab descent, the highest concentration of Arab Americans in any U.S. city (Census Report 2003). The Arab Americans in Dearborn are concentrated on the eastern side of the town, where Mercer High School, the site of my study, is located (see chapter 2 for further discussion of the high school). Lebanese Shi'a families make up about two-thirds of Arab Americans in Dearborn, are well established and have considerable economic and social presence. Yemen, Iraq, and Palestine are the other home countries for Arab Americans in Dearborn; these families tend to have arrived in the U.S. more recently and have considerably fewer economic and social resources than the Lebanese families. My ethnographic research shows that differences in social power and socioeconomic status have led to tension between Lebanese and non-Lebanese families, which plays out at Mercer High School, following a pattern similar to anti-immigrant sentiments found in dominant white communities. Non-Lebanese students feel discriminated against by the mostly Lebanese school administration, and Lebanese students often hold prejudices against non-Lebanese students, particularly Iraqi and Yemeni students who have recently immigrated to the U.S. I return to this topic in Chapter 2.

Despite its proximity to Detroit, Dearborn has a distinctly suburban feel, with neat rows of mostly single-family houses, office parks, and strip malls lining the wide boulevards that are common throughout greater Detroit. The main streets in Dearborn are lined with shops carrying Middle Eastern food, clothing, and media. Many stores cater to the Arabic and Muslim community members. Stores that are not selling a particular Middle Eastern, Arab, or Muslim product still have signs in Arabic, for the many monolingual Arabic speakers in the area. Local franchises of national fast-food chains offer halal meat on their menus.

Dearborn is also the headquarters for sociopolitical organizations such as the Arab Anti-Discrimination Committee (ADC), which work to shape and defend portrayals and perceptions of Arab Americans (particularly Muslims) in mainstream U.S. media reports and stories (Shryock 2002), and the Arab Community Center for Economic and Social Services (ACCESS), which, along with other, smaller organizations, provides many resources that enhance the economic and social lives of Arabs in Dearborn, including job training, tutoring, and other social services.

Though Dearborn is a hub of the Middle Eastern population in the United States, Arab Americans who live in Dearborn do not encompass the diversity of the Arab American community, either at the national level, or throughout Southeastern Michigan. Rather, Dearborn represents a unique slice of Arab American demographics in the U.S., and its demographics in many ways highlight the importance of national, religious, and family ties that influence patterns of residence for Arabs in Southeastern Michigan.

In doing research on and in Dearborn, a paradox emerged between the idea of Dearborn as an epicenter of the Arab world in America (a commonly held view in and outside of Dearborn) and the positioning of Dearborn as one of several Arab communities in Southeastern Michigan. On the one hand, the social prominence of Dearborn and immediate contact with residents (as I experienced during my research) support an idea that Arab Americans in Dearborn are representative of all Arab Americans. On the other hand, a broader perspective shows that Dearborn is not identical to other Arab American communities, and in fact there are strong differences among them, particularly in terms of religious practice and identity. While Arab Americans in Dearborn are largely Muslim, they make up two-thirds of Muslims in Southeastern Michigan (DAAS 2004, 8). DAAS respondents reported mixed feelings about the prominence of the Dearborn Arab community; Muslims and Dearborn residents generally agreed that Dearborn improved the image of Arabs in wider audiences, while Arab Christians were less likely to view Dearborn as an asset to Arab identity (DAAS, 8). One of the consequences of these divisions for the participants in my research (which I discuss in greater detail in Chapter 2) is that their own views on what it means to be Arab are often centered on their own experiences, which are highly localized. Thus, the Mercer High School participants' views on being Arab American often indicate a presumption of Muslim religious practice such that the differences between Muslim and Christian Arab Americans are not central to the participants' lives because the participants often conflate Arab and Muslim.

1.4 Ethnicity, mainstream sound change, and the issue of participation

As I discussed briefly in section 1.3, sociolinguistic research is now well informed by the theory and method of the social constructionist paradigm, particularly in looking at conversational interaction and the moment-to-moment unfolding of identity (Rampton 1995; Bucholtz 1999; Lo 1999; De Fina 2006; Del Torto 2008). Research on the social patterning of fine-grained phonetic variation also now often incorporates ethnographic information and a focus on the dynamic nature of identity and identity construction (Mendoza-Denton 1997; Fought 1999; Eckert 2000; Hall-Lew 2008, 2009; Drager to

appear). Though some of this work focuses on ethnic identity, sociolinguists' understanding of the role speaker ethnicity plays in the spread of mainstream regional sound changes is still lacking (Fought 2006). Part of the problem lies in some of the assumptions associated with the linguistic practices of ethnic minority speakers in the U.S. and in some of the assumptions about the social meanings of mainstream sound change variables. In his volume on the social factors involved in language change, Labov (2001) lays out an argument that "non-white" speakers are, in fact, not involved in mainstream sound changes:

> In Boston, New York, Philadelphia, Buffalo, Detroit, Cleveland, Chicago, San Francisco, and Los Angeles, the progress of the sound changes we have been studying stops short at the racial line. All speakers who are socially defined as white, mainstream, or Euro-American, are involved in the changes to one degree or another…But for those children who are integral members of a sub-community that American society defines as "non-white" -- Black, Hispanic, or Native American -- the result is quite different. No matter how frequently they are exposed to the local vernacular, the new patterns of regional sound change do not surface in their speech…The situation of the growing Asian American community is not yet clear, but present indication show that in Philadelphia, at least, second-generation speakers of English do not adopt features of the local dialect. Further research on different sectors of the Asian American community should illuminate the significance of belonging to a "non-white" sector of the American society (506-7).

This claim, despite its basis in just a handful of studies, has currency in sociolinguistic studies of sound change spread: research in this area has, to some extent, oriented around this assumption, such that researchers may even have expectations that speakers of non-white ethnicities will not be involved in mainstream sound changes. Many of the more recent studies on the NCS (e.g. Gordon 2000; Evans 2001; Roeder 2006) and other regional sound changes (e.g. Fought 1999; Eberhardt 2008) discuss minority speakers' use of sound change variants in terms of "participation" in a sound change. But, as Carmen Fought argues in her (2006) book *Language and Ethnicity,* generalizing Labov's claim "to *all* minority groups in all geographic areas seems clearly premature" (145; emphasis in original). Fought points out that even in several early studies that lent support to Labov's original claim, careful analysis of speakers' patterns of variation reveal situations that are much more complicated; the patterns never (or have yet to) come down to binary results in which all white speakers participate in sound changes and all non-white speakers don't participate in them (145-148). She notes that in Labov's early work, in New York City (1966) and on Martha's Vineyard (1972), there is evidence

of speakers from ethnically distinct groups following the linguistic patterns of the mainstream speech community.

There is now a growing body of work that investigates the speech of non-white speakers, including research that focus on minority speakers and sound changes (e.g. Poplack 1978; Mendoza-Denton 1997; Fridland 2003; Ito 2008; Hall-Lew 2009). Many of these studies affirm Fought's argument, showing that ethnicity alone is not necessarily a good or useful predictor of whether a person's speech will have mainstream sound change patterns. Fought writes that, "as important as ethnicity is, and we have seen the dramatic effects that ethnic boundaries can have, it is not necessarily the overriding factor in every linguistic 'act of identity'" (147). In many cases, local identities play a strong role in socially-patterned linguistic variation (e.g. Fridland 2003; Hall-Lew 2009). In Fought's own work with Mexican American high school students in Los Angeles, she found that Mexican Americans' use of variables in California vowel shifts, related to an interaction of social factors such as social class and gender, along with local gang membership and affiliation, and not just ethnicity. Hall-Lew's (2009) research on Asian Americans in San Francisco's Sunset District shows a complex relationship between speakers' use of features of a mainstream California English variety, the social characteristics of age and sex, and speakers' local identities and ideologies about being San Franciscan. This research suggests that ethnicity, as a social variable affecting linguistic variation, is best understood when contextualized within the local realities of the speakers.

This dissertation contributes to the ongoing discussion on the spread of a mainstream sound change within a minority community. I consider how a group of Arab American adolescents might use the NCS as a means of expressing social distinctions that are specific to being Arab American in Dearborn. In my analysis of four NCS variables, I try to avoid assumptions about the influence of ethnicity on a speaker's use of NCS variables, by not treating the participants' Arab American ethnicity as a barrier to the NCS. Buying into the idea of participation and non-participation would make some of the research goals of this dissertation irrelevant, since it would assume non-white minority speakers in Michigan would not use the NCS system and would instead orient to their own sets of sociolinguistics norms in which the NCS does not exist because of barriers between ethnic minorities and whites. By not assuming that use of variables in a widespread shift is based solely on speaker ethnicity, we recognize that the barriers between white majority mainstream speakers and non-white minority speakers are permeable. Further, the idea of "participation" suggests that use of mainstream linguistic

variants is somehow inherently indexical of the mainstream community. As other studies have shown, minority speakers' use of mainstream variants can be indexical of social norms relevant to the minority community. That is, the social meaning of variables is not fixed but flexible and specific to the social context of the high school.

1.5 Vowel selection and research questions for this dissertation

I selected the vowels analyzed in this dissertation based primarily on prior studies of NCS vowels and Eckert's hypothesis that older variables in a set of sound changes have less local social meaning than newer variables (see §1.3). For this study, I chose to examine two vowels from the older portion of the shift /æ/ and /ɑ/, and two from the later stage of the shift, /ɛ/ and /ʌ/. This allows me to meet my broader objectives of understanding the spread of the NCS among Arab Americans and to test Eckert's hypothesis on the participants in my study.[5]

As discussed in section 1.2, the spread of the older variables is well documented (and to varying degrees this includes spread to speakers in smaller, rural communities, and to speakers of non-white ethnicity), while the spread of the newer variables, though they have been shifting for at least 25 or 30 years, is less well documented. Even some recent studies have still not expanded very much beyond the oldest three variables. Evans (2001) investigated only /æ/, as did Ito (1999); Roeder's (2006) study includes analysis of /ɛ/ variation along with the three older variables /æ, ɑ, ɔ/, but she excludes /ɪ/ and /ʌ/ from her analysis in part because of lack of stability and clarity regarding the direction(s) of their variation, and, further, the bulk of her discussion focuses on variation in /æ/ production. On the other hand, Gordon's (2001) study and Eckert's (2000) work both include all six vowels. Clopper, Pisoni, and de Jong's (2004) acoustic survey of six regional varieties of American English reports the presence of the NCS in speakers from the Northern region (the Upper Midwest). In their findings, all Northern speakers show fronting of the low, older NCS vowels, while only the women in their study show backing of /ʌ/ and /ɛ/, two of the newer elements in the shift (1668-1669).

The older variables in the NCS, /æ/, /ɑ/, and /ɔ/, then, may be sociolinguistic resources in the construction of individual and group identity for broad or global social characteristics, while the more recent variables, /ɛ/, /ɪ/, and /ʌ/, may serve as sociolinguistic resources in the construction of specifically local identities. By selecting vowels from both stages of

[5] I don't include /ɪ/ and /ɔ/ in my study to keep the scope of the project manageable.

the shift for this study, I can study whether the relative chronology of the variable relates to the kinds of socially-patterned variation each vowel carries.

Hypotheses

The broad hypotheses of my study are listed below:

1. Because the Arab American community has been well-established in Dearborn for multiple generations, I predict that the participants in my study, all Arab American, will show NCS-like variation for each of the four vowels in the study.

2. Following Eckert's (2000) hypothesis on the spread of sound change, I predict that statistical analysis will show more socially-patterned variation for the two newer linguistic variables /ɛ/ and /ʌ/ than for the socially-patterned variation of the two older variables /æ/ and /ɑ/.

3. I predict that through an examination of my ethnographic findings I will uncover social variables that are related to distinctions among Arab Americans and that are linked to the socially-patterned variation of the four linguistic variables. This hypothesis serves to test the idea that ethnic minority speakers can make social use of so-called mainstream linguistic variation in ways that are relevant to them.

1.6 Dissertation organization

The remainder of this dissertation presents the findings of this research project. In Chapter 2, I describe Mercer High School, the research site, and my methods for data collection. I discuss the ethnographic information and findings that inform the social variables that I incorporate into the statistical analysis, with particular attention to participants' sense of ethnic identity. In Chapter 3, I discuss the phonetic methods of the dissertation and provide an overview of the data. I perform some diagnostic tests to illustrate the presence of NCS-like variation in the participants' data. In Chapters 4 and 5, I present results of the statistical analysis, which consists of univariate tests and multivariate models for each of the four linguistic variables. In these chapters I discuss the findings in relation to some of the past findings on the NCS. In Chapter 6, the conclusion, I return to the main themes I discuss in this chapter and consider the relationship between the ethnographic findings and the statistical results in greater detail. I also evaluate the effectiveness of Eckert's theory for the data in this study.

Chapter 2: Mercer High School

2.1 Introduction

Mercer High School, the site of my research, is located at the eastern edge of Dearborn, Michigan, very close to the Detroit border. Set back on a small plot of land along one of the many wide boulevards that are characteristic of Detroit and its suburbs, Mercer, a beautiful, large stone building completed in 1928, is registered as a historical landmark in the U.S. Registry of Historical Buildings. It looks like it could be an American high school in a popular film.

When I pulled into the parking lot of Mercer for the first time, I noticed that the signs for the visitors' spots were printed in both English and Arabic. Though I had a sense that there were "a lot" of Arab families in Dearborn, that sign was my first clue of the size and presence of the Arab community at Mercer. Upon entering the school, I made my way to the main office. Inside, waiting to meet with the principal to discuss my research plans, I watched as the administrative staff, mostly women in headscarves, worked at their desks, dealt with all manner of student requests, and talked with parents in Arabic and English. At one level, the interactions I was watching were mundane and unremarkable, the normal stuff that makes up the day-to-day life of any high school. But, at a different level, Mercer didn't seem so ordinary to me. The outward expressions of a specific ethnic and cultural identity – the language, clothing, and other elements of Arab American practice – were new to me in a high school setting. But, as I discuss below, my unfamiliarity with Arab American cultural practices in a day-to-day setting helped me refine my approach to fieldwork and learn to separate what was interesting to me and what was useful for the analysis.

While taking everything in, I found myself mentally keeping tally of "all things Arab." In fact, it was all too easy to build a catalog of actions and words that meant "Arab American" to me. As I continued to spend time in the classrooms and grew familiar with the everyday life of Mercer, however, I began to realize that the images of Arab American-ness I saw were closely interwoven into the fabric of high school life, and that

Arab American identity was not a simple collection of discrete behaviors. Ethnic identity was not easily (if at all) separable or distinguishable from the rest of the "student" experience and I had to resist my desire to categorize overlapping and intersecting practices into distinct groups. Instead, it was often the relationship between practices, and the juxtaposition of apparently contrasting practices, that contributed to ethnic identity.

There are two main goals for this chapter. First, I discuss the methods I used to collect data, as these methods play a significant role in developing my awareness of my background as a researcher and of how this has contributed to my understanding of practice and identity at Mercer. Second, I describe those practices at Mercer which contribute to the building and negotiation of ethnic identity, through an examination of observations from my fieldnotes and quotes from sociolinguistic interviews with participants.

2.2 Overview of the school

Approximately 2,400 students in grades 9 through 12 attended Mercer in the 2006-2007 school year, when I did my fieldwork at the high school. Students are mostly from the eastern part of Dearborn, though some recent changes in district boundaries mean that students from western Detroit (who are almost all African American) also attend Mercer. The families of students at Mercer are socioeconomically diverse; about half the students qualify for free lunches, but there is also a lot of visible consumption and consumerism in the form of cell phones, expensive cars, and brand-name clothing and accessories. While many students come from families who have been in Dearborn for several generations, others are from families who have arrived within the past few years, displaced by sociopolitical events in the Middle East and drawn to the existing established Arab American community in Dearborn and nearby areas.

The district's official demographic records do not provide a sense of how many students at Mercer identify as Arab; the district follows the general U.S. practice, as exemplified by the U.S. Census, of assigning Arab ethnic identities to the racial category of "white". Though there are no official records about the Arab population at Mercer, district and school administrators' unofficial estimates indicate that 85-90% of students are Arab, and about three-quarters of those students are Lebanese. Two to three percent of students at Mercer are African American, and less than 10% of students are white (i.e., a non-Arab,

European or Caucasian background). About half of the teachers and administrators at Mercer are Arab, and the principal and two assistant principals are Lebanese.[6]

No officially recorded data exists to confirm this, but my observations suggest that most of the Arab students at Mercer were also Muslim (and the results of the Detroit Arab American Study [2004] back up the observations). I only encountered one student, in a classroom setting, who identified as Arab and Christian; none of the Arab students I interviewed identified as Christian, and none of them ever explicitly acknowledged a presence of Arab Christians, whether at Mercer, in Dearborn, or even in greater Detroit. The district and the school have adjusted some practices to accommodate the religious practices of the many Muslim students. During Ramadan, for example, the month of fasting, extra space was available for students who were fasting and did not want to go into the cafeteria during lunchtime.[7]

2.3 Data collection methods

In this section, I describe my methods of data collection, encompassing the fieldwork, observation, notetaking, and sociolinguistic interviews I completed for this research. My data collection methods allowed me to collect both linguistic data, for the phonetic and statistical analysis that follows in chapter 4, and social and ethnographic information, which ground the analysis of the linguistic data in the local world of the high school.

I spent the 2006-2007 school year at Mercer, going to the school two to four times a week as my schedule and the school's permitted, for a total of 102 visits. I gained access to the high school through the district superintendent's office and with the approval of the school's principal. After my initial visits to various classrooms, I settled into a routine of visiting a select few classrooms regularly, including Art, Speech, Arabic, French, and World Literature classes. Some teachers invited me to visit regularly, while others agreed to let me come to their classes when I asked them. I tried to visit classrooms that seemed more interactive, but the level of interaction tended to vary both from class to class and over the course of the year. Through regular classroom visits, I was able to have ongoing interaction with some students. In addition to the regular visits to a few classrooms, I also

[6] These estimates come from the assistant superintendent of the school district, Mercer's principal, and several teachers I spoke with during fieldwork. The district took surveys of students to assist with their bilingual education program and the English proficiency testing required of about 200 students. I also took informal counts in all the classrooms I visited to get a sense of the distribution of ethnicities.

[7] Middle Eastern cultural practices and history were not included in the curriculum except in Arabic courses, which had the same curriculum contents as World Language courses (e.g. French, Spanish).

interacted with students in the cafeteria during lunchtime, before or after school, and between classes. Below, I discuss the two main components of my fieldwork: sociolinguistic interviews and ethnographic observation.

2.3.1 Gathering ethnographic data

Before I began my fieldwork and data collection at Mercer, I had done enough reading and talked to enough researchers to know the importance of ethnographic research and that it would play a role in this study. Through careful observation and interaction with the participants, ethnographic methods allow researchers to make sense of the social practices and meaning-making of the people they are studying from the perspective of the people themselves. Sociolinguistic research has repeatedly demonstrated that a successful analysis of socially-patterned linguistic variation takes into consideration the local meanings and understandings of participants. Local meaning and identity may correspond quite clearly to a broad social demographic such as sex or social class, or it may be a locally-relevant distinction that corresponds only indirectly to a more global characteristic (e.g. Labov 1963; Bucholtz 1999; Fought 1999; Eckert 2000; Mendoza-Denton 2008).

The goal of understanding participants' actions and practices on their own terms made sense at an abstract level, but actually leaving my assumptions at the door turned out to be more difficult than I had anticipated. In my first couple of weeks at Mercer, I visited a variety of classrooms to get acquainted with the school, the students, and the teachers. I took copious notes, trying to get down all the details I could about the students, the classrooms, the way things were. I attempted to note demographic information about the students in hopes of extrapolating a demographic sketch of the school. In a speech class one day, my attention kept returning to three students – all girls wearing white headscarves – who spent most of the class whispering, passing notes, and texting on their mobile phones. I found them distracting: Why weren't they paying attention to the teacher? Why weren't they doing their work? Why weren't they more respectful?

In my notes on that day, I commented on the girls' behavior, noting that students these days were not nearly as well-behaved or studious as they had been when I was in school. After a few weeks, I came back to my notes and I noticed that in all the classrooms I visited, there were students who did not give their undivided attention to the teachers. Even in the classroom with the three girls, I had notes on students who were equally inattentive to the goings-on at the front of the room, but for some reason I had spared

them my judgment. Why had these girls stuck out, especially considering that the only thing that seemed to be strikingly new or different from my own high school experience was that the students at Mercer had cell phones? I kept coming back to the three girls and my notes on them and my feeling that they should have been holding themselves to higher standards than the other students.

I eventually realized – or admitted – that my expectations about the girls and my surprise at their apparent misbehavior really came down to stereotypes I had about Arab or Middle Eastern women that guided my "unguided" observing. I expected "girls in headscarves" (perhaps a sort of natural class of people in my mind) to be studious, quiet, and cooperative for all sorts of reasons: because they were girls, because I had seen countless media portrayals of Arab and Middle Eastern women as subservient, because I myself was a good student in high school.

Reporting on this minor epiphany makes me cringe at my naiveté and prejudices, starkly obvious with the gift of hindsight. But, eventually recognizing the rather embarrassing assumptions that I brought to the table made real for me in my own research the notion that there is "no gaze from nowhere", that I was observing these students from a position of my own (Irvine and Gal 2000). As a result, I was able to bring a critical eye to my own role in the research process. I paid careful attention to my note-taking, reflections, and interactions, with the goal of recognizing my prejudices so that I could keep them in check and adjust how and what I paid attention to during my fieldwork. Doing so allowed me to focus my analytic insights and helped me to differentiate between observations that were personally enlightening or curious, and insights that were specifically relevant to the goals of my research. In later encounters with students, I was able to quickly notice and dispel expectations I had about students, or avoid those expectations altogether. It became much easier for me to recognize when my reactions were about my own expectations about what *should* be happening and not what was actually happening. When I spoke to Noor, for example, who wore a scarf and long skirts, I again had to recognize my own prejudice when I was surprised to hear her tell me she didn't think she dressed conservatively. As she went on to explain she didn't (yet) wear *abeya*, garments that cover a woman's hands, I was able to set aside my surprise so I could focus not on the differences in our worldviews but on her perspective.

My specific experiences of coming to terms with preconceived and unexamined expectations about how people will behave—and finding those expectations to be mired

in the stereotypes and media representations of Arab culture that are presented daily to Americans—are not unique. No researcher is truly a blank slate. The meaning of fieldnotes shifts as the researcher's perspective changes and their understanding of their work with their participants deepens, and this requires the researcher to reflect on their own beliefs and assumptions. Thus, I quickly came to realize that fieldnotes are not finished when they have been written (Emerson, Fretz, and Shaw 1995). Part of the process of making sense of my observations and the conversations I had was to return to my notes and interpret and reflect on what I saw and heard from the new perspective I gained as my familiarity with my research grew. Thus, my fieldnotes—which I took during and after each visit to the school—and my reflections on them, serve as a main source of ethnographic information about the school. By studying my notes as they accumulated, I was able to notice patterns as they emerged and more easily identify when my own biases colored my observations. Ultimately I came to better understand my research as a dynamic process that required critical reflection on my part, and not a static set of observations. Reflection on notetaking as a process did not lead to drastic changes in my research, but it helped me adjust my research in small, cumulative ways, often showing me the breadth or narrowness of my observations. On one occasion, reflection on my notes led me to see I was paying a lot of attention to a few isolated, loner students in one classroom and almost overlooking a larger, gregarious group of students. I adjusted my focus to get a broader perspective on the dynamics of that classroom. My understanding of the local social meaning-making processes rests in large part on the fieldnote process, so the seemingly small adjustments that result from regular reflection on the overall process end up having a rather large impact on the ethnography as a whole.

2.3.2 Interviews

The sociolinguistic interview—usually a series of open-ended questions designed to get the participant talking somewhat freely about their life experiences—is a common source of data in sociolinguistic studies of phonetic/phonological variation (see, e.g., Milroy 1987). In some ways, interview data straddles a gap between, on one side, naturally-occurring conversational data and, on the other, word-list data obtained through laboratory recordings, both of which have advantages and disadvantages as a source of data for sociophonetic research. Conversational data has the main advantage of being speech out in the real world, and for this reason it is most ideal, since a primary aim of sociolinguistic research is to understand language variation and change through observation of actual language use, instead of relying on researcher introspection and intuition. But several factors involved in conversational data recordings (e.g. setting,

interlocutors, speech rate, topic) are often beyond the control of the researcher, and these often pose challenges to conducting successful acoustic analysis on fine-grained phonetic variables (e.g. there could be too much noise if recordings take place in a room with background noise; several participants speaking at once makes it difficult to examine the speech of one of the participants). Laboratory recordings allow for maximum control of these factors, since participants usually read from a researcher-created word list in a quiet or sound-attenuated room, but do not really provide "naturally-occurring" speech. Several studies have shown differences in the phonetic details of tokens taken from "casual speech" versus "clear speech" laboratory recordings, ranging from effects on vowel duration to changes in the size of the overall vowel space (e.g. Smiljanić and Bradlow 2005).[8]

Sociolinguistic interviews offer the researcher a degree of control over some recording variables (e.g. interlocutor, setting, topic of conversation), while providing speech data that is naturally occurring, though certainly a more formal speech event than mundane daily conversation. The linguistic data for this dissertation come from sociolinguistic interviews with the participants. I conducted interviews with students in a quiet, carpeted library room; this provided a setting that was comfortable and familiar for students and also alleviated some of the recording issues that occur when the setting is a louder, more public space (e.g. the school cafeteria). I formulated a basic set of questions for the interviews, which centered on themes of friendship, life in the school, future education and work plans, and portrayals and perceptions of Arab Americans (see Appendix A). These questions served as guideposts for the interview rather than a checklist that had to be followed to the letter. I tried to keep the interviews conversational and as relaxed and informal as possible by following the students' lead during an interview. This helped counteract the formal question-answer nature of the interview.

I recruited students for interviews primarily through classroom and cafeteria interactions. Students were not targeted to fit a sample, though I aimed for a majority of Lebanese speakers once I realized that Lebanese ethnicity is a salient social characteristic at Mercer. Data from 17 students (9 males and 8 females) are included in this study (see §2.4 for further information on the speakers and their demographic and background

[8] The issue of clear speech vs. conversational speech data presents a problem when researchers use phonetically oriented studies of vowel patterns as a baseline of a particular language variety, since these studies use word list readings as the source of linguistic data (e.g. Hillenbrand *et al* 1995; Hagiwara 1997; Clopper *et al* 2004). See Chapter 3 for further discussion.

information). A sample of 17 students is at the smaller end of sample sizes in sociolinguistic studies, but permits a greater depth of analysis than is afforded by a broader study that includes more speakers but fewer data points for each one (see Anderson 2003). In addition to providing the raw data for the quantitative analysis of this dissertation, the sociolinguistic interviews also provide a wealth of social and ethnographic information, which I discuss below in §2.4.

2.3.3 My status as a researcher, participant, and observer; insider-outsider

Participant-observation illuminates the relationship between the researcher and researched. As much as we as researchers would like to be a fly on the wall in our observations (Labov 2001) to get information unsullied by our very presence, this is usually not possible, and so we must learn how to work with our presence. I discovered that my presence or status at Mercer shifted as I moved between spaces. In hallways, I blended in easily with students. Occasionally a student would approach me to find out if I was a new student, but usually I just got lost in the shuffle, making it easier to figure out patterns of movement and where students tended to gather. In classrooms I just visited once, students often thought I was a student-teacher or occasionally a new student (teachers almost always introduced me as a visitor from the University of Michigan; a few teachers emphasized that I was in the classroom to watch students' behavior, which may have led students to think I was evaluating their performance in some way). In the classrooms I visited regularly, students were aware of my presence to varying degrees. Several of the students I spoke to asked for help with homework, for advice on choosing college courses (several students took college courses at the local community college), or sought commiseration when complaining about the class or the teacher.

The teachers whose classrooms I visited regularly often asked me to participate in the class in small ways. In the French class, I talked to the students about my experiences studying abroad in France during college, and participated in oral exercises. In the Speech class, I sometimes participated in classroom activities – reading aloud in front of the classroom and asking questions during the debates. In the Art class, I often sat with the students and participated in sketching activities, and talked to students about their work. These small moments of participation helped me feel integrated into classroom life and meant that students took more notice of me than when I was in my usual spot at the back of the classroom.

Though I usually felt like an outsider in the high school, I found that for most students I talked to and interviewed, there were subtle ways in which I was, however briefly and liminally, an insider. I was obviously an outsider since I was a researcher from Ann Arbor, I didn't grow up in Dearborn, I am neither Arab nor Middle Eastern, and I don't speak Arabic. But I am the daughter of immigrant parents, and my phenotype (South Asian with black hair, brown eyes, and brown skin) marked me as non-white. These similarities allowed me to shift my relationship with students along a continuum of familiarity and unfamiliarity. I could ask questions about being Arab, Muslim, and Middle Eastern without causing offense (or inflicting more than minimal damage) since I could relate points of convergence and divergence between their experiences and my own in the realm of immigrant and child-of-immigrant experiences. Sometimes these moments were quite small, as in this interview with Zeinab, a 16-year-old Lebanese student:[9]

Zeinab:	like in every house / an Arabic person's house always has this one house that nobody touches / it's just there it's all antiques
Sai:	oh like a room=
Zeinab:	=yeah it's like nobody touches it
Sai:	do they cover the couches with plastic
Zeinab:	yeah with the plastic / exactly ((laughs))

This brief moment of humor over a shared understanding of stereotypes about decor in an immigrant family's home would not have been available to me if I did not have that shared experience of growing up in a community of children of immigrants. Later in the conversation, however, Zeinab's attempt to relate her feelings to mine aren't as effective:

Zeinab:	you know like if you were to be Arabic or spoke Arabic and I'm Arabic / we'd sit and be like c'mon you know / it's like it's kind of hard to explain/ you kind of have that vibe there where you just know he understands where you're coming from because you're Arabic / it's like your people or something / I don't want to say it like that / I don't want to be in like a racial something or anything like that / it's just weird I don't know I can't really explain it/ you have to be there/ I don't know/ it's pretty weird/ like if you were to be someone who's like from / I don't know what you are=
Sai:	=my family's from India=
Zeinab:	=yeah if you were like to sit with an Indian person and have a conversation with them in English compared to another person in

[9] All names are pseudonyms.

English / like you'd feel like wouldn't you feel a different vibe or something

Sai: yeah?

Zeinab: like you'd feel more comfortable with the Indian person than the American person (.5)

Sai: [is that how you feel /

Zeinab: [that's how I feel=

Sai: =so do you feel like most like with your friends/ that most of your friends are Arabic

What's noticeable in this excerpt is that when Zeinab makes an assertion that I would be more comfortable with an Indian person than an American (i.e., white) person, I fail to provide an appropriately agreeable response. I didn't actually fully agree with Zeinab's assertion, but I didn't want to derail the conversation with explanations of why and I also didn't want her to feel defensive or otherwise uncomfortable, as she had already indicated she wasn't fully comfortable – revealed by her statement about not wanting to sound racist – with her assertion. So I tried to return the focus of the conversation back to her and her friendships. Just as I tried to avoid making assumptions about students' beliefs and views, I had to negotiate (for better or worse) moments in which they made assumptions about my views.

In other instances, my non-white ethnicity may have allowed students to speak freely about their perspectives on mainstream white culture. In this excerpt, Alex, a 15-year-old Syrian student, offers a suggestion about the kind of discrimination that might happen in a city where everyone is white:

Alex: like in the white boy cities / no offense to the white peoples / um they probably like make fun of a guy who doesn't come in with skateboard hair or something / something like that I'm not sure / but everywhere there's always going to be something.

Alex's description of the kind of conformity required in a "white boy" city, "skateboard hair", relies on broad, perhaps media-based, stereotypes of white youth culture and could possibly be construed as offensive to white people.

These situations, along with others, showed how my role as a researcher was fluid, shifting across spaces and contexts. Even within a conversation, my relationship with a participant could be quite flexible and I had to learn how to negotiate the flexibility of my own role as part of the research process to both minimize my presence and remain aware

of its influence. In the remainder of this chapter I discuss the social and ethnographic findings of my fieldwork and interviews, with the goal of providing a description of social practices at Mercer that contribute to ethnic identity and meaning and students' views and perceptions of their ethnic identity.

2.4 Arab American identity at Mercer

Definitions of identity are dynamic, shifting in response to the specific cultural, political, and religious norms and expectations of a particular situation or setting. Arab American identity, despite being regularly presented and perceived as unified in mainstream U.S. culture and media, is no exception. Arab American identity in the U.S. often gets reduced to crude stereotypes promulgated by media coverage of the Middle East and portrayals of Arabs, Middle Easterners, and Muslims in American popular culture, the most obvious of these being a caricature of all Arabs as radical Islamist terrorists (see Naber 2000 for a discussion of recurring images of Arabs in American popular culture). But in reality, Arab American identity encompasses peoples with diverse history, beliefs, values, religion, and cultural practices (see, e.g. Suleiman 1999; Abraham and Shryock 2000; Naber 2000; Census Report 2003; Ajrouch 2004). The specifics of Arab American identity at Mercer play out against the backdrop of the high school and the larger sociocultural context of Dearborn. Arab American identity at Mercer is local, taking on meanings that can only be interpreted through the specific set of practices that exist at the school. But the identity is also tied to broadly understood conceptions of Arab American identity that are themselves linked to actual Arab American practices; cultural, historical, and political connections to the Middle East and Arab countries; and stereotypes, prejudices, and beliefs about Arab Americans commonly held by and perpetuated in the dominant, mainstream U.S. culture.

In the sections below I report on Arab American identity at Mercer through a series of examples from my fieldwork and interviews, which include regular practices that often go unnoticed, and more salient practices that stand out against the backdrop of daily activities. The goal in this section is not to provide a holistic account of identity practices at Mercer, but to illustrate the points I found especially relevant to understanding Arab American ethnic identity at Mercer. These include the intersection of Arab and American identity; Arabic language use; the sociocultural context of Dearborn; Arab American students' perceptions and views of non-Arab students; and students' choices of and views on identity labels. Many of these themes intersect with one another, and examples I use to illustrate one point often relate quite clearly to others. These intersections highlight the

many-layered and nuanced nature of identity in practice; even in explicit discussions of identity and ethnicity, multiple strands weave together in complex ways.

2.4.1 Arab and American

A clear and overarching observation of general cultural practice at Mercer is that it is a blend of practices, including, but not limited to, some that are distinctly Arab and some that are distinctly American. These two cultural designations are not fixed, nor are they mutually exclusive, but there are aspects of each that do not overlap and, maybe more importantly, which have come to be associated with a particular ethnic/national culture through practice and through stereotype. At Mercer's cafeteria, pizza and soda were available alongside chicken shawarma. Administrators and teachers held meetings with parents in Arabic and English. Physical education classes were sex-separated. The library's collection included Arabic books, magazines, and newspapers. Acts for the yearly talent show included vocal performances of Arabic language songs, dance numbers choreographed to hip hop music, and comedy routines that drew humor from ethnic and racial stereotypes. When the large number of students who participated in Mercer's bilingual education program (designed to help Arabic-speaking students develop control of spoken and written English) took their yearly language exams, the entire school's schedule adjusted to accommodate the testing schedule. Life at Mercer was a distinct blending of Arab and American that came across to me as effortless.

Students' dress and clothing choices highlighted the cultural blending, particularly for female students. I estimate, based on day-to-day experiences and taking informal tallies during each visit to a new classroom, that over half of the girls at the school wore headscarves.[10] But girls who wore scarves often coordinated them with the rest of their outfits, which included tight-fitting (though long-sleeved) shirts, Detroit Pistons' basketball jerseys or their boyfriend's letterman's jacket. Sometimes these clothing choices suggested a paradox between the purported religious purpose of wearing a scarf (covering oneself, protecting one's modesty, etc.) and the actual practice (e.g., tight-fitting clothes are not particularly modest). Other items of clothing or accessories also indexed Arab identity: t-shirts emblazoned with the flag of Iraq or Lebanon; Iraqi soccer jerseys; necklaces with pendants of Arabic words; rubber bracelets meant to symbolize solidarity with Lebanon (in the style of the yellow LiveStrong bracelets popularized by Nike and the cyclist Lance Armstrong). The items signaled affiliation with a particular

[10] Far fewer also wore *jilbabs*, long cloaks that cover the entire body. I did not encounter any students who wore veils covering their faces.

national background – only Lebanese students wore the Lebanese wristbands; only Iraqi students wore the Iraqi soccer jerseys. But students were also interested in following American clothing trends; for example, a particular brand of tennis shoes gained popularity among many students over the course of the year. Dee, a 17-year-old senior, complained that all students did was follow trends:

> Dee: Most of us all look alike / wallah a year ago it was all G-unit t-shirts. Or South Pole Aeropostale American Eagle Hollister / (.) cause that's what's wrong with us / that's what's bad / that's the one thing that's really bad / we change / like someone did this, that's it we're all changing and doing this / That's what I hate about it / one minute we're all this and the next we're all that.

All the brands Dee mentions here are American brands, clothes readily available at chain clothing stores in Dearborn and throughout the country. A high school student's desire to follow the latest trends in fashion appears to transcend cultural boundaries.

The consumption of media and popular culture also provides examples of distinctly Arab American practices. Shadya and her friends regularly watched *Superstar*, an Arabic language, Lebanese version of the popular American television show, *American Idol*, in which contestants perform songs and the general public votes for their favorite singer. *Superstar* provides an interesting example of how students' cultural interests intersect. The availability of *Superstar* in the U.S. is dependent on subscription to satellite Arabic language television channels, which broadcast shows produced in Lebanon and other Middle Eastern and Arab countries; students have access to this at home only if their parents can afford it and have an interest in it. Many families subscribed to the Arabic language channels because they wanted to watch Arabic language news programs like *Al-Jazeera*, which focus on sociopolitical events in the Middle East. *Superstar* is different from news programming; it is a Lebanese show based on an American show (which is in turn based on a British television show). *Superstar* includes performances of popular Arabic songs, traditional/modern Arabic dress, and other markers of Middle Eastern culture. Contestants on the show are from countries throughout the Middle East, not just Lebanon. In the U.S., watching *Superstar* is an activity that bridges and synthesizes a cultural divide, and combines two cultures in an appealing and accessible way. Shadya and her friends choosing to watch *Superstar* indexes not only an interest in Lebanese and Middle Eastern culture and media but also the intersection of those cultures with American popular culture. In short, Arab American identity at Mercer encompasses a

juxtaposition of not just distinctly Arab and distinctly American practices, but also those practices at the intersection of Arab and American cultures.

2.4.2 Language use

Many aspects of the linguistic practices at Mercer also index Arab American identity. Students, teachers, and administrators used Arabic regularly at the school. Many of the students' parents used Arabic when talking to administrators or teachers (as many parents did not speak English). Though official district policy requires the use of only English as the language of communication (non-English languages can be used in foreign language classes; Arabic is offered as a foreign language at Mercer), the rule was regularly disregarded in the offices, classrooms, and hallways. Teachers' enforcement of the policy varied widely. Some teachers used some Arabic when conversing with their students. On a few occasions I witnessed teachers reprimanding or disciplining students in Arabic outside of the classroom. But other (Arabic-speaking) teachers refused to respond when a student used Arabic, reminding them, in English, to use English in the classroom. About 10% of students at Mercer are recent immigrants who are still learning English and have varying degrees of control in the language. In one class I visited regularly, one student would help translate the non-Arabic-speaking teacher's directions from English into Arabic for two girls who had both come from Lebanon within the past two years.

For most students though, English was the primary language for communication, and Arabic was part of their lexicon in only a handful of words. But there were several words in common use throughout the school by Arab students and some non-Arab students (though with much less frequency or regularity). For example, when students reported about slang, they consistently mentioned a few words (e.g. *wallah* 'I swear'; *yallah* 'Come on'), as shown in the excerpts below (Arabic words in these examples are italicized).

Sai: ok let's see/what are some of the other slang words used here at Mercer/
Noor: slang words oh my god there's so many / umm / typical Mercer student would probably say bro cuz *wallah* like after every other word/ what do they say / it's just like they'll you know shorten up words like oh hey I swear to god and like that it's it's just regular words yeah /

Sai: Arabic words you hear non-Arabic kids/teachers use?
Alex: yeah all the time *wallah* yeah all the time/ *inshallah* I hope so by god's will/ *hallan* like hi, hello / some of the basics/ can't think of them right now but I hear it all the time

Arab American students reported that many non-Arab students were familiar with Arabic words used at Mercer.

Sai: yeah so for kids who don't understand any Arabic like white kids or African American kids like what do they do when a teacher speaks Arabic/
Zeinab: I don't know actually cause Mercer is mostly all Middle Eastern students somehow / like that=
Sai: =yeah
Zeinab: and like the / if you were talk to a black person and say something in Arabic they'll know what it means / cause they're around it so much
Sai: so so most of the non Arabic kids have picked up on=
Zeinab: =yeah they've /

Sai: do you use it [Arabic] with just your friends or is it like=
Reem: =there's actually the people who don't speak Arabic / like it catches on to them cause they've been here for so long so a lot of them you see them using wallah and stupid little things/ok wallah's not stupid but the bad words / and things like that / a lot of the Americans and white people / they all know it now/
Sai: what do you think of that/
Reem: I like it I think it's funny/
Sai: why do you like it/
Reem: it's just funny to hear them /it shocks you/like what'd you just say/

Arabic use at Mercer for the most part went unnoticed day-to-day by Arab American students at Mercer. Many words have entered into the lexicon of many Arab American students who otherwise only speak English at the school. Additionally, most non-Arab students were aware of the Arabic words, and at the very least knew their meanings, even if they did not incorporate them into their vocabulary. I have not investigated the presence of other Arabic elements, such as syntactic or prosodic features, but based on my experiences at Mercer, I predict that we would find influences from Arabic in other aspects of speech as well. Anecdotally, during my fieldwork I regularly noticed prosodic patterns that seemed different from "regular" American English prosody, but this was not systematically explored.

2.4.3 Dearborn as an all-Arab town

Another commonly held view at Mercer was the idea of Dearborn as an all-Arab town. 30% of Dearborn's 130,000 citizens are Arab or Middle Eastern, according to the most recent U.S. Census data. 30% is a high percentage for a minority group in a community,

but the remaining 70% of Dearborn's population is overwhelmingly white. The few African American students who attend Mercer actually live in Detroit and attend the school because of redistricting. Yet the concentration of Arabs in Dearborn (emphasized by the tendency for Arabs in Dearborn to reside in the eastern section of town) is enough for both Arabs and non-Arabs alike to think of Dearborn as an all-Arab town, a description given both affectionately and derisively to Dearborn, depending on the person doing the labeling.

Dee: I just smile it off / I love it / it's cool / it's like you like a idiot staring at me so whatever/ keep staring
Sai: Yeah / but so that doesn't really happen in Dearborn does it?
Dee: In Dearborn it doesn't / like if someone / you can tell if someone's never been to Dearborn/ they're all like whoa what are these people doing
Sai: yeah
Dee: It's become like a little Arabic town/like we do do the same things like you see overseas (.)
[with our sto:res
Sai: [like what
Dee: Everything everything we do / we sit there on the porch in the summer till like 2 in the morning smoking our *gida*[11]

Dearborn's relatively large Arab population, which has resulted in the development of a lot of social services and resources in the area specifically geared to Arab immigrants, has drawn many students' families:

Dee: We'd come to Dearborn every summer to visit family/ and there aren't as many Arabs in Boston/ you know my parents didn't want us to forget our background/ and if there was more Arabic people it would be easier/ so my mom and dad decided to buy a house here and we moved here.

Noor: then we decided to move to Dearborn cause there are lots of Arabs there

For students, the number of Arabs in their hometown was a varyingly positive, neutral or negative phenomenon. Dearborn can be comfortable because there are so many Arab families, but this also makes the town uninteresting because everyone is the same.

[11] I asked Dee to clarify this term, which she described as a tobacco pipe or hookah.

Sai: What do you like about Dearborn?
Reem: It's comfortable/ You can walk into a place and know people/ You feel like everybody is your family/ (.) most of the time everybody in Dearborn is your family / because a lot of us Lebanese people have a lot of cousins/ and we grew up here /I'm used to it/ I wouldn't live anywhere else unless I had to

Sai: What did you like about Boston more than Dearborn?
Dee: It was just like a lot more things to do you know? / like here it's the same old/ and over there you met like / there was more cul- you know different cultures / here it's like our main culture is you know Arabs and Muslims / and over there and different things/ Just funner to be there

In my social analysis, I include students' future plans to stay in or leave Dearborn as an independent social variable, based in part on participants' varying views about the importance of Dearborn in their lives. While students had different reasons for wanting to leave Dearborn or leave Michigan (see §3.8 for further discussion), reasons for staying in Dearborn were often linked to students' recognition of the importance of family and cultural ties.

The notion that Dearborn was an all-Arab town had consequences for Arab students' views of non-Arab students. As some of the examples above indicate, non-Arab students often got erased (in the very idea that Dearborn was all-Arab) or overlooked. Below, I discuss how the erasure of non-Arab students and internal divisions among Arab American students are relevant to the social order at Mercer.

2.4.4 Divisions among Arab American students

Ethnic identity relies on opposition (Giampapa 2001). Some "other" group is required to provide contrast and difference, crucial components of ethnic identity. A broad white culture was present at Mercer through the institutional practices and ideologies of the high school itself, popular culture, and local communities, but this presence was always in juxtaposition with students' perceptions of Dearborn as an Arab town and Mercer's student body as mostly Arab. In day-to-day life at Mercer, internal divisions within the Arab American population provided a means for creating opposition and othering.

Social stratification of Arab American students at Mercer was linked with the dominant social order of eastern Dearborn. Muslim Lebanese families are the largest and most economically prosperous Arab community in eastern Dearborn; their social dominance

spills into the high school, where roughly three-quarters of Arab students are Lebanese. The Lebanese students often perceived themselves to be part of the cool, mainstream group, rather than a particular clique or exclusive group. As one student I spoke with told me, the Lebanese kids were "normal". Students from Iraq and Yemen often had recently migrated from the Middle East due to sociopolitical turbulence in their homelands and were seen as immigrants by other students. They lay at the bottom of the Arab students' social ladder and were often the target of ridicule. Stereotypes and prejudices about Yemenis and Iraqis were widespread and drew upon common themes – students were poor, filthy, illiterate, liars, and/or thieves. Alex, a male sophomore of Syrian background, comments on Lebanese, Yemeni, and Iraqi students, which illustrates one perspective on how nationality mattered in social relationships:

Alex: It's like you know most of the school/ their nationality is Lebanese/ and so you know they place theirself as higher class than like Iraqis and Yemenis

Alex: They think they're like the cool ones.
Sai: The Lebanese students?
Alex: The- yeah / cause it's like the most populated here / you don't see much attraction you know of like from like uh / what I mean by that is um / you know like the Iraqis and the Yemenis they're always looked down at / you know like who are you? / you're garbage you know?

Other students did not see the same kinds of divisions. Reem provides one example:

Sai: do you think there are divisions at this school between kids of different backgrounds / the Lebanese kids and the Yemeni kids/
Reem: no no I don't think so/

Alex and Reem's drastically different perspectives on the importance of nationality in influencing friendships illustrate a pattern that emerged in these discussions: many of the Lebanese students (Reem is Lebanese) did not think there were such divisions among Arab American students, while many of the non-Lebanese students did see the differences that Alex (who is Syrian) describes. From the Lebanese students' position of power as the mainstream, dominant group, it is not surprising that they would be unaware of or deny the discrimination and prejudice they purportedly perpetuate. Lebanese students' erasure of these differences in social rank, which non-Lebanese (and some Lebanese) students regularly attested to, further normalizes their experience and creates a world in which it is *the* experience of Arab Americans at Mercer.

Another aspect of the social divisions at Mercer related to how Arab American students perceived non-Arab students and their position at the school. Participants' discussions of their friendships revealed some differences in how they viewed non-Arab students. Some were quick to describe themselves as open to friendships with people of all backgrounds. Reem's comments below are illustrative of views shared by many students who described their friendships as crossing ethnic lines.

Sai: so you have friends from lots of different backgrounds
Reem: yeah oh yeah/
Sai: do you think most people are like that/
Reem: like um/
Sai: like have friends from um/all over/
Reem: oh yeah / I don't know anybody racist if you want to put it in those words /
Sai: well no not necessarily racist but like=
Reem: =I know but / like I have a lot of friends from different backgrounds and it doesn't bother me / I don't think anybody should be treated differently because of their background/

On the other hand, Zeinab's comments below show that some students do seek out friendships with students of similar background.

Sai: so do you feel like most / like with your friends/ that most of your friends are Arabic
Zeinab: yeah I have a lot of white friends and black friends and stuff but most of my friends that I usually hang out with are Arabic
Sai: like your closest=
Zeinab: =yeah my closest=
Sai: [friends?
Zeinab: [friends
Sai: do you think that most of your friends are the same a- / kind of feel the same way
Zeinab: yeah=
Sai: =like they want to be=
Zeinab: =around like Arabic people and stuff yeah
Sai: yeah
Zeinab: it just meshes better it's like

At Mercer, then, the "opposition" needed for the creation and perpetuation of ethnic identity is found in distinctions drawn at different levels: between Arab and non-Arab

students, and between Lebanese and non-Lebanese students. These distinctions reflect ethnic divisions found in the U.S. and the social structuring that is specific to Dearborn.

Mainstream/marginalized opposition

The distinction between Lebanese and non-Lebanese students exemplifies a broader social opposition in which certain groups and identities are mainstream within Mercer's social landscape, while other groups and identities are marginalized. This distinction is clear in many students' understanding of ethnicity at Mercer—Lebanese students are mainstream at Mercer, while many non-Lebanese students are marginalized or feel marginalized—but I am also interested in how the mainstream/marginalized distinction relates to the social variables of sex, religious practice, and future plans. The distinction between boys and girls at Mercer was not explicitly discussed in the sociolinguistic interviews, but there is a degree to which girls' behaviors and actions are scrutinized and restricted in ways that boys' behaviors and actions are not. Male participants at Mercer are mainstream in that their practices are normalized, while the practices of female students, because they are open to challenge, are marginalized. My purpose here is to introduce the mainstream/marginalized opposition as one that plays an important role in explaining some of the statistical results, an opposition I address in chapter 6 in greater detail and in relation to more social variables.

2.4.5 Religious practice

While Arab students at Mercer came from a variety of national backgrounds, the overwhelming majority of students identified as Muslim. All students in the interviews – and all Arab American students I interacted with at Mercer – identified as Muslim, but I noticed differences in the extent to which being Muslim was a part of their regular, daily lives. In Dearborn, there is a high degree of overlap between cultural and religious practices associated with Islam and being Arab, so many students who engaged in cultural/religious practices or maintenance practices (such as wearing a scarf, eating halal meals, taking Arabic classes) would not necessarily consider themselves to have regular *religious* practice. Practices identified as strictly religious, rather than simply being a part of Arab/Muslim culture, were often identified by their institutional or educational nature, and revolved around prayer, involvement at a mosque, and engaging intellectually with the qu'ran. Thus, in using religious practice as a social variable, I make a distinction between students who regularly engage in institutional and educational religious practices and those who do not.

I also identified a component of religious practice that centered around students' intentions regarding religious practice and beliefs about what good religious practice looks like. Students described their current religious practice, but often compared it to their past practices or to their planned future practices. Being Muslim was not going to change (or they did not foresee it changing), but they often believed that *how* they would go about being Muslim would change. Students' discussion of their religious practice also highlights the varied reasons and motivations behind their decisions: ranging from introspective questions about religion to a view that regular and serious religious practice was the purview of grownups.

Aisha, a sophomore who was born in Palestine and spent the first years of her life in Jordan before moving to Dearborn, described herself in her interview as not currently active in her religious practice. She had several reasons for this, but she also described this as a temporary phase in her life (for which she identified no known endpoint).

Sai:	Is your family-are you guys religious?
Aisha:	Yeah my mom and my dad /My mom is very- and I don't pray I haven't prayed in like a couple months now / (.) I've had like a lot of things with like faith and all that it's just like (.5) There comes a time when you have to question everything I guess / so: first I got mad that why are you questioning it and now I'm like it's just a phase that you have to go through and you experience it and
Sai:	[mhmm
Aisha:	[learn from it and then you move past it / and I think my mom's letting me- cause she knows I'm not praying (..) she's letting me do it

Zeinab, a junior of Lebanese background who was born and raised in Dearborn, identifies strongly as Muslim but does not pray "at all". She rarely attends mosque – only for holidays, etc. – but envisions herself engaging with the religious aspects of her culture more frequently in the future when she's older. None of the women in Zeinab's immediate family wear a head scarf, but Zeinab thinks she will someday. Zeinab makes a connection with a fuller set of religious practices and getting older.

Zeinab:	When I was younger I used to go to Arabic school and they used to teach us and stuff. But like I stopped doing that. My mother teaches me here and there but it's not like I'm totally full on religious or anything.
Sai:	do you pray regularly?
Zeinab:	No, I do not pray.
Sai:	Oh you don't pray at all?

Zeinab: At all
Sai: Do you ever go to the mosque?
Zeinab: Only if a family member has died or during Ramadan or during the holidays and stuff.

Sai: so do you think you'll wear a scarf =
Zeinab: =[one day=
Sai: =[later
Zeinab: =hopefully
Sai: does your mom=
Zeinab: =my mom doesn't
Sai: does your sister
Zeinab: no
Sai: but you think that you'd like to
Zeinab: I would one day eventually yeah
Sai: what do you think will have to change for you to be ready
Zeinab: umm well I probably have to change the way I speak like I'd want to learn most of the religion before I'd want to put on a scarf so I know I'm doing it for the right reasons and not just putting it on cause I know I have to
Sai: mhmm
Zeinab: so / and I'd have to like set- my whole lifestyle would totally change and I'm just not ready for that

Another student describes her religious practice as including daily prayer and regular mosque attendance, but for her this is not considered enough. Noor, a sophomore born in Iraq who came to the U.S. at age 7, wears a scarf and often wears long skirts. Religious practice is a regular part of her life, but she doesn't see herself as fully religious yet, because she does not cover the tops of her hands or wear a veil over her face, but these are practices she plans to engage in when she is older. I don't know if Noor will do those things in the future – she plans to, but her plans also involve attending college and working full time, so it's impossible to foresee how the social pressures she may encounter will bear on these decisions. But, the crucial point here is not what she chooses to do, but that she does not view her religious practices as fixed in time. She envisions them evolving and changing over time.

Noor: Some people wear an abeya to school where-do you know what that is? wear it, um
Sai: What's it called?
Noor: An abeyah . it's like a formal dress and it's just, it's just a long dress but it's religious dress and it's like (..) I was like I was talking to my mom the other day and she was like when are you going to wear abeyah xx

Sai: Does she wear one?
Noor: My mom? Yeah she wears one and I just wear skirts and then she's like-I wear sometimes skirts and umm shirts long pants..and um she's like when are you going to wear abeyah and I'm like what do you mean abeyah I'm *never* going to wear one and of course I say that ((laughs)) but later on I'll of course wear one it's just- sometimes they're pretty . I wear one to the mosque and stuff . I don't wear one to school cause- they're comfortable but I don't feel comfortable in them

A more practical and less philosophical reason for shifting levels of religious practice came from Hamze, a junior who came to the U.S. from Lebanon at age 10. Hamze used to attend mosque every Friday but then had to stop, because his class schedule changed and he could no longer skip class to attend mosque. Thus, he has scaled back his regular religious practice somewhat, but still engages in personal daily prayer, and other kinds of involvement with his mosque. These examples show that though students readily described their religious practice at this point in time, they also identified ways in which these practices were dynamic or temporary.

2.4.6 Ethnic identity labels

When I began this project, I wrote descriptions of it for school officials and professors, and in that writing I used the term *Arab American*. In some ways it was a knee-jerk "politically correct" decision—the "nationality/ethnicity-plus-American" (with hyphen optional) is a standard descriptive term for various ethnic minority groups in the U.S., and it didn't occur to me to deviate from popular and academic usage. But, after just a few short days at Mercer, it became clear to me that students used *Arabic* or *Arab* to refer to their ethnicity. I was curious about the absence of *Arab American*, so in interviews I asked students about the terms—why they chose to use or not use different labels. Dee's view of the difference between Arab and Arab American involved staking a claim on the United States as a country. *Arab American* as an identity term—instead of *Arab*—is a way for Dee to assert herself as a citizen, and to show that her claim to the country is as strong as any other American's claim. She is not a guest or interloper, as may be implied by use of *Arab*.

Sai: Do you see yourself as Arab and then (.) American? Or is it Arab American or just Arab?
Dee: Arab (..) and then American /we've learned / like now our generation more / if someone asks me like I'm Arab American you know cause I'm a citizen=
Sai: if someone asks you=

Dee: =yeah / if someone asks me now yeah I'm Arab American / I used to be like I'm Arab buddy / what are you talking about / like I I haven't been born here / but I haven't lived anywhere else so this is all I know like now I've learned to say Arab American / I used to be like I'm Arab=

Sai: =What do you think is different about saying Arab American instead of Arab

Dee: If you say Arab / you're like I'm Arab and I'm gonna go that's it that's all I am / but when you say Arab American it's like I live here this is my country too so I'm just putting em together / I'm learning to like mix the cultures /

Sai: Yeah

Dee: But like my parents say we're only Arab / I'm like / my parents they say we're Arab what are you talking about? / I'm like mom we're Arab American now ((laughs))

Sai: ((laughs))

Dee: She's like whatever/ you know she loves America and all but she still says I'm Arabic / what are you talking about I'm Arabic / but yeah most of us will say Arab before we say American/

Alex was quite adamant about a difference in social meaning between using *Arab* and using *Arab American*. For him, the implications of using a particular identity label related to the particular social context in which they were used. Careful use of terminology was important in order to not worry people who may view Arab Americans negatively based on stereotypes.

Sai: So do you think there's a difference between Arab and Arab American?

Alex: To be honest yeah. In this school, yeah. I thought the p.c. thing to say was Arab American and then I came here and everyone says I'm [eræb][12] Technically we're all Arab Americans but they say [eræb] I don't know just to represent I guess / don't say it because nationality the majority of the school is Arab / don't even say I'm Arab American but if I go to some white area I'm Arab American.

Sai: What do you think would be different if you said in that like white neighborhood or whatever

Alex: If I said [eræb]?

Sai: or just [ɛrəb]

[12] I note the pronunciation of *Arab* in this excerpt because it is unlike his pronunciation in the rest of the interview. Using [eræb] (instead of [ɛrəb], which is what I heard almost exclusively at Mercer) created a contrast and evoked for *me* stereotypes of close-minded Americans who assume all Arabs are terrorists. This evocation fits in with what Alex sees as how he would be perceived by the white majority if he does not choose his identity labels carefully.

Alex: probably think of me something bad (..) terrorist or you know / stuff like that / probably you know think I'm some stupid guy some stupid Arabic guy / son of Bin Laden

Not all students had such specific ideas about identity labels. When I asked Reem, a 16-year-old Lebanese student, about her ethnic identity, she rejected the idea that there was a difference between using *Arab*, *Arab American*, or a term of national identity such as *Lebanese*, though she acknowledged that at Mercer, many people were interested in an ethnic identification that further divided the category of Arab. Reem did not raise any potential social implications of her choices; her responses to my questions suggest that her thoughts about the use of identity labels did not include consideration of a larger picture the way Dee's and Alex's comments do.

