This is to certify that the

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Diffusion of Urban Sound Change in Rural Michigan: A Case of the Northern Cities Shift

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Rika Ito

has been accepted towards fulfillment of the requirements for

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Major professor

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DIFFUSION OF URBAN SOUND CHANGE IN RURAL MICHIGAN: A CASE OF THE NORTHERN CITIES SHIFT

By

Rika Ito

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ABSTRACT

DIFFUSION OF URBAN SOUND CHANGE IN RURAL MICHIGAN:
A CASE OF THE NORTHERN CITIES SHIFT

By

Rika Ito

This dissertation examines the degree to which a new urban speech pattern, the so-called 'Northern Cities Shift' (NCS), has been accommodated to by rural mid-Michigan speakers. This study aims to provide adequate descriptions of the spread of the NCS within a rural community, focusing on individual differences and exploring possible explanations for such variation in terms of both linguistic (internal) and social (external) factors. The examination is based on a quantitative analysis with supplementary qualitative analysis of 36 sociolinguistic interviews. For quantitative analysis, the data are taken from a word list, and they are subjected to a computerized acoustic analysis. Due to the infancy of the NCS in rural Michigan, only the first step of the shift (i.e. fronting and raising of the low front vowel) is examined in this study.

With respect to linguistic factors, the data convincingly show that fronting precedes raising in the low front vowel shifting. The data also show patterns in the effects of adjacent segments, particularly manner of articulation of the following segment. It is concluded that rural speaker's accommodation to the NCS in the rural area is more or less determined by the phonetic facts. Thus, the results support arguments that the variation of

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the low front vowel is phonetically controlled (e.g. Callary 1975, Kieser et al. 1997, Labov 1994, Labov, Yeager, and Steiner 1972).

With respect to the effects of social factors, fronting is lead by the working-class and female speakers, and the differences are statistically significant. An age difference, however, is not observed. With respect to raising, there is not much variation across the speakers. Lack of any significant age difference suggests that the diffusion of this sound change is extremely slow in the rural area studied.

Based on a qualitative analysis of conversational data, it is suggested that fine differences in the advancement of the low front vowel raising is affected by individual orientation and identity, even though such accommodation takes place below the level of consciousness. Individuals who want to be associated with urban fashionable culture and do not mind leaving the community (i.e. less locally loyal individuals) tend to accommodate their speech more to the NCS, thus tend to have more raised low front vowels. Individuals who enjoy local country life and plan to stay in the area (i.e. more locally loyal individuals), however, tend to refuse to accommodate their speech. The former tend to be young females and the latter tend to be young males. Thus, this study supports Trudgill's (1986) proposals that the linguistic accommodation is important in the diffusion process and that diffusion takes at the level of individuals, i.e. attitudinal factors play a major role in diffusion at the micro level.

To my parents,

To my parents, Keiko and Yoshiyuki Ito, and my sister, Yumi Kato

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Minasan hontoo ni arigatoo gozaimashita.

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Chapter 1

INTRODUCTION

This dissertation examines the process of diffusion of linguistic changes: how and why linguistic innovations are spread in both linguistic and social dimensions. In order to explore such processes, this study investigates the degree to which a current urban sound change, the so called 'Northern Cities Shift' (here after NCS), has been accommodated to by rural mid-Michigan speakers. This study aims to provide adequate descriptions of the spread of the NCS within a rural community, focusing on individual differences and exploring possible explanations for such variation in terms of both social (external) and linguistic (internal) factors, based mainly on a quantitative analysis with supplementary qualitative analysis.

This first chapter describes the overview of this project and its rationale. It begins with a brief description of assumptions in the study of language change and variation, concerning the mechanisms of language change (1.1), then moves to the description of the phenomenon under investigation, the NCS (1.2). The issues related to the diffusion of linguistic change are outlined in 1.3. An outline of the present study is given in 1.4, and its goals are summarized in 1.5. A summary and the outline of this entire dissertation is given in 1.6.

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1.1 Assumption: the mechanisms of language change are two-fold

One of the ultimate goals of sociolinguistic research is to understand the mechanisms of language change. It has been proposed that such mechanisms are explained by both linguistic (internal) and social (external) factors (e.g. Labov 1972, 1994, Labov, Yeager, and Steiner 1972, Milroy 1993, Weinreich, Labov, and Herzog 1968). From the beginning of modern sociolinguistic studies, the importance of social factors has been emphasized. For example, Labov et al. (1972:3) state that 'linguistic theory must take social factors into account for a rational account of language change.' Milroy (1993) puts forward this position in a statement which clearly favors of social factors over linguistic factors:

> A linguistic change is a social phenomenon, and it comes about for reasons for marking social identity, stylistic differences and so on. If it does not carry these social meanings, then it is not a linguistic change...[N]o specific sound change is ever likely to happen at any particular time even when favourable structural conditions exist in the language (e.g. when it is regarded as 'natural')...It appears that for the change to take place it is necessary for the *social* conditions to be favourable (Milroy 1993: 231-2). (Emphasis as in original)

In last three decades, sociolinguistic research has successfully demonstrated how social factors are crucial in accounting for synchronic variation. It has discovered that parameters such as age, sex, social status, and ethnicity are important in understanding the heterogeneity in speech communities. From a different line of research, Milroy (1980) and Milroy and Milory (1992) show that the types and density of social networks in a local community are important factors in preserving a local dialect and introducing a new speech pattern whose origin is outside the community. In addition to the identification o

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identification of such parameters, some scholars have proposed explanations which underlie such factors. For example, Eckert (1989b), Labov (1990), and Trudgill (1972) explore the reasons for the sex (or gender) differences.

Although almost all sociolinguistic studies discuss the effects of social factors, relatively few studies pay as much attention to internal factors as to social factors, despite the fact that it is clearly understood that the mechanism of language change is two-fold. In the case of phonological variation, many studies simply describe linguistic variables themselves, or at most provide detailed description of phonetic variation. Attempts to explore possible linguistic explanations are still rare. This is also true in the study of the NCS.

1.2 The Northern Cities Shift

The NCS is one of the major on-going sound changes in the United States and has been examined for more than three decades (e.g. Callary 1975, Eckert 1988, 1989a, 1989b, 1991, Eckert and McConnell-Ginet 1995, Fasold 1969, Gordon 1997, Keiser, Hinskens, Migge, and Strand 1997, Herndobler 1993, Ito 1996, Ito and Preston 1998, Knack 1991, Labov 1994, 1996, Labov, Ash, and Boberg 1997, Labov, Yeager, and Steiner 1972). The NCS has attracted researchers partly because of its complexity and uniqueness. In contrast to other phonological variation (e.g. categorical consonantal variation such as t/d deletion and vowel mergers such as *cot/caught*), the NCS affects one's phonological system as a whole. In this sound change, six short vowels are rotating as a chain,[1] of which first step is fronting (or tensing) and raising of the low front vowel /æ/. Under the influence of the NCS, the word *bag* is pronounced as *beg* or even *big* and sometimes accompanied by the increase of duration and/or the development of an inglide. The fact that short vowels are shifting is unique, especially when sound change is viewed from a historical point of view, since it is long vowels that have under gone various diachronic changes (e.g. the Great Vowel Shift), not short vowels. Short vowels have remained relatively stable in other historical chain shifts in English. Thus, the NCS is referred to as 'a massive change that bears no resemblance to any chain shift previously recorded in the history of the [English] language' (Labov 1994:10).

As its name shows, this sound change is typically observed, (and has nearly been completed), in large cities in the North such as Syracuse, Rochester, Buffalo, Cleveland, Toledo, Detroit, Flint, Gary, Chicago, and Rockford (Labov 1996). Its effect on small communities between these cities is not as strong (Callary 1975, Labov 1994), as predicted by the gravity model for the diffusion of language innovations (Trudgill 1983:61). Because of this geographic pattern, the NCS is characterized as an essentially urban phenomenon (Labov 1994:178). (See Chapter 2 section 2.2.)

The other characteristic of this sound change is that it is a case of 'change from below' — in terms of both awareness and position in the socioeconomic hierarchy (Labov 1972). This means that although speakers

[1] Is it really a chain shift? See Gordon (1997) and Stockwell and Minkova

have altered their pronunciation, they are not aware of such modification, i.e. the operation is completely below the level of the speaker's consciousness. An interesting consequence of the lack of speaker awareness is the change's systematicity. In contrast to 'change from above' (e.g. Labov's (1966) classic study of 'r-lessness' in New York department stores), 'change from below' usually appears first in one's vernacular (or 'least monitored' speech), and, more interestingly, it represents the operation of linguistic (internal) factors (Labov 1972, 1994:78). Although systematicity is also realized at the macro-level (e.g. at the phonological level), here we focus at the micro-level, i.e. adjacent phonetic environment. Effects of adjacent segments have been explored in early studies (Labov et al. 1972, Callary 1975), but their examination is limited for various reasons (e.g. the number of the vowels examined, and the environments investigated). In addition, results from different studies do not agree with one another. The most two recent studies (Gordon 1997, Keiser et al. 1997) re-address the issue of the effects of adjacent segments, but their conclusions are completely opposite: one is skeptical of the systematicity of effects of adjacent segments, and the other supports such effects. Thus, for example, although following nasals are best known as a promoting factor for the first step of the shift (i.e. fronting and raising of the low front vowel, /æ/), as reported in Labov et al. (1972) and Keiser et al. (1997), this is not supported in Callary (1975) and Gordon (1997). (See Chapter 2 section 2.4.) Thus, a further analysis of the effects of adjacent segments is

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definitely needed. The second implication of 'change from below' is related to the innovators of such change. The most advanced speakers are apt to be upwardly mobile individuals, usually young females with the upper-working and lower middle class background (Labov 1994:156) and previous studies of the NCS confirm this tendency.[2] Recent studies conducted in Michigan (Gordon 1997, Ito and Preston 1998) show that the degree of modification of one's speech in the direction of this sound change indicates various aspects of an individual's identity, not only the ones related to such traditional variables as sex, status, and ethnicity, but also to such micro-level ones as attitude toward the local community — 'local identity' or 'local loyalty,' originally discussed in Labov (1963). (See Chapter 2 section 2.3.)

1.3 Issues which need to be explored — the process of diffusion

In spite of the popularity of the NCS among sociolinguists and the number of studies that have examined it, there remain gaps in our knowledge of the shift. The present study attempts to fill some of these. One of the main questions which needs to be addressed is how and why such an innovation spreads in both linguistic and social dimensions (c.f. the 'transition problem' (Weinreich et al. 1968)). As for the linguistic dimension, there are two levels of diffusion: one is at the macro (or phonological) level, at which the degree of advancement of the shift is concerned, and the other one is at the micro (or phonetic) level, at which the effects of adjacent segments are concerned (c.f. the implicational model of language change

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[2] Gordon (1997), however, finds interesting mismatch in his data.

(Bailey 1985)). As described earlier, the effects of adjacent segments are still unresolved, so detailed analysis of adjacent segments is needed.

The social dimension of the diffusion also consists of two levels: macro and micro (Trudgill 1986). Diffusion at the macro level concerns the diffusion in physical space, based on a demographic factor (i.e. the size of the communities) and a geographic factor (i.e. the distance from the center where original change has started). Thus the 'geographic diffusion model' or 'gravity model' predicts that the bigger the community and the closer it is to the center point, the more likely it is to be influenced by the change (Chambers and Trudgill 1980, Trudgill 1983). At the micro level, however, Trudgill admits our lack of knowledge.

> However, we obviously know much less about how the diffusion of linguistic forms takes place at the micro level. Clearly, if a linguistic feature has spread from one region to another, it must have spread from one speaker to another, and then on to other speakers, and so on. But how *exactly* are linguistic forms transmitted from one geographical area to another *at the level of individual speaker?* (Trudgill 1986:39) (Emphasis as in original)

Trudgill suggests that the best explanation for micro-diffusion lies in the theory of linguistic accommodation (cf. Giles 1973, Giles, Coupland, and Coupland 1991, and studies cited in Giles et al.), which is observed in face-to-face interaction. The basic concept of accommodation theory is that a speaker moves his/her speech pattern towards that of an interlocutor in order to gain the interlocutor's approval if the speaker wishes that approval (i.e. convergence), and 'the greater the speakers' need to gain another's social approval, the greater the degree of convergence there will be' (Giles et al.

1991:19). For example, one may reduce pronunciation dissimilarities (Gile 1973, cited in Trudgill 1986:2).[3] The opposite of convergence is divergence: a tactic of intergroup distinctiveness of individuals in search of a positive social identity (Giles et al. 1991:28). Thus, by diverging (or emphasizing one's own social communication style), members of an ingroup accentuate the differences between themselves and the outgroup members present (Ros and Giles 1979, cited in Giles et al. 1991:28) in order to value their identity. Trudgill notes that convergence is 'a universal characteristic of human behavior' (Trudgill 1986:2). Although Gile's study (1973) is based on short time accommodation, Trudgill suggests that it also works for long term accommodation, emphasizing the necessity for a positive 'attitudinal factor':

> In face-to-face interaction ... speakers accommodate to each other linguistically by reducing the dissimilarities between their speech patterns and adopting features from each other's speech. If a speaker accommodates frequently enough to a particular accent or dialect, I would go on to argue, then the accommodation may in time become permanent, particularly if attitudinal factors are favourable. The geographical parameter of diffusion models becomes relevant simply because, other things being equal and transport patterns permitting, people on average come into contact most often with people who live closest to them and least often with people who live furthest away. The demographic parameter becomes relevant because the larger the population of a city, the more likely an individual from elsewhere is to come into contact with a speaker from that city (Trudgill 1986:39-40).

Thus, Trudgill's position suggests that paying attention to individuals' attitudes should be a key to understanding diffusion at the micro level. Thus, it seems plausible that local identity plays a role in accommodation to the

[3] See Giles et al. (1991:7) for a list of studies on other features of convergence (speech rate, pausal phenomena, utterance length, and non-verbal cues such as smiling, gaze).

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NCS in a rural community. Local identity is recognized as a crucial factor in the process of variation in southern US speech (e.g. Feagin 1998, Hazen 1998).

1.4 The present study

As we have seen, previous studies have uncovered various aspects of the NCS, but there are still areas which need further investigation. In order to contribute to our understanding of the shift, this dissertation examines the process of diffusion of the NCS, i.e. how and why the urban sound change is spreading in a rural mid-Michigan community in both linguistic and social dimensions. In other words, it analyzes the degree to which the NCS has been accommodated to by rural mid-Michigan speakers, focusing on individual differences. In order to conduct sociolinguistic research 'faithfully,' both social and linguistic factors are equally valued and examined. In addition to providing adequate descriptions, the current study explores possible explanations for such variation based on both factors, employing mainly a quantitative analysis and a supplementary qualitative analysis.

A small community, Clare (approximately 140 miles from Detroit, and 90 miles from Lansing, population approximately 3,000, based on US Census 1990) and its surrounding towns, was chosen as the target speech community because it is assumed that the speech norm of the NCS has not spread much in these areas and because of its ethnic homogeneity (more than 98% of the residents are European American). Since most existing studies of the NCS were conducted in and around urban centers, the spread of the sound change in rural communities is understudied. In fact, for Michigan, nothing has been reported north of Lansing (except for a few speakers in Ito and Preston 1998). In addition, although modern sociolinguistic studies in the US have successfully documented urban dialect differences between majorities and minorities (e.g. European Americans vs. African Americans) in larger cities in the North for over three decades, rural speech communities in the North whose residents are not ethnically different from majorities have been neglected until very recently. The investigation of the diffusion of an urban sound change beyond cities enables us to capture a better picture of how a linguistic innovation is transmitted from one place to another.

The data examined here are from a larger data set — over sixty sociolinguistic interviews conducted by the researcher from October 1998 to April 1999. Thirty-six speakers (almost equally divided by age, sex, and status) were selected for the analysis. These speakers were chosen strictly on the basis of their native status in the community and ethnicity. As for their native status in the community, each speaker was required to meet the sampling criteria of having been born and raised in the community in order to eliminate other possible influences. As for ethnicity, both parents needed to be European Americans. For quantitative analysis, the data are taken from a word list (106 tokens for each respondent, 33 of which are of the low front vowel). All tokens are subjected to a computerized acoustic analysis that has allowed us to extract the first and second formant frequencies of each respondents' vowels, which are associated with the height and backness dimension of the vowel space, respectively. Because the NCS is a case of

'change from below,' the wordlist style does not prevent our eliciting vernacular speech (Ash 1999). Labov comments (personal communication) that wordlists are 'better' than conversational speech because speakers 'exaggerate' their speech in them. In addition, it enables us to manipulate the phonetic environments. Due to the infancy of the NCS in the area, only the first step of the shift (i.e. fronting and raising of the low front vowel) is examined in this study. A program for vowel system analysis and statistical tests (t-tests and analysis of variance — ANOVA) are used in order to assess the vowel spaces and the degree of fronting and raising of the low front vowel, although the use of ANOVA in this study is for experimental purpose. For qualitative analysis, relevant parts of the interviews are transcribed and used in the evaluation of the social orientation of individuals.

As for linguistic factors, first the degree of fronting and raising of the low front vowel is examined by comparing its relative position with reference to other vowels, such as /ɛ/ (the vowel of *bed*), /ɪ/ (the vowel of *bit*), and /i/ (the vowel of *beat*) within individuals in order to determine the degree of the macro-level of linguistic diffusion. Index scores are given based on the result of t-tests between the low front vowel, and the reference vowels (e.g. /ɛ/, /ɪ/ and /i/). Because each individual has a different vocal tract, comparison of absolute frequencies is not appropriate, and since normalization was deemed inappropriate (since it might have reduced some distinctiveness within some systems and exaggerated it in others), comparison of vowel systems was not

made across speakers except with reference to relative positions based on index scores.

As for the low level diffusion, we need to know whether adjacent segments are influential in low front vowel movement, although 'change from below' predicts that there should be such a systematic pattern. In order to test this, tokens of the low front vowels are coded based on the preceding and following segment. The following segments are further coded based on both point and manner of articulation. In order to analyze the micro level linguistic diffusion, index scores are calculated by means of t-tests between each subset of the low front vowel (based on the adjacent segments) and the reference vowels. Thus, the degree of effects of adjacent segments for the low front vowel movement is subject to elaborate acoustic and statistical examination.

Since adjacent segments will be shown to have some impact on the movement of the low front vowel, patterns are sought and possible phonological and phonetic explanations are explored. Although articulatory phonetics has been thought to provide reasons for the course of sound change — reflecting an idea of the speaker as a source of sound change (Jesperson 1949:15ff, Martinet 1964:169ff, Hale 1962, cited in Ohala 1981:178), the phonetic studies reviewed in this study are primarily acoustic and perceptual. Since the manner of articulation of the following segments is presumably the most effective factor in the shift (e.g. Labov 1994) and manner is believed to influence sound quality (Jennedy, Poletto, and Weldon 1994:53), prime focus

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is put on the manner of articulation of the following segments, although this does not mean that the examination of preceding segments as well as the point of articulation of the following segments will be ignored. In addition to acoustic and perceptual phonetics, phonological theory (such as the theory of syllable structure and assimilation) is also examined for explanation.

As for social factors, the difference in the degree of accommodation to the NCS is mainly examined based on age, sex, and social status, though density of local network (based on Milroy 1980) and socio-economic index (based on Warner 1960) are also considered. In addition, since the NCS is an urban phenomenon, the effect of 'local loyalty' is explored. The impact of local identity in synchronic variation was discussed as early as Labov's Martha's Vineyard study (1963), in which a positive attitude towards the local area was the strongest predictor for the centralization of the onset of /aw/ and /ay/, referred as 'islander loyalty.' As expressed earlier (section 1.3, page 8), it seems plausible that local identity especially plays a role in accommodation to an 'urban' sound change in a 'rural' community. Here, 'local loyalty' is evaluated based on the content of the interview in which respondents are asked to express their opinions toward their local community.

1.5 The goals of this study

The preceding discussion has identified a general view of the issues which are addressed in this present study. The following summarizes the goals of this study :

(1) To produce an adequate description of the variation of the initial stage of the NCS within a rural community in terms of both linguistic (internal) and social (external) factors.

Particularly,

(1a) To examine the degree to which adjacent segments (preceding and following, and, for following segments, both point and manner of articulation) are influencing the variation of /æ/ fronting and raising

(1b) To investigate the degree to which social factors (age, sex, and social-status) are influencing the variation of /æ/ fronting and raising. The variable 'local loyalty' is also considered.

(2) To explore possible explanations for such variation in terms of both social and linguistic factors.

1.6 Summary

This first chapter described the overview of this project, its rationale, and goals, including a brief illustration of the phenomenon under investigation, the NCS. In order to pursue the goals stated in this chapter, this dissertation is organized as follows. In Chapter 2, relevant previous studies are critically reviewed in order to identify not only their significance but also to reveal weaknesses which need to be explored. Chapter 3 illustrates the methods used in this study. Chapter 4 presents the main quantitative results. Chapter 5 evaluates the results, and seeks to understand what these results mean. The concluding remarks, including remarks on the limitations of this study and suggestions for future study, are given in Chapter 6.

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Chapter 2

PREVIOUS RESEARCH ON THE NORTHERN CITIES SHIFT

In this chapter, relevant previous research will be critically reviewed in order to identify not only its significance but also weaknesses which need to be explored. The first two sections review the Northern Cities Shift and its characteristics: the vowels involved in the shift and their chronological order (2.1), and the geography of the NCS and its urban characteristics (2.2). The later two sections focus on two factors which are the keys to understanding the mechanisms of language change: external (or social) factors (2.3) and internal (or linguistic) factors (2.4). It is hoped that this chapter will lead us to understand existing research on the Northern Cities Shift and the relevance of the present study with reference to it (=research).

2.1 Vowels involved and their chronological order

In the NCS, six short vowels are rotating as a chain: three front vowels (/ɪ/, /ɛ/and /æ/); two back vowels (/ɑ/ and /ɔ /); and the central vowel /ʌ/. As described below, the entire rotation was not recognized until Eckert's contribution on (ʌ)[1] backing in late 1980's. The first explicit recognition of this phenomenon was in Fasold's unpublished paper (1969). Based on Shuy, Wolfram, and Riley's (1966) Detroit survey, he discusses three shifts engaging fronting: (æ) raising, (ɑ) fronting, and (ɔ) fronting (cited in Labov 1994:178).[2]

The first step of the shift is raising and fronting of the low-front vowel /æ/ to a higher position, close to the /ɛ/ or even /ɪ/ region. After the low

[1] Phonetic symbols in the parentheses indicate that they are linguistic variables.
[2] Because of this work, Labov calls Fasold the 'discoverer' of this shift (Labov 1994:178).

front vowel leaves its low front position, the low-back vowel /ɑ/ moves forward. After the low-back vowel movement, /ɔ/ lowers and fronts into the position vacated by /ɑ/. In addition to these first three shifts, Labov, Yaeger, and Steiner (1972) identify lowering of /ɪ/ and /ɛ/ as parts of the NCS through the examination of data from Detroit (Shuy et al. 1966), Chicago, and the Buffalo area, including Rochester and a nearby small town, Chili. In the later stage of the shift, the mid-front lax vowel /ɛ/ lowers towards /æ/, and /ɪ/ lowers towards /ɛ/. In the 1980s, Eckert (1988 and elsewhere) reports two important facts on the latest stages of the shift which were not observed in the data from the 1960s or 1970s (Labov 1994:191). Based on her three years of participant observation in several suburban Detroit high schools, particularly two years in one high school, Eckert shows (1) two directions of (ɛ) shifting — lowering towards /æ/ and backing towards /ʌ/, and (2) (ʌ) moving towards /ɔ/, which completes the circular character of this change. Although the involvement of these six vowels in the NCS and the temporal ordering of the first three changes are well-accepted, the ordering of the last three changes is still not as precise as that of other more established sound changes such as that in Philadelphia (Labov 1994:195). For example, Labov (1994:195) suggests the following ordering.

(1) Changes near completion

1. Raising of /æh/ (= /æ/)[3]

Midrange changes

2. Fronting of /a/ (= /ɑ/)

3. Centralization and fronting of /oh/ (= /ɔ/)

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[3]Labov uses the following symbols: /æh/ (= /æ/), /a/ (= /ɑ/), /oh/ (= /ɔ/), /e/ (= /ɛ/), /i/ (= /ɪ/).

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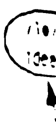

Figure 2.

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Labov admits that the ordering between lowering of /ɪ/ and /ɛ/ is still not clear (195). This concern is reflected in his 1996 proposal, which is illustrated in Figure 1.

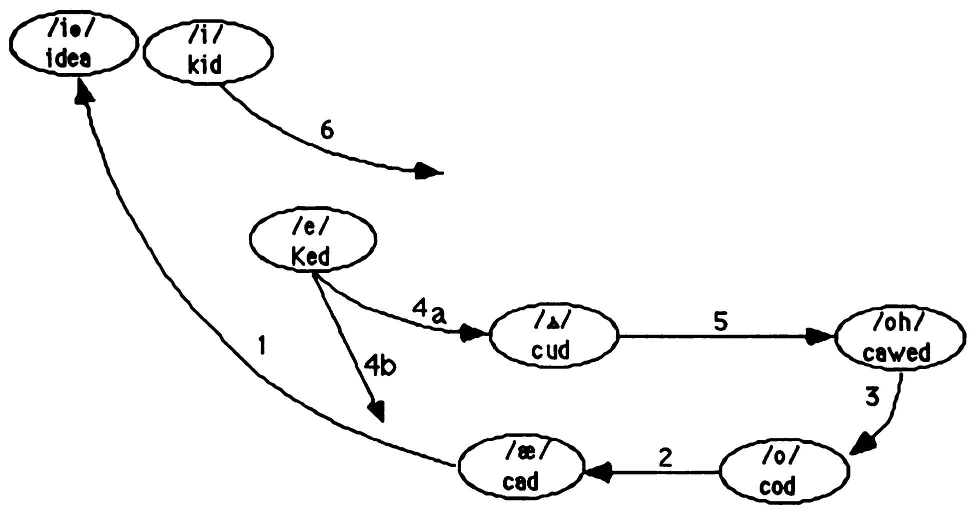

Figure 2.1: The Northern Cities Shift (based on Labov 1996)

Although raising of (æ) has been considered the oldest change (e.g. Labov 1994:195), a recent study challenges this assumption. Gordon (1997:295) proposes lowering of (ɔ) as the first step. He also questions the status of the chain shift itself. Although Gordon's suggestion is interesting, we do not have enough evidence, aside from his own results, to pursue his proposal. As we will see in a later chapter, raising of (æ) as the first change is linguistically more natural in the light of acoustic and perceptual phonetics studies, especially on the effects of following nasals in perceived vowel height

(Beddor 1982, Wright 1986): low nasalized vowels are perceived as higher than their oral counterparts and high nasalized vowels are perceived as lower than their oral counterparts. As we will see later in this chapter, a following nasal is the most established environment for low front vowel raising. These two facts cannot be just a coincidence. Johnson (1997:159-60) speculates that shifts in perceived vowel height due to nasalization can be 'the acoustic origin of vowel shift patterns.' Because of abundant supporting data from fieldwork as well as supporting evidence from acoustic and perceptual phonetic studies, Labov's proposal is more plausible than Gordon's. Therefore, the present study assumes Labov's proposal as a working hypothesis.

2.2 Geography of the NCS and its urban characteristics

The NCS is found throughout the industrial Inland North and is most strongly advanced in the largest cities (Labov, Ash, and Boberg 1997). The industrial Inland North is defined as in (2) in Labov et al. (1997).

(2) a. New York State (Binghamton, Syracuse, Rochester, Buffalo)
b. Northeast portion of Ohio bordering Lake Erie (Cleveland, Akron, Lorain, Elyria)
c. All of Michigan (Detroit, Ann Arbor, Flint, Grand Rapids, Kalamazoo)
d. Northwest Indiana bordering on Lake Michigan (Gary)
e. Northeastern Illinois (Chicago, Rockford)
f. Southeastern Wisconsin (Kenosha, Madison)
EXCLUSION: Erie (because of the merger of /ɑ/ and /ɔ/ and other features characteristic of Pittsburgh.)

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Among those cities, especially the largest cities, the patterns of vowel systems of the speakers are 'extraordinarily homogeneous,' in contrast to considerable differences among the large cities in the North Midland, such as Pittsburgh, Columbus, Dayton, Cincinnati, Indianapolis, Evansville, and St. Louis (Labov 1996).

The NCS is characterized as an urban phenomenon (Labov 1994:178), and many studies have documented its existence in the cities mentioned above. However, its urban characteristics are best illustrated in Callary (1975). His study is based on data from 18 first-year female college students who were born and raised in 18 different Northern Illinois counties. Each respondent represents a different county. If the nineteenth-century wave theory is valid in the contemporary setting, the height of (æ) will be predicted to decrease as the distance from Chicago increases. However, that is not what Callary finds in his data. Callary points out that there is a correlation between the degree of (æ) raising and increasing urbanization. For example, two speakers from the Iowa border counties, which are 160 miles away from Chicago, used raised variants as often or even more often than speakers from counties adjacent to Chicago (160). In addition, his data show that the most rural group (i.e. speakers from communities where population is less than 4000) has not participated in (æ) raising (161). Thus, Callary proposes a hypothesis that 'as community size increases, vowel height increases proportionately' (168).

In Michigan, Detroit and its suburban areas have been investigated since the 1960s. As for other larger cities, the so-called 'tri-cities,' i.e. Bay City, Saginaw, and Midland, are listed as under the influence of the NCS, (illustrated by the reversal of /æ/ and /ɛ/ position in vowel space) in addition to the cities mentioned in (2c) in *the Phonological Atlas of North America* (Labov 1996) based on telephone surveys. Other studies conducted in

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Michigan explore communities other than Detroit: Grand Rapids (Knack 1991), Paw Paw and Chelsea — along Interstate 94, the main highway linking Detroit and Chicago (Gordon 1997), and Ithaca, Mt Pleasant, and Roscommon — north of Lansing (Ito 1996, Ito and Preston 1998). These studies show that the NCS has been spreading not only in larger cities but also to their surrounding and rural areas. However, the degree of participation among speakers from rural areas is still limited to the earlier stages (Ito 1996, Ito and Preston 1998).[4]

2.3. External factors

Another characteristic of the NCS is that it is a case of 'change from below' (Labov 1994:98-99). That is, even though speakers are influenced by this sound change, they are unaware of it. For example, Labov and his associates find no dramatic style shift between word lists and reading passages and argue that that is one piece of evidence of unawareness among speakers (Labov et al. 1972:92). In addition, systematic differences between vowel systems of the younger generation and that of the older generation illustrate that it is an on-going change with the younger generation leading. As for social status and ethnicity, Herndobler (1993:147) points out that it is white, working-class females and sometimes young males who lead this sound change in northern Illinois. This minor difference in status identity in leadership has not caused extensive re-evaluation, however, since the middle of the status range, not the extreme, is seen as the leading group in every interpretation.

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[4] Gordon (1997) does not discuss the degree of participation of each speaker. Thus, we do not know how much the NCS has spread into the two communities which he investigated. It seems, however, he assumed that all six vowels have been influenced.

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In addition to these traditional social distributions that characterize 'change from below,' studies conducted in Michigan — especially more recent ones — identify variables which reflect more micro level differences among individuals, such as those which reflect speaker attitudes in terms of affiliations which reflect their social identity. These studies demonstrate the complexity of the interrelationship between linguistic change and the role of the speaker's identity. Among those, the work of Eckert (1988, 1989a, 1989b, 1991) seems to be the most influential.

Eckert focuses on the younger generation, particularly teenagers who are always early adopters of sound change in progress. Compared to children and preadolescents whose social identity and linguistic patterns are largely determined by family and their neighbors, teenagers are at the stage of being able to choose such social identities. She assumes that the acquisition of local phonological variation among teenagers is crucially involved with the search for and development of their own social identity (Eckert 1988:183). As mentioned in section 2.1, through two years of participant observation of one graduating class in a suburban Detroit high school, Eckert (1988, 1989a, 1989b, 1991) finds two directions of (ε)— lowering and backing — among high school students. Although socio-economic status is usually a powerful factor in sound change, that of the parents does not seem to have much direct effect on the individual's participation in the NCS among these teenagers. Instead, Eckert finds that two opposing class-based social categories in the high school, namely 'jocks,' who were school-oriented, and 'burnouts,' who were non-school oriented, are more crucial for these students: backing of (ε) was led by burnouts, while lowering was favored by jocks.

In addition to social category affiliation, Eckert (1989) explores the effects of gender — as a reflection of the social construction of sex, rather than

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mere biological sex differences — in this sound change. She points out that the role of gender is not uniform across all changes: for these high school students, fronting of (æ) and (ɑ) are 'sex markers,' (advanced tokens are used to express their femaleness), backing of (ɛ) and (ʌ) are 'social category markers,' (advanced tokens are used to express their social identity as burnouts), and fronting of (ɔ) is both (262). She concludes that the girls' greater differentiation of the new changes and their greater use of older changes are due to their greater need to use social symbols for self-presentation because, compared to boys, girls are deprived of access to real power (263-4).

Based on her fieldwork involving 33 upper-middle class speakers in Grand Rapids, Knack (1991) shows the role of ethnicity and network in determining participation in the NCS. Knack argues that non-participation in (ɔ) lowering serves as identification of Jewishness in the upper-middle Jewish community. This variable was chosen because of its bi-directionality: (ɔ) undergoes lowering and fronting in the NCS, whereas it is raised and backed among New York Jews, to whom many Grand Rapids Jews have personal connections. Her interviews and post-interview questionnaires of nine Jewish women and eight Jewish men, Gentile women, and Gentile men, elicit the respondents' network (such as involvement in religious activities and organizations as well as business and friendship), and social concerns related to ethnicity. Knack finds that male speakers participate more in lowering and fronting than women, while women participated in raising and backing more than men, which seems to be at odds with what we expect. Knack argues that this is due to differences in networks between men and women: men, who have greater contact with the Gentile community, lead in lowerin

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lowering, and women, who have greater involvement within the Jewish community, lead in raising and backing (256).

Both Eckert and Knack's studies were carried out in larger cities in Michigan. The studies conducted in late 1990s start exploring the spread of the NCS outside of these focal areas.

In order to investigate diffusion process of NCS outside larger cities, Gordon (1997) compares the residents of two small communities, Chelsea and Paw Paw (populations 3,772 and 3,169, respectively[5]), which are situated along Interstate 94, the main highway linking Detroit and Chicago. As Chelsea is much closer to Detroit than Paw Paw, which is halfway between Detroit and Chicago, Gordon originally expected that the NCS changes would be much better established in Chelsea than in Paw Paw, as the wave theory predicts. However, the result of the analysis of 32 interviews was the reverse: Paw Paw residents are more advanced than Chelsea residents. The degree of advancement in four out of the six NCS vowels is significantly different between the respondents of these two towns, and, in every case, Paw Paw speakers lead (250). Gordon considers reasons behind such resistance to the NCS among Chelsea speakers. He finds it in negative feelings toward the newcomers from cities like Ann Arbor, which were expressed in interviews among Chelsea respondents. Gordon speculates that conservative forms might serve as a symbol of some aspect of 'native Chelsea identity,' which is parallel to the use of diphthongization to symbolize native island identity among residents of Martha's Vineyard (Labov 1963) (254). In short, avoidance of a new incoming change is associated with urban centers for Chelsea residents, but assertion and even exaggeration of localized features was used

[5]Population figures are from 1990 US Census.

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by Martha's Vineyard residents (255). A similar pattern is observed in Ito and Preston (1998).

In our pilot study, Ito and Preston (1998) examine the spread of the NCS in rural northern Michigan by analyzing three pairs of teenagers and their mothers from Ithaca, Mt. Pleasant, and Roscommon. The data were subjected to acoustic analysis, involving extraction of first and second formant frequencies and calculation of the means of the first three NCS vowels — (æ), (ɑ), and (ɔ). Comparison between the relative positions of each vowel within a vowel space and relative positions of each vowel with reference to an assumed 'pre-shifting' vowel space (Peterson and Barney 1954) is used in order to assess the degree of participation in the NCS. Geographic factors, such as the size of the town and the distance from major city did not uniformly have the expected influence. Contrary to the prediction, the most advanced speaker among the six was a girl from Roscommon, the smallest and the most northern place (476). Through the examination of interviews, we find that this girl is not interested in local, small-town life; instead she wants to get out there as soon as possible. In contrast, a teenage girl from Mt. Pleasant, who is not as advanced, enjoys small-town life and is planning to remain in the area. Thus, we suggest that along with other traditional social variables, personal orientation as expressed in local loyalty plays a role in predicting degree of participation in the NCS. Speakers who have less local loyalty are more advanced in the shift (479), which is compatible with Gordon's (1997) finding.

As reviewed above, the participation in this sound change in progress is not arbitrarily determined. Instead, it reflects every aspect of an individual's identity: ascribed personal characteristics, over which individuals have the least control (e.g. age, gender, and ethnicity) as well as

acquired characteristics (e.g. status, group membership, and individuality, such as local identity) (Preston 1989:119). As revealed in earlier studies, age, gender, geography, and social status are important factors in predicting participation in the NCS. Group membership (cf. Eckert) and an individual's attitude toward local community (cf. Gordon, Ito and Preston) will make further fine distinctions among speakers in a speech community regarding their participation in such on-going changes as the NCS.

2.4 Internal factors

The effects of linguistic factors are emphasized in earlier studies, such as Labov, Yaeger, and Steiner (1972), and Callary (1975). Labov et al. discuss not only micro level issues such as the effects of adjacent segment, but also macro level issues such as phonological systems. However, linguistic factors are not discussed much after these early studies. Recent studies have refocused on the issues of adjacent segment (e.g. Gordon 1997; Keiser, Hinskens, Migge, and Strand 1997), although the conclusions are very different. As a result, in contrast to extended studies on the effects of social factors, internal factors, especially the effects of the adjacent segments on the movement of each vowel, have been understudied. Our knowledge is limited to some of the favoring adjacent segments — mostly following segments — and only in earlier stages of the shift, i.e. low front vowel shifting, except Gordon (1997). In addition, most studies describe just the linguistic variables themselves or at most give a precise description of phonetic variation rather than proposing any explanation behind such variation. Thus, we need to study whether these environments are arbitrarily chosen by speech communities or whether there is some possible phonetic/phonological motivation behind these choices. In this section,

instead of cataloging all the discussion of adjacent segments for all six vowels, the review will focus mainly on the environments for low front vowel shifting.[6]

Labov and his associates (1972) argue mainly for the effects of following segments. They report that raising of (æ) in the northern cities has much simpler selectional rules than that of New York City: all (æ) can be raised in the NCS although those before voiceless stops are least likely to be raised (75). The relative degree of effect with respect to the following segments which favor (æ) raising is proposed as the following.

(3) The relative effects of the following segment for (æ) raising:

nasal > stop > fricative (Labov et al. 1972)

The most favored environment, following nasals, is parallel to the vowel shift in New York City, as well as that of other places in which the low front vowel is raised. However, the order of lower ranks (i.e. stops and fricatives) in the northern cities is opposite to that of New York City: following stops favor raising more than fricatives in northern cities, while fricatives favor raising more than stops in New York City. There are some ranking differences even among northern cities. While velar stops are favored in raising among Chicago speakers, their effect is the reverse among Buffalo and Detroit speakers (80). In addition, the relative effects of different stops are proposed as (4). Because of insufficient number of tokens, voiced counterparts were not examined.

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[6]Interested readers may see section 2.2.2 in Gordon (1997) and his results (chapter 5 and 6).

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(4) Relative effects of following stops for (æ) raising:

tʃ > t > p > k (Labov et al. 1972)

This ordering suggests that point of articulation also plays a role in the advancement of raising. /tʃ/ and /t/, which are articulated in the front portion of the mouth, promote raising while velar /k/ is the least favored segment. This ordering, however, is not absolutely rigid across speakers. The reverse orders between two adjacent environments (such as p > t, and t > tʃ) are also observed among some speakers from Buffalo and Detroit (83).

As for the preceding segments, only one environment is identified as having significant impact, namely initial liquids or liquid clusters (e.g. *lap, black, grand*) which disfavor raising (81). Thus, following nasals and preceding liquids or liquid clusters are identified as the most favored and the most disfavored environments for the vowel shift, respectively.

Callary (1975) takes a strong position in terms of the effect of preceding environment. He states that the preceding environment is 'apparently irrelevant' in (æ) raising (1975:162). Callary finds the dominant role in the following velar: '/æ/ is raised first before velars and only then before alveolars and labials' (162). He does not find the strong effect of following nasals as Labov and his associates observed (162). In addition, he reports on the relative influence of voicing for stops: voiceless stops promote raising before voiced ones (161).

Labov (1994) proposes a more elaborated relative order than that of his and his associates' early proposal, as shown in (5).

(5) The relative degree of advancement for raising and fronting of the low front vowel (æ)

The manner of articulation of the following segment:

nasals > voiceless fricatives > voiced stops > voiced fricatives > voiceless stops

The point of articulation of the following segment:

palatal > apical > labial, velar (Labov 1994:100)

Labov includes the relative effects of the point of articulation of the following segment in addition to the effects of the manner of articulation. For example, (æ) shifting is most advanced in the following palatal environment, while least advanced in labial and velar environments. Although fine differences among obstruents are proposed in terms of voicing, the relative order does not coincide with Callary's proposal.

The effects of adjacent environments for vowels other than (æ) have been briefly discussed for the effects of following segment, mainly voiceless stops in (ɑ) and (ɔ) shifting in Labov et at. (1972), preceding labials in (ʌ) shifting in Eckert (1988), and following /l/ in (ɛ) shifting in Eckert (1991). However, these findings cover only a few salient environments. In addition, none of the studies examines the effects of adjacent environments for (ɪ) lowering. Thus, although the impact of adjacent segment is expected, no study has described the whole picture.

In order to overcome this shortcoming, Gordon (1997) conducted the first complete analysis for all six NCS vowels of the effects of adjacent segments both preceding and following, in terms of the point of articulation as well as the manner of articulation. The data are subjected to statistical analyses in order to determine the relative effects of each segment. The results for (æ) are reproduced in (6).

(6) Gordon's (1997) results for the phonological condition of (æ)-shifting

FAVORED BY:	DISFAVORED:
preceding voiceless	preceding alveolar
preceding velar	**preceding palatal**
preceding stop	preceding /l/
following interdental	**preceding /r/**
following nasals	following voiced
following /l/	following palatal
final syllable	following velar
	following fricative
	4+Syllable words
	medial syllables

Categories shown in boldface are those for which the phonological index score was outside one standard deviation of the overall score. (Gordon 1997:198)

Gordon finds that the effects of preceding contexts also have significant impact of shifting for every one of the NCS vowels in addition to following segments (230). His data confirm that following nasals promote shifting although their impact is not 'as strong as suggested by earlier researchers' (242). As for the effects of place differences, Gordon examines all consonants rather than just the voiceless stops as in Labov et al. (1972) and Callary (1975). A hierarchy similar to that proposed by Labov et al. is offered with an exception: following palatals are identified as the least effective promoters of shifting (Gordon 1997:228). However, he reports that 'none of the indices associated with these place differences were exceptional' (228). Gordon identifies interdentals as one of the most favoring environments, which has not been discussed in other studies. As for the preceding context, Gordon's data confirm that liquids are a disfavoring environment, which corresponds with the fin

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with the finding of Labov et al. Between two liquids, preceding /r/ disfavors shifting more than preceding /l/ (228).

Gordon points out that some of the results coincide with articulatory as well as acoustic explanations. For example, preceding and following palatals and velars disfavor shifting, especially backing of (ɛ), because of the following reasons:

> Palatals are produced with a front tongue body position as are phonemic velars (in English) when adjacent to front vowels like /ɛ/, and these front articulations might be expected to discourage any backing tendency. A comparable acoustic account might also be offered. Front tongue body positions are associated with a high F2 frequency, and the F2 transition into or out of vowels flanking consonants with such articulations (i.e. fronted "velars" or palatals) will be relatively high. These transitions may influence perceived vowel quality, particularly in vowels of short duration where the transitional period represents a greater portion of the vocalic signal (Olive et al. 1993:347). Because backing of (ɛ) involves a decrease in F2, it is, it seems, less likely to occur in an environment marked by high F2 frequencies (Gordon 1997:238).

However, this type of account faces difficulties in explaining (æ) shifting. Although palatals and velars are expected to promote (æ) shifting, three of the four environments (i.e. both preceding and following palatals, and following velars) disfavor shifting of this vowel. Similar discrepancies are observed in terms of the effects of other places as well as manners of articulation, such as the effects of nasals and liquids.

As for preceding liquids, Gordon finds very interesting patterns in their effects and the directions of the shift: preceding /l/ and /r/ favor (ɛ), (ʌ), and (ɪ) shifting, mainly characterized as backing movements, while they disfavor (æ), (ɑ), and (ɔ) shifting, mainly characterized as fronting movements. However, this pattern does not hold as neatly for following /l/. This environment favors shifting of all vowels except (ɔ), which is slightly disfavored, and (ʌ), for which there are not enough tokens to evaluate. He speculates that the different effects of /l/ lie in the distinction of 'light' and 'dark' /l/, where the former occurs in prevocalic position and the latter characterized as a velarized variant, occurs in postvocalic position. However, the phonetic account of this connection remains unclear: even though the following /l/ is predicted to disfavor the shift involving fronting (such as (æ) and (ɑ) shifting) because the effect of lowering F2 is expected more in dark /l/ than in light /l/, such a pattern was not observed in his data (241).

As for nasals, he points out the effects of nasalization in perceived vowel height based on the research of Beddor (1991). From an acoustic perspective, nasalization introduces nasal formants in addition to oral formants. The frequency value of the nasal formant with respect to F1 affects the perception of vowel height, i.e. the frequency value of F1. (See the following section for a detailed discussion.) Thus, Gordon predicts 'nasals will promote raising of low vowels (because these are characterized by a high F1) and promote lowering of high vowels (because these are characterized by a low F1)' (242). However, he is not convinced by this acoustic/perceptual explanation.

Because of these inconsistencies, Gordon states that 'the results are only weakly or partially consistent with phonetically based predictions, and there are other cases for which it is difficult even to arrive at predictions' (242). Therefore, he concludes that phonetic motivation is 'unexpectedly little' and even questions its existence (275).

Gordon's data do make it very difficult to provide straightforward explanations for each case of shift for each of the six vowels. However, this should not be interpreted as evidence of the non-existence of phonetic and/or phonological motivation. We may not be able to account for every single case from the m

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from the most favoring effect to the least with respect to the first (i.e. the oldest) step of the shift to the most recent one. However, we should be able to address some general patterns of influence on this on-going change. It is not logical to imagine that favoring environments are arbitrarily chosen. There should be some general principles which govern variation in the NCS.

Some attempts have been made to explore the reasons behind the linguistic factors. Keiser, Hinskens, Migge, and Strand (1997) approach the problem of linguistic factors in a quite distinctive way. Whether raising and fronting of (æ) in Columbus, Ohio, due to the NCS or something else is hard to argue, since the area is outside the NCS region, and especially in view of lack of evidence for fronting of (ɑ). However, it can be understood as evidence of the NCS in its infancy in the area (Keiser et al. 1997:60). The researchers' focus on exploring linguistic factors is clear: their analysis is based on data gathered from local radio on-air personnel (two males) in Columbus, Ohio, and only two social factors (social status and style) are examined. They provide detailed acoustic phonetic and phonological analysis with careful selection of statistical tests, although their analysis is limited to (æ) raising and fronting. The eight factors used by Keiser et al. are reproduced in (7). These are related to various linguistic levels: phonetics, phonology (such as syllable and stress), morphology and lexical class or lexicon.

(7) Internal factor groups for the tensing and raising of /æ/ (Keiser et al. 1997:56)

a. membership in *mad, bad, glad* lexical class
- belong to class
- end in *-ad* but are not *mad, bad, glad*
- other

b. grammatical category[7]
- preterit strong verb
- preterit irregular verb
- preterit regular (weak verb)
- non-verb

c. right-hand morphological boundary
- word
- Class 1 suffix[8]
- Class 2 suffix
- inflectional suffix

d. proximity to right-hand word boundary, measured in terms of syllables

e. stress
- stressed monosyllabic word
- primary
- secondary

f. preceding phonetic segment(s) (in the case of a morpheme-internal cluster, all segments of the cluster were noted)

g. following phonetic segment

h. syllable membership of the following consonant
- following consonant(s) in the same syllable ('tautosyllabic')
- following consonant shared with the next syllable ('ambisyllabic')[9]

Keiser et al. find that not all these factors are statistically significant for the vowel shift. They identify two different sets of factors: following nasals and word stress for raising, and following nasal and syllable membership of the

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[7] Examples of preterit strong verbs are follows: *ran*, *swam*, and *began*. This class of words was neither tensed or raised in Philadelphia. No tokens of irregular preterit verbs were found in the data.

[8] From O'Grady, et al (1997:132-3), 'Class 1 affixes are characterized by the fact that they often trigger changes in the consonant or vowel segments of the base and may affect the assignment of stress [i.e. *-ity, -ive, -ize, -ion*]...In contrast, Class 2 affixes tend to be phonologically neutral, having no effect on the segmental make up of the base or on stress assignment [i.e. *-ness, -full, -ly, -ish*]' (Keiser et al 1997:56 footnote 19).

[9] 'On phonetic grounds alone, it seems impossible to decide whether the consonant following /æ/ in words such as *planet*, *flannel*, *personality*, and *California* is ambisyllabic, or instead falls in the onset of the following syllable. At least in the lexical representation, lax vowels are not allowed in open syllable in English (or in other Germanic languages such as Dutch and

following consonant and tensing, respectively. Thus, the effect of following nasals, which has been argued as the most favorable phonetic environment from such early studies as Labov et al., is confirmed as the main predictor for both dimensions of the shift: tensing and raising of (æ). Although the remaining two factors — word stress for raising and syllable membership of the following consonant for tensing — are not identical, Keiser and his associates point out that they are not entirely unrelated because both of them pertain to prosodic organization (65). Thus, Keiser and his associates strongly support the argument for the phonetic and phonological motivation behind the vowel shift.

As summarized above, even in early studies, some linguistic environments, such as following nasals, are recognized as promoting factors. However, researchers have not yet agreed on this point. The two most recent studies (Gordon 1997, Keiser et al. 1997) reach completely opposite conclusions on the effects of linguistic factors: one doubts phonetic/phonological motivation and the other sees a strong possibility of phonological motivation, especially with respect to sonority values and prosodic organization. I will take the position in favor of the existence of the effects of phonetic/phonological factors. There are at least some studies which support such an argument (Callary 1975, Eckert 1991, Ito 1998).

When he examined the geographical diffusion of the NCS, Callary (1975) found that people in rural areas started raising the low front vowel

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German, for that matter)' (Keiser et al 1997:56 footnote 20).

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only in the most established environment: 'the least urban group is only now beginning to participate in the change and it is following the phonetic route most closely adhered to by the more urban groups — /æ/ is raised first before velars and only then before alveolars and labials' (162). His finding suggests that these favored environments are the same across social groups (in his study, those determined by geography); the less advanced group follows the same path as the more advanced group does.

Eckert (1991) investigates a relationship between linguistic constraint and the development of social constraint. She argues that 'the development of social constraints in a change begins with a strong phonetic constraint' (226) and that it is due to perceptual saliency: '[t]he change becomes noticeable only when it spreads to other environments, and only then does it become a potential carrier of social meaning' (225). She illustrates this in her discussion of (ɛ) shifting. Although there is a significant difference between jocks and burnouts in backing of (ɛ) to [ʌ], with burnouts leading, there is no significant difference between these two groups before /l/, in spite of the fact that this is the 'most highly constrained environment' (225). In fact, jock girls lead slightly in this environment, whereas burnouts use the alternative backed and lowered variant [ɑ] (225). She argues that backing in this environment is not salient enough, due to the assimilation effect which masks the perception of the vowel. This lack of perceptual saliency leads to a difference in backing of the vowel between two opposing groups: jock girls use the environment for backing because it is safe due to natural linguistic processes, while burnout girls avoid

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Figure 2.2.

girls avoid it because it is not as noticeable as it should be, so that they seek a 'more noticeable alternative' (225). Eckert's study suggests that people can access such facts as what natural linguistic processes are regardless of their conscious knowledge and that they skillfully manipulate these linguistic facts in order to mark their social differentiation.

Another piece of evidence is given in Ito (1998) where I proposed that the favored environment for low front vowel raising, namely following nasals, is not arbitrarily chosen but may arise because of the acoustic and perceptual nature of nasalized vowels, an interpretation proposed by Beddor (1982, 1993) and Wright (1986). Studies of nasalized vowels are reviewed here because a following nasal changes the preceding vowel into a nasalized vowel in English (Ladefoged 1982:87).

Beddor aims to discover universal patterns of nasal vowel height shifts in order to reevaluate the major proposals concerning the influence of nasalization on changes in vowel height. Through an investigation of synchronic phonological processes in 75 languages, she proposes a unified analysis consisting of five regularities. A summary of her survey is seen in Figure 2.2.

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High nasal vowels: Lower

Low nasal vowels: Raise

Mid nasal vowels
- Non-contextual: Lower
- Contextual
  - Back: Raise
  - Front: Lower (unless the mid 'back' vowel is raised in that language, in which case 'both' front and back vowels raise).

Figure 2.2: Cross-language patterns of nasal vowel raising and lowering of 75 languages (Beddor 1982)

Beddor finds that the height of the vowel is crucial in identifying the direction of changes in vowel height due to nasalization. That is, (a) high nasal vowels are systematically lowered, (b) lower nasal vowels are raised, and (c) mid vowels show regularities if vowel backness and context are taken into account. Thus, Beddor uncovers the fact that lower nasal vowels are systematically raised through phonological processes across the 75 languages, despite the fact that they are geographically distant and genetically unrelated.

In order to find explanations for such patterns, Beddor seeks reasons in acoustic and perceptual aspects, rather than articulatory, of phonetics. She focuses on acoustic characteristics of vowel nasalization since nasal vowels are phonetically more complex than their oral counterparts, due to the nasal coupling which introduces the nasal formant. Although the difference between oral and nasal vowels is found in the frequency, amplitude, and bandwidth of oral formants, the most marked differences typically occur in the first formant region, for the following reasons: (1) the vowel height dimension is

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dimension is inversely related to F1 frequency, and (2) the nasal formant (hereafter FN) appears in or around this region. That is, when two formants occur within a critical frequency range (about 3.5 Bark, where 3.5 Bark is roughly equivalent to 425 Hz), perception of their height and backness appears to involve calculation of the center, which is referred to as the 'center of gravity' (COG) effect (Chistovich et al. 1979, Beddor 1982:180-1). In other words, when FN and F1 occur close to each other, human ears may not be able to distinguish them. The perception of vowel height corresponds roughly to the average of the F1 region, rather than the F1 peak. Thus, despite the correlation between tongue height and the location of the first formant, the perception of vowel height is not solely determined by F1. Beddor suspects that the COG effect predicts perceptual vowel raising if F1 is greater than FN and perceptual vowel lowering if F1 is less than FN. Figure 2.3 schematically represents the relation between FN and F1 with respect to perceptual vowel height due to the COG effect.

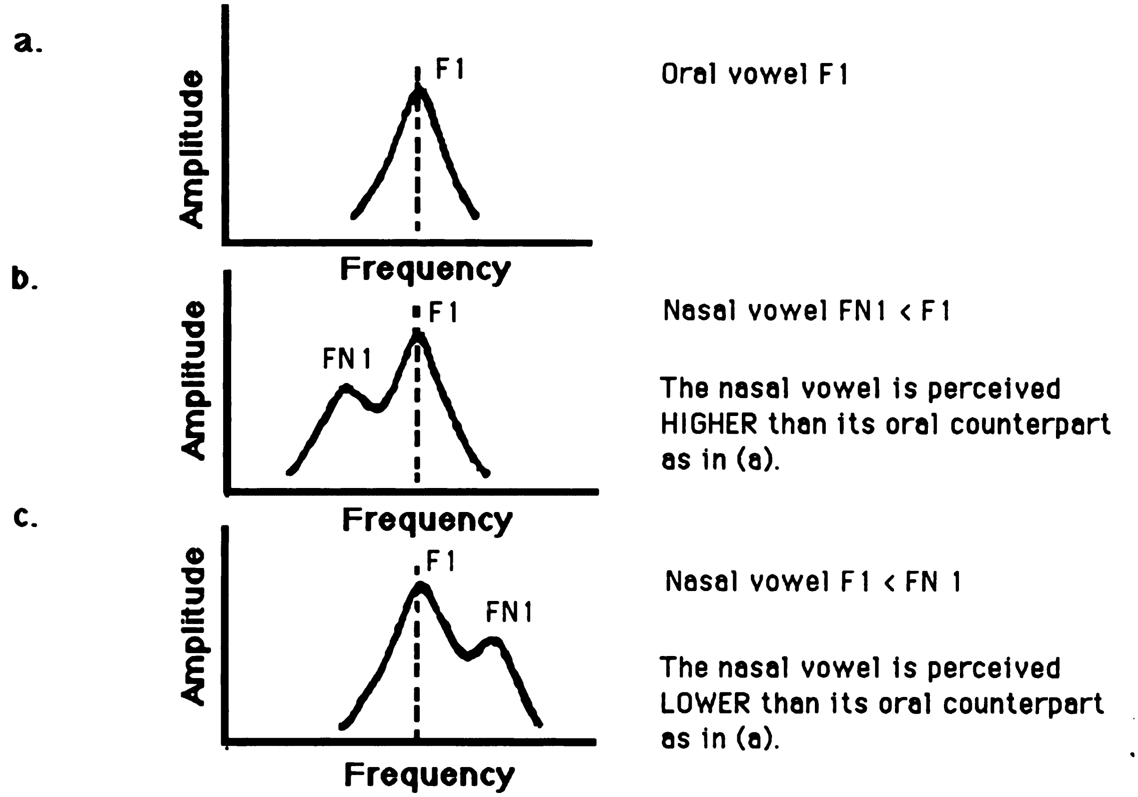

Figure 2.3: Schematic representation of F1 of oral (a) and FNs of a nasal vowel (b and c) (based on Beddor 1982:181)

That is, a nasal vowel is perceived higher than its oral counterpart when the frequency value of FN is less than that of F1 as represented in Figure 2.3b. In contrast, a nasal vowel is perceived lower than its oral counterpart when the frequency value of F1 is greater than that of FN as represented in Figure 2.3c.

In order to test this effect, Beddor conducted an acoustic study, involving the measurement of vowel tokens produced by two native speakers each of English, Turkish, Hindi and Igbo[10] and compared the acoustic characteristics of oral and nasal vowels by using two types of spectral analysis: a fast Fourier transform (FFT) and an autocorrelation linear predictive coding

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[10] These languages were chosen based on several criteria -- genetic affiliation (English and Hindi are Indo-European languages, Turkish is Altaic, and Igbo belongs to the Niger-Congo family), and most importantly vowel inventory, i.e. the number and height of vowels in the systems.

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(LPC) analysis. As for low front vowels, English and Hindi tokens were used because Turkish and Igbo do not have those vowels in their vowel inventory. She measured the F1 and FN, and calculated the average frequency of both, i.e. the COG effect, referred to as the 'centroid' — 'the center frequency of the area under the spectral curve within the frequency range of 100-1100 Hz.'[11] If a simple phonetic explanation exists for raising and lowering pattern of nasal vowels across languages, then F1 would have been higher in nasal than in oral vowels for the pairs of high vowels, but lower in nasal than in oral vowels for the pairs of low vowels in every language. However, in general, she did not find a consistent oral-nasal difference in F1 frequency. Rather, her data show that there were consistent oral-nasal differences in most vowels only when the centroid of vowels (rather than F1 alone) was taken into consideration. The general patterns of oral versus nasal centroid frequency confirm Beddor's argument, and it is important only to note that the centroid value for the nasal low front vowel was consistently lower than that of its oral counterparts, resulting, of course, in 'vowel raising.' These patterns were also true for the phonemic nasal vowel centroids. In Hindi, which has a phonemic nasal low-front vowel, there was no effect of context on acoustic measurements; that is, the phonemic nasal was already 'positioned' by its inherent nasality and did not differ from a oral vowel (in its nasal context) as regards its F1/FN and centroid frequencies. Thus, Beddor concludes that the acoustic characteristics of nasalized vowels explain differences in vowel height in phonological systems in various languages.

Wright conducted a study of perceptual vowel space which demonstrates that his American respondents perceived low nasal vowels as higher than their oral counterparts and perceived high nasal vowels as lower

[11] See Beddor (1982:200-1) for the justification of this decision.

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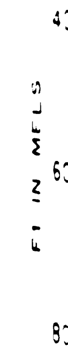

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than their oral counterparts, although all nasal-oral pairs were produced with approximately the same tongue configuration. Figures 2.4 and 2.5 represent the F1 and F2 values of the stimuli and the results of the perceptual study, respectively.

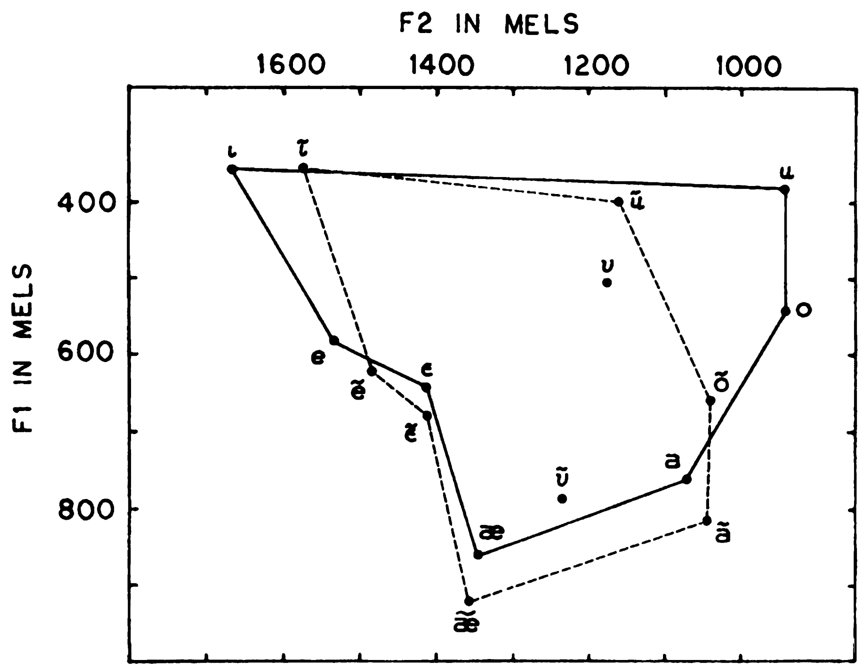

Figure 2.4: F1 versus F2 plot of the mel values of the stimuli (Wright 1986:58)

Figure 2.4 reveals that nasal vowels are PHYSICALLY lower than their oral counterparts, except for the high front vowel. However, as illustrated in Figure 2.5, Wright's respondents judged lower nasal vowels as higher than their oral counterparts and judged higher nasal vowels as lower than their oral counterparts, despite the acoustic facts illustrated in Figure 2.4. This perceptual space corresponds to Beddor's cross-language patterns.

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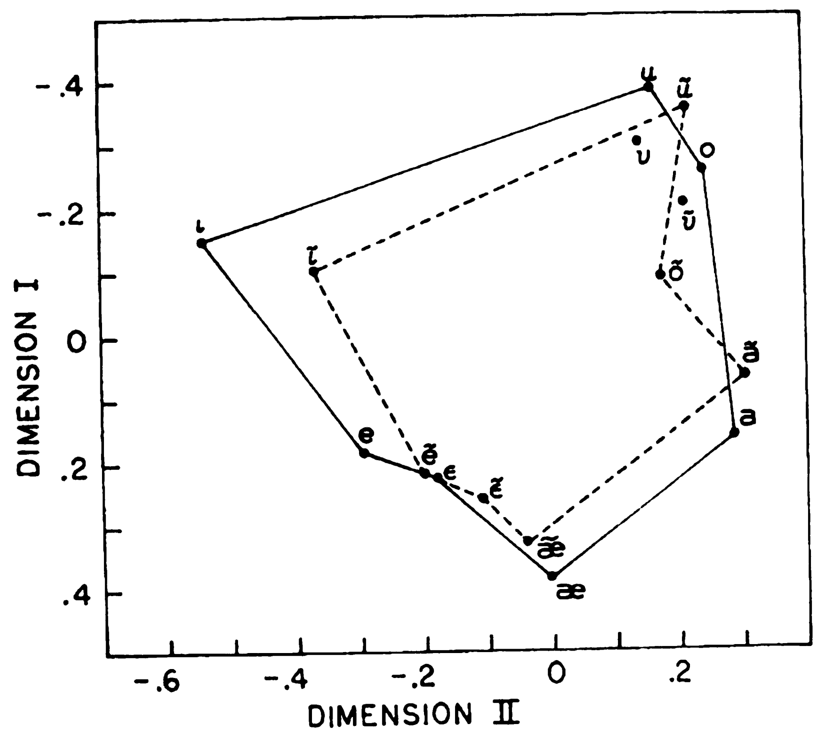

Figure 2.5: The first two dimensions in the perceptual space as determined by INDISCAL (Wright 1986:55)

Wright suggests that the difference in perceptual height between low and non-low vowels may be unraveled when the relation between the first oral formant the first nasal formant is considered: FN is lower than F1 for low vowels while FN is higher than F1 for non-low vowels, as in Figure 2.6.

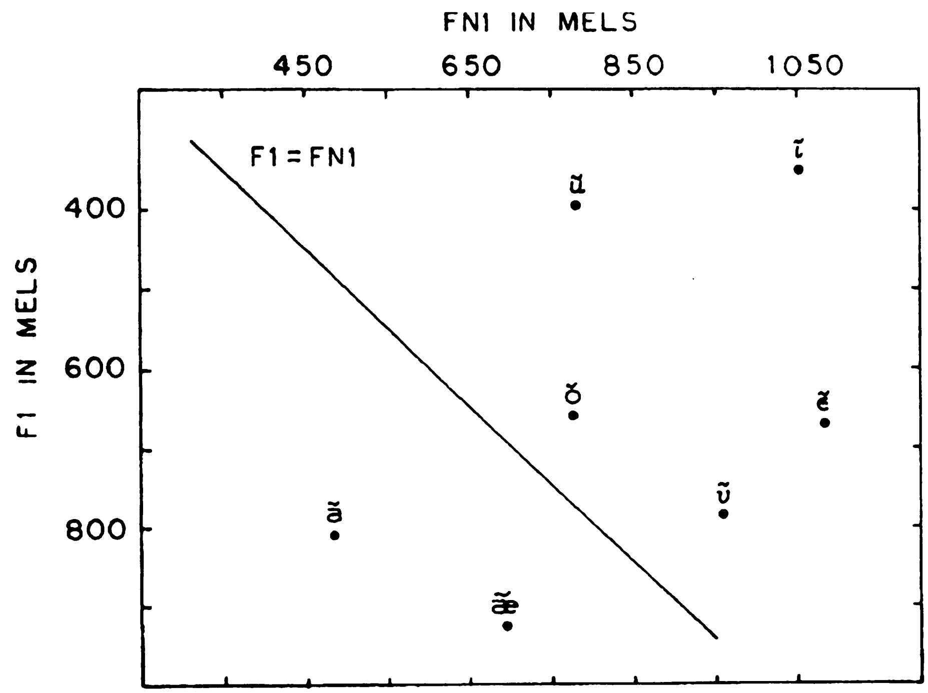

Figure 2.6: Relation between the first oral formant and the first nasal formant of the vowel stimuli (Wright 1986:59)

In Figure 2.6, low nasal vowels and non-low nasal vowels are divided into two groups with respect to F1 and FN. The diagonal line divides the space into an area in which the first nasal formant is lower than the first formant and into another area in which it is higher. If the COG effects are considered, the puzzle unravels. That is, nasalized vowels are perceived as higher than their oral counterparts because their nasal formant is lower than their F1, so that the average between FN and F1 is lower than F1, while non-low vowels are perceived as lower than their oral counterparts because their FN is higher than F1, and the average is higher than F1.

Thus, Wright concludes that the relative position of FN with reference to F1 is the key to understanding the perception of the nasalized vowels, rather than the F1 peak value itself, which confirms Beddor's argument.

The evidence provided by these studies explains the case of raising and fronting of the low front vowel in the NCS in a natuaral way: the most favored environment, namely following nasals, is not arbitrarily chosen, but is based on acoustic and perceptual characteristics of nasalized vowels. It also suggests the importance of experimental phonetics/phonology in analyzing sociolinguistic variation in order to pursue the ultimate goal — an investigation of the principles of language change which also govern synchronic variation.

2.5. Summary

In this chapter, facts about the NCS (e.g. the vowels involved and the geographic areas under its influence) were reviewed. As for social factors, recent studies emphasize the importance of more micro level differences among individuals in addition to the traditional variables such as age, sex, ethnicity, and social status. Linguistic factors have been neglected in analysis, and two most recent studies reach completely opposite conclusions on their effects. Acoustic and perceptual studies of nasalized vowels reveal that favoring environments are not arbitrarily chosen but based on the nature of sounds.

As we have seen, despite that the fact that the NCS has been investigated by many scholars for last three decades, there are some areas which have not yet been explored (i.e. residents in rural areas, individual differences such as local loyalty, phonetic reasons behind such variation).

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The next chapter discusses how the present study is designed in order to fill this gap.

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Chapter 3

METHODOLOGY

This chapter describes the methods used in this study. The first half of this chapter describes the respondents and the procedures of data collection (3.1), and the latter half illustrates how the collected data were processed and analyzed (3.2).

3.1 Data collection

3.1.1 Speech community

In this study, speakers from a small community in central Michigan are chosen as the target group. Focusing on residents of rural Michigan itself is meaningful since except for Gordon (1997), all previous studies in the state were conducted in larger cities. Nothing has been reported on north of the Lansing, Flint, and Grand Rapids areas (cf. Labov 1996). Since the establishment of the field, neglect of northern rural areas is a general shortcoming in modern sociolinguistic studies in the US. Sociolinguists in the US have documented urban dialect differences between majorities and minorities (e.g. European American vs. African-American or other ethnic minorities), especially in larger cities in the North, but rural areas where the population is more homogeneous have not attracted these researchers. It is mainly in the South that rural areas have been examined (Bailey 1973:171-2). Thus, the diffusion process of the NCS beyond the cities needs to be inv

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investigated in order to capture a better picture of this process. An examination of speakers who are different from the majority only because of their residential area will allow us to investigate more micro level differences among individuals who are not distinguished by traditional social factors, such as the influence of local loyalty or a positive attitude toward the local community.

Clare and other surrounding smaller communities such as Harrison, Gladwin, and Houghton Lake fit such a description; they are small and distant (but not too distant) from major cities. A partial map of Michigan showing the location of these communities is given in Figure 3.1.

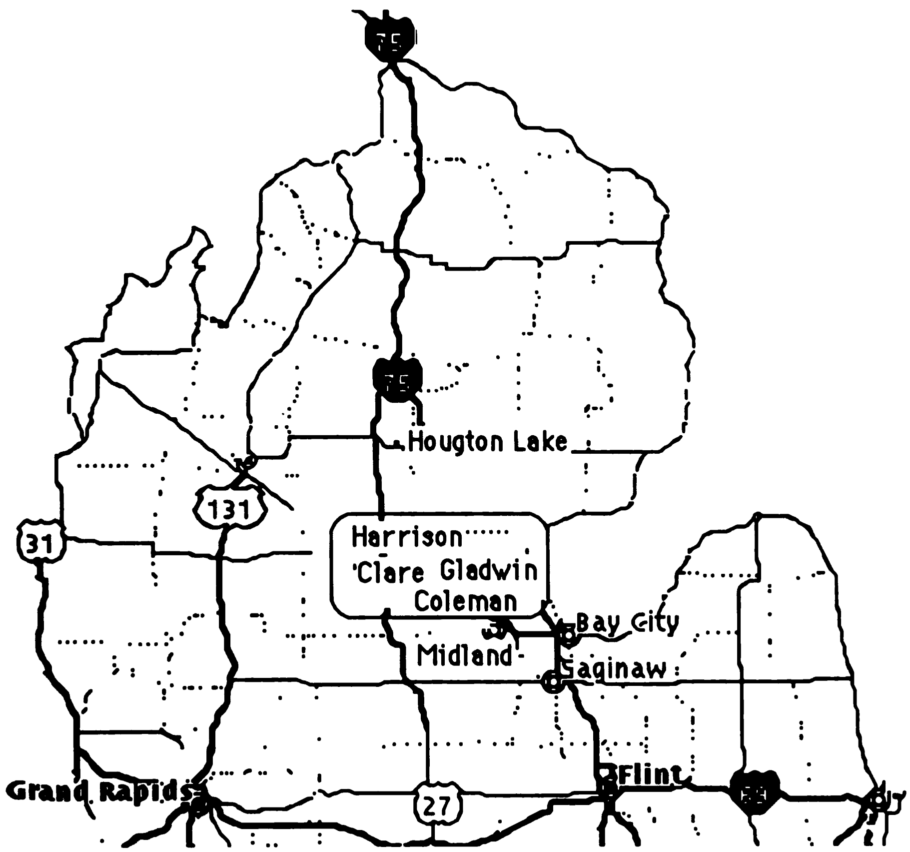

Figure 3.1: A partial map of Michigan

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Generally speaking, people in Michigan divide the state into two parts: 'down-state,' where industry and urban life prevails and 'up-north,' where there are various kinds of nature-related vacation areas. People in down state occasionally spend time up-north on vacation. Figure 3.1 confirms that these small towns are located in up-north: they are far enough from major cities (e.g. Clare is approximately 150 miles from Detroit and 80 miles from Lansing) and are relatively close to each other -- only about 20-30 miles apart. All of these towns are north of Mt. Pleasant (population 23,285[1]) which seems to be at the border between down-state and up-north. There is a state university there, and, more importantly, the population of Mt. Pleasant has been rapidly growing over the last several years since the opening of a casino. Driving along US-27 north, it is easy to notice that Mt. Pleasant is the last large community of down-state; after passing the city, there is little but open spaces. For example, at highway exits near Mt. Pleasant, there are road signs saying 'to Mackinaw Bridge,' which is a symbol of the far north. Beyond the city limits of Clare, there is a sign which says 'Clare: Gateway to North.' In addition, the fact that there is a Michigan Welcome Center in Clare clearly suggests that the area is devoted to tourism; there are no major industries in this community. In addition to this geographic placement (both physical and psychological), town size is important. That information is given in Table 3.1.

[1] Based on the US Census (1990).

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Table 3.1 Demographic information on speech community (US Census 1990)

Place	Population	Percentage of White population
Clare	3,013	98.3%
Harrison	1,835	98.4%
Gladwin	2,682	98.6%
Houghton Lake	3,353	99.6%
Coleman	1,237	99.1%

Callary (1975) refers to a place with a population of 4000 or less as (mostly) rural. Even the biggest town among these (Houghton Lake) has only a little over 3000 people; thus all these towns satisfy this definition of rural. Most importantly, all of these towns are ethnically homogeneous: more than 98% of their population is ethnically European American.

Since these towns are similar to one another in terms of geographic and demographic facts, it is assumed that they belong to the same or very similar speech communities.

3.1.2 Respondents

In order to examine the degree of participation in this urban sound change among rural residents, three social factors were used: age, sex, and social status. Although local loyalty is predicted to be inversely related to the advancement of the participation in the NCS (Ito and Preston, 1998) it cannot be controlled for in sampling since such attitudes will be revealed only in the intervi

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interviews. The data examined here are from a larger data set — almost 60 interviews conducted by the researcher during October 1998 to April 1999. The primary data set consists of a total of 36 speakers, distributed almost evenly with respect to these three parameters: both sexes, two age groups (younger (14-20) and older (39-57)), and two social status groups (working-class and middle-class). The sample design is summarized in Figure 3.2.

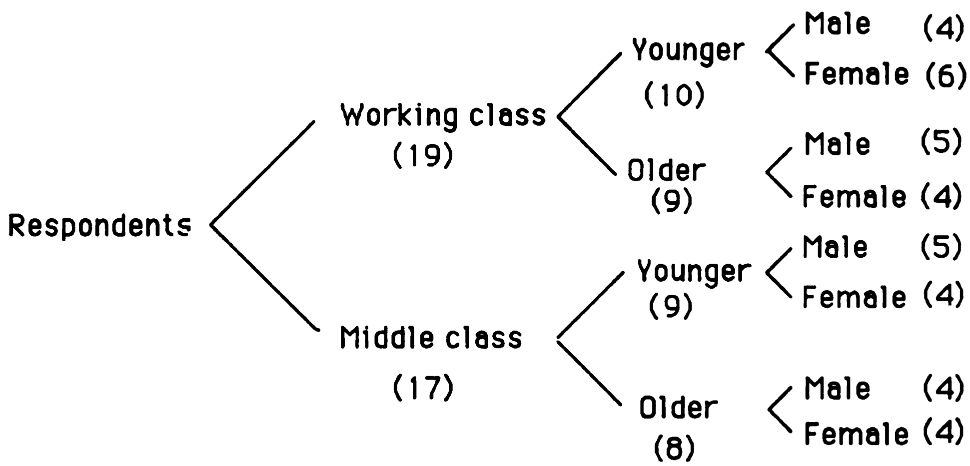

Figure 3.2: Overview of sample design (Total N =36)

As seen in the figure, at least four respondents were sampled for each cell.

Each respondent was carefully selected based on native status in the community and ethnicity. As for native status, he or she had to meet the sampling criteria of having been born and raised in the rural community. As for the ethnicity, both parents had to be European-Americans. Respondents were contacted by the 'friend of a friend' method, as described in Milroy (1980).

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Sociolinguistic interviews were conducted in various places — workplace, home, or community centers, depending on the availability and wishes of each respondent. Some were interviewed alone, and some were interviewed with their friends or family members. The interview had two parts: a sociolinguistic interview and the reading of a word-list and a passage (see Appendix A and B, respectively).[2] As for the sociolinguistic interview, two kinds of questions were asked: (1) the FACTS about the respondents (the place they grew up, the schools they attended, their job, hobbies, their plans for the future, and questions designed to estimate their network relations[3]), and (2) their ATTITUDE toward their town and people who live in urban areas (questions such as 'Is this a good place to grow up? Why?' and 'What is the best/worst thing about living here?,' 'Do you see any differences (e.g. in life-style, personality) between people in big cities and people around here? Why?'). In the reading of the word-list, the respondents were asked to read 106 words, which were selected to contain the vowels in the first three steps of

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[2] In addition to this, a perceptual test referred to as a 'Gating Experiment' (Labov 1994:194-5) was conducted, although the results are not examined in this dissertation.

[3] Milroy's (1980) five criteria to assign network score will be used in this study:

1. Membership of a high-density, territorially based cluster.
2. Having substantial ties of kinship in the neighborhood (more than one household, in addition to his (or her) own nuclear family).
3. Working in the same place as at least two others from the same area.
4. The same place of work as at least two others of the same sex from the area.
5. Voluntary association with workmates in leisure hours. This applies in practice only when conditions 3 and 4 are satisfied (141-2).

The actual questions asked in this study are listed in Appendix C, question 5 (about network relationship).

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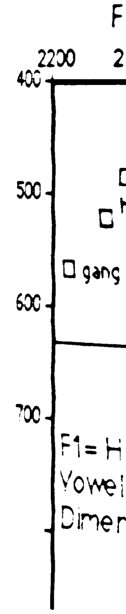
the NCS, namely /æ/, /ɑ/, and /ɔ/. Words containing tokens of three other vowels involved in the NCS and other diphthongs were also collected to compare the relative position of vowels in each respondent's vowel space. At the end of each interview, respondents listened to a short recording of an advanced speaker of the NCS and asked whether they have heard such pronunciations and whether they talk that way themselves. Each interview was digitally recorded by using a Sony MZ-R30, a portable MiniDisc recorder, and an external clip-on microphone. Each session took approximately 45 minutes to one hour.

3.2 Data analysis

3.2.1 Acoustic measurement and representation of vowel space

The collected data were subjected to two kinds of analysis: quantitative and qualitative. The most fundamental data, the reading of the word-list, were subjected to a computerized linear predictive coding (LPC) analysis in order to extract the first and second formant frequency of the respondents' vowels. Computer Speech Lab (Model 4300B, Software Version 5.X), manufactured by Kay Elemetrics Corp. was used on an IBM computer. The extracted frequency scores were input to PLOTNIK (version 4.0), a vowel system analysis program developed by William Labov at the University of Pennsylvania. The program plots individual tokens in vowel space and allows the researcher to calculate mean values and standard deviations, and conduct t-tests, etc. Samples of PLOTNIK analyses are given in Figure 3.3 and 3.4, in which individual tokens and mean values are displayed, respectively.