Sai: What would you say is your ethnic background?
Reem: Arab American / is that ethnic background?
Sai: sure well there's no right or wrong answer
Reem: I think I'm an Arab American
Sai: Do you ever say Lebanese?
Reem: Yeah some people will ask you you know / if you tell them Arabic / they're going to tell you / Are you Yemeni Iraqi / I'll tell them Lebanese/
Sai: are those people mostly also Arabic
Reem: sometimes yeah most of the time yeah
Sai: Do you think there is a difference between saying Arab and Arab American/
Reem: I think they're kind of the same thing / I've told people both and Lebanese / I don't know I think it all fits in the same category

Though Reem tells me her choice of ethnic label would be *Arab American*, moments later she uses the term *Arabic*, and shortly after says she thinks they are part of the same category. Comments from Dee, Alex, and Reem show the variety of perceptions students have about the set of identity labels available to them. Table 2.1 below summarizes the responses from all seventeen participants.[13] Though the table gives participants' yes or no responses, as the examples above suggest, the students' discussions often drew upon their own ideologies about the terms, their beliefs about how other people (Arabs and non-Arabs) will perceive them depending on their labeling choice, and knowledge about what Mercer students' expectations are in terms of self-identification.

[13] All names are pseudonyms, either selected by the student or assigned by me if a student did not want to pick their own. I assigned pseudonyms that were commonly used at the school (the pseudonyms Dee and Alex were not in common use at the school; they were selected by the students).

Table 2.1 Summary of ethnic label choice importance

Does a person's choice in ethnic label matter?	**Participants**		
	Name	*Sex*	*Country of origin*
Yes	Aisha	F	Palestine
	Alex	M	Syria
	Asad	M	Lebanon
	Bilal	M	Lebanon
	Dee	F	Iraq
	Jamil	M	Lebanon
	Noor	F	Iraq
	Shadya	F	Lebanon
	Zahrah	F	Lebanon
No	Daoud	M	Lebanon
	Hamze	M	Lebanon
	Hassan	M	Iraq
	Lina	F	Sierra Leone
	Mohammed	M	Lebanon
	Rasim	M	Lebanon
	Reem	F	Lebanon
	Zeinab	F	Lebanon

As the table shows, participants are almost evenly split in their views on the importance of ethnic label choices. But, there does not appear to be an obvious correlation with other social parameters such as sex or nationality. Slightly more women than men thought ethnic label choice is important and slightly more men than women thought that choice is not important. Only two out of the eight participants who thought label choice was not important were non-Lebanese; participants who said yes were more evenly split between Lebanese and non-Lebanese ethnic categories. One possible generalization is that students' views on the importance of ethnic label choices do seem connected to their own friendship experiences. Both students who have had an easy time making friends across racial and ethnic lines and students who had friendship circles that were very restricted racially and ethnically often found labels less important. Students who had experienced discrimination because of ethnicity or viewed ethnicity from a larger, more political perspective (i.e. the shape of Arab American identity outside of Dearborn) often had more emphatic views on the importance of ethnic label choices. I include ethnic label importance as a variable in my statistical analysis of the four NCS vowels in chapters 4 and 5, and in chapter 6, I discuss the statistical results in connection with the ethnographic findings discussed here.

2.5 Conclusion

This chapter discussed my methods of data collection, a description and overview of Mercer High School, and an analysis of aspects of Arab American identity at Mercer. While chapter 1 provided some broader contextualization and history of Arab Americans in the U.S., this chapter focused on findings specific to these participants and this community, distinct not only from a national overview of Arab Americans but also from the Arab American community throughout Southeastern Michigan. The discussion presented here provides social context for the linguistic analysis throughout this project. In chapter 3, I discuss the phonetic methods and draw upon many of the themes here to present the social variables used in the statistical analysis. The social variables introduced in chapter 3 are a combination of broader social categories like gender and age at immigration, and more local distinctions like the regularity of religious practice and the importance of ethnic labels. This is part of my goal of grounding the statistical analysis in findings from my ethnographic work and also serves to test Eckert's theory on how different kinds of social variables act on different vowels within one shift. Chapters 4 and 5 present the statistical results, and in chapter 6, I relate those statistical findings back to the ethnography.

Chapter 3: Phonetic and Statistical Methods

3.1 Introduction

In this chapter I discuss the methods of my analysis of the four NCS vowels. I begin with an overview of sociophonetics as a method and an approach to research, followed by a discussion of some of the main methodological components of a sociophonetic approach. I then turn to an overview of the results of the acoustic measures. In §3.8, I introduce the independent linguistic and social variables included in the statistical analysis and my hypotheses about each of the social variables. The final section of this chapter discusses the methods of statistical analysis employed in chapters 4 and 5.

3.2 Sociophonetics: developing methodology

Within sociolinguistics, discussions of the different kinds of methodology involved have been varied – from approaches to collecting data and measuring phonetic variation, to selecting statistical tests. Some kinds of methods have been treated extensively in the field: there has been an increased – and now well-established – focus on the care with which sociolinguists obtain and incorporate social information about speakers into analyses of language (Rickford and Eckert 2001; Bucholtz and Hall 2005; Hay and Drager 2007). While this documentation, discussion, and development of the social side of methodology has flourished in sociolinguistics (e.g., Eckert 2000; Anderson 2003; Dodsworth 2005), a similar focus on the acoustic methods has lagged. Sociophonetic studies involve applying the acoustic methods of fine-grained phonetic analysis to investigations of socially-patterned phonetic variation. It has only been recently, though, that sociolinguists have begun to catch up with phoneticians in regards to the tools and methods of analyzing vocalic (and consonantal) variation at a phonetic level. In this section I discuss the effects of this missing discussion on sociophonetics and what the field could gain from improving documentation and discussion of acoustic methods.

In the past, there has been inconsistency from study to study regarding what information about acoustic methods gets included and what gets left out in sociophonetic studies. In contrast, phonetic studies of vocalic variation regularly include careful documentation of acoustic methods (Hillenbrand 1995; Hagiwara 1997; Clopper, Pisoni, and de Jong

2004). But there is a key difference between phonetic studies of variation and sociophonetic studies. In phonetic studies, many of the factors related to data collection are carefully controlled (e.g. recording setting, token selection), making it relatively easy to achieve some consistency across studies. The social (or speaker) variables involved in phonetically-oriented studies are also carefully controlled, and ethnographic information—which can be messy and complicated—is not usually included or even obtained (Hillenbrand 1995; Hagiwara 1997; Clopper *et al* 2004). In sociolinguistic studies, however, researchers often give up control over several variables (e.g., setting, interlocutor, recording quality) in the data collection to privilege the use of naturally occurring speech as their data source, which introduces a lot of variation into the methods required for collecting data and thus variation into the data itself. This focus on naturally-occurring speech and in the social patterns of language use complicates how uniformly sociophoneticians can apply methods. Often differences in how data is collected or analyzed is part of the research itself; as a wide range of studies have demonstrated, changes in various aspects of the data collection and analysis can have non-trivial effects on the outcomes of the data analysis. Rickford and McNair-Knox's (1994) study on style-shifting in an individual speaker shows how the identity of the interviewer can affect the participant's stylistic use of several phonological variables. Similarly, Smiljanić and Bradlow's (2005, 2008) research, situated in phonetic rather than sociolinguistic research, demonstrates that a distinction between clear and casual speech, even within a laboratory recording context, plays out in the acoustic measures of vowels (including formant values, vowel space size, and vowel duration). Studies that use speech from word lists to provide vocalic measures may yield very different results from studies that take data from conversational or even interview speech. In fact, the decision to use one or the other kind of data can be strategic; for example, Maclagan and Hay choose word-list data specifically to get the most extreme examples of the merger they are studying in New Zealand English (2007, 7). Hillenbrand, Clark, Getty, and Wheeler's (1995) phonetic study of the vowel space of Midwestern speakers demonstrates the differences that can arise based on how a formant is measured. Their primary analysis focuses on static formant measures to describe the vowel space of speakers in the NCS region (mostly from Southeastern Michigan), but they also explore how a dynamic measure of formant trajectories illuminates acoustic differences between vowels whose vowel spaces overlap when looking at a static measure alone.

There remains a crucial dividing line in sociolinguistic studies of variation: the use of auditory coding (e.g. Mendoza-Denton 1997; Gordon 2000) instead of acoustic coding

(e.g. Anderson 2003; Nguyen 2006). This difference is particularly important in studies of vocalic variation in part because the statistical tests appropriate for the two different kinds of data can differ rather sharply (see §3.2 for further discussion).[14] Acoustic analysis is increasingly replacing auditory coding in sociophonetic research.

Another example of variability in sociophonetic methods is in the normalization procedure; that is, transformations performed on raw acoustic measures to minimize differences across speakers that are due to physiology and are not relevant to the sociolinguistic analysis of the data. There are several normalization procedures that have been used in sociolinguistic research, and these different procedures may limit cross-study comparability. Some recent studies (e.g., Clopper *et al* 2004; Dodsworth 2005) have chosen to use the "winning" normalization procedure from Adank, Smits, and van Hout's (2004) evaluation of several normalization strategies for use in language variation research (see §3.6 below for further discussion of Adank *et al*'s evaluation process and of the normalization procedure used in this study). But Adank *et al*'s evaluation has by no means set a gold standard in normalization for all sociophonetic research (e.g., Thomas 2001; Watt and Fabricius 2003; Roeder 2006; Baranowski 2008), and normalization procedures may, again, be dependent on specific details of the research questions (Watt & Fabricius 2003; Fabricius 2007; Thomas and Kendall 2009). For instance, some procedures – including the "winning" transformation from Adank *et al* – require, or are considerably more accurate with, data from several vowels, but a researcher may not be interested in collecting that range of data. Some normalization procedures do not perform as well if data come from language varieties with different phonological inventories. The studies I referenced above that use Adank *et al*'s winning procedure all look at multiple vowels in one language variety or across varieties with similar vowel inventories, but many studies do not fit these two criteria (and this discussion here does not consider how phoneticians' research questions shape their normalization needs). This variability in methods is at least partly a result of the wide range of research questions that fall under the purview of sociophonetics.

Despite the challenges faced in standardizing sociophonetic methods, several scholars within the field have paid particular attention to the discussion of methods in

[14] Though sociophonetics implies the use of acoustic methods, research on many consonantal variables has continued to rely on auditory coding (e.g. Nguyen 2006 uses acoustic methods for the vocalic variables but auditory coding for the consonantal variable; but see also Docherty and Foulkes 1999, who use instrumental techniques to examine phonetic variation of /t/).

sociophonetics. At the annual North American sociolinguistics conference, New Ways of Analyzing Variation (NWAV), a series of ongoing workshops has focused on developing the best practices and methods for sociophonetics in light of the lack of consensus among researchers (Di Paolo, Yaeger-Dror, and Plichta 2006; Di Paolo and Yaeger-Dror 2009).[15] Several recent studies (e.g. Anderson 2003; Nguyen 2006; Roeder 2006; Maclagan and Hay 2007; Dodsworth 2008) provide detailed explication of their acoustic methods. Even though the studies cited (among others) have varying approaches, their careful and transparent documentation and explanation provides useful information for future researchers and increases the chances that a particular research project can be in dialogue with later studies.

Transparent documentation of methods is important in the case of regional sound changes like the Northern Cities Shift, since findings that can be compared to other findings have the potential to answer broader questions about the shift as a whole and contribute to sociolinguistic theories of sound change spread. If researchers continue to be careful and transparent in explaining the methods used to arrive at their results and findings, we can continue to amass a body of research that could be more than a collection of studies tied together only by a focus on the same set of variables. Currently, though, many studies on the NCS must in some sense stand alone, because their findings are not comparable to others, which may hinder efforts to draw connections between studies and thus efforts to draw broad conclusions about the nature of the Northern Cities Shift (this issue comes up in some of the discussion in chapters 4 and 5). Below, I discuss the sociophonetic methods of the present study; this discussion both provides a record of the methods involved in this study and contributes to the growing attention paid to sociophonetic methods.

3.3 Use of acoustic methods

I use instrumental acoustic methods to measure and analyze a targeted subset of the vowels recorded in this study. Sociophonetic studies use acoustic measures of the speech signal to examine (among other measures) the relative position of vowels in a speaker's overall vowel space. The frequencies of the first (F1) and second (F2) formants correspond roughly to the articulatory positions of the tongue body in the height and backness dimensions, respectively. Instrumental methods are now used regularly in sociolinguistic studies of vocalic variation (Anderson 2003; Nguyen 2006; Dodsworth

[15] The workshop organizers published a book focusing on sociophonetic methods in 2009 (Di Paolo and Yaeger-Dror 2009).

2008), though several researchers also combine instrumental and impressionistic techniques to measure vowel tokens. For example, Gordon (2001, 46-52) codes most of the tokens in his study impressionistically (coding each token twice and then comparing for accuracy), but also acoustically analyzes a sub-sample of tokens to supplement the auditory measurements. Mendoza-Denton (1997, 92) initially inspects waveforms and spectrograms of tokens in her analysis, as a means of training herself and providing an instrumental guide for auditory coding of the bulk of the tokens (with occasional reference to the acoustic measures to ensure accuracy). There are several disadvantages to auditory coding and analysis of vocalic variables. One of these issues is listener subjectivity in the perception of vocalic variation and limitations of detail in the analysis. Auditory coding of vowel tokens results in categorical variables that require each token to be assigned to a category such as "fronted" and "non-fronted". The burden of drawing a line between the two categories (or, in some cases, distinguishing between several degrees of fronting [e.g. Gordon 2001]) falls upon the researcher, whose own perceptual biases will play a role in making that decision. Though using multiple coders can alleviate some of the subjectivity and bias that comes with relying upon the perception of one coder, auditory coding still does not produce a continuous variable, which is needed for the statistical analysis to encompass the full extent of the phonetic variation found in speech.[16] Acoustic measures of vowel tokens, on the other hand, do provide a continuous variable based on the values measured for the first and second formants for that token, and do not make a categorical distinction for vowel qualities such as height or frontness. Acoustic measures of the first and second formants also allow for analysis of vocalic variation that falls along multiple paths within the F1-F2 vowel space (e.g. the purported NCS variation associated with /ɛ/, which may be both backing and lowering [Eckert 2000]).

In this study, my acoustic dataset is the first and second formant measures of four of the NCS vowels. My description of the vowels and statistical analyses (see chapters 4 and 5) rely on the F1 and F2 measures, and in their relation to one another (such as the distance between the F2 of /ɛ/ and /ɑ/) to consider the overall picture of the NCS. In the next section I discuss the use of a benchmark NCS speaker to serve as a point of reference for the relative positions of the vowels within an NCS vowel space.

[16] Statistical packages have been designed specifically to deal with categorically-coded, binomial sociolinguistic data (e.g. VARBRUL), but this does not address the continuous nature of acoustic data, nor does it take advantage of statistical tests that are used throughout the social sciences (Nguyen 2006).

3.4 Baseline Northern Cities Shift speaker

Sociophonetic studies that look at ongoing sound change may use the vowel space of a baseline speaker to serve as a reference point for the sound change (e.g. Anderson 2003; Roeder 2003). A benchmark is useful when the degree of sound change spread is unknown for the vowel productions of the speakers under investigation, as is the case for the Mercer students. For this study, I use the vowel space of a speaker from suburban Detroit as my point of comparison. I sought out a baseline speaker for whom I have access to raw acoustic measures to maximize my ability to conduct descriptive and statistical comparisons between the participants in my study and the one I use as a baseline. The raw data for this speaker come from Bridget Anderson's (2003) research on sound change among Appalachian migrants and African Americans in the Detroit area. Anderson's research included the speech of five white women native to suburban Detroit to serve as baseline. I obtained the recordings of one of those speakers from Anderson, and was thus able to extract tokens and measure the formant frequencies myself, which provides some consistency in the formant measures. Having the raw formant measures for this speaker also allows me to normalize them the same way I did the data from my own participants. The other advantages of using this speaker are that the data come from a sociolinguistic interview, so the setting is similar to my own data, and the speaker grew up in a town very near to Dearborn.

My decision to use this particular speaker as a baseline speaker for the NCS is based on her demographic information and on Anderson's (2003) measures of her speech. The baseline speaker is a white female, born and raised in a small town south of Detroit, who was 32 years old at the time of the recording in 1999. In Anderson's study, she is part of a group of five Northern women whose speech is used as a benchmark in comparison to Appalachian migrant speakers and African American speakers in Southeastern Michigan. Anderson finds features of the NCS in the five Northern women's vowel productions, in particular raised /æ/ and backed or lowered /ɛ/, while the vowels of the Appalachian migrant speakers and African American speakers do not show the same patterns. Additionally, Anderson's measures show that the five Northern women's vowels pattern similarly to each other; the baseline speaker's vowels are like the vowels of other speakers also believed to be NCS speakers. (See Anderson 2003, 49-63, for more detailed discussion and measurements.) This baseline speaker is perhaps not ideal since she was recorded about a decade before the present study and she is older than the speakers in the present study, but she nevertheless provides a useful illustration of a typical NCS speaker.

3.5 Interview setting

All seventeen interviews took place in a small, carpeted room in Mercer High School's library. Interviews ranged from just over half an hour to over an hour, and consisted of open-ended questions aimed at getting interviewees talking casually about their lives and experiences. Interviews were digitally recorded in PCM (uncompressed) format on a Marantz CDR420 digital steady-state recorder, using a Sennheiser omni-directional microphone, on mono setting. The recorder has a hard drive that stores the recordings, which I then transferred to my computer as .wav files. I used Praat software[17] to prepare tokens for measurement and take acoustic measures.[18]

3.6 Normalization procedure

Normalization procedures transform the formant values into standardized values that can be compared across speakers. They are used to preserve the phonemic variation and sociolinguistic/dialectal variation of a particular vowel token while minimizing variation due to the physiology and anatomy of an individual talker.

Several normalization procedures have been proposed (e.g. Lobanov 1971; Nearey 1978; Syrdal and Gopal 1978; Watt and Fabricius 2003) and these fall under two main categories. Vowel-intrinsic normalizations use acoustic information from one token to categorize that vowel token. Vowel-intrinsic procedures are often non-linear transformations of the frequency scale, such as log, mel, or Bark transformations; spectral peak relations (e.g., f0-F1, F1-F2) may also enter into the calculations. Vowel-extrinsic procedures use information from multiple vowels – the underlying assumption is that, in normalizing, a hearer requires information that is distributed across more than one vowel.

Adank, Smits, and van Hout (2004) survey eleven vowel normalization procedures, both vowel-intrinsic and vowel-extrinsic, drawing on and expanding previous studies that judge the effectiveness of the many normalization techniques for research on language variation. They conducted several statistical tests (Linear Discriminant Analyses and Multivariate Analyses of Variance) on data from Dutch speakers that were stratified by region and sex. Winning normalizations performed best in the tests by having the highest percentage of normalized values assigned correctly to their original vowel categories. Adank *et al* find that the vowel-extrinsic procedures are most effective in normalizing the

[17] Praat is a free application for phonetic-acoustic analysis. It is available for download here: http://www.fon.hum.uva.nl/praat/.

[18] Thank you to Susan Lin for showing me the basics of Praat scripting and providing me with useful scripts that streamlined this whole process.

data; of these, transformations proposed by Lobanov and Nearey perform best in Adank *et al*'s tests. Contrary to what they expected, the vowel-extrinsic procedures were most effective at preserving the phonemic and sociolinguistic information in tokens, while minimizing physiological information. They found that the procedure proposed by Lobanov (1971) performed best in their tests, followed closely by two other vowel-extrinsic normalization procedures.

Lobanov's procedure is a *z*-score transformation. Converting formant values to *z*-scores replaces each value with "the distance between it and the mean, where the distance is measured as the number of standard deviations between the data value and the mean" (Johnson 2006, 34). *Z*-scores always have a normal distribution, with a mean of 0 and a standard deviation of 1. In addition to being vowel-extrinsic, Lobanov's formula is also formant-intrinsic, which means that each formant (F1, F2) is normalized individually. Adank *et al* (2004) conclude that the vowel-extrinsic, formant-intrinsic normalization procedures are the ones most suitable for language variation research. Both of the transformations that Lobanov and Nearey proposed fall under this category.

NORM, the online Vowel Normalization and Plotting Suite[19], offers five different normalization procedures, including Lobanov's and Nearey's. I choose to use the Lobanov transformation to normalize the data in this dissertation (see also Clopper *et al* 2005 and Dodsworth 2008). The *z*-score transformation is a general standardization procedure used in statistics (Johnson 2006) that has not been developed specifically for linguistics (or sociolinguistics), but Adank *et al*, show that, despite this non-specificity, the *z*-score transformation is an effective means for normalizing variable phonetic data. Following these findings, I use Lobanov's transformation to normalize the vowel spaces of the speakers in my study, given the formula's effectiveness at minimizing physiological differences while preserving phonemic and sociolinguistic variation. The formula is given in (1), below:

$$(1) \qquad z = (f - \mu)/\sigma$$

In this formula, z is the transformed normalized frequency value, f is the raw frequency (Hz) of that formant value, μ is the mean frequency of the formant (across all tokens of all vowels), and σ is the standard deviation of the mean (μ).

[19] NORM is available for free online at: http://ncslaap.lib.ncsu.edu/tools/norm/index.php

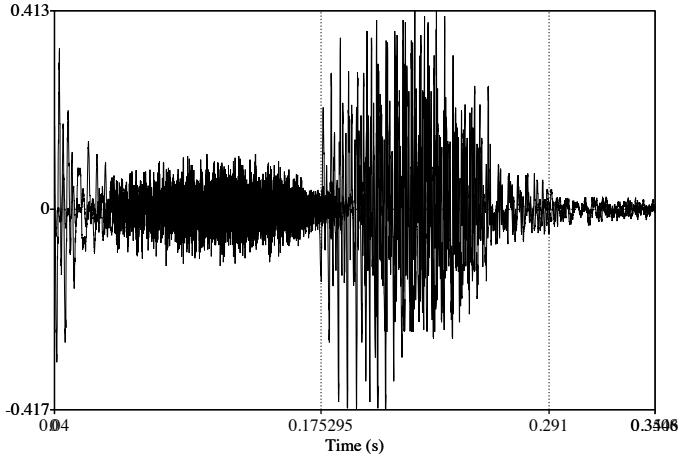
The primary drawback of using Lobanov's formula (or any other vowel-extrinsic normalization procedure) is the relatively large amount of data required to normalize a vowel – the normalization is optimal when formant measures are taken from all the vowels in the language (Thomas and Kendall 2007). To address this drawback, I included measures of /i, e, o, u/, in addition to measures of the four target vowels /æ, ɑ, ɛ, ʌ/. These additional tense high and mid vowels balance out the overall vowel space that I am investigating, and make the *z*-score normalization procedure more effective since the peripheral points of the American English vowel space are all included (Thomas and Kendall 2007).

3.7 Token measurement

For each of the 17 speakers in the study, I aimed for 30 tokens for each of the following eight vowels: /i, e, ɛ, æ, a, ʌ, o, u/. While other researchers have included more tokens (e.g. Eckert 2000; Dodsworth 2008), previous research by Guy 1980 and Nguyen 2006 suggests that 30 tokens is a reasonable number for statistical analysis of vocalic variation and so I aimed for 30 tokens of each vowel to keep the measurement task manageable. For all vowels, I selected primarily monosyllabic and bisyllabic tokens, though there are exceptions, including longer words in which the target vowel is in the stressed position. The phonological environment for tokens varies, but I excluded words in which the environment following the target vowel is a nasal to avoid the acoustic effects of coarticulatory vowel nasalization. Unstressed and reduced vowels were excluded from analysis. No more than seven tokens of one lexical item from each speaker were used in the sample. See Appendix B for a list of sample words.

I took measurements of F1 and F2 with Praat's automatic formant tracker. To do this, I marked the onset and offset of each vowel, at the first and last periodic pitch pulses, respectively, of each vowel, as shown with the dotted lines in Figure 3.1, in the sample word *step*.

Figure 3.1 Marking of onset and offset for formant measures.



I then ran a script in Praat, which took three measures of the vowel: F1 and F2 frequency at vowel midpoint and vowel duration. A midpoint measure is a static measure that does not capture the dynamic nature of formant frequencies over the duration of a vowel, but is nonetheless frequently used for acoustic measures of vowels. Future research may incorporate dynamic measures to explore questions about differences in formant trajectories being a potential source of phonemic differentiation (as discussed in Hillenbrand *et al* 1995).

The F1 and F2 frequencies generated by Praat's automatic formant tracker were all hand-checked, with particular attention paid to formant frequencies that lay outside one standard deviation of the mean value of the formant of the vowel for each speaker. If hand-corrections were needed, it was often because the automatic formant tracker had collapsed or ignored formants. In total, I hand-corrected 418 tokens, or 5% of the total 8,328 formant measures (F1 and F2 for each of 4,164 tokens).[20] Table 3.1 provides token counts by vowel for each speaker.

[20] Four speakers (all male) accounted for 51% (210) of the formants that needed correcting. In most of these cases, the LPC tracker had collapsed formants together.

Table 3.1 Summary of token counts by vowel and speaker.

	NCS Vowels				Other Vowels				
Speaker	ɛ	æ	ɑ	ʌ	i	e	o	u	**Total by Speaker**
Aisha	31	39	32	30	23	32	28	31	246
Alex	30	34	33	40	27	33	23	23	243
Asad	39	31	44	30	20	36	22	23	245
Bilal	19	35	16	28	29	29	24	20	200
Daoud	15	35	18	43	35	33	21	18	218
Dee	40	43	29	37	30	21	26	28	254
Hamze	31	33	31	19	23	31	23	28	219
Hassan	26	35	20	29	30	31	20	24	215
Jamil	32	41	27	29	28	34	22	25	238
Lina	30	37	13	25	34	21	16	15	191
Mohammed	26	29	16	40	37	28	13	21	210
Noor	39	35	39	32	28	34	24	21	252
Rasim	37	37	27	29	25	45	20	20	240
Reem	32	44	40	29	33	27	20	23	248
Shadya	31	40	32	31	30	36	27	28	255
Zahrah	38	46	39	36	19	23	25	22	248
Zeinab	20	30	14	27	22	21	24	23	181
Baseline	35	29	44	27	27	49	22	28	261
	551	653	514	561	500	564	400	421	4164

Though instrumental phonetic methods are more accurate, less likely to be affected by biases in researcher's own auditory perceptions, and allow for a more fine-grained analysis than auditory coding of vowels, it is not the case that acoustic methods provide an entirely objective alternative to auditory coding that completely removes the influence of the researcher. Many decisions, including deciding on where to mark the onset and offset of a vowel, and hand correcting vowel formants when the researcher determines the automatic tracker to be incorrect, clearly rely on researcher subjectivity. However, the overall advantages and the level of detail allowed by an instrumental analysis outweigh these drawbacks. Instead, I aim for consistency across all the tokens in my study, so potential biases are less likely to strongly skew the data in a particular way.

In the remaining sections of this chapter I provide an overview of the measures that are used in the statistical analysis in chapters 4 and 5. Following that, I introduce the independent linguistic and social variables, then introduce my hypotheses about the effects of the social variables on the four NCS vowels under investigation. Finally, I describe the statistical methods used in the analyses of chapters 4 and 5.

3.8 Overview of vowel space (comparison to baseline speaker)

This section offers an overview of the participants' collective vowel space. I include some non-statistical comparisons to a baseline NCS speaker to gain a sense of whether or not features of the NCS are present in the data sample.

Normalized F1 and F2 frequencies for all vowels, averaged across speakers, are presented in Table 3.2. The *z*-score normalization process I use (see §3.6) orients transformed values around the origin (0,0) in the F1-F2 plane, so the normalized values used throughout this discussion are not on the familiar Hertz scale. It is possible to re-scale normalized values to a Hertz scale, but this adds an unnecessary layer of transformation.

To aid with interpretation of normalized values, a graphic representation of the data in Table 3.2 is given in Figure 3.2 (I also use figures throughout my discussion of the statistical analysis). Figure 3.3 plots means for all individual speakers – participants and baseline – for all vowels. The baseline speaker serves as a reference point, providing a picture of a white speaker born and raised in Southeastern Michigan whose speech is characterized by the NCS variables. Because I only have one baseline speaker, statistical comparisons between that speaker and the participants as a group are challenging because of the differences in sample size. However, in my discussion below I include one-sample t-tests for each relevant vowel formant that compare each participants' tokens for that vowel to a test value that equals the baseline speaker's mean for that vowel formant. This offers a statistical comparison between the Mercer speakers vowel productions and the baseline speaker's measures that complement the descriptive diagnostic tests below.

Figure 3.3 shows that the individual vowel averages from the baseline speaker's data are within the clouds – indeed, often roughly in the middle of the clouds – described by the individual means for the participants. (Individual means are given in Table 3.4 and Table 3.5.)

Table 3.2 Average normalized first and second mean formant values by vowels.

Formant	Vowel	Mercer		Baseline	
		Average	SD	Average	SD
F1	i	-1.23	0.40	-1.23	0.29
	e	-0.71	0.33	-0.66	0.37
	ɛ	0.47	0.64	0.46	0.52
	æ	0.66	0.57	0.48	0.52
	a	1.35	0.68	1.40	0.50
	ʌ	0.33	0.63	0.40	0.64
	o	-0.24	0.47	-0.16	0.46
	u	-1.10	0.39	-1.18	0.27

Formant	Vowel	Mercer		Baseline	
		Average	SD	Average	SD
F2	i	4.40	1.64	4.50	0.94
	e	3.74	1.48	2.98	1.02
	ɛ	-0.32	1.72	-0.43	1.37
	æ	1.26	1.52	0.86	0.80
	a	-3.04	1.94	-2.56	1.30
	ʌ	-2.89	1.89	-2.49	1.36
	o	-5.26	2.29	-5.40	0.87
	u	0.85	2.74	0.76	1.28

\

Figure 3.2 Vowel averages for all participants and baseline speaker.

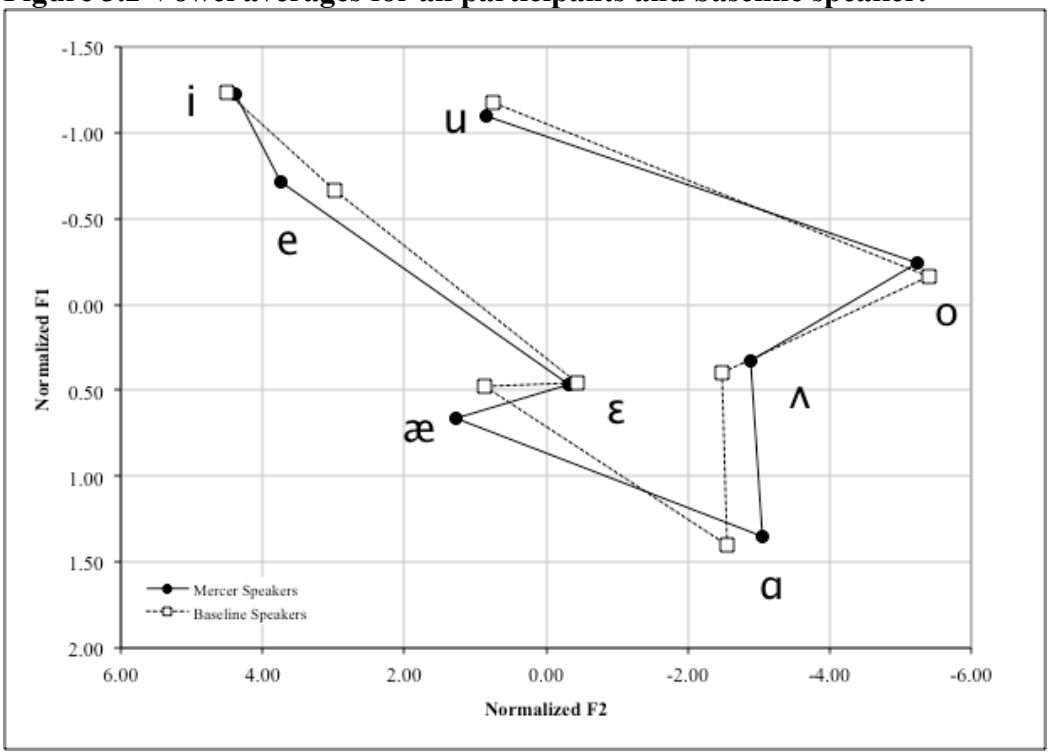
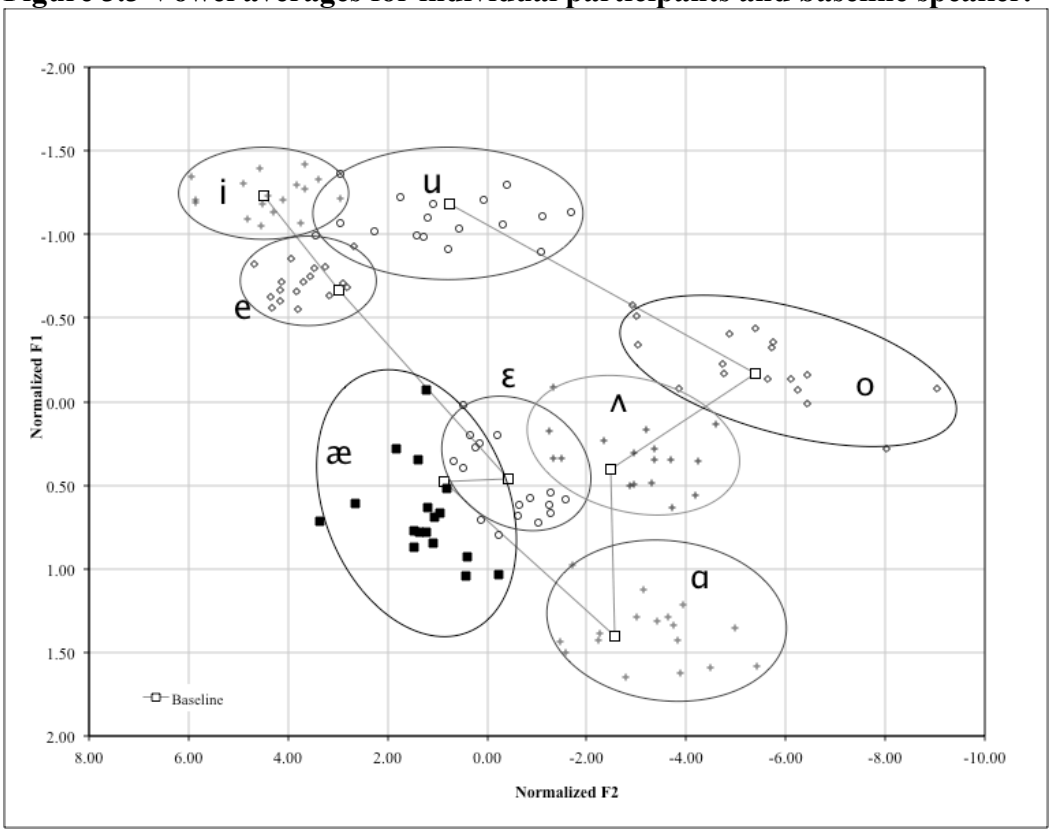


Figure 3.3 Vowel averages for individual participants and baseline speaker.



A note about /u/-fronting

The very marked fronting of /u/ found for both the baseline speaker's and the participants' productions is not included in my hypotheses (because /u/ is not part of the NCS), but fronting of this vowel in the Midwest and elsewhere in the U.S. is widely recognized. The fronting of /u/ follows patterns of back vowel fronting that are common in many varieties of English in the United States. The fronting of /u/ appears to be part of a broader linguistic phenomenon of mainstream varieties of U.S. English (Anderson 2003; Hall-Lew 2009), but some research has also found that /u/-fronting can carry social meaning (e.g. Fought 1999). While it is unlikely that /u/-fronting carries social meaning at Mercer, this pattern of fronting could be investigated in future research.

Is it the NCS or isn't it?

The figures above suggest that the baseline speaker's vowel productions fall within the range of the Mercer participants' vowels as well, but this provides only a descriptive comparison between the baseline speaker's vowels and the Mercer speakers'. Statistical comparisons between the two groups is difficult, because the baseline speaker is a group of just one speaker. Another way to address the question of whether observed formant frequencies are indicative of the NCS is to inspect relative vowel positions in the vowel space. Labov (1996)[21] offers several diagnostic comparisons that take advantage of the relative positions of vowels within the vowel space to assess the presence of the NCS. To complement the diagnostic tests, I also performed several one-sample t-tests comparing mean formant values between individual Mercer speakers and the baseline speaker. The t-tests serve to strengthen the assessments of the diagnostic tests and provide a measure which captures more information than the descriptive information captured by the mean difference measures.

The first comparison involves /æ/ and /ɛ/. An NCS speaker would have an /æ/ that is higher and more fronted than /ɛ/, which means the /æ/ would have a lower F1 and a higher F2 than /ɛ/. A less advanced NCS speaker would have an /æ/ that is more fronted than /ɛ/ but not more raised, which means a higher F2 but not a lower F1. The second component of the NCS diagnostics is what Labov refers to as the "reversal" of /ɛ/ and /ɑ/. For this comparison, as /ɛ/ backs and /ɑ/ fronts, their F2 values become more aligned. In

[21] http://www.ling.upenn.edu/phono_atlas/ICSLP4.html

the most advanced stages of the NCS, the F2 values are virtually equal. These diagnostics are summarized in Table 3.3 below.

Table 3.3 Labov's diagnostic measures for the NCS

NCS shift	Description in F1/F2 space	Diagnostic
Stage 1 of /æ/-shifting	/æ/ is more **fronted** than /ɛ/ but still lower than /ɛ/	F2-/æ/ higher than F2-/ɛ/
Stage 2 of /æ/-shifting	/æ/ is more fronted and more **raised** than /ɛ/	F1-/æ/ lower than F1-/ɛ/
Fronting of /ɑ/ and backing of /ɛ/	/ɛ/ and /ɑ/ have become **aligned** in the F2 dimension	Difference in F2-/ɛ/ and F2-/ɑ/ close to or at zero

Below, I use these diagnostic tests to get a sense of how NCS-like the speakers in this study are individually and as a group (individual means of F1 and F2 are given in Tables Table 3.4 and Table 3.5). Table 3.6 to Table 3.8 summarize the results of the diagnostics. Within each of the diagnostic tables, the speakers are ordered from least NCS-like to most NCS-like based on the results of the comparison. The baseline speaker is included as a reference point. As normalized formant values are likely not as familiar for formants as the traditional Hertz scale, Table 3.4 and Table 3.5 also includes the normalized means for the Mercer speakers and for the baseline speaker rescaled to Hertz.[22]

[22] I re-scaled normalized F1 and F2 means for Mercer speakers and for the baseline speaker following the scaling algorithm in NORM: The Vowel Normalization and Plotting Suite (Thomas and Kendall 2007).

Table 3.4 Individual means of normalized F1 for NCS vowels.

	Vowel (NCS only)			
Speaker	ɛ	æ	a	ʌ
Aisha	0.71	1.04	0.98	0.34
Alex	0.25	0.78	1.43	0.31
Asad	0.39	0.28	1.31	0.28
Bilal	0.73	0.61	1.58	0.56
Daoud	0.62	0.52	1.43	0.64
Dee	0.20	0.93	1.44	0.17
Hamze	0.58	0.63	1.29	0.35
Hassan	0.02	1.04	1.65	0.23
Jamil	0.27	0.78	1.21	0.34
Lina	0.66	0.69	1.62	0.13
Mohammed	0.68	0.67	1.59	0.49
Noor	0.36	0.85	1.12	0.34
Rasim	0.55	0.71	1.35	0.35
Reem	0.20	0.34	1.38	0.50
Shadya	0.62	0.77	1.29	0.17
Zahrah	0.80	-0.07	1.50	-0.09
Zeinab	0.57	0.87	1.34	0.51
Mercer Mean	0.47	0.66	1.35	0.33
Baseline	0.46	0.48	1.40	0.40
Means rescaled to Hertz (for illustrative purposes)				
Mercer	591	616	705	573
Baseline	590	592	711	582

Table 3.5 Individual means of normalized F2 for NCS vowels.

	Vowel			
Speaker	ɛ	æ	a	ʌ
Aisha	0.12	0.42	-1.71	-1.32
Alex	0.14	1.36	-2.24	-2.96
Asad	0.47	1.83	-3.40	-3.36
Bilal	-1.04	2.65	-5.42	-4.18
Daoud	-0.66	0.81	-3.83	-3.71
Dee	0.35	0.40	-1.48	-1.24
Hamze	-1.57	1.20	-3.63	-3.36
Hassan	0.48	-0.23	-2.78	-2.35
Jamil	0.23	1.23	-3.95	-3.68
Lina	-1.27	1.05	-3.89	-4.60
Mohammed	-0.61	0.96	-4.48	-3.30
Noor	0.66	1.08	-3.13	-1.49
Rasim	-1.27	3.36	-4.98	-4.23
Reem	-0.19	1.38	-2.27	-2.94
Shadya	-1.26	1.46	-3.00	-3.18
Zahrah	-0.23	1.22	-1.57	-1.33
Zeinab	-0.87	1.48	-3.75	-2.87
Mercer Mean	-0.32	1.26	-3.04	-2.90
Baseline	-0.43	0.86	-2.56	-2.49
Means rescaled to Hertz (for illustrative purposes)				
Mercer	1706	1910	1354	1373
Baseline	1692	1858	1416	1425

Stage 1, the fronting of /æ/ (relative to /ɛ/), appears to be a more robust feature of the data than /æ/-raising. Eleven of the 17 speakers surpass the baseline speaker's F2 difference between /æ/ and /ɛ/, whose results are shown in red in Figure 3.4. Further, the positive differences in Table 3.6 and the rising slopes in Figure 3.4 illustrate that /æ/-fronting relative to /ɛ/ is a feature of all but one of the speakers' mean values. It appears that /æ/-fronting is a robust feature among the participants in this study. The presence of /æ/-fronting and the wide range of formant values across the Mercer participants make this a good candidate for socially-patterned variation.

Since these diagnostic tests rely on differences between vowel measures in the F1 or F2 dimension, t-tests are also needed to examine statistical differences between difference measures. For each diagnostic test, I found the difference between each token measure of the target vowel and the mean of the second target vowel. I then ran a t-test for each

speaker that compared these difference measures to the mean difference measure (between the two target vowels) for the baseline speaker. For each diagnostic test, a t-test p-value of $p<.05$ indicates that the difference between the relative position of the two target vowels and the baseline speaker's relative position of those two vowels is statistically significant. These p-values are given in the relevant tables. In general, mean differences that are close to the baseline speakers' mean difference do not have statistically significant t-test results, but there are exceptions. This is because the mean difference on its own does not capture the range of values, and thus variation, found in the 30 or so token measures used in the t-tests.

For the diagnostic of /æ/-fronting, speakers are ranked from having the least to most fronted /æ/ productions relative to their /ɛ/ productions. the t-test patterns are in concord with results of the mean difference ranking: the vowel measures for the six speakers closest to the baseline speaker do not have mean differences that are statistically significant different from that of the baseline speaker. Though Mohammed and Reem's vowels have the same mean difference between the F2 of /æ/ and /ɛ/ (1.57), Reem's mean t-test result suggests that her tokens are significantly different from that of the baseline speaker. This difference in significance may be attributed to how Mohammed's and Reem's mean F2 of /æ/ values and F2 of /ɛ/ values compare to the baseline speaker. Mohammed's values are both closer in value to the baseline speaker than Reem's values; the difference is the same, but Reem's /æ/ and /ɛ/ are overall more fronted than Mohammed's and the baseline speaker's vowels.

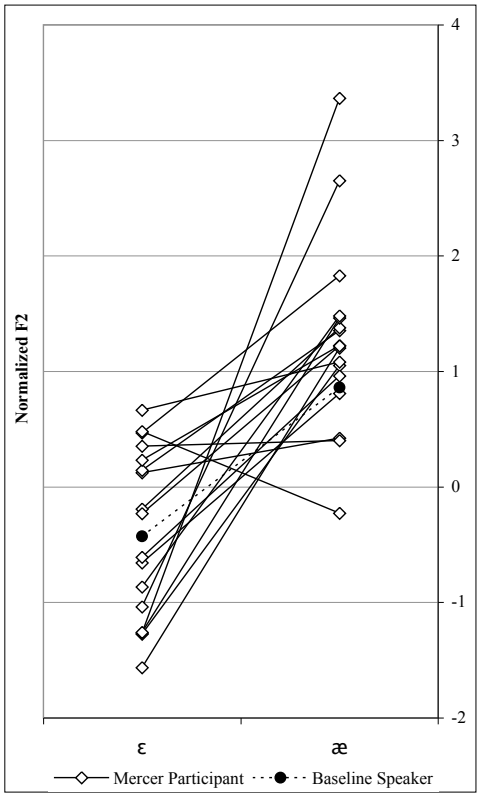
Table 3.6 Diagnostic of /æ/-fronting (normalized F2/æ/-F2/ɛ/ difference).

Speaker	F2/æ/	F2/ɛ/	F2/æ/-F2/ɛ/ Difference	t-test p-value
Hassan	-0.23	0.48	-0.71	p<.001*
Dee	0.40	0.35	0.05	p<.001*
Aisha	0.42	0.12	0.30	p<.001*
Noor	1.08	0.66	0.42	p<.001*
Jamil	1.23	0.23	0.99	p=.255
Alex	1.36	0.14	1.21	p=.749
Baseline	**0.86**	**-0.43**	**1.29**	**----**
Asad	1.83	0.47	1.36	p=.771
Zahrah	1.22	-0.23	1.45	p=.110
Daoud	0.81	-0.66	1.47	p=.330
Mohammed	0.96	-0.61	1.57	p=.371
Reem	1.38	-0.19	1.57	p=.011*
Lina	1.05	-1.27	2.33	p<.001*
Zeinab	1.48	-0.87	2.35	p=.001*
Shadya	1.46	-1.26	2.72	p<.001*
Hamze	1.20	-1.57	2.77	p<.001*
Bilal	2.65	-1.04	3.69	p<.001*
Rasim	3.36	-1.27	4.63	p<.001*

** significant at a level of p<.05*

t-test compares each speaker's mean F2/æ/-F2/ɛ/ difference to that of the baseline speaker's. See above for further discussion.

Figure 3.4 Normalized F2 difference between /æ/ and /ɛ/ by speaker



The diagnostic of /æ/-raising (stage 2) showed that many speakers did not on average have as much /æ/-raising relative to /ɛ/ as the baseline speaker (whose F1 values for /æ/ and /ɛ/ were only .01 apart from each other, indicating a strong degree of /æ/-raising). Rising slopes (from left to right) in Figure 3.5 indicate /æ/-raising; only 5 out of 17 speakers have an F1 of /æ/ that is more raised than their F1 of /ɛ/. However, there are three Mercer speakers who have very little difference between their F1 values for /æ/ and their F1 values for /ɛ/; this is indicative of /æ/-raising in the NCS. As the widely varied slopes in Figure 3.5 indicate, this diagnostic suggests there are many participants who lag behind the baseline speaker for /æ/-raising, but there is also a fair amount of raising among the participants. Further, as seem in Table 3.7, for eight of the speakers, the t-test results are not significant; that is, the difference between their /ɛ/ and /æ/ productions is not statistically distinct from the difference between the baseline speaker's /ɛ/ and /æ/ productions. Though Reem's vowels again have a mean difference that is relatively close to the baseline speaker's mean difference, her t-test had significant results. This significance may arise from the fact that Reem's F1 measures for both /ɛ/ and /æ/ are overall lower than the measures for the baseline speakers' F1 of /æ/ and /ɛ/.

/æ/-raising is not uniform across speakers, which suggests that this phase of /æ/-shifting as part of the NCS is not as well-established as the first stage, but it is present to a limited extent. Of note is the extreme rising slope in Figure 3.5, which belongs to Zahrah. Her /æ/ pronunciations were extremely raised – to the point of becoming diphthongal – compared to her peers, and I heard them as such during the interview.

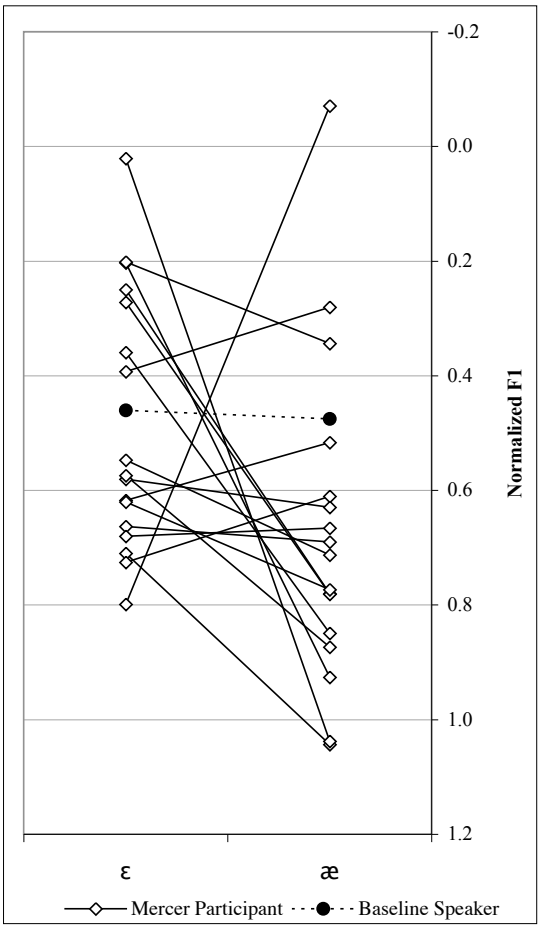
Table 3.7 Diagnostic of /æ/-raising (normalized F1/ɛ/-F1/æ/ difference)

Speaker	F1-/ɛ/	F1-/æ/	F1/ɛ/-F1/æ/ Difference	t-test p-values
Hassan	0.02	1.04	-1.02	p<.001*
Dee	0.20	0.93	-0.72	p<.001*
Alex	0.25	0.78	-0.53	p<.001*
Jamil	0.27	0.78	-0.51	p<.001*
Noor	0.36	0.85	-0.49	p<.001*
Aisha	0.71	1.04	-0.33	p<.001*
Zeinab	0.57	0.87	-0.30	p=.005*
Rasim	0.55	0.71	-0.17	p=.059
Shadya	0.62	0.77	-0.15	p=.217
Reem	0.20	0.34	-0.14	p=.017*
Hamze	0.58	0.63	-0.05	p=.474
Lina	0.66	0.69	-0.03	p=.886
Baseline	**0.46**	**0.48**	**-0.01**	**----**
Mohammed	0.68	0.67	0.01	p=.741
Daoud	0.62	0.52	0.10	p=.240
Asad	0.39	0.28	0.11	p=.239
Bilal	0.73	0.61	0.11	p=.069
Zahrah	0.80	-0.07	0.87	p<.001*

** significant at a level of p<.05*

t-test compares each speaker's mean F1/ɛ/-F1/æ/ difference to that of the baseline speaker. See above for further discussion.

Figure 3.5 Normalized F1 difference between /ɛ/ and /æ/ by speaker.



The final diagnostic offered by Labov examines the fronting of /ɑ/ and the backing of /ɛ/. Unfortunately, this diagnostic does not separate these two features of the NCS, but the relative position of the two variables in the front/back dimension is still useful because it captures the notion that, as the shift progresses, F2 frequencies of these vowels move closer together and their difference approaches zero. In this comparison, it should be noted that, even for the baseline speaker, the difference in mean F2 for /ɑ/ and /ɛ/ is not close to zero. For the baseline speaker, /ɑ/ is still back relative to /ɛ/. As seen in Table 3.8, six of the Mercer speakers have F2 values of /ɑ/ and /ɛ/ that are closer together than the baseline speaker's, while the rest of the Mercer speakers' two values are more distant from each other. Six of the speakers also have t-test results that show no significant differences between their F2 /ɛ/ and /ɑ/ values and the difference for the baseline speakers. The data in Table 3.8 also show that having a mean difference similar to the baseline speaker's does not entirely account for the results of the t-tests. For this diagnostic in particular, the difference measure alone does not capture how the Mercer

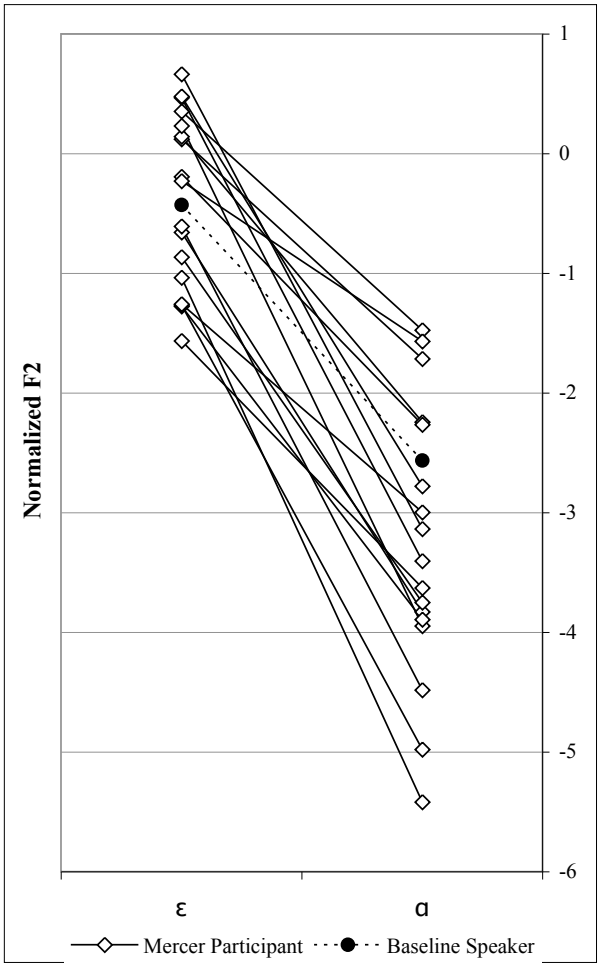
speakers compare to the baseline speaker for /ɑ/-fronting and /ɛ/-backing. Further, based on this diagnostic, the participants in the study and the baseline speaker are not NCS-like for /ɑ/-fronting and /ɛ/-backing. One factor that may affect this diagnostic is the nature of the variation of /ɛ/ in the NCS. At the time these diagnostics were published in 1996, /ɛ/ was a very new part of the picture of the NCS and the dimensions of its variation were unknown. In chapter 5, I explore the variation of /ɛ/ in greater detail.

Table 3.8 Diagnostic of /ɑ/-fronting and /ɛ/-backing (Normalized F2/ɛ/- F2/ɑ/ difference).

Speaker	**F2/ɛ/**	**F2/ɑ/**	**F2/ɛ/- F2/ɑ/ Difference**	**t-test p-value**
Shadya	-0.23	-1.57	1.34	p=.177
Zahrah	-1.26	-3.00	1.74	p<.001*
Dee	0.35	-1.48	1.83	p=.081
Aisha	0.12	-1.71	1.84	p=.013*
Hamze	-1.57	-3.63	2.06	p=.789
Reem	-0.19	-2.27	2.07	p=.616
Baseline	-0.43	-2.56	2.14	----
Alex	0.14	-2.24	2.38	p=.465
Lina	-1.27	-3.89	2.62	p=.390
Zeinab	-0.87	-3.75	2.89	p=.001*
Daoud	-0.66	-3.83	3.17	p<.001*
Hassan	0.48	-2.78	3.26	p<.001*
Rasim	-1.27	-4.98	3.71	p=.034*
Noor	0.66	-3.13	3.80	p<.001*
Asad	0.47	-3.40	3.87	p<.001*
Mohammed	-0.61	-4.48	3.87	p=.002*
Jamil	0.23	-3.95	4.18	p<.001*
Bilal	-1.04	-5.42	4.38	p<.001*

** significant at a level of p<.05*
t-test compares each speaker's mean F2/ɛ/- F2/ɑ/ difference to that of the baseline speaker. See above for further discussion.

Figure 3.6 Normalized F2 difference between /ɑ/ and /ɛ/



Clopper *et al* (2005) also provide evidence that speakers with NCS features do not show alignment in the F2s of /ɛ/ and /ɑ/. Figure 3.7 below reproduces a figure from Clopper *et al*, and shows that /ɑ/ and /ʌ/ are more aligned along the front/back dimension than /ɑ/ and /ɛ/. In Clopper's data, /ɑ/ is more fronted than /ɔ/, but remains well back of /ɛ/. Labov's diagnostics do not include examination of variation of /ʌ/, perhaps because it is such a new element of the shift and its trajectories were not well understood when he developed the diagnostic. But we can see that, for the Mercer participants and baseline speaker in Figure 3.3 and the Clopper *et al* speakers in Figure 3.7, /ʌ/ and /ɑ/ occupy a similar region of the F2 space. Perhaps Labov's proposed diagnostic overestimated how far /ɑ/ is (or would be) fronted in the NCS or perhaps that dimension of variation in the NCS is region-specific.

Figure 3.7 Vowel means for males (partial reproduction of Figure 7 from Clopper *et al* 2005: 1670).

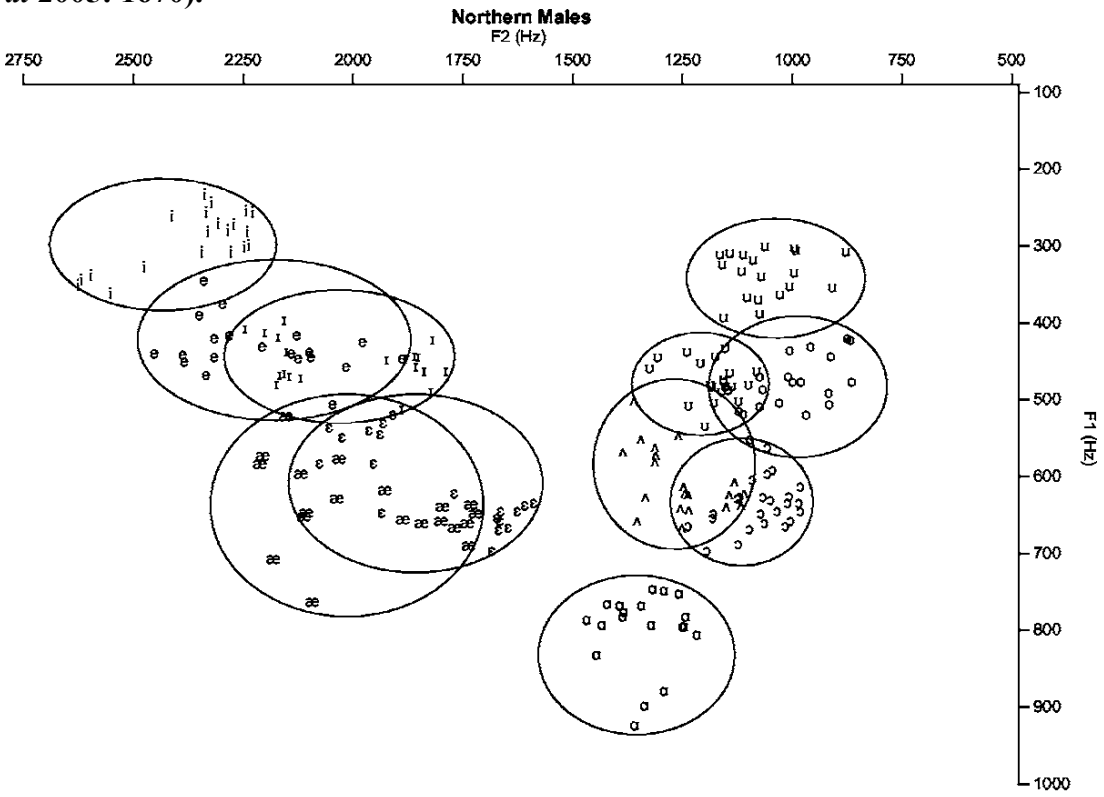


Figure 3.8 compares the F2 frequencies of /ɑ/ and /ʌ/ produced by the participants and the baseline speaker. The rising slope from left to right shows that, for many of the Mercer participants, their mean F2-/ɑ/ is still less than their mean F2-/ʌ/. However, for the baseline speaker, the two mean F2 values are almost in alignment (the difference between the two is just .07). About a third of the speakers (5 out of 17) have an /ɑ/ that is more fronted relative to /ʌ/ than the baseline speaker, but the majority of students do not. Part of this may be attributable not only to a lesser degree of /ɑ/-fronting, but also a lesser degree of /ʌ/-backing, another shift in the NCS which would also draw these two F2 values closer together. T-test results in Table 3.9 suggest that the relationship between /ɑ/ and /ʌ/ for ten of the speakers is not significantly different from the relationship between /ɑ/ and /ʌ/ for the baseline speaker. The overall spread of the mean difference values and the many non-significant p-values that do not cluster around the baseline speaker also suggest that the relative position of these two vowels is highly variable.