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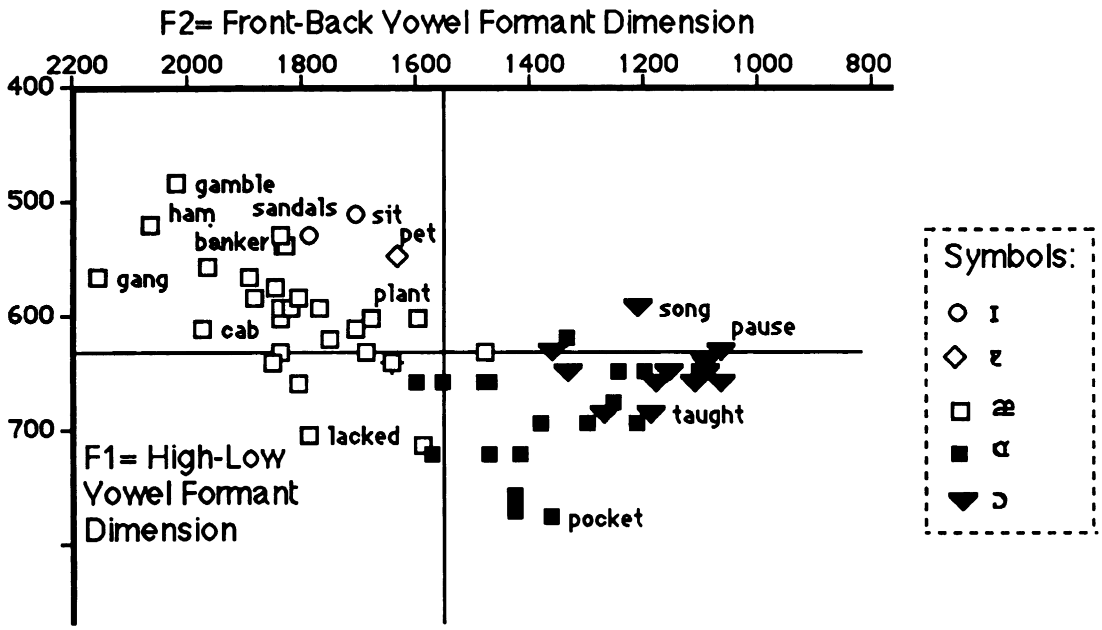

Figure 3.3: Vowels of Ron (individual tokens) (Ito 1998)

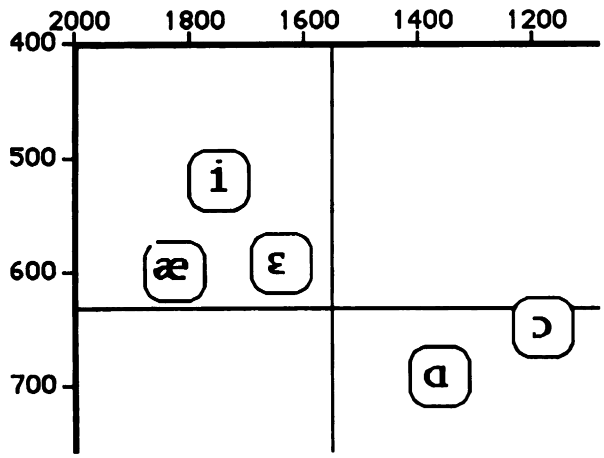

Figure 3.4: Vowels of Ron (mean) (Ito 1998)

In these figures, the first and second formant frequencies are superimposed on a traditional vowel chart: the F1 frequencies are inversely associated with the height dimension, and the F2 frequencies are associated with the front-back dimensio

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back dimension. Figure 3.3 suggests that a following nasal promotes low front vowel raising and fronting since five out of six tokens in this environment occupy the upper left corner (i.e. higher and more front). However, this kind of impressionistic interpretation needs be tested by another procedure, such as t-test. A full explanation of the use of these statistical tests will be given in the following chapter.

3.2.2 Determining the degree of accommodation

The degree of accommodation of each respondent is determined by using a vowel chart like Figure 3.4. This assessment is accomplished by comparing (1) relative positions of each vowel within a person's vowel space and (2) relative positions of each vowel with reference to assumed 'pre-shifted' and 'fully-shifted' vowel systems.

In order to establish a 'pre-shifted' vowel space, tape-recorded interviews collected as a part of the Dictionary of American Regional English (DARE) project were used. Here, interviews of two older individuals (one male and one female) from Gaylord, Michigan, conducted in 1970, were subjected to acoustic analysis. Although only these two individuals are used here for real time comparison, it is interesting to note that their vowel systems are very similar, except for the position of the low front vowel, to those in Peterson and Barney's (1954) study, which is based on more than 70 respondents. Figures 3.5 and 3.6 show the vowel space of the man and the woman, respectively. These means were calculated based on the acoustic measurement of words containing relevant vowels with primary stress several toke

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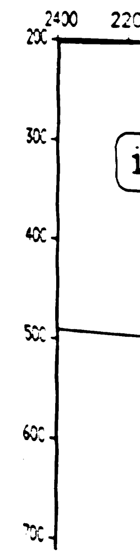

Figure 3.5: V
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Figure 3.6: V

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(several tokens for each vowel) from a tape-recorded interview of a casual conversation. Figures 3.7 and 3.8 show the vowel systems of male and female respondents based on the results of Peterson and Barney (1954).

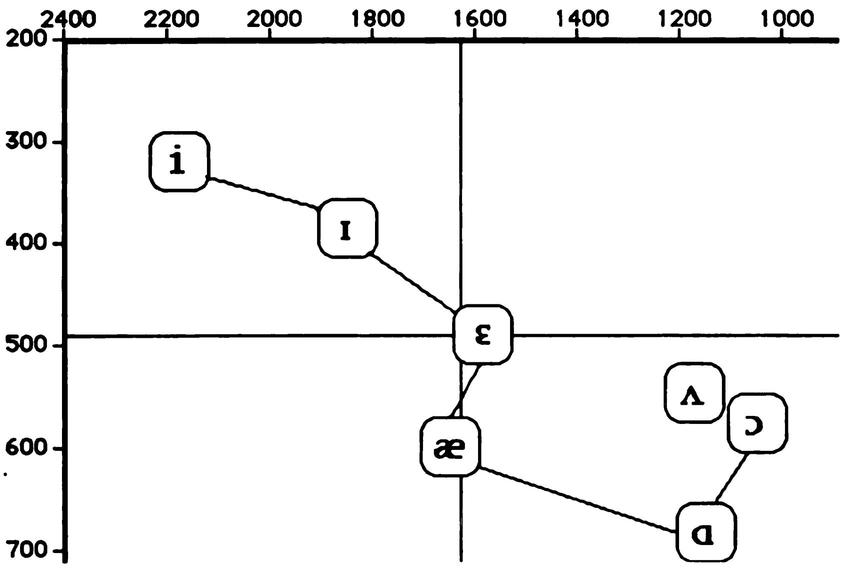

Figure 3.5: Vowels of Male, Gaylord, Michigan (DARE respondent, born in 1920, interviewed in 1970, grade school, skilled tradesman, white)

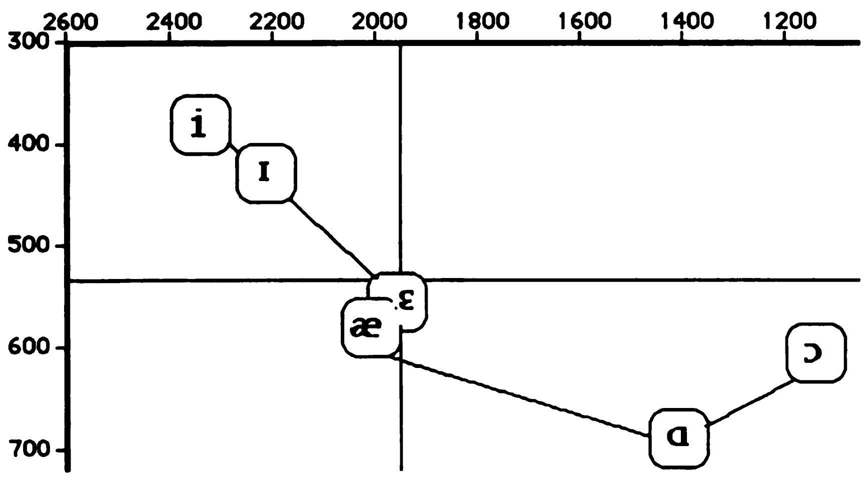

Figure 3.6: Vowels of Female, Gaylord, Michigan (DARE respondent)[4]

[4] No information was documented on the female respondent, but the content of the interview clearly shows that she is a sister of the man, similar in age and other relevant characteristics.

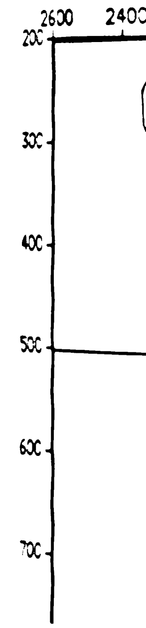

Figure 3.7: Vo

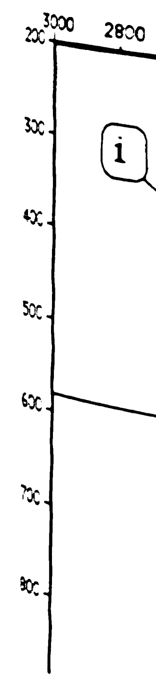

Figure 3.8: Vo

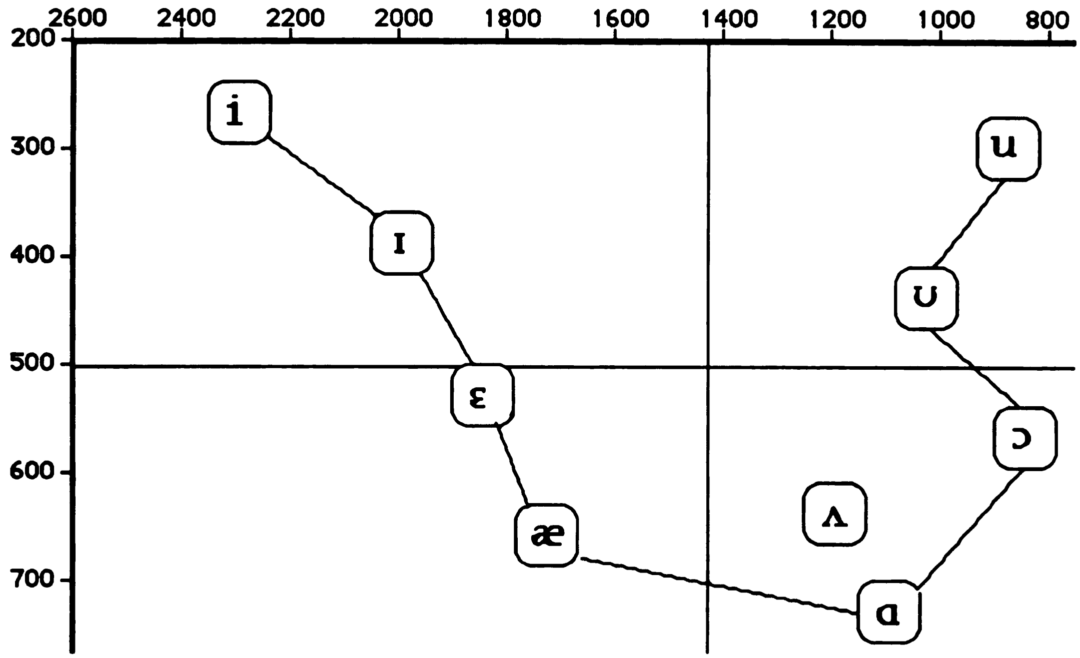

Figure 3.7: Vowels of Males (based on Peterson and Barney 1954)

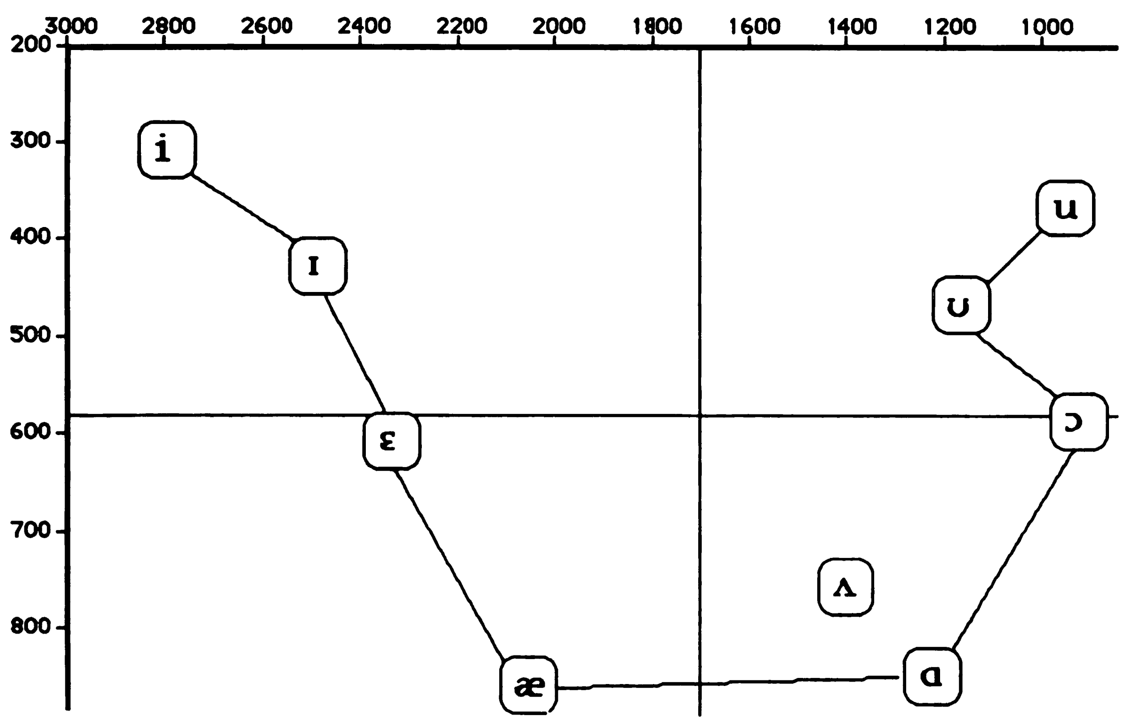

Figure 3.8: Vowels of Females (based on Peterson and Barney 1954)

Comparison of these four figures suggests the following. First, there are individual differences in vowel space: the range for the high-low dimension and that of the front-back dimension are different from one speaker to another. For example, although the high front vowel (/i/) is the highest for all four speakers' systems, there are approximately 100 Hz difference in F1 and almost 200 Hz in F2 between the Gaylord man (Figure 3.5) and the Gaylord woman (Figure 3.6). Since every individual has a different voice quality, especially different formant frequencies, the comparison of absolute frequencies across individuals should not be made. Instead, comparison of relative positions from one system to another needs to be made, regardless of the absolute frequencies.

Second, the difference in relative positions between DARE respondents (Figure 3.5 and 3.6) and Peterson and Barney's results (Figure 3.7 and 3.8) is minimal. In contrast to the 'U' shape configuration seen in Peterson and Barney's results, the shape of the Gaylord man's system (Figure 3.5) differs only in terms of the position of the low front vowel: it is more fronted (i.e. more tensed) in his system, but there are no signs of raising. In the Gaylord woman's system (Figure 3.6), the vowel is very close to the mid lax vowel, revealing that it is as tense and even more raised than the man's. This observation is confirmed by t-tests between the mean value of the mid vowel and that of the low front vowel. There is a significant difference between the mid vowel and the low front vowel in the F1 dimension in the man's system ($p < .025$), but they are not significantly different in the F2 dimension. In

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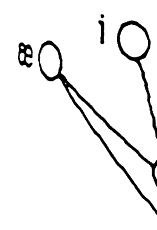

Leslie R.

Figure 3.9: No

dimension. In the woman's system, however, neither F1 nor F2 is significantly different.

The comparison of these four systems shows that late middle-aged northern residents in 1970's were minimally influenced by the NCS, but only in the first step (i.e. low front vowel raising): raising and tensing are minimally observed in the woman's system, but only tensing is observed in the man's system. The difference between the man's system and the woman's confirms that (1) tensing is a pre-condition for raising and (2) women lead in the case of the 'change from below' (e.g. Labov 1972, 1990, 1994). Following from these facts, raising will be the main topic of discussion in the following chapters.

We have established what the 'pre-shifted' systems look like. Now let us explore the other end of the referential system, i.e. 'fully-shifted' system. Figure 3.9 shows the vowel space of advanced speakers (mother and daughter), illustrated in Labov (1996).

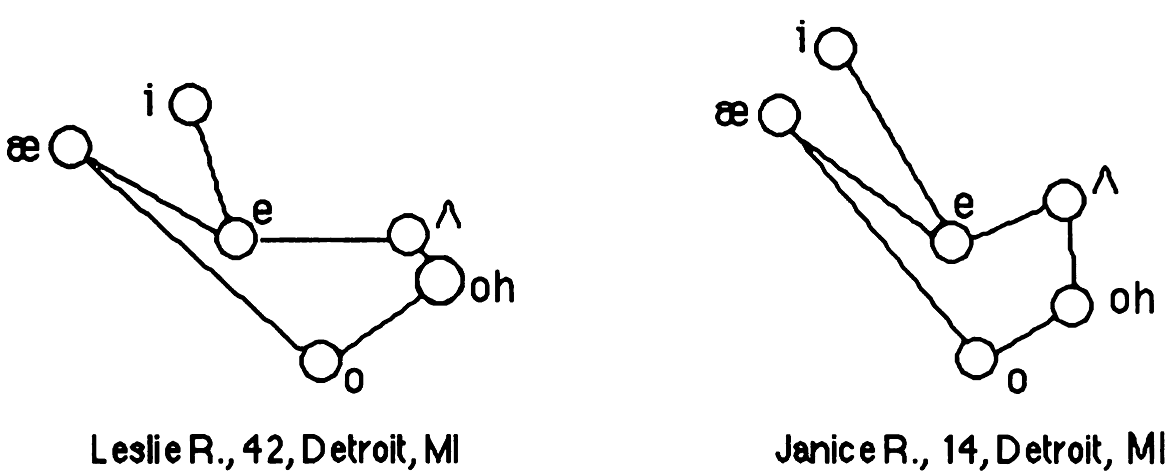

Figure 3.9: Normalized means of the vowels involved the NCS (Labov 1996)

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Labov explains the characteristics of these systems as follows:

> Here /æ/ has risen to upper mid front position, considerably fronter than short /ɪ/, and /e/ [= /ɛ/] has fallen to mid central position. For Leslie R., /e/ is still to the front of /o/ [= /ɑ/], but for the daughter, Janice, the fronting of /o/ and the further backing of /e/ has led to what is almost a vertical alignment. At the same time, wedge has moved back and /oh/ [= /ɔ/] down, so that it is now directly above /oh/ (Labov 1996).

Compared to the 'pre-shifted' systems (Figures 3.5-3.8), the 'U' shape configuration is totally distorted in these advanced speakers' vowel systems, and each step of the sound shift illustrated in Figure 2.1, is observed in Figure 3.9.

Comparison of these reference systems with those of the respondents from my pilot study of six respondents enables us to determine the degree of participation. For example, Ron's (Figure 3.4) participation in the NCS seems to be limited to the first step, i.e. low front vowel raising and tensing: his low front vowel is raised and fronted into the mid front lax vowel region, but no sign of movement is observed in either the low back or mid back vowels, step 2 and 3, respectively of the NCS. Figure 3.10 shows the mean scores of five of the six NCS vowels for these respondents.

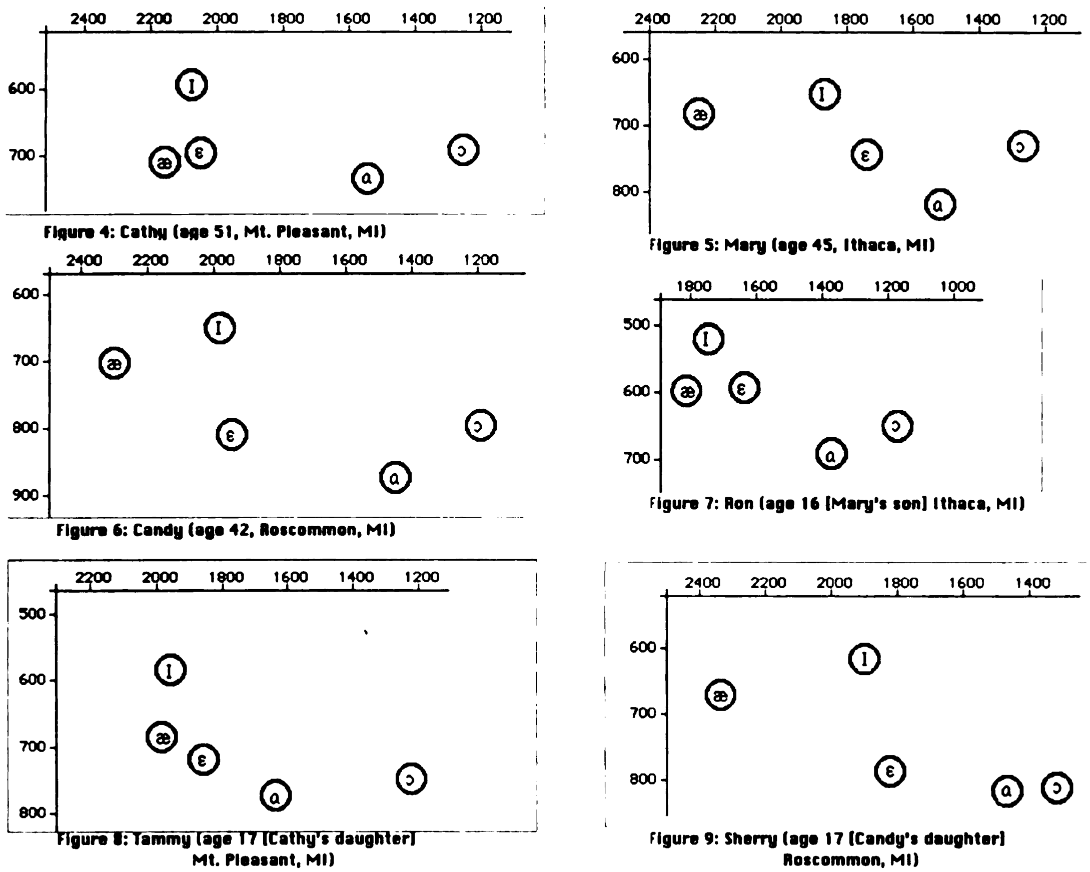


Figure 3.10: Vowels of rural Michiganders (Ito and Preston 1998:271-3)

By comparing these six vowel systems, we find that the degree of participation in the NCS among the six is as follows: The most advanced speaker is Sherry, followed by Tammy, Mary and Ron. Cathy is the most conservative speaker. The degree of their participation in the NCS can be partially predicted by such social factors as age and sex, but the distance from major cities does not seem to have much effect. Most interestingly, the difference between the two most advanced speakers (Tammy and Sherry) is better explained by considering another factor, namely, their preference for their local community. The interviews revealed that Tammy shows local

loyalty, while Sherry shows lack of local loyalty (Ito and Preston 1998). In the present study, the difference in the degree of participation in the NCS among 36 respondents is mainly examined by age, sex, and social status, but density of local network (based on Milroy 1980) is also considered. Parts of the sociolinguistic interviews are transcribed and subjected to a qualitative discourse analysis of content in order to assess individuals' orientation with respect to local identity. The qualitative content analysis of interview data will allow us to capture people's opinions on what they like/dislike about the local area and their reasons.

As for linguistic factors, the effects of the surrounding environment (both point and manner of articulation, focusing mainly on the following segment), are examined by t-tests and one-way ANOVAs, although the use of ANOVA in this study is for experimental purpose. Both tests are run on a statistical package for SYSTAT for Macintosh.

3.3 Summary

This chapter described the methods used in this study. In section 3.1, the respondents and the data collection procedures were discussed. Section 3.2 described the how the collected data were processed and analyzed. In the following chapter, the results of the present study will be discussed based on the methods described in this chapter.

Chapter 4

RESULTS

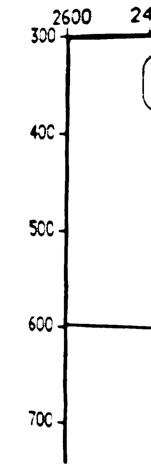
This chapter presents the results of the study whose methods have just been described. Even though there are six vowels involved in the NCS, the respondents from rural Michigan are participating in only the very first stage of the shift — low front vowel raising and fronting. Not many respondents showed signs of participation in the second step, (ɑ) shifting, and since this number is relatively small (seven out of thirty six, or 19%), the following presentation focuses on (æ) shifting only. Because fronting had already been observed, even among late middle-aged northern respondents in the 1970's and is assumed to be a precondition for raising (e.g. Labov 1994), emphasis is placed on raising; fronting is only supplementarily discussed.

First, overall results are described. Then, the effects of adjacent segments (preceding segment, following segment with respect to point of articulation and with respect to manner of articulation) are examined.

4.1 'Raw' results and the use of t-tests

4.1.1 Vowel systems of individuals

Figure 4.1 describes the mean values of Pete's (a middle-class man) vowels.



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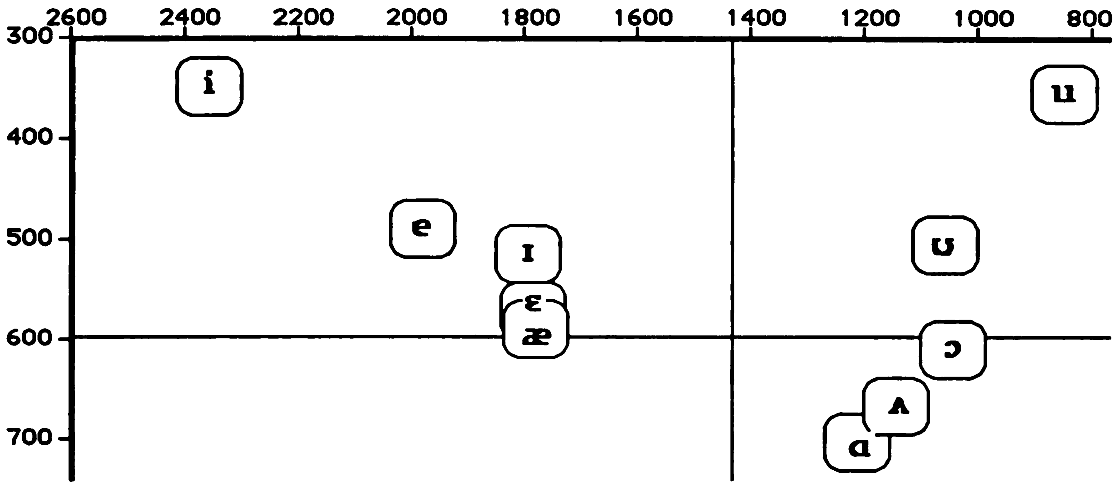

Figure 4.1: Vowels of Pete (49, Gladwin, middle-class) (index scores: F1=2, F2=2); see explanation of the indices in the text.

Pete's system seems to be very similar to those of pre-shifted speakers as revealed by its 'U' shape configuration (as discussed in the previous chapter). But careful observation leads us to suspect that his system may be abnormal because the three front vowels (/ɪ/, /ɛ/, and /æ/ seem not to be distinct from one another. Such an impressionistic judgment, based on looking at his vowel system, can be tested objectively by a t-test, which identifies whether these means are significantly different or not. The t-tests show that there is a significant difference between /ɪ/ and /ɛ/ in the F1 dimension ($p < .001$), confirming that these two vowels are distinct from each other in terms of height. However, these two vowels are not significantly different in the F2 dimension. In other words, /ɪ/ and /ɛ/ are differentiated by their height, but not by their backness. As for /ɛ/ and /æ/, neither the F1 and F2 dimensions is significantly different, i.e. they cannot be differentiated in either the height or backness dimension due to Pete's (æ)'s movement toward /ɛ/ territory. Thus, despite our first impression that Pete's system is unlike a pre-shifted system, close inspection reveals that his (æ) is minimally fronted and raised. There are no indicat

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are no indications of (ɑ) or (ɔ) shifting; these vowels are still in the same region as those in pre-shifted systems, and /ɪ/ and /ɛ/ are distinct in height.

4.1.2 The use of t-test

T-tests are not only useful in identifying the difference and similarity between two vowels within an individual, but can also be powerful tools for determining the degree of participation in (æ) shifting across speakers. In the previous chapter, we established that the DARE man (Figure 3.5) has a more conservative system than the woman (Figure 3.6) because t-tests identified that his (æ) is significantly lower than his /ɛ/, while her (æ) is not. As we observed in Pete's system, our impressionistic judgment of vowel positions may not be reliable; an objective method, here, t-test, is used to evaluate the degree of (æ) shifting, based on acoustic measurement, as described below.

(1) Degree of (æ) shifting

Index for height (= F1) dimension:

Index	Criteria
1	(æ) is lower than /ɛ/ (i.e. (æ) is significantly different from /ɛ/, at .05 level in the t-test.)
2	(æ) = /ɛ/ (i.e. (æ) is not significantly different from /ɛ/.)
3	(æ) is higher than /ɛ/ (i.e. (æ) is significantly different from /ɛ/, and the mean of (æ) is closer to that of /ɛ/ than that of /ɪ/.)
4	(æ) is higher than /ɛ/ (i.e. (æ) is significantly different from /ɛ/, and the mean of (æ) is closer to that of /ɪ/ than that of /ɛ/).
5	(æ) = /ɪ/ (i.e. (æ) is not significantly different from /ɪ/).

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Figure 4.2

Index for backness (= F2) dimension:

Index	Criteria
1	(æ) is backer than /ɛ/ (i.e. (æ) is significantly different from /ɛ/.)
2	(æ) = /ɛ/ (i.e. (æ) is not significantly different from /ɛ/.)
3	(æ) is fronter (= more peripheral) than /ɛ/ (i.e. (æ) is significantly different from /ɛ/, and the mean of (æ) is closer to that of /ɛ/ than /i/.)
4	(æ) is fronter than /ɛ/ (i.e. (æ) is significantly different from /ɛ/, and the mean of (æ) is closer to that of /i/ than that of /ɛ/.)
5	(æ) is not different from /i/ (i.e. (æ) is not significantly different from /i/.)

In the F2 dimension, /i/ was used as anchoring point rather than /ɪ/ because there was less between /ɪ/ and /ɛ/ than between /i/ and /ɛ/ in most respondents' systems. In addition, since /i/ is in the outer position of a vowel space (in 'the peripheral track' (Labov 1994)), and occupies the frontest position, it is a better reference point.

Based on this coding, Pete (Figure 4.1) received indices of 2 in both the F1 and F2 dimensions. The DARE man received 1 and 2, and the DARE woman 2 and 2. Thus, Pete and the DARE woman are shifting their (æ) to the same degree, while the DARE man is more conservative than these two respondents.

Figure 4.2 illustrates another respondent's vowel system.

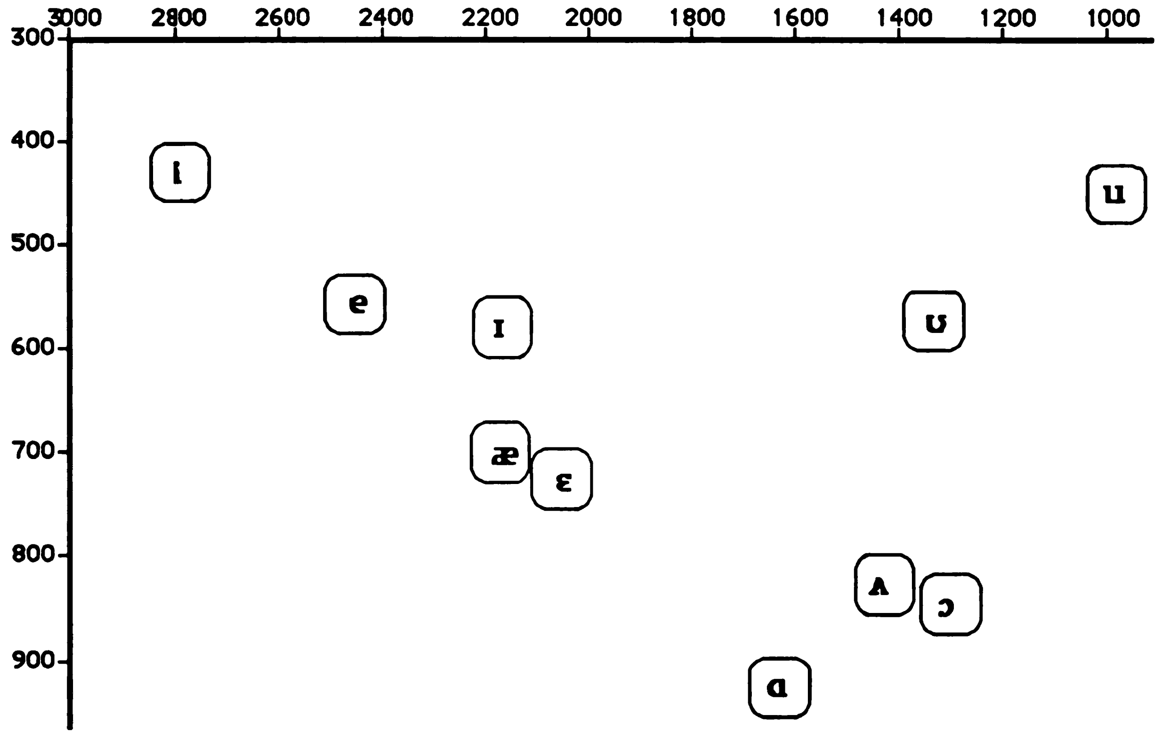

Figure 4.2 Vowels of Sue (55, Clare, middle-class) (index scores: F1=2, F2=2)

Let us compare the vowels of Pete (Figure 4.1) and those of Sue (Figure 4.2). By looking at these two figures, we see that Sue's (æ) is higher than her /ɛ/, while Pete's (æ) is lower than his /ɛ/, and Sue's (æ) is more fronted than Pete's (æ), because her (æ) is in front of her /ɛ/, whereas Pete's (æ) is right below his /ɛ/. As (æ) is fronted and raised in the NCS, Sue seems to be more advanced in low front vowel raising than Pete. However, there are no statistical difference between these two systems. T-tests show that (æ) is not significantly different from /ɛ/ in either the F1 and F2 dimension in both systems. Thus, relying on the results of statistical tests enables us to make a better judgment in comparison of the systems across the speakers than depending on our impressions.

The fact that Pete's system is more like that of the DARE woman than that of the DARE man is interesting because it is women who are advanced, usually one generation ahead in the case of 'change from below' (Labov 1994:101). This generational difference, however, does not hold for all respondents. In Sue's system, for example, her (æ) is more fronted and raised than the DARE woman's, but the difference between these two women's systems is not statistically significant. Sue's degree of (æ) shifting is the same as the woman's, who was interviewed almost three decades ago. As described below, most respondents had a system similar to Pete's and Sue's, i.e. minimal raising and fronting.

The most conservative system among the thirty-six respondents is illustrated in Figures 4.3, the vowels of Jonathan, a working class boy.

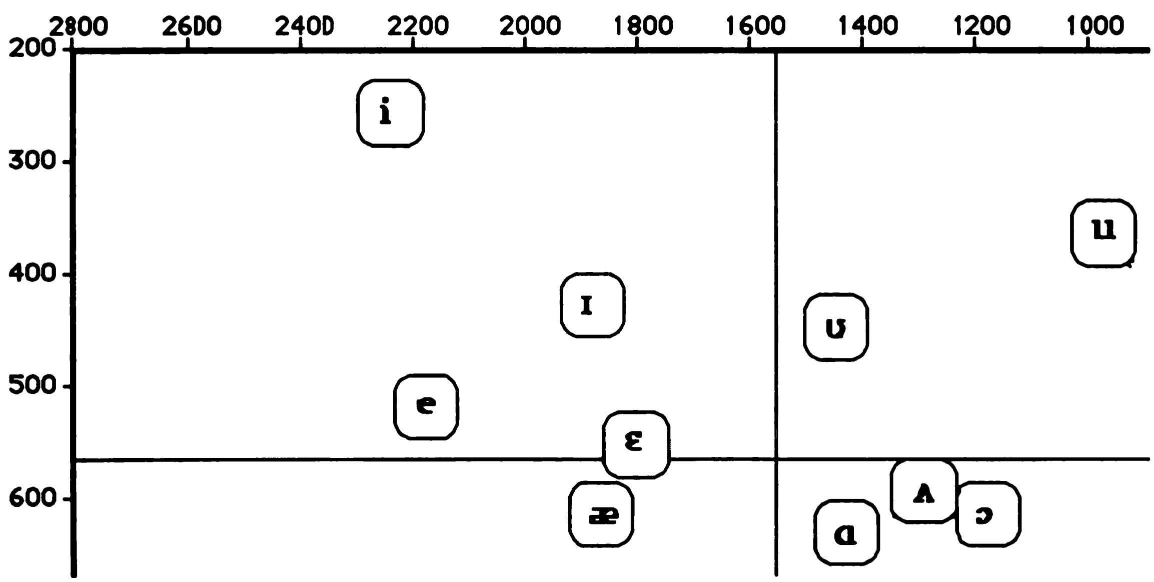

Figure 4.3: Vowels of Jonathan (17, Gladwin, working-class) (index scores: F1=1, F2=2)

Jonathan's system is more like the DARE man (Figure 3.5) than that of Pete (Figure 4.1): the 'U' shape configuration is distorted only by his (æ)'s front ward movement. T-tests identified that his (æ) was significantly lower than /ɛ/ ($p < .025$) (i.e. the index score is 1 for F1), and it was not statistically different from /ɛ/ in the F2 dimension (i.e. the index score is 2 for F2). That

Jonathan is a younger respondent, not an older one, is of interest because this does not fit the pattern that we expect in the model of sound change in progress: the younger generation usually participates more vigorously in the change than the older generation. Another respondent as conservative as Jonathan was Ray, also a young respondent with a middle-class background.

Now let us examine the other end of vowel system, the most advanced system among the respondents. Figure 4.4 illustrates the vowels of Kate, a middle-class woman in her late forties.

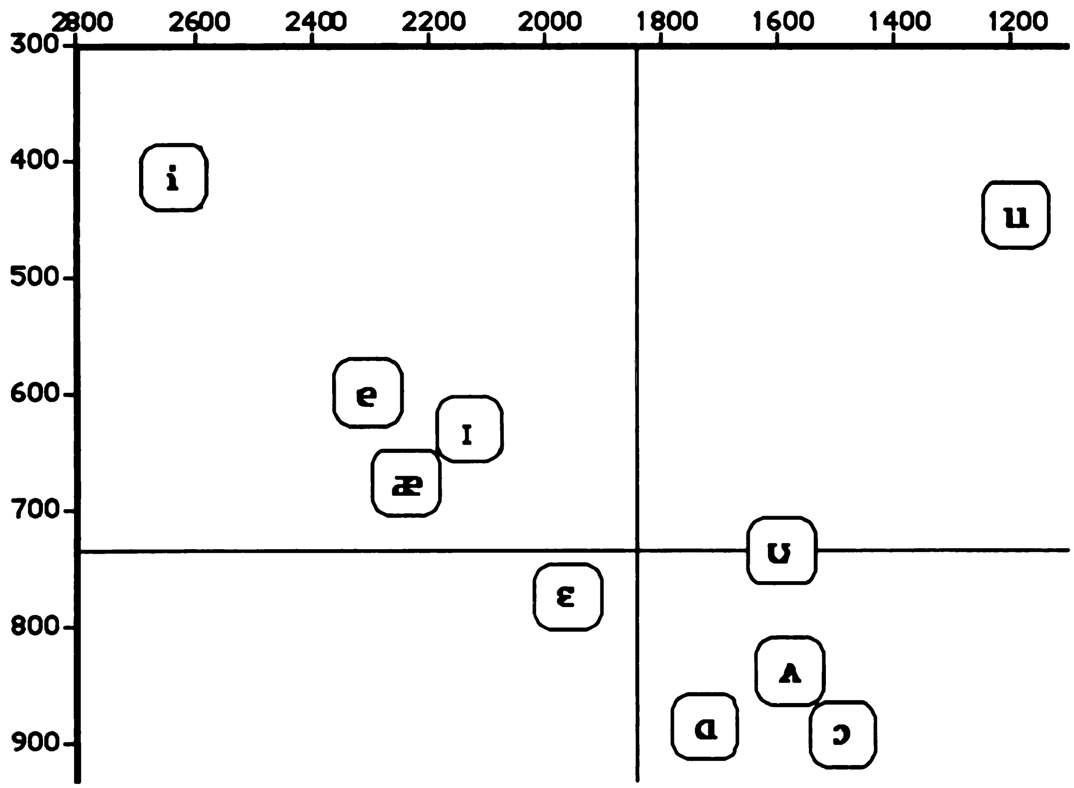

Figure 4.4: Vowels of Kate (Gladwin, 47, middle-class) (index scores: F1=5, F2=3)

The position of Kate's (æ) is more similar to that of advanced speakers from Detroit, illustrated in the previous chapter (Figure 3.9) than to those of Pete (Figure 4.1) and Sue (Figure 4.2). In Kate's system, (æ) has risen higher than /ɛ/ and is even fronter than /ɪ/. T-tests confirm that (æ) is significantly higher than /ɛ/ ($p < .025$) and not statistically different from /ɪ/, earning an index score of 5. As for the backness dimension, Kate's (æ) is significantly fronter than /ɛ/ ($p < .005$) but is significantly backer than /i/ and closer to /ɛ/. Thus, the index score of 3 was given.

4.2 Overall results

All the other respondent' vowels were also plotted by PLOTNIK, and relevant t-tests were performed in order to compare the relative position of (æ) with respect to /ɛ/, and to determine the degree of (æ) shifting. These results and other appropriate results (such as calculation of network scores and results of the gating test) are summarized in Table 4.1.

What we find here is rather remarkable: there is not much difference among respondents in (æ) shifting. More than 80% of the respondents fell into one of two groups: F1 = 2 and F2 = 2 (13 respondents or 36.1%), or F1 = 2 and F2 = 3 (17 respondents or 47.2%). These respondents' degree of (æ) shifting is identical to or minimally different from that of the DARE respondents.

Table 4.1: General results

			name	*age*	*town*	*relation*	*F1*	*F2*	*ntw*	*gating*
M	Y	M	Colin	17	G		2	2	3	11
M	Y	M	Pat	14	G	Colin's brother	1	2	3	15
M	Y	M	Dennie	16	G	Pete's son	2	2	5	14
M	Y	M	Ray	14	G	Dennie's brother	2	2	5	16
M	Y	M	Jamie	15	G	Pat's friend	2	2	5	17
M	Y	F	Alison	18	HL		2	3	0	16
M	Y	F	Lisa	18	H		2	2	1	15
M	Y	F	Jane	20	G		2	3	0	13
M	Y	F	Janet	18	G		2	2	3	13
M	O	M	Rick	50	C		2	2	4	n/a
M	O	M	John	52	C	Rick's cousin	2	2	4	14
M	O	M	Pete	49	G	Dennie&Ray's dad	2	2	3	12
M	O	M	Mike	40	CM		2	3	2	n/a
M	O	F	Cally	49	C	Rick's wife	2	5	3	13
M	O	F	Linda	46	C	John's wife	5	3	3	13
M	O	F	Kate	47	C		5	3	0	13
M	O	F	Sue	55	C		2	2	4	15
W	Y	M	Ned	16	G	Colin's friend	2	3	2	10
W	Y	M	Jonathan	17	G		1	2	3	n/a
W	Y	M	Nevin	16	G	Jonathan's brother	2	3	2	15
W	Y	M	Adam	15	G	Pat's friend	2	2	2	10
W	Y	F	Alice	16	G	Colin's girl friend	2	3	2	19
W	Y	F	Violet	20	G		3	3	2	11
W	Y	F	Amily	15	G	Violet's cousin	2	3	2	n/a
W	Y	F	Trish	20	HL		2	3	0	15
W	Y	F	Beth	16	G	Violet's sister	2	3	3	13
W	Y	F	Nina	16	G		2	3	3	15
W	O	M	Bill	57	C		2	3	2	11
W	O	M	Bob	58	C	Bill's friend	2	2	1	12
W	O	M	Brian	48	G	Amily's dad	2	2	2	n/a
W	O	M	Chad	41	G	Jonathan& Nevin's dad	2	3	2	15
W	O	M	Raymond	47	G	Vilot&Beth's dad	2	3	1	12
W	O	F	Shannon	47	C	Bill's wife	2	3	1	13
W	O	F	Jan	44	G	Brian's wife	2	3	1	n/a
W	O	F	Lilly	39	G	Adam's mom	2	3	1	14
W	O	F	Sandi	44	G	Alice's mom	2	3	3	17

Abbreviation:
M: middle class, W: working class (first column); Y: younger respondents, O: older respondents (second column); M: male, F: female (third column); G: Gladwin, C: Clare; CM: Coleman; H: Harrison; HL: Houghton Lake; ntw: network scores (tenth column)

When the F1 dimension is considered, only two respondents (Jonathan and Ray) received the index score of 1, denoting that their systems are as conservative as that of the DARE man and more conservative than that of the DARE woman. Only three respondents (Violet, Kate, and Linda) scored more than 3, indicating that they are more advanced speakers than the DARE woman. All the other thirty-one respondents fell into 2, meaning that there is no difference from the DARE woman. Among the outliers, there is an interesting pattern regarding age and sex. The two least raised respondents were both young males, and the three advanced speakers were females, but the two most raised speakers were not younger women, but older women.

As for the F2 dimension, more than half of the respondents (twenty-one out of thirty six or 58.3%) scored 3 or above, showing that fronting is more advanced than for the DARE respondents. The remainder scored 2, confirming that their (æ) is minimally fronted. Fronting was more common among the working-class than among the middle-class. While the majority of the middle-class respondents scored 2 (eleven out of seventeen or 64.7%), the majority of the working class scored 3 or more (fifteen out of nineteen or 78.9%). This difference was statistically significant (chi-square 5.353, p = 0.021). Table 4.2 summarizes these results.

Table 4.2: (æ) fronting with respect to social class

index of F2	*middle class*	*working class*
2	11 (64.7%)	4 (21.1%)
3 or more	6 (35.3%)	15 (78.9%)

$X^2 = 5.353$ (Yates corrected) (1df) $p = 0.021$

Sex was another significant factor in fronting. Women tend to have a more fronted (æ) than men. Whereas only six male respondents (33.3%) had a more fronted variant (i.e. 3 or more), the majority of female respondents (83.3%) had this variant in their systems. Their difference was also statistically significant (chi-square 7.314, p=0.007). This is summarized in Table 4.3.

Table 4.3: (æ) fronting with respect to sex

index of F2	*male*	*female*
2	12 (66.7%)	3 (16.7%)
3 or more	6 (33.3%)	15 (83.3%)

$X^2 = 7.314$ (Yates corrected) (1df) $p = 0.007$

Since both social class and sex showed significant effects, the combined effects are dramatic. As shown in Table 4.4, middle-class men were most conservative and working-class women were most advanced in (æ) fronting. The degree of fronting among working-class men and middle-class women fell between these two extreme groups, with sex apparently more powerful than class.

Table 4.4: (æ) fronting with respect to social class and sex

index of F2	*middle men*	*working men*	*middle women*	*working women*
2	8 (88.9%)	4 (44.4%)	3 (37.5%)	0 (0%)
3 or more	1 (11.1%)	5 (55.6%)	5 (62.5%)	10 (100%)

Although status and sex were significant factors, age of speaker did not have such an effect. In both generations, more than half of the respondents had a more fronted (æ) in their systems, with the older generation in the lead. However, the difference was not statistically significant (chi-square 0.156, p = 0.463, n.s.).

Table 4.5 (æ) fronting with respect to age

index of F2	*younger*	*older*
2	9 (47.4%)	6 (35.3%)
3 or more	10 (52.6%)	11 (64.7%)

$X^2 = 0.156$ (Yates corrected) (1df) $p = 0.693$ (n.s.)

As we have seen, most respondents are minimally raising their (æ) and relatively increasing in fronting, but their degree of shifting is not so different from that of the DARE respondents. With respect to raising, it was teenage boys who had the most conservative systems. The most advanced systems were found among females, but the most advanced speakers were middle-class women, not girls. Fronting was led by working-class and female respondents, but no age effect was observed. In contrast to urban areas where a 'radical shift' is observed even within one generation, which is the 'characteristic of new vigorous changes' (Labov 1994:101), rural respondents did not display this pattern. The diffusion of the urban sound change seems to be retarded in this rural area.

4.3 The effect of adjacent segments

Up to the previous section, the degree of (æ) shifting was evaluated by comparison of the mean values of the relevant vowels. Thus, vowel systems were represented by using the mean of each vowel. This representation, however, hides an important fact: the existence of the range of vowel territory. The low front vowel, in particular, occupies a wide range as seen in Figure 4.6.

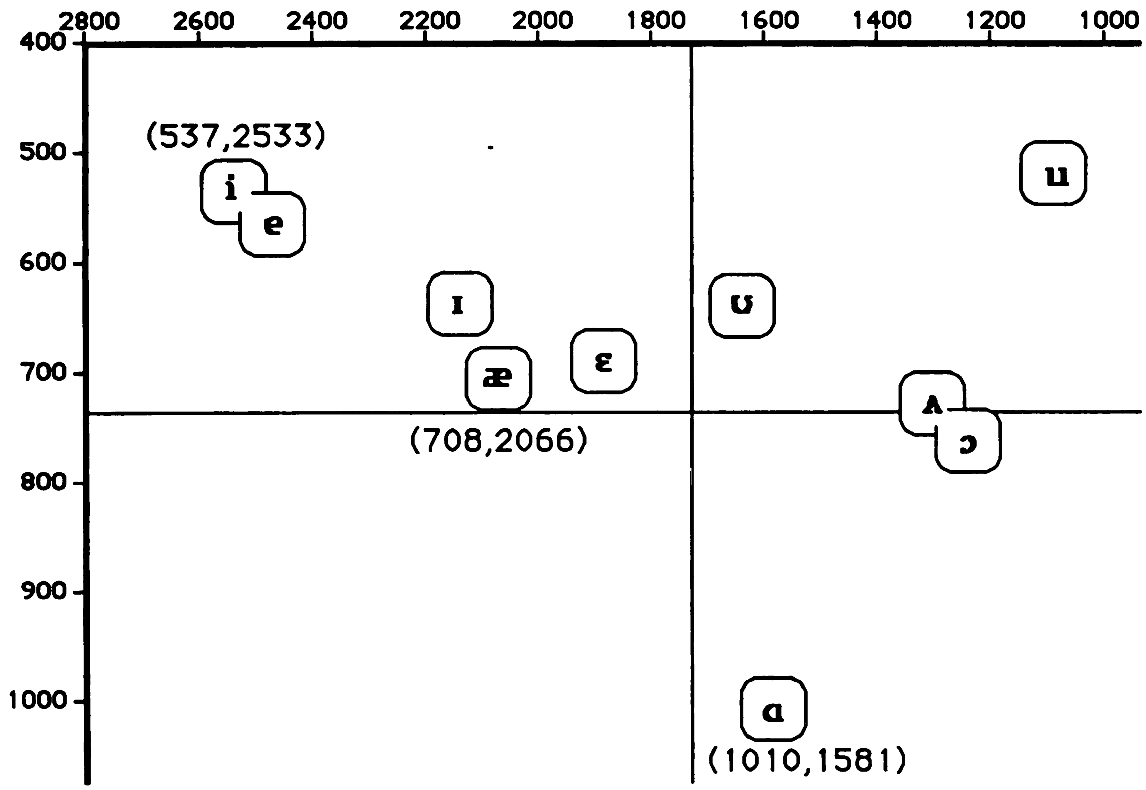

Figure 4.5: Vowels of Nina (16, working-class girl, Gladwin) (Index scores: F1=2, F2=3)

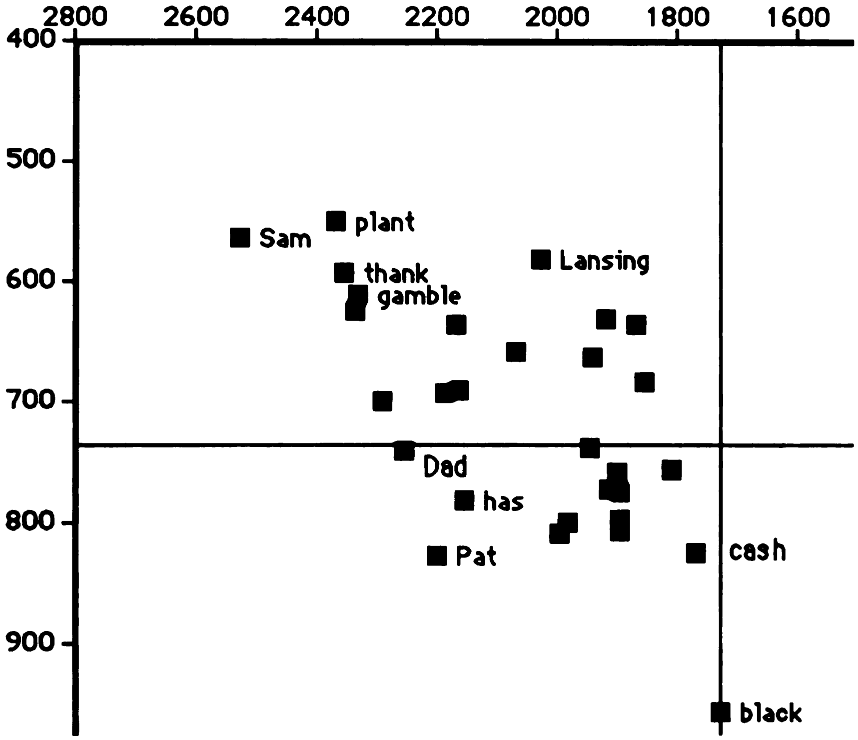

Figure 4.6: Vowels of Nina (16, Gladwin working-class) (æ) tokens only

The mean of Nina's (æ) is 708 Hz for F1 and 2066 Hz for F2, as shown in Figure 4.5, but her (æ) tokens are widely distributed in the front half of her vowel space. The most conservative token *black* (F1 = 958 Hz, F2 = 1724 Hz) is located in the typical position of (ɑ) (F1 = 1010 Hz, F2 = 1581 Hz), and the most advanced token *Sam* (F1 = 565 Hz, F2 = 2527 Hz) almost reaches the position of /i/ (F1 = 537, F2= 2533). Are there any patterns in the location of individual (æ) tokens with respect to the adjacent segment? If adjacent segments are irrelevant to the vowel shift, there should not be any differences between the overall index scores and those of environmentally selected subgroups of the low front vowel within the same individual's system. But if some adjacent segments promote or demote the vowel shift, we should be able to see some differences between the overall index scores and those of subgroups within a system. If some segments have such effects, we may be able to observe general patterns across individual systems. In this section, the effects of the adjacent segments (both preceding and following) are investigated. Although there are other ways to investigate the effects of adjacent segments (e.g. based on feature geometry), here traditional manner and place of articulation are involved as in other sociolinguistic studies. There were insufficient data for a fuller treatment which might have investigated the implications of some of these newer phonological theories. In order to calculate the degree of shift, t-tests between environmentally selected subgroups of (æ) and /ɛ/ are used for assigning index scores, just as in the previous section. In addition, one-way ANOVAs were run for each respondent in order to compare the similarities and/or differences among the subgroups of (æ) within a system, although the use of ANOVA here is for experimental purposes. In each run of ANOVA, F1 or F2 scores were the dependent variables and environmental factors (e.g. preceding segments, point of articulation of the following segments, or manner of articulation of the following segments) were the independent variables. The coding system from PLOTNIK was adopted, and both statistical tests were run on a statistical package, SYSTAT for Macintosh.

4.3.1 Preceding segment

As for the preceding segment, PLOTNIK codes only potentially effective environment, and eight distinctions were made in terms of place and manner. Due to its coding system, the strict separation of manner and place was not available. For example, the token *nap* is categorized as nasal but not as apical. The coding system and tokens are given in (2).

(2) Coding for preceding segment and number of tokens[1]

segments	# of tokens	tokens
no preceding segment (i.e. vowel initial)	2	*apple, ask, have, has*[2]
labials	6	*Pat, past, pal, badge, bath, banker*
apicals	6	*tab, Dad, Sam, Saginaw, zap, thank*
velars	4	*cabin, cash, gamble, gang*
nasals	3	*nap, mattress, mash*
liquids	4	*laugh, Lansing, rack, rag*
obstruent + liquid	3	*black, brag, plant*

Vowel initial and nasal tokens had to be deleted for raising considerations due to the fact that the following segments were exclusively voiceless stops and voiceless fricatives, which, as the following discussion will show, strongly retard raising. Palatal (*jazz*) was excluded since it is a singleton set. Thus, five t-tests and a one-way ANOVA were run for each respondent for the F1 dimension, and seven t-tests and a one-way ANOVA were run for the F2 dimension. Thus, a total of one hundred eighty t-tests (5 environments x 36 respondents) and thirty-six ANOVAs were performed in the F1 dimension, and two hundred fifty-two t-tests (7 x 36) and thirty ANOVAs were performed for the F2 dimension.

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[1] This is the maximal number of tokens. Although everyone had the same word-list, I could not get some of the acoustic measurements of tokens on CSL due to background noise, mispronunciation etc. Of course, some of these tokens are very small in number, and, technically, ANOVAs should not be run, but they show trends in the data. I have, of course, included the raw data for inspection in Tables 4.6, 4.8, 4.10, 4.11, 4.12, and 4.14.

[2] /h/ can be treated either as a vowel (based on phonological fact) or a glide (based on phonetic fact). I ran t-tests based on both coding for all the respondents, but no difference was observed.

4.3.1.1 F1 dimension (Raising)

In thirteen respondents' vowel systems (36.1%), at least one of the preceding segments produced significantly different vowels from the mid vowel. For example, Pat, one of the most conservative speakers, received an index score of 1 (i.e. his (æ) is in the pre-shifted position) for (æ) in general. But when the preceding segment was considered, his (æ) was minimally raised (i.e. index 2) with three out of five preceding segments: apicals, velars, and obstruent + liquid. The other two segments (labials and liquids) produced significantly lower vowels than the mid vowel (i.e. the index 1). In Jonathan's (another conservative speaker) system, only preceding labials produced significantly lower vowels than the mid vowel. Four other segments produced minimally raised vowels. Table 4.6 summarizes the index scores based on the preceding segment.

Table 4.6: (æ) raising with respect to preceding segment (N=36)

	1	2	3	4	5
apicals	0	33	1	0	2
velars	0	33	1	0	2
obst+liquids	0	36	0	0	0
liquids	3	32	0	1	0
labials	6	29	1	0	0

Labials retarded vowel raising: six respondents produced significantly lower vowels with this preceding segment. Initial obstruent-liquid (e.g. *black, brag,* and *plant*) is the best known retarding factor, but its effect was not strongly confirmed in the data. All respondents produced minimally raised vowels (i.e. the index of 2) with this segment. Although the effect was minimal, vowels with preceding apicals and velars were raised. Vowels with apicals and velars were as high as /ɪ/ (index 5) in two respondents' systems.

In order to see the differences and similarities of the effect of the preceding segment, an ANOVA was run for each respondent. No significant differences were found in most respondents' systems. Differences were found only in three (8.3%).[3] In these systems, five significantly different pairs were found by the post-hoc test (the Tukey Multiple Comparison Test). Table 4.7 summarizes the results.

Table 4.7: Significantly different pairs found in the post-hoc test of ANOVAs in three respondents

	labials	apicals	velars	liquids	obst + liq
labials	--				
apicals	*	--			
velars	1	*	--		
liquids	*	1	2	--	
obst + liq	*	1	*	*	--

* = n.s.

Differences were found mostly between apicals or velars and another segment. The velar-liquid pair was significantly different in two respondents' systems, where velars were producing higher vowels than liquids. Significant differences were found in the pairs apical-liquid, apical-obstruent+liquid, and velar-labial, but they were found in only one case each.

The results of t-tests and ANOVAs suggest that labials are a disfavoring factor, and preceding apicals and velars are favoring factors for raising. Due to the lack of following segment variety, the effect of vowel and nasal initial structures could not be investigated.

[3] The results of ANOVA for these three respondents are as follows:
dependent variable: F1; independent variables: H$: preceding segment

	SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
John	H$	62065.080	4	15516.270	2.786	0.058
Linda	H$	360861.739	4	90215.435	5.748	0.004
Shannon	H$	16341.359	4	4085.340	4.573	0.010

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labials	--				
apicals	*	--			
velars	1	*	--		
liquids	*	1	2	--	
obst + liq	*	1	*	*	--

* = n.s.

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4.3.1.2 F2 dimension (Fronting)

In twenty-nine respondents' systems (80.6%), at least one of the preceding segments produced at least minimally fronted vowels. The results of t-tests are given in Table 4.8.

Table 4.8: (æ) fronting with respect to preceding segment (N=36)[4]

	1	2	3	4	5
apicals	0	20	13	3	0
labials	0	20	14	2	0
nasals	0	23	12	1	0
velars	0	26	7	3	0
#_	0	32	3	1	0
liquids	1	34	1	0	0
obst+liquids	3	33	0	0	0

Preceding apicals and labials seem to promote fronting. Sixteen respondents produced a fronter vowel than the mid vowel in these environments. Preceding velars were the next promoting factor. Vowels with this segment were raised more than minimally in ten respondents' systems. Preceding nasals also promote fronting. Recall, however, that nasal tokens all have following voiceless obstruent segments. Fronting might really be more dramatic than shown here. The preceding segments which promoted and resisted raising most do not correspond to those which effect fronting most. Obstruent-liquid clusters retard fronting but not minimal raising. Labials appear to retard raising but promote fronting. Only apicals seem to favor both fronting and raising.

[4] The assignment of the index score was slightly modified here because of the small number of tokens (two tokens for /i/), and assigning 5 based on t-tests seemed to obscure the results. Thus, 4 is the highest index score for the F2 dimension hereafter. Since I could not get accurate acoustic measurements for two respondents' (Pat and Jamie) /i/, its position was estimated.

In eleven systems (30.6%), ANOVAs found significant differences among the means of F2 of (æ) with respect to the preceding segment.[5] Most differences were found in pairs between obstruent + liquid clusters and other segments except preceding liquids. Among them, the pair obstruent-liquid and apical was most frequently found, followed by obstruent-liquid and nasal in six and five systems, respectively. Table 4.9 shows the results of post-hoc tests.

Table 4.9: Significantly different pairs found in the post-hoc test of ANOVAs in eleven respondents

	#_	labials	nasals	apical	velar	liquids	obst + liq
#_	--						
labials	*	--					
nasals	1	*	--				
apicals	*	*	*	--			
velars	*	*	*	*	--		
liquids	*	1	3	1	1	--	
obst + liq	1	4	5	6	3	*	--

As described above, the results provide supporting evidence for the effect of preceding segments both in the F1 and F2 dimensions. Preceding apicals seems to promote both raising and fronting. Preceding labials seem to demote raising but promote fronting. Obstruent-liquid clusters do not prevent raising but minimally retard fronting. Recall that the distribution of following segments did not allow the investigation of vowel- and nasal initial effects on raising. The effect of the preceding segment is summarized in Figure 4.7.

[5] F-ratios ranged from 2.591 (Brian) to 7.828 (Linda), and probabilities from p=0.049 (Brian) to p=0.000 (Linda). See appendix G for complete results.

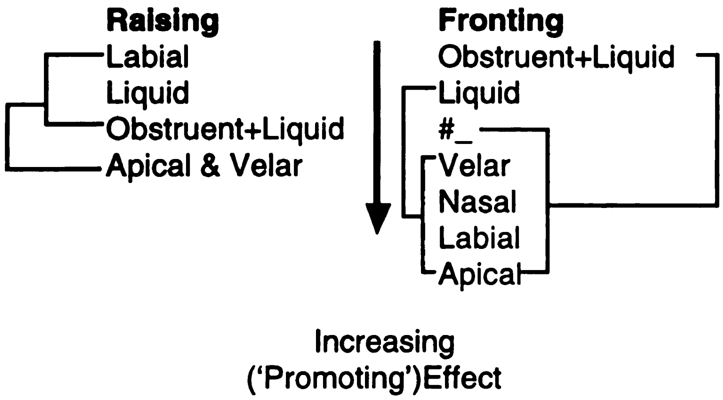


Figure 4.7: Summary of the effects of preceding segment[6]

4.3.2 Place of articulation of the following segment

As for place of articulation of the following segment, PLOTNIK allows us to make six distinctions: labials, labiodentals, interdentals, apicals, palatals, and velars. The first two were combined as labial in this study, and interdental was excluded for analysis because there was only one token in this category. The tokens for each category are given in (3).

(3) Coding for following segment with respect to place of articulation and number of tokens

segments	# of tokens	tokens
labials (including labio-dentals)	9	*nap, apple, zap, tab, cabin, laugh, have, gamble, Sam*
apicals	10	*Pat, mattress, ask, past, Dad, has, jazz, pal, Lansing, plant*
palatals	3	*badge, cash, mash*
velars	8	*black, rack, brag, black, Saginaw, rag, banker, thank*

[6] With respect to ANOVA differences, only those major differences are described which are illustrated by the connected lines. For raising, the connected lines show that labials, liquids, and/or obstruent+liquid are different from apical and/or velars. For fronting, obstruent+liquid are different from at least one of the other segments, except liquids. Liquids are different from at least one of the four segments (velars, nasals, labials, and apicals).

4.3.2.1 F1 dimension (Raising)

Although previous studies report that place of articulation has effects on vowel shifting, its effects were not observed in the vowel systems of rural Michigan residents. T-tests identified only four cases of significant differences between the vowels subdivided by point of articulation and the mid vowel, and these were observed in only two respondents' (5.6%) systems, despite the fact that a hundred and forty-four t-tests (4 environments x 36 respondents) were run in total. No differences were observed in the other thirty-four respondents' systems, regardless of their overall index scores. Table 4.10 describes the results.

Table 4. 10: (æ) raising with respect to point of articulation of the following segment (N=36)

	1	2	3	4	5
apicals	0	34	1	1	0
palatals	0	35	1	0	0
velars	0	36	1	0	0
labials	0	36	0	0	0

Ned (a working-class boy) produced significantly higher vowels than the mid vowel with following apicals (index 4). Another respondent, Violet (a working-class girl, who is one of the advanced speakers) produced significantly higher vowels with following palatals, apicals, and velars.

In addition, ANOVAs did not find any significant differences among subgroups of (æ) in any respondents' systems. The closest to a significant level was found in Jan's (a working-class woman) system ($p < .0582$), but Tukey Multiple Comparison Test identified no significant differences among these four environments: the labial-velar pair received the lowest probability, but that was still far from the .05 level ($p < .1543$). From the results of t-tests and ANOVAs, the place of articulation of the following segment seems to be irrelevant to vowel raising among these respondents.

4.3.2.2 F2 dimension (Fronting)

Although point of articulation of the following segment did not have any impact in raising, we observed some effects of it in fronting. In twenty-five respondents' systems (69.4%), at least one segment produced significantly fronter vowels than the mid vowel. The result is described in Table 4.11.

Table 4.11: (æ) fronting with respect to point of articulation of the following segment (N=36)

	1	2	3	4	5
palatals	0	18	13	5	0
apicals	0	16	18	2	0
labials	0	28	7	1	0
velars	0	33	3	0	0

Following palatals and apicals seem to promote fronting, but not following labials and velars. More than half of the respondents produced fronter (æ) tokens with palatals and apicals, but the majority of the respondents produced minimally fronted vowels even with labials and velars. The order of the most effective segment to the least (palatals/apicals > labials > velars, where '>' means 'more effective than') is exactly the same as the one proposed in Labov (1994:100).

Although t-tests showed the differences in the effect of fronting, ANOVAs did not find any differences among the mean of F2 values with respect to point of articulation. ANOVAs found only one significantly different pair in one respondent's system (Dennie, a middle-class boy). His labial-velar pair was found to be significant, suggesting, perhaps, that velars are most retarding.

The effect of point of articulation of the following segment in raising was not confirmed by either t-tests or ANOVAs. As for the F2 dimension (fronting), the results of the t-tests suggest that following apicals and palatals promote fronting, while labials and velars demote fronting. The results of ANOVAs, however, did not suggest that the differences were dramatic. Thus, the effects of the point of articulation seem not be especially strong, even for fronting, although t-tests are more likely to be accurate with these data.

4.3.3 Manner of articulation of the following segment

As for manner of articulation of the following segment, PLOTNIK enables us not only to examine manner itself, but also to combine it with voicing status. Five environments were examined here, as described in (4).

(4) Coding for following segment with respect to manner of articulation and number of tokens

segments	# of tokens	tokens
voiceless stops (VLS)	7	*apple, nap, zap, Pat, mattress, rack, black*
voiced stops (VS)	6	*tab, cabin, Dad, Saginaw, brag, rag*
voiceless fricatives (VLF)	6	*bath, laugh, ask, past, cash, mash*
voiced fricatives (VF)	3	*have, has, jazz*
nasals (NAS)	7	*gamble, Sam, Lansing, plant, thank, gang, banker*

Laterals (*pal*) and affricates (*badge*) were excluded from the analysis because they were both singleton sets. As described below, the results of t-tests and

ANOVAs showed that manner of articulation is a reliable predictor for vowel shifting, because the effects of the following manner are consistent across the speakers.

4.3.3.1 F1 dimension (raising)

In twenty-three respondents' systems (63.9%), at least one of the following segments produced significantly different vowels from the mid vowel. The summary of the results is given in Table 4.12.

Table 4. 12: (æ) raising with respect to manner of articulation of the following segment (N=36)

	1	2	3	4	5
NAS	0	29	1	1	5
VF	0	32	0	2	2
VS	0	32	3	0	1
VLF	8	28	0	0	0
VLS	11	25	0	0	0

Here, the five segments are divided into two groups: one which favors raising (i.e. index scores were always 2 and higher) and one which disfavors it (i.e. index scores were always 2 or less). Following nasals, voiced fricatives, and voiced stops seem to promote raising, and voiceless stops and voiceless fricatives seem to demote raising. It seems that voicing matters most in raising. Seven out of thirty-six (19.4%) respondents produced higher vowels in the nasal environment. Five out of these seven raised their (æ) as high as /ɪ/ (index '5'). Eleven respondents (30.6%) produced non-shifted vowels with following voiceless stops. The results confirm that following nasals are the most favored segment and following voiceless stops the most disfavored.

The difference between the segments which promoted raising, especially following nasals, and those which disfavored it was also observed in ANOVAs. Significant differences were found in twenty-one respondents' systems (58.3%).[7] Pairs found to be significantly different by post-hoc tests in these twenty-one systems are summarized in Table 4.13.

Table 4.13: Significantly different pairs found in the post-hoc test of ANOVAs in twenty-one respondents

	NAS	VF	VLF	VLS	VS
NAS	--				
VF	1	--			
VLF	11	*	--		
VLS	12	3	*	--	
VS	2	*	3	3	--

The most frequently identified pair was nasal-voiceless stop, followed by nasal-voiceless fricative (twelve, and eleven out of twenty-one systems, respectively). Significant differences between voiced obstruents and voiceless obstruents were also found (the pairs voiced fricative-voiceless stop, voiced stop-voiceless fricative, and voiced stop-voiceless stop) although these were less frequent (three cases each). The results correspond to previous findings: following nasals are promoting factors and following voiceless stops are demoting ones. In addition, the data suggest that following voiceless fricatives are not a promoting factor, but a demoting one.

4.3.3.2 F2 dimension (fronting)

In twenty-nine respondents' systems (80.6%), at least one of the following segments produced at least minimally fronted vowels. The results of t-tests are given in Table 4.14.

[7] *F*-ratios ranged from 2.712 (Jan) to 10.9003 (Mike), and probabilities from p=0.058 (Ray) to p=0.000 (Mike). See appendix G for complete results.

Table 4.14: (æ) fronting with respect to manner of articulation of the following segment (N=36)

	1	2	3	4	5
NAS	0	10	16	10	0
VF	0	21	14	1	0
VLF	0	26	8	2	0
VLS	1	30	4	1	0
VS	1	31	4	0	0

Following nasal is the most effective promoting segment for fronting, as observed in raising. In this environment, minimally fronted (æ) was found only in ten respondents' system. The other twenty-six respondents produced a more fronted vowel (sixteen respondents received index 3, ten received index 4). The next most favored segment was voiced fricatives, as in raising (twenty-one respondents minimally fronted and fifteen fronted even more). In contrast to its effect on raising, following voiceless fricatives did not prevent fronting but rather promoted fronting (but see the result of ANOVAs). Ten respondents produced more than minimally fronted vowels (i.e. index 3 and 4) in this environment. Following stops seem to prevent fronting, regardless of their voicing status. In both environments, one respondent produced very conservative vowels (i.e. index 1). The difference in manner (fricatives or stops) seems to matter most in the process of fronting.

In fourteen respondents' systems (38.9%), significant differences in means of F2 scores were found in ANOVAs, when manner of articulation of the following segment was involved.[8] Table 4.15 summarizes the results of post-hoc tests of the fourteen systems in which significantly different pairs were found.

[8] F-ratios ranged from 2.915 (Janet) to 15.381 (Amily), and probabilities from p=0.058 (Lily) to p=0.000 (Amily). See appendix G for complete results.

Table 4.15 Significantly different pairs found in the post-hoc test of ANOVAs in fourteen respondents

	NAS	VF	VLF	VLS	VS
NAS	--				
VF	2	--			
VLF	9	*	--		
VLS	14	*	*	--	
VS	9	*	*	1	--

All the significantly different pairs were in the first column, except one (a voiceless stop-voiced stop pair). The significant difference between nasals and voiceless stops was found most frequently, in fact, in all these fourteen respondents' systems. The difference between nasal-voiceless fricative and nasal-voiced stop were found in nine respondents' systems each. As the differences among obstruents were found in only one system, the result suggests that following nasals have an effect on fronting distinct from that of other manners of articulation.

As described above, the results confirmed the effect of manner of articulation of the following segment both in raising and fronting. Following nasals promote both raising and fronting while voiceless stops demote the shift. Although following voiceless fricatives have been shown to be favoring environments for fronting, the effect seems to be weaker than the voiced counterpart. The summary of the effects of manner of the following segment is shown in Figure 4.8.

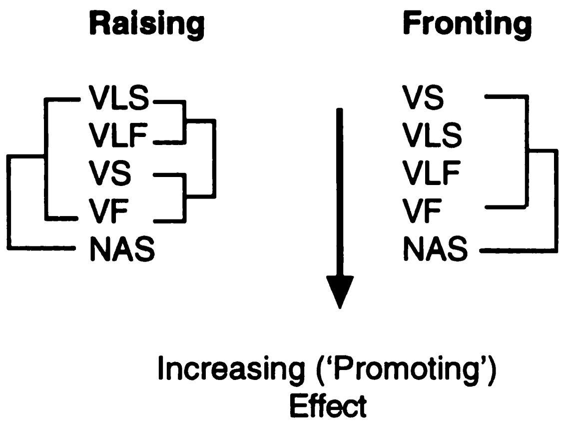


Figure 4.8: Summary of the effects of manner of articulation of the following segment[9]

4.3.4 Summary

In the preceding sections, the effects of adjacent segment were examined by using t-tests and ANOVAs for evaluation. The variation of the positions (both the F1 and F2 dimension) of (æ) tokens was best accounted for by the manner of articulation of the following segment, but preceding segments also seem to effect raising and fronting. Point of articulation of the following segment, however, did not have as much influence as expected on raising among the respondents in this study. The effects of preceding obstruent + liquid, following nasals, and following voiceless stops were confirmed in this study.

Since manner of articulation is confirmed as the most reliable factor for raising in the vowel shift, its effects and correlation with social factors are examined in the next section. Only the F1 dimension (raising) is explored because the F2 dimension (fronting or fronting) is a preparatory condition for

[9] Here again, only major differences are summarized for ANOVA differences. For both raising and fronting, the connected lines show that nasals are different from at least one of the obstruents. In addition, voiceless obstruents are different from their voiced counterparts in raising.

raising. Special attention is paid to following nasals because the effects of that segment are distinct from that of others (as shown in the ANOVA tests conducted on individual systems).

4.3.5 More on the effects of manner articulation of the following segment

4.3.5.1 Based on t-tests

In the F1 dimension, three segments were found to be the source of higher vowels: following nasals, voiced fricatives and voiced stops. The degree of the effect in (æ) raising among the three, however, was not the same. As described in Table 4.12, five respondents received an index 5 (i.e. (æ) is as high as the high front vowel /i/) in the nasal context. For voiced stops, on the other hand, three out of four respondents received only 3 (i.e. (æ) is significantly higher than /ε/ and is closer to /ε/ than /ɪ/). If we calculate average index scores of respondents who raised their (æ) more than minimally (i.e. more than index 2) with respect to manner, the average scores are the following: following nasals (4.57), voiced fricatives (4.50), and voiced stops (3.50). Following nasals as the source of higher vowels is best observed in Nina's system, shown in Figure 4.9.

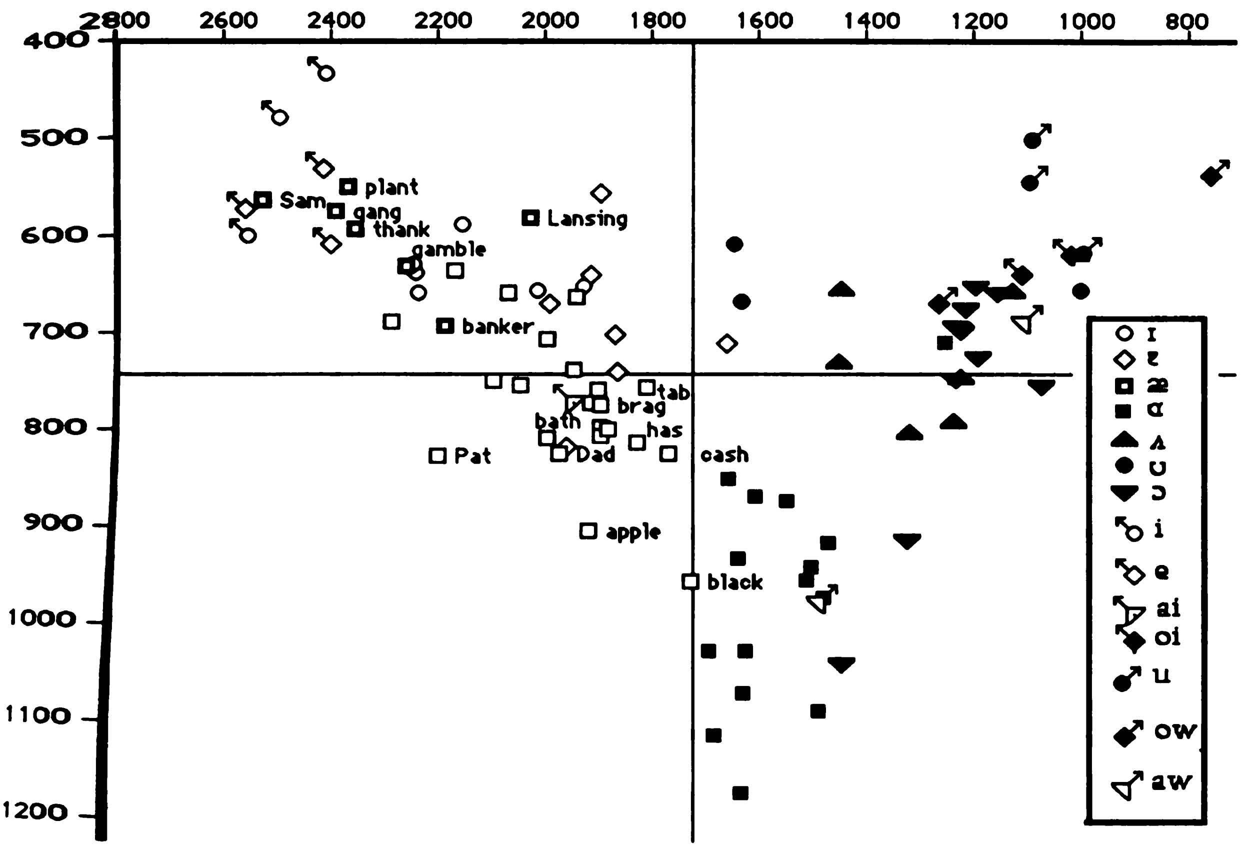


Figure 4.9 Vowels of Nina (16, Gladwin, working-class) (tokens) (index scores: F1=2, F2=3)

In Nina's system, all the seven tokens with following nasals occupy the upper left corner, sharing the space with /ɪ/, /i/, and /ɛ/. As a result, tokens with following nasals received index 5, (as high as /i/), although the overall index score for the F1 dimension was just 2.