Figure 3.8 Normalized F2 difference between /ɑ/ and /ʌ/

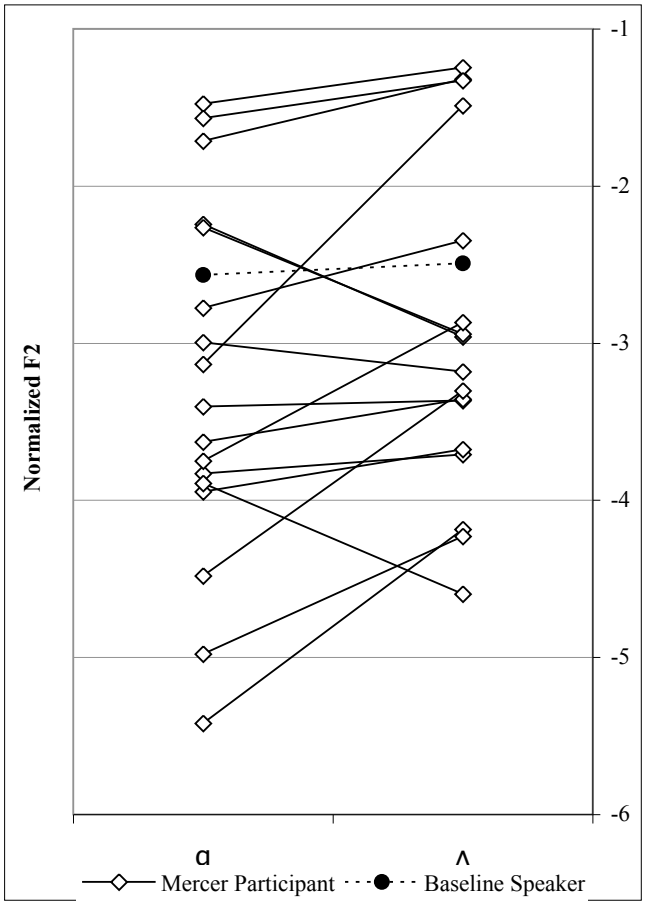


Table 3.9 Difference between normalized F2--/ɑ/ and F2-/ʌ/ by speaker

Speaker	F2-/ɑ/	F2-/ʌ/	F2/ɑ/-F2/ʌ/ difference	t-test p-values
Noor	-3.13	-1.49	-1.65	p<.001*
Bilal	-5.42	-4.18	-1.23	p=.033*
Mohammed	-4.48	-3.30	-1.18	p=.027*
Zeinab	-3.75	-2.87	-0.88	p<.001*
Rasim	-4.98	-4.23	-0.75	p=.342
Hassan	-2.78	-2.35	-0.43	p=.220
Aisha	-1.71	-1.32	-0.40	p=.008*
Hamze	-3.63	-3.36	-0.27	p=.490
Jamil	-3.95	-3.68	-0.27	p=.593
Zahrah	-1.57	-1.33	-0.24	p=.095
Dee	-1.48	-1.24	-0.23	p=.354
Daoud	-3.83	-3.71	-0.12	p=.826
Baseline	**-2.56**	**-2.49**	**-0.07**	**----**
Asad	-3.40	-3.36	-0.04	p=.863
Shadya	-3.00	-3.18	0.19	p=.385
Reem	-2.27	-2.94	0.68	p<.001*
Lina	-3.89	-4.60	0.70	p=.173
Alex	-2.24	-2.96	0.72	p=.019*

* significant at a level of p<.05

t-test compares each speaker's mean F2/ɑ/-F2/ʌ/ difference to that of the baseline speaker. See above for further discussion.

Overall, the three diagnostic comparisons from Labov, along with the additional comparison between /ɑ/- and /ʌ/-shifting, allow us to assess the presence of the NCS among these participants' data. For all four diagnostic tests, there are participants on either side of the baseline NCS speaker and a great deal of variation across participants. There is a good indication that some features of the NCS are present, particularly /æ/-fronting (stage 1 of /æ/-shifting) and /ɑ/-fronting, at least relative to /ʌ/. /æ/-raising is also present in these data, though this is quite varied from speaker to speaker, with just one speaker showing the most advanced stage of /æ/-raising. Most speakers' /æ/ and /ɛ/ fall roughly in the same region of F2 space (Figure 3.3). The diagnostic tests do not provide a specific numerical estimate of the NCS among these participants, but they do provide a measure that points toward the NCS being an available resource at Mercer. To investigate how these vowels might function as sociolinguistic resources for the participants, I

analyze the effects of several independent linguistic and social variables. Below I discuss the independent variables I include in the statistical analysis.

3.9 Independent variables

This section introduces the independent linguistic and social variables used in the analysis of the each of the four NCS vowels in this study. While the linguistic variables are ones that appear regularly in studies of vocalic variation, the social variables are a combination of broadly defined macrosocial characteristics and variables that are based on ethnographic information specific to Mercer High. The univariate analyses in this chapter do not give a comprehensive statistical account of the variation of each of the four vowels, but help to clarify the nature of the effects of individual variables and provide some valuable information for the multivariate statistical models that follow in chapters 4 and 5. After describing the social variables, I then state my hypotheses about how each social variable relates to the older and newer elements of the NCS.

3.9.1 Linguistic variables

In this study I consider the effects of three linguistic variables: the preceding phonological context, the following phonological context, and the vowel's position in the word from which it is taken (e.g. initial or medial). These variables have been regularly shown to have significant effects on vocalic variation and the effects of linguistic variables on phonetic variation in vowels are often greater than the effects of social variables on phonetic variation (Eckert 2000).

Table 3.10 Summary of linguistic variables included in statistical analysis.

Variable	Levels
Preceding Phonological Context	Pause
	Labial (p, b, f, v)
	Dental (θ, ð)
	Alveolar (t, d, s, z)
	Alveo-palatal (ʧ, ʤ)
	Velar (k, g)
	Glide (j, w)
	Liquid (l, r)
	Glottal (h)
Following Phonological Context	Pause
	Labial (p, b, f, v)
	Dental (θ, ð)
	Alveolar (t, d, s, z)
	Alveo-palatal (ʧ, ʤ)
	Velar (k, g)
	Glide (j, w)
	Liquid (l)
	Glottal (h)
Position in Word	Initial Medial

The four vowels under investigation rarely occurred word-finally in stressed position and for this reason only tokens occurring word-medially and word-initially are included in the statistical analysis. (This excludes only 4 tokens total. Most vowels occurring word-finally in stressed position are non-peripheral or tense vowels.) Vowels that occur word-initially in tokens typically have a preceding phonological context that is not a pause, although even when no pause occurs word boundaries may have an impact on the phonetic variation of vowels, as shown by the statistical results reported in chapters 4 and 5.

3.9.2 Hypotheses about linguistic variables

The hypotheses about the effects of the linguistic variable on the four vocalic variables are based on research in phonetics on the coarticulatory effects of adjacent consonants on vowels. For the preceding and following phonological contexts, effects of the preceding

or following consonant (or pause) on the target vowel are well documented (e.g. Stevens and House 1963; Hillenbrand, Nearey, and Clark 2001).

In general, among the more effects of phonological context on vowels are those due to the place of articulation of the surrounding consonants, and those effects are seen in the F2 of the vowel, especially the transitions into and out of flanking vowels. The effect of these transitions on the vowels depends on vowel frontness or backness – i.e., on the inherent F2 values of the vowel, which are higher frequency for front vowels and lower frequency for back vowels. In general, labials have low-frequency F2 transitions, and can be expected to lower the F2 frequency of front vowels. Dentals, alveolars, and post-alveolars have a mid-frequency F2; back vowels flanked by these consonants will have a relatively high-frequency F2 transition while front vowels may have slightly lower F2 transitions. "Velars" in English are articulatorily fronted in front vowel contexts. Their main effect is relatively high-frequency F2 transitions for flanking back vowels.

There is some evidence that the strength of effects of preceding and following phonological context differ. Stevens and House examine the effects of symmetrical consonantal contexts (i.e., the preceding and following sound is the same) in their research, but Hillenbrand *et al* (2001) find that place of articulation effects on a vowel are in fact due primarily to the preceding place of articulation, while the effects of the following consonant are relatively weak.

In this study, the divisions within the preceding and following phonological context categories (see Table 3.10) are based primarily on the consonant's place of articulation (e.g., labial, velar), but a few contexts are based on manner, rather than place, of articulation (i.e. glide, liquid). This has the potential to confound the effects of place (primarily F2 influences) and manner (primarily F1 influences). I address some of the potential effects of this confounding in chapters 4 and 5, and suggest ways to address this in future work.

The third linguistic variable included in the statistical analysis of the vocalic variables is the position in word (initial or medial). This variable is not as widely studied in phonetic research as are the coarticulatory effects of flanking consonants on vowels, but it is often included as a linguistic variable in sociolinguistic studies of vocalic variation, though studies have found few significant effects based on position in word (e.g. LYS 1972; Eckert 2000; Gordon 2001). There is some research on the phonetic effects of prosodic

domains suggesting that articulatory strengthening occurs at the edges of prosodic domains (e.g. Fougeron and Keating 1997; Cho 2005; Lehnert-LeHouillier and McDonough 2009). For position in word, word-initial tokens may be more phonetically enhanced (e.g. front vowels are more fronted) than word-medial tokens. However, findings on the effects of word position are not robust, especially in comparison to the effects of flanking consonants. Thus, my hypothesis, given below, is that I expected to find little if any effects from word position.

Hypotheses

1. In the statistical models, preceding context is more likely to have a significant effect on the vocalic variables than following context.
2. Because the main phonological context variable in place, there will be relatively little effect from preceding and following phonological context on the F1 of the vocalic variables.
3. Effects of preceding and following context on vocalic variables (restricted to effects of place):
    - /ɑ/ Relatively high frequency F2 expected in non-labial contexts.
    - /æ/ Lower-frequency F2 is expected in labial contexts; slight F2 lowering may also more generally occur in non-velar contexts.
    - /ɛ/ Relatively high frequency F2 expected in non-labial contexts.
    - /ʌ/ Relatively high frequency F2 is predicted in non-labial contexts; slight F2 lowering may occur in labial contexts.
4. Effects of position in word. Word position will have little effect on the F1 and F2 measures of the target vowels.

3.9.3 Social variables

The social factors included in this analysis are based on (1) global social characteristics that often have a significant effect on the variation of sociolinguistic variables and (2) the ethnographic findings discussed in chapter 2. Chapter 2 provides a descriptive overview of many aspects of participants' social interactions and world; I have interpreted the description, fieldwork observations and sociolinguistic interview data to create variables compatible with a statistical analysis. The social variables that emerge from ethnography were never presented as explicit labels to participants during interviews. I have created the variables after listening to, transcribing, and reflecting on the interviews and my fieldnotes. Here I describe each of the social variables; a summary of the variables and their individual levels is provided in Table 3.11 below.

The first social variable, *sex*, is relatively straightforward, and participants' labels are assigned based on self-identification. (No students provided answers that challenged a

male-female sex-identification binary.) The category of *Lebanese/non-Lebanese* refers to whether or not an Arab American student identifies as Lebanese. This category creates a broad intra-ethnic distinction (i.e., all non-Lebanese students – which includes Iraqi, Palestinian, Syrian, and other students – are grouped together). I test this variable because of the social distinction between Lebanese and non-Lebanese students that is specific to the immigration and settlement patterns of Dearborn. Assignment of this variable is again straightforward and based on students' self-identification of ethnic identity and nationality. None of the participants in this study has parents of mixed national background. The variable of *age at immigration* is also a direct translation of reported information, demarcating three levels: students born in the U.S.; students who were born abroad and came to the U.S. before the age of 5; and students who were born abroad and came to U.S. after the age of 5. The age of 5, while in some respects arbitrary, was chosen as a break point for this variable because I perceived a qualitative difference between students who came to the U.S. before the age of 5 and students who immigrated after. Five years old is also the average age for starting public school (Kindergarten) and formal education, which may include language classes for immigrant students. Statistical results (as presented chapters 4 and 5) demonstrate whether my hypothesis about the break is statistically significant.

The final three variables are more subjective – all three are based on information reported to me in interviews, but I impose a degree of artificial categorical differentiation between students. Further, the categorizations are subjective and based on my reflections on, and perceptions and assessment of, students' responses during interviews. All students identified as Muslim but described varying degrees of religious practice. The variable *religious practice* has two levels: *regular religious practice* that includes, for example, daily prayer, weekly mosque attendance, and knowledge of the Qu'ran; and *sporadic religious practice*, which includes students who pray or attend mosque irregularly or sporadically (e.g., once a month, or for religious holidays) or the few students who identified as Muslim and as religious but stated they were not actively practicing (through prayer, mosque attendance, fasting, or other explicit participation in religious events and traditions).

The next variable, *future plans*, describes students' long-term intentions to stay in Dearborn, as those plans were given to me in the interview.[23] The level *stay in Dearborn* includes students who have no intention of leaving Dearborn. Nine of the 17 students fell into this category. Students who had no plans or intentions to leave Dearborn were certainly the norm among students I interviewed and students who I encountered in non-interview settings. Students felt an obligation to their families and felt it was important to be near them. A few students in this category said their families and "all the Arabs" in Dearborn drove them crazy but they couldn't imagine being anywhere else. Some students also indicated their families would not let them leave Dearborn. Students in the *leave Dearborn* level wanted to leave Dearborn but intended to stay in Michigan. These students were generally interested in economic or educational opportunities not available in their hometown, though a few students also wanted to get a little distance from Dearborn while remaining close enough to see family regularly. Students in the leave Dearborn category overall seemed to be the least emphatic about their future plans; they are the participants whose categorization may be most likely to change. The third category, *leave Michigan*, includes students who have no intention of staying in Michigan. The four participants who fell into this category had widely varied reasons for wanting to leave Dearborn and Michigan. One student wanted to pursue an acting career and wanted to go to college in New York City to meet those goals. Another student wanted greater economic opportunities and felt the economic downturn in Michigan would be severely detrimental to their plans. And other students just wanted to get out of Dearborn and see what else was out there.

The final social variable is *importance of ethnic label*, which has two levels: students who think that there is an important, meaningful, and context-dependent difference in the array of ethnic label choices available to students; and students who don't see much, if any, difference among the ethnic label choices available to them. Part of my impetus for including this variable is that a student's views on these ethnic labels seem to indicate their level of awareness of larger social forces that bear on their ethnic identity, and that their choices affect their interpersonal relationships.

[23] A caveat to keep in mind here is the possibility that students' plans could change drastically depending on changing family, economic and educational circumstances.

Table 3.11 Summary of social variables included in statistical analysis.

Social Variable	Levels
Sex	Male
	Female
Lebanese / Non-Lebanese	Yes
	No
Age at Immigration	U.S.-born
	By age 5
	After age 5
Regular Religious Practice	Regular
	Sporadic
Plans to stay in/leave Dearborn	Leave Michigan
	Leave Dearborn (but stay in Michigan)
	Stay in Dearborn
Importance of Ethnic Label	Important
	Not Important

3.9.4 Hypotheses about the effects of the social variables

The section below includes predictions of how each social variable will impact the variation of the vowels. My hypotheses about the variation associated with each social variable are drawn from Eckert's theory of sound change spread, which I discussed in chapter 1. Recall that in her model, based on the findings from her research among adolescents at Belten High School in Southeastern Michigan, the social distribution of older linguistic variables is more diffuse, associated with broader social categories and characteristics. Newer linguistic variables, on the other hand, provide potential for the expression of local social distinctions. For the students at Belten High, local identity is based on an orientation towards or away from the locally based urban culture (Eckert 2001:224). Thus the newer variables originate (geographically) in urban centers and they are also associated with and indexical of urbanness. In my study, the local social variables are not associated with an urban identity, but rather they are linked to the local-to-the-high-school distinctions and social characteristics that are relevant and meaningful to students at Mercer.

For each of the social variables below, my hypothesis is two-fold. The first part is a prediction about whether the social variable will have a statistically significant effect on the older or newer variables. The older variables are /ɑ/ and /æ/; the newer variables are /ɛ/ and /ʌ/. The second part of the prediction concerns the nature of the effect of the social variables on the vocalic variation.

Sex: Speaker sex is predicted to show statistically significant variation in the *older* variables. Female speakers should be more NCS-like than male speakers.

Reasoning: I base this prediction on generally observed trends in sociolinguistic studies in which women tend to lead men in the use of new variants. Labov (1991) summarizes findings from many sociolinguistic studies in which women lead men in "changes from below" – that is, changes like the NCS which are system-internal.

Lebanese/Non-Lebanese: This ethnically-based distinction is predicted to show variation in the *newer* variables. Lebanese speakers should be more NCS-like than non-Lebanese speakers.

Reasoning: Lebanese students make up a substantial majority (about 75%) at Mercer High School (a reflection of the demographics in Dearborn). Lebanese students are comfortable with their social position at school. Many non-Lebanese students express discomfort with the school's social order and think that the Lebanese majority discriminates against them. Use of NCS variants could be indexical of affiliation with the mainstream group, which at Mercer is the Lebanese crowd. Non-Lebanese students may use non-NCS variants to distance themselves from Lebanese peers. Though ethnic identity is generally a macro-social characteristic, the meaningful ethnic distinctions at Mercer are intra-ethnic and highly localized; therefore, following Eckert's model, I predict that the newer (and possibly more salient) variables will be more suited to serve as sites of intra-ethnic differentiation.

Age at Immigration: I predict that this variable will have a similar effect on *all four* vocalic variables, both old and new. U.S.-born participants will be the most NCS-like, while students who came after age 5 will be the least NCS-like. The group of students who came the U.S. by age 5 will fall in between the other two groups.

Reasoning: My predictions about the relationship between students' age at time of immigration and their vocalic variation are based on acquisition of a first versus second language and not on the social information. Students who have lived their entire lives in Dearborn will have more exposure to the NCS and therefore are more likely to have picked it up. Students who have come to Dearborn later will have less exposure to English and to the NCS variety of English generally spoken in Southeastern Michigan and are more likely to speak English that may be phonologically influenced by their first language. While the predictions for the effects of this variable are tied more to acquisition than to social information, there is also a

degree to which immigrant status at Mercer matters socially, often playing a role in students' friendships and social networks.

Level of Religious Practice: This variable should show statistically significant effects on the patterns of the *newer* vowels in the NCS. Students with a sporadic religious practice should be more NCS-like than students who have regular religious practice.

Reasoning: Everyone I interviewed identified as Muslim and as religious, but participants seemed to qualitatively differ in their level of practice. Students generally expressed a neutral stance about their religious practice; it seems that religious practice is a central part of their lives but blends into the background in terms of social relationships. I predict that students in the sporadic group will use more NCS-like variants.

Importance of Ethnic Labels: Students who find ethnic labels not important should be more NCS-like than students who find ethnic labels important. I predict that this variable will have a statistically significant effect on the *newer* vocalic variables in the NCS.

Reasoning: Students who think the labels are important may have more awareness of social difference and discrimination and its impact on students' lives.

Future Plans: Students who plan to stay in Dearborn will be more NCS-like than students who plan to leave Dearborn or to leave Michigan. The *older* vocalic variables will show this variation.

Reasoning: Students who want to leave Dearborn may be more interested in distancing themselves from the norms of the high school and town. I hypothesize that this variable affects the *older* vocalic variables as students' long-term plans are not a social characteristic that is exclusive or local to Mercer.

3.10 Statistical methods

In this section I describe the statistical methods used in the analysis of each of the four NCS vowels considered in this study. For each vowel, the first step is an analysis of the effects of each independent linguistic and social variable. While the univariate analyses of independent variables do not control for the effects of the other variables, they do provide information about the direction of the effects of each variable that cannot be as easily determined from a multivariate model.

A note about the linguistic variables of following and preceding contexts is needed. For each of the two phonological contexts, preceding and following, I eliminated a context from analysis if there were fewer than 10 tokens in order to maximize the statistical power of the test (at the suggestion of my statistical consultant to improve accuracy of statistical results). Thus, the phonological contexts included in the statistical analysis vary for each vowel. While some contexts, such as alveolar, often occur frequently as preceding and following contexts for tokens, this also varies from vowel to vowel. /æ/, for instance, has 138 tokens with /h/ as the preceding context and 115 tokens with dental sounds as the preceding context, considerably more tokens for both contexts than any other of the vowels. This is due to the patterns of English and lexical frequency, perhaps particularly in words used in an interview setting. While it would be ideal for the purposes of statistical testing and comparison if the contexts were consistent across vowels, the variation perhaps more accurately represents the distribution of these vowels in non-scripted speech. In the section on linguistic variables for each vowel, I provide the preceding and following contexts and include token counts for each one. In order to maintain consistency, eliminated tokens are also not included in the mixed models created for each of the vowels (see below for discussion on mixed models).

In the univariate analysis, linguistic variables are tested at the token level, while social variables are tested at the speaker level. Thus, the univariate analysis for linguistic variables include several hundred cases and the univariate analyses for social variables each include only 17 cases, the individual speaker averages for the relevant (first or second) formant measure. While the univariate analysis of the linguistic variables violates the independence assumption – that all the token measures are independent from one another – it does allow an examination of the raw patterns in the data. The univariate analysis of the linguistic variables serves as a first look at the data, but is not the focus of the statistical analysis. The tests performed on the social variables – one-way ANOVA and Mann-Whitney u-tests – are not designed to address the complexity that arises with repeated measures for one speaker. What this means is that these tests are done on average formant values for each speaker instead of on formant measures for all individual tokens, giving these tests less statistical power than the multivariate mixed models that are the culmination of the statistical analysis. But since the social variables here are all constant within one speaker, speaker-level measures are nevertheless appropriate for the univariate analysis.

For the multivariate model, however, which incorporates all of the independent variables together, a token-by-token analysis is employed. Like the univariate linguistic analysis, the multivariate model gains in statistical power and accuracy by using hundreds of tokens instead of just 17. Since the multivariate model includes linguistic predictors, and these vary within and across speakers, speaker-level measures would not be appropriate. Using multiple measures of the same vowel from one speaker, however, violates the independence assumption, which asserts that any one token in the model is equally independent from all other tokens. On the contrary, tokens from one speaker are not as independent from each other as they would be from tokens from any other speaker. Tokens from one speaker are clustered together. To address this issue, a mixed model is used instead of a simpler regression model, and the speaker is treated as a random effect in the model.

The design of each mixed model began with an initial model that included all six social variables, the linguistic variables that showed up as statistically significant in the univariate analyses (for most of the vowels, all three linguistic variables are included). Additionally, the initial model includes five two-way interactions between four of the social variables – sex combined with Lebanese/non-Lebanese ethnicity, religious practice, and ethnic labels, and ethnicity combined with religious practice and ethnic labels.

3.11 Summary

This chapter began with an argument in favor of expanding documentation and discussion of methods in sociophonetic studies. In addition to providing necessary methodological information, documenting the details of the phonetic methods may help this work speak to future work in meaningful ways. As I discuss later in chapters 4 and 5, I have a limited capability to relate this study to past work because of the vast disparities in methods of analysis, but perhaps, as sociophonetic studies move towards improved documentation and transparency in methods, comparisons will be more specific and thus more useful in identifying trends and patterns across studies.

I discussed several aspects of the acoustic methods used in this study, including normalization procedure I use to standardize the data values and allow for cross-speaker vowel comparisons, methods for token selection, and acoustic measures of the first and second formants. This chapter also provides an overview of the data, and several diagnostic tests which suggest that the NCS is present among the participants' data and

that there is a great deal of variation across participants. Finally, I introduced the linguistic and social variables, along with hypotheses about the effects of both types of variables on the four vowels, and briefly described the statistical tests used in my analysis, the results of which are discussed in the next two chapters.

Chapter 4: The Older Variables: /ɑ/ and /æ/

4.1 Introduction

This chapter presents statistical analyses – in the form of multivariate mixed-effects models -- of two of the older variables in the NCS: /ɑ/ and /æ/. For each vowel, prior to presenting the mixed model, I begin with several univariate tests, which consider the effects of each of the independent linguistic and social variables separately. The univariate analysis provides a "first look" at the data, and gives information about the direction of the effects of the individual variables. But the univariate tests do not have the same kind of statistical power as the mixed model results. Inclusion of both tests is potentially confusing in that the univariate and multivariate results often differ from one another. Disparities between the two kinds of test results lie in the inclusion of additional factors in a mixed model; the mixed model is not a simple addition of all the univariate analyses. However, univariate analyses facilitate comparisons to past research, which include a combination of univariate and multivariate tests, and so I have chosen to include them in my results and discussion. Ultimately, though, I rely on the results of the mixed models to analyze and discuss the social patterning of the four NCS vowels as the mixed models provide a more comprehensive picture of the social variability of each vowel.

In earlier chapters I discussed research on the NCS in general (see chapters 1 and 3), and in this chapter I discuss the results of the univariate statistical tests in relation to past findings. /ɑ/ and /æ/ are the two most well-studied variables within the NCS and, as such, there is a fair amount of research on their patterns of variation, though the methods and discussion of these findings are varied. I conclude this chapter with a discussion of the older variables together and a preliminary examination of how the results of the mixed models compare to my hypotheses (§3.9.4) about the effects of the social variables on the older variables. Finally, a caveat is in order: throughout this discussion I interpret the statistical results in terms of articulatory dimensions (fronting/backing and

raising/lowering), but it is important to note that these articulatory descriptions are in fact inferred from the acoustic measures.

4.2 /ɑ/

Socially meaningful /ɑ/-variation occurs along the (front/back) F2-dimension, and the diagnostic tests in chapter 3 suggested that among these participants there is robust but variable /ɑ/-fronting. Many of the participants' /ɑ/ had F2 values that were the same as or higher than their /ʌ/ measures. Several participants also had a mean /ɑ/ F2 value that was higher, suggestive of more fronted articulations, than that of the baseline NCS speaker whom I used as an illustrative comparison. Results of the mixed model show a wide range of social variation linked to /ɑ/-fronting, suggesting that any social patterning for this vowel is not focused on a particular social distinction but linked to several.

4.2.1 Univariate analysis of linguistic variables

This section reports on the results of the three linguistic variables, which all had significant effects on the F2 of /ɑ/. In my hypotheses on chapter 3 I made the following prediction about the effects of the linguistic variables on /ɑ/:

- Relatively high frequency F2 expected in non-labial contexts.

This hypothesis guides my discussion of the results below.

Preceding context

A one-way analysis of variance of the effects of preceding context on the F2 of /ɑ/ was statistically significant at a level of $p<.001$. (Sounds included in each category are specified in 3.9.1.) The token counts and mean F2 for each context included in the ANOVA are summarized in Table 4.1 ranked from lowest to highest mean F2 (interpreted as least to most fronted). Recall that all formant values are normalized (see §3.6). The table also includes rescaled values in Hertz for each category. Rescaled Hertz values are included in several tables in this chapter and chapter 5. They are calculated based on raw data only and are meant to illustrate the magnitude of difference between categories in a way that may be more familiar to readers than normalizd values; they do not play a role in the statistical analysis. Graphical representations throughout the discussion show the relative position of normalized values in the F1/F2 acoustic space and should also assist with interpreting the effects of independent variables. Here, the difference between the highest and lowest F2 values of over 100 Hertz suggests differences that are perceptible. Scheffe post-hoc tests, summarized in Table 4.2, revealed

significant differences between the contexts of velar and alveolar, velar and pause, and post-alveolar and pause (See Appendix C for full statistical results). Preceding post-alveolar or velar contexts have the two most fronted F2 averages of all the contexts. The effects of post-alveolar and velar contexts on /ɑ/-fronting are expected based on my hypothesis. The least fronted context, glide, did not show significant differences with post-alveolar or velar contexts; this is likely due to the low number of tokens preceded by glides, as the low token count will result in a higher standard error. As my hypotheses were based on place rather than manner effects, no prediction about the effect of glide was made. Of the 12 glide tokens included, 11 of those glides are labio-velar /w/, which, like other labials, is epected result in a lower F2 for /ɑ/. Similarly, the low number of tokens preceded by /h/, which have a mean F2 that is very close to the mean of tokens preceded by post-alveolar sounds (post-alveolar mean F2 = -2.36 and /h/ mean F2 = -2.34), likely also contributes to the lack of significant differences between /h/ and other contexts.

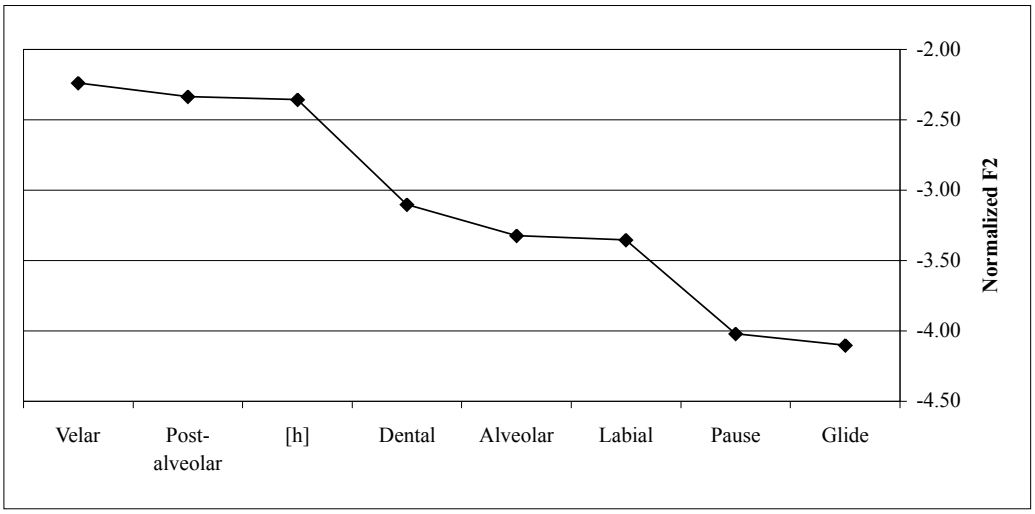
Table 4.1 Mean normalized formants by preceding context for /ɑ/.

Context	Token count	Mean F2	Rescaled Hz
Glide	12	-4.10	1218
Pause	42	-4.02	1225
Labial	53	-3.35	1297
Alveolar	190	-3.32	1325
Dental	13	-3.10	1351
/h/	14	-2.36	1457
Post-alveolar	35	-2.34	1439
Velar	105	-2.24	1459
Total	464	-3.04	1354

Table 4.2 Partial summary of pairwise post-hoc tests of preceding contexts for /ɑ/.

	Glide	Pause	Labial	Alveolar	Dental	/h/
Velar	---	***	†	**	---	---
Post-alveolar	---	*	---	---	---	----
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant						

Figure 4.1 F2 of /ɑ/ by preceding phonological context



In summary, as Figure 4.1 shows, there appears to be three tiers of contexts. Pause and /w/ (glide) contexts have the lowest mean F2 /ɑ/ values, the middle tier of dental, alveolar, and labial contexts all have mean F2 /ɑ/ values that hover around the overall mean for all the contexts together; these results for dental and alveolar contexts are contrary to my prediction that they would promote /ɑ/-fronting. Finally, velar, post-alveolar and /h/ contexts have the most fronted mean F2 /ɑ/ values. Below I compare these results to past findings on the NCS.

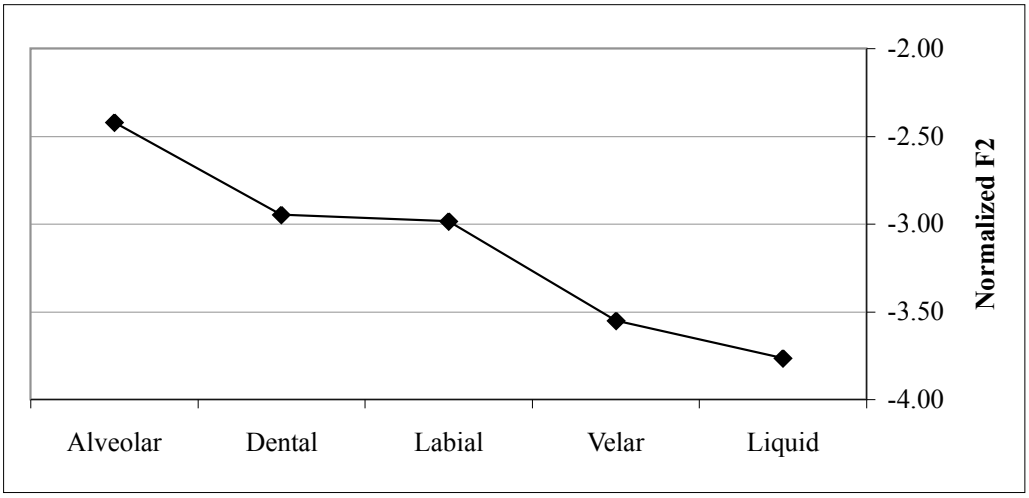
Following context

The following context variable, summarized in Table 4.3, also showed significant effects on the F2 of /ɑ/ in a one-way ANOVA at a level of $p<.001$. The contexts of dental and labial both have a mean F2 of /ɑ/ that is very close to the overall mean, and have no significant effect on /ɑ/-fronting. The dental result is unexpected based on my hypotheses that dental (and other non-labial) contexts would result in higher F2 /ɑ/ values. Liquid and velar contexts have mean F2 of /ɑ/ values that are much less fronted than the overall mean, while the alveolar context has a mean /ɑ/ value that is much more fronted than the overall mean for /ɑ/, which is as expected. The effect of the liquid context is difficult to interpret when comparing its effects to other contexts that are based on place; a drawback of my liquid and glide context categories is that they don't separate out place and manner.

Table 4.3 Summary of following context for /ɑ/

Context	Number of tokens	Mean F2	Rescaled Hz
Liquid	24	-3.76	1262
Velar	147	-3.55	1295
Labial	142	-2.99	1363
Dental	20	-2.95	1377
Alveolar	130	-2.42	1471
Total	463	-3.04	1354

Figure 4.2 F2 of /ɑ/ by following context



Scheffe post-hoc tests confirm the significance of this pattern, revealing significant differences for /ɑ/-fronting between alveolar, the preceding context with the most fronted mean /ɑ/ value, and liquid and velar, the contexts with the least fronted /ɑ/. The higher degree of significance between alveolar and velar contexts than between liquid and alveolar contexts is likely due to the lower token count for liquid context, which results in a higher standard error and lowers the likelihood of obtaining significant results. Scheffe post-hoc tests are more conservative in finding significance in pairwise comparisons than other kinds of post-hoc tests (e.g. Tukey) and I use them to accommodate the wide range of token counts across contexts, particularly for the preceding and following context tests.

Table 4.4 Summary of post-hoc results for ANOVA of following context on F2 of /ɑ/

	Velar	Labial	Dental	Alveolar
Liquid	---	---	---	*
Velar		---	---	***
Labial			---	---
Dental				---
Alveolar				
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant				

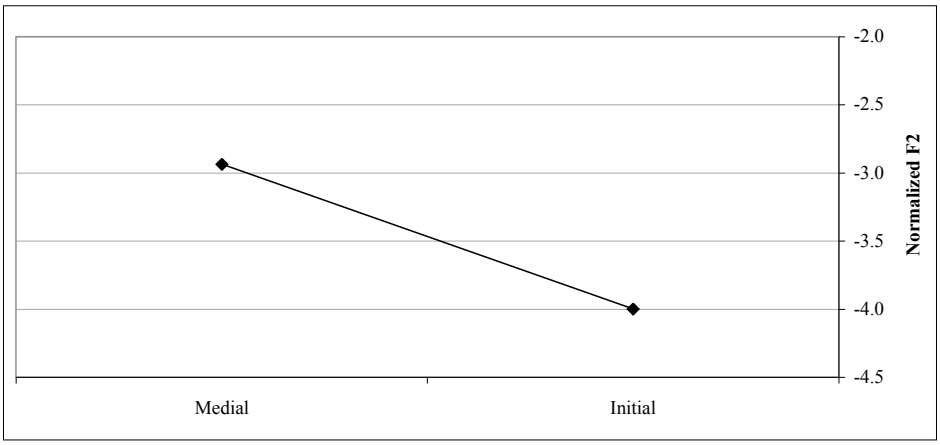
Position in word

The position in word variable tested differences between tokens occurring in word-initial and in word-medial positions (see §3.9 for discussion of why word-final tokens are not included). I tested the effects of word position using a Mann-Whitney u-test, which is similar to a t-test but is a non-parametric test for comparing means between groups of unequal size. For this variable the difference in token count for the two categories is large --word-medial tokens make up the overwhelming majority of tokens (90.7%)-- but the u-test showed significant results (p=.001; U=6367.5) between the two groups. Tokens occurring in word-initial position are significantly less fronted than tokens occurring word-medially, which is not expected based on my hypothesis that word position will have little effect on F1 or F2 of the target vowels. One possible explanation is that word-initial tokens are more peripheral than word-medial tokens as a result of domain-intial strengthening (see e.g., Cho and Keating 2009, Lehnert-LeHouillier and McDonough 2009). For /ɑ/, this means word-initial tokens are more backed than word-medial tokens. However, as domain-initial strengthening effects are not robustly found in vowels, this is only a tentative possiblity.

Table 4.5 F2 of /ɑ/ by position in word

Position	**Number of Tokens**	**Mean F2**
Initial	43	-4.00
Medial	424	-2.94
Total	467	-3.04

Figure 4.3 F2 of /ɑ/ by position in word.



All three linguistic variables show robust effects on /ɑ/-fronting in the univariate analyses. For both preceding and following contexts, there are contexts which promote /ɑ/-fronting and contexts which discourage it. Preceding velar, post-alveolar, and /h/, and following alveolar all result in higher mean F2 /ɑ/ values , while preceding pause and liquid and following velar and glide result in lower mean F2 /ɑ/ values. In relation to my hypothesis, these findings are not unexpected, though some of the effects I expected to see (e.g. lower F2 /ɑ/ in labial contexts and higher F2 /ɑ/ in dental contexts) are not present. The effects of preceding and following context are robust and many of these general patterns, particularly the effects of preceding context, are strong enough to appear in the mixed model below (§4.2.4). /ɑ/ occurring in word-initial position is overall less fronted than word-medial /ɑ/ tokens, but the results of the mixed model show that the effect of position in word are tempered by the other independent variables and is not significant in the model.

4.2.2 Univariate analysis of social variables

The six social variables, and select interactions between some of the variables, were all submitted to individual statistical analysis to gauge the effects of each variable, though without controlling for the effects of the others. The results of the univariate statistical tests are summarized in Table 4.6, which is organized by the significance of the results of each test. As with the univariate linguistic tests, variables with two levels (e.g. speaker sex) were tested with a Mann-Whitney u-test. Variables with three or more levels (e.g. age at immigration) were tested using a one-way Analysis of Variance (ANOVA) and Scheffe post-hoc tests. The effect of speaker sex on /ɑ/-shifting was the most robust and no other social variable on its own had a significant effect on the variation of F2 of /ɑ/.

The effect of ethnicity (defined here as a distinction between Lebanese and non-Lebanese) approached significance (p=.062), but was not significant as a variable on its own. The interaction of speaker sex and other variables, along with the interaction of ethnicity and other variables proved to be some of the more robust results of the univariate analyses. Below I discuss the significant (and marginally significant) results. Full results of the tests for all of the variables can be found in Appendix C

In chapter 3 I presented hypotheses about the effects of each of the social variables on the vocalic variation. I predicted that three of the six social variables would have an effect on /ɑ/-variation as follows:

Sex	Female speakers will have more fronted /ɑ/ than male speakers
Age at Immigration	U.S. born speakers will have the most fronted /ɑ/ and speakers who arrived in the U.S. after age five will have the least fronted /ɑ/.
Future Plans	Students who plan to stay in Dearborn will be more fronted than students who plan to leave Michigan or leave Dearborn.

In light of these hypotheses, many of the results of the statistical analysis are unexpected, which I discuss further in chapter 6.

Table 4.6 Results of social variables on /ɑ/-variation

Variable	**Test type**	**p-value**
Significant (p<.05)		
Sex	u-test	.036
Sex*Lebanese/Non-Lebanese Ethnicity	ANOVA	.017
Sex*Religious Practice	ANOVA	.049
Marginally significant/Approaching significance (p<.065)		
Sex* Ethnic Labels	ANOVA	.058
Lebanese/Non-Lebanese Ethnicity	u-test	.062
Not significant		
Age at Immigration	ANOVA	.387
Ethnicity * Religious Practice	ANOVA	.070
Ethnicity*Ethnic Labels (on F1)	ANOVA	.072
Religious Practice	u-test	.093
Importance of Ethnic Labels	u-test	.139
Future Plans	ANOVA	.595
Ethnicity*Ethnic Labels (on F2)	ANOVA	.143

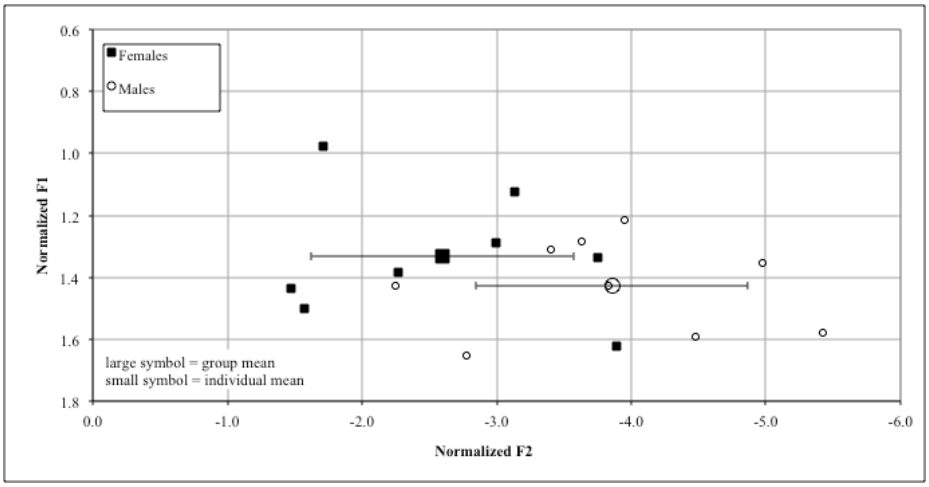
Speaker sex

A Mann-Whitney test of speaker sex on the F2 of /ɑ/ showed significant differences (p=.036; U = 14; z= -2.117). As hypothesized, female speakers had a higher (i.e. more fronted) mean F2 value than the mean F2 of /ɑ/ for male speakers, and the rescaled Hertz in Table 4.7 below suggest that the difference between male and female speakers of roughly 150 Hertz is perceptible. Figure 4.4 below illustrates this overall pattern of females having /ɑ/ productions that are more fronted than those for male speakers. The scatter plot in Figure 4.4 shows that three females have the most fronted individual means while four males have /ɑ/ productions with the least fronted individual means, with a fair amount of overlap between the productions of males and females in the middle. The edges of the space of F2 variation appear to be fairly distinct with respect to gender. The overall female lead in /ɑ/-fronting is a fairly common finding in sociolinguistic studies of sound changes like the NCS, though we will see that this pattern does not hold across all four vowels. Below I discuss interactions with sex showing that /ɑ/-fronting appears to be a resource for social differentiation between women in the study, but not men. In §4.3.4 I briefly discuss this and I return to this topic in chapter 6.

Table 4.7 F2 of /ɑ/ by speaker sex

Sex	N	Mean Normalized F2	Standard Deviation of F2	Rescaled Hz
Male	9	-3.857	1.01	1456
Female	8	-2.600	.98	1303

Figure 4.4 /ɑ/ by speaker sex



Lebanese/non-Lebanese ethnicity

Contrary to my prediction that ethnicity would not influence variation in the older variables, tests on the effect of Lebanese/non-Lebanese ethnicity on the F2 of /ɑ/ had results that approached significance (p=.062; U=14; z=-1.910). Though the averages in Table 4.8 indicate that overall Non-Lebanese students have /ɑ/ productions that are more fronted than Lebanese students' /ɑ/ productions, the averages only tell part of the picture. The error bars in Figure 4.5, which mark one standard deviation on either side of the mean, show a great deal of overlap between Lebanese and non-Lebanese speakers. But, productions of four of the Lebanese speakers and two of the non-Lebanese speakers lie outside of the error bars, indicating a fair amount of variation across participants in both groups. In Figure 4.6 a comparison of the range of non-Lebanese speakers' mean F2 of /ɑ/ values and the Lebanese speakers' mean F2 of /ɑ/ values is possible and shows that the upper end of the ranges are very similar (-1.48 for the most fronted non-Lebanese speaker and -1.57 for the most fronted Lebanese speaker), while the lower end of the ranges are quite different. The least fronted Lebanese speaker's vowels have a mean value of -5.42, compared to the least fronted non-Lebanese speaker's vowels, which have a mean value of -3.89. The vowel productions of Lebanese participants have a much larger range of variation than the non-Lebanese participants' productions and the Lebanese group's range is as far fronted as the non-Lebanese group's range. Thus, the difference in mean values for the group (which only approaches significance) is likely to be more about the differences at the lower end (the least fronted) of the ranges than differences at the higher end. That is, the individual means suggest that rather than a non-Lebanese lead in /ɑ/-fronting, there is a lag in or resistance to /ɑ/-fronting among Lebanese participants.

Table 4.8 Lebanese/non-Lebanese ethnicity and /ɑ/

Ethnicity	**N**	**Mean F2**	**Standard Deviation of F2**
Lebanese	11	-3.66	1.12
Non-Lebanese	6	-2.54	.91

Figure 4.5 /ɑ/ by Lebanese/non-Lebanese ethnicity

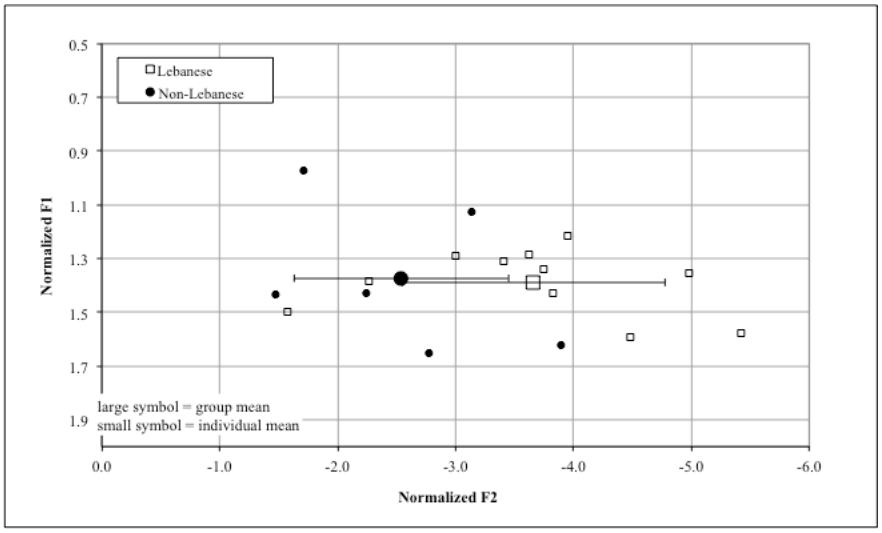
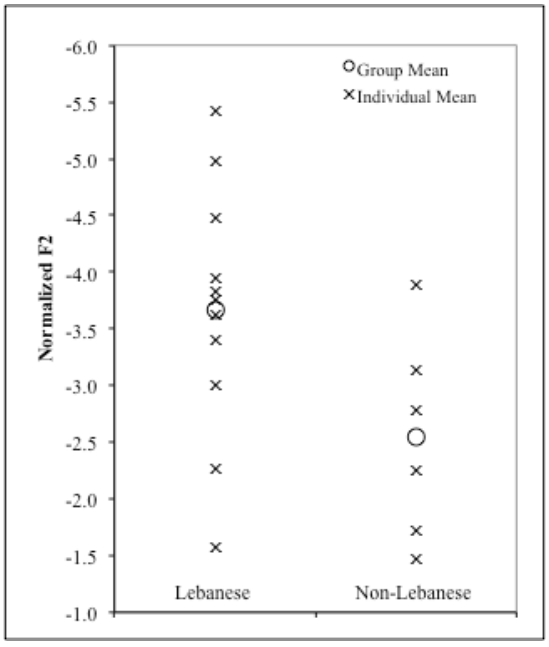


Figure 4.6 Individual and group mean F2s for /ɑ/ by ethnicity



Below I discuss the interaction of speaker sex with three other variables. These tests clarify the variation linked to speaker sex and suggest that some of the other social variables I proposed are gender-differentiated for /ɑ/-fronting.

Speaker sex and Lebanese/non-Lebanese ethnicity

The combination of speaker sex and ethnicity showed a significant effect on /ɑ/-fronting in a one-way ANOVA at a level of p=.017. The post-hoc tests showed no significant

results in pairwise comparisons of groups in the interaction, but the mean /ɑ/ for Lebanese male participants differed from the mean /ɑ/ values for both Lebanese and non-Lebanese female participants at levels that approached significance or were marginally significant: the mean /ɑ/ for Lebanese males differed from the mean /ɑ/ for Lebanese females at a level of p=.083 and from non-Lebanese females at a level of p=.064.

Table 4.9 Mean F2 by speaker sex and ethnicity for /ɑ/

Sex	Ethnicity	Average (norm) F2	N
Female	Non-Lebanese	-2.39	4
	Lebanese	-2.40	4
Male	Non-Lebanese	-2.45	2
	Lebanese	-4.08	7

Figure 4.7 and Figure 4.8, below, show that Lebanese males' /ɑ/s are on average less fronted than those of all three other groups. The figures also show how close the average F2 values of the Lebanese and Non-Lebanese females are to each other and to non-Lebanese males. The error bars in Figure 4.7 show very little overlap between Lebanese males' /ɑ/s and those of the three other groups in the interaction. The vowels of the Lebanese male with the most fronted productions (with a mean of -3.40) are still less fronted than the means of the productions for the other three groups (though his mean is more fronted than two female speakers). /ɑ/-fronting, or in this case, Lebanese males' /ɑ/ productions *not* being as fronted as their fellow students', may be a source of differentiation along ethnic lines for males but not for females or it may be a way that Lebanese males in particular distinguish themselves from all other students.

Figure 4.7 Sex and Lebanese/non-Lebanese ethnicity and /ɑ/.

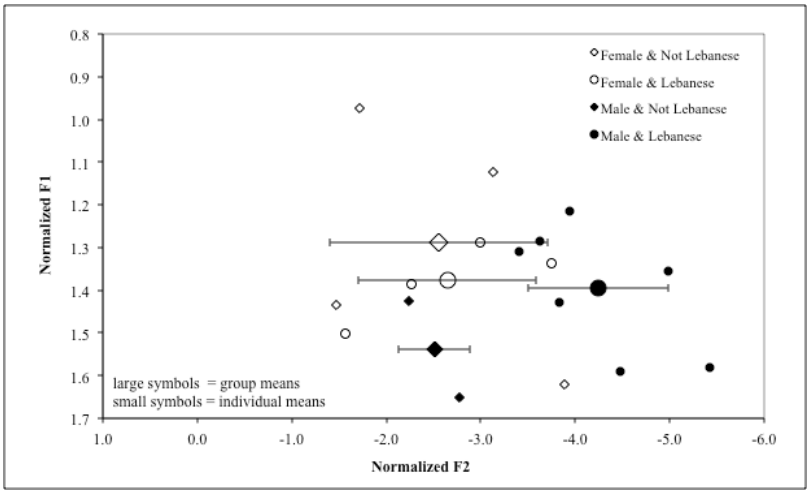
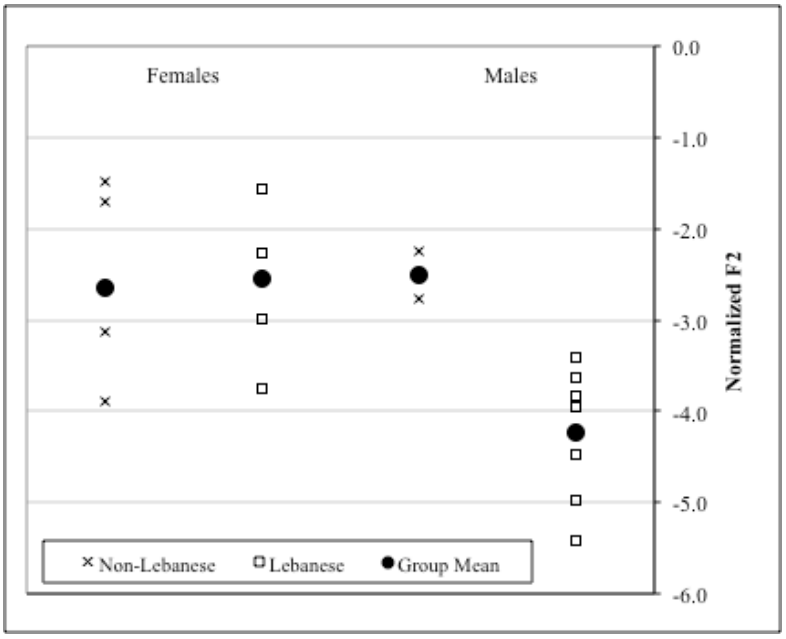


Figure 4.8 Individual and group mean F2 of /ɑ/ values by sex and ethnicity



Speaker sex and religious practice.

I hypothesized that religious practice would not have a significant effect on /ɑ/-fronting (as an older vowel in the NCS), but a one-way ANOVA of the effects of the combination of speaker sex and level of religious practice on the F2 of /ɑ/ was significant at a level of p=.049 (religious practice on its own did not have significant effects on /ɑ/-fronting). Post-hoc tests showed no significant differences in pairwise comparisons, but the difference between the /ɑ/ productions of males with a regular practice and the /ɑ/ productions of females with a sporadic practice was marginally significant at a level of p=.068. No other pairwise comparisons approached significance or were marginally significant. Females who practice religion sporadically have, on average and to varying degrees, more fronted /ɑ/s than the other groups, with the three females with the most fronted /ɑ/s all in the sporadic religious practice category. Males with regular religious practice had the least fronted /ɑ/ productions on average but the individual means are more spread out than the mean /ɑ/ values for females with sporadic practice. A generalization of females with sporadic practice having an overall lead in /ɑ/-fronting is somewhat tempered by the rather wide range of individual means within each of the groups (except perhaps for females with regular religious practice, as evidenced by the smaller standard deviation range shown in Figure 4.9 and clustering of individual means shown in Figure 4.10). Here and throughout, a description of large spread or tight

clustering of individual means around the group mean serves as a non-statistical indication of the reliability of the group mean as being representative of the individuals that make up the group. Tightly clustered means indicate a more reliable group mean than widely spread individual means. However, the size of the group should be kept in mind, as some of the groups in the analyses have just two or three individuals.

Table 4.10 Mean F2 of /ɑ/ by speaker sex and religious practice

Speaker Sex	Religious Practice	Average F2	Number of Speakers
Female	Regular	-3.34	3
	Sporadic	-2.16	5
Male	Regular	-3.98	5
	Sporadic	-3.70	4

Figure 4.9 /ɑ/ by speaker sex and religious practice

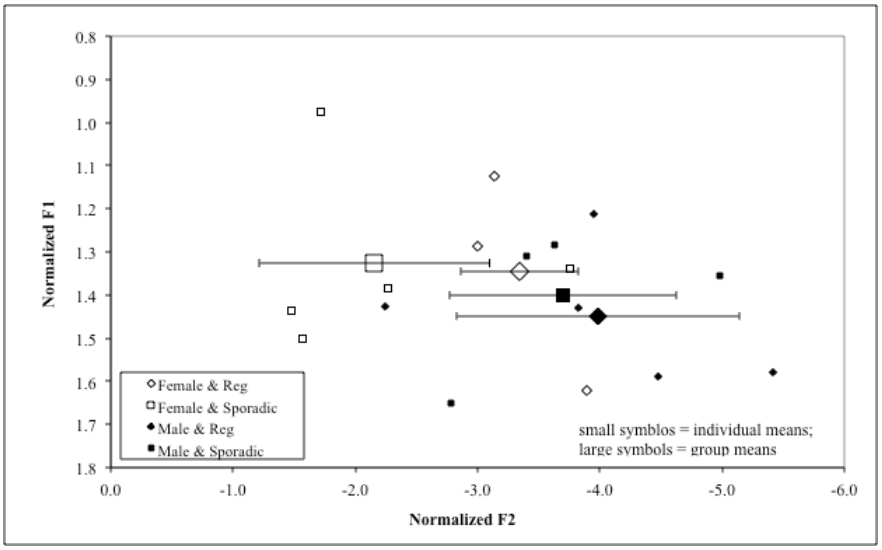
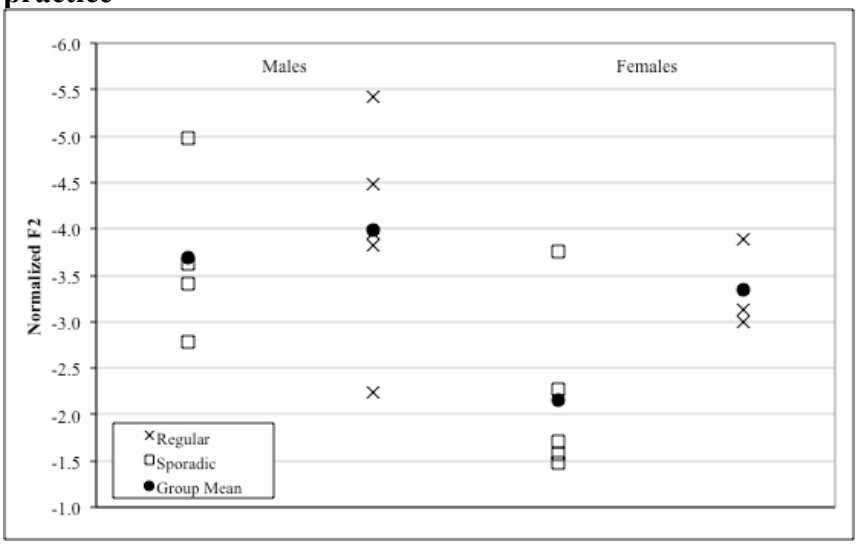


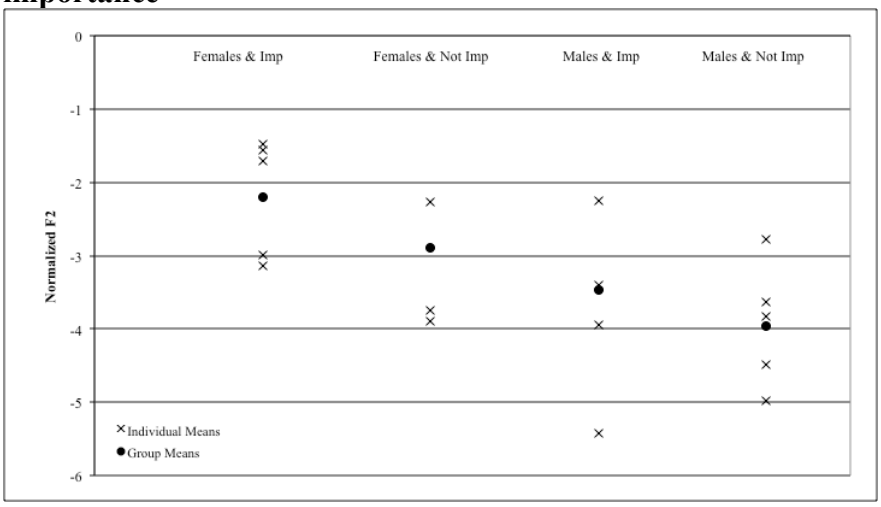
Figure 4.10 Individual and group mean F2 values of /ɑ/ by sex and religious practice



Speaker sex and ethnic label importance

The final interaction involving speaker sex is with the importance of ethnic labels, and it showed an effect on /ɑ/-fronting that approached significance (p=.058), though I hypothesized that ethnic label importance would not have a significant effect on /ɑ/-fronting. Post-hoc tests revealed a difference in /ɑ/ values that was marginally significant (p=.087) between females who think choice in labels is important and males who do not think choice in ethnic labels is important. The group mean F2 values in Figure 4.11 show that females who think labels are important had the most fronted /ɑ/ values and males who didn't think they were important had the least fronted /ɑ/ values, with the other two groups having /ɑ/ values in between. The effect of the combination of sex and ethnic label is not as strong on /ɑ/-fronting as the combination of sex with ethnicity or sex with religious practice.