Also interesting with respect to following manner are patterns of users in such environments. Segments which produced significantly higher vowels than the mid vowel were more common in women's systems than men's, and segments which produced significantly lower vowels were more common in men's than women's, as described in Table 4.16.

Table 4.16: Distribution of respondents by sex (F1 dimension, manner)

segment	*total*	*male*	*female*
nasal	7	1	6
voiced fricative	4	2	2
voiced stop	4	3	1
voiceless stop	11	9	2
voiceless fricative	8	6	2

Bold type represents the segments which produced higher vowels.

Six out of seven systems in which following nasals produced vowels significantly higher than the mid vowel were those of young females (four working-class and two middle-class). The remaining one was a middle-class older male. In fact, in all these four working-class girls' systems, the index score for the tokens with following nasals was 5 (e.g. Nina in Figure 4.6), but it was only 3 in the man's system. Following voiced stops as a source of higher vowels, on the other hand, was rare among women (just one out of four). Kate, one of the most raised respondents, happened to be the unique female respondent, and in her system, following voiced fricatives were also significantly higher than the mid vowel. Another female respondent whose following voiced fricatives produced vowels significantly higher than the mid vowel was Lily, a working-class woman. Thus, the segments which produced higher vowels were not same across generations among female speakers: the younger generation used the following nasal as a maximal raising environment, and the older generation used non-nasal environments such as voiced stops and voiced fricatives. There were two male respondents (one middle-class and one working-class), whose following voiced fricatives produced significantly higher vowels. Three respondents whose following voiced stops produced significantly higher vowels were all working-class (one boy and two men). Thus, only one boy produced significantly higher (æ) when manner of articulation was involved.

Producing conservative vowels (i.e. vowels significantly lower than the mid vowel) was less common among females, but they were observed in a few young respondents' systems. In Jane's system (a middle-class young woman), both following voiceless stops and voiceless fricatives produced vowels significantly lower than the mid vowel. In Violet and Beth's systems (working-class young women who are sisters), following voiceless fricatives and voiceless stops produced vowels significantly lower than the mid vowel, respectively. The older female respondents, on the other hand, did not have such segments. For them, their lowest vowels were not different from the height of the mid vowels. Among male respondents, following voiceless stops produced significantly lower vowels in nine systems across age groups and social status: three middle-class boys, three working-class men, two middle-class men, and one young working-class boy. Interestingly enough, in these three middle-class boys' systems, following voiceless fricatives also produced vowels significantly lower than the mid vowel. The remaining three cases were found in two working-class men's systems and one middle-class man's.

We observed that following nasals, voiced fricatives and voiced stops advanced (æ) raising, but following voiceless stops and voiceless fricatives had the opposite effect. These segments are the keys to understanding the wide range of the (æ) region: tokens with promoting segments are in the upper left corner in the vowel space, and those with demoting segments are in the lower position, adjacent to advanced (ɑ) tokens. Although we did not see much difference among respondents where the overall index score (i.e. relative position of the low front vowel with respect to the mid vowel) was concerned, now we know that there are fine differences among them. Some produced vowels significantly lower than the mid vowels in their vowel system, while some produced significantly higher vowels, although overall relative positions with regard to the mid vowel were the same (i.e. no difference from the mid vowel). In order to examine a pattern of ranges in the (æ) region, the following categorization is used, based on the results of the t-tests with respect to following manner.

(5) Grouping of respondents based on the results of t-tests

A	following voiceless fricatives and/or voiceless stops produced significantly lower vowels than /ɛ/.
B	no difference was observed from /ɛ/ regardless the following segments
C	following nasals, voiced fricatives, and/or voiced stop produced significantly higher vowels than /ɛ/.
D	both A and C

Figure 4.10 schematically illustrates A through D by using the range of (æ) tokens and the mean value of /ɛ/ in a vowel system. Table 4.17 summarizes the corresponding number of respondents who fit into each category.

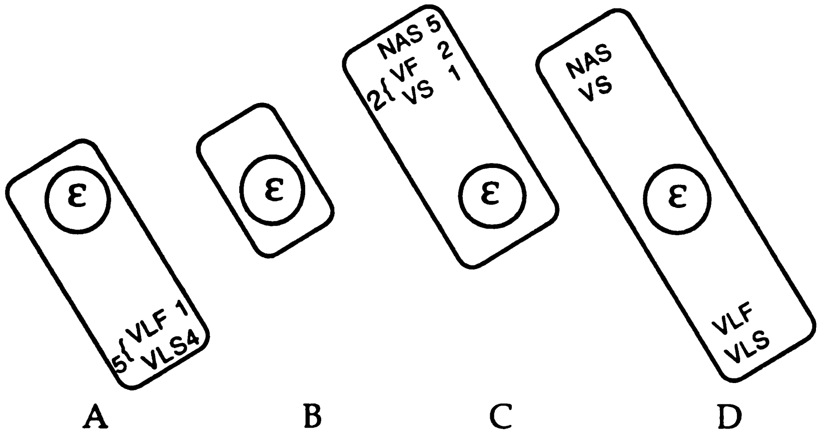


Figure 4.10: Schematic representation of the relationship between the range of (æ) tokens and /ɛ/ (mean)[10]

Table 4.17: Summary of vowel systems based on the effect of manner of articulation on raising

System	Number of respondent
A (not so raised)	10 (27.8%)
B (minimally raised)	13 (36.1%)
C (more or less raised)	10 (27.8%)
D (mixed)	3 (8.3%)

The biggest percentage among the respondents was B (thirteen, 36.1%) and only three respondents (8.3%) were categorized as D. Thus, it is rare to have extremely advanced tokens while having excessively conservative tokens at the other end within a system. Eight out of the ten who had system A were male respondents. Seven out of ten who had system C were female respondents: five young girls and two women. The difference among the systems can be seen as a path of upward movement of the low front vowel.

[10] The number in the figure represents the number of respondents. For example, in A, VLS was significantly lower the mid vowel in one respondent's system, VLS was significantly lower in the four respondents' system, and VLS and VLS were significantly lower in five respondents.'

Among these four systems, A is the least raised one because tokens with some segments still stay below /ɛ/. B is more raised than A but not as raised as C. D can be interpreted as a variation of C in which conservative tokens have not yet moved. That A is the least raised system is supported by the fact that the two most conservative speakers, Jonathan and Ray were in fact categorized as A. The three most advanced speakers, however, belonged to different categories: Linda was B, Kate was C, and Violet was D.

4.3.5.2 Based on ANOVAs

Now let us return to the issue of the comparative impact of the following segment. As described in section 4.3.3.1, ANOVAs found that twenty-one out of thirty-six respondents (58.3%) had significantly different pairs in their systems where manner of articulation of the following segment was concerned.

Sixteen of these twenty-one systems had significant differences between nasal and other segments, most typically voiceless stop and voiceless fricative, while other pair comparisons turned out to be not significant, except in three systems. In these systems, at least one pair was significantly different within the comparison of obstruents. In five other systems, following nasals did not differ from other segments, but there were significant differences among obstruents, such as pairs of voiced stop-voiceless stop and voiced stop-voiceless fricative. Since these five systems did not recognize the major distinction between nasal and obstruents, they were not different from the system which did not find any differences in the F1 scores at all. Figure 4.11 illustrates the differences and similarities in the effect of manner of articulation of the following segment (based on the mean of F1 scores) which are realized in individual systems.[11]

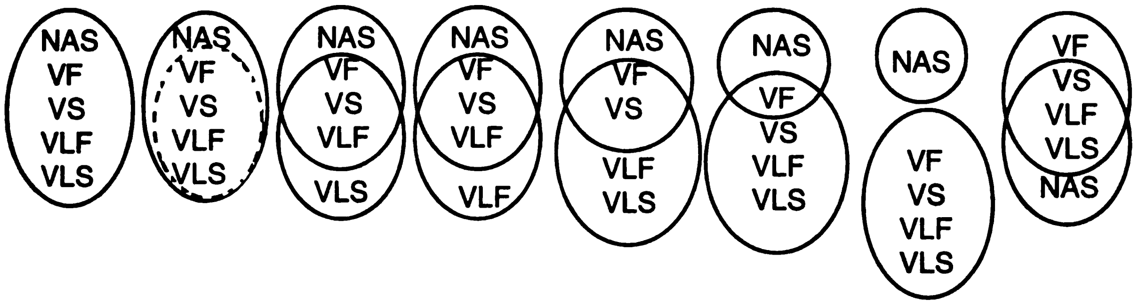


Figure 4.11: Differences and similarities of the effect of manner of articulation, based on the result of ANOVAs

In fifteen (41.7%) respondents' systems, manner of articulation of the following segment did not make any significant differences in the mean of F1 scores (system 'Ia'). System Ib is a variation of this system, since a few differences were found only among obstruents (shown in the broken circle). In total, twenty (55.6%) respondents had one of these systems.

In system IIa, the mean F1 scores of (æ) with following nasals was significantly different from the mean with following voiceless stops but not different from other segments, namely following voiced fricatives, voiced stops, and voiceless fricatives. In addition, there was no difference among obstruents. Three respondents had this system. In system V, the mean F1 with following nasals was completely different from the mean with all the other four subgroups, while no significant difference was found in comparisons among these four obstruents. Only one respondent had this system. Throughout the systems IIa to V, following nasals produced vowels

[11] The differences among obstruents were ignored for simple representation (e.g. pairs of voiced stop-voiceless stops, voiced fricative-voiceless stop etc.)

with lower F1 (i.e. higher position in a vowel space) than following voiceless stops and/or voiceless fricatives. Thus, following nasals were the major source of higher vowels, following voiceless obstruents were the major source of lower vowels, and there were no distinctions among obstruents. The results correspond to those of the t-tests.

System VI was the only exceptional case in which following nasals were significantly different from voiced fricatives, in which nasals producing significantly higher F1 (i.e. lower position in a vowel space) than voiced fricatives. Rick, a middle-class man, had this system.

Except for system VI, there is a pattern in the configuration of the effect of manner of articulation of the following segment. At one end, there are no differences among the environmentally conditioned variants, and at the other end, more differences were observed. It suggests that these incipient shifters are not randomly shifting their vowels, but are doing so based on some phonetic principles.

There were no specific patterns with respect to demographic facts on respondents in most cases from I to III. For example, twenty respondents had system I and they are equally divided by age, gender, and status: ten younger respondents and ten older, ten male and ten female respondents, and eleven working-class and nine middle-class. The more advanced systems (IV and V), however, were found only among young female respondents.

4.3.5.3 Combination of the results of t-test and ANOVAs

In this last section, the intersection of the results of t-tests and ANOVAs is examined. In Table 4.18, Roman numerals represent patterns based on ANOVAs (shown in Figure 4.11), and letters (columns) represent patterns observed in t-tests (shown in Figure 4.10 and Table 4.17).

Table 4.18: Summary of individual systems according to t-tests and ANOVA pattern

	A more conservative	B minimally raised	C more advanced	D mixed	Sub total
Ia	4	9	2	0	15
Ib	2	0	3	0	5
IIa	0	1	0	2	3
IIb	1	1	0	0	2
III	3	1	2	1	7
IV	0	1	1	0	2
V	0	0	1	0	1
VI	0	0	1	0	1
Sub total	10	13	10	3	36

From the least raised system (A) to more or less raised system (C), the majority of the respondents' system was Ia. Only D is unused in this respect with two speakers in IIa. System III was found to occur regardless of the degree of raising (A through D). Less dispersed systems (IIa and IIb) were found among A, B, and D, but not C whose system is more or less raised than others. More dispersed systems (IV, and V) were found only among respondents who had minimally raised or had more or less raised systems (B and C). In fact, these respondents were all young females.

As seen above, although there is variation in the height of (æ) with respect to manner of articulation of the following segment, the differences in the mean of F1 scores based on the environment failed to reach significant differences in more than half of the respondents' systems, regardless of their degree of raising. This tendency was not found among three respondents who had exceptionally wider vowel targets. In the rest of the respondents' systems, following nasals produced vowels significantly different from at least one of the obstruent environments. Though fewer than half of the respondents had such differences, there was a pattern among these respondents. Those who had more conservative systems did not have a wide dispersion of (æ) based on the following segment, but those who had more advanced systems tended to have more dispersion. Thus, the degree of advancement of the shift and the configuration of the effects of the following segment seem to be related.

4.4 Summary

Residents of northern Michigan are participating in the NCS, but the degree of participation is limited to the first step — low front vowel shifting — and only at a minimal level. Fronting was more common among working-class than middle-class, and among female than male respondents, and the differences were statistically significant. Age difference, however, was not observed. As for raising, there was not much difference across the speakers, except the fact that the most advanced three speakers were female while the most conservative speakers were two young boys.

As for the effects of the adjacent segments, manner of articulation of the following segments was most reliable for both raising and fronting. The results support previous findings of the effects of following nasals as favoring and voiceless stops as disfavoring factors. The effect of preceding stop + liquid — another well-known disfavoring segment — was also confirmed. The effect of point of articulation of the following segment, however, was not observed among these respondents for raising, although some environments were distinctive for fronting.

Although there was as not much variation across the speakers where overall height of (æ) was concerned, variation was observed where manner of the following segment was concerned. The comparison of the vowel target with reference to the mid vowel showed that (æ) is indeed shifting toward a higher position, and young female respondents seems to be leading the shift. Although promoting and demoting segments were found in t-tests, ANOVAs found no differences in the mean of F1 scores of (æ) with respect to manner of articulation of the following segment in the majority of the respondents' systems. Where differences were found, a major distinction was observed between nasals and voiceless obstruents. The degree of difference between nasals and obstruents was greatest among young females. The cross examination of the results of t-tests and those of ANOVAs suggest that less raised speakers tend to have less dispersion in the arrangement of (æ), while more or less raised speakers tend to have more dispersion. It was young female speakers who raised most and who had most dispersion. Both the linguistic and social details of these factors (and the correlation of the two) will be provided in detail in the next chapter.

Chapter 5

DISCUSSION

This chapter attempts to understand the results reported on in the previous chapter, and seeks to know what these results mean. In the first half of the chapter, the findings of this study will be compared with previous work. Then, possible phonetic and phonological reasons for the variation will be explored. In the second half of the chapter, the results will be examined with respect to social factors (age, social-status, network scores, sex and local loyalty).

5.1 Linguistic facts

5.1.1 Incipient participation in the NCS

The previous chapter has shown that the diffusion of this urban sound change has not yet advanced much in this rural community. The participation in the NCS among residents of northern Michigan is limited to the first stage as revealed in the position of the (æ) class with reference to the mid vowel in the majority of the respondents. For most speakers, (æ) is only minimally raised: the vowel is only as high as /ɛ/. The reversed position of (æ) and /ɛ/ was observed in only three female respondents' systems. The system of the two most conservative speakers was not so different from that of the DARE man. This finding supports the general pattern of geographic diffusion of the NCS — a modified wave model (i.e. change spreads from a focal point to other places, but skips smaller communities between them) (Chambers and Trudgill 1980), as demonstrated in Callary (1975) and Labov (1994). That is, the size of the community is one of the most crucial factors for the advancement of the NCS. Its effect becomes more evident when we compare this rural community and near-by cities, such as Midland and Saginaw, where the spread of the NCS has been documented in Tao (1996, 1997), and Labov, Ash and Boberg (1997), respectively. This issue ('Why is the accommodation to the NCS much slower in smaller towns?') will be discussed in more detail later in this chapter.

5.1.2 Fronting as a preparatory condition for (æ) raising

The data convincingly showed that fronting precedes raising in low front vowel shifting (see section 4.2). That fronting precedes raising in (æ) movement was observed in the speech community a whole, as well as in individual systems. For the group, the degree of fronting was more advanced than that of DARE respondents (index 3 as opposed to 2), but the degree of raising was the same as the DARE woman in most respondents' systems (index 2). With respect to individual systems, the degree of fronting is more advanced than that of raising. For example, even the most conservative speakers (Jonathan, Pat, and the DARE man) had at least fronted (æ) in their systems, although raising was not observed in their systems as revealed by the indices (1,2). In addition, the fact that no respondents had a system in which raising occurred without fronting supports this generalization. The only combinations of the index scores among the respondents were (1,2), (2,2), (2,3), (2,5), (3,3), and (5,3), but not (2,1) or (3,2) (see Table 4.1). Therefore, it was confirmed that F2 increase (i.e. fronting) of (æ) is a precondition for F1 decrease (i.e. raising). In other words, nobody raises the low front vowel without fronting first. This is a supporting evidence for Labov's Principle of chain shifting I: 'In chain shifts, tense nuclei rise along a peripheral track' (Labov 1994: 176). Since a peripheral vowel is situated near the outer side of the vowel space, peripherality is achieved by fronting in the case of front vowels. Thus, it is fronting that makes /æ/ become peripheral. Labov's principle predicts that a vowel cannot be raised unless it becomes peripheral, which is the exact case which was observed in the data. Other related issues concerning the early adopters of fronting (the working-class and female respondents) will be discussed later in this chapter, when social factors are discussed.

5.1.3 The effect of adjacent segments

The results confirm that adjacent segments influence the degree of shifting of the low front vowel. Among them, manner of articulation of the following segment was the most influential, as described in the literature (see section 4.3.3). The effect of point of articulation of the following segment on fronting (section 4.3.2) and the effect of preceding segment on both raising and fronting (section 4.3.1) were also observed, but their effects were relatively minor in the present data.

Within manner of articulation of the following segment, the results of the present study correspond to previous findings with respect to the most favored segment and the least favored segment: following nasals promote for raising and fronting and voiceless stops retard the shift. The relative effects of remaining segments were slightly different for raising and fronting, and different from previous studies: voiced obstruents were more favored than their voiceless counterparts in raising, while fricatives were more favored than stops in fronting. But these differences between raising and fronting as well as the difference from previous studies may be minor, since ANOVAs seldom found significant differences among obstruents.

The fact that the effects of adjacent segments reported on here are very similar to the previous findings supports Callary's (1975) conclusion on the incipient raisers in rural communities: rural residents were raising the low front vowel only in well-established environments observed among advanced NCS speakers. Moreover, patterns observed in the results of both t-tests and ANOVAs in this study demonstrated that phonetic effects are quite rigid throughout the community. Thus, when we focus on the effects of adjacent segments, it can be concluded that rural speakers' accommodation to the NCS in this study is more or less determined by the phonetic facts.

Although the data showed interesting patterns, the present analysis is still limited due to a small number of tokens. For example, even though the data showed that preceding segments also play a role in vowel shifting as observed in Gordon (1997), the data did not allow us to explore details of its effect due to a lack of following segment variety. Some of the categories were excluded from analysis because of a singleton set (e.g. preceding palatals, following laterals). In order to tease out fine differences between the effects of following and preceding segments, we need to examine all possible combinations, and this was beyond the focus of the present study. Separate studies, including more controlled ones (e.g. laboratory experiments), focused on adjacent segments seem to be necessary in order to explore the low-level phonetic effects on (æ) shifting. In such studies, alternative coding systems such as those reflecting different models of feature geometry should be considered. These studies will help us not only to understand the phonetic regularity of this sound change, but also to evaluate whether the phonetic regularity is universal across the speakers regardless of their social affiliation, or association with a particular group of speakers and/or the stage of the shift (i.e. incipient vs. final). In either case, this line of research will enrich our understanding of the low-level relationship between the linguistic factors and the social factors in this sound change.

5.1.4 Trajectory of the target space of (æ) vowel

Although there was almost no variation in the degree of (æ) raising overall, there was variation where manner of the following segment was concerned. The data showed that the target of (æ) in a vowel space is shifting upward (see Figure 4.10 and Table 4.17). This is true for the whole group as well as for individuals. As a group, vowel systems were shifting from a not so raised system, A (where some adjacent segments produced vowels significantly lower than the mid vowel), to a more or less raised system, C (where some adjacent segments produced vowels significantly higher than the mid vowel). Within individual systems, the target of (æ) covered a wide range, from the most advanced tokens (such as with following nasals) to the most conservative ones (such as with voiceless obstruents). This confirms the idea that the process of this vowel shifting is phonetically gradual (c.f. the Neogrammarian's argument). Since there were only three speakers who had extremely wide targets for (æ), this suggests that speakers do not normally prefer having a wide target territory for the vowel. The reasons for this could reflect functional and communicative aspects of language: it is more difficult for listeners to understand phonemes with large phonetic target areas, so a speaker avoids such problems.

5.1.5 The differences and similarities of the effect of manner of the following segment

Although perhaps not statistically justified, ANOVA results suggested a pattern in the way the relative effect of manner of the following segment was organized. Respondents' systems varied from one in which no difference was observed among the following segments to one in which following nasals were completely different from other segments (see section 4.3.5.2, Figure 4.11). When a difference was identified, the major difference was found between nasals — the most promoting segment — and voiceless obstruents — the most retarding segments — across the speakers. This is another piece of evidence that supports the notion that the variation of (æ) is phonetically controlled among these incipient raisers. It can be said that speakers are incorporating this new norm into their speech by using expected phonetic resources in advancing their degree of accommodation to the NCS despite the fact that they are still incipient participants. In other words, the effects of adjacent segments are more or less deterministic at the beginning stage of the shift.

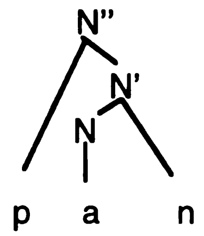
5.1.6 Possible explanation for the effects of adjacent segments

The findings summarized above support the notion that the variation of (æ) is phonetically controlled, not arbitrarily chosen by speakers (cf. Callary 1975, Keiser et al. 1997, Labov 1994, Labov et al 1972). In this section, possible phonological and phonetic explanations will be explored for why manner of the following segment is most influential in (æ) shifting.

The fact that the following segment is more influential than the preceding segment seems to be very reasonable from a phonological point of view, more specifically due to a universal assimilation tendency: in world languages, regressive assimilation is more common than progressive assimilation in phonological processes (Bloomfield 1933:372). Thus, it is not surprising to find that the effect of manner of articulation of the following segment is more crucial than that of the preceding segment.

The dominant role of the following segment over the preceding one can be explained by an appeal to syllable structure: the organization of sound is not linear but hierarchical, or multi-layered as shown in (1).

(1) syllable structure (Kenstowicz 1994:253)



(1) reflects Levin (1985), where she proposes that the syllable is a projection of the single category nucleus, represented by N in (1). In this view, a coda is seen as the complement of a nucleus, dominated by the first projection N,' whereas an onset is adjoined on the next-level, N". Thus, a coda is structurally closer to a nucleus than an onset. Because of this hierarchical organization, a postvocalic segment (i.e. coda) could be more influential on vowel quality than a prevocalic segment (i.e. onset) because of its structural proximity. The notion of syllable structure also appears to predict that the same segment would have a different impact depending on its position in a syllable, due to the hierarchical organization of sounds. Because of the lack of segmental variation, the present study could not examine this prediction, but future study will explore whether this is true or not.

As for the fact that the manner is very important, but place does not play as large as a role in the course of (æ) shifting, one of the possible reasons seems to be related to phonetic facts. It is known that manner of articulation influences the acoustic property of sound (Jannedy, Poletto, and Weldon 1994:53). As illustrated in Chapter 2, the shift in the perceptual height of nasalized vowels is one example of this. Another related fact seems to be contextual effects on vowel duration (House 1961, Klatt 1975, Peterson and Lehiste 1960, van Santen 1992).

Van Santen (1992) reports that voicing and manner of a postvocalic consonant have significant effects on vowel duration, but place of articulation does not have such an effect. This seems to have nothing to do with (æ) shifting at a first glance. However, if we consider the quality of advanced (æ) tokens, this may not be irrelevant. In the course of fronting and raising associated with (æ) movement, the vowel develops an inglide (e.g. Labov et al. 1972, Labov 1994). It is plausible to speculate that the development of the inglide is partly achieved by increasing duration. Since fronting is a preparatory condition, and the tense-lax distinction is often labeled as the long-short distinction, this speculation seems to be in the right direction. In addition, there is another coincidental fact which supports this speculation. Van Santen (1992) finds that vowels were shorter when they were preceded by a stop-liquid cluster (531), which is the most retarding preceding environment for fronting.

With respect to voicing, the data corresponded to van Santan's study: vowels were more raised before voiced consonants than before their voiceless counterparts. However, the effect of relative influence of voicing and manner of the postvocalic consonant in vowel duration does not directly correspond to the order of preferred segments which were reported here (on both the F1 and F2 dimensions). A summary of van Santen's findings is given in (2):

(2) Relative influence of vowel duration with respect to voicing and manner of the post vocalic consonant:

vd fricative > vd affricate > vd stop > nasal > vl fricative > liquid > vl affricate > vl stop (van Santen 1992:529).

Klatt (1975) reports similar results, but in his data there were no significant differences in the effect of voiceless fricatives, nasals, and voiced stops.

Lack of direct correspondence between the relative influence of the following manner in vowel duration and vowel shifting might suggest that there is no relation between these two facts. However, the fact that manner is more important than point of articulation is still valid. It can be speculated that the effects of manner of the following segment (ignoring the detailed facts on the relative influences within the group) on vowel duration can be the first potential phonetic trigger for (æ) shifting, more specifically for (æ) fronting. In the next step (i.e. raising), the following nasal context will be the first potential factor for raising, due to the acoustic property of nasalized vowels. Without any specific evidence, this is just one of the possible speculations. However, it is hoped that this will bring up issues which researchers need to consider in investigating phonetic and/or phonological accounts for the effects of adjacent segments. Future studies need to be done in order to explore this speculation and other possibilities.

In this section, linguistic factors, specifically the effects of adjacent segments, were examined. In the next, these are incorporated with social factors.

5.2 Social factors

There was not much variation among the respondents in terms of the position of their (æ) with reference to (ɛ), but fine differences were observed where manner of the following segment was concerned. In both cases, the patterns of accommodation to the NCS seem to be best accounted for by sex (or gender), as in other sociolinguistic studies. The effect of social status was minimally observed, but that of age did not show its expected pattern.

5.2.1 Effect of age

The least expected result in the present data is that there were no age differences. As for the overall position of (æ) with respect to /ɛ/, no radical differences were observed between parent-child pairs, or between parents' generation and the DARE respondents (see Table 4.1 and 4.5). Although the younger generation is expected to be more advanced in a change in progress, here only one of the three most advanced speakers was a younger (female) respondent, and both of the most conservative speakers were younger (male) respondents. The lack of age effect was also observed in the advancement of raising in terms of following manner (cf. Table 4.17). Table 5.1 shows additional information on the distribution of respondents by age.

Table 5.1: Distribution of respondents by age

System	Number of respondents	young	old
A (not so raised)	10 (27.8%)	6 (31.6%)	4 (23.5%)
B (minimally raised)	13 (36.1%)	6 (31.6%)	7 (41.2%)
C (more or less raised)	10 (27.8%)	6 (31.6%)	4 (23.5%)
D (mixed)	3 (8.3%)	1 (5.2%)	2 (11.8%)

$X^2 = 1.103$ (3df) $p = 0.776$ (n.s.)

Although slight differences between the younger and older generations were found, (i.e. the three systems were evenly distributed in the younger generation, while in the older generation, the majority had minimally raised system), there was no statistical difference between these two age groups (chi-square 1.103, n.s.).

As for the dispersion of (æ) class assessed by ANOVAs (cf. Figure 4.11), more dispersed systems (such as IV and V) were found only in younger respondents, as summarized in Table 5.2. This is an interesting fact, since this is the only place where we found some kind of age differences. However, since ANOVA analysis is used here as an experimental tool, it is not clear whether this distributional difference is accurate or not. In addition, it seems that the difference is not due just to age, but to sex (or gender) difference, because these three respondents all happen to be young females, not males. Thus, the results in general did not show any age differences.

Table 5.2: Distribution of respondents in ANOVA analysis based on age

	I	II	III	IV	V	VI
young	10	3	3	2	1	0
old	10	2	4	0	0	1

Because the NCS is a case of 'change from below,' the lack of age difference appears to be very strange. The results seem to suggest that the diffusion of the NCS in this area is simply an extremely slow process. Since the diffusion is so slow (mainly due to demographic and geographic factors), we do not see as much generational difference. These demographic and geographic factors seem to limit the chance of exposure to the NCS for these respondents. As a result, younger people do not sound much different from older people. However, as we will see in the later chapter, some respondents, especially some young females, accommodate their speech more than others. This seems to be related to their attitude towards urban culture and local life.

5.2.2 Effect of social status

Fronting was clearly led by the working-class, although that tendency was not observed in raising (see Table 4.1 and 4.2, respectively). No social status differences were observed in the advancement of raising in terms of the following manner or the dispersion of (æ), as shown in Table 5.3 and Table 5.4, respectively.

Table 5.3: Distribution of respondents by status

System	Number of respondent	Middle	Working
A (not so raised)	10 (27.8%)	5 (29.4%)	5 (26.3%)
B (minimally raised)	13 (36.1%)	7 (41.2%)	6 (31.6%)
C (more or less raised)	10 (27.8%)	4 (23.5%)	6 (31.6%)
D (mixed)	3 (8.3%)	1 (5.9%)	2 (10.5%)

$X^2 = 0.701$ (3df) $p = 0.873$ (n.s.)

Table 5.4: Distribution of respondents in ANOVA analysis based on status

	I	II	III	IV	V	VI
Middle	9	2	3	2	0	0
Working	11	3	4	0	1	1

The fact that a working-class lead was observed only in fronting strongly supports general sociolinguistic findings, i.e. that is the working-class responds first to new changes. Because of their infancy in the NCS, no difference was observed in raising, either in overall position of (æ) and in segmental effect (chi-square 0.701, n.s.). This limited effect of social status might partially reflect the structure of the local community. In contrast to urban areas where social hierarchy is more obvious and complex (through occupation, residential areas, and diversity in ethnicity etc.), social stratification is not so apparent in rural areas. It can be speculated that residents of less socially stratified communities may have no motivation to differentiate themselves from other social groups. As a result, their speech patterns are not so different from one to another.

5.2.3 Effects of social network

There were no significant differences in raising but fronting with respect to social network scores. However, there were interesting correlations between network scores and the sex and social status of the speaker. maybe this explains the more shifted dis

Milroy (1980) shows that people who have open (or loose) networks in their local community are more likely to accept a new change that originates outside their local community, while people who have close-knit (or strong) networks are less likely to accept a new change, as they tend to maintain and enhance their local vernacular. In this study, it was the working class who had significantly lower network scores than the middle class. A t-test showed a significant difference in the network scores between the middle class and the working class ($p = 0.042$). In addition, a Pearson correlation test found a negative correlation between the socioeconomic score index (SES) and social networks scores ($-.44$, $p = 0.007$): the lower the SES (i.e. higher in the social status), the higher in the network scores. The fact that people with close-knit networks (i.e. the middle class) are less advanced in tensing than those with open-knit networks (i.e. the working class) corresponds to Milroy's proposal: strong social networks reinforce the use of local speech, which reflects a speaker's strong sense of solidarity and loyalty to that community, whereas weak social networks in the community allow speakers to be more accessible to non-local speech.

The pattern observed here (i.e. the working class has a more open network than the middle class) is somewhat different from the typical case. Usually, it is the working class that tends to have strong ties to their community, resulting from having relatives and co-workers in their neighborhood and interacting extensively with their co-workers outside of work, and these ties are strengthened by multiplexity. In this study, it was middle class respondents who had relatively denser social networks than the working-class. It is not obvious why this pattern appears among these respondents. Dennis Preston (personal communication) points out that it could be related to the structure of the local society and its economic conditions. In contrast to a typical urban working class, rural working-class people are facing a different social reality. In an area where there are no major industries, working-class people may need to work in small factories and local businesses with a few co-workers, or need to find jobs outside the local community. They also may need to be more transient because of the lack of job security. Once an economic problem impacts the area, and small factories and local businesses decide to lay off workers, they need to move somewhere else. Middle-class people, on the other hand, tend to have more secure jobs, and they are more likely to be able to stay in the area. The strong network in the community among the middle-class seems to be well-illustrated by the cases of Pete and Rick (two middle-class men from Gladwin). Pete, who is a CPA, told me that how hard it was to come back to the area, especially for college graduates. 'You cannot come back to a job, you have to create a job.' That is how he started his business. In fact, his brother and sister came back to the area in order to work in Pete's office, and later they started their own business. As a result, he has relatives in the local community, and most importantly, his business requires him to work with people in the same community. Thus, Pete is well-connected with people there. Rick is a third-generation farmer, and owns a farming cooperation with his family (parents, relatives, and children). In fact, his parents live next door, his brother, his cousin (John, another respondent) and his son live just a few miles away. Since his work associates are his own family, his network is multiply-related. In contrast to these two middle-class men, Chad (a working-class man from Gladwin) works at a large company in Midland. Unlike urban factory workers, he needs to commute more than forty minutes every day, and does not have any coworkers from his neighborhood. His work requires him to spend more time people from other than the immediate community, and, as a result, he has open networks. These patterns in employment seem to be a norm in the area. A comment from Lisa (a middle-class girl from Harrison) supports this. She expressed that the town is run by a particular family, and 'most people who are well-off, who are doing OK financially, they either have a business here or travel (i.e. commute to surrounding work centers, such as Midland, Standish, etc.).'

Another interesting correlation was found between the sex of the speaker and network scores. A t-test confirmed that women's network scores were significantly lower than men's (p = 0.02). As the theory of social network predicts, women are indeed accommodating their speech to the NCS more than men. More detailed effect of sex (or gender) will be discussed in the next section.

5.2.4 Effects of sex (gender)

In the present study, sex of the speaker was the only social factor which influences variation of (æ): women are participating more in the NCS than men. Though there was no statistical support for the variation of raising due to the lack of variation in the F1 dimension, there was an interesting distributional pattern in that the three advanced raisers were all female speakers and the two most conservative speakers were boys (see Table 4.1). With respect to fronting, a statistical difference was found between male and female respondents' systems, with women in the lead (see Table 4.3 and 4.4). In the low-level variation, young women used following nasals as a maximal raising environment, which is in fact the most established environment for raising among urban speakers, and the most natural one due to phonetic facts (see Table 4.16). In addition, women had more or less raised systems based on following manner, though the difference did not reach the level of significance (chi-square 6.226, p=0.010, n.s.). Table 5.5 shows this.

Table 5.5: Distribution of respondents by sex

System	Number of respondent	Male	Female
A (not so raised)	10 (27.8%)	8 (44.4%)	2 (11.1%)
B (minimally raised)	13 (36.1%)	5 (27.8%)	8 (44.4%)
C (more or less raised)	10 (27.8%)	3 (16.7%)	7 (38.9%)
D (mixed)	3 (8.3%)	2 (11.1%)	1 (5.6%)

$X^2 = 6.226$ (3df) $p = 0.101$ (n.s.)

Although sex difference did not reach the statistically significant level, its probability is much higher than those of age or status factors (p=0.776, 0.873, respectively). Thus, it seems that it shows a trend.

Although the ANOVA analysis is experimental, more dispersed organization of (æ) were observed mainly among women, particularly young women, as shown in Table 5.6.

Table 5.6: Distribution of respondents in ANOVA analysis based on sex

	I	II	III	IV	V	VI
Male	10	3	4	0	0	1
Female	10	2	3	2	1	0

These results confirm that females tend to be early innovators of a sound change in progress (e.g. Labov 1990, Trudgill 1972). The results also correspond to those of Eckert (1989), who states that older steps of the sound change in the NCS serve as a sex marker among teenagers in suburban Detroit. In addition, the fact that young women use following nasals as a maximal environment for raising suggest that these young women are learning a new vowel system in the expected way, because the way they are modifying their vowel systems matches the pattern observed among urban speakers, one which also reflects phonetic facts.

Several accounts of women's lead in sound change have been offered in the literature. Trudgill (1972) introduces a notion of 'overt' and 'covert' prestige. He argues that women rely on overt prestige which is associated with standard usage while men use covert prestige which is associated with toughness and locality. Eckert (1989) and Eckert and McConnell-Ginet (1995) explain it with the notion of linguistic capital: women need to rely on linguistic capital due to their lack of access to real power. In the present study, the differences between men's and women's degree of accommodation seems to fit both Trudgill and Eckert's account. One of the possible reasons for the gender differences in the degree of accommodation might be related to the urban characteristics of the change and the differences in the way each group evaluates it. That is, urbanness might mean something different for men and for women. Hock and Joseph (1996) state that beyond the urban Chicago area, the new sound change[1] has been 'reinterpreted as a relatively prestigious sign of urbanization' although within Chicago, it is considered as low in prestige, associated with 'white, male, even macho, working-class' (346-7). As a result, beyond urban centers, the change has been seen as a sign of fashionableness, and women are generally encouraged to be 'more conscious of trends in fashion than men, therefore are more likely to adopt it' (347). This reinterpretation process seems to be true among rural Michiganders as well. That is, women tend to value the association with urbanness as positive, while men tend not to value it. Overt prestige could be achieved by accommodating to the urban sound change, while covert prestige could be achieved by delaying accommodation to it. Some supporting evidence is drawn from the interviews.

[1] Hock and Joseph call the sound change the 'Chicago Sound Shift' but it seems obvious that it refers to the NCS.

For example, a lack of the cultural events available in cities, such as concerts, plays, and shows, was pointed out as a disadvantage to living in the community by several women (e.g. Kate, Sue, Linda, and Trish), but such things were never mentioned by men. Another point was mentioned by Nina (a working-class girl from Gladwin), who received index scores of 2 and 2 for the overall position of (æ), but had a more or less raised system based on the environment (C), and used following nasal as the maximal raising environment; she also had the most dispersed system (V). She and her friend, Betsy[2] expressed how hard it is to catch up with things that are 'cool' in cities, as the following shows[3]:

(3) R: Do you think people in bi- big cities are different from the people from smaller town?

B: Yes, **they have a life, we don't**.

N: They they like-

R: (laughter)

N: They like- **They experience a lot more** and-

B: Yeah. **They have a life, we don't**.

---

[2] As Betsy was not born and raised in the area, she was not included in the analysis.

[3] The transcription system used here is roughly the one devised by Gail Jefferson summarized in Schenkein (1978). Because of the purpose of the transcription, irrelevant details were ignored (such as simultaneous speech). Relevant parts of the speech are in boldface.

N: If you put me somebody from a big city and somebody like me and Betsy, you know. If you're gonna put me and Betsy with somebody like from a BIG city

B: It's hard.

N: We're like **reTARDed.** Not retarded but

B: Yeah.

R: In what sense.

B: That's the thing. You really **have to struggle** to keep up conversation

N: Right. I mean it's **really hard.**

B: To keep up to date with things like **fashion** and **what's in**...Just things that are hip and doesn't come to us later. So you really have to struggle and keep ahead of the game. If you have friends and people you meet a lot. Cause like we don't go dancing. We don't, you know. **We don't get the newest songs** on our radio stations. Our radio stations get songs like **AFTer they've been you know played for a while**. Just stuff like **clothes**. We have to like- **you really have to watch magazines and stuff to keep up that.**

N: Right. So it's kinda like- I mean you considered us actually like retarded I guess but maybe we're not retarded but

B: **Really behind times.**

N: Yeah.

R: Hmmm.

N: Cause I guess it's like putting the 60's with the 90's or-

B: Not quite that bad though.

R: (Laughter)

N: Yeah.

B: I'd say we're **about six months behind times.**

R: Hmmm.

N: **But that's still a LOT.**

R: Although you read magazines?

B: Yeah, and stuff but (it's) still **hard to keep up** with all the

N: Yeah.

R: Hmmm.

For these girls, it is very important to 'catch up' to what is going on in cities, otherwise, they feel they are 'retarded' and 'behind.' In this sense, these two girls can identify a model group — which is the first step for changing their behavior (La Page and Tabouret-Keller 1985:182). Girls' need to catch up to things seems to be met by being a member of a certain group within their community in order to represent their value or identity. Jamie and Pat (middle-class boys, who received index scores 2 and 2, and had system B) mentioned that there are three groups in their class and 'practically all the girls are in the "city" group.' These two boys on the other hand, identity themselves as members of the 'country' group.

(4) J: You can say there's mainly...there's probably- probably three groups.

The one group would be like the city people...who ah- **mainly care for fashion, looking good** and all that stuff. And there's another group which is country people who talk about like **hunting, paintball, um.. cars, bikes and all that stuff.** Then there's another group which is mainly a low percentage which are the people who hang around each other that probably do drugs and stuff like that.

R: Do you think you belong to one of those?

J: I mainly stay in the country group.

P: Yeah.