Figure 4.11 Individual and group mean F2 of /ɑ/ by sex and ethnic label importance



Summary of univariate analysis of social variables

In the univariate tests of the social variables, in which effects of other variables are not controlled, only sex had a statistically significant effect on variation in the F2 of /ɑ/. Neither age at immigration or future plans had significant effects on /ɑ/-fronting in the univariate analysis, contrary to my predictions. Among the participants, females had /ɑ/ values that were more fronted than /ɑ/ values for males. Individually, none of the other social variables showed significant effects on the F2 of /ɑ/, though the difference between Lebanese and non-Lebanese students approached significance (and shows up in the mixed model as a significant predictor). Combining sex with other social variables clarified some of the variation. The effects of both speaker ethnicity and level of religious practice on F2 of /ɑ/ appear to be differentiated by gender, though individual pairwise comparisons in tests of both combinations did not show statistically significant results. The results of the effects of speaker sex on /ɑ/-fronting are consistent with past research, both in studies of the NCS and in language variation research more generally (Labov 2001). Combinations of speaker sex with ethnicity and religious practice showed significant effects on /ɑ/-fronting. While looking at the means across the groups suggested differences between groups in both interactions, these tendencies did not show up as significant in post-hoc tests of individual pairwise comparisons.

Though I am unable to include this interaction in the mixed model, the pattern of male Lebanese students standing out from other students speaks to their somewhat distinct, and more mainstream position in the school, as I discussed briefly in 2.4, both in terms of

their gender and their ethnicity. Male Lebanese students experience a position of privilege, escaping many of the pressures faced by female students and discrimination faced by non-Lebanese students. The pattern of /ɑ/-fronting by females with sporadic practice and females who think ethnic label choices are important indicates that groups who are not in the same kind of position of privilege are taking the lead in this variable. The pattern seen here in the univariate analysis hints at the overall social patterning of /ɑ/-fronting—in which groups affiliated with a mainstream identity or social category have less fronted /ɑ/ productions—and it is seen again in the several social variables that are significant predictors in the model of /ɑ/-fronting. I return to this discussion below, and in chapter 6 I discuss this pattern in relation to the patterns of the other three NCS vowels.

The discussion above considered each social variable (or interactions between two social variables) in isolation, without compensating for the effects of other variables—both linguistic and social—on the variation of /ɑ/-fronting. The mixed model I discuss below provides a picture of the variation taken altogether. Thus, it is a more accurate picture of the effects of the variables. Controlling for other variables shows results that are related but not identical to the picture given in univariate analysis. Before presenting the mixed model, I compare the findings of the univariate analyses to past studies.

4.2.3 Comparison to past studies

One of the primary challenges in making comparisons to past research is methodological differences in how formant measures or coding indices are treated as dependent variables. In the present analysis, as I discussed in chapter 3, the measures of formant values are normalized but remain continuous; no attempt is made to create discrete categories of variants such as “backed” and “fronted” (or multiple discrete categories along a scale from backed to fronted or lowered to raised). Because of this, discussion and results in my analysis are all relative. No one particular token (or groups of tokens) is considered to be a backed or fronted variant on its own, but rather tokens are backed or fronted in relation to one another. This makes it difficult, if not impossible, to decide if a particular token (or groups of tokens) is “NCS-like” or “shifted”, but it allows for a more detailed and more powerful statistical analysis. It also does not impose an artificially constructed or arbitrary categorization (however compelling that categorization may seem) on the measures.

In contrast to the approach taken here, much of the previous work on the NCS treats the dependent variable as categorical: a token is shifted or it is not. In impressionistic analysis, this is to be expected, as coders assign each token to one of the predetermined categories. But in other cases, acoustically measured tokens are converted from a continuous measure to a discrete measure, with the researcher devising a means of categorization, based either on perceptual distinctions or on a relationship to a relatively stable vowel (Mendoza-Denton 1997, 2008; Gordon 2001; Dodsworth 2005). Using a dependent variable with discrete categories accommodates the needs of the statistical package Varbrul once commonly used in variationist research. More recently, however, the (sub)field of sociophonetics has begun using statistical methods that are not discipline-specific but used throughout social science research. While this benefits the accuracy of the statistical findings (Johnson 2009) and promotes cross-field dialogue, it does in some ways limit discussion of past findings to general findings rather than specific details. The results of Varbrul- and Goldvarb-type analyses divide independent variable levels into those that favor shifting and those that disfavor shifting. For instance, hypothetical results for the independent variable (called a factor group in Varbrul) of gender could be that women favor shifting and men disfavor shifting. The results of the present analysis and others like it (e.g. Nguyen 2006) look at the effects of variables on a continuous scale, which makes comparisons to past results challenging. Past findings also differ from each other and from this study in method, scope, and focus. Notably, the participants in most studies are white, while the participants here are Arab American. Also, Gordon (2001) observes that most studies consider different phonological factors and this is also likely to account for different results (155). The limitations on comparisons across studies should be kept in mind for the discussion below and for the discussion on /ɛ/ and /ʌ/ in Chapter 5.

The results in §4.2 above suggest that on average the most fronted tokens of /ɑ/ have preceding contexts of post-alveolar and /h/, followed closely by velar. Eckert's (2000) study of the jocks and burnouts at a Southeastern Michigan high school found very similar results (in a univariate Varbrul analysis) with velars and post-alveolars favoring /ɑ/-fronting, while all other contexts have little effect on it except /h/ (which weakly favors /ɑ/-fronting). Other research has had little to say on the effects of preceding context. LYS's (1972) survey-type acoustic study of the NCS focuses on the effects of the following context, examining the relative positions of /ɑ/ by context based on acoustic measures, but without statistical comparisons of the acoustic measures. Gordon performed chi-square tests in his study of speakers in two rural southern Michigan towns

and found no significant effects of preceding context on /ɑ/-fronting; no preceding context significantly favored or disfavored shifting of /ɑ/. The preceding contexts with the least fronted mean F2 values are glide and pause, neither of which is indicated in past research as contexts that result in lower F2 values of /ɑ/. The similarity in this study to Eckert's findings and the geographic proximity between Belten High and Mercer High suggest that the preceding context findings may be geographically specific to the immediate suburban areas of Detroit. The similarity of results may also be specific to the life-stage of adolescents, but Gordon's study includes adolescents and adults from both rural towns, and there are no differences by age group in his results.

In this study, tokens with the following context of alveolar had overall the most fronted mean F2, and this context differed significantly from the two least fronted contexts, liquid and velar. LYS (1972) finds following post-alveolars to most favor shifting, followed by alveolar and velar contexts. Eckert's (2000) results are similar to LYS's findings: following post-alveolars and velars fairly strongly favor /ɑ/-fronting. Gordon found that following velars favor shifting while following post-alveolars disfavor shifting, which is the opposite of both LYS's and Eckert's findings with respect to post-alveolars. Gordon does not offer an explanation for why the findings might be different, though it is again possible that geographical differences, in how the shift has spread across phonological contexts and in how far it has shifted across speakers, play a role; LYS' data, like Eckert's and the present study's, also come from the Detroit area. Tokens with following post-alveolars were excluded from the analysis in this study because of the low token count (just 5 tokens across all speakers), but their mean F2 of -2.14 would make them the most fronted following context (the next most fronted context, alveolar, has a mean F2 of -2.42), which is suggestive of being in line with the findings of Eckert and LYS, though not statistically meaningful. Alveolar as a following context does not show up in any of the prior studies as strongly favoring /ɑ/-shifting, though none of the studies find that following alveolar disfavors fronting, either.

The final linguistic variable considered here is that of the token's position in the word, which shows significant differences in the univariate analysis. Eckert (2000) includes word boundary as a factor in her analysis but does not explicitly refer to the variable in her discussion of results, implying that word boundary does not have a significant effect on the fronting of /ɑ/. Gordon tests the effects of the token's syllable position in the word, rather than the token's position in the word, but this does not have a significant effect on /ɑ/-fronting. Word boundary does not appear in general to play strong role in /ɑ/-fronting

in past research, and the mixed model shows that the effects of word position do not hold in the mixed model. The results of the univariate linguistic analysis in comparison with past linguistic analyses suggest that there may be geographical variation in the relative effects of linguistic variables on /ɑ/-fronting. While phonological contexts are not expected to vary geographically, as those effects are based on the acoustics of the vocal tract, it is possible, for example, that /ɑ/-fronting in certain phonological contexts could take on specific social meanings or become affiliated with particular social groups. However, further tests on the interaction of social and linguistic variables would be needed to explore this in detail.

Comparing the social variables in this study to past studies is also challenging because, apart from gender, none of the other variables I consider are found in past work because they are specific to the participants and the location of the study. Some of the variables also focus on intra-ethnic distinctions, which has not been an area of interest in past research.

In Gordon's (2001) study, women have more fronted /ɑ/ productions than men. Gordon's analysis of /ɑ/-shifting is a multi-way ANOVA of three social variables (sex, geographic location, and age) and their interactions, in which only sex has a significant effect on the social patterning of /ɑ/ (140). In Eckert's findings, girls also have more fronted /ɑ/s than boys, though the gender difference is attributed primarily to differences between burnout girls and boys, while jock boys and girls (the other half of the school's two polarized social categories) are not significantly different from each other with regards to /ɑ/-fronting.

Roeder finds age-related differences in /ɑ/-fronting among Mexican American women in Lansing; the youngest and oldest of the three age groups have the most fronted /ɑ/ values. Roeder suggests different reasons for the fronting in the two groups: while the youngest group is "accommodating" to the fronting of the local NCS variety, Roeder attributes the oldest group's fronted /ɑ/ values to influences from Spanish, which was the first language for the participants in that age group. Participant age at immigration, the variable in my model that is most related to differences in native- versus second-language acquisition, is not a significant predictor of /ɑ/-variation in the univariate analysis nor in the mixed model. However, the age ranges of the immigration groups in my study are much smaller than age groups in Roeder; all of my participants would be part of Roeder's youngest age group.

The results here, and in the mixed model below, confirm the general pattern that across studies the linguistic predictors are stronger than the effects of any social factors also included in a study, but do not indicate that any one linguistic pattern is universal across studies this far for /ɑ/-fronting. The social pattern of women having /ɑ/ productions that are more fronted than men's, seen among the Mercer participants, is also found in past research. However, this pattern appears to hold for only a subset of the speakers in the study.

4.2.4 Multivariate mixed model results

In this section I discuss the results of the mixed model, which estimates the relative effects of each variable as a predictor of variation in the F2 of /ɑ/, while controlling for the effects of all the other independent variables included in the model. The initial mixed model for /ɑ/-fronting – and all other mixed-efffect models in this dissertation -- included all three linguistic variables and the six social variables as main predictors. I included four interactions in the initial model, which I had also considered separately in my univariate analysis (sex combined with religious practice and ethnic label importance, and ethnicity combined with religious practice and ethnic label importance).[24] The final model for /ɑ/-fronting, presented below, is the last of several nested models I tested to fit the data. (Initial and final models are given in Appendix C.) The final model, in Table 4.11, which was the best-fitting model of those I tested based on the significance of changes in the -2 log likelihood (which assesses the fit of the model), includes the nine main social and linguistic predictors and the two interactions of sex and religious practice, and sex and ethnic label importance.

The model shows several predictors having a significant effect in the model of the F2 of /ɑ/, including some that were not significant in the univariate analysis. The overall social patterning of /ɑ/-fronting appears to be very diffuse across a wide range of social factors; there is no singular relationship between one social category, or even two, and /ɑ/-fronting. Estimated marginal means are predictions of F2 of /ɑ/ based on the results of the mixed model, which show the effects of predictors. The estimated means of significant predictors are discussed below. The effects of the linguistic variables of preceding and following contexts are both highly significant and each has a greater effect in the model

[24] I was not able to include the interaction of speaker sex and ethnicity in the model because one of the cells in that interaction – Non-Lebanese Male speakers -- only contained two speakers, which means that the model is unable to calculate standard error and, therefore, significance.

than any of the significant social predictors. As I mentioned above, position in word does not have a significant effect in the model. The social variables of sex, as I predicted, and ethnicity (which was not significant in the univariate analysis), contrary to my hypothesis, are significant predictors in the model. Future plans (as a main predictor) is also significant in the model, as I hypothesized, though it did not show up in the univariate analysis as having significant effects. Finally, the interactions of sex with religious practice and with ethnic label importance both had significant effects in the model, contrary to my hypothesis that neither religious practice nor ethnic label importance would have a significant effect on /ɑ/-fronting (as an older component of the NCS).

The disparity between the univariate results and the results of the mixed model occurs because univariate analysis considers the effects of an individual independent variable on its own, without considering the effects of other independent variables. The multivariate model considers simultaneously the effects of all the independent variables included in the model, so that calculating the effects of one takes into account all the others. Additionally, effects in the mixed model take into account standard error and the token counts within each level of each predictor, not just the patterns found in the raw data; this also provides a greater level of accuracy in measuring the significance of the independent predictors. Considering the variables together, rather than looking at each one individually, is ultimately a more accurate way to model the variation, since that is how they occur in the real world; the social variables I am interested in are bundled in speakers and not separate from one another.

Table 4.11 Mixed model for predicting F2 of /ɑ/.

Type III Tests of Fixed Effects

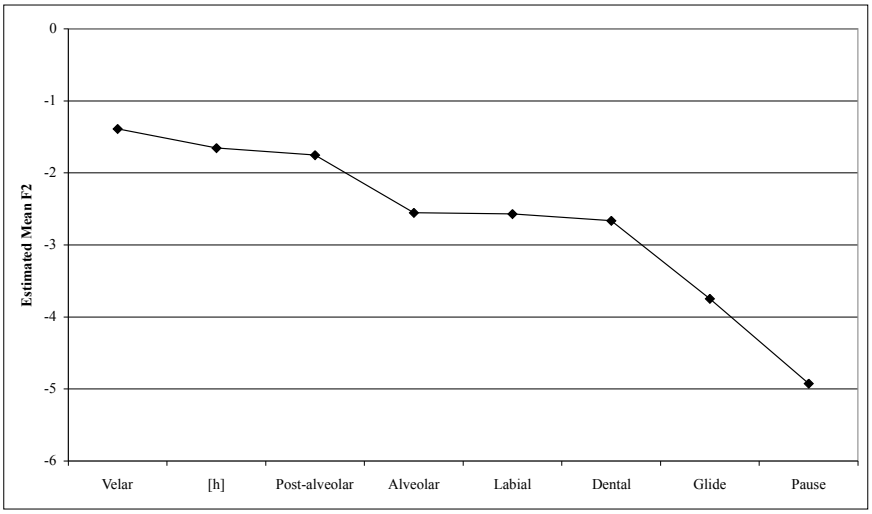
Source	Numerator df	Denom. df	F	p
Intercept	1	250.68	17.23	.0001
*Preceding Context	7	431.07	5.38	.0001
*Following Context	4	431.93	4.28	.002
Position in Word	1	426.77	.95	.331
*Sex	1	5.62	22.03	.004
*Ethnicity	1	4.73	9.40	.030
Age at Immigration	2	4.91	4.38	.081
*Future Plans	2	4.96	6.10	.046
Religious Practice	1	4.79	6.57	.053
Ethnic Label Importance	1	4.33	1.56	.276
*Sex * Religious Practice	1	4.81	11.68	.020
*Sex * Ethnic Label	1	4.99	6.76	.048

*significant predictor at a level of p<.05.

Below I discuss the results of significant predictors of the mixed model. The figures below show the estimated means predicted by the model for each of the significant predictors and interactions in the model.

The estimated means by preceding context, shown in Figure 4.12, follow the general pattern shown in the univariate analysis. Though ordering of effects is not identical, the general grouping of the contexts is. Velar, post-alveolar, and /h/ are the contexts estimated to have the highest F2 frenquencies for /ɑ/; dental, alveolar, and labial have estimated /ɑ/ in the middle; and post-alveolar and glide contexts have the lowest estimated /ɑ/ in the model. The model, as I discussed at the end of §4.2.1 regarding the univariate analysis, supports the most generalizable findings of past research that preceding velars most strongly favor fronting of /ɑ/, but does not confirm any other generalizations about the linguistic conditioning of /ɑ/-fronting as part of the NCS. The mixed model results follow my hypothesis, particularly with respect to the effects of velar and post-alveolar contexts. However, my hypothesis also predicted that alveolar and dental contexts would have higher F2 /a/ values than labial context and the model does not predict this.

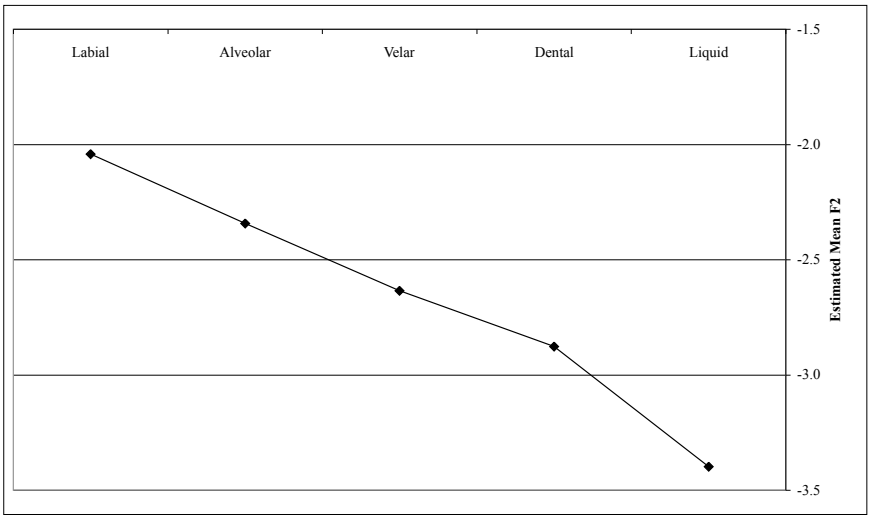
Figure 4.12 Estimated mean of F2 of /ɑ/ by preceding context



The estimated means of F2-/ɑ/ based on following context, shown in Figure 4.13, do not show the same pattern as the univariate analysis. In the model, a following labial is predicted to have the most fronted mean, followed by alveolar, velar, dental, and finally liquid. The effect of labial context here is particularly unexpected given the low F2 transitions. Inspection of F2 measures for individual tokens of /ɑ/ do not suggest that tokens with higher F2 values are restricted to particular lexical environments or preceding phonological environments.

The robustness of the effects of the preceding context on F2-variation of /ɑ/ appear to remain strong while controlling for other effects, while the effects of following context do not remain consistent when other factors are considered. When taken into consideration with other predictors, word position, the third of the linguistic variables I tested, is not a significant predictor of /ɑ/-variation, which is not unexpected, given that none of the prior studies found position in word or syllable position to have a significant effect on /ɑ/-fronting. The mixed model results for the linguistic predictors do not challenge past findings, but they also do not match them precisely. The similarity between this research and Eckert's – with velar and post-alveolar preceding context favoring /ɑ/-fronting – is upheld and an indication that there may be some geographic specificity to the linguistic conditioning. But this finding is not consistent across all four vowels in this study, as will be seen below and in chapter 5.

Figure 4.13 Estimated mean F2 of /ɑ/ by following context



Several social variables are also significant predictors in the model. The model predicts, as the univariate analysis shows, that women (estimated mean F2 = -1.62) will have a higher F2-/ɑ/ value than men (estimated mean F2 = -3.715), as shown in Figure 4.14, which is as I hypothesized. The difference between women and men interacts with the importance of ethnic label and with religious practice, neither of which is a significant predictor on its own in the mixed model. Figure 4.15 and Figure 4.16 both show the overall gender difference to hold for each of the interactions (i.e. men's values are lower than women's in both interactions), and further show that the primary differences in the both interactions are between the two groups of women in each interaction. Figure 4.15 shows that women who think the ethnic label is important have a higher estimated mean F2-/ɑ/ value than the estimated mean for women who do not think the ethnic label is important, while both groups of men have lower estimated mean F2-/ɑ/ values than either of the two estimated means for the female groups. Similarly, in Figure 4.16, the estimated mean F2 frequency for women with sporadic religious practice is higher than the estimated mean for women with a regular religious practice, and the means for both groups of women are higher (more fronted) than the estimated means for the two groups of men. The predictions for the interactions in this model suggest that /ɑ/-fronting may be a resource for social differentiation between women, but not between men. This is part of a larger pattern in which /ɑ/-fronting is linked to non-mainstream groups and social categories, while lack of /ɑ/-fronting is linked with more generally mainstream groups.

Figure 4.14 Estimated mean F2 of /ɑ/ by speaker sex

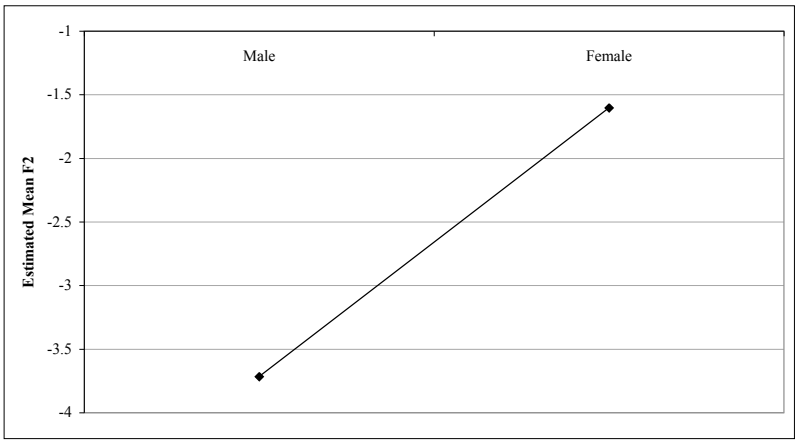


Figure 4.15 Estimated mean F2 of /ɑ/ by sex and ethnic label importance

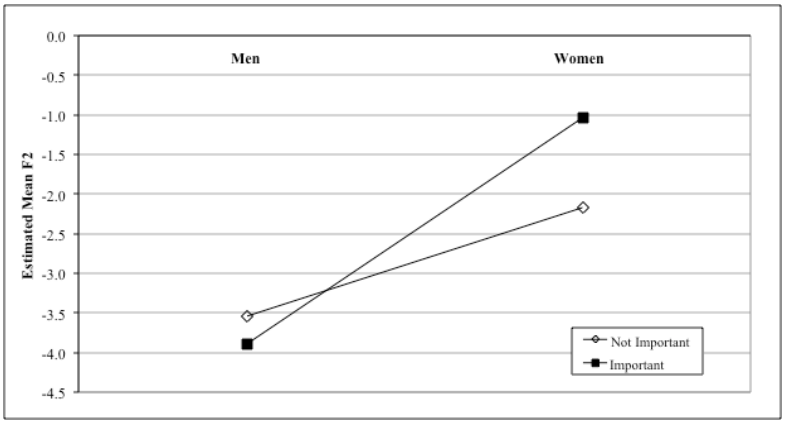
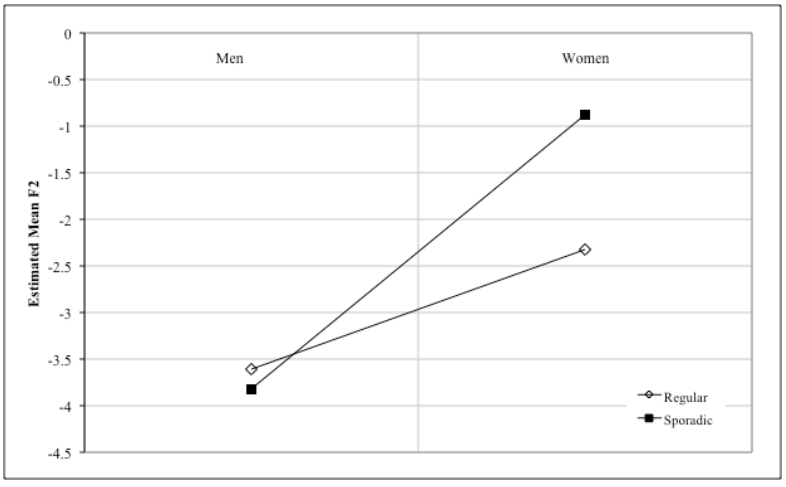
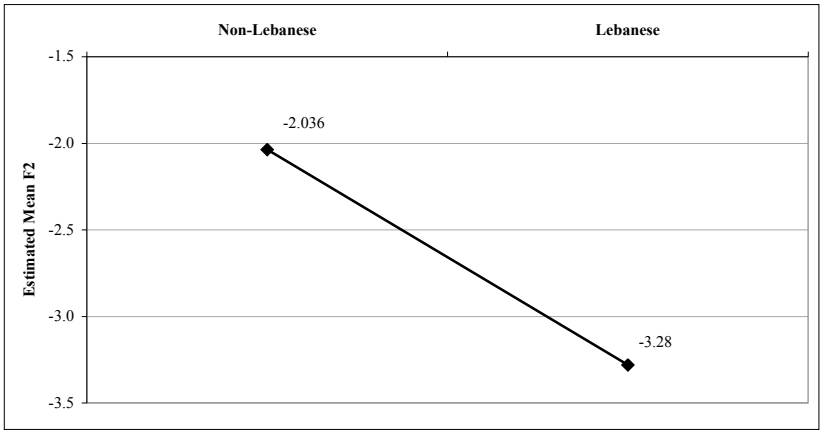


Figure 4.16 Estimated mean F2 of /ɑ/ by sex and religious practice



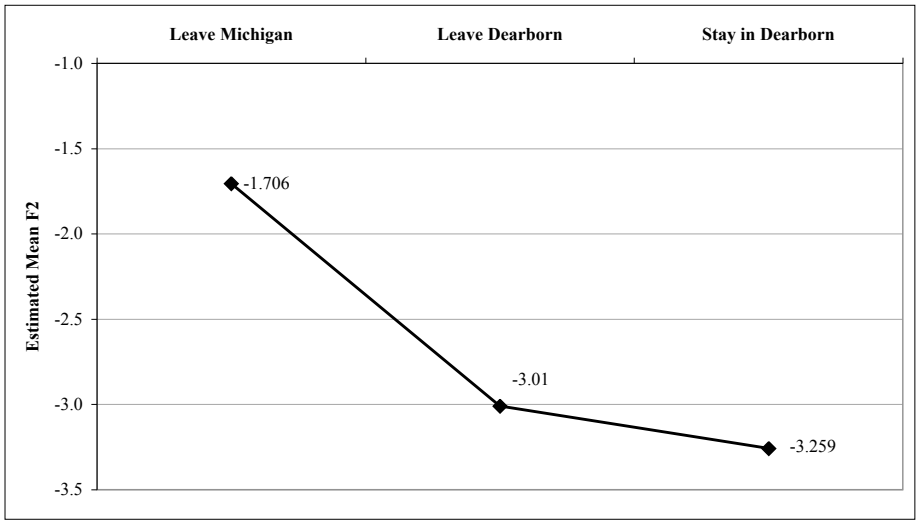
Contrary to my hypothesis, participant ethnicity is also a significant predictor of /ɑ/-variation in the model, with non-Lebanese speakers' estimated mean F2 frequncy higher than Lebanese speakers' estimated mean. I hypothesized that ethnicity would have significant effects on variation in the newer vocalic variables only, and I further predicted that Lebanese students would be more NCS-like than non-Lebanese students. Here, we see the opposite results of both predictions—ethnicity *is* a significant predictor of variation in an older variable, and non-Lebanese students are predicted have more fronted /ɑ/s than Lebanese students. As with the female lead in /ɑ/-fronting, the non-Lebanese lead here is also indicative of a link between fronting and a non-mainstream social category.

Figure 4.17 Estimated mean F2 of /ɑ/ by ethnicity



As expected based on my hypothesis, the model results show the variable future plans to be a significant predictor of /ɑ/-variation, shown in Figure 4.18. The estimated means predict that students who plan to leave Michigan have the most fronted mean F2-/ɑ/, compared to the estimated means for groups who plan to stay in Dearborn and stay in Michigan (but leave Dearborn). This is contrary to my hypothesis that students staying in Dearborn would have the most fronted /ɑ/, while students who planned to leave would have the least fronted /ɑ/. The model shows the opposite effect of what I predicted, and further, does not align with the other social predictors in the model based on a broad concept of non-mainstream social groups leading in /ɑ/-fronting, since the mainstream view on future plans at Mercer among Arab Americans is one of staying in Dearborn. However, many of the students who wanted to leave Michigan are motivated by specific career plans and hopes of economic success, which are fairly mainstream, non-marginalized views held by many students at Mercer who don't plan to leave Michigan.

Figure 4.18 Estimated mean F2 of /ɑ/ by future plans



In summary, the mixed model shows that several variables are significant predictors of /ɑ/-variation, though many of these results are unexpected based on the predictions I made in chapter 3. The preceding and following phonological contexts are both predictors. The social variables of sex, ethnicity, future plans, and the interactions of sex and ethnic label importance and sex and religious practice are all significant predictors of variation in the F2 of /ɑ/, and the nature of their effects is summarized below in Table 4.12. I have somewhat arbitrarily assigned each level of the variable to a category of shifting, based on the estimated means for the variable levels in the model. While this resembles the kind of discrete categorization I was seeking to avoid in the acoustic analysis, it does provide an overall picture of the direction of the effects of the variables all together.

As I discussed above, a loose pattern in several of the social variables linked to /ɑ/-fronting may be that groups that experience marginalization in some way or that are not entirely mainstream may be leading in /ɑ/-fronting, while more mainstream groups are lagging in fronting of /ɑ/. The distinction between non-Lebanese and Lebanese students is clear, and several students talked about the discrimination faced by non-Lebanese students (see §2.4). However, the position of privilege or mainstream quality associated with being male is more subtle, and perhaps more pervasive. Students did not often explicitly discuss gendered-differences or sexist practices, but there were many practices at Mercer which subtly reinforced gender differences and held girls to a different

standard than their male peers (e.g. many girls discussed not being permitted to participate in organized sports, or maintain friendships or romantic relationships with boys). Here, I have only discussed the possiblity of an association with non-mainstream or marginalized groups and /ɑ/-fronting, but I return to this discussion in chapter 6, with a goal of providing more detailed discussion of this possibility in relation to the ethnographic findings. In chapter 6 I also focus on some of the interaction variables I have not addressed explictly here in relation to the idea of a mainstream or non-marginalized position. Below I turn to discussion of /æ/-shifting.

Table 4.12 Summary of /ɑ/-fronting patterns

	Most Fronted	Middle/Neutral	Not/Least Fronted
Sex	Female		Male
Ethnicity	Non-Lebanese		Lebanese
Future Plans	Leave MI	Stay in MI	Stay in Dearborn
Sex * Religious Practice	Female/Sporadic	Female/Regular	Male/Sporadic Male/Regular
Sex * Ethnic Labels	Female/Important	Female/Not Important	Male/Important Male/Not Important

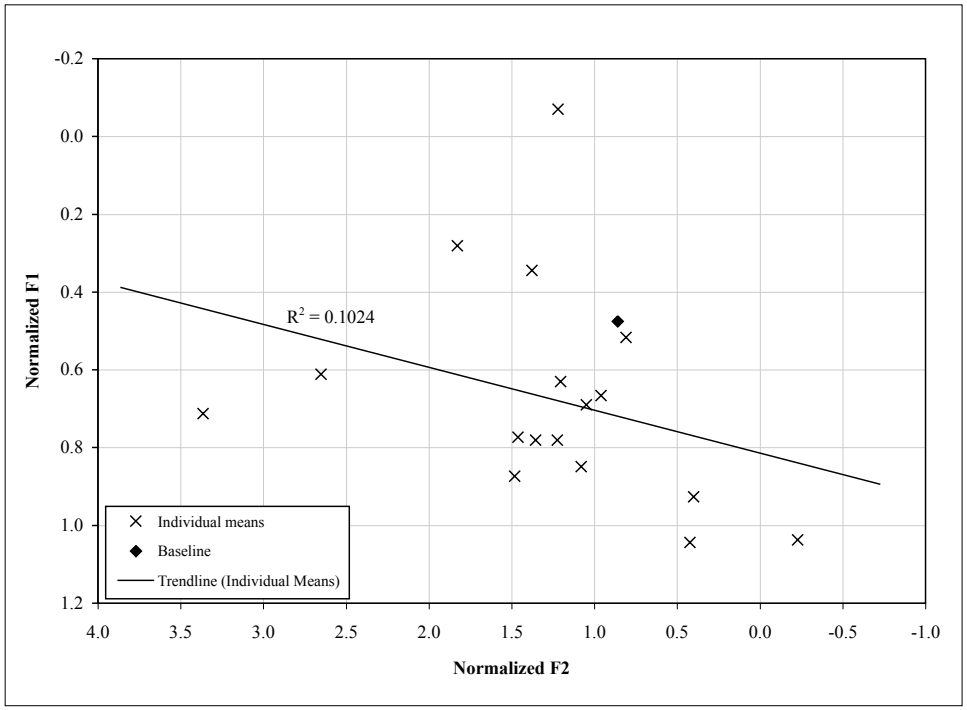
4.3 /æ/

Past research and descriptions of variation in /æ/ have focused mostly on the raising of /æ/ (Callary 1975; Herndobler 1993; Eckert 2000; Gordon 2001). But, as I discussed briefly in Chapter 3 (§3.8), variation in /æ/ among the Mercer participants is found in both the first and second formants; /æ/ is both raising (F1) and fronting (F2). This is not unique to Mercer participants. Roeder's discussion of /æ/-variation among Mexican Americans in Lansing looks at variation in the front/back dimension as well as raising. Evans (2001) focuses on /æ/-raising, but her plots of individual speaker means suggest there may be speakers who do not show /æ/-raising but do show /æ/-fronting (i.e., variation along the F2-dimension but not the F1-dimension). Evans, however, does not consider /æ/-fronting in her study because /æ/-fronting does not differentiate the local NCS variety from Southern-Shifted varieties spoken in the Appalachian region, where the participants in Evans' study have social ties. Herndobler (1993) heads her section on variation in /æ/ with "/æ/ Raising/Fronting" (147), but her impressionistic coding (the basis of her analysis of /æ/-variation) only makes references to levels of raising. Labov (1994) describes the shift in /æ/ in the NCS as one in which the vowel first tenses, then fronts, and finally raises. Speakers whose /æ/ tokens are extremely tensed and raised are considered to have the most "advanced" or "extreme" variety of the NCS (Eckert 2000, Gordon 2001, Labov 2001, Thomas 2001), but many NCS speakers show more moderate

variation in /æ/-raising and –fronting (e.g., Hillenbrand *et al* 1995; Gordon 2001; Clopper *et al* 2004). The findings of studies like Clopper *et al* (2004), which document the acoustic picture of vowel systems, suggest that there is variation along the F2 dimension, but these studies don't tell us whether or not that variation is socially patterned. While it is not that surprising to find a fair amount of variation along F2 in the data of my study, given that researchers have long acknowledged fronting as a stage in the shift, I think it is somewhat surprising to find a near-exclusive focus on raising in previous literature. Part of the possible obscuring of variation related to F2 may be related to the impressionistic coding of many of the past studies. Perceptually, it may be easier to hear differences in vowel height (F1) than in frontness/backness, and it may be difficult to detect fronting in vowels that are already front. LYS (1972) note that "the ear is quite sensitive to first formant position, but it is much less attuned to differences in second or third formant position" (4). Additionally, some perception research on confusion suggests some validity to my hypothesis and LYS' assertion; Benkí (2003) finds that listeners discern differences in F1 more accurately than they do differences in F2.

Another open question is how fronting and raising of /æ/ are related to each other in the social patterning of /æ/. Though the generally accepted stages of /æ/-shifting in the NCS suggest a relationship between the two dimensions, the general lack of attention to F2 in past research leaves us with a sparse understanding of the connection. But the relationship between F2 and F1 in /æ/-variation comes up in interesting ways below. In Figure 4.19, which displays a scatter plot of individual speakers means for /æ/, the trend line across the data points indicates a weak correlation, which is not significant ($r = -.319$; $R^2 = .102$; $p = .213$). There is very little relationship between fronting and raising at the speaker level. A speaker whose productions are more fronted than those of other speakers does not necessarily produce vowels that are more raised than those of other speakers. Univariate results suggest that, for some variables, there is no relationship between the F1 and F2 of /æ/, while for other variables there does appear to be a relationship between fronting and raising. I discuss this in more detail below, where it becomes clearer that variation in F1 and F2 are both significant, and sometimes related to each other, in the social patterning of /æ/.

Figure 4.19 Individual means for /æ/



4.3.1 Univariate results for linguistic variables

Tests on the effects of three linguistic variables showed different effects on F1 and F2. The variable preceding phonological context had a significant effect on F1 and F2, while the effects of following phonological context and position in word were both significant only with respect to F2 variation. I discuss the results below (full results of all statistical tests are in Appendix D). My hypotheses about the effects of linguistic variables on /æ/-shifting are listed here:

- Lower-frequency F2 is expected in labial contexts
- Slight F2 lowering may also more generally occur in non-velar contexts.

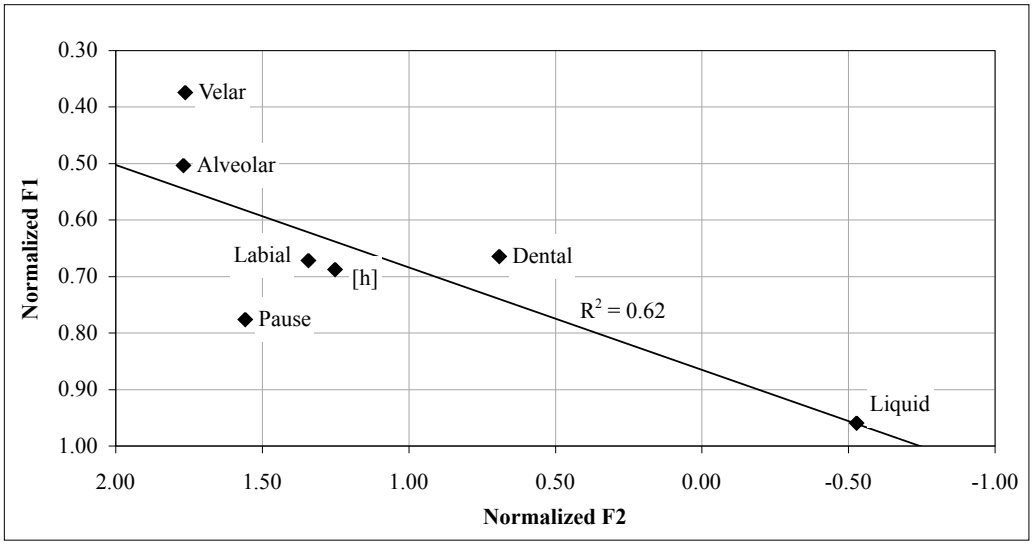
Preceding context

The one-way ANOVA of preceding context on /æ/ was statistically significant for both formants at a level of $p=.001$ for F1 and $p<.001$ for F2.

Table 4.13 Mean F1 and F2 values for /æ/ by preceding context.

Context	Token count	Mean F1	Mean F2	Rescaled F1	Rescaled F2
Liquid	18	.95927	-.52718	655	1680
/h/	138	.68751	1.25118	617	1911
Dental	115	.66470	.69163	615	1836
Velar	22	.37421	1.76324	578	1975
Labial	124	.67170	1.34351	616	1922
Pause	117	.77588	1.55873	697	1947
Alveolar	79	.50293	1.76922	701	1966
Total	**613**	.66985	1.25650	616	1911

Figure 4.20 /æ/ by preceding phonological context

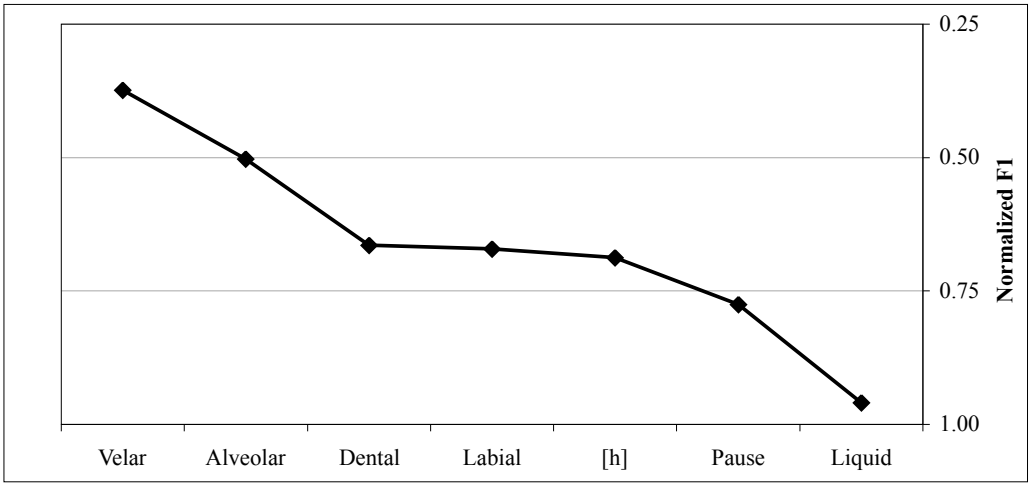


For the F1 values of /æ/, although the ANOVA showed an overall level of significance, none of the individual pairwise comparisons showed significant differences. The difference between the velar context, which had the lowest (most raised) mean F1-/æ/ value, and for liquid, which had the highest (least raised) mean F1-/æ/ value, was marginally significant at a level of p=.095, as was the difference between the mean F1-/æ/ values for pause and alveolar contexts at a level of p=.082.

Table 4.14 Post-hoc results for ANOVA of preceding context on F1 of /æ/

	Alveolar	Dental	Labial	/h/	Pause	Liquid
Velar	---	---	---	---	---	†
Alveolar		---	---	---	†	---
Dental			---	---	---	---
Labial				---	---	---
/h/					---	---
Pause						---
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant						

Figure 4.21 F1 of /æ/ by preceding phonological context.

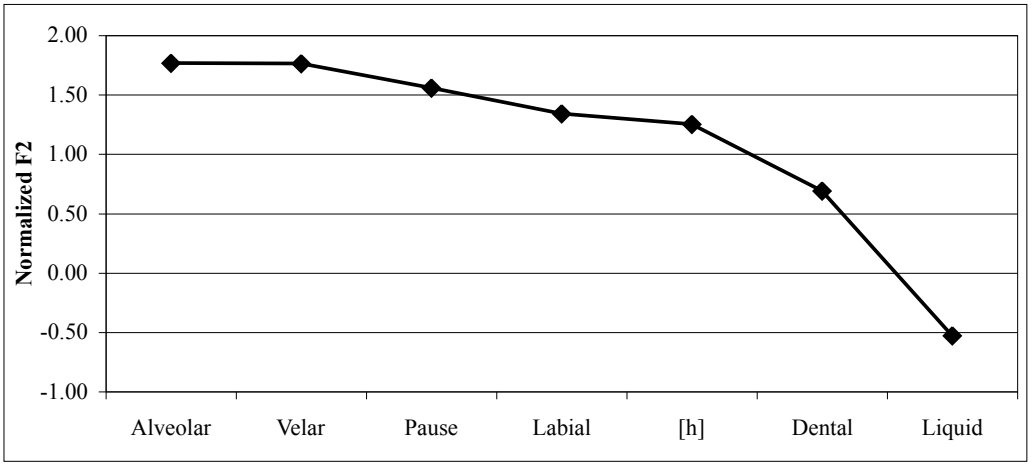


The preceding context also had a significant effect on F2 values of /æ/ (fronting) and post-hoc tests revealed several significant differences between pairs of contexts. The F2-/æ/ for the liquid context, which had the lowest frequency values, differed significantly from the F2-/æ/ values for all the contexts except dental, which had the second lowest value. The F2-/æ/ for the dental context also differed significantly from the F2 values for the alveolar and pause contexts (the lack of significance with the F2-/æ/ for the velar context is likely due to the low token count of velar [N= 22] as a preceding context relative to the other contexts). Higher F2 /æ/ values occur in velar contexts and lower F2 /æ/ frequencies occur in dental contexts, which are both expected based on my hypothesis, but the effect of labial context is not expected. I also did not predict lower F2 /æ/ frequencies in preceding liquid context, as my hypotheses were focused on place-effects.

Table 4.15 Post-hoc results for ANOVA of preceding context on F2 of /æ/

	Dental	/h/	Labial	Pause	Velar	Alveolar
Liquid	†	***	***	***	***	***
Dental		---	†	**	---	***
/h/			---	---	---	---
Labial				---	---	---
Pause					---	---
Velar						---
***: p<.001; ** p<.010; * p<.050; † p<.1; --- not significant						

Figure 4.22 F2 of /æ/ by Preceding phonological context



The effects of preceding context on F1 and F2 appear to be related to one another and a Pearson correlation is significant (r= .802; R^2= 0.62; p=.030). The trend line (R^2= 0.62) shown above in Figure 4.20 indicates that preceding contexts which promote fronting of /æ/ also promote raising. Table 4.16 ranks the effects from the context with the least fronted /æ/ to the context with the most fronted /æ/ and from the context with the least raised /æ/ to the context with the most raised /æ/. The relationship between fronting and raising holds for the two ends of the rankings. Liquid, the context with the least raised /æ/, is also the context with the least fronted /æ/. Velar and alveolar, the contexts with the most raised /æ/, also have the most fronted /æ/ values (the rankings are switched between F1 and F2, but the mean F2 for the two contexts differs only by .006). The /æ/ values for the contexts of dental and pause stand out as not following a similar pattern. Their positions in the rankings are switched from F1 to F2. /æ/s in preceding dental contexts are more raised than they are fronted, while /æ/s in pause contexts are more fronted than raised. Comparison of the trend line in Figure 4.20, which is based on mean F1 and F2 values by preceding contexts, to the trend line in Figure 4.19, which is based on

individual speaker means of /æ/, shows that the trend line based on preceding context mean values ($R^2 = 0.62$) is considerably steeper than the trend line based on speaker means ($R^2 = 0.10$). A Pearson correlation test confirms that the relationship between F1 and F2 by preceding context (r=-.802; $R^2 = 0.62$; p=.030) is significant and much stronger than the relationship between F1 and F2 by speaker, which is not significant (r=-.319; $R^2 = 0.10$; p=.213). I did not make predictions about the relationship between F1 and F2 of /æ/ differing across independent variables because I did not predict that there would be differences in the effects of the independent variables on the F1 and F2 of /æ/.

Table 4.16 Rank of effects of preceding context on /æ/

Rank of Effects on F1	Mean F1		Rank of Effects on F2	Mean F2
Liquid	.95927		Liquid	-.52718
Pause	.77588		Dental	.69163
/h/	.68751		/h/	1.25118
Labial	.67170		Labial	1.34351
Dental	.66470		Pause	1.55873
Alveolar	.50293		Velar	1.76324
Velar	.37421		Alveolar	1.76922

Following Context

The effects of following contexts, along with token counts and mean F1 and F2 values for each context, are summarized in Table 4.17. Four following contexts are included for /æ/. Tests on the effect of following phonological context were significant only for F2 (p=.001). Scheffe post-hoc tests showed significant differences between the following contexts of alveolar, the following context with the least fronted /æ/s, and velar, following context triggering the second most fronted /æ/s. The following context of post-alveolar, in which the most fronted /æ/ values occurred, did not differ significantly from the /æ/ values for the alveolar context, but this is likely due to there only being ten tokens of /æ/ followed by post-alveolars, resulting in a larger standard error for that context. Following context did not have a significant effect on raising (F1) of /æ/. The results for the effects of velar context is expected, while the effect of labial context is not as strong as I had predicted it would be.

Table 4.17 Mean F2 and F1 of /æ/ by following context

Context	Number of Tokens	Mean F1	Mean F2	Rescaled F1	Rescaled F2
Post-alveolar	10	0.66	1.73666	620	1931
Velar	144	0.73	1.65586	628	1959
Labial	158	0.65	1.24548	613	1911
Alveolar	311	0.65	1.07664	613	1887
Total	623	.66483	1.26394	616	1911

Figure 4.23 F2 of /æ/ by following phonological context

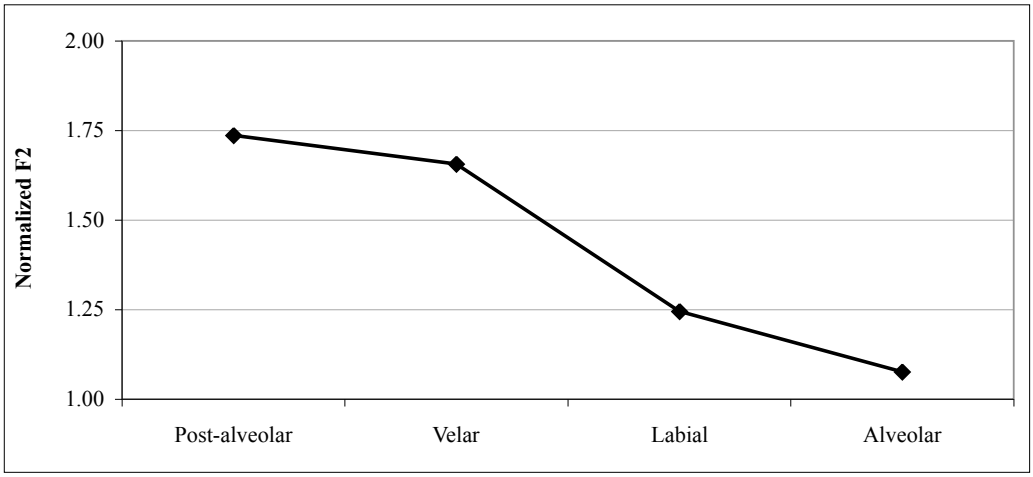


Table 4.18 Post-hoc results for ANOVA of following context on F2 of /æ/

	Labial	Velar	Post-alveolar
Alveolar	---	**	---
Labial		---	---
Velar			---
Post-alveolar			
***: p<.001; ** p<.010; * p<.050; † p<.1; --- not significant			

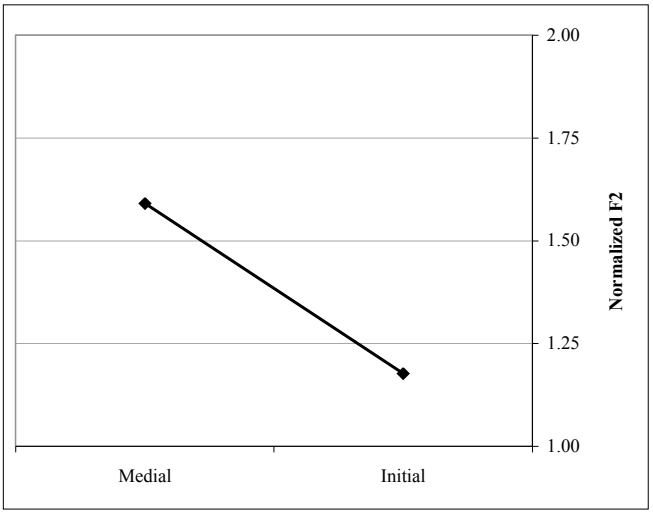
Position in Word

A Mann-Whitney u-test revealed significant differences between word-initial and word-medial tokens for the fronting of /æ/ at a level of p=.001. Position in word did not show a significant effect on the raising of /æ/. Tokens occurring word-medially had /æ/ values that were significantly more fronted than those for tokens occurring word-initially, which is contrary to my prediction that word position would not have significant effects on either F1 or F2.

Table 4.19 Mean F2 of /æ/ by position in word.

Position in Word	Number of Tokens	Mean F2
Initial	43	1.18
Medial	424	1.59
Total	467	

Figure 4.24 F2 of /æ/ by position in word



Summary

All three linguistic variables showed robust effects on /æ/-shifting in the univariate analysis. Preceding context had a significant effect on F1 and F2, while following context and position in word had significant effects on F2 only. The effects of preceding context on F1 need to be further investigated so that place and manner effects are not confounded. The fronting favored in velar and alveolar contexts is similar to past research in phonetics on coarticulatory effects (Hillenbrand *et al* 2001). The effect of velar contexts favoring fronting is expected based on my hypotheses, while the effect of labial contexts slightly promoting fronting is unexpected. The strongly discouraging effect of liquid on /æ/-fronting and –raising is not predicted by my hypotheses, but manner effects were not addressed. For the effects of following context on /æ/-fronting, the backing effects of labial contexts is expected as is the somewhat fronting effect of velar contexts. Finally the effects of word position, in which word-medial tokens are more fronted than word-initial tokens, is unexpected. As with /ɑ/-fronting, the results of the mixed models for /æ/, discussed below, show a slightly different picture than the results of the

univariate analysis. In the mixed models for /æ/, only preceding context is a significant predictor.

4.3.2 Social variables

Univariate analyses of the six main social variables and selected interactions between pairs of those variables were also performed for /æ/. Univariate tests were performed separately on F1 and F2 for /æ/-shifting. I discuss the significant results below. Full results are available in Appendix D.

My hypotheses on the effects of social variables on /æ/-shifting are the same as they were for /ɑ/-fronting (since my hypotheses are based in part on a distinction between older and newer vowels in the NCS and /ɑ/ and /æ/ are both older vowels). To remind the reader the details of the hypotheses they are listed again here:

Sex	Female speakers will have more raised and fronted /æ/ than male speakers
Age at Immigration	U.S. born speakers will have the most raised and fronted /æ/ and speakers who arrived in the U.S. after age five will have the least raised and fronted /ɑ/.
Future Plans	Students who plan to stay in Dearborn will have more raised and fronted /æ/ than students who plan to leave Michigan or leave Dearborn.

As with /ɑ/-fronting, the statistical tests for /æ/-shifting also have several results that are unexpected based on these hypotheses. As with /ɑ/-fronting, variation in /æ/ is linked to more social variables than I predicted.

Table 4.20 Summary of results of social variables for /æ/.

Variable	Test type	F1 results	F2 Results
Significant			
Ethnicity	u-test	**p=.007**	**p=.015**
Ethnicity * Religious Practice	ANOVA	**p=.030**	**p=.041**
(F2 only) Age at Immigration	ANOVA	p=.175	**p=.020**
Non-significant			
Ethnicity*Ethnic Labels	ANOVA	p=.092	p=.143
Sex	u-test	p=.423	p=.606
Religious Practice	u-test	p=.888	p=1.00
Importance of Ethnic Labels	u-test	p=.673	p=.672
Future Plans	ANOVA	p=.346	p=.236
Sex* Ethnic Labels	ANOVA	p=.954	p=.535
Sex* Ethnicity	ANOVA	p=.109	p=.142
Sex*Religious Practice	ANOVA	p=.932	p=.787

Lebanese/non-Lebanese ethnicity

Contrary to my predictions, differences between Lebanese and non-Lebanese participants for both raising and fronting of /æ/ were significant (F1 p=.007; F2 p=.015). Lebanese speakers' /æ/s are, on average, more raised and more fronted than non-Lebanese participants' /æ/s; the mean values of F1 and F2 of /æ/ for each group are summarized in Table 4.21. Rescaled Hertz for both F1 and F2 suggest differences between Lebanese and non-Lebanese are on average perceptible. But the group averages alone obscure some of the variation across individuals within the two groups, particularly in the Lebanese group. The scatter plot in Figure 4.25 shows how varied individual Lebanese speakers are along both the F1 and F2 dimensions. Lebanese and Non-Lebanese participants' /æ/ productions also show different patterns with respect to the relationship between fronting and raising. Non-Lebanese students' /æ/ productions show a strong correlation between the two, indicated by the solid trend line in Figure 4.25; a Pearson correlation test is significant for this correlation (r=-.830; $R^2 = 0.70$; p=.041). Lebanese participants' /æ/ productions show no significant correlation between raising and fronting, indicated by the nearly flat dashed-line trend line (r=.128; $R^2 = 0.02$; p=.707). For Lebanese participants' /æ/ productions, the overall envelope of variation is much broader for both the F1 and F2 dimensions than it is for non-Lebanese participants'. Lebanese participants tend to have overall more fronted or more raised /æ/ values than non-Lebanese participants, though not necessarily both. Non-Lebanese participants' productions do not show nearly as much variation along either the F1 or F2 dimensions as Lebanese participants' productions and their mean values are not as fronted or raised as Lebanese participants. Additionally, non-Lebanese participants' variation shows an apparent relationship between F1 and F2. That is, non-Lebanese students whose productions are more raised than other non-Lebanese students' productions are generally also more fronted in their productions; this same pattern does not hold true for Lebanese students.

Table 4.21 Mean F1 and F2 values of /æ/ by ethnicity

Ethnicity	Number of Speakers	Mean F1 (norm)	Mean F2 (norm)	Rescaled F1	Rescaled F2
Lebanese	11	0.556	1.599	600	1953
Non-Lebanese	6	0.888	0.680	645	1833

Figure 4.25 /æ/ by ethnicity

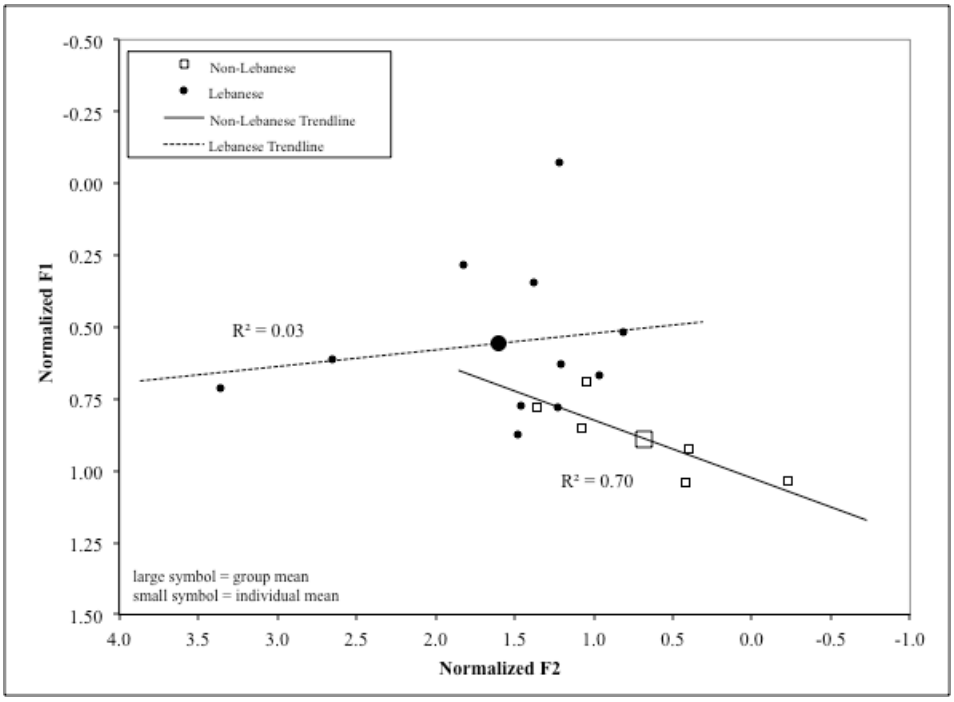


Figure 4.26 Individual and group mean F1 values for /æ/ by ethnicity.

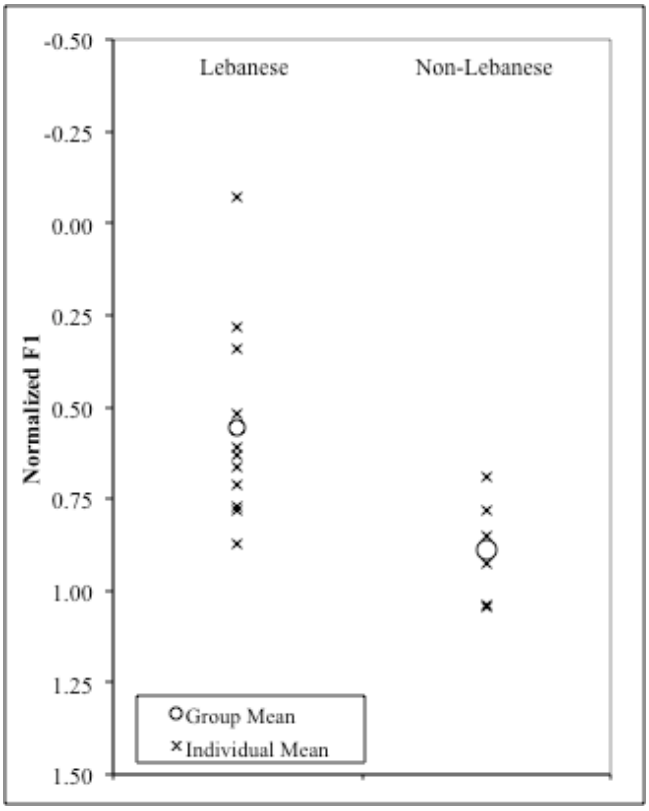
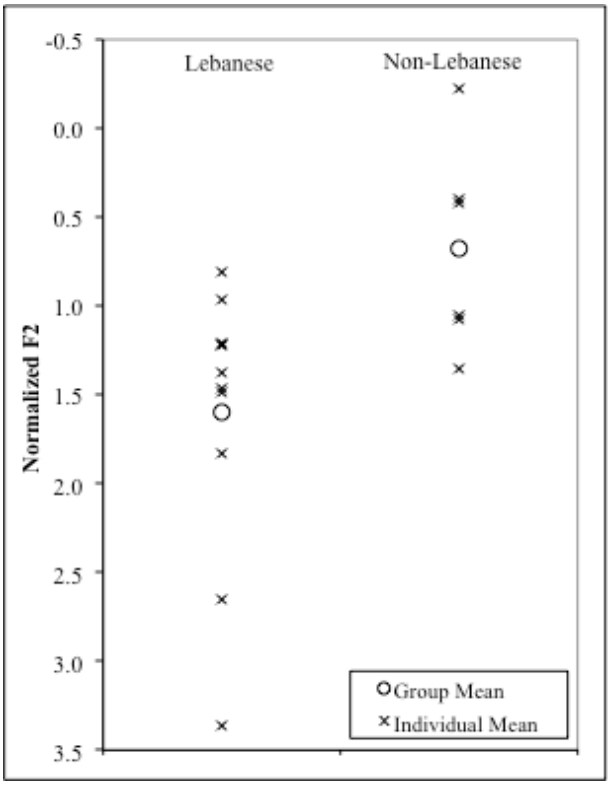


Figure 4.27 Individual and group mean F2 values for /æ/ by ethnicity.



Age at Immigration

As I predicted, univariate analysis of participants' age at time of immigration was significant, though only for F2 of /æ/. The variable did not have a significant effect on F1 of /æ/. Scheffe post-hoc tests showed only marginally significant differences between F2-/æ/ values for U.S.-born students and for students who came to the U.S. by age 5 (p=.099) and for students who came to the U.S. after age 5 (p=.058). The scatter plot in Figure 4.28 suggests a correlation between speaker's age at immigration and an increase in fronting or raising of /æ/, and a test of the correlation between the F2 of /æ/ and age at immigration showed a significant negative correlation between the two; F2 increases (fronts) as age at immigration (with binned, not continuous, categories) lowers (r= -.644; R^2=.4147; p=.005), which is as I predicted.

Table 4.22 Mean F1 and F2 of /æ/ by age at immigration

Age at Immigration	Number of participants	Mean F1	Mean F2
U.S.-born	11	0.580	1.648
by age 5	4	0.877	0.738
after age 5	2	0.777	0.291

Figure 4.28 /æ/ by age at time of immigration.

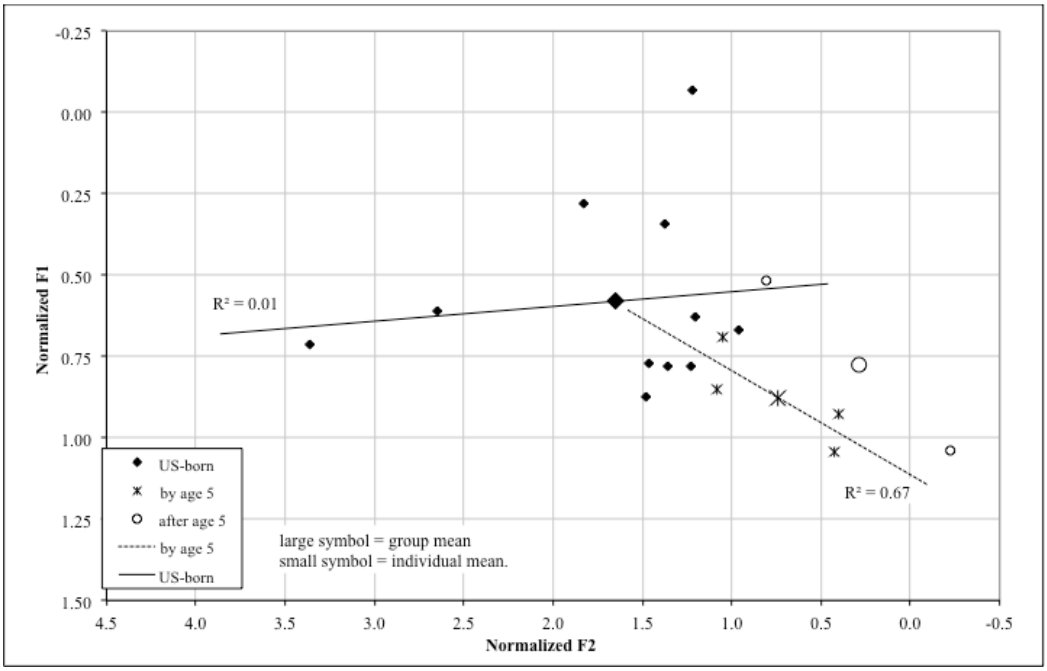
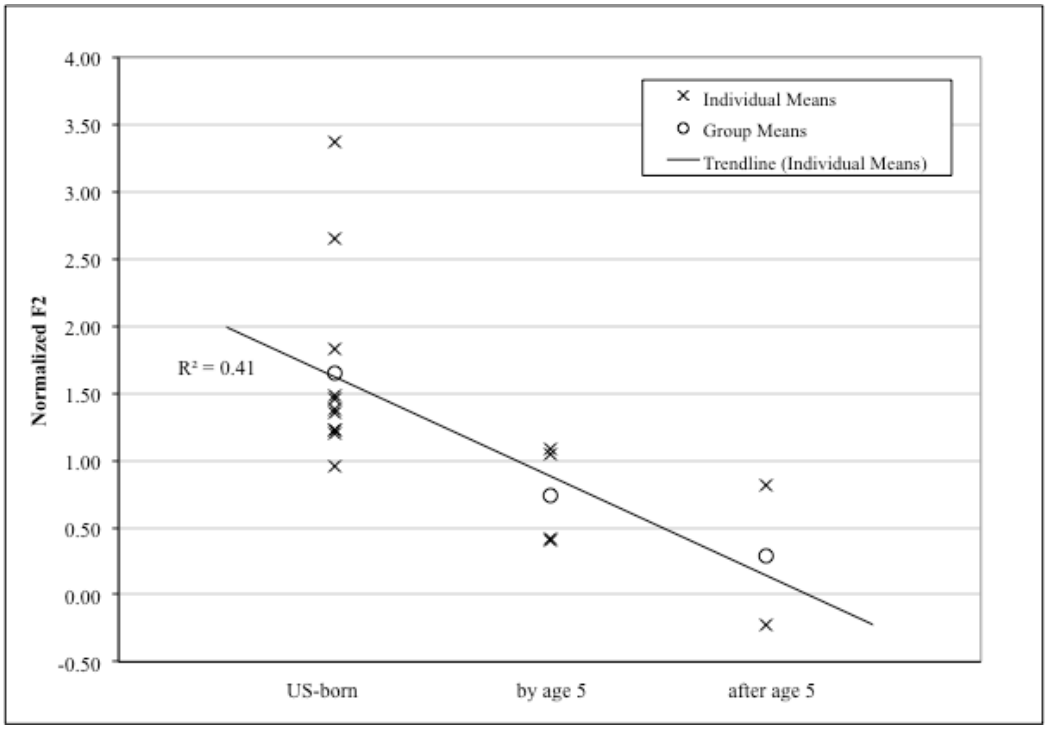


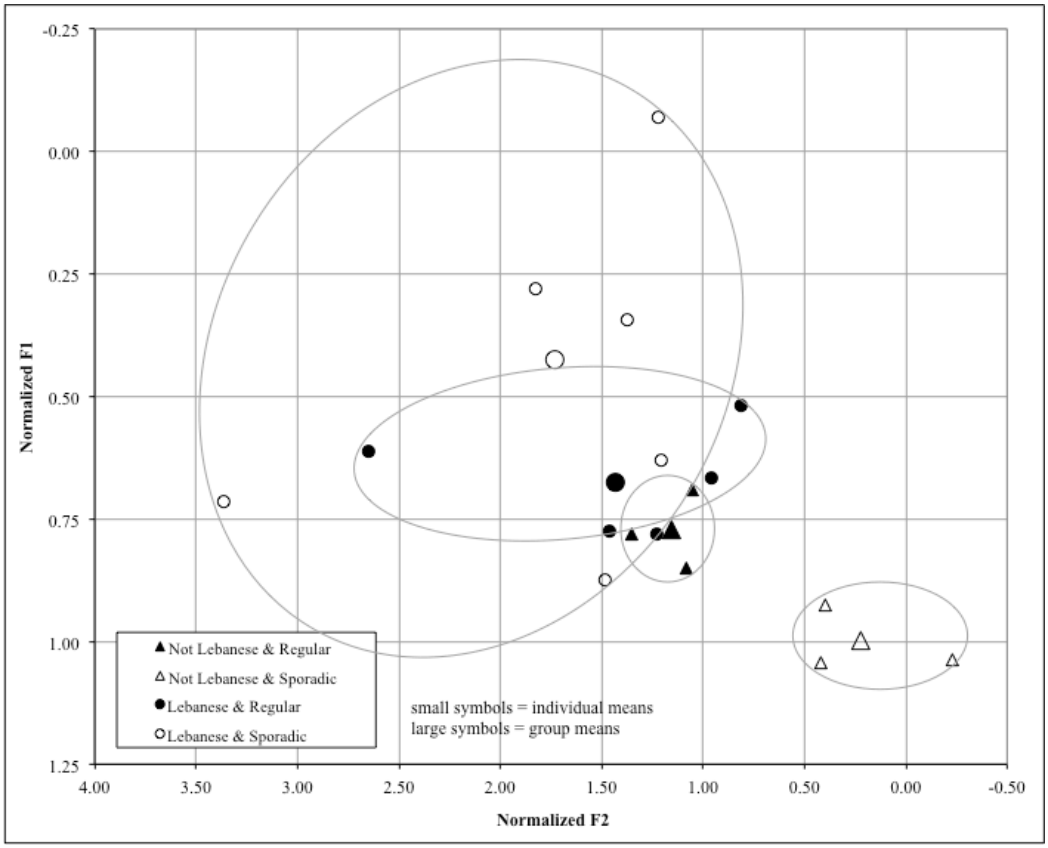
Figure 4.29 Individual and group means of F2 of /æ/ by age at immigration



Ethnicity and religious practice

Contrary to my predictions for both social variables, the interaction of ethnicity and religious practice showed significant effects in one-way ANOVAs on the F1 and F2 of /æ/. For both F1 and F2, post-hoc tests revealed significant differences between the /æ/ values of Lebanese students with sporadic religious practice and the /æ/ values of non-Lebanese students with sporadic religious practice. Lebanese students with sporadic practice had overall the most fronted and most raised /æ/ productions, while non-Lebanese students with sporadic practice had overall the least fronted and least raised /æ/ productions. Students who identified as practicing religion regularly, both Lebanese and non-Lebanese, had, on average, /æ/ productions in the middle of the other two groups. The results of this interaction clarify to some extent the results of the test on ethnicity alone, which showed significant differences for both F1 and F2 of /æ/ between Lebanese and Non-Lebanese speakers. The findings of this ANOVA suggest that the ethnic distinction is primarily between students with sporadic religious practice, while students with a regular religious practice do not show the same difference in /æ/-variation. However, the individual means for Lebanese participants with sporadic practice, seen in Figure 4.30 are wide-ranging along both F1 and F2 dimensions, while the individual means for the non-Lebanese students with sporadic practice are more closely clustered together, though there are only three speakers, so less spread is expected. It could be the case that non-Lebanese students with sporadic religious practice are in some way resisting the fronting and raising of /æ/.

Figure 4.30 /æ/ by speaker ethnicity and religious practice



4.3.3 Comparsion to past research

Past findings on linguistic variables

Like /ɑ/-fronting, results for /æ/ also show similarities to and differences from past research. Much of the research on /æ/ has focused on raising, often to the exclusion of fronting. In the models for /æ/-shifting, preceding context had significant, but different, effects on both F1 and F2 of /æ/ and following context had a significant effect on fronting only. Word position was not a significant predictor in either model. In Eckert's study, both the following and preceding segments were significant predictors of /æ/-raising (recall that her analysis is based on a coding index that does not separate fronting from raising), but following segment was the strongest overall predictor of /æ/-shifting, with following nasals and velar voiced obstruents most favoring shifting. LYS also found following nasals to be strong promoters of /æ/-raising (as I discussed in chapter 3, target vowels occurring in nasal contexts were excluded from token selection). Gordon -- whose analysis is also based on a coding scheme that combines raising and shifting into one

index -- found that preceding velars strongly favored /æ/-shifting, while post-alveolars disfavored shifting and other preceding phonological contexts did not show significant effects on /æ/-shifting. Callary's study on the effect of a speaker's community size on /æ/-raising finds that the preceding environment has no effect on /æ/-raising; it is irrelevant to whether or not the 'raising rule' is applied (1975:162). Callary finds that the following context does show an effect on /æ/-raising, however, with velar context having the most raised /æ/ productions and labial context the least raised /æ/ productions, and alveolar contexts having /æ/ productions in the middle. In contrast, in Roeder's (2006) study of Mexican Americans in Lansing, MI, she finds that following context, except following nasals, has minimal effect on /æ/-shifting. She also finds that preceding velars promote /æ/-raising more than other places of articulation. My results suggest that preceding and following velars affect shifting in both dimensions, which is generally in line with past findings discussed here, though LYS found that tokens with following velar contexts were the least shifted among the Detroit speakers in their study, though not the Chicago speakers (Gordon 2001, 153).

In my univariate tests of word position, word-initial tokens of /æ/ were significantly more fronted than word-medial tokens, while the difference in raising was not significant. However, the mixed model does not uphold the findings of the univariate results of the effects of word position; it is not a significant predictor in either the F1 or the F2 models. Gordon's statistical analysis, which considers each independent variable separately, like the univariate analysis, shows that for his data, word-final /æ/ strongly favored shifting, while word-medial /æ/ strongly disfavored shifting (Gordon does not discuss how he obtained word-final /æ/, which does not occur in English). However, Gordon's study and this one looked at different word positions (initial and medial, vs. medial and final) and my final model includes several independent variables while Gordon performs univariate analyses only.

Past findings on social variables

Roeder's work also suggests that the relationship between fronting and raising of /æ/ is not entirely clear or straightforward, and that the suggested progress of the shift—that fronting always precedes raising—may be more malleable than was previously thought. Roeder finds that while all age groups of female Mexican American respondents in her study are NCS-like for the height of /æ/, only female respondents under 45 years have accommodated to the F2, or front/back, position of NCS /æ/. For Roeder, this indicates

that fronting does not necessarily have to precede raising for /æ/ in the NCS (cf. LYS 1972, Ito 1999). Roeder also finds that that the men in her study are generally lagging behind women in their accommodation to the NCS variables (56). The univariate results here do not show significant differences between male and female speakers, but below I discuss this difference as part of the mixed model results.

Callary's work on the effect of community size on /æ/-raising finds that speakers from larger communities have overall more raised /æ/ values than speakers from smaller communities. Since all the Mercer participants reside in the same community and town, I cannot compare my findings to Callary's, though his results suggest that, based on Dearborn's relatively large size (about 100,000 residents in 2000), we would be likely to find /æ/-raising in general.

Like several other studies and the present one, Herndobler's study of /æ/-raising among working-class residents of East Chicago also shows gender differences, with women having more raised /æ/ productions than men. Herndobler also finds an age component among her participants: younger women have overall more raised and fronted /æ/ than older women. Evans' (2001) work on /æ/-shifting among Appalachian migrants in Ypsilanti, MI, also finds that women lead men in /æ/-raising (2001:39). In Eckert's work, while female students had overall more raised /æ/ than male students and particularly in use of the most advanced (i.e. most raised) variants, the gender difference is due almost entirely to distinctions between Burnout girls and boys, with Jock girls and boys showing little differentiation from one another with respect to /æ/-raising.

One unexpected feature of the social patterning of /æ/-variation in this study is the link between participant gender and the fronting, but not the raising, of /æ/. The male lead in the fronting of /æ/ is not a pattern found in any previous studies of the NCS. The few more recent acoustic studies of the NCS (e.g. Hillenbrand *et al* 1995; Clopper *et al* 2004), which present both F1 and F2 data, show that /æ/ is fronting along with raising among speakers in the NCS region. Hillenbrand *et al* (1995) compare data to the classic Peterson and Barney (1952) vowel plots and find in their data a considerable amount of fronting relative to the Peterson and Barney data for both men and women (3104). In the Hillenbrand *et al* data, the more noticeable differentiating feature of /æ/-variation between men and women is raising of /æ/ relative to /ɛ/, not fronting of /æ/; women in the study show more raising of /æ/ than men. Clopper *et al*'s data show that Northern speakers in their study have more fronted /æ/ than contemporaneous speakers from all

other regions of the United States, but they find no significant differences between male and female participants from the northern region with respect to the fronting of /æ/. Roeder's (2006) study finds that that the younger women in the study have more fronted /æ/ values than the older women, while men do not show the same degree of /æ/ fronting. The pattern of women leading men in a sound change is expected based on past findings of how men and women contribute to the spread of sound changes, but in fact the statistical model in this study predicts the reverse for the participants. It is possible that the male lead in /æ/-fronting among the Mercer participants is attributable to the two male participants with considerably more fronted /æ/ values than all other speakers' /æ/ values. Removing those two speakers (Rasim and Bilal) brings the mean F2 down from 1.42 to 1.02 (cf. the female mean of 1.06) and makes no change to the mean F1 of .67 (cf. the female mean of .68). These two male participants are likely to account for the male lead in fronting in the model, though they do not stand out socially in a way that suggests they should be treated as outliers for /æ/ productions.

4.3.4 Multivariate mixed model results for /æ/

As with the model of /ɑ/, the models presented in this section are the final of several I tested to fit the data. Mixed models have several advantages over other kinds of statistical tests, but one of the drawbacks is that they only model the variation of one variable. There are tests designed to look at two or more dependent variables simultaneously (e.g. MANOVA), but these tests have strict requirements about the kinds of data that can be used. Data gathered from sociolinguistic interviews (and here, most importantly, data which vary widely for preceding and following contexts) or other naturalistic or naturally occurring speech contexts are challenging to use in a MANOVA, since token-level predictors, like linguistic variables, could not be included. A MANOVA using the data from this study would essentially require the same phonological environments for each token, or would require that those token-level variables not be included in the data. Since preceding phonological context has repeatedly shown to be a significant factor in vocalic variation, MANOVA-type tests would be more appropriate for a study based on data that controls for that variation. To work around this issue for variation in /æ/, which occurs in both the F1 and F2 dimensions, I fit separate models for F1 and F2, but I then compare the results of the two final models. Separate models do have the advantage of showing how variables might affect one formant but not the other, which is the case with speaker sex. I discuss this somewhat unexpected finding below in greater detail.

Results of the final mixed model for the F1 of /æ/ are given in Table 4.23, results for F2 are in Table 4.24, and estimated means for significant predictors are discussed below.

Table 4.23 Mixed model of F1 of /æ/

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	11.654	27.565	.0001
*Preceding Context	6	586.759	3.200	.004
Following Context	3	586.727	.513	.674
Position in Word	1	588.416	1.155	.283
Sex	1	5.985	.017	.901
Ethnicity	1	6.215	3.553	.107
Future Plans	2	5.972	.178	.841
Religious Practice	1	6.021	.005	.947
Ethnic Label Importance	1	5.988	1.734	.236
Age at Immigration	2	6.041	.977	.429
Sex * Religious Practice	1	6.040	1.568	.257
*Ethnicity * Religious Practice	1	5.983	6.120	.048

* Significant at a level of p=.05

Table 4.24 Mixed Model for predicting F2 of /æ/

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	24.348	18.693	.0001
*Preceding Context	6	588.432	9.621	.0001
*Following Context	3	587.584	3.742	.011
Position in Word	1	592.899	.911	.340
*Sex	1	8.083	5.486	.047
Ethnicity	1	8.221	2.119	.183
Future Plans	2	8.039	3.419	.084
Religious Practice	1	8.072	.021	.888
Ethnic Label Importance	1	8.049	4.002	.080
Age at Immigration	2	8.129	1.576	.244
*Ethnicity * Religious Practice	1	8.021	6.432	.035

*Significant at a level of p<.05

Overall, the models have fewer significant predictors than the model of F2 of /ɑ/. Preceding context is a significant predictor in both models, while following context is a significant predictor for F2-variation only. The interaction of ethnicity and religious practice is a significant predictor in both models. It is the only social variable that is a significant predictor of F1-variation. Speaker sex is also a significant predictor of F2-variation.

Preceding context is a significant predictor in both models and the patterns in the mixed model are generally similar to those in the univariate tests, as shown in Figure 4.31. /æ/-raising (low-frequency F1) is most extensive in velar and alveolar contexts, as expected. /æ/-fronting (high-frequency F2) is most extensive in velar and alveolar contexts along with preceding /h/; the effect of velar context is expected based on my predictions. Following context has a significant effect on /æ/-fronting; higher-frequency F2 occurs in post-alveolar and velar contexts. The effect of velar context is expected, while the effect of post-alveolar is not expected based on my predictions. The general effect of preceding and following velar on /æ/-shifting is documented in past research (see above for discussion), and this effect holds in the mixed model with other variables also considered. While I predicted labial context to have a lowering effect on F2 frequency of /æ/, this effect is found in the mixed model for following labial only. The correlation between the effects of preceding context on F1 and F2 of /æ/ found in the univariate analysis is also seen here in Figure 4.31 for the estimated means. For the estimated means, a Pearson correlation shows a strong relationship between F1 and F2 ($r=-.801$; $R^2=.641$; $p=.030$), suggesting that the fronting and raising of /æ/ as part of the NCS are not entirely separate from one another. This may be due not exactly to the effect of phonological context, but to the strong general pattern of /æ/ showing combined characteristics of raising and fronting.

Figure 4.31 Estimated F1 and F2 means of /æ/ by preceding context

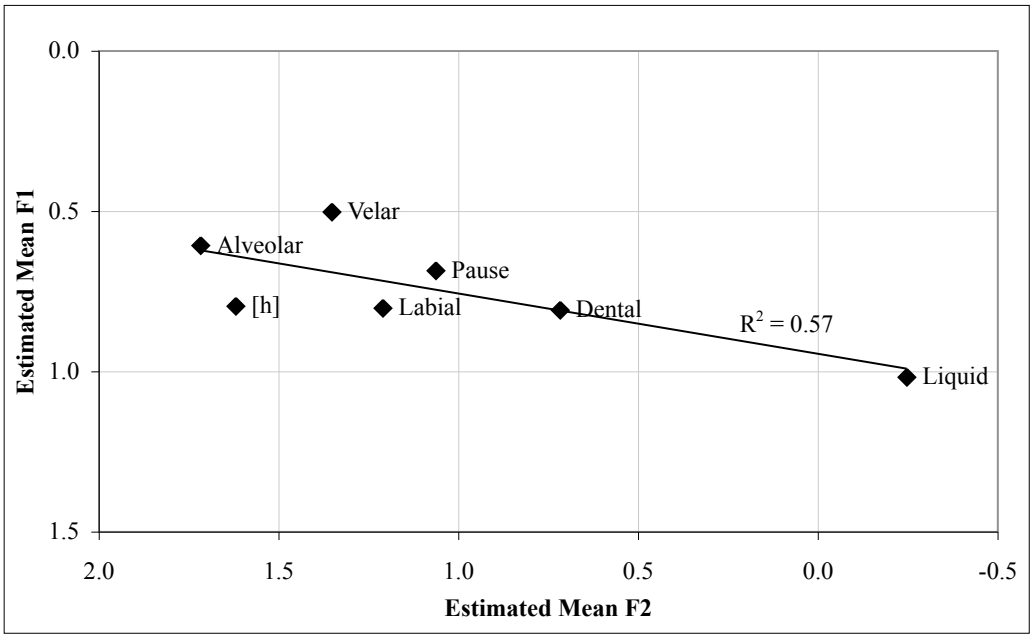
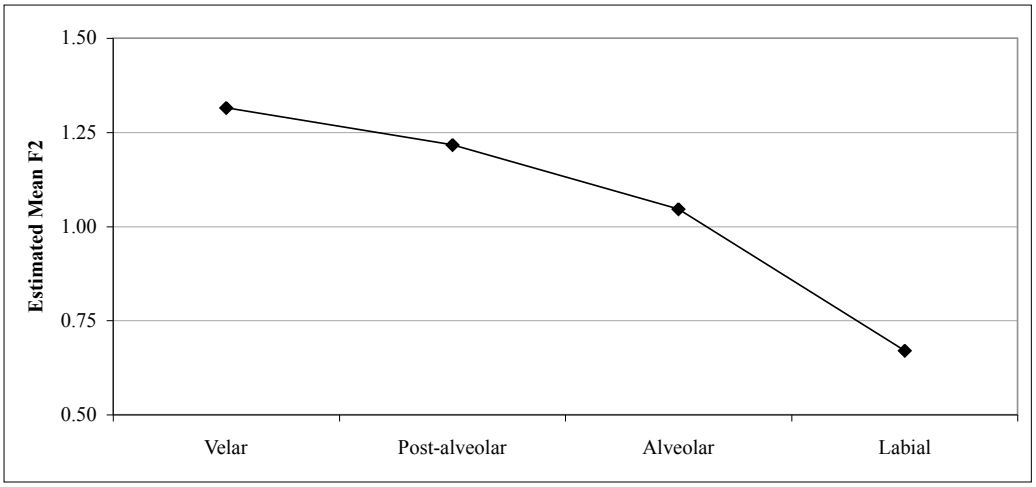


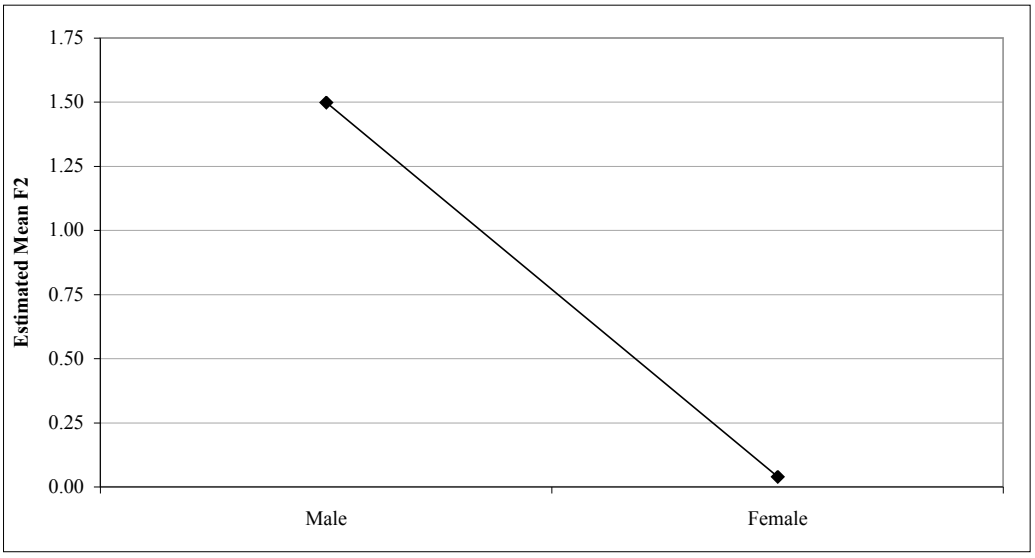
Figure 4.32 Estimated mean F2 of /æ/ by following context



As I predicted, participant sex is a significant predictor of /æ/-fronting in the model. However, unlike my hypothesis, the model predicts male participants to have a higher estimated mean F2-/æ/ than the estimated mean value for female participants. The strong male lead we see here is likely due to the effects from three male participants who have overall more fronted /æ/ productions than any of the other participants. Figure 4.34 shows

individual male and female participant averages for /æ/, along with the mean for the baseline speaker.

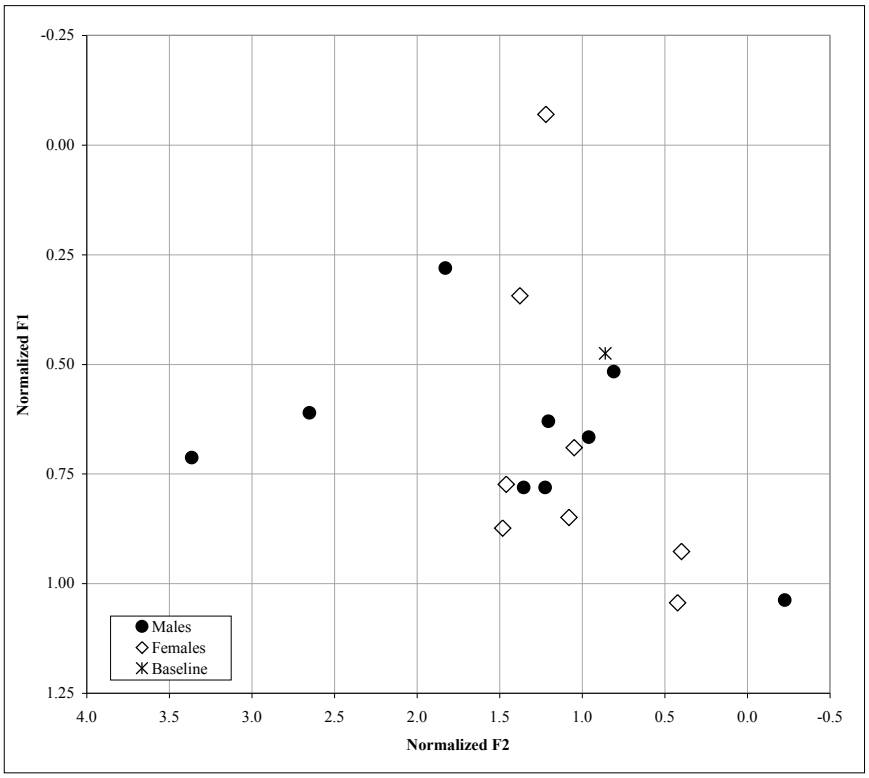
Figure 4.33 Estimated mean F2 of /æ/ by speaker sex



The mixed model for F1 did not have sex as a significant predictor of /æ/-raising, which is the feature of /æ/-variation in the NCS that is more commonly associated with and documented in the speech of young women. Raising is often described as the most advanced stage of the NCS; perhaps most of the community is at an earlier phase of /æ/-variation in which /æ/ is fronted but not especially raised. However, the presence at Mercer of speakers, both male and female, with very raised /æ/ productions suggests that there are people in Dearborn who have very advanced NCS /æ/ usage, and so those variants at the very least have reached Dearborn.

The social patterning of /æ/-fronting in these data is somewhat unusual in comparison to past research. Several studies (LYS 1972; Herndobler 1993; Eckert 2000; Evans 2001; Gordon 2001; Roeder 2006) find women leading men in raising of /æ/, but only Roeder's study addresses fronting as part of the NCS sound change impacting /æ/, and she finds women lead men in fronting, too. It may be that male participants in this study have not reached the same level of /æ/-raising as female participants, but the difference in the F1-/æ/ values between men and women was not significant in the mixed model and there is no indication that this is the case. As Roeder proposes, then, it may be that social differentiation can happen within one dimension but not the other.

Figure 4.34 /æ/ by male and female participants.



Though I hypothesized that neither ethnicity nor religious practice would have a significant effect on /æ/-variation, the interaction of these variables showed significant effects in models of both F1 and F2. Further, the estimated means of the models showed similar kinds of effects for each of the groups in the model. Figure 4.35 and Figure 4.36 show the estimated means for the interactions for F1 and F2, respectively, and the patterns of these means are similar for both formants. The F1 and F2 estimates for each group in the interaction are plotted together in Figure 4.37, which shows that the Lebanese group with sporadic practice is estimated to have both the most raised and the most fronted mean /æ/ values, while the non-Lebanese group with sporadic practice is estimated to have the least raised and the least fronted mean /æ/ values. Lebanese and non-Lebanese with regular practice have estimated means for F1 and F2 of /æ/ that are clustered in the middle.

The interaction between ethnicity and religious practice is the only social variable that shows up as a significant predictor for both F1 and F2, and it shows the same kind of effect on both F1 and F2. The difference in /æ/ between Lebanese and non-Lebanese

participants is clarified by differences in level of religious practice. Within each ethnic sub group, sporadic religious practice shows the opposite effect on /æ/-variation.

Figure 4.35 Estimated mean F1 of /æ/ by ethnicity and religious practice

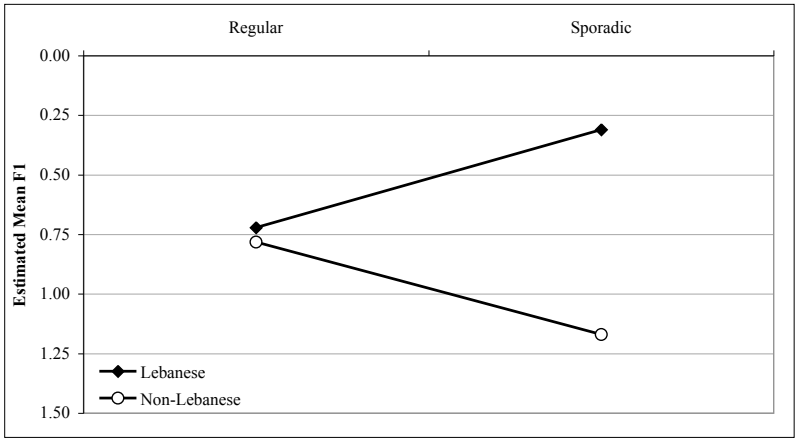


Figure 4.36 Estimated mean F2 of /æ/ by ethnicity and religious practice

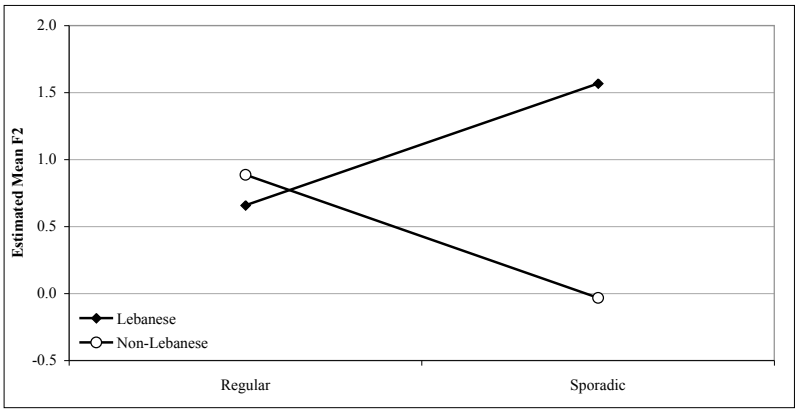


Figure 4.37 Estimated mean F1 and F2 of /æ/ by ethnicity and religious practice

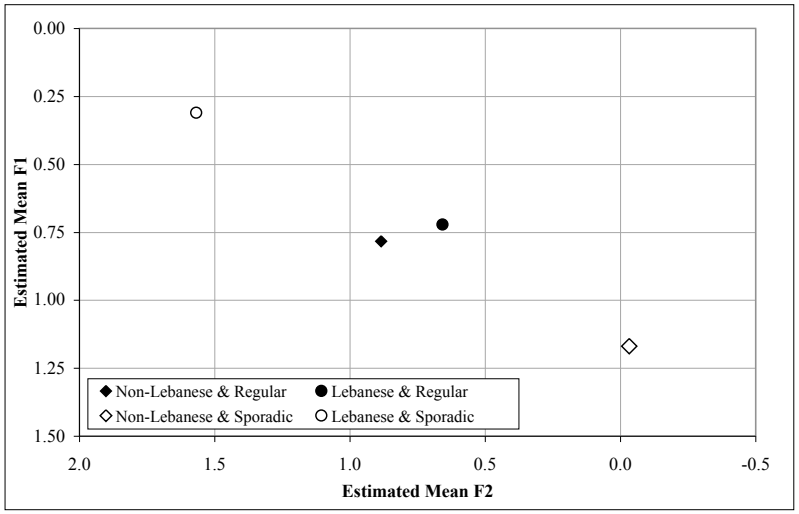


Table 4.25 below summarizes the significant predictors in the models of /æ/-shifting and the nature of their effects. The social predictors in the model are again a combination of broad social distinctions (speaker sex) and narrower, locally defined social categories, but the social patterning is restricted to just two social predictors. As the table shows, there is a male lead in /æ/-fronting only, while the interaction of ethnicity and religious practice has the same effect on both /æ/-fronting and /æ/-raising.

Table 4.25 Summary of /æ/-shifting patterns

	Fronted/Raised		**Not Fronted/Raised**
Sex	Male (fronted only)		Female
Ethnicity * Religious Practice	Lebanese/Sporadic	All Regular	Non-Lebanese/Sporadic

4.4 Summary and discussion

In this section I discuss the findings of the statistical analysis of /æ/- and /ɑ/-variation. In chapter 6 I continue this discussion, particularly in relation to Eckert's theory about the social meaning of variables and sound change spread.

The results of the mixed models for the linguistic variables showed that the effects of the linguistic variables are generally stronger than the effects of the social variables, as is regularly the case in studies of sociolinguistic variation. The mixed model results showed that the preceding context and following context both had significant effects on variation in /ɑ/ and /æ/. The effect of position in word did not have a significant effect in either mixed model. For /ɑ/-fronting, the effects are generally as expected, though labial context

did not have as much of an effect as I had predicted. The backing effect of glide context may be due to the fact that nearly all the glide tokens are labial-velar /w/. For following context, fronting in labial context is unexpected based on my hypothesis, and examination of individual tokens suggest that this is not related to specific lexical or preceding phonological environments. Further investigation is needed to see if there is a phonetic or linguistic explanation for that pattern.

For /æ/-shifting, many of the phonological effects are expected based on my predictions, though I expected labials to have a stronger backing effect on /æ/ than it does. The strong fronting effect of alveolar context is unexpected. For following contexts, the fronting effect of post-alveolar context on /æ/ is somewhat unexpected, but the rest of the results are generally expected. In future work, a more careful separation of manner and place contexts is needed so that the effects can be teased apart (as in the case of the effects of glide context on /ɑ/-fronting). This may also help resolve the generally unexpected apparent finding of significant place effects on F1 of /æ/.

The hypotheses I presented in chapter 3 regarding the effects of the social variables on the older variables were predicated on an assumption that the patterns of variation would be very similar for the two older variables, by virtue of their "age" in the shift. However, the mixed models for /æ/ and /ɑ/ suggest that the social patterning of the two older variables in the NCS examined in this dissertation are quite different from one another and linked to social factors in different ways.

The model for /ɑ/-fronting included several social variables as significant predictors of F2-variation, while the models for /æ/-shifting show just two social variables with significant effects on /æ/-variation, as shown below in Table 4.26.

Table 4.26 Summary of effects of independent variables by vowel

Vowel		Variables with significant effects on variation
ɑ	F2	Sex Lebanese/Non-Lebanese Ethnicity Future Plans Sex * Religious Practice Sex * Ethnic Label Preceding Context Following Context
æ	F1	Ethnicity * Religious Practice Preceding Context
	F2	Sex Ethnicity * Religious Practice Preceding Context Following Context

The numerous social variables in the model of /ɑ/-fronting suggest that this older variable in the NCS is not linked to one specific local meaning, but is more diffuse in its social patterning. Overall, the social variables suggest a pattern in which mainstream or non-marginalized groups and social categories lag in /ɑ/-fronting, but this is a very broad concept and one that I explore further in chapter 6. In contrast, the social patterning of /æ/-shifting is more restricted, and linked primarily to one interaction variable and to speaker gender, a much narrower range of social characteristics than for /ɑ/-fronting. This narrower social patterning is not predicted by Eckert's theory for the older variables.

In the context of my study, the separation between older and newer variables that is crucial to Eckert's theory is complicated by the passage of time. Though I divided the variables based on their "age" in the shift, the newer variables (see Chapter 5) are more well-established as part of the NCS in 2007 than they were in the early 1980s, when Eckert collected her data. The NCS has continued to progress in the thirty years since then, and the variables do not have the same geographical distribution that they did nearly 30 years ago. But while /ʌ/ and /ɛ/, as part of the NCS in 2007, may no longer be considered "new" variables, they are still newer than /æ/ and /ɑ/ and their recency as part of the NCS may still be factor in their socially-patterned variation.

In Chapter 3 (§3.9) I laid out my hypotheses for the effects of each independent social variable on the four vocalic variables. My hypotheses center around Eckert's concept of older and newer variables in a regional sound change being available for the expression

of different kinds of social meaning. The models of /æ/- and /ɑ/-variation do not show the same kind of social patterning and suggest that the kinds of social meaning available to the older variables in the NCS is fairly diverse. This is not entirely out of line with Eckert's theory; she argues that older variables are up for negotiation of social meaning available to a wider population (2000, 221). But it does not address the fairly local social variables (which, according to Eckert's theory, should be associated with newer variables in the NCS) in both models.

My hypotheses were formulated to test Eckert's theory about the social meaning attached to different variables in a shift, based on how long they have been around in the shift. The results for the older variables suggest that the findings so far do not support the theory. In chapter 6 I discuss several ways in which Eckert's theory is perhaps too specific to be applied to other contexts and ways in which it could be modified or expanded to be applicable, or even testable, in more settings, including those in which the primary social opposition is not a class-based distinction. I consider many of the factors that may be related to this: the loss of specific geographic origins; the effect of ethnic and cultural factors; the prominence and specificity of "urban" in Eckert's theory. Prior to that, however, I discuss the statistical results for the two newer NCS vowels in chapter 5.

Chapter 5: The Newer Variables: /ɛ/ and /ʌ/

5.1 Introduction

This chapter presents the results of the statistical tests and models for /ɛ/ and /ʌ/, two of the newer variables in the NCS. Compared to the two older variables discussed in Chapter 4, much less is known about the patterns of variation of the two newer variables investigated in this chapter. Sociolinguists lack information on how /ɛ/ and /ʌ/ vary phonetically and also on the social patterning of their variation and what kinds of social categories the variation might be linked. This gives us little context for understanding the acoustic properties of these vowels. (Gordon [2001] and Eckert [2000] both investigate these variables but their analyses are based on auditory not acoustic measures.)

The structure of this chapter follows that of chapter 4. Each of the two vowels is analyzed separately, with univariate analysis of variables followed by the multivariate mixed-effects model. As in chapter 4, the univariate analysis allows for a greater level of detail in understanding the patterns for each independent variable that are present in the actual data, along with some basic comparison to past research on NCS variables, while the mixed model provides a comprehensive analysis of the variation that includes all independent predictors along with estimates of mean F1 and F2 values based on the model. As with /æ/-shifting in chapter 4, both F1 and F2 are included in the analysis for both vowels and separate statistical tests are performed on the measures. For /ɛ/-shifting, Eckert describes backing as the primary trajectory of shifting in the NCS and argues that lowering of /ɛ/ is a *reversal* of the shift and an altogether different trajectory (2000). Gordon, on the other hand, describes /ɛ/-variation in the NCS as both backing and lowering, coding tokens in his study as backed, lowered, or backed and lowered. Other researchers describe /ɛ/-shifting primarily as backing (Labov 1991; Clopper *et al* 2005; Roeder 2006). Since past studies indicate a variation in both dimensions, and studies since Eckert's have included /ɛ/-lowering as part of the NCS, I include both dimensions in my analysis. Similarly, /ʌ/-shifting has been documented in both dimensions (Gordon 2001), though the primary dimension has been described as backing (Eckert 2000; Clopper *et al* 2005). With so little data on which to formulate predictions, there is no

compelling reason to leave the F1 dimension out of the model. The analysis of the two variables is followed by summary and discussion of the two vowels together. It should be recalled that, for the newer vowels, the direction of shifting is the opposite of the direction for the older variables; here, the direction is backing and lowering, instead of raising and fronting. As in chapter 4, I discuss results of statistical models in terms of articulatory dimensions, but these are inferred from acoustic measures.

5.2 /ɛ/

Variation in /ɛ/ as part of the NCS is described as backing or as backing and lowering, and the results of the univariate analysis show that /ɛ/ in the Mercer participants' data is varying along both F1 and F2 dimensions. Again, since sociolinguists know so little about the nature of /ɛ/-variation as part of the NCS, it is useful to be able to see the patterns of variation along each dimension separately. Recall that all tests are performed on normalized measures of F1 and F2. The following two sections present the univariate analysis along with comparison of those results to past findings.

5.2.1 Univariate analysis of linguistic variables

My hypothesis about the effects of the linguistic variables on /ɛ/-shifting is as follows:

- Relatively high frequency F2 are expected in non-labial contexts.

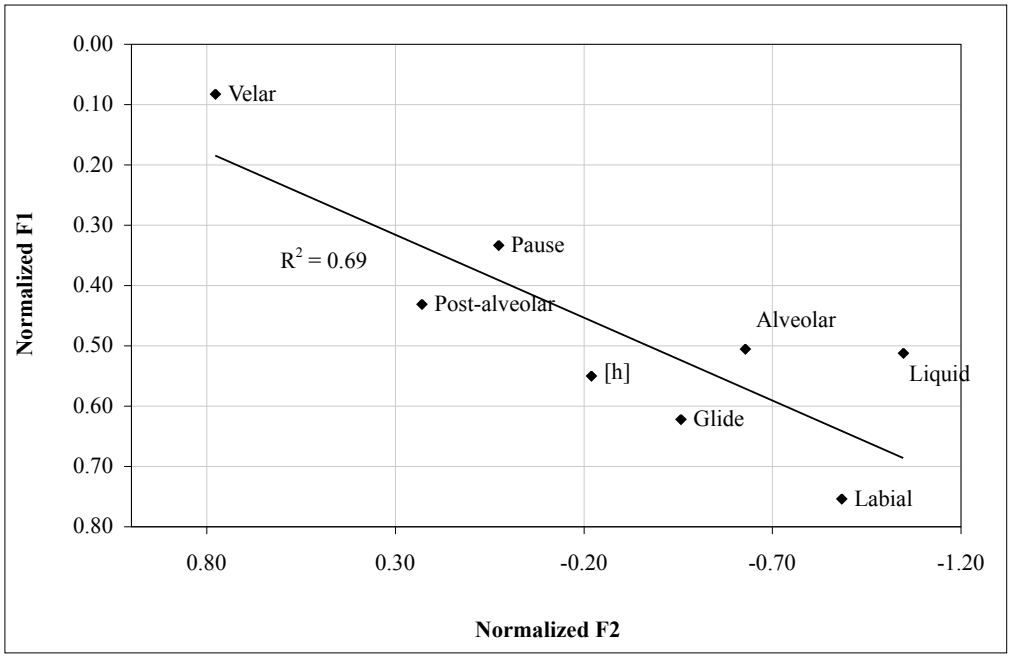
Preceding context

One-way ANOVAs of F1 and F2 of /ɛ/ by preceding phonological context showed significant differences across phonological contexts for both dimensions of variation. Figure 5.1 gives a scatter plot of average /ɛ/ by preceding context and shows the mean of vowels preceded by velars to have low F1 frequency (least lowered) and high F2 frequency (least backed), while vowels in labial contexts have high F1 frequency (most lowered) and those in liquid contexts have low F2 frequency (most backed). The mean F1-/ɛ/ and F2-/ɛ/ values for other preceding contexts fall between these contexts, and the steep trendline in Figure 5.1 suggests a strong degree of correlation between F1 and F2 for /ɛ/: if a context promotes backing of /ɛ/, it is likely to promote lowering in /ɛ/ as well. A Pearson test of the correlation of F1 and F2 is significant ($r=-.830$; $R^2=.69$; $p=.011$).

Table 5.1 Token counts and average formants by preceding context for /ɛ/

Preceding Contexts	Token Count	Mean F1	Mean F2	Rescaled F1	Rescaled F2
Liquid	14	.512	-1.048	597	1612
/h/	9	.550	-.220	591	1671
Glide	26	.622	-.457	615	1686
Post-alveolar	11	.431	.230	575	1793
Velar	79	.083	.777	541	1851
Labial	107	.754	-.884	626	1633
Pause	93	.333	.026	576	1753
Alveolar	170	.505	-.628	594	1669
Total	**509**	**.466**	**-.321**	**591**	**1706**

Figure 5.1 /ɛ/ by preceding phonological context



Post-hoc Scheffe tests revealed significant differences between several phonological contexts for F1 and F2, which are summarized below in Table 5.2 and Table 5.3 (pairwise comparisons not included in the tables are not significant; see Appendix E for full results for all statistical tests on /ɛ/). For variation in lowering, /ɛ/ tokens preceded by labials were overall the most lowered, and differed significantly from velar contexts, the overall least lowered /ɛ/ tokens, and from tokens preceded by alveolars and by pauses. Tokens preceded by velars differed significantly from glide-preceded and alveolar-preceded tokens, along with the labials. The moderate backing effect of glides is not easily interpretable; glide tokens for /ɛ/ are evenly split between /j/ and /w/, and

differences in the effects of those two contexts would need to be teased apart to better understand the effects of the glide context. The significant differences in the post-hoc tests generally show up between preceding contexts that are at either end of the range of variation of F1-/ɛ/, with means for /ɛ/ in the velar and pause contexts at the least lowered end and means for /ɛ/ in the labial and liquid contexts at the most lowered end. Vowels in alveolar contexts also differed significantly from /ɛ/ in the two most extreme contexts, labial and velar, despite being in the middle of the F1 values, which is likely due to the high token count for alveolar preceding context. The effect of velar context resulting in high frequency F1 of /ɛ/ is expected, though the general significance of these effects on F1 is unexpected.

For F2 results, or backing of /ɛ/, the significant differences found in the post-hoc tests are again generally between the two ends of the variation in backing and fronting. Velar, which has the least backed mean /ɛ/ as well as the least lowered mean /ɛ/, is significantly different from the /ɛ/ values for labial, liquid, and alveolar contexts, which are the three most backed contexts for /ɛ/. Low frequency F2 in labial context is as expected,

Table 5.2 Pairwise comparisons of preceding context for F1 of /ɛ/

	Liquid	**Alveolar**	**Glide**	**/h/**	**Post-alveolar**	**Pause**	**Velar**
Labial	---	*	---	---	---	***	***
Velar	---	***	**	---	---	---	
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant							

Table 5.3 pairwise comparisons of preceding context for F2 of /ɛ/

	Liquid	**Alveolar**	**Glide**	**/h/**	**Post-alveolar**	**Pause**	**Velar**
Labial	---	---	---	---	---	*	***
Velar	*	***	---	---	---	---	
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant							

Table 5.4 below ranks the effects of preceding context for F1 and F2 of /ɛ/, from most lowered and backed to least lowered and backed. The correlation between F1 and F2 indicates that preceding contexts which promote backing are also likely to promote lowering. Comparing the ranking of effects for F1 and F2 suggest that this is the case for the context of labial, which has most lowered and the second most backed mean /ɛ/ values, and for velar, which has the least backed and lowered mean /ɛ/ values. Further, post-alveolar and pause, the two contexts after velar that have the least lowered and backed mean /ɛ/ values, are also similarly ranked for F1 and F2. For the rest of the

contexts, the relationship between F1 and F2 is less conclusive from the ranking. Overall, there is a strong relationship between lowering and backing of /ɛ/ in relation to the preceding phonological context.

Table 5.4 Rank of effects of preceding context on F1 and F2

Rank of Effects on F1	Mean F1	Rank of Effects on F2	Mean F2
Labial	.754	Liquid	-1.048
Glide	.622	Labial	-.884
/h/	.550	Alveolar	-.628
Liquid	.512	Glide	-.457
Alveolar	.505	/h/	-.220
Post-alveolar	.431	Pause	.0264
Pause	.333	Post-alveolar	.230
Velar	.083	Velar	.777
Overall Mean	**.466**	**Overall Mean**	**-.321**

Following context

The following context of a token had a significant effect only on the F2 of /ɛ/ at a level of $p<.001$. The following context had no significant effect on the lowering of F1; this is phonetically expected given that the phonological contexts are primarily based on place, and these effects are expected to be seen primarily in F2. Table 5.5 shows token counts and average mean F2 values for each following context included in the ANOVA.

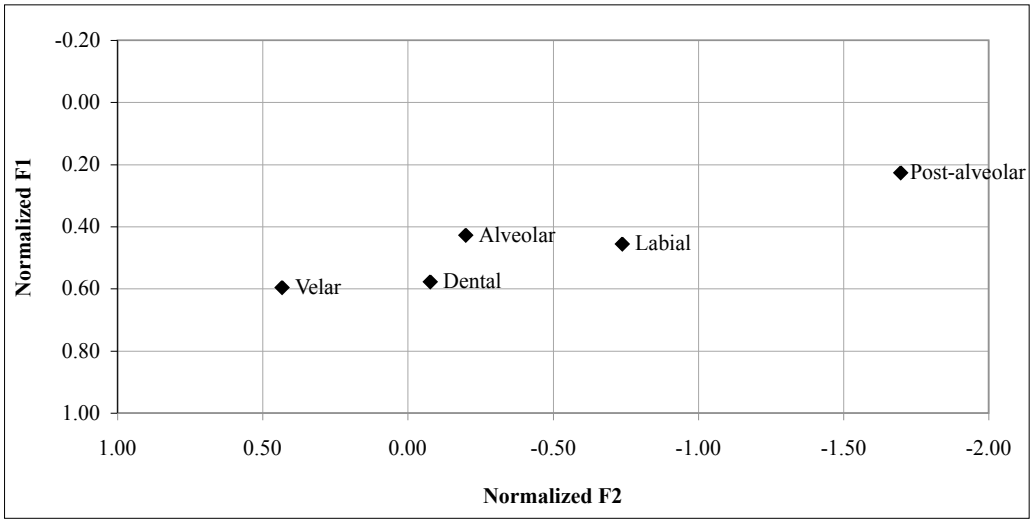
Table 5.5 Token count and mean F2 of /ɛ/ by following context

Context	Number of Tokens	Mean F2	Rescaled F2
Post-alveolar	11	-1.69679	1518
Dental	33	-.07649	1730
Velar	81	.43364	1810
Labial	166	-.73741	1651
Alveolar	223	-.19922	1724
Total	**514**	**-.29747**	**1707**

The scatter plot in Figure 5.2 shows that most of the /ɛ/-variation by following phonological context lies along the horizontal, or F2, dimension, which is expected for phonological contexts based mostly on differences in place of articulation. As with the results for preceding context effects, velar as a following context produced the overall least backed /ɛ/ tokens, which is as expected based on my hypothesis. Post-alveolar had

the most backed mean /ɛ/ value, which is unexpected based on my hypothesis that labial context will give rised to the lowest F2 values.

Figure 5.2 /ɛ/ by following context



Post-hoc pairwise comparisons of following contexts showed significant differences between several contexts. /ɛ/ in the following velar context differed from /ɛ/ in the post-alveolar and labial contexts, which had two most backed /ɛ/ values. /ɛ/ followed by a labial context also differed significantly from /ɛ/ with following alveolar context. Note that the widely varied number of tokens per following context skew the results, so that contexts with higher token counts (alveolar, labial) are more likely to show results in the post-hoc tests than contexts with lower token counts. Unlike the effect of post-alveolar in preceding context, which did not promote backing, following post-alveolar context appears to promote backing of /ɛ/.