J: Yeah. Yeah. The more of the city people more tend to be more involved with like basketball. Seems to be their main sport. It's like...It's like you gotta be good at basketball.

R: Not football?

J: Football is a more of a city sport mainly played by people who live in the country.

P: **Cause it's rougher and people who live in the city, normally don't like to-**

J: **To play rough sports**.

R: So how- suppose I go to your school then how can I identify them? The way they dress?

J: **The way they dress.** Most of the city people have probably gold necklaces, wear sports clothes, basketball jerseys and then the um Nike stuff and stuff like that. And then the country people more like wear like boots and blue jeans and stuff like that. Most of them have shorter hair. ..... **Practically all the girls are in the city group**. Like all of them.

P: Yeah, yeah.

J: **They are all... JUST in the latest fashion.**

According to Jamie, the difference between city people and country people is found their favorite sports, and most remarkably it is marked by the way the dress. City people 'care for fashion and look good' and they are 'all JUST in the latest fashion,' while country people wear just boots and blue jeans and do not care much. City people like to watch football but do not play because they do not like to play 'rough' sports. Football is played by country people. If we combine the comments made by Betsy and Nina, those who want to associate themselves with people in urban areas, (i.e. Betsy and Nina, and city people of Jamie and Pat's class) are not only identifying a model group, they also are modifying their own behavior in order to associate themselves with the model group (the 'second step' of modifying one's behavior in La Page and Tabouret-Keller 1985). The contrast between these two groups seems to be quite sharp.

Most interestingly, membership in the city group seems to be expressed by a certain attitude, or at least seems to be perceived to be associated with a certain attitude by other groups. An example is given in (5), where Jamie and Pat state how they see members of the city group.

(5) R: Hmmm. But city people don't mean that they are from the city of Gla-

J: Most of them are. You see like most of the people who hang around the city group who live right next to each other. They all live on, what road is that.

P: I don't know. I don't think anybody knows. It's kind of referred to as **snob-knob.**

J: Yeah, because most of the city people are more like **stuck up and snooty to people. Think they're better than everybody else, things like that.**

R: They THINK, right?

J: Yeah, they think and most.. some of them are, some of the girls. And they all like live in one area next to each other.

P: Yeah.

Even within a small town, the place where city-oriented people live is referred to as 'snob-knob,' and city people act like 'they are better than everyone else.' That means that city people strive to look good, and maybe because of their orientation, they are perceived to be snooty and to think that they are better than anybody else. Their attitude is perceived negatively by the country people. There is an interesting parallel: people from cities are also perceived to display the same attitude. This is well-illustrated in the conversation of Adam and Lily (a working-class mother and boy). Adam told me that he likes to live in Gladwin although teens in Flint make fun of his hometown by referring it to as 'Hicksville.' When he was asked about the differences between the people in big cities and the people in smaller towns, he mentioned the difference in attitude.

(6) R: Do you think people in big cities and people in smaller towns are different?

A: **Yeah. Their attitude. They think they are high and mighty...better than everyone.**

L: **Better than us.**

It seems that there is an interesting match between the attitude of the model group as perceived by local people, and that of the local people who want to associate with the model group. The city people are modifying themselves not only at a surface level (i.e. the way they look) but also even a deeper level (i.e. their attitude).

The attitude of people from cities is negatively commented on by a few other respondents, as shown in (7) and (8).

(7) (Raymond, a working-class man): During deer season, they are so rude.

(8) (Shannon, a working-class woman): It's like they've got money so affluent. You don't come here to take over everything.

As noted in Chapter 3, the area does not have any industries and relies on tourism. Raymond and Shannon's concerns reflect their hostility towards people from cities because of their attitude (rudeness and affluence). Their concern might reflect fear (i.e. these people might take over our place someday) or protest (i.e. these people should not be able to do whatever they want to do in our place). In either case, the attitude of people from cities is evaluated negatively by these local people.

The behavior of people from cities was sometimes seen as absurd by local people, despite the fact that those people are perceived to think that they are better than people from small towns. The following excerpt is drawn from the interview with Colin (a middle-class boy).

(9) R: Do you think that people in big cities are different from the people from small towns?

C: Oh, yeah. You can always tell during deer season.

R: (Laughter) More aggressive?

C: Oh, they come up and you know they're the guys wearing all brand new clothes, and they'll come in and. They'll be like ((in a different voice)) Yeah, I was out there for half an hour, and I didn't see any deer so I came back in.

R: What do you expect. (Laughter)

C: And you'll hear 'em. You'll always- you can always tell the city guys, cause they'll have the 50 pound deer. They'll have these little tiny deer and they'll be showing 'em off because they can't wait for any bigger ones. **When you're talking to people, you can tell.**

According to Colin, the behavior of hunters from the city is totally at odds with the behavior of real hunters for various reasons: (1) they wear brand new clothes, (2) do not have patience, (3) shoot small deer, (4) and are proud of themselves. Thus, hunters from the city do not get any respect from local hunters; they are only laughed at. Colin's comment on the speech of city people is also interesting, although we do not know whether he can tell the difference by the content of their talk or the way they talk, or a combination of both. But, at least, he notices the difference. Colin's comment on hunters from the cities comes from being a real hunter himself. When Colin's brother, Pat was interviewed (separately), he commented on how Colin hunts: he waits patiently until something that is worth hunting shows up in the field.

Hunting is a very tough and masculine sport, and a big part of men's life in the area. According to Jamie, '[i]t's a kind of town most people hunt and live in the country. Most people hunt and watch high school sports, that's about it.' In fact, more than half of the male respondents (ten out of eighteen, or 55.6%) hunt as a hobby. Thus, hunting could be a symbol for masculinity in the countryside. It seems not too illogical to speculate that urban life is not attractive for these male respondents. Since fast and fashionable urban life does not appeal to the people who want to be macho and tough, men are less likely to have desire to accommodate their speech to urban speech, even unconsciously. In other words, the speech of the NCS does not appear to have any covert prestige value for men. In order to maintain a tough-guy status, they delay their accommodation to the sound change, or if they indeed accommodate to it, they delay the process as much as they can. Having some tokens in a very conservative area in the vowel space (i.e. in the assumed pre-shifted position) might mark for their identity. In other words, their conservative pronunciation of the low front vowel with the voiceless obstruents might serve as a sign of their 'toughness.' Such an unconscious strategy is most natural since these segments are expected to retard raising due to phonetic and/or phonological facts.

In contrast to men, women tend to value urbanness as a positive value, and this might be partly due to the fact that women feel pressure to adopt mainstream culture in order to be a desirable and successful person. Thus, women are seen be encouraged to accommodate their speech to the urban sound change. In addition to their desire and need for adopting urban trends, women have another motivation for relying on the speech of the NCS. That is, they need to rely on linguistic capital more than their male counterparts, because women do not have access to real power. This might be a driving force for women, especially young women, to adopt the NCS.

As discussed above, differences in their orientation and the differences in reliance on the use of language seem to be one of the keys to accounting for gender differences in the degree of accommodation to the NCS. Differences in orientation are partly related to local loyalty, and which is the last social factor that will be discussed.

5.2.5 Effects of local loyalty

When this study was designed, it was hypothesized that respondents' personal attitude toward their community — local loyalty — would be a powerful predictor for assessing degree of participation in the NCS. However, since this factor is not predictable until interviews are done, we could not control for it. It was hoped that respondents would be equally divided into two groups (half of them 'locally loyal' and the other half 'non-locally loyal'), and preferably some would be at the extremes ('very locally loyal' and 'very non-locally loyal'). However, we could not get this ideal scenario in the present study.

In the interviews, almost all respondents showed their loyalty toward their community. The expressions, such as 'I'm a small town person,' 'I love to be in the country,' and 'This is my home' are used quite often by many respondents. Most of them appreciate the quiet, security, pace of life, beautiful countryside, and the space they have. In addition to these environmental characteristics, the respondents mentioned characteristics of people in the community as well: 'if someone is in trouble, we all help them as a community.' The fact that almost everyone was locally loyal could be one of the reasons why the spread of the NCS is so slow in this rural community.

When the content of the interviews was carefully examined, only five respondents displayed low local loyalty (i.e. Jamie, Nevin, Lisa, Alice, and

Nina): two young boys and three young girls. Although they seemed to be less locally loyal, none of them was 'strongly non-locally loyal.'

Midland has everything... lol

For example, Jamie (a middle-class boy) wants to live in Midland because 'it has everything,' but he still feels that his town is a good place to live because 'there are a lot of things to do. Things are limited but a lot of things to do outside.'

Nevin (a working-class boy) is 'planning to go to a local college to get basic' but not planning to stay in his town: 'Go somewhere warmer... South West.' All his family members know that he is leaving after graduation. But he also displays his appreciation for the area he grew up in. It is well illustrated in his frequent use of agreement back channeling while his brother Jonathan (one of the most conservative speakers who received index scores of 1 and 2) was describing the good things about living in the country.

(10) R: What is the best thing living in this area.

N: Probably seeing different seasons. All the seasons and...

J: I like it here because it's not busy.

N: Yeah.

J: I don't like cities too much.

N: Yeah.

J: Too much going on.

N: **Yeah. I like being in the country.**

R: Hmm. What is the worst thing about living in this area?

N: Kind of secluded...kinda- like I don't know. There's not a lot of people around here so it's- I mean it's kinda like- I kind of like being away from everybody but then other times you just kind of wish there was somebody around just so that you could go- do something. It's a lot easier, but I don't know. **It's not so bad really**.

It is not clear whether his first two uses of 'yeah' actually mean confirmation ('Yes, I'm agreeing with you') or are simply cases of neutral back-channeling ('Yes, I'm following what you are saying'). However, the third 'yeah' is a clear case of confirmation of what Jonathan said. He added 'I like being in the country.' Although he feels secluded, he still admits that 'it's not so bad really.'

Lisa (a middle-class girl) does not 'want to live here' because 'there's nothing really here.' But at the same time, she does not know whether she would like city life if she moves since she is 'a small town girl.'

Alice (a working-class girl) states that she is 'ready to go to other places now' although she still seems to have a positive orientation toward the country. She is planning to leave home after graduation to attend college. The places in her mind are Lake Superior State or Saginaw Valley, and she prefers to 'go north.' Her second choice, Saginaw Valley, is relatively close to home and is in a mid-size city — far from the metropolitan area.

Nina's (a working-class young girl) orientation toward urban culture was obvious as described above and in the following comment: 'I grew up here but I can't wait to leave. There's no opportunity at all.' But she mentions that she would come back when she is older for retirement or even she would not mind settling down to start a family.

As illustrated above, we did not find any extremely locally disloyal respondents in the present study. Even those five respondents who appeared to be less locally loyal were more similar to the locally loyal girl (Tammy), who loves the rural setting and plans to stay, than to the extremely locally disloyal girl (Sherry), who wants to get out of town, in our pilot study (Ito and Preston 1998). Excerpts from these two girls' are shown in (11) and (12), respectively.

(11) R: I see. Uh. So::. Well you mentioned a little bit, but what is the best thing or the advantage or the worst thing or disadvantage to: live somewhere around here?

T: To living somewhere around here? (pause) Um::. **I don't know as there's disadvantages.** Some of the advantages- I look at is- i- **when I- ever I have a family I would rather be up here** because I would be less apt to run into the crime and the gangs and all that stuff. And if you're out in=

[
R: Uh huh.

T: =the country it doesn't happen as often, and - then I wouldn't have to be=

[
R: (whispered) That's true.

T: =so worried about when my kids go out at night and things like that. **So I'd rather live here. Where I know my territory more or less.**

(Ito and Preston 1998:478)

(12) R: Have you ever wished to live somewhere else--

S: Oh: I wouldn't mind living on the la:ke. Higgins Lake, it's like real close to here, and I usually waitress at restaurants out by the lake. So, ... I've often thought that it would be neat to live on the lake, but ... **I'd just as soon get out of Roscommon.** So it doesn't really, I haven't really been (laughs) something I've given much thought to.

R: I see. Um. So, what is the advantage to live ... here?

S: Well, I don't know. Living in California I just- I liked the climate, I liked the place, it's something new. It's just seems to suit to my personality. I like seeing new places. So, ... I guess it would be more ... close to things, than — I don't know, it just clicks with me, so —

R: So what would be the ... worst thing or the disadvantage living here?

S: Living here? Ah- well, **being far from everything.**

R&S: ((laughter))

S: **Living kind of ... sheltered away from, uh —**

(Ito and Preston 1998:478-9)

None of the comments made by the five less locally loyal respondents were as strong as Sherry's: 'I'd just as soon get out of Roscommon,' 'being far from everything,' and '[l]iving kind of ... sheltered away.' Their comments are more compatible with Tammy's. Thus, the effect of local loyalty could not be assessed as neatly as hoped. The fact that there were more respondents in this study (thirty-six respondents) than in the previous study (six respondents) makes it seem that a respondent like Sherry is an extreme case. The contrast we observed between Sherry and Tammy is very dramatic in terms of the relationship between the difference in their orientation and the difference in their degree of accommodation in the NCS. (Tammy is in the second step of the shift, while Sherry is in the third or even possibly the fourth step of the shift.) This type of sharp contrast might not be found frequently. It may be normal to find many locally loyal respondents. Thus, it appears that we need to consider degree of local loyalty (strongly locally loyal to less locally loyal) rather than dichotomizing the respondents into two categories (either loyal or non-loyal). If we incorporate the difference in orientation towards urban life as discussed in the previous section, differences seem to emerge. It can be speculated that people who are less locally loyal and at the same time value urban culture tend to accommodate their speech to the NCS earlier, whereas people who are more locally loyal tend to resist accommodation. In the previous section, it was argued that hunting could be a symbol for masculinity in the country. By the same token, hunters could be considered as most locally loyal. The difference between five less locally loyal respondents and the more locally loyal hunters is examined below to illustrate this point.

Among the five least locally loyal respondents, four had the more or less raised system C (Lisa, Alice, Nina, and Nevin) and one had a minimally raised system B (Jamie). None had a conservative system. The two boys, Jamie and Nevin, do not hunt.

As mentioned in the previous section, six out of the ten hunters had not so raised systems. The other three others had a minimally raised system, and only one had a more or less raised system. Interestingly enough, the hunter with the more or less raised system was Chad (a working-class man) who works at Dow Chemical in Midland, where the NCS is more advanced. Thus, the majority of less locally loyal respondents had more advanced vowel systems, while the majority of very locally loyal respondents had conservative ones.

Without statistical support, this is just a speculation. However, content-based qualitative discourse analysis gave us an insight into how individual's preference and identity towards their local community could play a role in the degree of accommodation to the urban sound change. This supports the position expressed in several other studies (Feagin 1998, Gordon 1997, Hazen 1998, Ito and Preston 1998, Labov 1963).

5.3 Summary

In the first section, the findings of the present study were summarized and compared with those of previous studies. Although it is not perfect, the patterns observed in the results of both t-tests and ANOVAs demonstrate that phonetic effects are quite rigid throughout the community. It was concluded that rural speaker's accommodation to the NCS in this study is more or less determined by the phonetic facts. Possible phonetic and phonological reasons for the vowel shift were also explored. It was speculated that regressive assimilation, syllable structure, and contextual effects on vowel duration were related to the vowel shift. In the second half of this chapter, the impact of social factors was examined. In this rural community, gender seems to be the only factor that account for the variation of (æ), and the gender difference appears to be related to the difference in orientation towards urban culture as well as local loyalty. It appears that women's desire for association with urban culture and their need to rely on linguistic capital motivates them to acquire the NCS earlier than men. This seems to be more salient among young girls than older women. Finally, although this is speculative, individual orientation such as local loyalty seems to play a role in degree of accommodation: the majority of locally loyal respondents had not so raised systems, whereas the majority of less locally loyal respondents had more or less raised systems. Thus, it seems that young women who are less locally loyal and have an urban preference tend to accommodate their speech to the NCS most in the rural community.

Chapter 6

CONCLUSION

This dissertation examined the degree to which a new urban sound change, known as the Northern Cities Shift, has been accommodated to by rural mid-Michigan speakers in both linguistic and social dimensions. By the examination of the vowel spaces of the 36 respondents, this study has provided a description of the spread of the NCS within a rural community, focusing on individual differences, and explored possible explanations for such variation in terms of both social (external) and linguistic (internal) factors.

With respect to linguistic factors, the present study provided a detailed acoustic and statistical account of fronting and raising of the low front vowel. The data convincingly showed that fronting precedes raising in low front vowel shifting. The data also showed patterns in the effects of adjacent segments. It was concluded that rural speaker's accommodation to the NCS in this study is more or less determined by the phonetic facts. Thus, the results supported arguments that the variation of the low front vowel is phonetically controlled (e.g. Callary 1975, Keiser et al. 1997, Labov 1994, Labov et al. 1972). Manner of articulation of the following segments was confirmed as the strongest factor in predicting fronting and raising of the low front vowel. More specifically, fronting and raising of the vowel was promoted most dramatically by following nasal consonants (e.g. *Sam* and *gang*), while fronti

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fronting was demoted most by following stops (e.g. *nap* and *tab*), and raising was demoted most by following voiceless obstruents (e.g. *cash* and *zap*). Although perhaps not statistically justified due to the small number of items studied, a series of ANOVAs suggested a pattern in the way the relative effect of manner of the following segment was organized (and ANOVAs are recommended as a means of study of larger data sets). It was shown that a major distinction in the effect of the following segments in the raising dimension lay between nasals and voiceless obstruents, when such a difference was identified. In contrast to previous studies, the effect of point of articulation was found only slightly in fronting and not observed at all in raising. Although a preceding stop + liquid cluster (e.g. *black*) is known as a disfavoring segment, its effect was observed only in fronting but not in raising. Other preceding segments also seemed to have some impact as reported in Gordon (1997); however, a lack of following segment variety in the present data did not allow us to explore this possibility in detail.

In addition to the description of the effects of adjacent segments, phonetic and phonological explanations for such patterns were also explored. It was suggested that syllable structure and a universal assimilation tendency were responsible for the dominant role of the following segment over the preceding segment. The dominant role of manner over point of articulation in the following segment was to be related to contextual effects on vowel duration.

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The present study also examined whether a correlation could be identified between social factors and the degree of one's advancement in low front vowel fronting and raising. The results showed that fronting was more advanced among the working class than the middle class, and among female than male respondents. These differences were statistically significant. Since the working-class and female respondents had more open networks than the middle-class and male respondents, the results confirmed that network ties in the local community were important in accounting for the degree of accommodation to the sound change. An age difference, however, was not observed. With respect to raising, there was not much variation across the speakers, except for the fact that the most advanced three speakers were females while the most conservative speakers were two young males. These results confirmed the observation that the general pattern of geographic diffusion of the NCS reflects a gravity model (i.e. a new norm spreads from one focal point to an other, but skips smaller communities, Chambers and Trudgill 1980, Trudgill 1983) as demonstrated in Callary (1975) and Labov (1994). Lack of any significant age difference suggested that the diffusion of this sound change was extremely slow in this rural community.

Based on a qualitative analysis of conversational data, the advancement of (æ) movement even at such low-levels as the ones studied here could be affected by individual orientation and identity, even though such accommodation takes place below the level of consciousness. The content analysis of discourse revealed that individuals who appreciated and wanted to

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wanted to be associated with urban fashionable culture and did not mind leaving the community (i.e. less locally loyal individuals) tended to accommodate their speech more to the NCS and, thus, tended to have more or less raised low front vowels (i.e. raising the vowel most dramatically, particularly in the context of following nasals, the most natural raising environment). On the contrary, individuals who enjoyed local country life and planned to stay in the area (i.e. more locally loyal individuals) tended to refuse to accommodate their speech and, thus, tended to be more conservative (i.e. retaining the vowel in the pre-shifted position). The former tended to be young females and the latter tended to be young males. It appeared that a category difference, such as that of gender, was related to differences in orientation towards urban culture as well as local loyalty. Thus, this study suggested how individuals could adopt a new change into their systems both linguistically and socially, thus, supporting Trudgill's (1986) proposals that the linguistic accommodation is important in the diffusion process and that diffusion takes place at the level of individuals, i.e. attitudinal factors play a major role in diffusion at the micro level.

Although several interesting points were made, it must be admitted that there are shortcomings in this study. First, although the number of tokens for each vowel seemed to be sufficient for evaluating each respondent's vowel system, more data are needed to conduct even more sophisticated analyses of the effects of adjacent segment, such as that of preceding segment, and the interactions among the context (i.e. preceding and followin

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following segments). A series of ANOVAs were used for experimental purposes. They showed an interesting trend, but the results need to be tested in studies which are specifically designed to examine such facts. In future studies, it is desirable to acquire an even more extensive set of vowel tokens in a wider variety of contexts. In such studies, alternative coding systems such as those reflecting different models of feature geometry could be considered. Results of such studies would help us not only to evaluate the speculations made in this study but also to further investigate phonetic and/or phonological explanations for the effects of adjacent segments. Such studies are definitely needed in order to explore the degree to which language universals play a role, especially at the early stage of the diffusion of linguistic innovation.

Second, although the present study demonstrated that comparison of individual systems was quite feasible, normalization of the data might be useful. After normalization, direct comparison of frequency scores across speakers can be made, so that community (rather than individual) statistical comparison is possible. Such an approach would provide interesting complementary analyses.

Finally, there should be further investigation of the effects of individual differences in orientation toward urban culture and local loyalty on the degree of accommodation to the NCS. One such possible investigation might be a case study of differences between some of the locally loyal respondents from the present study and individuals from the same local community who are also locally loyal but different in their native status (i.e. being born and raised in other communities, especially ones such as Detroit and Lansing, where the NCS is almost complete). In fact, quite a few interviews have not been analyzed due to the restrictions on the selection of respondents for this study. These 'non-native' speakers were assumed to have been exposed to the NCS when they were young; thus, it is assumed that their vernaculars would be similar to those which are heavily influenced by the NCS. It would be interesting to see the degree to which such speakers display features of the NCS.

Why language change and variation exist at a certain time and in a certain place still remains a puzzle, but it is hoped that the present study has filled in some of the gaps in our understanding of how such phenomena take place by. It is hoped that this study demonstrated how rigid linguistic factors are and how precise social factors can be at an early stage of the diffusion of a sound change. The investigation of the role of social factors, especially individual social identity, and of the role of linguistic universals in language variation, contributes to our understanding of the mechanisms of language change, which, in turn, may help to account for diachronic and synchronic phenomena in a more integrated way. The search will continue as long as languages are used by people for the ordinary purpose of communicating with one another.

APPENDICES

APPENDIX A: WORDLIST

Vowels of the first three steps of the NCS:

Step 1: /æ/ N=31	labial/labio-dental/ interdental	apical (alveolar)	palatal	velar
Voiceless Stops	nap, apple, zap	Pat, mattress	N/A	rack, black, brag
Voiced Stops	tab, cabin	Dad	badge	Saginaw, rag
Voiceless Fricatives	bath, laugh	ask, past	cash, mash	N/A
Voiced Fricatives	have	has, jazz	N/A	N/A
Nasals	gamble, Sam	Lansing, plant, thank	N/A	gang, banker
Liquids	N/A	pal	N/A	N/A

Step 2: /ɑ/ N=17	labial/labio-dental/ interdental	apical (alveolar)	palatal	velar
Voiceless Stops	mop, stop	pot	watch	rock, block
Voiced Stops	Bob	body	logic	N/A
Voiceless Fricatives	profit	possible	gosh	N/A
Voiced Fricatives	father	N/A	N/A	N/A
Nasals	Tom	John	N/A	N/A
Liquids	N/A	car, doll	N/A	N/A

Step 3: /ɔ/ N=13	labial/labiodental/ interdental	apical (alveolar)	palatal	velar
Voiceless Stops	N/A	caught	N/A	chalk
Voiced Stops	N/A	N/A	N/A	dog, fog
Voiceless Fricatives	awful, moth	lost	N/A	N/A
Voiced Fricatives	N/A	pause, closet	N/A	N/A
Nasals	N/A	gone	N/A	song
Liquids	N/A	horse, tall	N/A	N/A

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Vowels of the last three steps of the NCS

Step 4 (/ɛ/): pen, mesh, bet, fed, step, neck, bend (7)
Step 5 (/ʌ/): bun, puff, cup, sub, duck, dust (6)
Step 6 (/ɪ/): tin, hit, kid, tip, pig, fist, fish, pill (8)

Other vowels (24):
boot, food, pool, good, foot, pull, hope, hole, road, sleep, peel, meat, bead, hate, state, make, bite, night, ride, house, loud, mouse, toy, oil

TOTAL: N = 106

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APPENDIX B: READING PASSAGE

A BAD DAY FOR DUCKS

Tom and Bob were supposed to meet at Tom's house. They planned to go to a nearby pond and watch the ducks. While waiting for Bob to get there, Tom picked up around the house. He put the electric fan away for the winter and did the dishes.

He wanted a snack before he left, so he peeled an apple and cut it into slices. He bit into one, but it was awful, probably rotten. He spit it out and tired to rinse his mouth out with hot, black coffee. He poured it into a tin cup, but when he put it up to his lips, he spilled it on his hand. His hand puffed up and hurt a lot, so he stuck it under the faucet to make it feel better.

He grabbed a dusty hat out of the closet and shook it, but he couldn't get the dirt off. He got a cap instead and put a scarf around his neck and put on his socks and boots. There was a big hole in his sock, and Bob was really late. It was already past 2:00. Nothing was working out.

Just then Bob phoned and said he wanted to talk. He told Tom that the flock of ducks had left the pond. A pack of dogs had chased them off. Tom was sad; he had really wanted to see the ducks, but Bob said that they could go shoot some pool instead. Tom thought that was a good idea and forgot all about the ducks and this burned hand.

APPENDIX C: SOCIOLINGUISTIC INTERVIEW

Interview Questions for older respondents [for younger respondents, 'work' is replaced by 'school')

1. Where were you born? (Are you originally from this area?)

2. How long have you been in this area? Have you lived in other places? Where? How long?

3. Which schools did you attend?

4. What do you do for living? (position, title) Do you like working there?
   --for younger respondents: Could you describe your school? Do you participate in any extra curricular activities? What are they?

5. (about network relationship)
   - Does your best friend (or good friends) live in your neighborhood?
   - Do you have any relatives who live in your neighborhood?
   - Are there any people who also work at your work place from your neighborhood? How many?/Same sex?
   - Do you spend time with your co-workers after work? How often?

6. What do you usually do when you have spare time?

7. What was the town like when you grew up? Has it changed since then? How?
   --for younger respondents: Is this a good place to grow up? Why?

8. Are you planning to stay here after your retirement? Why?
   --for younger respondents: Are you planning to stay here after graduation?

9. Have you ever wished to live somewhere else? Why?

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10. What is the best thing about living around this area?

11. What is the worst thing about living around this area?

12. Do you have friends and relatives who live in big cities?
    - If YES: Where? Do they have a different life style from people in small towns?
    - If NOT: Do you think people in big cities are different from people in small towns?

13. According to the Lansing State Journal (Sept. 21, 1998), there are two kinds of people in small towns: the ones who will stay where they were born and grew up, and the ones who will go away. Is it true? Which group do you think you belong to?

14. WL & RP

15. GATING EXPERIMENT

16. I heard that some people pronounce words like 'bag' and 'man' in a different way. (PLAY THE TAPE) Have you noticed this before? Do you know anybody who speaks this way? How about yourself?

Status Rank

Occupation:

Housing

APPENDIX D: INDICES OF SOCIAL STATUS

(adopted from Warner 1960)

Status Ranking Instructions:

Occupation:	1	Lawyers, doctors, engineers, judges, architects, managers of large business
	2	High school teachers, trained nurses, librarians, small business owners, accountants, large farm owners
	3	Social workers, grade school teachers, optometrists, minor officials of business, bank clerks, auto sales, contractors
	4	Small business managers, stenographers, mail clerks, most store clerks, factory foremen, private repairmen (e.g. plumbers)
	5	Beauticians, carpenters, plumbers, etc. ... (employed by others), barbers, firemen, bartenders, restaurant cooks, tenant farmers
	6	Semi-skilled workers, skilled worker assistants, watchmen, truck drivers, waitpersons (in small restaurants), small tenant farmers
	7	Heavy laborers, janitors, newspaper delivery, odd-job persons, migrant workers
Housing	1	Grand, ostentatious
	2	Very good, attractive, roomy, landscaped
	3	Good, only slightly larger than utilitarian demands, more conventional and less showy than the first two categories
	4	Average, private one and a half to two story, nice lawns, some extra room, small well-cared for lawns
	5	Fair, just enough room for needs, well-kept up but no extras
	6	Poor, run-down, often too small for needs, not in shambles or beyond repair
	7	Very poor, perhaps not even designed as housing, beyond repair, crowded

Neighborhood	1	Very high -- The best place to live in this area; known as the area of the 'well-to-do'
	2	High -- An area with an excellent reputation, low crime, good schools, large houses and yards
	3	Above average -- Not pretentious but nice, clean, tidy neighborhood
	4	Average -- Solid working class area; neat, not fancy but a nice place to live
	5	Below average -- Some run-down housing, close to industrial or other undesirable residence areas
	6	Low -- areas regarded as 'slums'
	7	Tenement areas; shacks, lean-tos, 'squatters' areas

Education	1	Graduate or professional school	2	College
	3	High school	4	Some high school
	5	Junior high school	6	Elementary school
	7	Little or no schooling		

Computation: Occupation x 4 + Education x 3 + Housing x 3 + Neighborhood x 2

Ratings[1]	12-17	Upper
	18-22	Upper-Upper Middle
	23-24	Upper Middle-Upper
	25-33	Upper Middle
	34-37	Upper Middle-Lower- Middle
	38-50	Lower Middle
	51-53	Lower Middle-Upper Lower
	54-62	Upper Lower
	63-66	Upper Lower-Lower Lower
	67-69	Lower-Lower-Upper Lower
	70-84	Lower Lower

High school students and non-working spouses have the same scores as the principal working member of the family (except as can be independently determined).

[1] In this study, only the computed absolute numbers were used rather than these ratings.

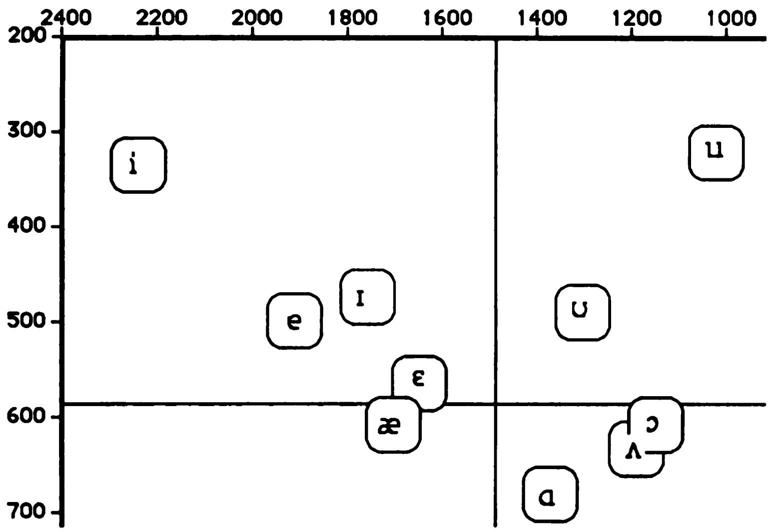

Figure 7.1: Vowels of Colin (17, Gladwin, middle-class) (Index scores: F1=2, F2=2)

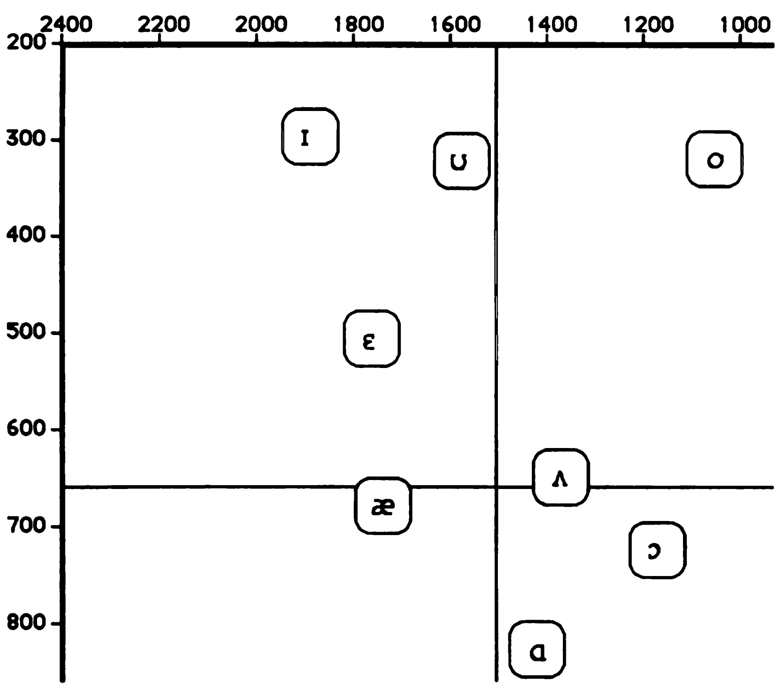

Figure 7.2: Vowels of Pat (14, Gladwin, middle-class, Colin's brother) (Index scores: F1=1, F2=2)[1]

[1] The acoustic mesurement of tokens with /i/, /e/, and /u/ was not possible.

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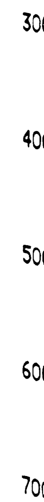

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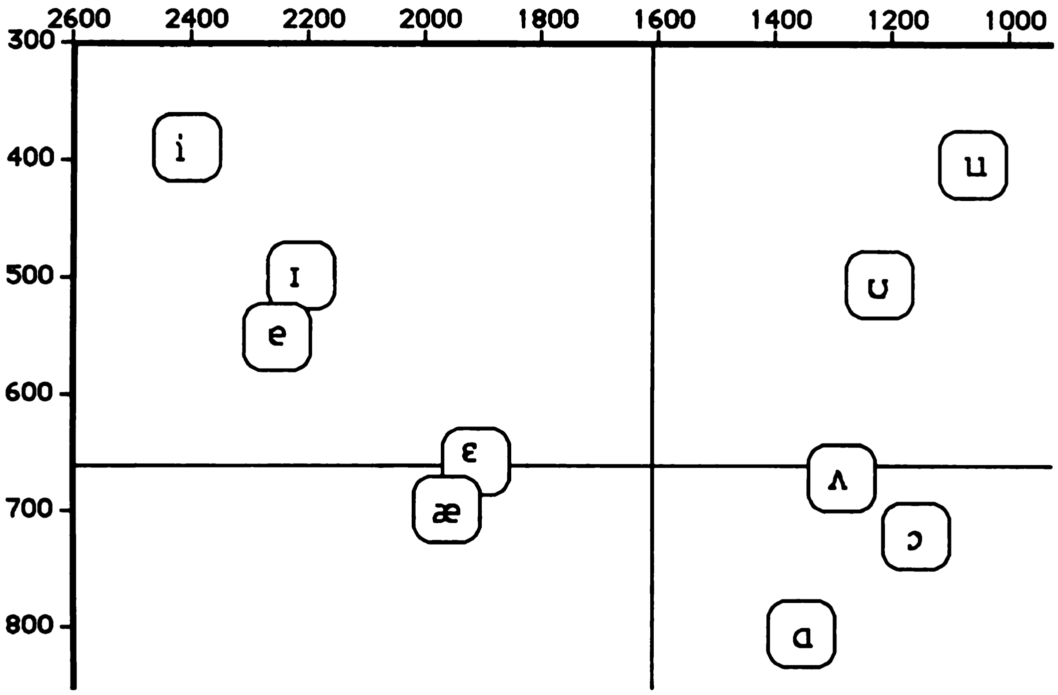

Figure 7.3: Vowels of Dannie (16, Gladwin, middle-class) (Index scores: F1=2, F2=2)

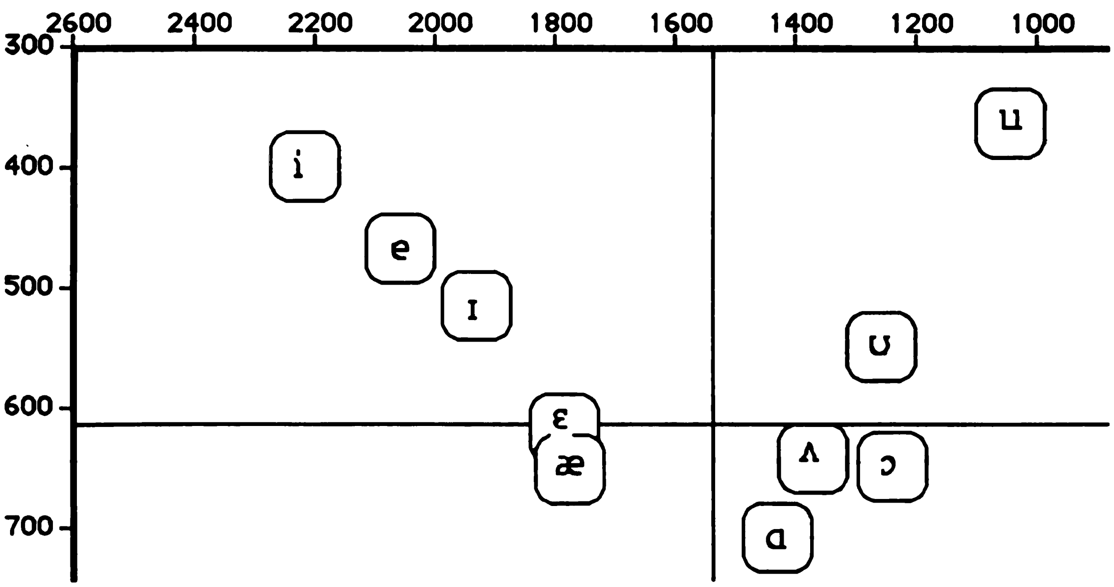

Figure 7.4: Vowels of Ray (14, Gladwin, middle-class, Dennie's brother) (Index scores: F1=2, F2=2)

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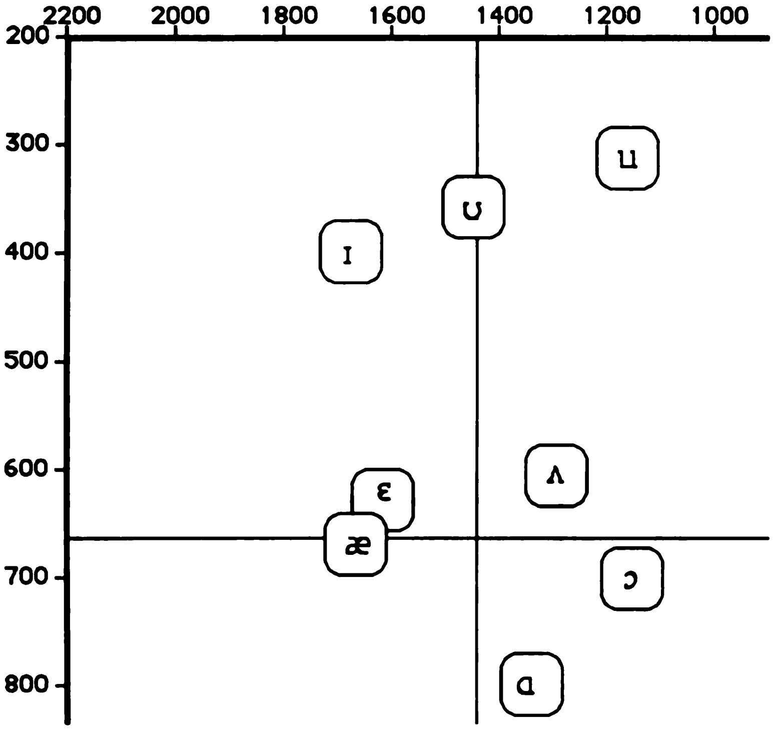

Figure 7.5: Vowels of Jamie (15, Gladwin, middle-class, Pat's friend) (Index scores: F1=2, F2=2)[2]

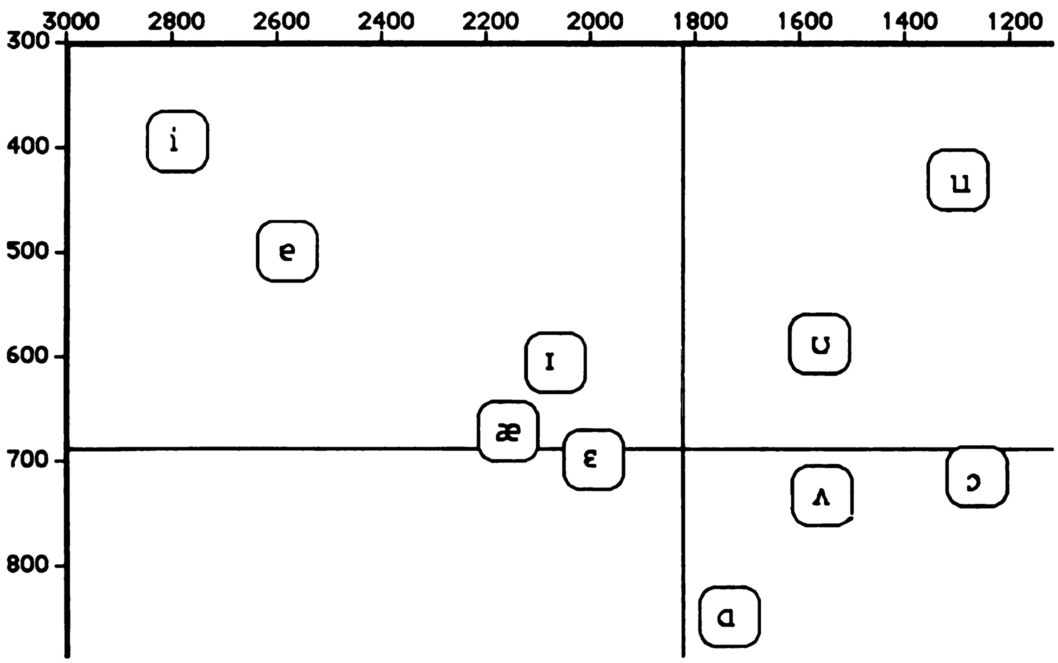

Figure 7.6: Vowels of Alison (18, Houghton Lake, middle-class) (Index scores: F1=2, F2=3)

[2] The acoustic mesurement of tokens with /i/ and /e/was not possible.

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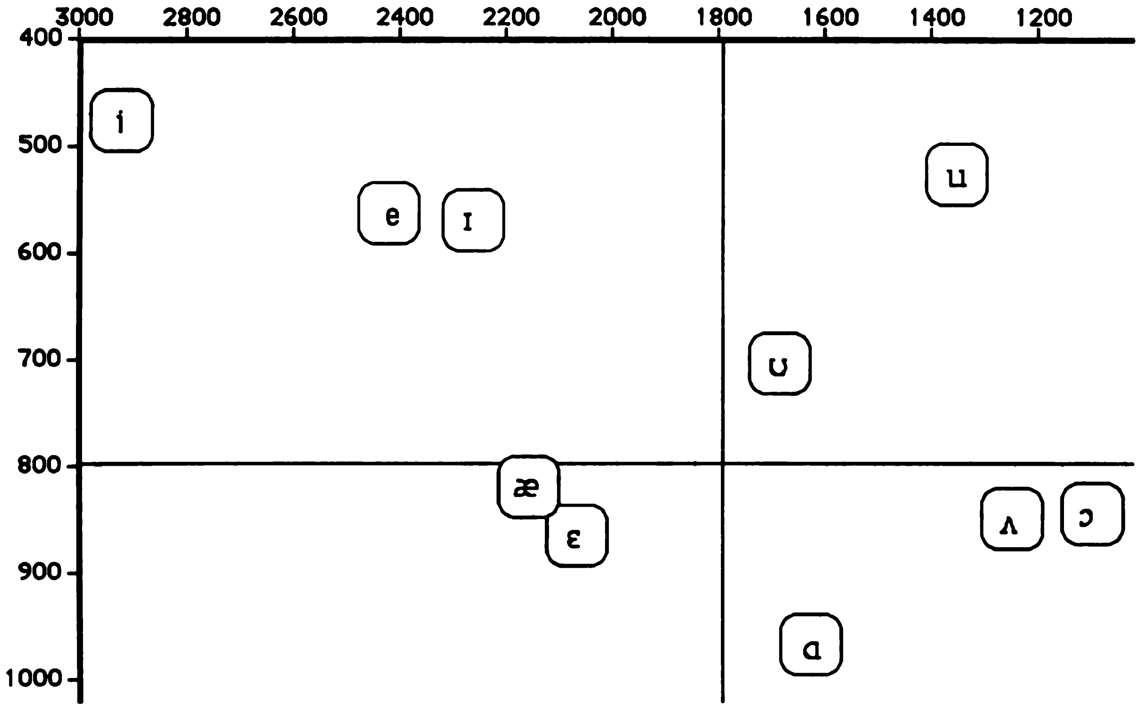

Figure 7.7: Vowels of Lisa (18, Harrison, middle-class) (Index scores: F1=2, F2=2)

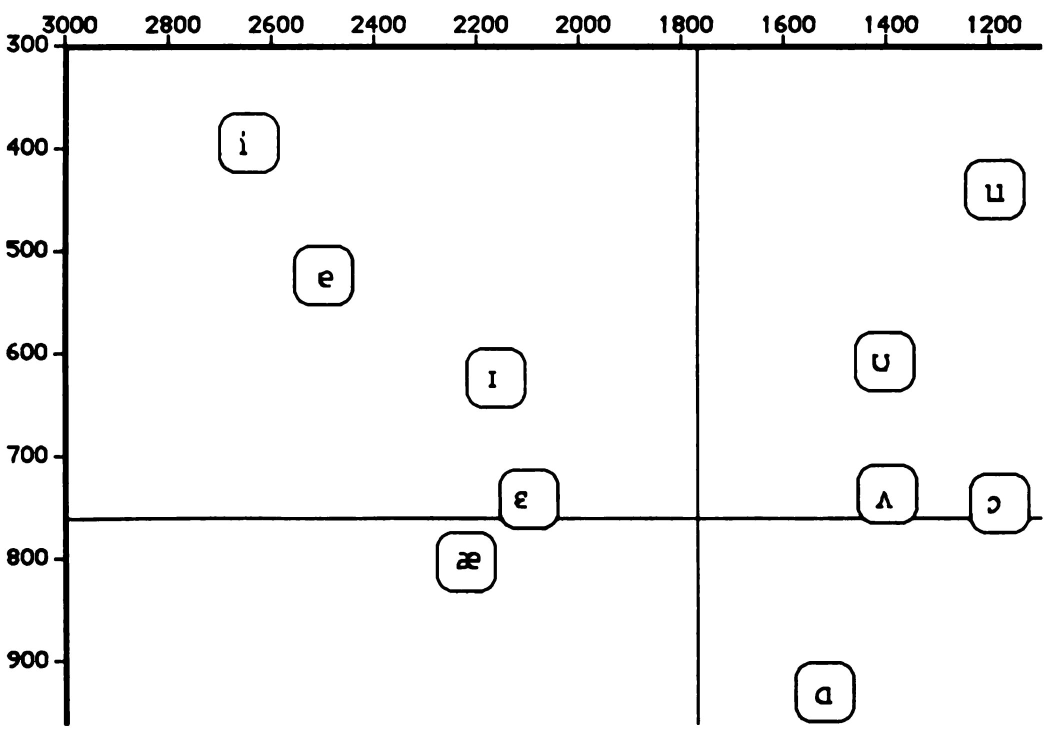

Figure 7.8: Vowels of Jane (18, Gladwin, middle-class) (Index scores: F1=2, F2=3)

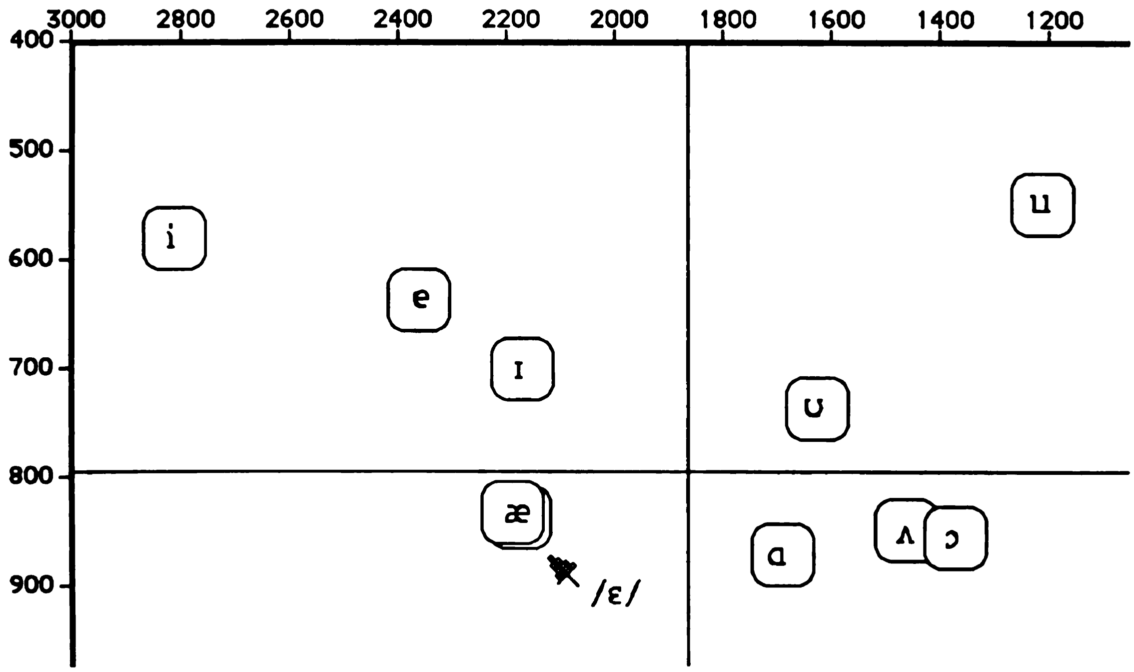

Figure 7.9: Vowels of Janet (18, Gladwin, middle-class) (Index scores: F1=2, F2=2)

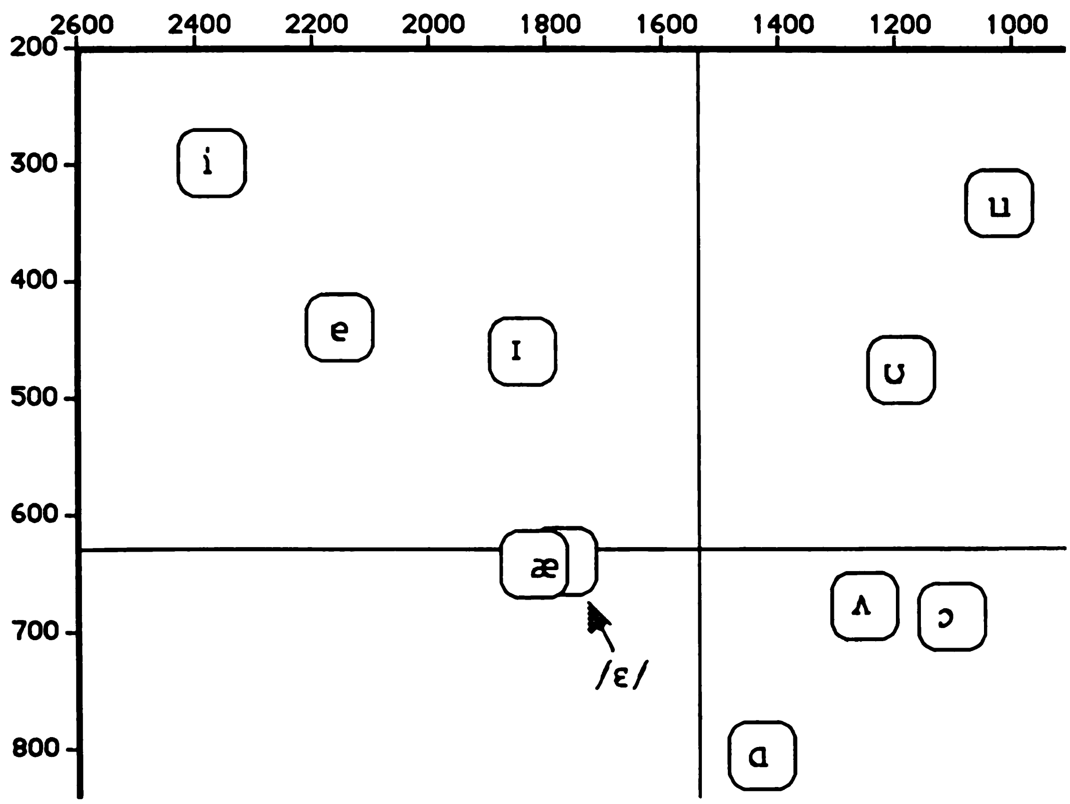

Figure 7.10: Vowels of Rick (50, Clare, middle-class) (Index scores: F1=2, F2=2)

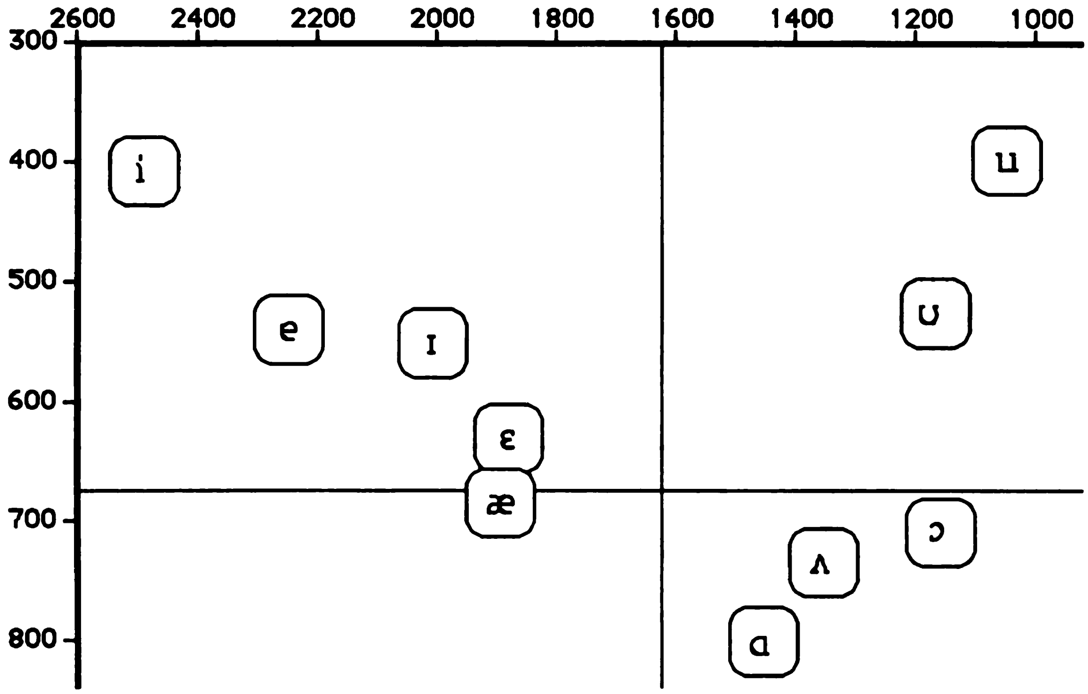

Figure 7.11: Vowels of John (52, Clare, middle-class, Rick's cousin) (Index scores: F1=2, F2=2)

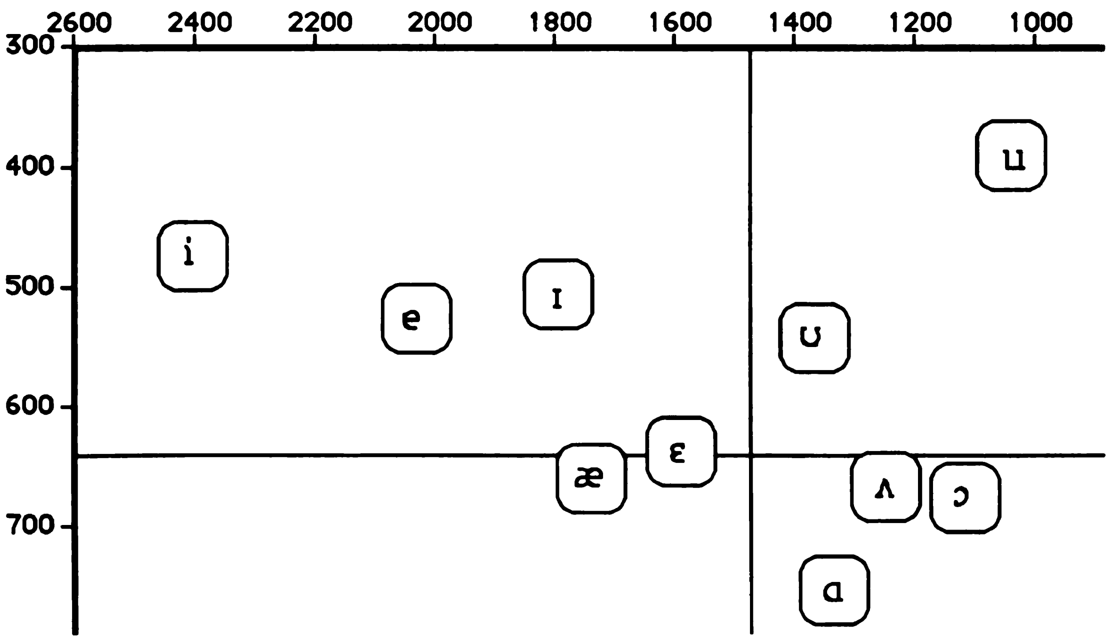

Figure 7.12: Vowels of Mike (40, Coleman, middle-class) (Index scores: F1=2, F2=3)

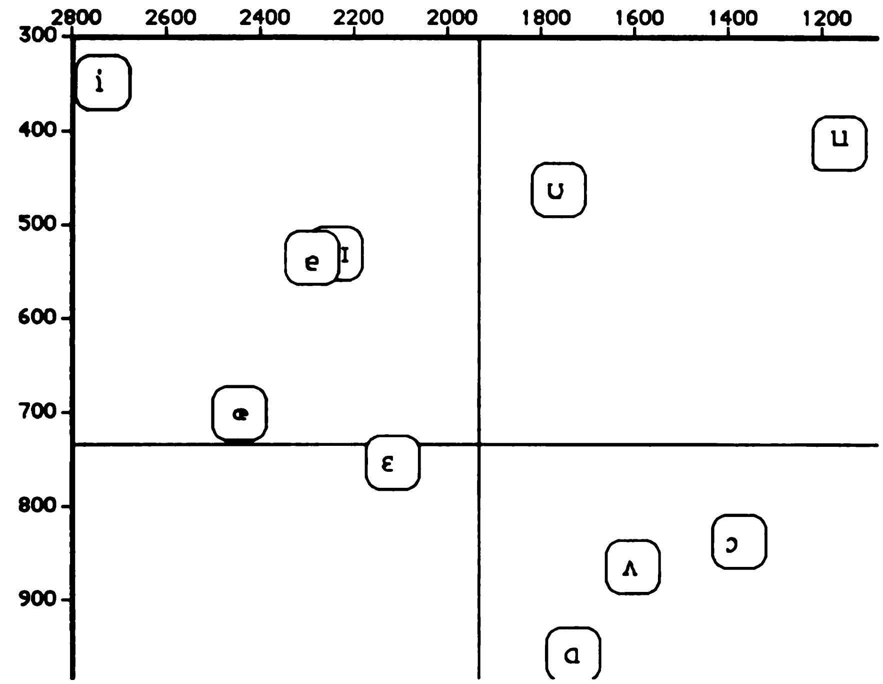

Figure 7.13: Vowels of Cally (49, Clare, middle-class, Rick's wife) (Index scores: F1=2, F2=5)

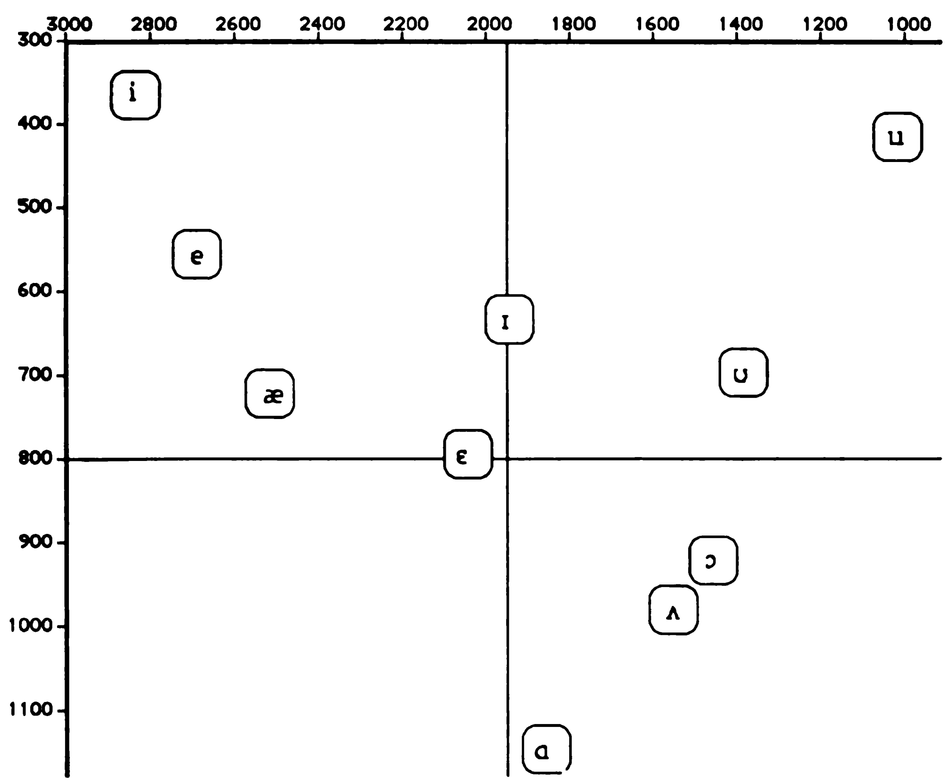

Figure 7.14: Vowels of Linda (46, Clare, middle-class, John's wife) (Index scores: F1=5, F2=3)

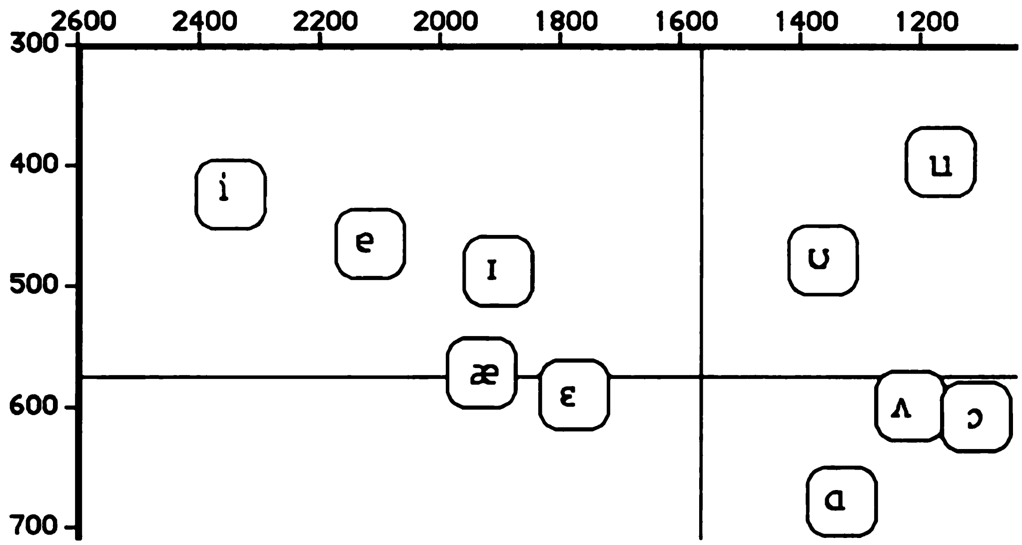

Figure 7.15: Vowels of Ned (16, Gladwin, working-class, Colin's friend) (Index scores: F1=2, F2=3)

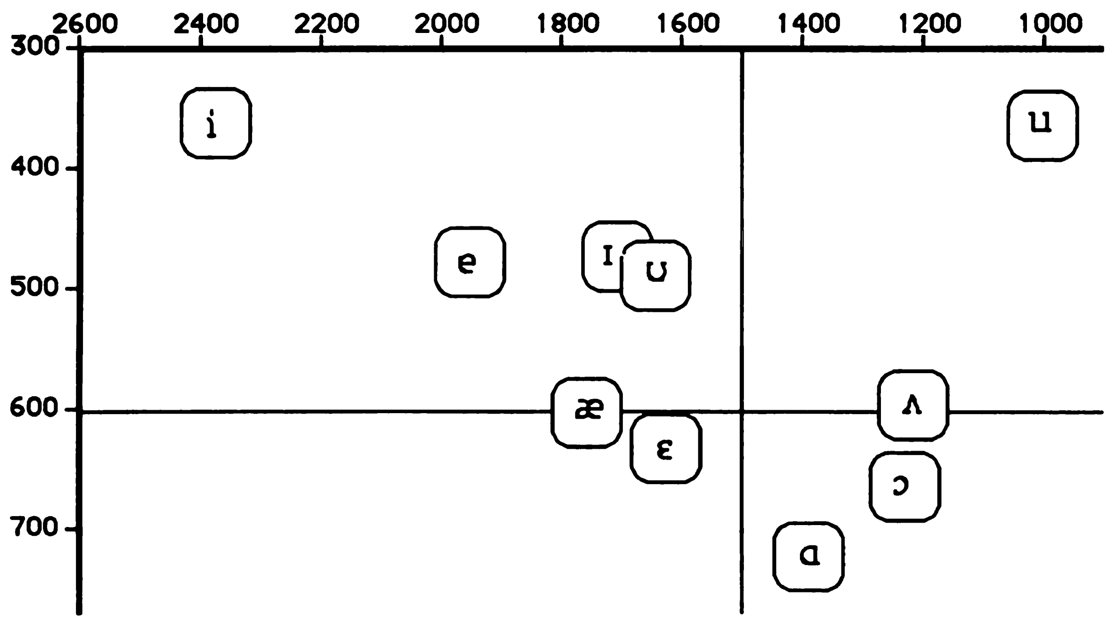

Figure 7.16: Vowels of Nevin (16, Gladwin, working-class, Jonathan's brother) (Index scores: F1=2, F2=3)

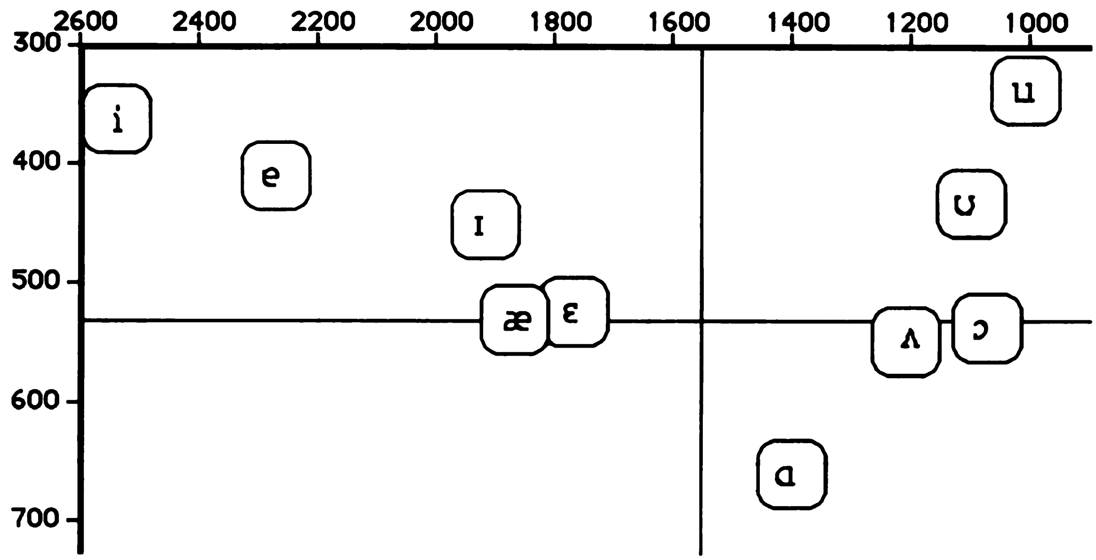

Figure 7.17: Vowels of Adam (15, Gladwin, working-class, Pat's friend) (Index scores: F1=2, F2=2)

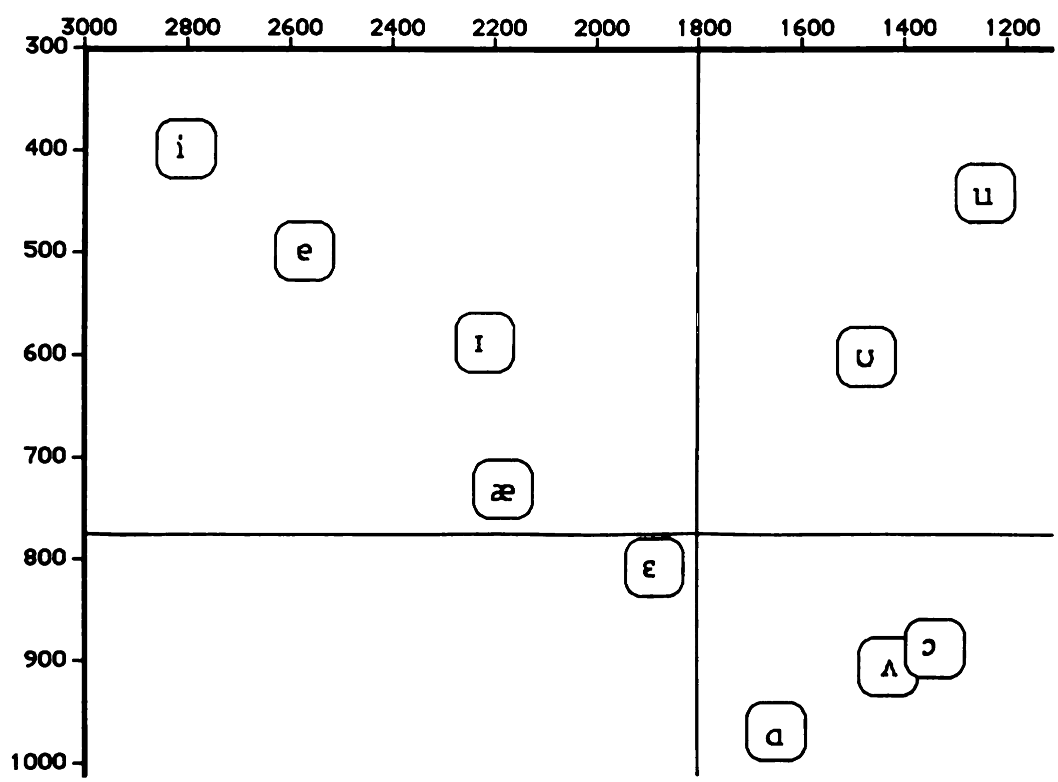

Figure 7.18: Vowels of Alice (16, Gladwin, working-class, Colin's friend) (Index scores: F1=2, F2=3)

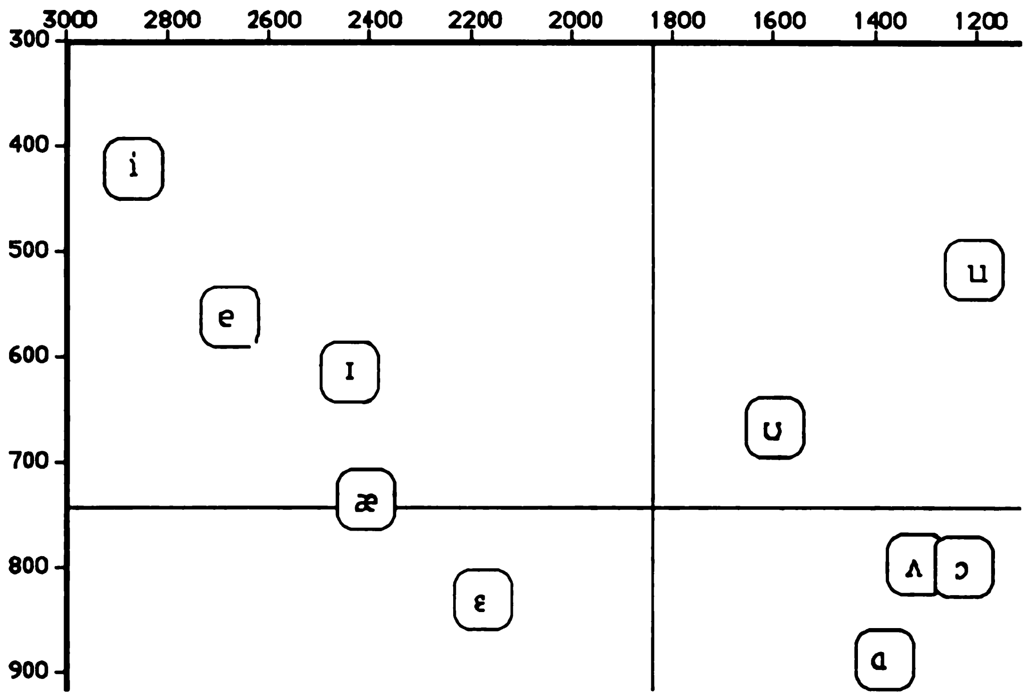

Figure 7.19: Vowel's of Violet (20, Gladwin, working-class) (Index scores: F1=3, F2=3)

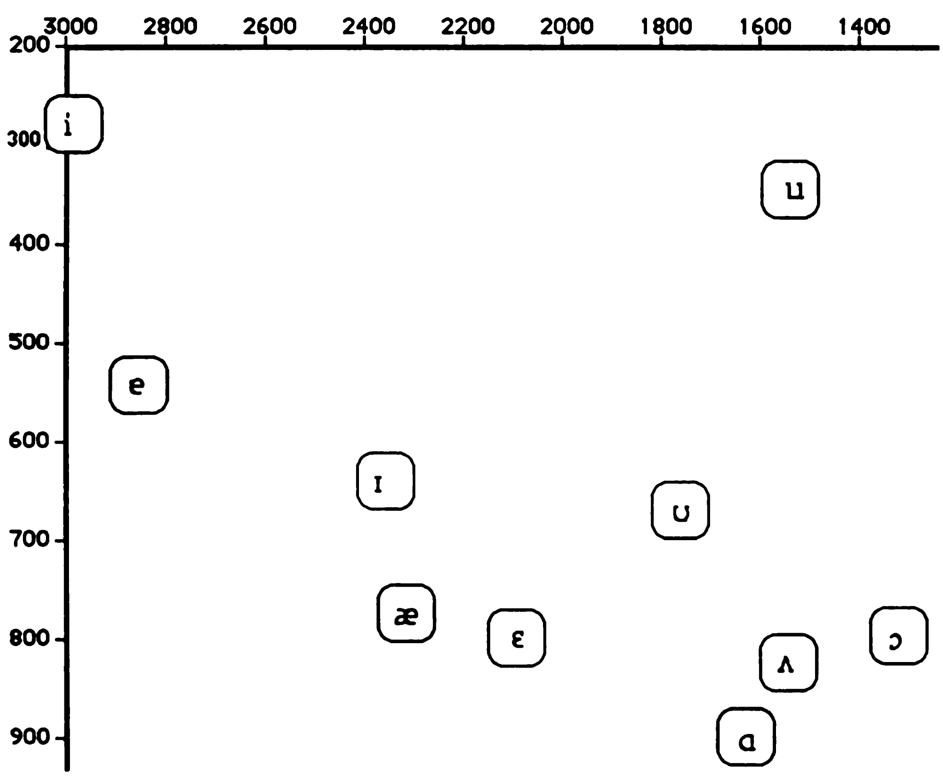

Figure 7:20: Vowels of Amily (15, Gladwin, working-class, Violet's cousin) (Index scores: F1=2, F2=3)

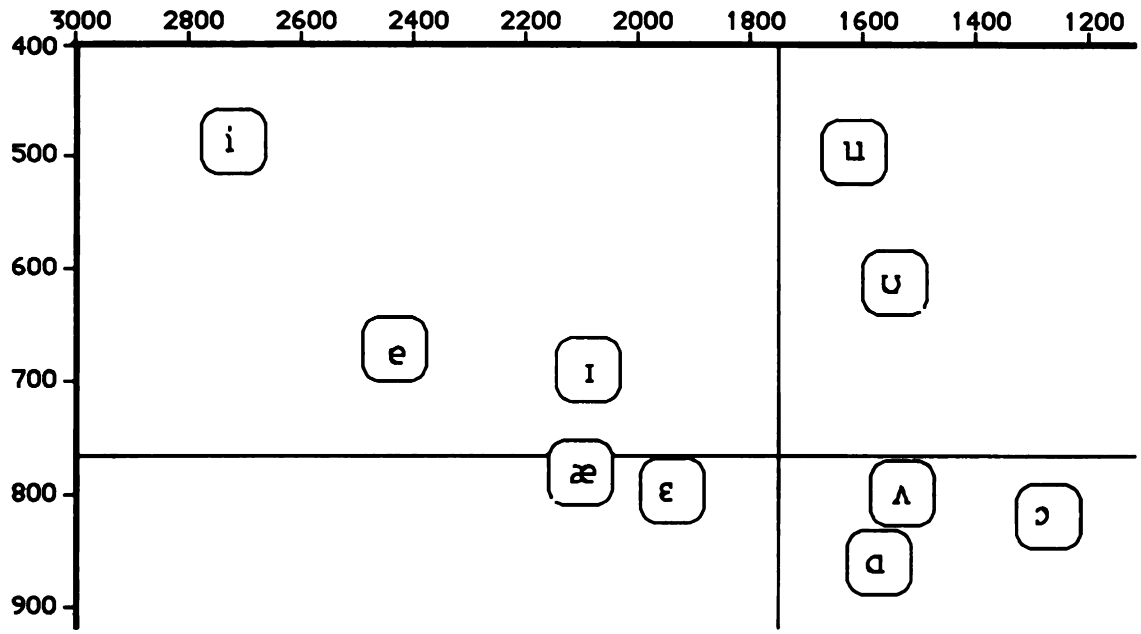

Figure 7.21: Vowels of Trish (20, Houghton Lake, working-class) (Index scores: F1=2, F2=3)

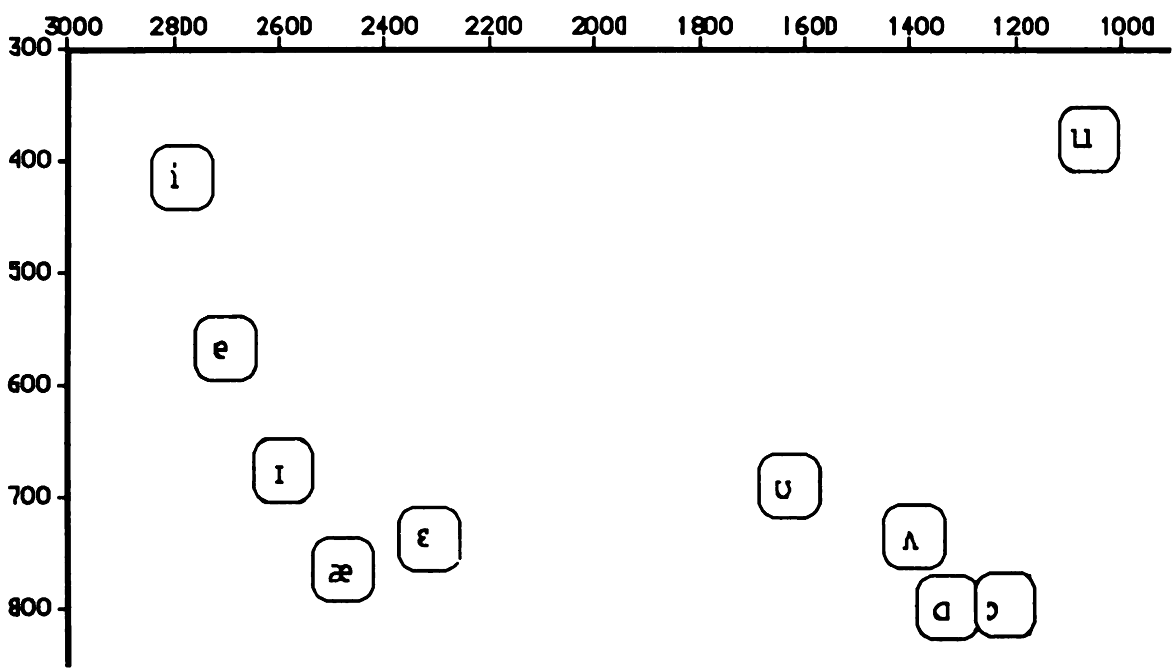

Figure 7.22: Vowels of Beth (16, Gladwin, working-class, Violet's sister) (Index scores: F1=2, F2=3)