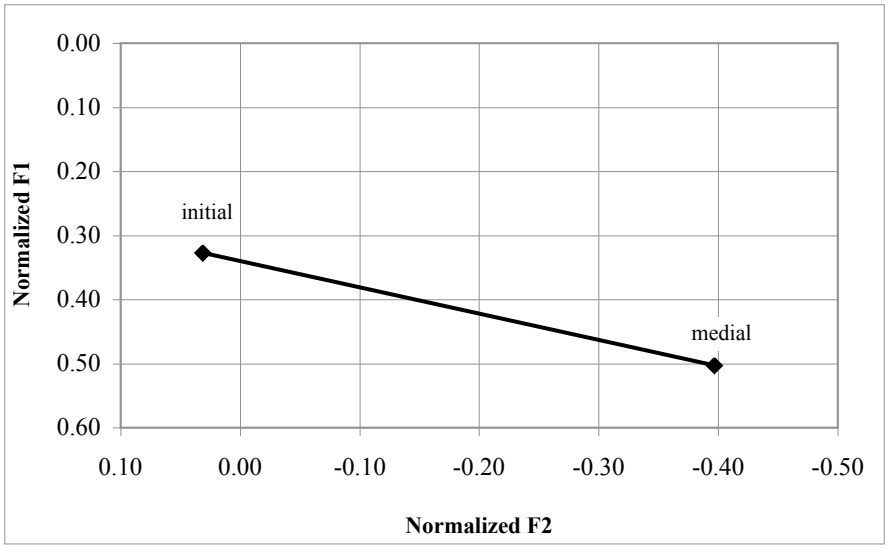
Table 5.6 Pairwise comparisons on F2 of /ɛ/ by following context.

	Labial	**Alveolar**	**Dental**	**Velar**
Post-alveolar	---	†	†	**
Labial		*	---	***
Alveolar			---	†
Dental				---
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant				

Position in word

As with the variables in chapter 4, word position for /ɛ/ distinguishes between tokens occurring in word-initial and word-medial tokens. Figure 5.3 shows that the mean F1 and F2 for /ɛ/ occurring in medial position is more lowered and more backed than /ɛ/ occurring in word-initial position. Mann-Whitney u-tests comparing initial and medial word positions for /ɛ/ showed that the differences between the two positions is significant for both F1 (p=.009; U=16552.5) and F2 (p=.027; U=17091.0). This result is contrary to my hypothesis that word position will have little effect on F1 or F2 values.

Figure 5.3 /ɛ/ by position in word



All three linguistic variables show significant effects on /ɛ/-shifting in the univariate analysis, and both backing and lowering are patterned by the linguistic variables. A preceding velar impedes both backing and lowering of /ɛ/ and a following velar also impedes backing of /ɛ/. Preceding and following labials in general promote backing and lowering of /ɛ/. Backing being promoted by labial context is expected based on my hypothesis. The effect of position in word, with word-medial tokens being more backed and lowered than word-initial tokens, is unexpected. After discussing the results of the univariate social analysis, I compare the univariate results to past studies.

5.2.2 Univariate analysis of social variables

In Chapter 3 I hypothesized that the social variables listed below would have significant effects on the /ɛ/-variation:

Ethnicity	Lebanese participants will have more backed and lowered /ɛ/ than non-Lebanese participants
Age at Immigration	U.S. born speakers will have the most backed and raised /ɛ/ and speakers who arrived in the U.S. after age five will have the least backed and lowered /ɛ/.
Religious Practice	Participants with sporadic religious practice will have more backed and lowered /ɛ/ than participants with regular religious practice
Ethnic Label Importance	Participants who think ethnic labels are not importance will have more backed and lowered /ɛ/ than participants who think ethnic labels are important

Somewhat surprisingly, the univariate analysis of the six social variables, and several interactions between pairs of those variables, showed no significant effects from any of the variables in either F1 or F2. Two of the variables, ethnicity and ethnic label importance, did show only very marginally significant effects and only in /ɛ/-backing, and the interaction of those two variables was also marginally significant. Below I describe the three results with marginally significant results, with the caveat that none of these results meets the threshold of significance and therefore any patterns in the data must carry little weight in the statistical analysis.

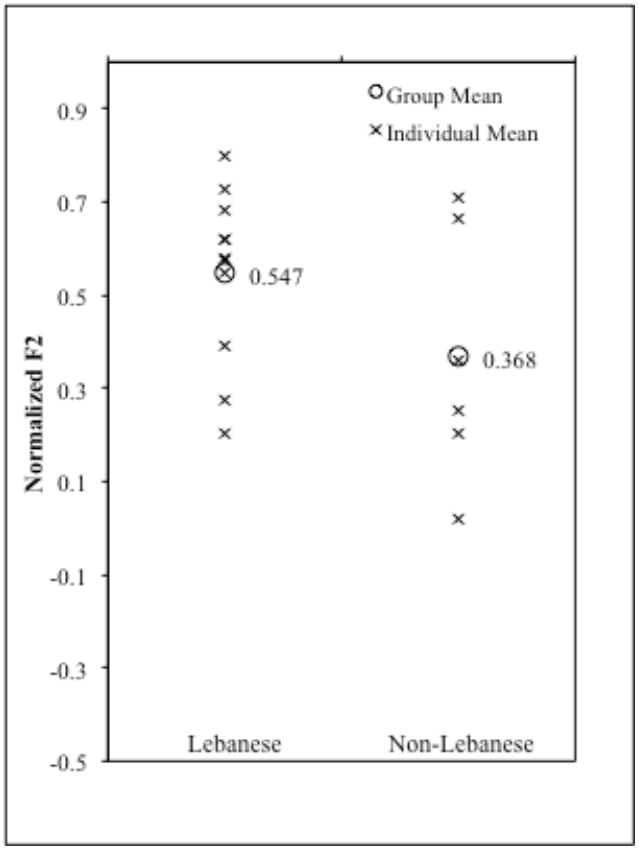
Table 5.7 Summary of univariate tests of social variables on /ɛ/-shifting

Variable	**test type**	**p for F1**	**p for F2**
Marginally significant			
Ethnicity	u-test	.256	**.078**
Ethnic Label Importance	u-test	.743	**.074**
Ethnicity * Ethnic Label	ANOVA	.522	**.085**
Not significant			
Sex	u-test	.673	.963
Age at Immigration	ANOVA	.574	.417
Religious Practice	u-test	.423	.743
Future Plans	ANOVA	.214	.515
Sex * Ethnicity	ANOVA	.130	.277
Sex * Religious Practice	ANOVA	.821	.869
Sex * Ethnic Labels	ANOVA	.895	.316
Ethnicity * Religious Practice	ANOVA	.426	.235

As I hypothesized, participant differences in ethnicity have an effect on /ɛ/-backing, though this effect is only marginally significant. Figure 5.4 below shows that vowels of non-Lebanese participants are slightly more backed than those of Lebanese participants.

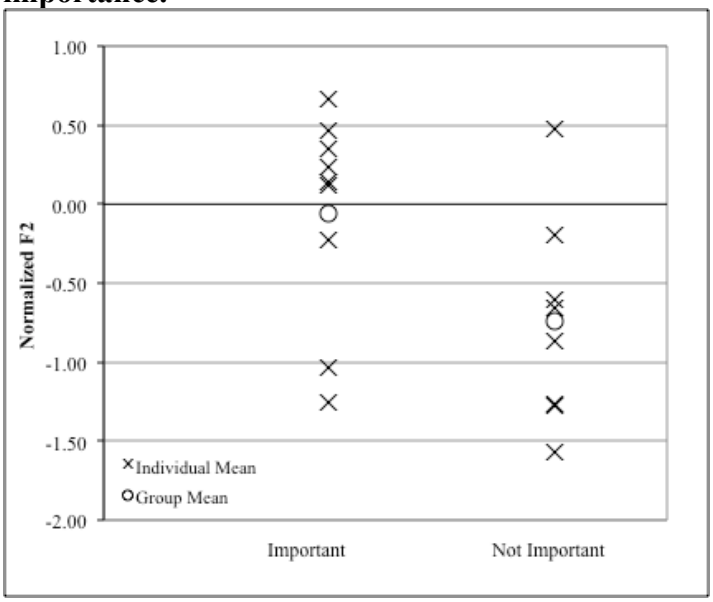
There is, however, a great deal of overlap between the individual means for the speakers in the two groups, and there also does not appear to be any indication of an overall pattern for individual speakers. In both groups, the individual means are quite variable.

Figure 5.4 Individual and group means for F2 of /ɛ/ by ethnicity



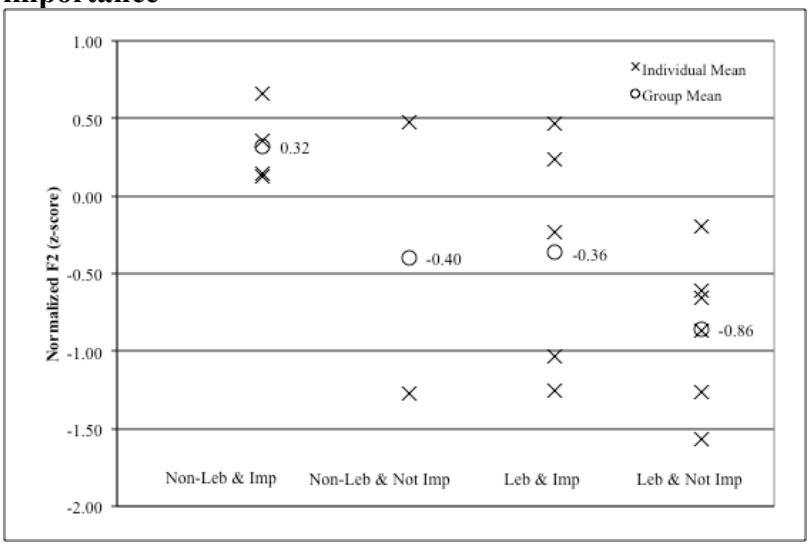
Ethnic label importance, as I hypothesized, also has an effect on F2 of /ɛ/, but again, this difference is only marginally significant; participants who think label choice is not important have an overall more backed mean F2-/ɛ/ than participants who think that label choice is important. Individual means show overlap across the two groups, though there is a substantial cluster of participants in the group who think label choice is important (seven of the nine) whose /ɛ/s are not backed, and six of those participants are more backed than the mean for the group. In comparison, the mean /ɛ/ values for the participants in the 'not important' group are spread out on either side of the mean for the group and do not show a similar type of clustering.

Figure 5.5 Group and individual mean F2 of /ɛ/ by ethnic label importance.



The interaction of these two variables also showed marginally significant results in a one-way ANOVA. Non-Lebanese participants who think ethnic label choice is important have the least backed mean /ɛ/ and are also clustered fairly closely around the mean. This follows the pattern for ethnic label importance, but does not follow the overall pattern above of non-Lebanese participants having more backed /ɛ/s than Lebanese participants do. Lebanese participants who don't find ethnic label choice important have the most backed mean /ɛ/, but the individual means within this group are fairly spaced out and overlap with individuals in the other groups. There is also overlap between the least backed group (non-Lebanese participants who think label choice is important) and the two middle groups.

Figure 5.6 Individual and group mean F2 of /ɛ/ by ethnicity & ethnic label importance



Though these results are not statistically significant in the data presented here, it is possible that more data would support these marginally significant findings. The restriction of these marginally significant results to the F2-dimension also suggests that the social patterning of /ɛ/-shifting may emerge first in /ɛ/-backing instead of -lowering. Several studies have identified backing as the primary dimension of shifting for /ɛ/. But the overall results of the univariate tests indicate that the variation of /ɛ/-shifting in these data are linked to linguistic variables, not social variables.

Comparison to past studies

There is just a handful of studies that have looked at the patterning of /ɛ/ in the NCS. The two with the most detailed results, Gordon's study of the NCS in two small towns and Eckert's study at a suburban Detroit high school, are both based on impressionistic coding. As with the analogous discussions in chapter 4, the remaining discussion in this section is more about how general patterns in the findings compare to older research than it is about suggesting concrete or definitive patterns about NCS variation.

One of the open questions about /ɛ/-variation in the NCS is its trajectory. While Gordon identifies backing, lowering, and backing and lowering as part of the shift, most other studies describe just backing as the primary direction of the shift. There may also be geographic variation in the nature of /ɛ/-shifting; Labov 1991 identifies /ɛ/-lowering as a feature of shifting in Chicago and backing as the trajectory for /ɛ/-shifting in Detroit.

Eckert argues that lowering in suburban Detroit is a response to and a move away from /ɛ/-backing; among her speakers, lowering is a separate type of shift that is a symbolic reversal of the NCS. The preliminary results of the univariate analysis suggest that any social patterning of /ɛ/-shifting among these participants is restricted to backing, but the linguistic patterning of /ɛ/-shifting is occurring in both the F1 and F2 dimensions.

Several past studies explore the linguistic conditioning of /ɛ/. I discuss here those that are comparable to the variables investigated in this study. Gordon (2001) finds that preceding velars and post-alveolars both strongly disfavor shifting (he does not distinguish between backing and lowering in his discussion of linguistic conditioning), which is similar to my results, where preceding velar context is least NCS-like. Gordon's finding that a preceding /h/ strongly favors shifting does not appear to be the case for the data in this study, where vowels preceded by labials and liquids have the most backed and lowered /ɛ/s. However, Gordon did find that preceding liquids in his study also generally favored shifting. Gordon finds no significant differences in the effect of following context based on place of articulation, while in these results, there are significant differences between /ɛ/ values for following velar and following post-alveolar contexts. Finally, while in this study position in word shows a significant effect on backing and lowering of /ɛ/ in the univariate analysis, Gordon finds no such effects from position in word in his analysis.

Eckert's findings focus mainly on linguistic constraints on backing. Eckert finds, as in this study, that preceding liquids favor backing, but does not find in her data that preceding labial context favors backing, as it seems to in this study. She finds that for lowering, the most significant favoring linguistic variable is emphasis, but she also finds that following velar and post-alveolar contexts both favor lowering. In this study, following post-alveolar context is at the NCS-end of the spectrum, but following velar context has the least NCS-like /ɛ/ of the contexts. Eckert reports no results on the significance of position in word on /ɛ/-shifting in her study.

Roeder, whose work focuses on the sociolinguistic patterns of Mexican Americans in Lansing, performed acoustic analysis of /ɛ/-backing, but did not look at its linguistic patterning. Several previous studies (Gordon 2001; Clopper *et al* 2004; Roeder 2006,) find women leading men in the backing of /ɛ/. Roeder and Clopper *et al* both find no differences between men and women in lowering, while Gordon's analysis combines the two trajectories. The present study's univariate analysis finds no significant differences

by gender in /ɛ/-shifting. Eckert finds that social category (i.e., the jock/burnout distinction) is a greater factor in /ɛ/-backing than speaker sex among the high school participants in her study, but she still finds a pattern in which girls lead boys in /ɛ/-backing. It is possible that this change is not gender-differentiated among the Mercer participants because the shift is older now than it was in prior studies, but this would not explain why other elements in the NCS are gender-differentiated among Mercer students. As I discuss below, the lack of significant social patterning of /ɛ/ in the multivariate model suggests that the variation that is present in the data is not explained through the social variables I am testing in this study. Since these social variables are linked to patterning of other NCS vowels, as seen in chapter 4 and later in this chapter, this suggests to me that /ɛ/-shifting may not (yet) be a sociolinguistic variable among these participants.

5.2.3 Multivariate mixed-effects model results

Contrary to my predictions, the mixed-effects models for F1 and F2 of /ɛ/ showed no significant results for any of the social variables. While I did predict that ethnic label importance would be a predictor of /ɛ/-backing, the effect of this social variable is only marginally significant.

Table 5.8 Mixed-effects model for F1 of /ɛ/

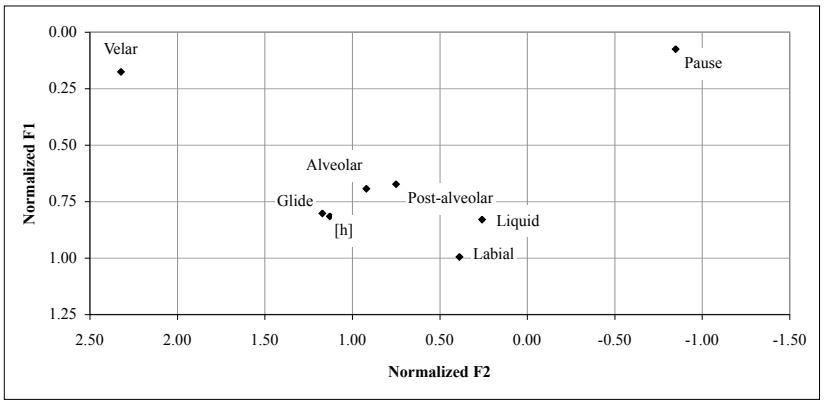
Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	284.055	6.830	.009
Preceding Context	7	483.137	10.197	.0001*
Following Context	4	483.652	8.045	.0001*
Position in Word	1	481.476	.427	.514
Speaker Sex	1	8.569	1.357	.275
Age at Immigration	2	8.745	.224	.804
Ethnicity	1	8.854	2.702	.135
Future Plans	2	8.216	1.622	.255
Religious Practice	1	7.857	.667	.438
Ethnic Label Importance	1	7.891	.439	.526
*significant at a level of p<.05				

Table 5.9 Mixed-effects model for F2 of /ɛ/

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	135.844	1.580	.211
Preceding Context	7	481.243	10.621	.0001*
Following Context	4	481.583	18.040	.0001*
Position in Word	1	480.163	4.196	.041*
Speaker Sex	1	7.240	.155	.705
Age at Immigration	2	7.174	.530	.610
Ethnicity	1	7.304	.204	.665
Future Plans	2	7.044	.068	.935
Religious Practice	1	6.790	1.531	.257
Ethnic Label Importance	1	6.808	4.542	.072
Sex * Ethnic Label Importance	1	6.915	1.279	.296
*significant at a level of p<.05				

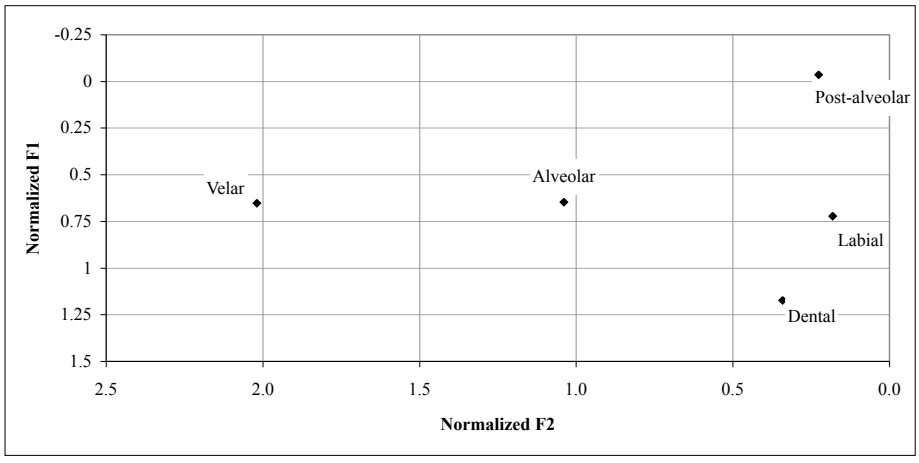
The linguistic predictors of preceding and following context are both significant for both models and Figure 5.7 and Figure 5.8 below show the estimates for F1 and F2 plotted together for each predictor. The estimated mean values for /ɛ/ by preceding context generally follow the findings of the univariate analysis, though the model predicts somewhat different relative F1 and F2 means for the contexts that fall in the middle of the univariate analysis, especially for the context of pause. But the model does predict velar to be the context with the least backed and raised mean /ɛ/, as expected. Labial and liquid are the contexts with the most backed and lowered mean /ɛ/, with the exception of pause context. The backing effect of labials on /ɛ/ is expected, but the effect on F1 is not expected.

Figure 5.7 Estimated mean F1 and F2 of /ɛ/ by preceding context



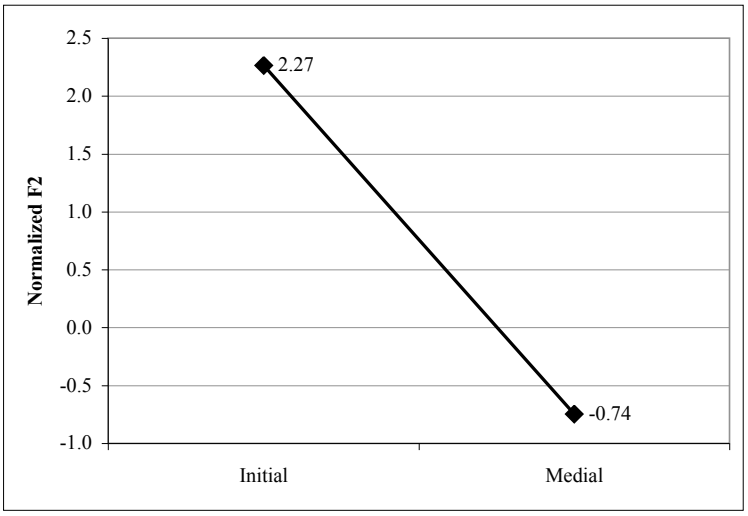
The estimates for /ɛ/ by following context in Figure 5.8 are for both F1 and F2. (The univariate analysis only showed significant results for F2.) Following velar has the least backed estimated mean /ɛ/, while post-alveolar, labial, and dental have the most backed estimated mean /ɛ/ values. These results are not expected; only labial context is expected to have lower F2 for /ɛ/. Post-alveolar context has the lowest estimated mean F1 /ɛ/, while dental has the highest estimated mean /ɛ/.

Figure 5.8 Estimated mean F1 and F2 of /ɛ/ by following context.



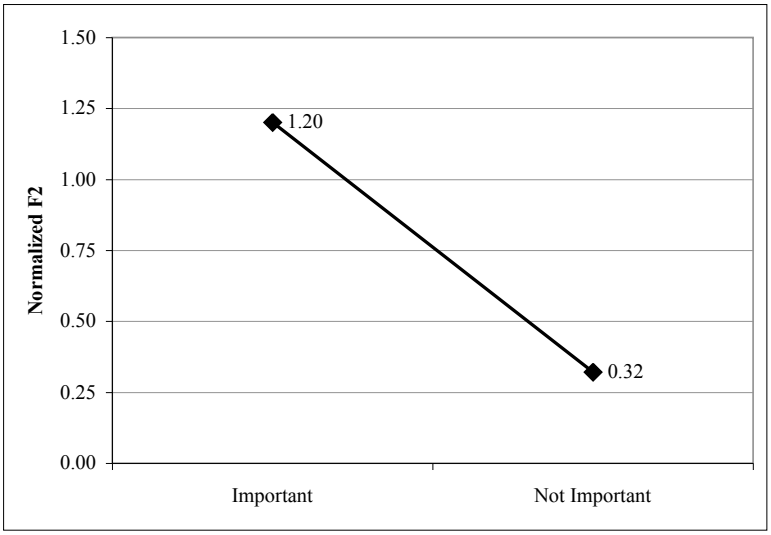
The final linguistic variable showed significant results in the F2 model only. /ɛ/ is more backed in word-medial than in word-initial position, which is unexpected.

Figure 5.9 Estimated mean F2 of /ɛ/ by position in word.



Ethnic label importance is the only social variable that is a marginally significant predictor of /ɛ/-backing. The estimated means show that the group who thinks the labels are not important are leading in backing, which is the same pattern seen in the univariate results (which were also only marginally significant). These results, however, are not strong enough to suggest any kind of social patterning of /ɛ/-shifting.

Figure 5.10 Estimated mean F2 of /ɛ/ by ethnic label importance



The results for the mixed models of the F1 and F2 of /ɛ/, in which only linguistic predictors show significant results, suggest the /ɛ/-shifting is not yet a sociolinguistic variable whose patterning is linked to any of the social variables in this study. The mixed

model also narrows down some of the variation from the linguistic predictors; following context and position in word are significant predictors only in the F2-dimension. For /ɛ/-shifting, the linguistic and social predictors are not interrelated. If we take the marginal effects of some of the social predictors in the univariate analysis to be early indicators of an emerging social pattern, then perhaps the linguistic conditioning of /ɛ/-shifting precedes the social patterning. This seems likely, as sound changes often begin in particular linguistic contexts and then continue to spread to others. /ɛ/-shifting at Mercer suggests that though the NCS as a whole is an available resource, individual components of the shift may not yet carry sociolinguistic weight.

5.3 /ʌ/

The second variable discussed in this chapter, /ʌ/, like /ɛ/-shifting, has been studied very little in sociolinguistics due in part to its recency as part of the NCS. As with /ɛ/-shifting, the general direction of /ʌ/-shifting associated with the NCS is backing. However, variation within the F1 dimension (generally agreed to be lowering, though see Eckert 2000, who also identifies raising as part of the NCS variation for /ʌ/) is also considered to be possible variation (Eckert 2000; Gordon 2001; Roeder 2006), and so both dimensions are examined here.

5.3.1 Univariate analysis of linguistic variables

My hypotheses about the effects of the linguistic variables on /ʌ/-shifting are:

- Relatively high frequency F2 is predicted in non-labial contexts
- Slight F2 lowering may occur in labial contexts.

Preceding context

One-way ANOVAs on the effects of preceding context on the first and second formants of /ʌ/ were both significant. Table 5.10 below summarizes the token counts and mean formant values for each preceding context. The rescaled values for F2 in particular suggest perceptible differences between preceding contexts.

Table 5.10 Preceding context for /ʌ/

Context	Token Count	Mean F1	Mean F2	Rescaled F1	Rescaled F2
Glide	11	.07308	-2.73818	540	1394
Post-alveolar	24	-.08914	-1.15699	520	1611
Velar	156	.12020	-2.51360	546	1424
Labial	115	.55243	-3.35327	602	1319
Pause	45	.50000	-3.84898	596	1266
Alveolar	164	.39001	-2.95735	580	1362
Total	**515**	**.32506**	**-2.90067**	**574**	**1374**

Post-hoc tests comparing pairs of means show several significant differences between preceding contexts for F1. Tokens preceded by post-alveolars have overall the least lowered mean /ʌ/ compared to the other preceding contexts and this difference is significant in comparison with the contexts that have highest mean F1 for /ʌ/: alveolar, labial, and pause. Tokens preceded by velars also showed significant differences with /ʌ/ in the three contexts with the highest F1 values, while /ʌ/ preceded by glides showed no statistically significant differences with /ʌ/ in any other contexts. /ʌ/ in velar and post-alveolar contexts did not differ significantly from one another and vowels preceded by alveolars, labials, and pauses also showed no significant differences from each other. The overall significance of these results for F1 of /ʌ/ are surprising, given that place effects generally do not have an effect on F1-variation. As I have discussed previously, some of these effects may be due to a conflation of place and manner effects, though this would need to be addressed in future work with more refined differences in phonological contexts. However, it may also be that the strong phonological context effects seen here on F1 of /ʌ/ is due in part to the apparently strong relationship between F1 and F2 for /ʌ/

The results of post-hoc tests for F2 are strikingly similar to those of the F1 post-hoc tests. /ʌ/ preceded by post-alveolars have the highest mean F2 frequency and are once again significantly different from the mean F2 of /ʌ/ in alveolar, labial, and pause contexts, the three contexts with the highest mean values. Additionally, F2 of /ʌ/ in post-alveolar contexts is also significantly different from F2-/ʌ/ in velar contexts. The results for /ʌ/ -backing are generally as expected. The non-fronting effect of labial context on /ʌ/-backing is expected, as is the non-backing effects of post-alveolar and alveolar contexts.

Table 5.11 Significant differences between preceding contexts for F1 of /ʌ/.

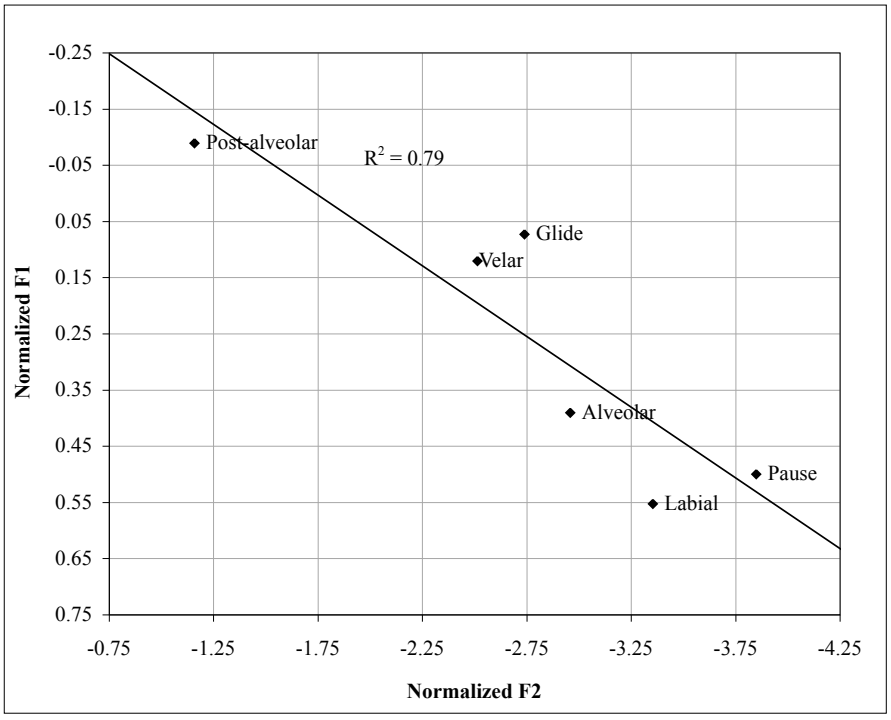
	Alveolar	Labial	Pause
Post-alveolar	**	***	**
Velar	***	***	**
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant			

Table 5.12 Significant differences between preceding contexts for F2 of /ʌ/.

	Alveolar	Labial	Pause	Velar
Post-alveolar	***	***	***	**
Velar	---	**	***	
Pause	*	---		
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant				

The scatter plot in Figure 5.11 shows a steep trendline indicating a fairly strong correlation (R^2=0.79) between F1 and F2 by preceding context; a Pearson test shows that this relationship is significant (r=-.890; R^2=0.79; p=.018). Backing of /ʌ/--a decrease in F2—correlates with a lowering of /ʌ/–-an increase in F1.

Figure 5.11 /ʌ/ by preceding phonological context.



Following context

One-way ANOVAs on the effects of following context showed significant results for both F1 and F2. Following contexts and token counts are summarized in Table 5.13.

Table 5.13 Following context for /ʌ/

	N	Mean F1	Mean F2	Rescaled F1	Rescaled F2
Post-alveolar	25	.352	-1.681	573	1508
Dental	30	.515	-3.546	588	1304
Velar	14	.446	-2.638	578	1361
Labial	150	.542	-3.935	600	1249
Alveolar	310	.211	-2.441	559	1435
Total	529	.335	-2.897	574	1374

Post-hoc tests, whose results are partially summarized in Table 5.14 and Table 5.15, showed a significant F1 difference between alveolar context, which has lowest mean F1 of /ʌ/, and labial, which has the highest mean F1 of /ʌ/. There are no other significant pairwise comparisons for lowering. Significant effects of following context on /ʌ/-lowering are again unexpected and further work is needed to separate place and manner effects. Pairwise comparisons for F2 revealed significant differences between post-alveolar and alveolar contexts, which had the highest F2 values for /ʌ/, and labial and dental, which had the lowest F2 values for /ʌ/. While the effect of labial context is expected, the effect of dental context is not. The correlation between F1 and F2 by following context is not significant (r=-.739; R^2=.546; p=.154).

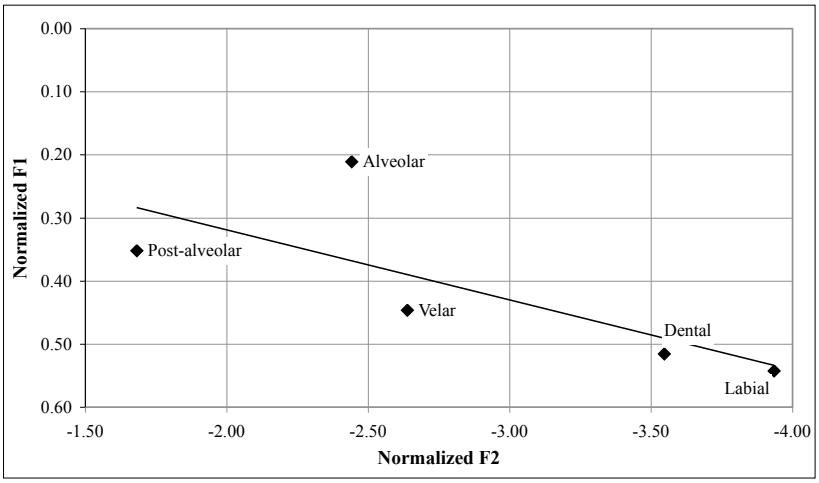
Table 5.14 Significant differences between following contexts for F1 of /ʌ/.

	Alveolar	Post-alveolar	Velar
Dental	---	---	---
Labial	***	---	---
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant			

Table 5.15 Significant differences between following contexts for F2 of /ʌ/.

	Labial	Dental	Velar
Post-alveolar	***	**	---
Alveolar	***	*	---
***: p<.001; ** p<.010; * p<.050; † p<.1 --- not significant			

Figure 5.12 /ʌ/ by following phonological context



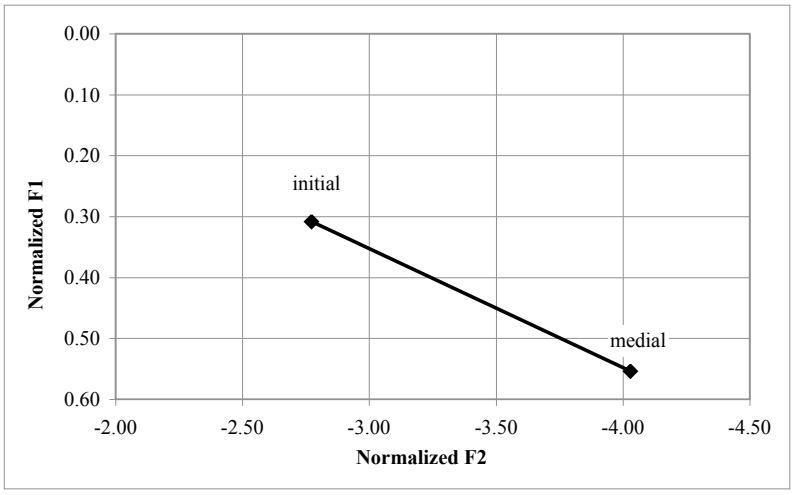
Position in word

For the third linguistic variable, position in word, /ʌ/ showed significant differences in Mann-Whitney u-tests for both F1 (p=.004, U =9635) and F2 (p<.001; U=8064). Figure 5.13 below shows that tokens with word-medial /ʌ/ are overall more backed (lower F2) and more lowered (higher F1) than word-initial tokens. The significance is not expected, but it does not hold in the multivariate analysis.

Table 5.16 Mean F1 and F2 of /ʌ/ by position in word

	Tokens	Mean F1	Mean F2
Initial	53	0.31	-2.77
Medial	480	0.55	-4.03
Total	533	0.34	-2.88

Figure 5.13 /ʌ/ by position in word



All three linguistic variables showed robust significant effects on /ʌ/-variation in both the F1 and F2 dimensions; for all three linguistic variables the nature of the effects was similar in both dimensions as well. The effects of preceding contexts are strongly correlated between F1 and F2. Both preceding and following post-alveolars impede /ʌ/-backing and –lowering. Labials overall triggered the most backed and lowered variants for both preceding and following contexts, which is expected based on my hypothesis for backing. Also unexpectedly, place-effects showed significant differences for F1 of /ʌ/, though this may be due to confusion of manner and place in the phonological context categories, and may also be due to some relationship between F1 and F2 for /ʌ/. Below I discuss these results in comparison with past research following the univariate analysis of social variables.

5.3.2 Univariate analysis of social variables

Hypotheses about the effects of social variables on /ʌ/-variation are identical to those for /ɛ/-shifting. They are listed again here:

Ethnicity	Lebanese participants will have more backed and lowered /ɛ/ than non-Lebanese participants
Age at Immigration	U.S. born speakers will have the most backed and raised /ɛ/ and speakers who arrived in the U.S. after age five will have the least backed and lowered /ɛ/.
Religious Practice	Participants with sporadic religious practice will have more backed and lowered /ɛ/ than participants with regular religious practice
Ethnic Label Importance	Participants who think ethnic labels are not importance will have more backed and lowered /ɛ/ than participants who think ethnic labels are important

Univariate tests on the effects of social variables, whose results are summarized in Table 5.17, indicate that, contrary to my hypotheses, sex is the primary variable showing statistically significant effects. Overall, variation in /ʌ/ associated with social variables was in the F2 dimension. Most of the variation in F1 is associated with linguistic factors rather than social factors.

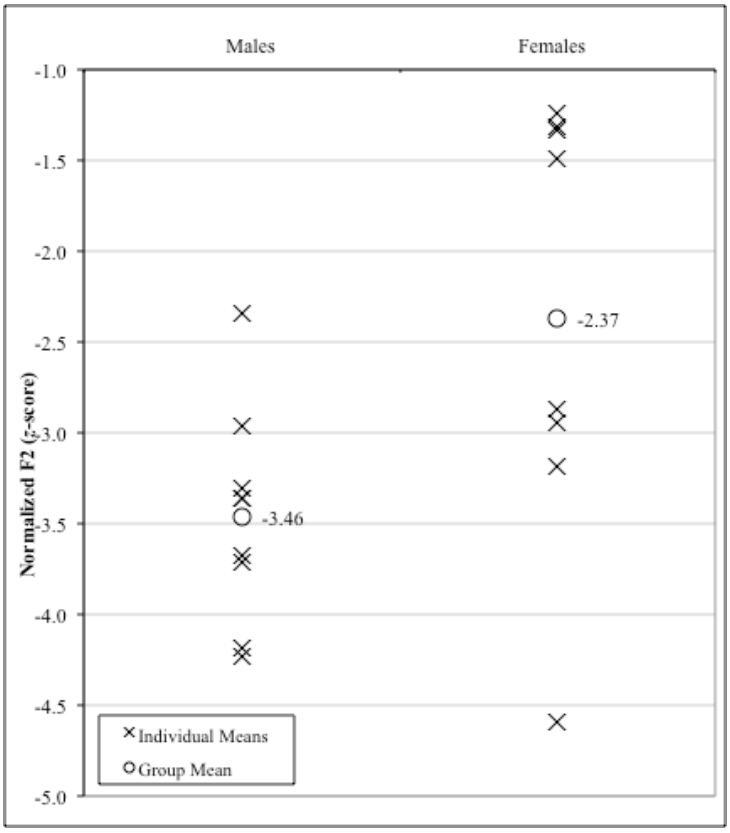
Table 5.17 Summary of effects of social variables on /ʌ/-variation.

Variable	Test type	Test Results
Significant (p<.05)		
Sex (F2 only)	u-test	F1 p=.139 **F2 p=.027**
Sex* Ethnic Labels (F2 only)	ANOVA	F1 p=.493 **F2 p=.007**
Marginally significant/Approaching significance (p<.065)		
Sex*Religious Practice	ANOVA	F1 p=.200 **F2 p=.063**
Ethnicity (F2 only)	u-test	**F1 p=.062** F2 p =.098
Ethnicity*Ethnic Labels (F2 only)	ANOVA	F1 p=.082 **F2 p=.060**
Non-significant		
Ethnicity * Religious Practice	ANOVA	F1 p=.429 F2 p=.071
Religious Practice	u-test	F1 p=.673 F2 p=.093
Sex* Ethnicity	ANOVA	F1 p=.309 F2 p =.087
Age at Immigration	ANOVA	F1 p=.475 F2 p=.248
Importance of Ethnic Labels	u-test	F1 p=.114 F2 p=.200
Future Plans	ANOVA	F1 p = .990 F2 p= .361

Sex

Backing of /ʌ/ showed significant differences between male and female participants in the study. Figure 5.14 below shows that male participants on average have lower F2, and so presumably more backed /ʌ/ productions than female participants; while the effects of speaker sex on /ʌ/ are unexpected, the male lead in /ʌ/-backing is in contrast to my general hypothesis about the effects of speaker sex on vocalic variation. The figure also shows that the individual means for men are somewhat more closely clustered around their group mean than the individual means for women are. The individual means for women are widely varied and include the most- and least-backed individual means across all speakers.

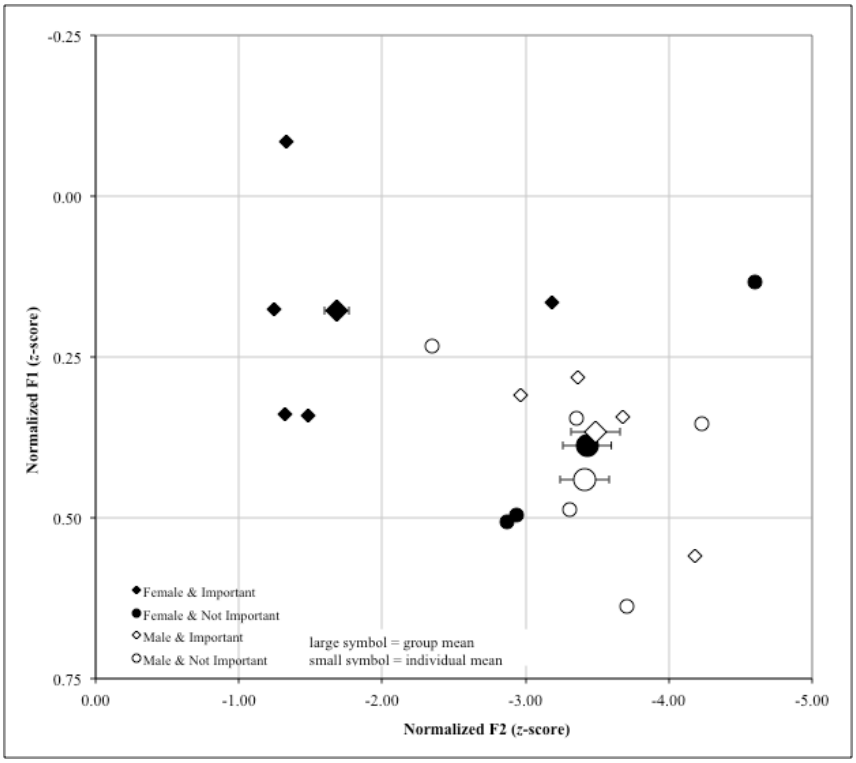
Figure 5.14 Individual and group mean for F2 of /ʌ/ by sex



Speaker sex and importance of ethnic label.

The combination of speaker sex and ethnic label importance showed significant results for the F2 of /ʌ/ in a one-way ANOVA. My prediction that participants who think these labels are important would have less NCS-like /ʌ/ productions than participants who think that ethnic labels are not important appears to be true among the female participants but not the male participants. As can be seen in Figure 5.15, below, females who think ethnic labels are important had less backed /ʌ/ productions than the other three groups' /ʌ/ productions.

Figure 5.15 /ʌ/ by speaker sex and importance of ethnic label



Pairwise comparisons with the mean F2 values for all three other groups, shown in Table 5.18, show significant differences. The other three groups did not differ significantly from one another. It appears that these three groups – males and females who don't think the choice of ethnic label is important and males who do think the choice is important – are showing an overall NCS pattern of backed /ʌ/ and are all quite similar to one another, while the females who think the ethnic label choice is important are overall not showing the NCS pattern.

Table 5.18 Scheffe post-hoc results for Sex and ethnic label importance in F2

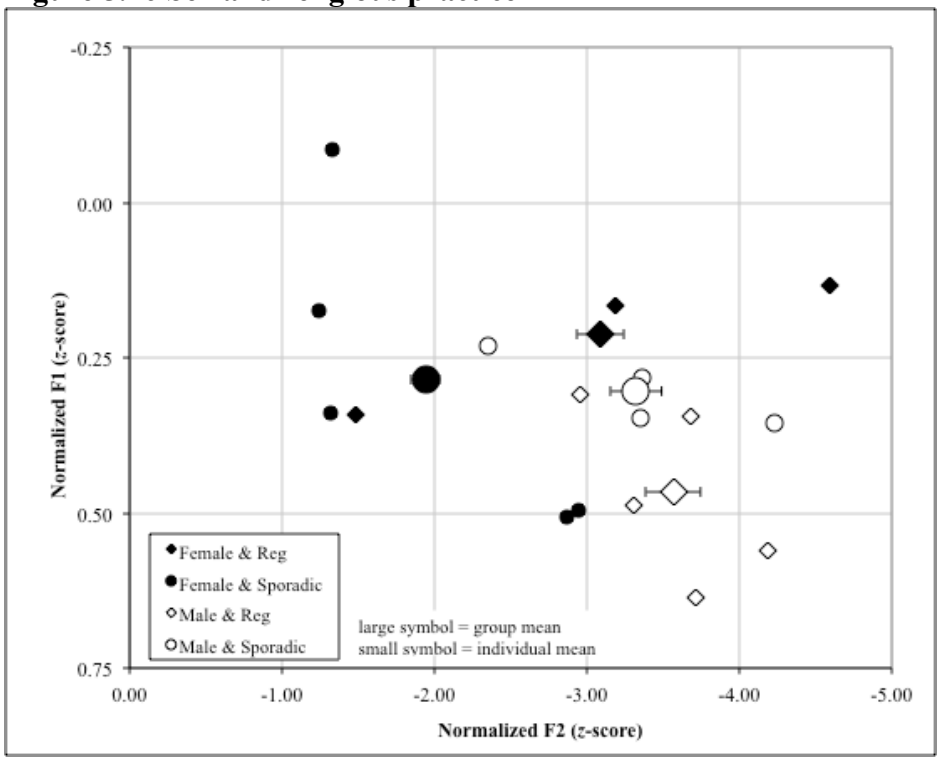
	p-value in comparison to Females & Important
Male & Important	.024
Male & Not Important	.029
Female & Not Important	.050

Sex and religious practice

The interaction of sex and religious practice showed marginally significant results in a one-way ANOVA for F2 (p=.063). I predicted that participants with regular religious

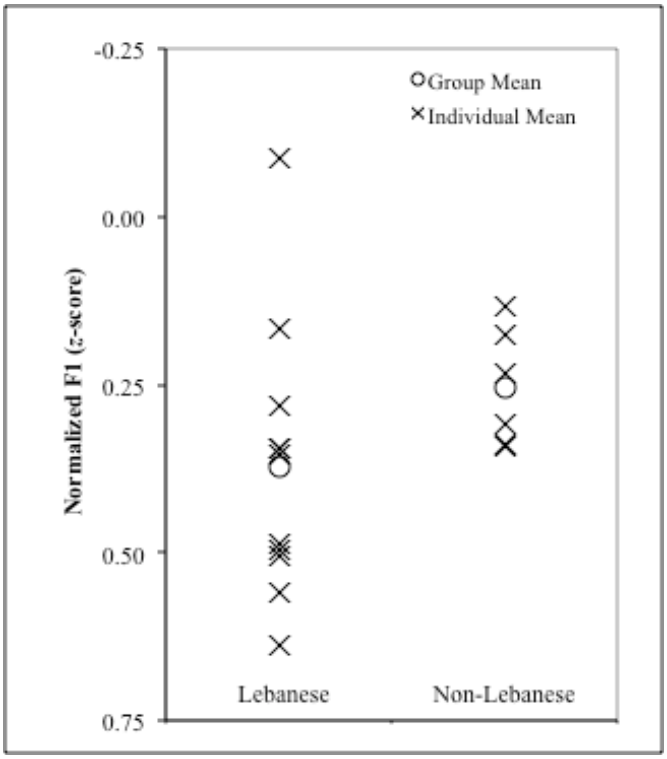
practice would have less NCS-like /ʌ/ productions than participants with sporadic practice. While Scheffe post-hoc tests showed no significant differences in the pairwise comparisons, the overall pattern, seen in Figure 5.16, looks similar to the pattern of the sex and ethnic label importance interaction: females with sporadic practice appear to have less backed /ʌ/ productions than the other groups, and the comparison of /ʌ/ for males with regular religious practice (the most backed mean F2) and for females with sporadic practice (the least backed mean F2) was marginally significant (p=.088).

Figure 5.16 Sex and religious practice



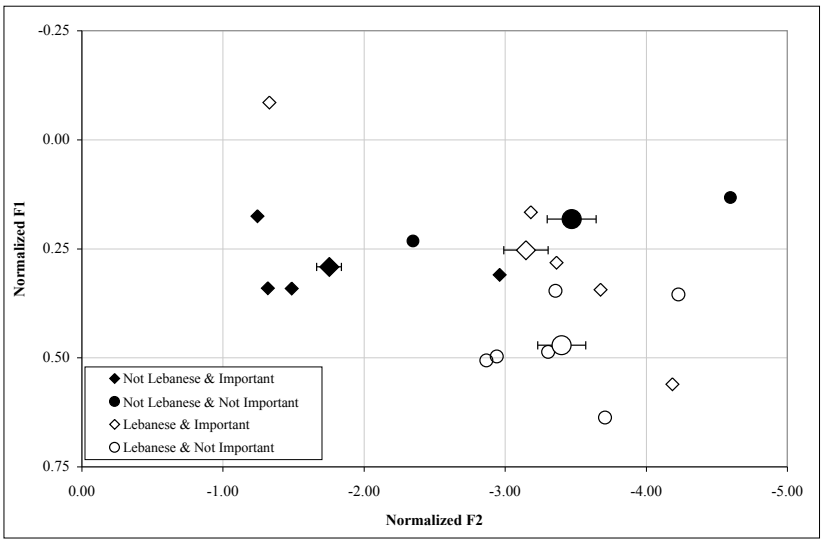
F1 showed marginally significant differences by participant ethnicity in a Mann Whitney u-test (p=.062; U=14.00) and, as I hypothesized, Lebanese participants overall had slightly lower /ʌ/ productions than the non-Lebanese participants did, as suggested by the formant values in Figure 5.17. However, the Lebanese participants showed a much wider range in F1 for individual means, encompassing the least and most lowered speakers, while the non-Lebanese participants showed much a much narrower range for F1 among individual means. Ethnicity is the only social variable in the univariate analysis that even suggests some social patterning of /ʌ/-shifting in the F1 dimension.

Figure 5.17 Individual and group means for F1 of /ʌ/ by ethnicity



The interaction of ethnicity and ethnic label importance showed marginally significant differences in a one-way ANOVA of F2 (p=0.60). Figure 5.18 shows that non-Lebanese students who think ethnic label choice is important have /ʌ/ productions that are less backed than /ʌ/ productions for the other three groups, which is the result I predicted for each of the social variables, but none of the pairwise comparisons was even marginally significant in post-hoc tests.

Figure 5.18 /ʌ/ by ethnicity and ethnic label importance



All but one of the significant and marginally significant univariate tests of social variables are significant in the F2 dimension, indicating that backing is the primary source of social differentiation for /ʌ/-shifting. Only differences in ethnicity are marginally significant for /ʌ/-lowering. The patterns in the univariate results of the social variables indicate a similar overall pattern to that found for /ɑ/-fronting. For /ɑ/-fronting, I suggested that many of the groups that led in fronting were associated with non-mainstream or somehow marginalized groups. Here, for /ʌ/-shifting, there appears to be the same kind of association, but the non-mainstream or marginalized social groups are not leading the shift, they are lagging in it. This association is maintained in the mixed model results below.

Comparison to past studies

There is even less research on /ʌ/-shifting in the NCS than /ɛ/-shifting, but the two most comprehensive studies, Gordon's and Eckert's, both discuss the linguistic and social patterning of /ʌ/-shifting. Gordon (2001) finds that shifting of /ʌ/ is rare compared to shifting in other variables and that it undergoes less extreme shifting than the other NCS variables. In his linguistic analysis, /ʌ/-shifting (both backing and lowering) is especially likely in preceding velar and /l/ contexts, while preceding post-alveolar and glide contexts both disfavor shifting. Following velar and post-alveolar both promote /ʌ/-shifting, and word position has relatively little effect. In the univariate results of my study, we see similar effects of preceding glide and post-alveolar contexts, but vowels

adjacent to a preceding velar are also towards the un-shifted end of the spectrum. Similarly, following post-alveolars and velars both do not appear to promote shifting in my study. Eckert's (2000) main linguistic findings for /ʌ/-backing (she does not identify lowering as part of the NCS trajectory) are that backing is especially likely in following and preceding labial and following interdental contexts. These findings align nicely with the results of my univariate analysis in which following dental and labial are the most backed contexts and preceding labial is the most backed preceding context.

Eckert finds that gender differences are second to social category differences in /ʌ/-backing in her study. She further finds that among the social category of jocks, boys lead girls. Gordon also finds a male lead among adolescents in one of the two small towns in his study, but an overall female lead across all the participants in his study. In Clopper *et al*'s study, women show more /ʌ/-backing than men. No robust gender patterning emerges for /ʌ/-shifting in past research, and though there is an overall tendency for women to lead, there is also some indication that among adolescents, a male lead, as indicated by the univariate analysis here, is not altogether uncommon. I attribute the male lead found in /ʌ/-shifting to their mainstream status, which I discuss further in chapter 6.

5.3.3 Multivariate mixed-effects model results

Table 5.19 and Table 5.20 show the results for the final mixed models for F1 and F2 of /ʌ/ (see §4.3 for discussion of mixed model methods). Each of the final models includes the three linguistic predictors, six social predictors and two interactions (the interaction variables are not the same in the two models). Significant predictors are marked in each table and below I discuss the estimates of mean F1 and/or F2 predicted by each of the models. Appendix E includes initial models. As with /ɑ/-fronting discussed in Chapter 4, the social patterning of /ʌ/-shifting is widely varied and not easily connected to one general social quality or characteristic. Additionally, the social patterning does not show a great deal of consistency between F1 and F2; that is, the two models contain different significant social predictors. The only significant social variable in common between the two models is the interaction of sex and the importance of ethnic labels, which is just marginally significant for F1 (p=.054). The model of F1-variation includes two other social predictors – sex and the interaction of ethnicity and ethnic labels -- and the model of F2-variation includes three other social predictors – ethnicity (marginally significant), religious practice, and the interaction of sex and religious practice. The difference in outcomes for F1 and F2 are contrary to my predictions, which are the same for both acoustic dimensions. Several of the variables are significant as I predicted (ethnicity,

ethnic labels, and religious practice). However, the models also include speaker sex as a significant predictor but do not include age at immigration, both of which are contrary to my predictions. Both models also include preceding and following contexts as significant linguistic predictors, and neither include position in word as a significant predictor. Age at immigration, future plans, and the importance of ethnic label are not significant predictors in either the F1 or the F2 model.

Table 5.19 Mixed-effects model for F1 of /ʌ/

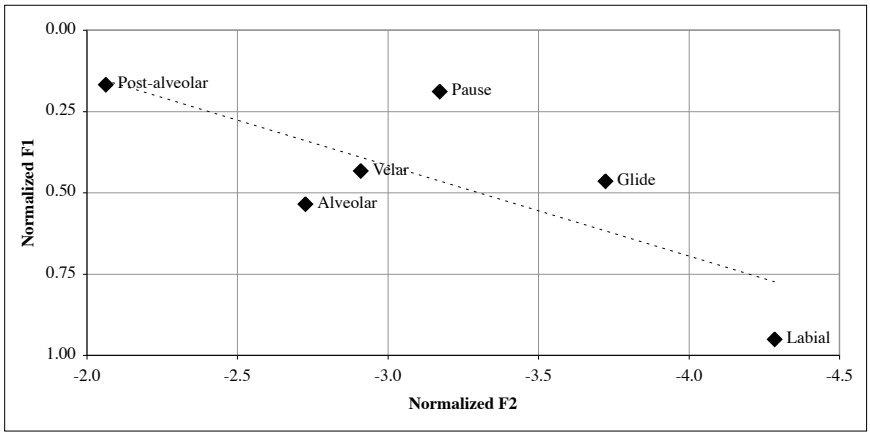
Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	50.866	19.948	.0001
*Preceding	5	486.574	14.066	.0001
*Following	4	490.072	9.842	.0001
Position in Word	1	489.624	2.631	.105
*Sex	1	6.539	5.765	.050
Age at Immigration	2	5.596	.786	.500
Ethnicity	1	5.100	2.265	.192
Future Plans	2	7.330	2.083	.192
Religious Practice	1	6.071	.650	.451
Ethnic Label	1	7.629	.099	.761
†Sex * Ethnic Label	1	7.045	5.351	.054
*Ethnicity * Ethnic Label	1	6.095	10.543	.017
*significant at p<.05; †marginally significant at p<.065				

Table 5.20 Mixed-effects model for F2 of /ʌ/

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	24.300	128.109	.0001
*Preceding	5	487.943	20.696	.0001
*Following	4	487.659	37.173	.0001
Position in Word	1	487.621	.000	.999
Sex	1	6.143	3.333	.117
Age at Immigration	2	5.743	.316	.741
†Ethnicity	1	5.393	5.801	.057
Future Plans	2	6.488	1.306	.334
*Religious Practice	1	5.907	11.338	.015
Ethnic Label	1	6.440	2.743	.145
*Sex * Religious Practice	1	5.844	7.365	.036
*Sex * Ethnic Label	1	6.396	14.876	.007
*significant at p<.05; †marginally significant at p<.065				

Both preceding and following context were highly significant predictors in both models. The pattern of estimated mean F1 and F2 for /ʌ/ by preceding context is similar to the pattern in the univariate analysis. As shown in Figure 5.19, post-alveolar context has the least backed and least lowered estimated mean /ʌ/, while labial context has the most backed and most lowered estimated mean /ʌ/. While these two contexts might indicate some relationship between F1 and F2 for preceding context, a Pearson correlation between the two formants by preceding context is not significant (r=-.440; R^2=.194; p=.383).

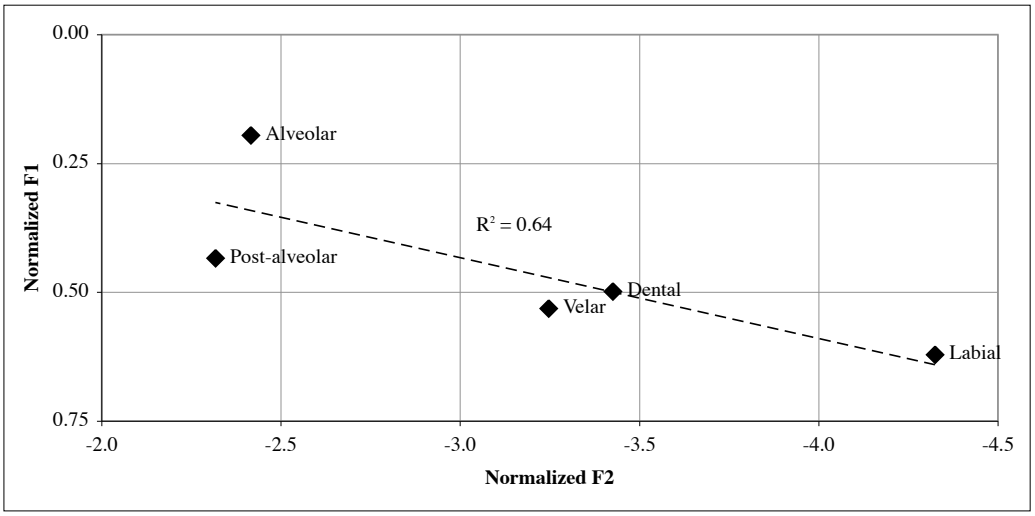
Figure 5.19 Estimated mean F1 and F2 of /ʌ/ by preceding context



The two models both have following context as a significant predictor for F1 and F2. A Pearson correlation for F1 and F2 by following context for estimated means is not significant (r=-.801; R^2=.64; p=.103). Following context estimated means span a fairly wide range within the F2 dimension, from labial at the most backed and post-alveolar at the least backed, and within the F1 dimension, from labial at the most lowered and alveolar at the least lowered.

The most backed and lowered variants in both preceding and following contexts occur next to labials, while post-alveolars overall suppress backing and lowering. The multivariate results here for preceding and following contexts generally follow the patterns found in the univariate results and also do not further complicate the comparison between these results and past studies. The results of preceding context in the mixed model are generally as predicted by my hypothesis for /ʌ/-backing and the results for following context are also as expected, except for the somewhat promoting effect of dental context on /ʌ/-backing. However, the significant results for F1 for both preceding and following contexts are again unexpected.

Figure 5.20 Estimated mean F1 and F2 of /ʌ/ by following segment



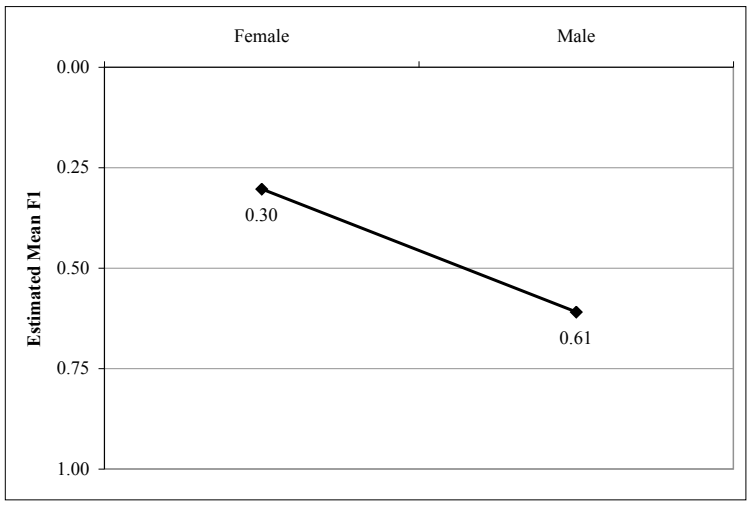
Sex

Contrary to my hypothesis, the model for F1 variation estimates that male speakers will have a higher F1 for /ʌ/ than female speakers, as shown in Figure 5.21. The difference in the F2 dimension that was statistically significant in the univariate analysis (§5.3.2), with

male speakers' vowels having a lower F2 than those of female speakers, is not significant in the mixed model. But recall that the univariate analysis is considering only the raw data, while the mixed model is considering the effects of speaker sex as part of a set of social and linguistic predictors.

This is another instance in the data, like /æ/-fronting discussed in chapter 4, in which males show a lead over females in being NCS-like, an unexpected pattern given the generally accepted and demonstrated theory that women tend to lead men in sound changes like the NCS. However, as I discussed above, my tentative argument is that the male speakers are affiliated with a mainstream or non-marginalized status at Mercer, and it is this mainstream status within the high school that may account for the male lead in two of the NCS variables.

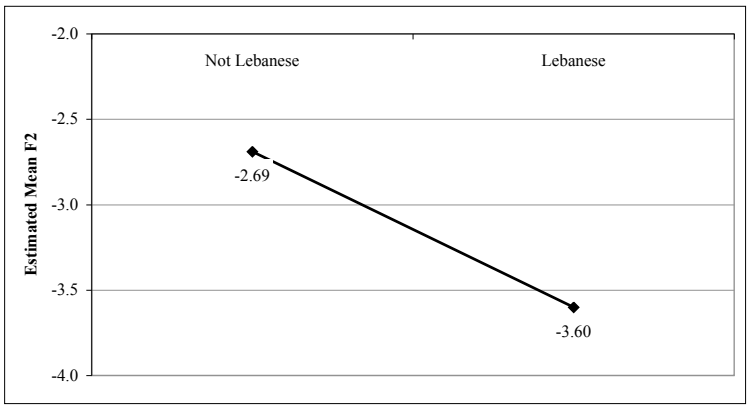
Figure 5.21 Estimated mean F1 of /ʌ/ by speaker sex



Ethnicity

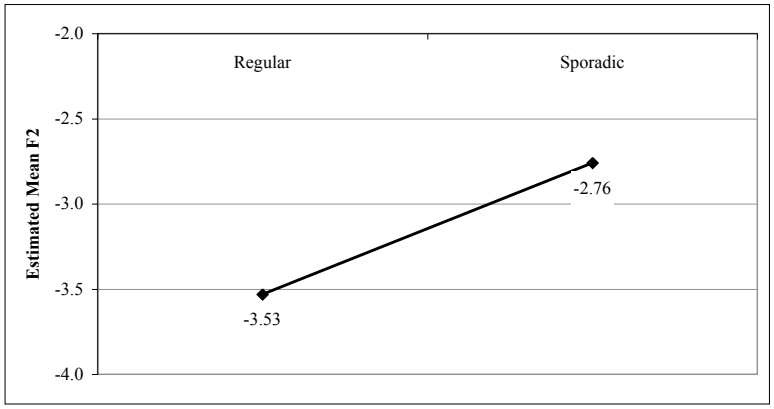
The effect of ethnicity on /ʌ/-backing was just marginally significant (p=.057), but the general tendency as shown in the estimated means in Figure 5.22 is that Lebanese students have a more backed estimated mean /ʌ/ than non-Lebanese students, which is in line with my predictions. In the univariate analysis, ethnicity had a significant effect on the F1 of /ʌ/, but not F2. Again, though both sex and ethnicity show different effects in the mixed models than they do in the univariate analyses, this is not that surprising given that each of the mixed models are providing a much more complex and comprehensive analysis of the data than the individual univariate tests.

Figure 5.22 Estimated mean F2 of /ʌ/ by ethnicity



Religious practice, which did not show significant effects in the univariate analysis, is a significant predictor of /ʌ/-backing, which is also expected based on my hypotheses. Also as expected, participants who identify as having a regular religious practice are estimated to have a more backed /ʌ/ than participants with sporadic practice, as shown in Figure 5.23.

Figure 5.23 Estimated mean F2 of /ʌ/ by religious practice



The effects of the interaction of sex with religious practice, a significant predictor in this model, clarify this difference further. The estimated means in Table 5.21 show that the group with the lowest frequency mean F2 is females with sporadic practice (mean F2 = -2.07), while males with sporadic religious practice and all speakers with regular religious practice have means that low frequency, with values ranging from -3.45 to -3.60.

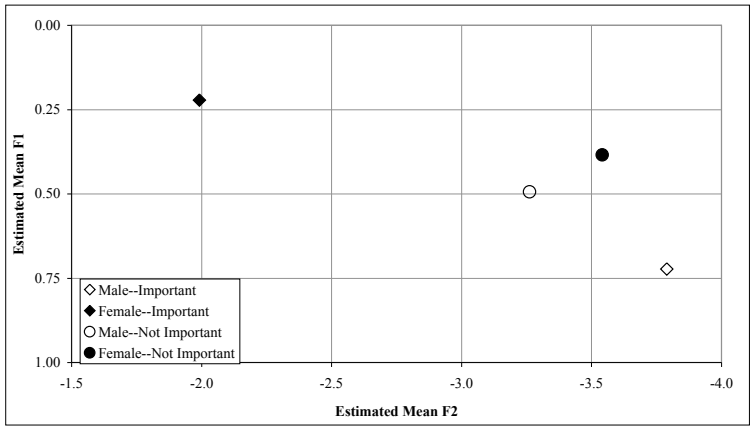
Table 5.21 Estimated mean F2 of /ʌ/ by religious practice and sex

Religious Practice	Sex	Mean F2
Regular	Male	-3.60
	Female	-3.46
Sporadic	Male	-3.45
	Female	-2.07

The final predictors in the two models are both interactions with the ethnic label importance variable. In these models for /ʌ/-variation and the model for F1 of /æ/ in chapter 4, it looks as though this social variable plays its role in the social patterning of NCS vowels as a social variable that provides further detail about patterns of variation that are based on the broader social categories of speaker sex and ethnicity. For /ʌ/-shifting, the ethnic label importance variable provides further information about how the variables sex and ethnicity pattern the data. The interaction of sex and ethnic label importance is a significant predictor in the F2 model (p=.007) and a marginally significant predictor (p=.054) in the F1 model, while the interaction of ethnicity and ethnic label importance is a significant predictor of F1-variation only (p=.014).

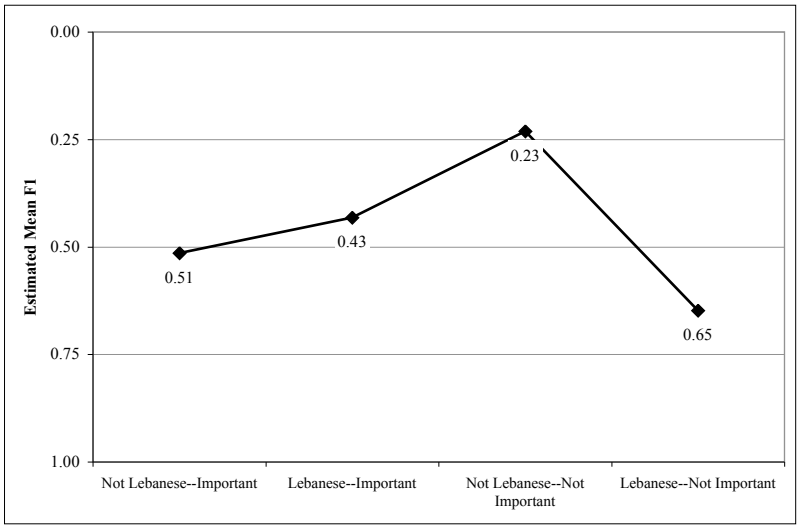
Figure 5.24 below shows that the patterns predicted by the estimated means for F1 and F2 based on the interaction of sex and ethnic label importance follow those described for F2 in the univariate analysis in §5.3.2: females who think choice in ethnic labels is important do not have a backed or lowered estimated mean /ʌ/, while the other three groups have similarly backed and lowered estimated mean /ʌ/. My prediction about the ethnic label importance variable appears to be correct for female speakers.

Figure 5.24 Estimated mean F1 and F2 of /ʌ/ by sex and ethnic label importance



The final variable, the interaction of ethnicity and ethnic label importance, shows significant effects on F1-variation. The model predicts that the non-Lebanese group who thinks ethnic label choice is not important will have the least lowered mean /ʌ/ value, while the Lebanese group who thinks ethnic label choice is not important will be have the most lowered mean /ʌ/ value, as suggested by the F1 values in Figure 5.25. The two groups who think ethnic label choice is not important have estimated mean /ʌ/ values that fall in between the other two groups. Here, the effect of ethnic label importance in interaction with ethnicity does not show the same kind of pattern as it does in interaction with speaker sex; in fact, it shows essentially the opposite effect. In the sex and ethnic label interaction, the two ends – most NCS-like and least NCS-like – are defined by differences between the two groups who think ethnic label choice is important, while for the ethnicity and ethnic label interaction, the two ends are defined by differences between the two groups who don't think ethnic label choice is important.

Figure 5.25 Estimated mean F1 of /ʌ/ by ethnicity and ethnic label importance



Below I summarize the effects of the significant social predictors on /ʌ/-shifting in Table 5.22, to get a sense of how the variables pattern together. As with /ɑ/-shifting, social patterning of /ʌ/-variation is linked to several social variables. As I discussed briefly above, the categories and groups—particularly male, Lebanese, and regular religious practice—associated with NCS-shifting for this vowel generally appear to be linked to

mainstream or non-marginal status. In chapter 6 I discuss this idea in relation to the ethnographic findings.

Table 5.22 Summary of /ʌ/-shifting patterns

	Not shifted		**Shifted**
F1 only			
Sex	Female		Male
Ethnicity * Ethnic Label	Not Lebanese—Not Important	All--Important	Lebanese—Not Important
F1 and F2			
Sex * Ethnic Label	Female--Important		Male—Important All--Not Important (backed only)
F2 only			
Ethnicity	Not Lebanese		Lebanese
Religious Practice	Sporadic		Regular
Sex * Religious Practice	Female--Sporadic		All--Regular; Male--Sporadic

Another pattern is that there is very little overlap between the social patterning of F1 and F2; only one of the social variables is significant or marginally significant in both models. There does appear to be some consistency for the sex and ethnicity variables across the two models. That is, interactions including these variables appear to maintain the patterns of the variable on its own, so that, for instance, the male lead over females seen in the F1 model is also seen in F2-variation within the group of students with sporadic religious practice. Similarly, the Lebanese lead in F2-backing is also seen in the ethnicity and ethnic label interaction in F1 among the group who thinks ethnic label choice is not important.

However, the patterning of ethnic label importance is not maintained across the two interaction variables in which it is found. While in the interaction with ethnicity, the primary distinction is within the group who thinks label choice is not important, in the interaction with sex, the primary distinction is within the group who thinks ethnic label choice is important. In chapter 6 I discuss the relationship between the findings of the models of the four vowels and the ethnographic information I gathered (see chapter 2). Gendered and ethnic differences in how participants view religious practice and identity and how they view being Arab/Arab American may help to explain some of the results in this chapter and chapter 4. Further, they may inform discussion about the different kinds

of social variables I have used in this study; I address this further below and in greater detail in chapter 6.

5.4 Discussion

In this chapter I presented a description and statistical analysis of the social and linguistic patterns of variation of /ʌ/ and /ɛ/, two of the newer vowels in the NCS. The models for /ɛ/-shifting showed robust linguistic patterning for both F1 and F2, while the social patterning of /ɛ/ was essentially non-existent, save for a marginally significant effect from the ethnic label importance variable. On the other hand, linguistic and social variables are included in both of the models for /ʌ/-shifting. The patterning of /ʌ/-variation is linked to several social variables in a broad and diffuse way that makes it difficult to pinpoint a specific kind of global social patterning.

The models of variation for /ɛ/ and /ʌ/ are summarized in Table 5.23. The effects of the linguistic variables are generally as predicted by my hypotheses. Backing of /ʌ/ and /ɛ/ is especially evident in labial contexts, as expected. Velar context impedes /ɛ/-backing as expected, and post-alveolar context impedes /ʌ/-backing as expected. Unexpected for /ʌ/-backing is that following dental context promoted backing. But the most striking unexpected result is that place-effects are significant for F1-variation in both vowels. As I mentioned above, a more careful separation of place and manner contexts in future research may help clarify these findings. It is also possible that the effects of phonological context on F1 are an artifact of the relationship between F1 and F2 for these vocalic variables in the NCS, though this may be the case for preceding phonological context only and not following phonological context.

The models of variation for /ɛ/ and /ʌ/, along with the models for the two vowels in chapter 4, do not easily boil down to a simple generalization in which the older variables pattern in one way and the newer variables another. There is no dividing line between social variables that have significant effects on the older vocalic variables and those that have significant effects on the newer ones. And there are few similarities within each pair of new and old variables. On the face of it, Eckert's overall theory about how sound change progresses and how variables will pattern socially does not appear to hold for the data presented here. This outcome may relate in part to the fact that none of the variables in my study is centered around an urban/suburban (or urban/non-urban) distinction, which is a fundamental component of Eckert's theory. Part of it may be that Eckert's theory does not address how a social landscape may be particular to an ethnic minority

community with a strong social presence. In chapter 6 I elaborate on these ideas and discuss the overall effectiveness of Eckert's theory.

Table 5.23 Summary of effects of independent variables by vowels

Vowel	Social variables	Linguistic variables
ɛ	Ethnic Label Importance (F2 – marginal significance only)	Preceding Context (F1 & F2) Following Context (F2) Position in Word (F1 & F2)
ʌ	Sex (F1) Ethnicity * Ethnic Label (F1) Sex * Ethnic Label (F1 & F2) Ethnicity (F2) Religious Practice (F2) Sex * Religious Practice (F2)	Preceding Context (F1 & F2) Following Context (F1 & F2)

As I mentioned above, another issue is whether or not there are different kinds of social variables. The patterning in /ʌ/-variation suggests two categories of social variables. The first consists of more or less static categories which are defined to a great extent by membership or belonging. In this study, sex, ethnicity, and age at immigration are the variables that fall into this first group. Though the literature would certainly identify sex/gender and ethnicity as fluid and constructed, participants often view these categories as fixed pieces of information about participants that are viewed as unproblematic aspects of identity. The second group of variables in this study are categories based largely on students' attitudes and opinions, and are less likely to be fixed (though students may present them as fixed). In this study, religious practice, ethnic label importance, and future plans are variables whose categories derive from generalizations about the participants' opinions and attitudes. The results of the models suggest that while the variables in the first category are significant predictors on their own, the significance of the variables in the second category is found mostly in their interactions and in how the attitude variables further clarify patterns based on the static variables.

In chapter 6 I discuss these and other issues in further detail, beginning with a summary of the four variables. I then discuss how the ethnographic findings of my study help to explain some of the patterns found in chapters 4 and 5. In particular, I explore how gendered and ethnically/culturally-based differences in attitudes on religious practice and ethnic identity relate to the social patterning of the four NCS vowels. Finally, I evaluate the effectiveness of Eckert's model as a means for explaining sound change spread among these students at Mercer and consider ways in which it could be adjusted to account for the patterns present in these data.

Chapter 6: Discussion

6.1 Introduction

This project examines the sociolinguistic practices of Arab American adolescents in Dearborn, MI. The linguistic variables of interest in this project are four vowels which are part of the Northern Cities Shift sound change. Previous chapters in this dissertation have provided ethnographic information, discussions of methodology, and statistical results on the social and linguistic patterning. While my aims in this study have been to follow the tradition of combining qualitative and quantitative methods to get a more comprehensive picture of how the social and the linguistic pieces fit together than would be possible with just one approach, the qualitative and quantitative components of the study have remained largely distinct from one another in the discussion thus far. In chapter 2 I presented the ethnographic findings, in which I discussed several themes that emerged from my fieldwork at Mercer high school and sociolinguistic interviews with participants. These ethnographic findings inform the social variables, which are introduced in chapter 3 and used in the statistical models in chapters 4 and 5, but the social variables themselves do not explain the patterns found in and across the models. In this chapter one of my goals is to draw the ethnographic findings and statistical results together, to understand the patterns in the models and determine what lies behind the social variables.

A primary goal of this dissertation is to assess the applicability of Eckert's model of sound change first introduced in chapter 1. Eckert's theory – briefly, that newer and older variables in a sound change behave differently in relation to social meaning – formed the basis for the hypotheses in chapter 3 on which social variables would influence which NCS vowels and how. The statistical models in chapters 4 and 5 show that none of the hypotheses I formed based on Eckert's theory is correct. In this chapter, I discuss the ways in which my results do not fit Eckert's model.

Below, I summarize the findings of the multivariate models in §6.2. Though I presented univariate and multivariate results for each vowel, the focus here is on the multivariate

models. Univariate tests were used in chapters 4 and 5 as a way to examine in more detail the patterns of individual variables, but they do not provide an accurate statistical picture of the variation as a whole for each vowel. I also included univariate tests in order to provide points of comparison with past research.

The models for the four vowels show unexpected patterns of social variation based on hypotheses designed to test Eckert's proposal for how sound change is picked up and then subsequently spreads/travels through a community. Recall that in Eckert's theory, the newer elements of the NCS are affiliated with an urban identity through their origins in urban Detroit. Burnout students, who are oriented to local, working-class norms, introduced the newer variables to their high school through their urban contacts, creating and reinforcing an opposition to jock students, who were focused on the institutional and middle-class goals and practices of the high school. Older variables in the NCS did not have such a highly localized meaning or context and were available at the high school as a means of indexing broader social differences (primarly along gender lines). My goal was to investigate whether or not there was a distinction in the kinds of social meaning and patterns associated with the newer and older variables in the shift.

In §6.3 I discuss some of the findings of the models in relation to the ethnographic findings I first introduced in Chapter 2. While the ethnographic findings form the basis of several social variables, some of the nuance and details of those findings get obscured by the discrete levels of the social variables. For example, the variable of religious practice divides students into two groups, but it does not reveal students' differing views on how or why they are engaged in, say, sporadic practice. As I argue below, these kinds of details, particularly as they may be gendered or linked to ethnic differences, may help in understanding some of the patterns found in the mixed models.

I address ways in which Eckert's model does not work for the data and findings presented here in §6.4. Ultimately, I argue that some of the components of her model are too specific to her data and setting and do not apply to the Mercer data. I also argue that the moment in time she captures with her data – at presumably the beginning of /ʌ/-shifting in the NCS – pinpoints a very specific stage of language change and spread, and it may be the specificity of this moment that accounts for some of the distinctions between old and new she makes. I propose that a broadened version of Eckert's theory, particularly one that does not rely on a specific geographic link to urban identity, is better suited to this study and may be more applicable to other studies in the future. Ultimately, Eckert

and I share the same goal of gaining a better understanding of how social information contributes to the spread of regional sound change. Finally, I consider the role of ethnicity and how working with data from ethnic minority speakers complicates the picture of regional language spread.

6.2 Summary and overview of results from multivariate models

In chapters 4 and 5 I presented the findings of the quantitative multivariate analysis of each of the four vowels. Results for each vowel included one or two mixed-effects models, which identified those linguistic and social variables that had a significant effect on the variation of the vowel in question. It is useful here to summarize the results of those models and the general patterns of variation they describe.

6.2.1 Summary of results for linguistic variables

The mixed models included significant linguistic predictors for each vowel, summarized in Table 6.1 below. Preceding and following context are significant predictors for all four vowels, and in all cases had more robust effects on the patterning of the vocalic variation than the social predictors. In the case of /ɛ/-shifting, only linguistic predictors are significant in the models, which, as I discussed in chapter 5, indicates that /ɛ/ in the NCS is not yet a sociolinguistic variable at Mercer.

Overall, the effects of the linguistic variables on the NCS vowels predicted by the mixed models are generally as expected, with some exceptions to the hypotheses I presented in §3.9. For /ɑ/-fronting, the strong effect of following labial on F2 is unexpected. For /æ/-fronting, /ɛ/-backing, and /ʌ/-backing, the findings are generally as expected.

Some of the broader unexpected results were the significant effects of place differences on F1 values for /æ/, /ɛ/, and /ʌ/. This may be addressed to some degree by separating place and manner more carefully in phonological context categories. It may also be an issue of variation in the NCS such that context results in F1 are a manifestation of their shifting being linked to F2.

Research on the linguistic factors that have significant effects on NCS vocalic variables suggests that there is geographical variation with regards to the phonological contexts that result in NCS shifting and those that don't. This is unexpected phonetically, since predictions about the effects of phonological contexts are based on the acoustics of the vocal tract and these are not expected to vary by geographical location. Nevertheless, the

findings of the present study and past research indicate that what is phonetically expected is not always what is happening on the ground. One way to explore this in future research would be to examine the interrelatedness of phonetic and social variables. It is possible that shifting in particular phonological contexts takes on social salience for particular social groups, either through occurrence in specific lexical items, emphasis, or stress (see e.g. Eckert 2000 for discussion of the effect of emphasis on /ʌ/-shifting and Gordon for an investigation of the effects of lexical item on shifting across the NCS variables). Other researchers (e.g. Nguyen 2006) have also found an interaction between phonological context and social factors. Research in this area may shed light on unexpected phonetic results and it may provide more detail about the role of specific speakers or groups of speakers in the transmission and spread of sound change.

Table 6.1 Summary of significant linguistic predictors

Vowel	Significant linguistic predictors and key findings
/ɑ/	*Hypothesis*: Relatively high frequency F2 is expected in non-labial contexts.
	Unexpected finding: high F2 in context of following labial
/æ/	*Hypothesis*: Lower-frequency F2 is expected in non-labial contexts; Slight F2 lowering may also more generally occur in non-velar contexts.
	Findings as expected. Lower frequency F2 in labial contexts and relatively high F2 in velar contexts. Unexpected finding: Preceding context has a significant effect on F1
/ɛ/	*Hypothesis*: Lower-frequency F2 is expected in non-labial contexts; Slight F2 lowerng may also more generally occur in non-velar contexts.
	Findings as expected. Relatively low frequency F2 for labial contexts and relatively high F2 in velar contexts. Unexpected finding: Significant effects on F1
	Position in Word Unexpected finding. Lower frequency F2 in word-medial position.
/ʌ/	*Hypothesis*: Relatively high frequency F2 is expected in non-labial contexts; Slight F2 lowering may occur in labial contexts.
	As expected. Relatively low frequency F2 in labial contexts. Unexpected finding: Significant effects on F1

6.2.2 Summary of results for social variables

Table 6.2 summarizes the results of the four models by social variable. It also includes the basic hypotheses for each variable from chapter 3 about which set of vowels – older or newer – I predicted were likely to be affected by that variable based on Eckert's theory of sound change spread. Literature on the NCS identifies two phases of the shift, the older involving /ɑ/, /æ/, and /ɔ/, and the newer involving /ʌ/, /ɛ/, and /ɪ/, and Eckert finds in her study that the social patterning of vowels among the students at Belten High is

explained in part through a distinction in the kinds of meaning that older and newer variables are/can be associated with. Following her argument, in my hypotheses, I predicted that broader variables with a more global kind of social distinction will be linked to the older vowels in the NCS, while variables with a local meaning and distinction will be linked to the newer variables.

Table 6.2 Summary of mixed model results by social variable

Variable	**Hypothesis**	**Vowels and formants affected**	
Sex	Older – Females more NCS-like than males	**ɑ--F2**	**æ—F2**
		ʌ--F1	ɛ--None
Ethnicity	Older—Lebanese more NCS-like than non-Lebanese	**ɑ--F2**	æ—None
		ʌ--(F2)	ɛ--None
Future Plans	Older—Stay in Dearborn will be most NCS-like	**ɑ--F2**	æ--None
		ʌ--None	ɛ--None
Age at Immigration	All—U.S.-born most NCS-like, after age 5 least NCS-like	ɑ--None	æ--None
		ʌ--None	ɛ--None
Religious Practice	Newer—Sporadic practice will be more NCS like than regular practice	ɑ-- None	æ—None
		ʌ--F2	ɛ--None
Ethnic Label Importance	Newer—Labels not important will be more NCS-like than labels important	ɑ--None	æ—None
		ʌ--None	**ɛ--(F2)**
Interactions (No hypotheses were made for interactions)			
Sex * Ethnic Label		**ɑ--F2**	æ—None
		ʌ--F2 (F1)	ɛ--None
Sex * Religious Practice		**ɑ--F2**	æ—None
		ʌ--F2	ɛ--None
Ethnicity * Ethnic Label		ɑ--None	æ—None
		ʌ--F1	ɛ--None
Ethnicity * Religious Practice		ɑ--None	**æ—F1 F2**
		ʌ--None	ɛ--None
In the second column, shaded cells indicate incorrect hypothesis; cells outlined in black indicate correct hypothess; plain cells indicate mixed results for hypothesis.			

As shown in Table 6.2, not only were nearly all of my hypotheses incorrect with regards to the predictions I made about which vowels would be affected and how, there was not a single variable for which the older variables both patterned one way and the newer

variables patterned another. My prediction about sex was wrong in that it affected old and new variables and it showed a male lead for some vowels and a female lead for other vowels. The only vocalic variable that followed my prediction about the effects of sex is /ɑ/-fronting, which shows a female lead. My prediction about the effects of sex was wrong and this may be due in part to my lending too much weight to the notion that women lead men in so-called "changes from below" like the NCS. There is enough counter-evidence to this pattern – in studies of the NCS no less – that this pattern should not be taken for granted. Also, the results for sex do support the general finding that differences between men and women are regularly found in sociolinguistic studies of variation.

Neither of the two variables affected by ethnicity (/ɑ/ and /ʌ/) fits with my prediction that Lebanese speakers would lead in shifting of the older variables. Though the variable future plans only affected one older variable, /ɑ/-fronting, it showed the opposite effect that I predicted, with participants who plan to leave Michigan being the most NCS-like. Age at immigration showed no significant effects on any of the variables, while I predicted that it would have an effect on all four vowels in the same way. Religious practice affected one newer variable, /ʌ/-shifting, but not in the way I predicted, which was that the sporadic practice group would lead in backing and lowering. Instead, participants with regular religious practice showed a lead in /ʌ/-backing, and interaction with speaker sex showed that this lead was due largely to the effect of male speakers in that group. And lastly, the ethnic label variable did affect one newer variable, /ɛ/-shifting, in the way that I predicted, with the group who thinks labels are not important leading in /ɛ/-backing. However, this variable was only a marginally significant predictor in the model for /ɛ/-backing and I include it here because it was the only predictor in the models for /ɛ/-shifting. The discrepancies between the hypotheses and the results suggest that Eckert's theory is inadequate for explaining the sociolinguistic spread of sound change in my study and possibly other studies. But the hypotheses encompass a fairly narrow or specific interpretation of Eckert's theory, and, as I discuss below, a broader understanding of her theory can account for much of the social patterning of the four vocalic variables in this study.

In the results of my study, the newer and older distinction is not a particularly meaningful way to consider the social patterning of the variables. It is not the case that the social patterning of the older variables is mostly aligned with the more global social categories (like speaker sex) and the newer vowels are mostly aligned with the more local social

categories (like religious practice). Nevertheless, there are several patterns and findings in the data that are interesting. In the remainder of this section, I describe the overall patterns among and across the four vowels found in the data and below (§6.3) I discuss these findings in relation to the ethnography.

Two of the six main social variables, sex and ethnicity, are significant predictors of variation in more than one vocalic variable (see Table 6.3 for summary of each social predictors' significant effects). The gender patterning of the NCS for these four vowels is not consistent across vowels. The model for /ɑ/-fronting predicts a strong female lead in fronting, while the models for /æ/-shifting and /ʌ/-shifting both show male leads, albeit only in one acoustic dimension for each of the vowels. Differing patterns of sex-differentiation within the NCS indicate that the social meaning of the NCS is not uniform – individual variables pattern differently and speakers use them differently. Gordon (2001:204) observes a similar pattern in his study of the NCS. He argues that this is due to the process of the shift. At this stage in the shift, all of the NCS vowels are available "as an assembled whole" as individual sociolinguistic variables and do not have to be acquired in a manner that follows traditional patterns of chain shifting. That is, the non-uniformity is not all that surprising. However, at a later stage in the spread of the NCS, Gordon predicts that eventually the components of the shift must come back together into their connected and interrelated system. Gordon argues that this later stage of the shift has to happen so as not to cause phonemic disruption, but this has not been verified empirically. Further, phonemic disruption may not be a sufficient requirement for the eventual even social distribution of the NCS variables, since language change can result in phonemic disruption. I would argue that it is still an open question about how "complete" the NCS is, or what it even means for a shift to be complete. However, Gordon's proposal, which highlights how vocalic variables in the shift may pattern differently at different points in time, does suggest that the relative newness of the newer variables could matter significantly for Eckert's model. I return to this idea in §6.4.

The male lead for two of the vowels is interesting but it is not an unknown pattern. Eckert and Gordon both found instances in their studies of the NCS of male adolescents leading over females. In Eckert's work, jock boys lead jock girls in /ʌ/-backing and in Gordon's work, adolescent males in Chelsea, one of the two towns in his study, lead adolescent females in /ʌ/-shifting. Perhaps the male lead in /æ/-fronting and /ʌ/-backing lies in differences between adult and adolescent patterns, but this does not really explain, then, the female lead in /ɑ/-fronting. Another way of approaching the difference between male

and female patterns of NCS usage is the possibility that the identity and position of males at the school is privileged or mainstream (within the school) in a way that those of the girls are not. I discussed this briefly in previous chapters. At Mercer, among Arab American students, the practices of girls (e.g., scarf-wearing, friendships and romantic relationships, how they act and talk) are often open to evaluation and judgment in ways that boys' practices are not. Being a boy is mainstream at Mercer, and perhaps the larger Arab American community in Dearborn, because it is normalized and taken for granted, while girls face more pressure and expectations about their behaviors as girls. The mainstream/marginalized distinction encompasses several social variables including gender, and it is this broader distinction that helps explain differences in the vowel patterns; for /æ/ and /ʌ/ the mainstream social categories and identities show a lead in NCS-shifting, while for /ɑ/, the marginalized social categories and identities show a lead in NCS-shifting. When I use the term *mainstream* here, I am referring to mainstream *within* the high school and not to the more global affiliation between the NCS and a mainstream white community that I have referenced throughout this dissertation. In §6.4.1 I discuss how this marginalized/mainstream distinction is very similar to one that Eckert makes about the jock and burnout groups in her study, and may be more generalizable than the class distinction that tends to get emphasized in discussions surrounding the jock/burnout distinction.

Ethnicity also does not show the same patterning across the vowels for which it shows significant effects. Non-Lebanese participants lead in /ɑ/-fronting, but Lebanese participants lead in /ʌ/-backing. In /æ/-shifting, the effects of ethnicity are seen in its interaction with religious practice for both raising and fronting. Ethnicity differentiates between the group of Lebanese participants with sporadic practice, the most NCS-like group, and non-Lebanese with sporadic practice, the least NCS-like group. The effects of ethnicity are only seen within the sporadic practice participants, not among the participants with regular religious practice. Like speaker sex, ethnicity at Mercer can also be divided into a mainstream group – Lebanese students – and a non-mainstream or marginalized one – non-Lebanese students. Whereas discrimination against or the marginalization of girls was not regularly acknowledged at Mercer, discrimination against non-Lebanese students was openly acknowledged (and in some cases lamented). The mainstream and non-mainstream categories within these social variables help explain some of the patterns of social variables in the models. The mainstream categories of the social variables seem to pattern one way for /æ/-shifting and /ʌ/-shifting (the mainstream categories lead in NCS usage) and pattern the opposite way for /ɑ/-fronting (the non-

mainstream categories lag in NCS usage). Below I discuss the specifics of /ɑ/-fronting and /ʌ/-shifting, which show particularly opposite social patterns.

The remaining four variables are each significant predictors in no more than one of the four vowels. The variable future plans is a significant predictor for /ɑ/-fronting (participants wanting to leave Michigan are the most fronted group), and age at immigration is not a significant predictor in any models. Ethnic label importance is a marginally significant predictor of /ɛ/-backing, and religious practice is a significant predictor of /ʌ/-backing. However, both of the latter two variables also appear in interactions with both sex and ethnicity in several of the models, which I discuss further below.

An interesting pattern emerges among the significant predictors found in the models for /ɑ/-fronting and /ʌ/-shifting and relates to the possibility that some of the social variables aligning with a distinction between mainstream and non-mainstream identities. These two vowels share four predictors in common in their models, and these predictors show opposite or nearly opposite effects on the two vowels. For speaker sex, females lead in /ɑ/-fronting, but males lead in /ʌ/-lowering (there are no differences between men and women in /ʌ/-backing). For ethnicity, non-Lebanese leads in /ɑ/-fronting while Lebanese leads in /ʌ/-backing (there are no significant differences by ethnicity for /ʌ/-lowering). The results of the models also have generally opposite effects from the two interactions of sex with religious practice and sex with ethnic label importance. For /ɑ/-fronting, the mixed model finds that in these two interactions, females with sporadic religious practice and females who think ethnic label choice is important lead in fronting. Conversely, for /ʌ/-shifting, the models predict that females with sporadic religious practice will have the *least* backed productions within that interaction (in the F2 dimension only), and females who think ethnic label choice is important lag in both /ʌ/-backing and /ʌ/-lowering (though this is only marginally significant for F1). For these social variables, shifting vowel productions in the direction of the NCS for /ɑ/-fronting, and *not* shifting in the NCS-direction of /ʌ/-shifting follow the same pattern, and vice versa. The same social groups and categories that are "pro-NCS" for one vowel are "anti-NCS" for another vowel, and for some of the social categories (sex, ethnicity, and religious practice), these align with a distinction between mainstream and non-mainstream identities. /ɑ/ and /ʌ/ don't make just different kinds of social distinctions, they make social distinctions that are opposed to one another. Sociolinguists cannot assume that a regional sound change like the NCS will have uniform social patterning or meaning across individual variables

in the shift. It also draws attention to the role of social meaning in the spread of sound change. While Gordon's (2001:204) proposal (see above) allows for individual vowels in a shift to show different patterns of usage across speakers, it is not clear how two vowels with opposing social meanings would arrive at a final system in which they are patterning the same way in the same speaker. Gordon's proposal, and perhaps discussion of sound change in general, may underemphasize the role of social information in the spread of sound change and may overemphasize separation between speakers and their linguistic systems.

Table 6.3 Summary of social patterning of vowels by variable.

Variable	Vowels	How
Sex	/ɑ/	Female lead
	/æ/	Male lead in fronting
	/ʌ/	Male lead in lowering
Ethnicity	/ɑ/	Non-Lebanese lead in fronting
	/ʌ/	Lebanese lead in backing
Future Plans	/ɑ/	Leave MI – lead in fronting
Religious Practice	/ʌ/	Regular lead in backing
Ethnic labels	/ɛ/	Not Important lead in backing (marginal only)
Sex * Religious Practice	/ɑ/	Female+Sporadic lead fronting; All males least fronted /ɑ/ productions
	/ʌ/	Female + Sporadic least backed /ʌ/ productions; All others equally backed /ʌ/ productions
Sex * Ethnic Label	/ɑ/	Female+Important lead in fronting; All males least fronted /ɑ/ productions
	/ʌ/	Female+Important least NCS-like; Male+Important most NCS-like All Not Important /ʌ/ productions in the middle
Ethnicity * Religious Practice	/æ/	Lebanese+Sporadic most NCS-like Non-Lebanese+Sporadic least NCS like All Regular /æ/ productions in the middle
Ethnicity * Ethnic Label	/ʌ/	Lebanese+Not Important leads in lowering Non-Leb+Not Important least lowered All Important /ʌ/ productions in the middle

Ethnic minority speakers and regional sound change

The results of the models also touch on findings that are not directly related to the focus on the social patterning of the NCS vowels. The findings confirm that ethnic minority speakers use at least three of the NCS vowels (i.e., variables of a regional sound change usually associated with white speakers) sociolinguistically, and the social patterning found in the models is not based on a link between the NCS variables and participation in a (globally) mainstream, white identity. One of the goals of this work is to move away from the framing of ethnic minority speakers' use of regional sound change variants as "participation" in the shift. While *participation* is a useful shorthand for talking about what speakers do, it connotes a sense in which regional sound change is the sole and inherent property of a one set of speakers and not another. And more often than not, use of regional sound change variables gets indexed as participation in white culture, though several studies have shown, across a range of ethnic identities and groups, that this is not the case (e.g. Fought 1999; Anderson 2003; Fridland 2004; Silva-Corvolàn 2008; Hall-Lew 2009). Another problematic aspect of the term is that participation in a sound change also suggests a divorcing of speakers and language, that the sound change exists somehow apart from the speakers themselves. Instead, sociolinguistic research stands to benefit from considering the sociolinguistic practices of ethnic minority speakers on their own terms, without assuming a context in which the regional variety is considered to be the language of white speakers. I have explored how the NCS patterns socially within a group of Arab American speakers at a high school in Deaborn, MI, and aside from providing an assessment of Eckert's theory of sound change, this work also demonstrates that Arab Americans use vowels in the NCS sociolinguistically, in ways that make distinctions among Arab Americans, rather than in contrast to a white population.

6.3 Some ethnographic discussion of variables

In this project, I ask questions that are rooted in the sociolinguistic tradition of looking at phonetic variation, but I aim to ground my analysis and interpretation of my findings in my understanding of students' interactions in the social world of their high school. My goal is to bridge the gap between the tables of numbers produced by statistical tests and the pages of transcripts and fieldnotes produced by ethnographically-oriented research. This marriage of sociophonetic and variationist approaches with ethnographic methods is of course increasingly common, and ties together so-called qualitative and quantitative methods (though as I discuss in chapter 3, behind much of the "objectivity" assigned to quantitative methods lie the subjective decisions made by the researcher). In this section,

I discuss some of the patterns I highlighted above in light of findings from fieldnotes and sociolinguistic interviews.

Fixed vs. fluid variables

In chapter 5 I discussed the possibility of the social variables belonging loosely to different categories – those which participants view as fixed properties of their identities and those which are more fluid and may change over time. Social variables from these categories appear to pattern the data in different ways (seen in the interactions of fixed and fluid variables): fixed properties like sex and ethnicity outline the general pattern while the more fluid, attitude-based variables offer further refinement and detail to the general pattern. Some examples of how these categories get discussed or addressed by the participants is found in the data and I discuss them below.

I should note here that I am not making the argument that researchers should view social categories like sex and ethnicity as fixed; there is ample evidence showing how these identities are constructed, achieved, and contested through discourse and other social practices. But the point is that participants generally view these categories as fixed for themselves and their interlocutors. The distinction in how fixed and fluid social variables pattern the NCS vowels in this study may provide a broader way to conceive of differences between social variables as an alternative to the specific distinction in Eckert's theory that relies on a very close link between local and urban that may not be present in all settings where the NCS is used sociolinguistically.

6.3.1 Ethnicity

The fixed or static nature of ethnic identity can be seen in the question Arab students often asked of each other: "What are you?" Students asked this question of each other in a matter-of-fact way and students knew the expected answer was to give their family's national origin. (Though phenotype is not always a reliable indicator of distinguishing between Arab and European American students, I never saw a student ask another student "What are you?" and get a response along the lines of "white" or, "I'm not Arabic".) Ethnic identity in this exchange, which I heard repeatedly at Mercer, ultimately boils down to where students or their parents are from, and it is this information about ethnicity that seemed most relevant for students when they were at Mercer or in Dearborn.

Students' own identification with these categories, either with a nationality-based ethnicity or the broader category of Arab, was not usually explicitly described as dynamic

or context-specific. Still, some participants did show recognition of situations and contexts in which ethnicity, or aspects of it, was dynamic, but only in the sense that the relevant contrast could change (e.g., from a distinction between nationalities, to a broader distinction between white and Arab). Awareness of the context-specific nature of ethnic identity really only happened outside of Mercer. Further, many students did not appear to always see a distinction between being Arab and being, for example, Lebanese. For some students, these ethnic labels were one and the same (and I discuss this further below).

6.3.2 Religious practice

In the models of vocalic variation, religious practice does not show the same patterning across the three vowels in which it is a significant predictor. For /ʌ/-shifting, participants with a regular practice lead in backing, while for /ɑ/-fronting there is a lead in shifting among females with sporadic practice. And for /æ/-shifting, speakers with sporadic practice have either the most or the least shifted /æ/ productions, depending on their ethnicity. Below I discuss the relationship between religious practice and speaker sex and ethnicity.

Religious practice in interaction with ethnicity

The two models for /æ/-shifting both have the interaction of ethnicity and religious practice as significant predictors. The main difference in /æ/ productions is found between the two groups of students with sporadic practice, and the pattern is the same for F1 and F2. Lebanese students with religious practice have the most fronted and most raised /æ/s, while non-Lebanese participants with sporadic practice have the least fronted and least raised /æ/ productions. /æ/ values for all students with regular religious practice fall in between these two groups and do not differ significantly from either of them. Differences in what sporadic practice means for Lebanese and non-Lebanese students may help explain why the two groups with sporadic practice pattern in different ways.

One possible explanation is that for Lebanese and non-Lebanese students, the level of religious practice carries different meanings. For Lebanese students, the difference between students with regular versus sporadic religious practice may be smaller and less socially significant than it is for non-Lebanese students. Several Lebanese students talked about their families being "Americanized" in many different ways and religious identity was a part of that process. In her interview with me, Zeinab, a Lebanese female student, identified strongly with being Arabic and Muslim, but did not see herself as very religious:

Zeinab: When I was younger I used to go to Arabic school and they used to teach us and stuff. But like I stopped doing that. My mother teaches me here and there but it's not like I'm totally full on religious or anything.
Sai: do you pray regularly?
Zeinab: No, I do not pray.
Sai: Oh you don't pray at all?=
Zeinab: =At all
Sai: Do you ever go to the mosque?
Zeinab: Only if a family member has died or during Ramadan or during the holidays and stuff.

For Lebanese students, who are generally unproblematically part of the mainstream, socioeconomically powerful group in Mercer, less and less religious practice may be part of a process of assimilation occurring at a family or cultural level, but does not diminish or erode their strong, though perhaps symbolic, affiliation with being Arab and being Muslim. Zeinab went on to describe her own religious practice as what she saw as normal or regular:

Zeinab: 'Cause there are a lot of kids that don't follow everything.
Sai: What do you mean everything?
Zeinab: Like the religion, you have the girls that walk around with the scarves and everything. Total package. Then you have the regular ones like me that are just -- not that you don't care but you're not ready to take that step.

For Lebanese participants, having a sporadic religious practice is mainstream and what lots of students do. In contrast, for non-Lebanese participants, sporadic religious practice was not part of a process of assimilation (some non-Lebanese students described their parents' resistance to assimilation); instead, sporadic religious practice was often about the participant's personal relationship with Islam or with their families. For example, Aisha, the Palestinian female student participant I discussed above, told me that she was not praying daily or attending mosque regularly because she was in the process of figuring out what religion meant to her, even though she also noted that this process was upsetting her family. Lebanese students with sporadic practice never identified their religious practice as a source of contention or conflict for them, while non-Lebanese students like Aisha who have sporadic practice may find it problematic because it is in conflict with their beliefs or with family pressures to participate in religious practices.

These differences in what sporadic religious practice means socially for Lebanese and non-Lebanese help account for the different patterns of /æ/-shifting linked to the two sporadic groups.

Religious practice in interaction with sex

The interaction of religious practice with sex is a significant predictor for /ɑ/-fronting and for /ʌ/-backing (significant only for F2). This interaction shows a similar pattern to that of religious practice and ethnicity, in which the main distinctions are between the groups with sporadic practice. As I discussed above, the distinctive group for each of these vowels is females with sporadic practice, who lead in /ɑ/-fronting and lag in /ʌ/-backing. Females who identify as having a sporadic practice are a mix of Lebanese and non-Lebanese participants. However, many of them are those who explicitly referred to the dynamic nature of their religious practice. I return to the idea of certain social categories being part of the mainstream or normalized set of practices; but here I think the non-mainstream position on religious practice – identifying as having a sporadic practice – applies particularly to girls and to non-Lebanese students, i.e., groups that are already not mainstream. For girls, this is because many of the expectations governing their behavior are rooted in religious and cultural traditions (or beliefs about what those traditions are), while for many non-Lebanese students, as I have discussed above, actively acknowledging a sporadic religious practice is in part to acknowledge a break with what is traditional and regular. The patterns I mentioned above in relation to mainstream and non-mainstream apply here, with sporadic religious practice among women and non-Lebanese students being least NCS-like for /ʌ/-shifting and /æ/-shifting, but being most NCS-like for /ɑ/-fronting. In §6.4.1, I discuss how this distinction may be applied in extending Eckert's model.

6.3.3 Ethnic label importance.

Views on the importance of ethnic label choice were not as fluid as students' description of their religious practice, but they were often rooted in specific personal experiences or ideologies (or, perhaps, they were attributable to lack of those experiences). Students who had personally experienced discrimination, or knew people who had, were more likely to be sensitive to differences in ethnic label choice than students who had not personally experienced discrimination because of their ethnic identity. This variable is really about participants' perceptions and attitudes.

In Chapter 2 (§2.4.6) I discuss students' perceptions of different ethnic labels. I used the variable of ethnic label importance to distinguish between students who thought there was a difference in terms (mainly between *Arab* and *Arab American*, but also distinctions between nationalities and the term *Arab*) and students who didn't see an important difference in the ethnic labels. Most of the students who did see a difference were quick to explain why – e.g., Dee chooses Arab American in mixed company because she wants to be clear that she too is an American citizen; Alex uses it because he doesn't want to scare white people and have them think he is a terrorist if he just uses *Arab*. But other students just saw the terms as all the same, to be used interchangeably (see relevant interview excerpts in §2.4.6).

My goal in using this social variable in my analysis was to investigate students' sensitivity or awareness of the difference in connotation of these terms in the outside world. I was inspired by the work of Robin Dodsworth (2005, 2008), who introduces the concept of "sociological consciousness" – the recognition of links among different levels of social structure – into her sociolinguistic study of /o/-fronting in a suburban community near Columbus, OH, that is undergoing changes due to sprawl and development. In Dodsworth's study, she analyzes the effects of the lens(es) through which participants view the effects of changes in population and development on community identity. Dodsworth finds that differences in sociological consciousness and attitudes about sprawl in the community account for variation in /o/-fronting.

I hypothesized that participants' views on ethnic label choices were representative in some way of their understanding of larger social structures that inform and shape views of Arab Americans, the contexts of racism against Arab Americans, and how their decisions about how they named themselves might relate to these broader social structural issues. Participants interpret the meaning of choice in ethnic labels differently (as is to be expected), and these differences matter in the social patterning of vowels. The role of this variable in the mixed models appears to be primarily in interaction with ethnicity and sex, as a way of further describing variation within groups. In interaction with ethnicity, which had a significant effect on just /ʌ/-lowering, the pattern is such that the difference is between Lebanese and non-Lebanese groups who don't think choices in ethnic label are important, while the /ʌ/ productions of both groups who think ethnic label choice is important fall in between the other two.

Ethnic label importance in interaction with sex is a significant predictor of /ɑ/-fronting and for both dimensions of /ʌ/-shifting. As I mentioned above, these two vowels show different patterns for this interaction: females who think the labels are important lead in /ɑ/-fronting, while they lag in /ʌ/-shifting. I don't see ethnic label importance dividing into a mainstream and non-mainstream position in the same way that I argue for sex, ethnicity, and religious practice. I don't think the views expressed by a particular view of the importance of ethnic labels constrain behavior in the same way that these other variables do. There are no perceived social consequences (that I am aware of) at Mercer for thinking ethnic label choices are important or not important in the same way that girls, non-Lebanese students, and some students with sporadic religious practice perceive that their actions, as they relate to these aspects of their identity, matter.

In the next section I evaluate the effectiveness of Eckert's theory in greater detail, including reasons why it does not work for this data. In light of some of the discussion here, I also propose some changes or modifications that could be made to the model to be more inclusive.

6.4 Applicability of Eckert's model

One of the main aims of this dissertation has been to assess the effectiveness of Eckert's model of sound change. New changes that are part of a shift begin in urban areas and spread out to suburban areas. In Eckert's theory, burnouts at suburban Belten High introduced the newer variables, which are acquired through their contact with the urban environment. At Belten High, burnouts, particularly burnout girls, use the new NCS variables, /ʌ/-backing and /ɛ/-backing, as a means of indexing their urban, working-class identity and their orientation to and engagement with the local community instead of the institutional norms of the high school. Older variables, like /ɑ/-fronting and /æ/-raising, have already spread throughout the suburbs and have no urban symbolic value. Rather, they serve as markers for more global and diffuse social distinctions like gender. The main issues I address below regarding Eckert's theory are the link between local/urban identity and the urban origins of the variable, the relative newness of the new variables in her study and this one, and the reliance on class distinctions as the primary, underlying oppositional force between jocks and burnouts.

Eckert's work relies on distinctions and issues that are highly localized, but the primary opposition between jocks and burnouts is very closely linked to a distinction between middle class and working-class, and though she notes that the opposition is also one of

marginalization and mainstreaming, her work does not address the possibility that this link between social class and mainstream/marginalized is one that is specific to Belten. In fact, Eckert argues that the distinction (encompassing class and mainstream/marginalized) she finds at Belten is a distinction or oppositional force that is essentially universal to the U.S. high school experience (2000). But research on adolescents and youth in the U.S. (and elsewhere) has demonstrated that adolescent social orders do not have to be rooted in adult social class divisions (Bucholtz 2002), and while the jock/burnout distinction is notable and common, it is not the only possibility. Bucholtz' own research at Bay City High School (e.g., 1997, 1999, 1999a) identifies a few loose collectives of mainstream "cool" students, who are not all defined in opposition to one another, along with other kinds of social groups, like nerds, whose goals are centered neither around being cool nor around being uncool (see also e.g. Bakht 2010, Matthews 2005). Similarly, at Mercer, I never got the sense that there was a polarizing social division that defined the whole school's social order, while Eckert discusses how the jock/burnout division was immediately apparent at Belten. Rather, like my own high school experience and the ones described by Bucholtz and others, Mercer students were organized into groups or loose cliques of students that interacted and overlapped with each other and which were formed mostly through old friendships from middle school or the home, or through shared classes and extra-curricular activities. For Arab Americans at Mercer, engagement with the local community of Dearborn was engagement with the Arab community (recall the common reference to Dearborn as "Arabtown), and in other parts of this dissertation I have discussed distinctions within that local Arab identity. In contrast, Eckert finds that ethnic identity is downplayed among her students; a passage in Eckert's (2000) volume points to a change in the presentation and production of ethnic identity in the suburbs of Detroit:

> Although a variety of European and a scattering of Middle Eastern ethnic groups are represented in its population, Neartown plays down its diversity. There are no ethnic neighborhoods or businesses, there is little ethnic pride or posturing in the schools. Its internal geography reproduces locally the socioeconomic continuum within which the town is embedded, and the neighborhoods run from solid working class at the Detroit end of town to relatively affluent upper middle class at the other (102).

During her fieldwork at Belten in 1982, Eckert finds assimilation to a global or homogenized American culture and erasure of distinct ethnic practices to be very common. The emphasis on social class distinctions, which are produced in the geography

of the town and social divisions of the school, may overwhelm any opportunities or need for ethnic identities, but the reality of suburban Detroit today is that ethnic distinctions are an important and salient part of life. Ethnic assimilation is not common practice at Mercer in Dearborn in 2007. Though students did talk about "Americanization" and loss of culture or heritage, there was a degree of pride in having a distinctive ethnic identity and in being Arab. Part of being Arab, for many students, is about *not* being white. Eckert's model does not address the issue of race and ethnicity as an important social force because it was not an important social force at Belten.

The class distinctions at the very center of Eckert's social divisions do not apply at Mercer, or they do not apply in the same, polarizing way. There are class distinctions, but they are not the salient social force at Mercer. Without a strong opposition based on social class, the geographic origins of the newer variables do not have the same kind of social meaning. The burnouts' affiliation with an urban identity is a crucial link between their use of the newer variables and the geographic origins of the variables. At Mercer, Arab American students were not oriented to the urban center and, without engagement with the geographical location, the so-called urban variables of Eckert's study lose their link between their geographical roots and their social meaning.

In addition to an absence of urban orientation among the participants, there is also the relative newness of the newer variables at the time of Eckert's study and the time of this study. Eckert was perhaps fortunate in that she did her fieldwork and collected her data at a point in time when the newer variables were rapidly spreading through speakers and communities. But they were not just "newer" variables, they were brand new. This is a very specific moment of "introducing" a new sociolinguistic variable, which is what Eckert argues the Burnout girls are doing with /ʌ/-backing and /ɛ/-backing at Belten. And it is likely that this stage of sound change, in which there is an opportunity for the vowel to gain a foothold as a sociolinguistic resource, is different from the situation that arises after the vocalic variables have already been introduced. The "newer" variables in my study have (if Eckert and others are correct) been around for 30 years. They are not being introduced to Mercer students by anyone. They are already "out there" – documented in the everyday linguistic practices of everyday people in everyday places – available to everyone and, perhaps most importantly, they are no longer attributed to their urban origins. While /ʌ/-shifting and /ɛ/-shifting are considerably new*er* than the other two variables in this study, /ɑ/-fronting and /æ/-raising, they are probably no longer considered "new", at least not in the sense that they were in Eckert's study.

6.4.1 Thoughts on modifying or expanding the model

Though Eckert's model can be presented in broad terms that make it testable in other settings, in the discussion above my goal has been to show how certain pieces of her theory are in fact very specific and rooted in the community and linguistic variables she studies. Thus, the universal application of her theory is unlikely. But Eckert's theory does highlight some important points about the role of social information in the spread of sound change that are often overlooked. In making a distinction between older and newer variables, her argument highlights that different vowels within a set of related sound changes can have different social patterns. The NCS does not have one uniform and consistent social meaning. Though Eckert finds those distinctions align with a separation between old and new variables, the results of my data show that variables can have different social patterns without requiring a division between older and newer. Though several studies have described variable social patterns for vowels in the NCS, this pattern has not been emphasized as a finding in its own right. But if it were, it could prove to be a promising avenue for researchers interested in further investigating the effects of social factors on the spread of sound changes "from below."

Social class is treated as the defining social force in Belten, and Eckert (generally implicitly though occasionally explicitly) overgeneralizes this to be a universal fact of American high schools and adolescent social orders. While social class certainly plays a role in the social dynamics of many American high schools and many adolescent social orders, sociolinguists and other researchers have shown that other social factors can play an equal, or more important, role in adolescent social interactions. But, another way to think of the opposition between jocks and burnouts is that the jocks are mainstream, in that their goals are supported by the institutional goals of the school, while the burnouts are marginalized and not supported by the school. While the goals of jocks and burnouts may be rooted in class distinctions, the distinction between mainstream and non-mainstream social identities do not necessarily have to be linked to social class. At Mercer, I describe several social variables as loosely connected to an opposition between mainstream and marginalized groups, and this distinction is useful in understanding how the sets of social variables are patterning the vocalic variation. So, one way to rethink Eckert's theory in light of this may be to look for social factors, if they exist, that create or contribute to an overall social opposition between mainstream and non-mainstream. Race, religion, ethnicity, residence, may all, depending on circumstance, serve the same kind of role that social class does at Belten. And though, as I mentioned above, scholars have argued against the role of social class as a universally oppositional force at

American high schools, several studies have found many instances of (tight- and loose-knit) groups of mainstream students and students outside of that mainstream. How that mainstream-ness gets defined is likely to be locally specific and linked to many social factors. In either case, the effect of this local information may be different from the effect of more global variables (though in this study that does not appear to be the case). In the case of Eckert's study the difference is in which vowels are affected by each kind of variable. Taking away some of the underlying specificity of Eckert's theory may open it up to other studies so that we can begin to recognize the social patterning of sound change variables that goes beyond sex and social class.

6.5 Conclusion

In this dissertation I have investigated the social and linguistic patterning of four Northern Cities Shift variables among seventeen Arab American high school students in Dearborn, Michigan. I used a combination of ethnographic, acoustic, and statistical methods to understand how the patterning of these four NCS vowels relates to both local and broad social information relevant to the participants. Further, I showed that the social patterning of the NCS is used by ethnic minority speakers on their own terms and not in relation to the mainstream, white social category that regional sound changes are usually affiliated with. This suggests that sound change spread is broad and not necessarily restricted by ethnic or other social boundaries. It also suggests to me that the role of social information in understanding spread still needs to be developed, and many questions remain about how speaker's social lives impact their use of regional sound change variables.

Through this study of the linguistic practices of Arab American adolescents, I also assessed the effectiveness of Eckert's theory of the role of social variables in the spread of regional sound change variables. While I ultimately conclude that many of the details in her theory are too specific to her data and her participants, I suggested ways in which her theory could be modified to work with other settings.

I hope that future work exploring regional sound change among minority speakers will also look at sociolinguistic variation on its own terms and that the research presented in this dissertation provides good reason to do so.

Appendix A: List of interview questions

I. Background and demographic information

1. Tell me about your family. Did you grow up in Dearborn? Were you born in the US?
2. Where did you grow up?
   - Have you lived in the same place your whole life?
   - When did you move to Dearborn?
   - When did you move to the US?
3. Where is your family from? When did they move to the US/Dearborn?

II. School, friendships, social networks

1. Who do you hang out with at school?
   - How long have you been friends with them?
   - Does Fordson have major social groups?
2. What do you and your friends do for fun?
3. What kinds of activities are you involved in?
   - Do you play any sports? Do you like music? Drama?
4. Do you have a job after school or during the summer?
5. What do you like about school?
6. What don't you like about school?
7. What do you plan to do when you graduate from high school? Are you going to work or go to college? What do you want to do when you graduate?
8. Do you think you'll stay in Dearborn or go somewhere else?
9. Are there divisions between Lebanese kids and Yemeni kids? What about Iraqi students?

III. Language

1. What languages do you speak at home?
2. Can you speak any languages other than English?
3. Do you ever speak Arabic (or any other languages) with your friends?
   - Do you have friends who don't speak Arabic who know some Arabic words?
   - What do you think about that?
4. Are there any slang words that only Fordson kids know?
   - What do they mean?
   - Are there any Arabic words you hear non-Arabic-speaking kids or teachers use?
5. The school district's rules are that you can't use any language other than English unless it's for the class room. So, you can only use Arabic in Arabic class.

- What do you think of that rule?

6. Do you or your friends ever use English and Arabic in the same conversation or sentence?
7. What do you think is the difference between saying you're Arab and saying you're Arab American? How do you choose which one to use?

IV. Current Events

4. How do you think Arabs are represented in the media?
5. Do you think people look at you differently because you are Arab? Does it change a lot when you leave Dearborn?
6. Do you think a lot of kids here are treated differently because they're Arab?

Appendix B: List of sample words used for tokens

Act	Actually
After	Ask
Asked	Back
Background	Bad
Basketball	Because
Best	Better
But	Cause
Class	Couple
Cousin	Dad
Definitely	Doctor
Does	Especially
Everybody	Everyone
Everything	Exactly
Except	Fact
Fast	Get
Got	Guess
Had	Half
Happens	Happy
Has	Have
Having	Head
Hospital	Husband
Job	Jobs
Just	Off
Other	Popular
Question	Respect
Said	Says
Second	Seven
Sophomore	Stop
Stopped	Stuck
Stuff	Talk
Talked	Talking
Talks	That
That's	Thought
Together	Top
Touch	Up
Whatever	Yes

Appendix C: Statistical tests for /ɑ/

Table 1. Preceding context ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
F2-NORM	Between Groups	165.712	7	23.673	6.805	.000
	Within Groups	1586.254	456	3.479		
	Total	1751.966	463			

Table 2. Scheffe post-hoc test for preceding context

(I) PrecCode	(J) PrecCode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
[h]	Glide	1.744151	.733730	.582	-1.02149	4.50980
	Palatal	-.021567	.589799	1.000	-2.24469	2.20156
	Dental	.744277	.718373	.993	-1.96348	3.45204
	Velar	-.118816	.530663	1.000	-2.11904	1.88141
	Labial	.997294	.560453	.869	-1.11522	3.10981
	Pause	1.662795	.575585	.306	-.50676	3.83234
	Alveolar	.966627	.516509	.834	-.98025	2.91350
Glide	Palatal	-1.765719	.623919	.334	-4.11745	.58602
	Dental	-.999874	.746641	.970	-3.81418	1.81444
	Velar	-1.862967	.568344	.153	-4.00523	.27929
	Labial	-.746858	.596255	.980	-2.99432	1.50060
	Pause	-.081357	.610500	1.000	-2.38251	2.21980
	Alveolar	-.777524	.555152	.962	-2.87006	1.31501
Palatal	Dental	.765844	.605786	.978	-1.51754	3.04923
	Velar	-.097248	.364032	1.000	-1.46939	1.27490
	Labial	1.018861	.406231	.507	-.51235	2.55007
	Pause	1.684362*	.426865	.031	.07538	3.29334
	Alveolar	.988194	.343071	.310	-.30494	2.28133
Dental	Velar	-.863093	.548376	.928	-2.93009	1.20390
	Labial	.253016	.577253	1.000	-1.92282	2.42885
	Pause	.918517	.591955	.933	-1.31274	3.14977
	Alveolar	.222350	.534692	1.000	-1.79306	2.23776
Velar	Labial	1.116109	.314268	.085	-.06846	2.30068
	Pause	1.781610*	.340521	.000	.49809	3.06513
	Alveolar	1.085443*	.226800	.002	.23057	1.94032
Labial	Pause	.665501	.385304	.886	-.78682	2.11783
	Alveolar	-.030667	.289729	1.000	-1.12274	1.06141
Pause	Alveolar	-.696168	.318014	.685	-1.89486	.50252

*. The mean difference is significant at the 0.05 level.

Table 3. Following context ANOVA

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
F2-NORM	Between Groups	101.107	4	25.277	7.122	.000
	Within Groups	1625.588	458	3.549		
	Total	1726.695	462			

Table 4. Scheffe post-hoc tests for following context

Multiple Comparisons						
Scheffe						
(I) FollCode	(J) FollCode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Liquid	Dental	-.815778	.570398	.727	-2.57993	.94837
	Velar	-.214127	.414769	.992	-1.49694	1.06869
	Labial	-.778373	.415793	.478	-2.06435	.50761
	Alveolar	-1.342527*	.418558	.037	-2.63706	-.04800
Dental	Velar	.601651	.449011	.773	-.78707	1.99037
	Labial	.037405	.449957	1.000	-1.35424	1.42905
	Alveolar	-.526749	.452513	.852	-1.92630	.87280
Velar	Labial	-.564246	.221676	.168	-1.24985	.12136
	Alveolar	-1.128400*	.226820	.000	-1.82992	-.42688
Labia	Alveolar	-.564154	.228687	.195	-1.27144	.14314

*. The mean difference is significant at the 0.05 level.

Table 5. Mann-Whitney u-test for position in word

Ranks[a]				
	PosCode	N	Mean Rank	Sum of Ranks
F1-NORM	Initial	43	222.99	9588.50
	Medial	424	235.12	99689.50
	Total	467		
F2-NORM	Initial	43	170.08	7313.50
	Medial	424	240.48	101964.50
	Total	467		

Test Statistics[a,b]		
	F1-NORM	F2-NORM
Mann-Whitney U	8642.500	6367.500
Wilcoxon W	9588.500	7313.500
Z	-.562	-3.259
Asymp. Sig. (2-tailed)	.574	.001

Table 6. Mann-Whitney u-test for sex

Ranks[a]				
	SexCode_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Male	9	9.78	88.00
	Female	8	8.13	65.00
	Total	17		
F2NORM_mean	Male	9	6.56	59.00
	Female	8	11.75	94.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	29.000	14.000
Wilcoxon W	65.000	59.000
Z	-.674	-2.117
Asymp. Sig. (2-tailed)	.501	.034
Exact Sig. [2*(1-tailed Sig.)]	.541[a]	.036[a]
a. Not corrected for ties.		

Table 7. Mann-Whitney u-test for Ethnicity

Ranks[a]				
	LebCode_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Not_Lebanese	6	9.67	58.00
	Lebanese	11	8.64	95.00
	Total	17		
F2NORM_mean	Not_Lebanese	6	12.17	73.00
	Lebanese	11	7.27	80.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	29.000	14.000
Wilcoxon W	95.000	80.000
Z	-.402	-1.910
Asymp. Sig. (2-tailed)	.688	.056
Exact Sig. [2*(1-tailed Sig.)]	.733[a]	.062[a]
a. Not corrected for ties.		

Table 8. ANOVA for Age at Immigration

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F2NORM_mean	Between Groups	2.719	2	1.359	1.015	.387
	Within Groups	18.745	14	1.339		
	Total	21.464	16			

Table 9. Mann-Whitney u-test for Religious Practice

Ranks[a]				
	ReligiousPractice_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Regular	8	9.50	76.00
	Sporadic	9	8.56	77.00
	Total	17		
F2NORM_mean	Regular	8	6.75	54.00
	Sporadic	9	11.00	99.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	32.000	18.000
Wilcoxon W	77.000	54.000
Z	-.385	-1.732
Asymp. Sig. (2-tailed)	.700	.083
Exact Sig. [2*(1-tailed Sig.)]	.743[a]	.093[a]
a. Not corrected for ties.		

Table 10. Mann-Whitney u-test for Future Plans

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
Total		.519	16			
F2NORM_mean	Between Groups	1.536	2	.768	.540	.595
	Within Groups	19.928	14	1.423		
	Total	21.464	16			

Table 11. Mann-Whitney u-test for Ethnic Label Importance

Ranks[a]

	EthnicLabel_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Important	9	7.33	66.00
	Not_Important	8	10.88	87.00
	Total	17		
F2NORM_mean	Important	9	10.78	97.00
	Not_Important	8	7.00	56.00
	Total	17		

Test Statistics[b,c]

	F1NORM_mean	F2NORM_mean
Mann-Whitney U	21.000	20.000
Wilcoxon W	66.000	56.000
Z	-1.443	-1.540
Asymp. Sig. (2-tailed)	.149	.124
Exact Sig. [2*(1-tailed Sig.)]	.167[a]	.139[a]

a. Not corrected for ties.

Table 12. ANOVA for interaction of sex and ethnicity

ANOVA[a]

		Sum of Squares	df	Mean Square	F	Sig.
F2NORM_mean	Between Groups	11.360	3	3.787	4.872	.017
	Within Groups	10.104	13	.777		
	Total	21.464	16			

Table 13. Scheffe post-hoc tests of interaction of sex and ethnicity

Multiple Comparisons[a]

Scheffe

(I) SexLeb	(J) SexLeb	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Male_NotLeb	Female_NotLeb	.04344	.76351	1.000	-2.3988	2.4857
	Male_Leb	1.72994	.70687	.164	-.5311	3.9910
	Female_Leb	.13434	.76351	.998	-2.3079	2.5766
Female_NotLeb	Male_Leb	1.68651	.55258	.064	-.0810	3.4540
	Female_Leb	.09090	.62340	.999	-1.9032	2.0850
Male_Leb	Female_Leb	-1.59560	.55258	.083	-3.3631	.1719

Table 14. ANOVA for interaction of sex and religious practice

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F2NORM_mean	Between Groups	9.505	3	3.168	3.444	.049
	Within Groups	11.959	13	.920		
	Total	21.464	16			

Table 15. Scheffe post-hoc tests for interaction of sex and religious practice

Multiple Comparisons[a]						
Scheffe						
					95% Confidence Interval	
(I) SexRelig	(J) SexRelig	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Male_Reg	Male_Sporadic	-.28674	.64341	.977	-2.3448	1.7713
	Female_Reg	-.64325	.70045	.838	-2.8838	1.5973
	Female_Sporadic	-1.82855	.60661	.068	-3.7689	.1118
Male_Sporadic	Female_Reg	-.35650	.73255	.970	-2.6997	1.9867
	Female_Sporadic	-1.54181	.64341	.177	-3.5999	.5162
Female_Reg	Female_Sporadic	-1.18530	.70045	.443	-3.4258	1.0552

Table 16. ANOVA for interaction of sex and ethnic Labels

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F2NORM_mean	Between Groups	9.137	3	3.046	3.212	.058
	Within Groups	12.327	13	.948		
	Total	21.464	16			

Table 17. Scheffe post-hoc results for interaction of sex and ethnic labels

Multiple Comparisons[a]						
Scheffe						
					95% Confidence Interval	
(I) SexLabel	(J) SexLabel	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Male_Imp	Male_NotImp	.18601	.65324	.994	-1.9035	2.2755
	Female_Imp	-1.57506	.65324	.173	-3.6646	.5144
	Female_NotImp	-.45033	.74374	.945	-2.8293	1.9287
Male_NotImp	Female_Imp	-1.76106	.61588	.087	-3.7311	.2089
	Female_NotImp	-.63634	.71115	.848	-2.9111	1.6384
Female_Imp	Female_NotImp	1.12473	.71115	.499	-1.1500	3.3995

Table 18. ANOVA for interaction of Ethnicity and Religious Practice

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F2NORM_mean	Between Groups	8.749	3	2.916	2.982	.070
	Within Groups	12.715	13	.978		
	Total	21.464	16			
a. Vowel = a						

Table 19. Scheffe post-hoc tests for interaction of ethnicity and religious practice

Multiple Comparisons[a]						
Scheffe						
		Mean Difference (I-J)			95% Confidence Interval	
(I) LebRelig	(J) LebRelig		Std. Error	Sig.	Lower Bound	Upper Bound
NotLeb_Reg	NotLeb_Sporadic	-1.10063	.80750	.615	-3.6836	1.4823
	Leb_Reg	1.04394	.72225	.571	-1.2663	3.3542
	Leb_Sporadic	.17588	.69932	.996	-2.0610	2.4128
NotLeb_Sporadic	Leb_Reg	2.14457	.72225	.073	-.1657	4.4548
	Leb_Sporadic	1.27651	.69932	.380	-.9604	3.5134
Leb_Reg	Leb_Sporadic	-.86806	.59886	.568	-2.7836	1.0475

Table 20. ANOVA for interaction of Ethnicity and Ethnic Labels

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.210	3	.070	2.952	.072
	Within Groups	.309	13	.024		
	Total	.519	16			
F2NORM_mean	Between Groups	7.118	3	2.373	2.150	.143
	Within Groups	14.346	13	1.104		
	Total	21.464	16			

Table 21. Initial mixed-effects model

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	87.666	14.546	.000
PrecCode	7	429.176	5.339	.000
FollCode	4	429.835	4.236	.002
PosCode	1	427.045	.948	.331
SexCode	1	3.845	11.620	.029
ImmigBin	1	4.016	1.215	.332
LebCode	1	3.756	5.510	.083
FuturePlans	2	3.562	3.764	.132
ReligiousPractice	1	3.666	3.375	.147
EthnicLabel	1	3.603	.322	.604
SexCode * LebCode	0	.	.	.
SexCode * ReligiousPractice	1	3.156	4.494	.120
SexCode * EthnicLabel	1	3.232	3.583	.148
LebCode * ReligiousPractice	1	3.263	.047	.841
LebCode * EthnicLabel	1	3.604	.090	.780

Table 22. Final mixed-effects model

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	172.516	20.187	.000
PrecCode	7	429.061	5.297	.000
FollCode	4	429.431	4.273	.002
PosCode	1	427.461	.940	.333
SexCode	1	5.350	5.523	.062
LebCode	1	5.151	4.294	.091
FuturePlans	2	5.052	2.819	.151
ReligiousPractice	1	5.031	2.355	.185
EthnicLabel	1	5.167	.214	.662
AgeImmigration	1	5.196	.060	.816
SexCode * ReligiousPractice	1	4.486	5.849	.066
SexCode * EthnicLabel	1	4.704	4.135	.101
LebCode * ReligiousPractice	1	4.592	.149	.716
LebCode * EthnicLabel	1	4.889	1.329	.302

a. Dependent Variable: F2-NORM.

Appendix D: Statistical tests for /æ/

Table 1. ANOVA for Preceding Context

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
F1-NORM	Between Groups	6.994	6	1.166	3.737	.001
	Within Groups	189.018	606	.312		
	Total	196.012	612			
F2-NORM	Between Groups	132.008	6	22.001	10.416	.000
	Within Groups	1279.988	606	2.112		
	Total	1411.996	612			

Table 2. Scheffe post-hoc results for preceding context for F1

Multiple Comparisons

Scheffe

(I) PrecCode	(J) PrecCode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Liquid	[h]	.271757	.139959	.708	-.22665	.77016
	Dental	.294565	.141565	.632	-.20956	.79869
	Velar	.585061	.177500	.095	-.04703	1.21715
	Labial	.287570	.140868	.654	-.21407	.78921
	Pause	.183390	.141401	.946	-.32015	.68693
	Alveolar	.456342	.145865	.136	-.06309	.97578
[h]	Dental	.022809	.070516	1.000	-.22830	.27392
	Velar	.313304	.128211	.427	-.14326	.76987
	Labial	.015813	.069106	1.000	-.23028	.26190
	Pause	-.088367	.070186	.953	-.33830	.16157
	Alveolar	.184585	.078794	.484	-.09600	.46517
Dental	Velar	.290495	.129962	.545	-.17231	.75330
	Labial	-.006996	.072303	1.000	-.26447	.25048
	Pause	-.111175	.073336	.890	-.37233	.14998
	Alveolar	.161777	.081612	.686	-.12885	.45240
Velar	Labial	-.297491	.129202	.506	-.75759	.16260
	Pause	-.401671	.129783	.146	-.86384	.06049
	Alveolar	-.128718	.134633	.989	-.60815	.35072
Labia	Pause	-.104179	.071981	.910	-.36051	.15215
	Alveolar	.168773	.080397	.622	-.11753	.45507
Pause	Alveolar	.272952	.081327	.082	-.01666	.56256

*. The mean difference is significant at the 0.05 level.

Table 3. Scheffe post-hoc results for preceding context for F2

Multiple Comparisons						
Scheffe						
(I) PrecCode	(J) PrecCode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Liquid	[h]	-1.778361*	.364211	.001	-3.07534	-.48138
	Dental	-1.218812	.368390	.092	-2.53067	.09305
	Velar	-2.290426*	.461901	.000	-3.93528	-.64557
	Labial	-1.870690*	.366576	.000	-3.17609	-.56529
	Pause	-2.085912*	.367963	.000	-3.39625	-.77557
	Alveolar	-2.296403*	.379579	.000	-3.64811	-.94470
[h]	Dental	.559550	.183501	.160	-.09391	1.21301
	Velar	-.512065	.333638	.884	-1.70017	.67604
	Labial	-.092329	.179832	1.000	-.73272	.54806
	Pause	-.307551	.182644	.829	-.95796	.34285
	Alveolar	-.518042	.205042	.383	-1.24821	.21213
Dental	Velar	-1.071614	.338195	.125	-2.27595	.13272
	Labial	-.651879	.188151	.064	-1.32189	.01814
	Pause	-.867101*	.190840	.002	-1.54669	-.18751
	Alveolar	-1.077591*	.212376	.000	-1.83387	-.32131
Velar	Labial	.419736	.336218	.955	-.77756	1.61703
	Pause	.204514	.337730	.999	-.99816	1.40719
	Alveolar	-.005977	.350350	1.000	-1.25359	1.24164
Labial	Pause	-.215222	.187314	.970	-.88226	.45182
	Alveolar	-.425713	.209214	.658	-1.17074	.31931
Pause	Alveolar	-.210491	.211635	.986	-.96414	.54316

*. The mean difference is significant at the 0.05 level.

Table 4. ANOVA for Following Context

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
F1-NORM	Between Groups	.795	3	.265	.821	.483
	Within Groups	199.967	619	.323		
	Total	200.762	622			
F2-NORM	Between Groups	35.317	3	11.772	5.224	.001
	Within Groups	1394.889	619	2.253		
	Total	1430.206	622			

Table 5. Scheffe post-hoc tests for following context for F1

Multiple Comparisons[a]

Scheffe

(I) LebRelig	(J) LebRelig	Mean Difference (I-J)	Std. Error	Sig.	95 % Confidence Interval	
					Lower Bound	Upper Bound
NotLeb_Reg	NotLeb_Sporadic	.03699	.16121	.997	-.4787	.5526
	Leb_Reg	-.02933	.14419	.998	-.4905	.4319
	Leb_Sporadic	.02865	.13961	.998	-.4179	.4752
NotLeb_Sporadic	Leb_Reg	-.06632	.14419	.975	-.5275	.3949
	Leb_Sporadic	-.00834	.13961	1.000	-.4549	.4382
Leb_Reg	Leb_Sporadic	.05798	.11955	.971	-.3244	.4404

Table 6. Scheffe post-hoc tests for following context for F2

Multiple Comparisons

Scheffe

(I) FollCode	(J) FollCode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Palatal	Velar	.080808	.490912	.999	-1.29531	1.45693
	Labial	.491181	.489498	.800	-.88098	1.86334
	Alveolar	.660022	.482277	.599	-.69189	2.01194
Velar	Labial	.410373	.172949	.132	-.07444	.89518
	Alveolar	.579214*	.151310	.002	.15506	1.00337
Labial	Alveolar	.168841	.146657	.723	-.24227	.57995

*. The mean difference is significant at the 0.05 level.

Table 7. Mann-Whitney u-test for Position in Word

Ranks[a]

	PosCode	N	Mean Rank	Sum of Ranks
F1-NORM	Initial	130	350.22	45528.50
	Medial	494	302.57	149471.50
	Total	624		
F2-NORM	Initial	130	359.13	46686.50
	Medial	494	300.23	148313.50
	Total	624		

Test Statistics[a,b]

	F1-NORM	F2-NORM
Mann-Whitney U	27206.500	26048.500
Wilcoxon W	149471.500	148313.500
Z	-2.681	-3.314
Asymp. Sig. (2-tailed)	.007	.001

Table 8. Mann-Whitney u-test for Sex

Ranks[a]				
	SexCode_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Male	9	8.00	72.00
	Female	8	10.13	81.00
	Total	17		
F2NORM_mean	Male	9	9.67	87.00
	Female	8	8.25	66.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	27.000	30.000
Wilcoxon W	72.000	66.000
Z	-.866	-.577
Asymp. Sig. (2-tailed)	.386	.564
Exact Sig. [2*(1-tailed Sig.)]	.423[a]	.606[a]
a. Not corrected for ties.		

Table 9. Mann-Whitney u-test for Ethnicity

Ranks[a]				
	LebCode_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Not_Lebanese	6	13.33	80.00
	Lebanese	11	6.64	73.00
	Total	17		
F2NORM_mean	Not_Lebanese	6	5.00	30.00
	Lebanese	11	11.18	123.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	7.000	9.000
Wilcoxon W	73.000	30.000
Z	-2.613	-2.412
Asymp. Sig. (2-tailed)	.009	.016
Exact Sig. [2*(1-tailed Sig.)]	.007[a]	.015[a]
a. Not corrected for ties.		

Table 10. ANOVA for Age at Immigration

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.283	2	.142	1.978	.175
	Within Groups	1.003	14	.072		
	Total	1.286	16			
F2NORM_mean	Between Groups	4.621	2	2.310	5.213	.020
	Within Groups	6.205	14	.443		
	Total	10.826	16			

Table 11. Scheffe post-hoc tests for age at immigration for F2

Multiple Comparisons[a]						
Scheffe						
(I) ImmigBin_mean	(J) ImmigBin_mean	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
US-Born	by age 5	.90995	.38871	.099	-.1530	1.9729
	after age 5	1.35713	.51177	.058	-.0423	2.7566
by age 5	after age 5	.44718	.57656	.745	-1.1294	2.0238

Table 12. Mann-Whitney u-test for Religious Practice

Ranks[a]				
	ReligiousPractice_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Regular	8	8.75	70.00
	Sporadic	9	9.22	83.00
	Total	17		
F2NORM_mean	Regular	8	9.00	72.00
	Sporadic	9	9.00	81.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	34.000	36.000
Wilcoxon W	70.000	81.000
Z	-.192	.000
Asymp. Sig. (2-tailed)	.847	1.000
Exact Sig. [2*(1-tailed Sig.)]	.888[a]	1.000[a]
a. Not corrected for ties.		

Table 13. ANOVA for Future Plans

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.061	2	.030	.346	.714
	Within Groups	1.225	14	.088		
	Total	1.286	16			
F2NORM_mean	Between Groups	.353	2	.176	.236	.793
	Within Groups	10.473	14	.748		
	Total	10.826	16			
a. Vowel = ae						

Table 14. Mann-Whitney u-test for Ethnic Label Importance

Ranks[a]				
	EthnicLabel_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Important	9	9.56	86.00
	Not_Important	8	8.38	67.00
	Total	17		
F2NORM_mean	Important	9	9.56	86.00
	Not_Important	8	8.38	67.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	31.000	31.000
Wilcoxon W	67.000	67.000
Z	-.481	-.481
Asymp. Sig. (2-tailed)	.630	.630
Exact Sig. [2*(1-tailed Sig.)]	.673[a]	.673[a]
a. Not corrected for ties.		

Table 15. ANOVA for interaction of Sex and Ethnicity

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.465	3	.155	2.455	.109
	Within Groups	.821	13	.063		
	Total	1.286	16			
F2NORM_mean	Between Groups	3.602	3	1.201	2.161	.142
	Within Groups	7.224	13	.556		
	Total	10.826	16			

Table 16. ANOVA for interaction of Sex and Religious Practice

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.041	3	.014	.144	.932
	Within Groups	1.245	13	.096		
	Total	1.286	16			
F2NORM_mean	Between Groups	.817	3	.272	.354	.787
	Within Groups	10.009	13	.770		
	Total	10.826	16			

Table 17. ANOVA for interaction of Sex and Ethnic Labels

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.031	3	.010	.108	.954
	Within Groups	1.255	13	.097		
	Total	1.286	16			
F2NORM_mean	Between Groups	1.619	3	.540	.762	.535
	Within Groups	9.207	13	.708		
	Total	10.826	16			

Table 18. ANOVA for interaction of Ethnicity and Religious Practice

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.624	3	.208	4.080	.030
	Within Groups	.662	13	.051		
	Total	1.286	16			
F2NORM_mean	Between Groups	4.954	3	1.651	3.656	.041
	Within Groups	5.872	13	.452		
	Total	10.826	16			

Table 19. Post-hoc tests for interaction of ethnicity and religious practice for F1

Multiple Comparisons[a]

Scheffe

(I) LebRelig	(J) LebRelig	Mean Difference (I-J)	Std. Error	Sig.	95 % Confidence Interval	
					Lower Bound	Upper Bound
NotLeb_Reg	NotLeb_Sporadic	-.22910	.18429	.679	-.8186	.3604
	Leb_Reg	.10387	.16483	.939	-.4234	.6311
	Leb_Sporadic	.31159	.15960	.325	-.1989	.8221
NotLeb_Sporadic	Leb_Sporadic	.54069*	.15960	.036	.0302	1.0512
Leb_Reg	Leb_Sporadic	.20772	.13667	.531	-.2294	.6449

*. The mean difference is significant at the 0.05 level.

Table 20. Post-hoc tests for interaction of ethnicity and religious practice for F2

Multiple Comparisons[a]

Scheffe

(I) LebRelig	(J) LebRelig	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
NotLeb_Reg	NotLeb_Sporadic	.96316	.54876	.413	-.7921	2.7185
	Leb_Reg	-.25986	.49082	.962	-1.8298	1.3101
	Leb_Sporadic	-.58439	.47524	.686	-2.1045	.9357
NotLeb_Sporadic	Leb_Reg	-1.22301	.49082	.154	-2.7930	.3470
	Leb_Sporadic	-1.54754*	.47524	.045	-3.0677	-.0274
Leb_Reg	Leb_Sporadic	-.32453	.40697	.886	-1.6263	.9772

*. The mean difference is significant at the 0.05 level.

Table 21. ANOVA for interaction of Ethnicity and Ethnic Labels

ANOVA[a]

		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.489	3	.163	2.662	.092
	Within Groups	.797	13	.061		
	Total	1.286	16			
F2NORM_mean	Between Groups	3.548	3	1.183	2.113	.148
	Within Groups	7.277	13	.560		
	Total	10.826	16			

Table 22. Initial mixed-effects model for F1

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	8.256	34.376	.000
PrecCode	6	586.492	3.226	.004
FollCode	3	586.167	.535	.658
PosCode	1	587.183	1.032	.310
SexCode	1	3.964	.497	.520
ImmigBin	2	4.033	.792	.513
LebCode	1	4.147	3.076	.152
FuturePlans	2	3.961	.008	.992
ReligiousPractice	1	4.028	.005	.950
EthnicLabel	1	4.034	.002	.964
SexCode * ReligiousPractice	1	3.912	5.349	.083
SexCode * EthnicLabel	1	3.950	1.616	.273
LebCode * ReligiousPractice	1	3.884	10.636	.032
LebCode * EthnicLabel	1	3.893	3.696	.129

Table 23. Final mixed-effects model for F1

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	11.654	27.565	.000
PrecCode	6	586.759	3.200	.004
FollCode	3	586.727	.513	.674
PosCode	1	588.416	1.155	.283
SexCode	1	5.985	.017	.901
LebCode	1	6.215	3.553	.107
FuturePlans	2	5.972	.178	.841
ReligiousPractice	1	6.021	.005	.947
EthnicLabel	1	5.988	1.734	.236
ImmigBin	2	6.041	.977	.429
SexCode * ReligiousPractice	1	6.040	1.568	.257
LebCode * ReligiousPractice	1	5.983	6.120	.048

Table 24. Initial mixed-effects model for F2

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	7.407	6.217	.040
PrecCode	6	586.545	9.670	.000
FollCode	3	586.203	3.792	.010
PosCode	1	587.283	1.059	.304
SexCode	1	3.910	4.173	.112
ImmigBin	1	3.954	.499	.519
LebCode	1	4.103	2.448	.191
FuturePlans	2	3.907	4.484	.097
ReligiousPractice	1	3.978	.252	.642
EthnicLabel	1	3.984	3.068	.155
SexCode * LebCode	0	.	.	.
SexCode * ReligiousPractice	1	3.856	2.003	.232
SexCode * EthnicLabel	1	3.895	3.171	.151
LebCode * ReligiousPractice	1	3.826	1.375	.309
LebCode * EthnicLabel	1	3.835	1.244	.330

Table 25. Final mixed-effects model for F2

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	24.348	18.693	.000
PrecCode	6	588.432	9.621	.000
FollCode	3	587.584	3.742	.011
PosCode	1	592.899	.911	.340
SexCode	1	8.083	5.486	.047
LebCode	1	8.221	2.119	.183
FuturePlans	2	8.039	3.419	.084
ReligiousPractice	1	8.072	.021	.888
EthnicLabel	1	8.049	4.002	.080
AgeImmigration	1	8.129	1.576	.244
LebCode * ReligiousPractice	1	8.021	6.432	.035

Appendix E: Statistical tests for /ɛ/

Table 1. ANOVA for Preceding Context

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
F1-NORM	Between Groups	23.100	7	3.300	8.856	.000
	Within Groups	186.696	501	.373		
	Total	209.796	508			
F2-NORM	Between Groups	167.666	7	23.952	8.947	.000
	Within Groups	1341.309	501	2.677		
	Total	1508.975	508			

Table 2. Scheffe post-hoc tests for preceding context for F1

Multiple Comparisons

Scheffe

(I) PrecCode	(J) PrecCode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Liquid	[h]	-.037952	.260812	1.000	-1.02059	.94469
	Glide	-.109985	.202361	1.000	-.87241	.65244
	Palatal	.080814	.245956	1.000	-.84586	1.00748
	Velar	.429234	.177016	.554	-.23769	1.09616
	Labial	-.241620	.173494	.963	-.89528	.41204
	Pause	.179048	.174999	.994	-.48028	.83838
	Alveolar	.006834	.169734	1.000	-.63266	.64633
h]	Glide	-.072033	.236088	1.000	-.96152	.81746
	Palatal	.118765	.274376	1.000	-.91498	1.15251
	Velar	.467185	.214761	.692	-.34195	1.27632
	Labial	-.203669	.211867	.996	-1.00190	.59457
	Pause	.216999	.213101	.994	-.58588	1.01988
	Alveolar	.044785	.208799	1.000	-.74189	.83146
Glide	Palatal	.190799	.219567	.998	-.63644	1.01804
	Velar	.539219*	.138020	.035	.01921	1.05923
	Labial	-.131635	.133474	.995	-.63451	.37124
	Pause	.289033	.135423	.714	-.22119	.79926
	Alveolar	.116819	.128548	.997	-.36750	.60114
Palatal	Velar	.348420	.196453	.871	-.39174	1.08858
	Labial	-.322434	.193286	.904	-1.05066	.40579
	Pause	.098234	.194638	1.000	-.63509	.83155
	Alveolar	-.073980	.189918	1.000	-.78952	.64156
Velar	Labial	-.670854*	.090552	.000	-1.01202	-.32969
	Pause	-.250186	.093402	.412	-.60209	.10172
	Alveolar	-.422400*	.083121	.001	-.73557	-.10923
Labial	Pause	.420668*	.086543	.002	.09461	.74673
	Alveolar	.248454	.075331	.147	-.03536	.53227
Pause	Alveolar	-.172214	.078734	.686	-.46885	.12442

*. The mean difference is significant at the 0.05 level.

Table 3. Scheffe post-hoce tests for preceding context for F2

Multiple Comparisons

Scheffe

(I) PrecCode	(J) PrecCode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Liquid	[h]	-.827574	.699076	.985	-3.46142	1.80627
	Glide	-.590849	.542406	.991	-2.63443	1.45273
	Palatal	-1.277697	.659258	.807	-3.76153	1.20613
	Velar	-1.825006*	.474471	.041	-3.61263	-.03738
	Labial	-.164320	.465031	1.000	-1.91638	1.58774
	Pause	-1.074332	.469064	.630	-2.84158	.69292
	Alveolar	-.420044	.454952	.997	-2.13413	1.29404
[h]	Glide	.236725	.632807	1.000	-2.14745	2.62090
	Palatal	-.450122	.735433	1.000	-3.22095	2.32071
	Velar	-.997432	.575641	.884	-3.16623	1.17136
	Labial	.663254	.567886	.987	-1.47632	2.80283
	Pause	-.246757	.571193	1.000	-2.39879	1.90528
	Alveolar	.407530	.559663	.999	-1.70106	2.51612
Glide	Palatal	-.686847	.588523	.987	-2.90418	1.53048
	Velar	-1.234157	.369947	.136	-2.62798	.15966
	Labial	.426529	.357761	.985	-.92138	1.77443
	Pause	-.483483	.362987	.971	-1.85108	.88411
	Alveolar	.170805	.344558	1.000	-1.12736	1.46897
Palatal	Velar	-.547310	.526571	.993	-2.53123	1.43661
	Labial	1.113376	.518082	.706	-.83856	3.06531
	Pause	.203365	.521704	1.000	-1.76222	2.16895
	Alveolar	.857652	.509054	.899	-1.06027	2.77557
Velar	Labial	1.660686*	.242715	.000	.74623	2.57514
	Pause	.750675	.250354	.256	-.19256	1.69391
	Alveolar	1.404962*	.222796	.000	.56555	2.24437
Labial	Pause	-.910012*	.231967	.033	-1.78398	-.03605
	Alveolar	-.255724	.201915	.978	-1.01646	.50502
Pause	Alveolar	.654288	.211036	.214	-.14082	1.44939

*. The mean difference is significant at the 0.05 level.

Table 4. ANOVA for Following Context

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
F1-NORM	Between Groups	2.744	4	.686	1.679	.153
	Within Groups	207.914	509	.408		
	Total	210.658	513			
F2-NORM	Between Groups	100.728	4	25.182	9.327	.000
	Within Groups	1374.189	509	2.700		
	Total	1474.917	513			

Table 5. Scheffe post-hoc tests for following context for F2

Multiple Comparisons Scheffe						
(I) FollCode	(J) FollCode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Palatal	Dental	-1.620303	.572054	.092	-3.38885	.14824
	Velar	-2.130436*	.527982	.003	-3.76273	-.49814
	Labial	-.959386	.511565	.476	-2.54092	.62215
	Alveolar	-1.497574	.507485	.070	-3.06650	.07135
Dental	Velar	-.510133	.339326	.688	-1.55918	.53892
	Labial	.660917	.313170	.349	-.30727	1.62910
	Alveolar	.122729	.306461	.997	-.82472	1.07017
Velar	Labial	1.171050*	.222698	.000	.48256	1.85954
	Alveolar	.632862	.213160	.067	-.02614	1.29186
Labial	Alveolar	-.538188*	.168435	.038	-1.05892	-.01746

*. The mean difference is significant at the 0.05 level.

Table 6. Mann-Whitney u-test for Position in Word

Ranks[a]				
	PosCode	N	Mean Rank	Sum of Ranks
F1-NORM	Initial	95	222.24	21112.50
	Medial	421	266.68	112273.50
	Total	516		
F2-NORM	Initial	95	289.09	27464.00
	Medial	421	251.60	105922.00
	Total	516		

Test Statistics[a,b]		
	F1-NORM	F2-NORM
Mann-Whitney U	16552.500	17091.000
Wilcoxon W	21112.500	105922.000
Z	-2.624	-2.214
Asymp. Sig. (2-tailed)	.009	.027

Table 7. Mann-Whitney u-test for Sex

Ranks[a]				
	SexCode_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Male	9	8.44	76.00
	Female	8	9.63	77.00
	Total	17		
F2NORM_mean	Male	9	8.89	80.00
	Female	8	9.13	73.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	31.000	35.000
Wilcoxon W	76.000	80.000
Z	-.481	-.096
Asymp. Sig. (2-tailed)	.630	.923
Exact Sig. [2*(1-tailed Sig.)]	.673[a]	.963[a]
a. Not corrected for ties.		

Table 8. Mann-Whitney u-test for Ethnicity

Ranks[a]				
	LebCode_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Not_Lebanese	6	7.00	42.00
	Lebanese	11	10.09	111.00
	Total	17		
F2NORM_mean	Not_Lebanese	6	12.00	72.00
	Lebanese	11	7.36	81.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	21.000	15.000
Wilcoxon W	42.000	81.000
Z	-1.206	-1.809
Asymp. Sig. (2-tailed)	.228	.070
Exact Sig. [2*(1-tailed Sig.)]	.256[a]	.078[a]
a. Not corrected for ties.		

Table 9. ANOVA for Age at Immigration

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.064	2	.032	.579	.574
	Within Groups	.769	14	.055		
	Total	.833	16			
F2NORM_mean	Between Groups	1.010	2	.505	.932	.417
	Within Groups	7.590	14	.542		
	Total	8.601	16			

Table 10. Mann-Whitney u-test for Religious Practice

Ranks[a]				
	ReligiousPractice_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Regular	8	10.13	81.00
	Sporadic	9	8.00	72.00
	Total	17		
F2NORM_mean	Regular	8	8.50	68.00
	Sporadic	9	9.44	85.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	27.000	32.000
Wilcoxon W	72.000	68.000
Z	-.866	-.385
Asymp. Sig. (2-tailed)	.386	.700
Exact Sig. [2*(1-tailed Sig.)]	.423[a]	.743[a]
a. Not corrected for ties.		

Table 11. ANOVA for Future Plans

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.165	2	.082	1.727	.214
	Within Groups	.668	14	.048		
	Total	.833	16			
F2NORM_mean	Between Groups	.778	2	.389	.696	.515
	Within Groups	7.822	14	.559		
	Total	8.601	16			

Table 12. Mann-Whitney u-test for Ethnic Label Importance

Ranks[a]				
	EthnicLabel_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Important	9	9.44	85.00
	Not_Important	8	8.50	68.00
	Total	17		
F2NORM_mean	Important	9	11.11	100.00
	Not_Important	8	6.63	53.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	32.000	17.000
Wilcoxon W	68.000	53.000
Z	-.385	-1.828
Asymp. Sig. (2-tailed)	.700	.068
Exact Sig. [2*(1-tailed Sig.)]	.743[a]	.074[a]
a. Not corrected for ties.		

Table 13. ANOVA for interaction of Sex and Ethnicity

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.286	3	.095	2.260	.130
	Within Groups	.547	13	.042		
	Total	.833	16			
F2NORM_mean	Between Groups	2.145	3	.715	1.439	.277
	Within Groups	6.456	13	.497		
	Total	8.601	16			

Table 14. ANOVA for interaction of Sex and Religious Practice

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.055	3	.018	.306	.821
	Within Groups	.778	13	.060		
	Total	.833	16			
F2NORM_mean	Between Groups	.447	3	.149	.238	.869
	Within Groups	8.154	13	.627		
	Total	8.601	16			

Table 15. ANOVA for interaction of Sex and Ethnic Labels

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.037	3	.012	.200	.895
	Within Groups	.796	13	.061		
	Total	.833	16			
F2NORM_mean	Between Groups	1.984	3	.661	1.299	.316
	Within Groups	6.616	13	.509		
	Total	8.601	16			

Table 16. ANOVA for interaction of Ethnicity and Religious Practice

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.155	3	.052	.994	.426
	Within Groups	.678	13	.052		
	Total	.833	16			
F2NORM_mean	Between Groups	2.331	3	.777	1.611	.235
	Within Groups	6.269	13	.482		
	Total	8.601	16			

Table 17. ANOVA for interaction of Ethnicity and Ethnic Labels

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.128	3	.043	.788	.522
	Within Groups	.705	13	.054		
	Total	.833	16			
F2NORM_mean	Between Groups	3.339	3	1.113	2.750	.085
	Within Groups	5.262	13	.405		
	Total	8.601	16			

Table 18. Initial mixed-effects model for F1

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	102.219	5.652	.019
PrecCode	7	480.158	10.069	.000
FollCode	4	480.492	7.976	.000
PosCode	1	478.295	.399	.528
SexCode	1	4.063	.333	.594
ImmigBin	2	4.127	.119	.890
LebCode	1	4.213	1.535	.280
FuturePlans	2	3.889	.537	.622
ReligiousPractice	1	3.789	1.133	.350
EthnicLabel	1	3.750	.006	.944
SexCode * ReligiousPractice	1	3.542	1.285	.328
SexCode * EthnicLabel	1	3.634	1.464	.299
LebCode * ReligiousPractice	1	3.617	.931	.394
LebCode * EthnicLabel	1	3.720	.752	.438

a. Dependent Variable: F1-NORM.

Table 19. Final mixed-effects model for F1

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	284.055	6.830	.009
PrecCode	7	483.137	10.197	.000
FollCode	4	483.652	8.045	.000
PosCode	1	481.476	.427	.514
SexCode	1	8.569	1.357	.275
ImmigBin	2	8.745	.224	.804
LebCode	1	8.854	2.702	.135
FuturePlans	2	8.216	1.622	.255
ReligiousPractice	1	7.857	.667	.438
EthnicLabel	1	7.891	.439	.526

a. Dependent Variable: F1-NORM.

Table 20. Initial mixed-effects model for F2

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	37.608	1.285	.264
PrecCode	7	479.327	10.499	.000
FollCode	4	479.378	17.898	.000
PosCode	1	478.176	4.201	.041
SexCode	1	4.082	.143	.724
ImmigBin	2	4.114	.242	.796
LebCode	1	4.150	.136	.731
FuturePlans	2	3.998	.044	.957
ReligiousPractice	1	3.947	.740	.439
EthnicLabel	1	3.925	1.072	.360
SexCode * ReligiousPractice	1	3.821	.154	.716
SexCode * EthnicLabel	1	3.870	.154	.715
LebCode * ReligiousPractice	1	3.860	.067	.809
LebCode * EthnicLabel	1	3.909	.053	.830

a. Dependent Variable: F2-NORM.

Table 21. Final mixed-effects model for F2

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	135.844	1.580	.211
PrecCode	7	481.243	10.621	.000
FollCode	4	481.583	18.040	.000
PosCode	1	480.163	4.196	.041
SexCode	1	7.240	.155	.705
ImmigBin	2	7.174	.530	.610
LebCode	1	7.304	.204	.665
FuturePlans	2	7.044	.068	.935
ReligiousPractice	1	6.790	1.531	.257
EthnicLabel	1	6.808	4.542	.072
SexCode * EthnicLabel	1	6.915	1.279	.296

Appendix F: Statistical tests for /ʌ/

Table 1. ANOVA for Preceding Context for F1 and F2

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
F1-NORM	Between Groups	19.377	5	3.875	10.666	.000
	Within Groups	184.947	509	.363		
	Total	204.324	514			
F2-NORM	Between Groups	161.186	5	32.237	10.093	.000
	Within Groups	1625.727	509	3.194		
	Total	1786.912	514			

Table 2. Scheffe post-hoc results for Preceding Context for F1

Multiple Comparisons Scheffe						
					95% Confidence Interval	
(I) PrecCode	(J) PrecCode	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Glide	Palatal	.162222	.219481	.990	-.57094	.89539
	Velar	-.047117	.188046	1.000	-.67528	.58104
	Labial	-.479346	.190241	.276	-1.11484	.15615
	Pause	-.426914	.202748	.490	-1.10418	.25036
	Alveolar	-.316929	.187744	.723	-.94408	.31022
Palatal	Velar	-.209339	.132170	.775	-.65085	.23217
	Labial	-.641568*	.135275	.001	-1.09345	-.18969
	Pause	-.589136*	.152362	.011	-1.09810	-.08018
	Alveolar	-.479150*	.131740	.022	-.91922	-.03908
Velar	Labial	-.432229*	.074086	.000	-.67971	-.18475
	Pause	-.379798*	.101999	.017	-.72052	-.03908
	Alveolar	-.269812*	.067415	.007	-.49501	-.04462
Labial	Pause	.052432	.105991	.999	-.30163	.40649
	Alveolar	.162417	.073316	.428	-.08249	.40732
Pause	Alveolar	.109986	.101440	.947	-.22887	.44884

*. The mean difference is significant at the 0.05 level.

Table 3. Scheffe post-hoc results for preceding context F2

Multiple Comparisons						
Scheffe						
					95% Confidence Interval	
(I) PrecCode	(J) PrecCode	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Glide	Palatal	-1.581196	.650724	.317	-3.75491	.59252
	Velar	-.224587	.557525	.999	-2.08697	1.63780
	Labial	.615086	.564033	.946	-1.26904	2.49921
	Pause	1.110796	.601113	.637	-.89719	3.11879
	Alveolar	.219163	.556629	1.000	-1.64023	2.07855
Palatal	Velar	1.356609*	.391862	.036	.04761	2.66561
	Labial	2.196282*	.401068	.000	.85653	3.53603
	Pause	2.691991*	.451729	.000	1.18301	4.20097
	Alveolar	1.800359*	.390586	.001	.49563	3.10509
Velar	Labial	.839673*	.219654	.013	.10593	1.57341
	Pause	1.335382*	.302409	.002	.32520	2.34556
	Alveolar	.443750	.199874	.426	-.22392	1.11142
Labial	Pause	.495710	.314246	.778	-.55401	1.54543
	Alveolar	-.395923	.217368	.651	-1.12203	.33019
Pause	Alveolar	-.891633	.300753	.120	-1.89628	.11302

*. The mean difference is significant at the 0.05 level.

Table 4. ANOVA for following context for F1 and F2

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
F1-NORM	Between Groups	12.378	4	3.094	8.279	.000
	Within Groups	195.860	524	.374		
	Total	208.238	528			
F2-NORM	Between Groups	276.359	4	69.090	22.335	.000
	Within Groups	1620.914	524	3.093		
	Total	1897.273	528			

Table 5. Scheffe post-hoc results for following context for F1

Multiple Comparisons						
Scheffe						
					95% Confidence Interval	
(I) FollCode	(J) FollCode	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Palatal	Dental	-.163951	.165561	.913	-.67574	.34784
	Velar	-.094626	.204082	.995	-.72549	.53624
	Labial	-.190856	.132072	.720	-.59912	.21741
	Alveolar	.140567	.127110	.874	-.25236	.53349
Dental	Velar	.069325	.197883	.998	-.54238	.68103
	Labial	-.026905	.122275	1.000	-.40489	.35108
	Alveolar	.304518	.116897	.149	-.05684	.66588
Velar	Labial	-.096230	.170852	.989	-.62437	.43191
	Alveolar	.235193	.167045	.739	-.28118	.75157
Labia	Alveolar	.331424*	.060808	.000	.14345	.51940

*. The mean difference is significant at the 0.05 level.

Table 6. Scheffe post-hoc results for following context for F2

Multiple Comparisons						
Scheffe						
					95% Confidence Interval	
(I) FollCode	(J) FollCode	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Palatal	Dental	1.865476*	.476283	.004	.39317	3.33778
	Velar	.957259	.587101	.617	-.85761	2.77213
	Labial	2.253481*	.379942	.000	1.07899	3.42798
	Alveolar	.760404	.365667	.365	-.36996	1.89077
Dental	Velar	-.908218	.569267	.637	-2.66796	.85153
	Labial	.388005	.351758	.875	-.69937	1.47538
	Alveolar	-1.105072*	.336289	.030	-2.14462	-.06552
Velar	Labial	1.296222	.491504	.140	-.22314	2.81558
	Alveolar	-.196854	.480554	.997	-1.68236	1.28865
Labial	Alveolar	-1.493076*	.174931	.000	-2.03383	-.95232

*. The mean difference is significant at the 0.05 level.

Table 7. Mann-Whitney u-test for Position in Word

Ranks[a]				
	PosCode	N	Mean Rank	Sum of Ranks
F1-NORM	Initial	53	325.21	17236.00
	Medial	480	260.57	125075.00
	Total	533		
F2-NORM	Initial	53	179.15	9495.00
	Medial	480	276.70	132816.00
	Total	533		

Test Statistics[a,b]		
	F1-NORM	F2-NORM
Mann-Whitney U	9635.000	8064.000
Wilcoxon W	125075.000	9495.000
Z	-2.899	-4.376
Asymp. Sig. (2-tailed)	.004	.000

Table 8. Mann-Whitney u-test for Sex

Ranks[a]				
	SexCode_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Male	9	10.78	97.00
	Female	8	7.00	56.00
	Total	17		
F2NORM_mean	Male	9	6.44	58.00
	Female	8	11.88	95.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	20.000	13.000
Wilcoxon W	56.000	58.000
Z	-1.540	-2.213
Asymp. Sig. (2-tailed)	.124	.027
Exact Sig. [2*(1-tailed Sig.)]	.139[a]	.027[a]

a. Not corrected for ties.

Table 9. Mann-Whitney u-test for Ethnicity

Ranks[a]				
	LebCode_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Not_Lebanese	6	5.83	35.00
	Lebanese	11	10.73	118.00
	Total	17		
F2NORM_mean	Not_Lebanese	6	11.83	71.00
	Lebanese	11	7.45	82.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	14.000	16.000
Wilcoxon W	35.000	82.000
Z	-1.910	-1.709
Asymp. Sig. (2-tailed)	.056	.088
Exact Sig. [2*(1-tailed Sig.)]	.062[a]	.098[a]
a. Not corrected for ties.		

Table 10. ANOVA for Age at Immigration for F1 and F2

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.051	2	.026	.784	.475
	Within Groups	.456	14	.033		
	Total	.507	16			
F2NORM_mean	Between Groups	3.285	2	1.643	1.542	.248
	Within Groups	14.914	14	1.065		
	Total	18.199	16			
a. Vowel = ^						

Table 11. Mann-Whitney u-test for Religious Practice

Ranks[a]				
	ReligiousPractice_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Regular	8	9.63	77.00
	Sporadic	9	8.44	76.00
	Total	17		
F2NORM_mean	Regular	8	6.75	54.00
	Sporadic	9	11.00	99.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	31.000	18.000
Wilcoxon W	76.000	54.000
Z	-.481	-1.732
Asymp. Sig. (2-tailed)	.630	.083
Exact Sig. [2*(1-tailed Sig.)]	.673[a]	.093[a]
a. Not corrected for ties.		

Table 12. ANOVA for Future Plans

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.001	2	.000	.010	.990
	Within Groups	.506	14	.036		
	Total	.507	16			
F2NORM_mean	Between Groups	2.466	2	1.233	1.097	.361
	Within Groups	15.733	14	1.124		
	Total	18.199	16			
a. Vowel = ^						

Table 13. Mann-Whitney u-test for Ethnic Label Importance

Ranks[a]				
	EthnicLabel_mean	N	Mean Rank	Sum of Ranks
F1NORM_mean	Important	9	7.11	64.00
	Not_Important	8	11.13	89.00
	Total	17		
F2NORM_mean	Important	9	10.56	95.00
	Not_Important	8	7.25	58.00
	Total	17		

Test Statistics[b,c]		
	F1NORM_mean	F2NORM_mean
Mann-Whitney U	19.000	22.000
Wilcoxon W	64.000	58.000
Z	-1.636	-1.347
Asymp. Sig. (2-tailed)	.102	.178
Exact Sig. [2*(1-tailed Sig.)]	.114[a]	.200[a]
a. Not corrected for ties.		

Table 14. ANOVA for interaction of Sex and Ethnicity

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.119	3	.040	1.323	.309
	Within Groups	.388	13	.030		
	Total	.507	16			
F2NORM_mean	Between Groups	7.032	3	2.344	2.729	.087
	Within Groups	11.167	13	.859		
	Total	18.199	16			

Table 15. ANOVA for interaction of Sex and Religious Practice

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.148	3	.049	1.781	.200
	Within Groups	.359	13	.028		
	Total	.507	16			
F2NORM_mean	Between Groups	7.620	3	2.540	3.121	.063
	Within Groups	10.579	13	.814		
	Total	18.199	16			

Table 16. Scheffe post-hoc tests for sex and religious practice interaction for F2

Multiple Comparisons[a]						
Scheffe						
		Mean Difference (I-J)			95% Confidence Interval	
(I) SexRelig	(J) SexRelig		Std. Error	Sig.	Lower Bound	Upper Bound
Male_Reg	Male_Sporadic	-.24299	.60514	.983	-2.1787	1.6927
	Female_Reg	-.47826	.65880	.911	-2.5855	1.6290
	Female_Sporadic	-1.62689	.57053	.088	-3.4519	.1981
Male_Sporadic	Female_Reg	-.23527	.68899	.989	-2.4391	1.9686
	Female_Sporadic	-1.38390	.60514	.207	-3.3196	.5518
Female_Reg	Female_Sporadic	-1.14863	.65880	.418	-3.2559	.9587

Table 17. ANOVA for interaction of Sex and Ethnic Labels

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.150	3	.050	1.816	.194
	Within Groups	.357	13	.027		
	Total	.507	16			
F2NORM_mean	Between Groups	10.851	3	3.617	6.399	.007
	Within Groups	7.348	13	.565		
	Total	18.199	16			
a. Vowel = ^						

Table 18. Scheffe post-hoc test for interaction of sex and ethnic labels for F2

Multiple Comparisons[a]						
Scheffe						
		Mean Difference (I-J)			95% Confidence Interval	
(I) SexLabel	(J) SexLabel		Std. Error	Sig.	Lower Bound	Upper Bound
Male_Imp	Male_NotImp	-.15746	.50434	.992	-1.7707	1.4558
	Female_Imp	-1.83409*	.50434	.024	-3.4473	-.2209
	Female_NotImp	-.07821	.57422	.999	-1.9149	1.7585
Male_NotImp	Female_Imp	-1.67663*	.47550	.029	-3.1976	-.1557
	Female_NotImp	.07925	.54905	.999	-1.6770	1.8355
Female_Imp	Female_NotImp	1.75588	.54905	.050	-.0004	3.5121
*. The mean difference is significant at the 0.05 level.						

Table 19. ANOVA for interaction of Ethnicity and Religious Practice

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.094	3	.031	.989	.429
	Within Groups	.413	13	.032		
	Total	.507	16			
F2NORM_mean	Between Groups	7.399	3	2.466	2.969	.071
	Within Groups	10.800	13	.831		
	Total	18.199	16			

Table 20. ANOVA for interaction of Ethnicity and Ethnic Labels

ANOVA[a]						
		Sum of Squares	df	Mean Square	F	Sig.
F1NORM_mean	Between Groups	.199	3	.066	2.796	.082
	Within Groups	.308	13	.024		
	Total	.507	16			
F2NORM_mean	Between Groups	7.692	3	2.564	3.172	.060
	Within Groups	10.507	13	.808		
	Total	18.199	16			
a. Vowel = ^						

Table 21. Scheffe post-hoc tests for ethnicity and ethnic labels interaction for F2

Multiple Comparisons[a]						
Scheffe						
					95% Confidence Interval	
(I) LebLabel	(J) LebLabel	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
NotLeb_Imp	NotLeb_NotImp	1.71874	.77857	.232	-.7717	4.2091
	Leb_Imp	1.39441	.60308	.200	-.5346	3.3235
	Leb_NotImp	1.64825	.58031	.090	-.2080	3.5045
NotLeb_NotImp	Leb_Imp	-.32434	.75217	.979	-2.7303	2.0816
	Leb_NotImp	-.07050	.73404	1.000	-2.4185	2.2775
Leb_Imp	Leb_NotImp	.25384	.54438	.974	-1.4875	1.9951

Table 22. Initial mixed-effects model for F1

Type III Tests of Fixed Effects[a,b]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	347.920	6.421	.012
PrecCode	10	496.287	8.123	.000
FollCode	6	501.374	7.145	.000
PosCode	2	500.723	1.682	.187
SexCode	1	4.120	4.081	.111
ImmigBin	1	3.192	.193	.688
LebCode	1	2.942	2.906	.189
FuturePlans	2	4.734	1.969	.239
ReligiousPractice	1	3.797	.314	.607
EthnicLabel	1	4.559	.010	.924
SexCode * LebCode	0	.	.	.
SexCode * ReligiousPractice	1	3.298	1.485	.303
SexCode * EthnicLabel	1	3.815	8.958	.043
LebCode * ReligiousPractice	1	3.329	4.035	.129
LebCode * EthnicLabel	1	3.619	12.757	.028

a. Vowel = ^

b. Dependent Variable: F1-NORM.

Table 23. Final mixed-effects model for F1

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	50.866	19.948	.000
PrecCode	5	486.574	14.066	.000
FollCode	4	490.072	9.842	.000
PosCode	1	489.624	2.631	.105
SexCode	1	6.539	5.765	.050
ImmigBin	2	5.596	.786	.500
LebCode	1	5.100	2.265	.192
FuturePlans	2	7.330	2.083	.192
ReligiousPractice	1	6.071	.650	.451
EthnicLabel	1	7.629	.099	.761
SexCode * EthnicLabel	1	7.045	5.351	.054
LebCode * EthnicLabel	1	6.095	10.543	.017

Table 24. Initial mixed-effects model for F2

Type III Tests of Fixed Effects[a,b]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	111.468	24.289	.000
PrecCode	10	501.332	11.803	.000
FollCode	6	499.937	24.524	.000
PosCode	2	501.262	.416	.660
SexCode	1	4.149	2.138	.215
ImmigBin	1	3.923	.010	.925
LebCode	1	3.790	3.277	.148
FuturePlans	2	4.344	.710	.541
ReligiousPractice	1	4.050	7.045	.056
EthnicLabel	1	4.331	1.624	.267
SexCode * LebCode	0	.	.	.
SexCode * ReligiousPractice	1	3.901	3.000	.160
SexCode * EthnicLabel	1	4.090	7.227	.053
LebCode * ReligiousPractice	1	3.908	.412	.557
LebCode * EthnicLabel	1	4.016	.007	.939

a. Vowel = ^

b. Dependent Variable: F2-NORM.

Table 25. Final mixed-effects model for F2

Type III Tests of Fixed Effects[a]				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	24.300	128.109	.000
PrecCode	5	487.943	20.696	.000
FollCode	4	487.659	37.173	.000
PosCode	1	487.621	.000	.999
SexCode	1	6.143	3.333	.117
ImmigBin	2	5.743	.316	.741
LebCode	1	5.393	5.801	.057
FuturePlans	2	6.488	1.306	.334
ReligiousPractice	1	5.907	11.338	.015
EthnicLabel	1	6.440	2.743	.145
SexCode * ReligiousPractice	1	5.844	7.365	.036
SexCode * EthnicLabel	1	6.396	14.876	.007

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