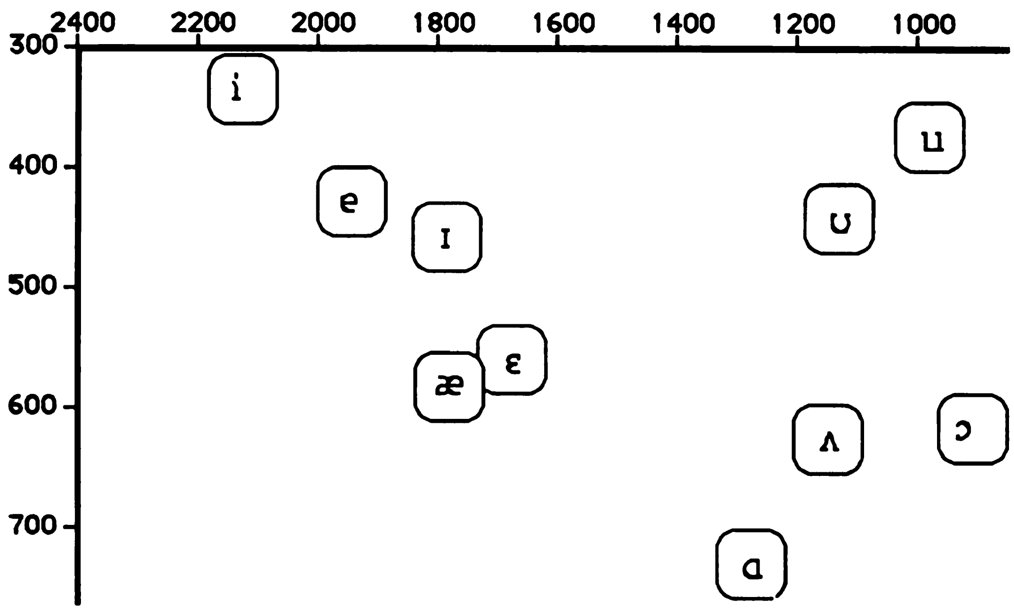

Figure 7.23: Vowels of Bill (57, Clare, working-class) (Index scores: F1=2, F2=3)

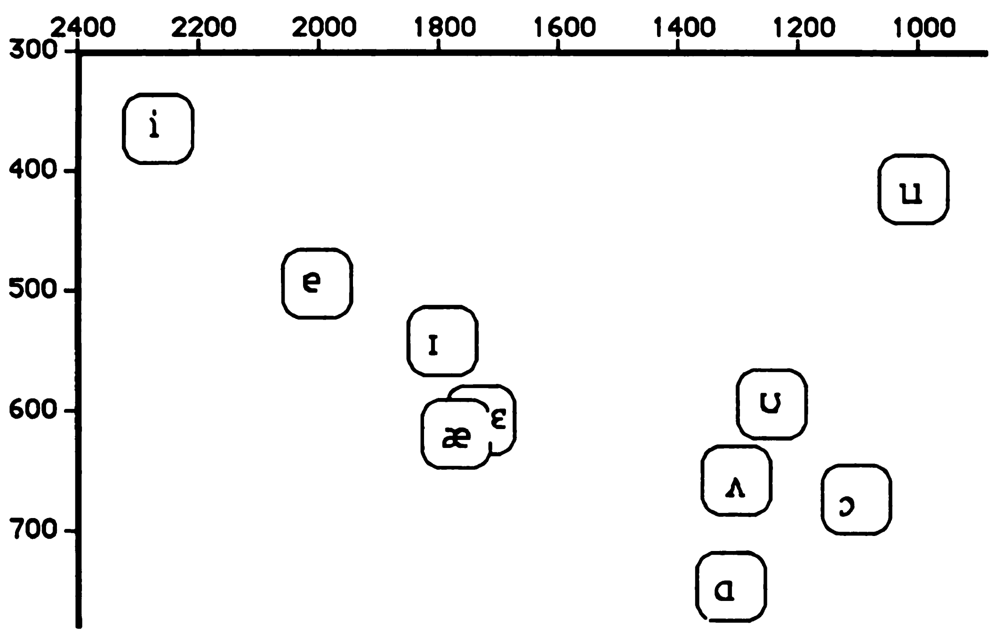

Figure 7.24: Vowels of Bob (58, Clare, working-class, Bill's friend) (Index scores: F1=2, F2=2)

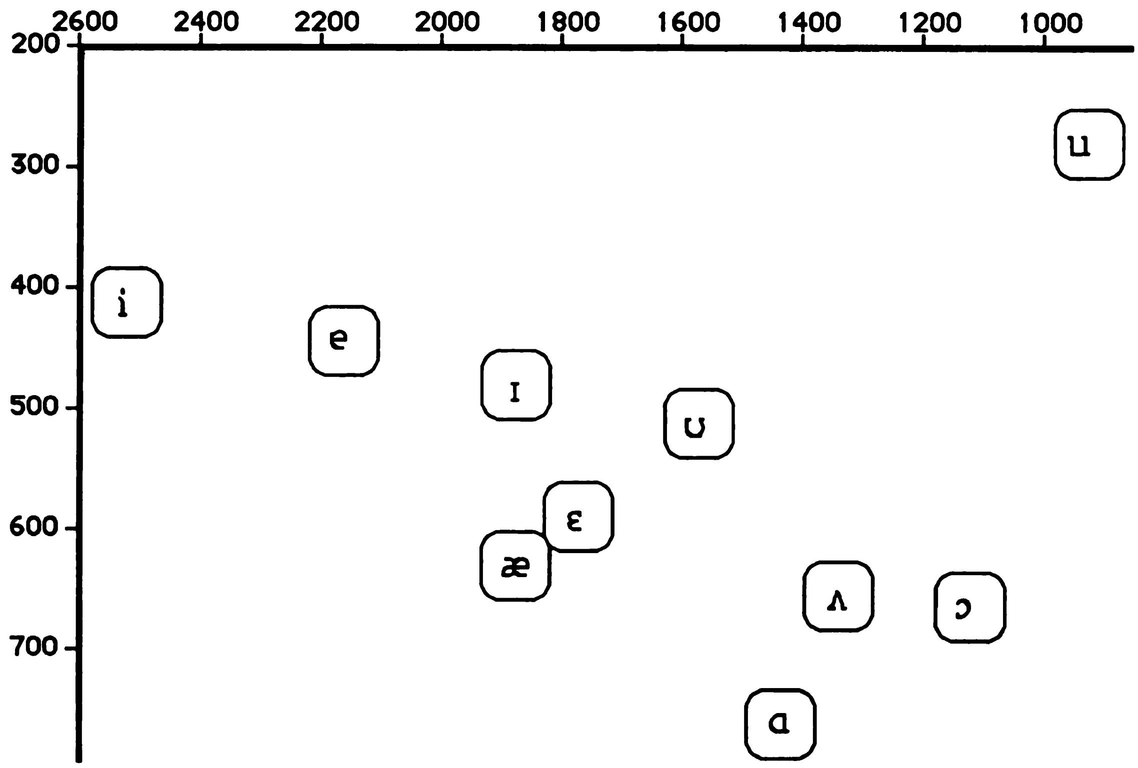

Figure 7. 25: Vowels of Brian (48, Gladwin, working-class, Amily's dad) (Index scores: F1=2, F2=2)

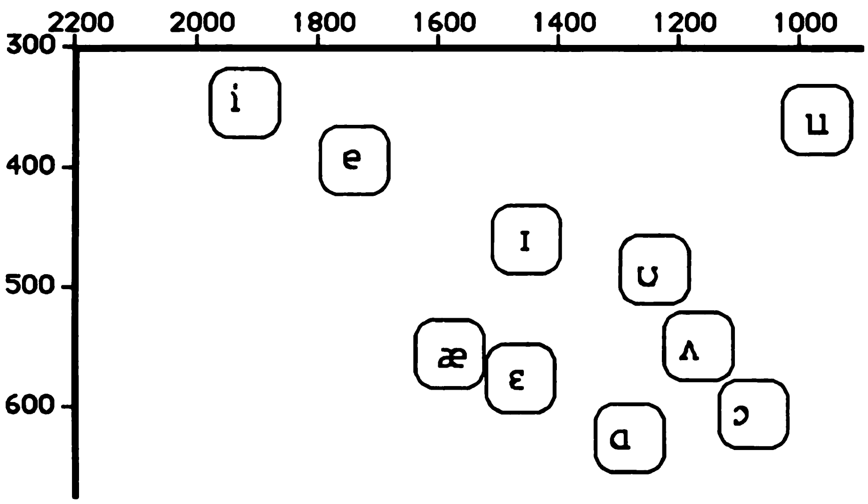

Figure 7.26: Vowels of Chad (41, Gladwin, working-class, Jonathan and Nevin's dad) (Index scores: F1=2, F2=3)

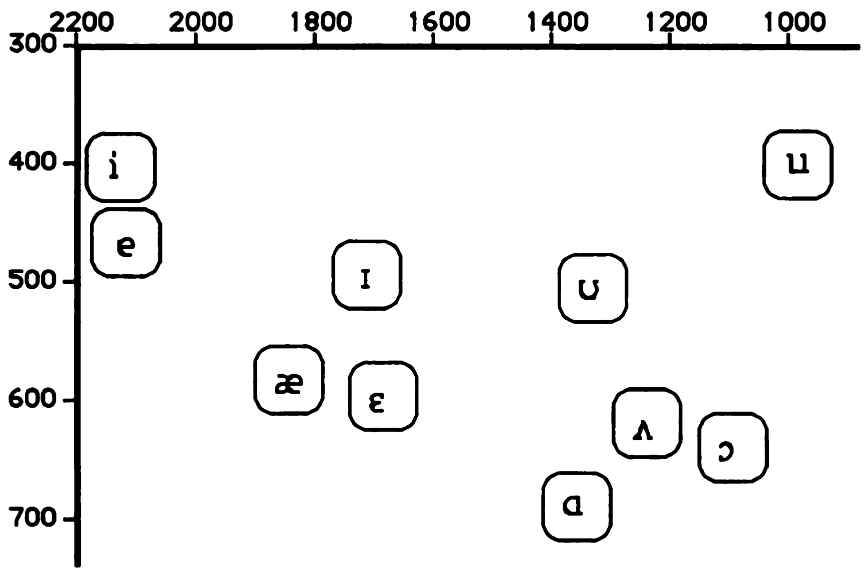

Figure 7.27: Vowels of Raymond (47, Gladwin, working-class, Violet and Beth's dad) (Index scores: F1=2, F2=3)

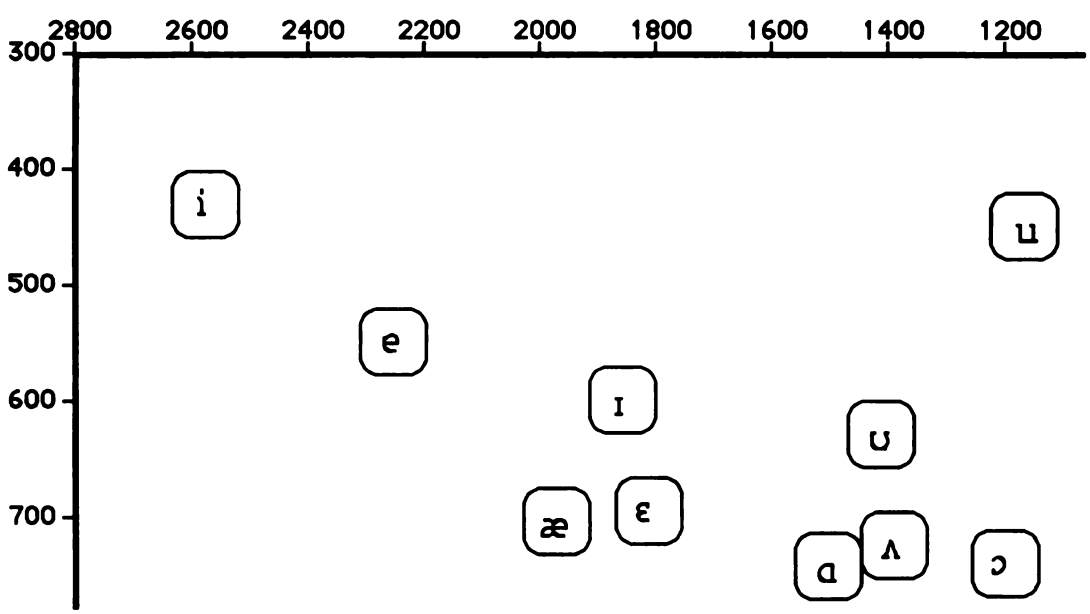

Figure 7.28: Vowels of Shannon (47, Clare, working-class, Bill's wife) (Index scores: F1=2, F2=3)

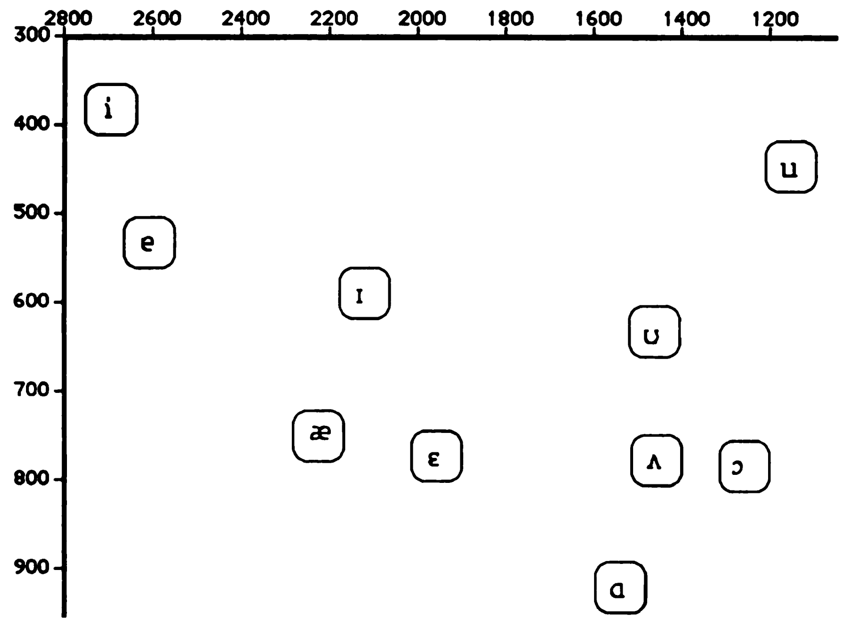

Figure 7. 29: Vowels of Jan (44, Gladwin, working-class, Brian's wife) (Index scores: F1=2, F2=3)

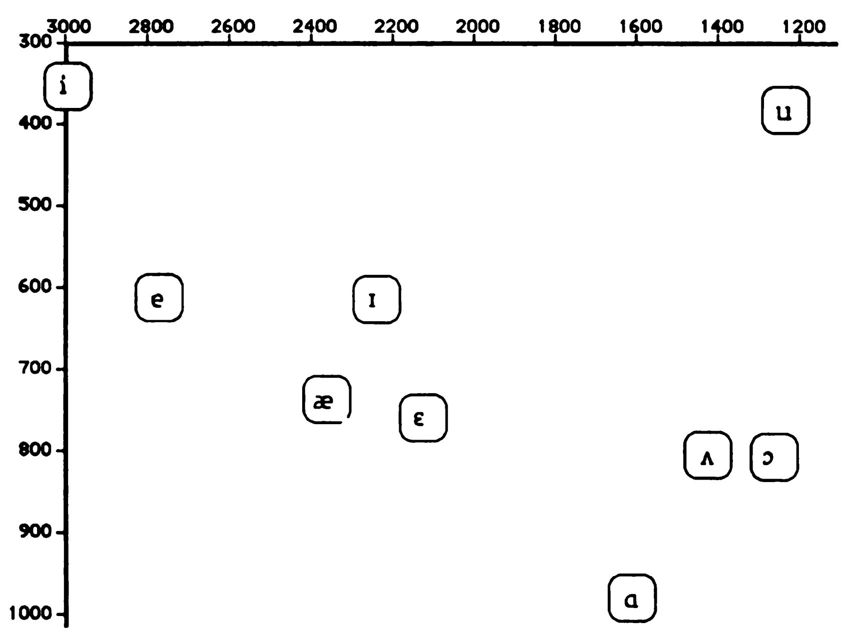

Figure 7. 30: Vowels of Lily (39, Gladwin, working-class, Adam's mom) (Index scores: F1=2, F2=3)[3]

[3] The acoustic mesurement of tokens with /ʊ/ was not possible.

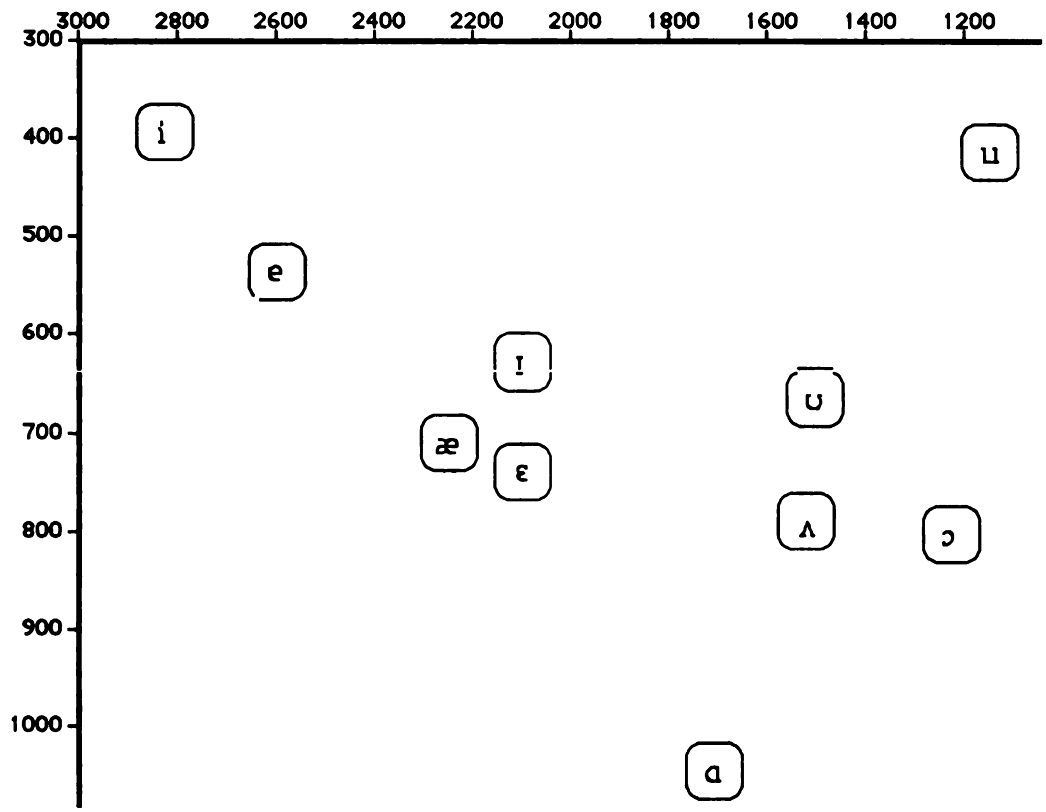

Figure 7.31: Vowels of Sandi (44, Gladwin, working-class, Alice's mom)
(Index scores: F1=2, F2=3)

APPENDIX F: F1 & F2 FREQUENCY VALUE OF THE /æ/ TOKENS

Table 7.1: F1 & F2 scores of /æ/
(Colin, 17, middle-class, Gladwin)

F1	F2	word
547	1645	apple
656	1592	ask
560	1611	badge
550	1693	banker
654	1595	bath
768	1542	black
681	1633	brag
599	1656	cabin
654	1702	cash
665	1837	Dad
453	1804	gamble
436	2032	gang
634	1706	has
735	1763	have
469	1699	jazz
628	1805	Lansing
750	1495	laugh
623	1757	mash
556	1731	mattress
640	1791	nap
748	1563	pal
675	1644	past
708	1636	Pat
609	1870	plant
627	1544	rack
745	1557	rag
571	1610	Saginaw
495	1912	Sam
593	1716	tab
553	1629	thank
692	1632	zap

Table 7.2: F1 & F2 scores of /æ/
(Pat, 14, middle-class, Gladwin)

F1	F2	word
735	1629	apple
774	1844	ask
734	1762	badge
775	1854	banker
732	1655	bath
749	1564	black
501	1512	brag
657	1678	cabin
605	1750	cash
672	1724	Dad
461	1818	gang
629	1758	has
506	1695	have
481	1745	jazz
719	1815	Lansing
754	1680	laugh
915	1795	mash
907	1734	nap
754	1603	pal
704	1701	past
556	1727	Pat
692	1878	plant
787	1625	rack
761	1688	rag
428	1596	Saginaw
538	1913	Sam
747	1726	tab
717	1734	thank

Table 7.3: F1 & F2 scores oF /æ/
(Dennie, 16, middle-class, Gladwin)

F1	F2	word
877	1935	apple
756	2079	ask
714	2060	badge
650	2009	banker
746	1739	bath
752	1565	black
639	1506	brag
735	1970	cabin
686	2057	cash
715	2035	Dad
500	2420	gamble
612	2157	gang
694	2003	has
729	2017	have
590	1994	jazz
607	1970	Lansing
743	1735	laugh
750	2007	mash
797	1927	mattress
668	1988	nap
772	1825	pal
759	1808	past
768	1933	Pat
633	1761	plant
693	1505	rack
676	1504	rag
769	1826	Saginaw
592	2301	Sam
680	2009	tab
743	2012	thank
717	1901	zap

Table 7.4: F1 & F2 scores of /æ/
(Ray, 14, middle-class, Gladwin)

F1	F2	word
877	1935	apple
756	2079	ask
714	2060	badge
650	2009	banker
746	1739	bath
752	1565	black
639	1506	brag
735	1970	cabin
686	2057	cash
715	2035	Dad
500	2420	gamble
612	2157	gang
694	2003	has
729	2017	have
590	1994	jazz
607	1970	Lansing
743	1735	laugh
750	2007	mash
797	1927	mattress
668	1988	nap
772	1825	pal
759	1808	past
768	1933	Pat
633	1761	plant
693	1505	rack
676	1504	rag
769	1826	Saginaw
592	2301	Sam
680	2009	tab
743	2012	thank
717	1901	zap

Table 7.5: F1 & F2 scores of /æ/ (Jamie, 15, middle-class, Gladwin)

F1	F2	word
726	1484	apple
538	1610	ask
633	1595	badge
586	1882	banker
789	1591	bath
825	1468	black
685	1541	brag
689	1640	cabin
607	1649	cash
592	1685	Dad
482	1814	gang
697	1643	has
740	1646	have
605	1722	jazz
681	1673	Lansing
674	1551	laugh
845	1678	mash
731	1848	nap
705	1681	pal
682	1635	past
804	1640	Pat
846	1784	plant
793	1534	rack
550	1507	rag
585	1547	Saginaw
783	1879	Sam
705	1733	tab
704	1685	thank
557	1646	zap

Table 7.6: F1 & F2 scores of /æ/ (Alison, 18, middle-class, Houghton Lake)

F1	F2	word
733	2278	apple
756	2251	ask
673	2237	badge
512	2567	banker
718	2126	bath
959	2036	black
685	2012	brag
697	2102	cabin
684	2188	cash
659	2261	Dad
640	2218	gamble
643	2797	gang
642	2134	has
664	2070	have
612	2091	jazz
623	1361	Lansing
805	2122	laugh
816	2277	mash
772	2140	mattress
792	2159	nap
700	2142	pal
661	2185	past
695	2177	Pat
632	2124	plant
638	1914	rack
618	2050	rag
583	2146	Saginaw
639	2052	tab
526	2021	thank
719	2087	zap

Table 7.7: F1 & F2 scores of /æ/
(Lisa, 18, middle-class, Harrison)

F1	F2	word
859	2082	apple
880	2135	ask
849	2105	badge
545	2319	banker
881	2043	bath
789	1753	black
899	1953	brag
810	2182	cabin
888	2029	cash
757	2235	Dad
761	2338	gamble
762	2339	gang
795	2204	has
842	2154	have
817	2173	jazz
742	2151	Lansing
958	1760	laugh
934	2173	mash
933	2106	mattress
916	2042	nap
826	2048	pal
848	2394	past
750	2134	Pat
805	1998	plant
789	1859	rack
986	1909	rag
877	2037	Saginaw
514	2468	Sam
851	2375	tab
821	2288	thank
808	2104	zap

Table 7.8: F1 & F2 scores of /æ/
(Jane, 20, middle-class, Gladwin)

F1	F2	word
824	2138	apple
850	2121	ask
724	2472	badge
713	2315	banker
864	2021	bath
764	1306	black
800	2074	brag
807	2108	cabin
814	2396	cash
663	2349	Dad
769	2457	gamble
767	2371	gang
729	2251	has
851	2026	have
652	2150	jazz
752	2108	Lansing
917	1952	laugh
876	2246	mash
940	2213	mattress
755	2212	nap
873	2219	pal
908	2231	past
933	2217	Pat
1025	2263	plant
919	2189	rack
723	2146	rag
766	2126	Saginaw
765	2522	Sam
892	2171	tab
857	2228	thank
724	2124	zap

Table 7.9: F1 & F2 scores of /æ/
(Janet, 18, middle-class, Gladwin)

F1	F2	word
915	2287	apple
904	2271	ask
875	2308	badge
667	2576	banker
904	2231	bath
908	1959	black
872	2055	brag
851	1861	cabin
870	2088	cash
984	2161	Dad
801	2281	gamble
670	2447	gang
837	2150	has
834	2034	have
843	2153	jazz
789	2343	Lansing
900	2166	laugh
799	2092	mash
759	2181	mattress
861	2088	nap
813	2198	pal
866	2196	past
814	2062	Pat
715	2106	plant
969	1715	rack
902	2081	rag
701	2236	Saginaw
875	2039	Sam
860	2179	tab
701	2506	thank
830	2214	zap

Table 7.10: F1 & F2 scores of /æ/
(Rick, 50, middle-class, Clare)

F1	F2	word
528	1781	apple
726	1836	ask
629	1757	badge
648	1884	banker
559	1709	bath
691	1607	black
590	1703	brag
597	1734	cabin
541	1850	cash
592	1837	Dad
697	1924	gamble
644	2015	gang
534	1829	has
583	1812	have
529	1901	jazz
803	1691	Lansing
714	1643	laugh
643	1999	mash
720	1750	mattress
748	1831	nap
650	1643	pal
664	1955	past
683	1793	Pat
686	1733	plant
690	1735	rack
677	1672	rag
684	1667	Saginaw
575	2007	Sam
550	1894	tab
768	1641	thank
683	1822	zap

Table 7.11: F1 & F2 scores of /æ/ (John, 52, middle-class, Clare)

F1	F2	word
828	1778	apple
732	1970	ask
652	2015	badge
615	2132	banker
685	1896	bath
901	1633	black
673	1817	brag
802	1663	cabin
625	1970	cash
611	1819	Dad
822	1885	gamble
619	2141	gang
687	1970	has
642	2005	have
611	1976	jazz
569	1896	Lansing
731	1646	laugh
812	1951	mash
723	1794	mattress
720	1906	nap
689	1811	pal
709	1923	past
741	1902	Pat
824	1494	plant
731	1742	rack
753	2008	rag
655	1683	Saginaw
586	1716	Sam
600	1952	tab
664	1931	thank
654	1716	zap

Table 7.12: F1 & F2 scores of /æ/ (Pete, 49, middle-class, Gladwin)

F1	F2	word
698	1578	apple
698	1816	ask
565	2003	badge
544	2083	banker
576	1838	bath
690	1254	black
545	1319	brag
672	1732	cabin
560	1852	cash
512	1908	Dad
576	2010	gamble
566	1921	gang
606	1758	has
575	1803	have
547	1832	jazz
575	1855	Lansing
681	1585	laugh
566	1840	mash
582	1815	mattress
561	1843	nap
614	1708	pal
602	1722	past
653	1704	Pat
560	1493	plant
593	1443	rack
581	1514	rag
635	1456	Saginaw
575	1725	Sam
533	1810	tab
580	1925	thank
591	1505	zap

Table 7.13: F1 & F2 scores of /æ/
(Mike, 40, middle-class, Coleman)

F1	F2	word
677	1622	brag
701	1671	cabin
673	1697	cash
623	1638	Dad
569	2198	gamble
616	1835	gang
670	1698	has
677	1671	have
622	1696	jazz
560	1813	Lansing
719	1525	laugh
640	1811	mash
697	1690	mattress
632	1801	nap
718	1492	pal
719	1647	past
707	1652	Pat
580	1738	plant
740	1507	rack
659	1665	rag
644	1614	Saginaw
583	2086	Sam
604	1815	tab
583	1804	thank
675	1687	zap

Table 7.14: F1 & F2 scores of /æ/
(Cally, 49, middle-class, Clare)

F1	F2	word
798	2406	apple
805	2467	ask
595	2685	badge
450	2618	banker
712	2637	bath
952	2278	black
677	1683	brag
725	1973	cabin
896	2011	cash
799	2260	Dad
690	2469	gamble
438	2770	gang
607	2535	has
666	2641	have
584	2625	jazz
757	2703	Lansing
675	2583	laugh
835	2349	mash
662	2507	mattress
652	2538	nap
610	2541	pal
804	2346	past
801	2476	Pat
664	2312	plant
712	1987	rack
686	2407	rag
706	2393	Saginaw
835	1990	Sam
622	2580	tab
759	2492	zap

Table 7.15: F1 & F2 scores of /æ/
(Linda, 46, middle-class, Clare)

F1	F2	word
789	2611	apple
655	2658	badge
607	2702	banker
705	2659	bath
948	2167	black
764	1848	brag
623	2379	cabin
699	2586	cash
647	2733	Dad
470	2740	gamble
728	2716	gang
684	2643	has
729	2531	have
612	2246	jazz
982	2055	Lansing
963	1956	laugh
782	2559	mash
752	2674	mattress
745	2611	nap
979	2435	pal
847	2589	past
793	2603	Pat
723	2282	plant
1069	2358	rack
854	2140	rag
798	2491	Saginaw
426	2655	Sam
741	2639	tab
584	2520	thank
518	2197	zap

Table 7.16: F1 & F2 scores of /æ/
(Kate, 47, middle-class, Clare)

F1	F2	word
719	2313	apple
761	2056	ask
590	2331	badge
589	2230	banker
647	2277	bath
884	1644	black
665	1886	brag
616	2297	cabin
624	2145	cash
734	2315	Dad
613	2552	gamble
637	2485	gang
525	2301	has
654	2261	have
470	2040	jazz
738	2240	Lansing
593	1918	laugh
781	2425	mash
818	2230	mattress
794	2013	nap
857	2221	pal
714	2228	past
693	2230	Pat
894	1990	plant
688	2106	rack
664	2217	rag
626	2041	Saginaw
745	2383	Sam
609	2254	tab
796	2389	thank
868	2040	zap

Table 7.17: F1 & F2 scores of /æ/
(Sue, 55, middle-class, Clare)

F1	F2	word
753	2130	apple
704	2350	ask
558	2453	badge
647	2357	banker
637	2232	bath
892	1591	black
749	1794	brag
833	1966	cabin
778	2268	cash
574	2363	Dad
614	2362	gamble
449	2377	gang
779	2205	has
776	2396	have
541	2353	jazz
621	1598	Lansing
829	1727	laugh
783	2283	mash
688	2208	mattress
711	2439	nap
891	1835	pal
781	2257	past
917	2099	Pat
737	2059	plant
809	1875	rack
601	1775	rag
781	1954	Saginaw
790	1841	Sam
605	2474	tab
695	2264	thank
766	1941	zap

Table 7.18: F1 & F2 scores of /æ/
(Ned, 16, working-class, Gladwin)

F1	F2	word
761	1772	apple
625	1935	ask
598	2172	badge
628	2048	banker
705	1711	bath
717	1492	black
602	1726	brag
562	1669	cabin
532	1865	cash
474	2013	Dad
481	2316	gamble
547	2146	gang
577	1919	has
604	1851	have
501	1960	jazz
541	1995	Lansing
635	1629	laugh
634	1851	mash
580	1867	mattress
528	1986	nap
472	1831	pal
525	1914	past
545	1912	Pat
510	1858	plant
623	1781	rack
563	1815	rag
520	1819	Saginaw
516	2190	Sam
501	1986	tab
562	2055	thank
599	1836	zap

Table 7.19: F1 & F2 scores of /æ/ (Jonathan, 17, working-class, Gladwin)

F1	F2	word
595	1720	step
663	1701	apple
574	1795	ask
632	1655	badge
602	1908	banker
616	1742	bath
630	1265	black
603	1649	brag
597	1954	cabin
598	1885	cash
530	1862	Dad
660	2051	gamble
495	2048	gang
584	1895	has
587	1928	have
523	1946	jazz
626	2094	Lansing
615	1598	laugh
685	1923	mash
623	1815	mattress
648	1829	nap
611	1883	pal
659	1736	past
686	1830	Pat
538	1858	plant
694	1670	rack
596	1799	rag
561	1859	Saginaw
721	2023	Sam
528	1825	tab
681	1994	thank
646	1882	zap

Table 7.20: F1 & F2 scores of /æ/ (Nevin, 16, working-class, Gladwin)

F1	F2	word
722	1809	apple
724	1568	ask
573	1839	badge
629	2061	banker
612	1688	bath
669	1454	black
530	1696	brag
597	1659	cabin
598	1869	cash
536	1790	Dad
473	1940	gamble
543	2094	gang
593	1684	has
586	1756	have
496	1799	jazz
543	1954	Lansing
654	1600	laugh
691	1735	mash
675	1734	mattress
680	1383	nap
758	1506	pal
650	1741	past
653	1679	Pat
637	1861	plant
646	1580	rack
601	1710	rag
622	1527	Saginaw
568	1930	Sam
527	1838	tab
634	1706	thank
545	1659	zap

Table 7.21: F1 & F2 scores of /æ/
(Adam, 15, working-class, Gladwin)

F1	F2	word
717	1780	apple
660	1917	ask
562	1880	badge
502	2045	banker
615	1768	bath
641	1578	black
507	1780	brag
510	1820	cabin
510	1849	cash
542	1892	Dad
476	2172	gamble
525	2144	gang
527	1792	has
567	1872	have
461	1908	jazz
493	2034	Lansing
469	1571	laugh
550	1856	mash
551	1800	mattress
464	1752	nap
618	1695	pal
599	1736	past
616	1727	Pat
464	1963	plant
523	1655	rack
485	1845	rag
475	1967	Saginaw
400	1976	Sam
559	1857	tab
533	1993	thank
525	1664	zap

Table 7.22: F1 & F2 scores of /æ/
(Alice, 16, working-class, Gladwin)

F1	F2	word
784	1833	apple
713	2344	ask
770	2208	badge
690	2343	banker
799	2218	bath
676	1988	black
733	1678	brag
831	2100	cabin
772	2292	cash
734	2262	Dad
686	1943	gamble
673	2225	has
838	1820	have
826	2221	jazz
568	2429	Lansing
644	1999	laugh
716	2276	mash
704	2204	mattress
713	2311	nap
812	2263	pal
648	2227	past
860	2048	Pat
779	2166	plant
905	2161	rack
641	1797	rag
649	2310	Saginaw
604	2458	Sam
992	1860	tab
619	2501	thank
645	2213	zap

Table 7.23: F1 & F2 scores of /æ/ (Violet, 20, working-class, Gladwin)

F1	F2	word
850	1195	apple
822	2435	ask
709	2535	badge
675	2491	banker
656	2566	bath
835	2088	black
787	2160	brag
860	2323	cabin
722	2406	cash
636	2634	Dad
632	2664	gamble
678	2570	gang
800	2171	has
737	2489	have
642	2393	jazz
664	2162	Lansing
753	2396	mash
838	2343	mattress
780	2595	nap
793	2321	pal
774	2330	past
827	2280	Pat
709	2364	plant
834	2330	rack
778	2376	rag
787	2301	Saginaw
444	2963	Sam
714	2624	tab
719	2466	thank
846	2390	zap

Table 7.24: F1 & F2 scores of /æ/ (Amily, 15, working-class, Gladwin)

F1	F2	word
933	2030	apple
779	2532	ask
762	2411	badge
587	2678	banker
748	2292	bath
900	1891	black
704	1940	brag
866	2130	cabin
962	2048	cash
705	2253	Dad
657	2767	gamble
711	2462	gang
906	2336	has
824	2425	have
554	2378	jazz
673	2815	Lansing
828	2009	laugh
736	2160	mash
748	2037	mattress
799	2216	nap
779	2217	pal
828	2112	past
849	2237	Pat
641	2872	plant
947	2001	rack
732	2252	rag
762	2112	Saginaw
711	2903	Sam
837	2140	tab
720	2390	thank
801	2305	zap

Table 7.25: F1 & F2 scores of /æ/ (Trish, 20, working-class, Houghton Lake)

F1	F2	word
838	1907	apple
861	2001	ask
704	2249	badge
775	2303	banker
805	2196	bath
821	1806	black
829	1943	brag
804	2109	cabin
818	2289	cash
669	2287	Dad
786	2190	gamble
740	2368	gang
814	2011	has
838	1890	have
808	2103	jazz
759	2130	Lansing
802	1659	laugh
735	2222	mash
809	1939	mattress
770	2130	nap
807	2155	pal
783	1959	past
754	2185	Pat
791	2080	plant
793	1928	rack
764	1902	rag
773	1882	Saginaw
781	2392	Sam
770	2288	tab
777	2000	thank
809	2102	zap

Table 7.26: F1 & F2 scores of /æ/ (Beth, 16, working-class, Gladwin)

F1	F2	score
879	2410	apple
725	2712	badge
761	2482	banker
882	2612	bath
831	2013	black
793	2122	brag
708	2360	cabin
800	2551	cash
626	2603	Dad
693	2266	gamble
777	2752	gang
758	2559	have
721	2515	jazz
835	2221	Lansing
718	2498	mash
855	2382	mattress
696	2482	nap
862	2457	pal
980	2335	Pat
857	2075	rack
772	2384	rag
854	2483	Saginaw
574	2610	Sam
803	2423	tab
570	2728	thank
802	2513	zap

Table 7.27: F1 & F2 scores of /æ/
(Nina, 16, working-class, Gladwin)

F1	F2	word
800	1981	apple
808	1895	ask
693	2161	badge
695	2184	banker
811	1991	bath
958	1724	black
775	1891	brag
760	1897	cabin
825	1766	cash
743	2254	Dad
613	2330	gamble
626	2335	gang
783	2154	has
798	1891	have
701	2290	jazz
583	2027	Lansing
686	1853	laugh
633	1918	mash
637	2166	mattress
638	1867	past
828	2196	Pat
550	2365	plant
774	1913	rack
661	2068	rag
740	1942	Saginaw
565	2527	Sam
757	1809	tab
594	2354	thank
664	1938	zap

Table 7.28: F1 & F2 scores of /æ/
(Bill, 57, working-class, Clare)

F1	F2	word
674	1554	apple
638	1953	ask
541	1830	badge
539	1787	banker
631	1714	bath
698	1213	black
601	1594	brag
593	1751	cabin
573	1846	cash
524	1868	Dad
482	1937	gamble
511	1989	gang
587	1910	has
576	1637	have
592	1795	jazz
518	1807	Lansing
626	1500	laugh
617	1824	mash
636	1714	mattress
620	1829	nap
626	1679	pal
596	1780	past
645	1853	Pat
606	1754	plant
652	1463	rack
563	1578	rag
540	1799	Saginaw
549	1917	Sam
553	1824	tab
619	1800	thank
635	1732	zap

Table 7.29: F1 & F2 scores of /æ/
(Bob, 58, working-class, Clare)

F1	F2	word
696	1730	apple
602	1784	ask
559	1823	badge
565	1750	banker
585	1679	bath
713	1376	black
571	1635	brag
595	1807	cabin
645	1832	cash
516	1892	Dad
588	2022	gamble
554	1945	gang
602	1822	has
599	1767	have
592	1330	jazz
626	1753	Lansing
647	1568	laugh
668	1897	mash
776	1812	mattress
608	1886	nap
669	1696	pal
645	1745	past
629	1755	Pat
724	1586	plant
672	1714	rack
598	1787	rag
650	1668	Saginaw
653	1776	Sam
631	1827	tab
614	1704	thank
660	1673	zap

Table 7.30: F1 & F2 scores of /æ/
(Brian, 48, working-class, Gladwin)

F1	F2	word
766	2223	apple
810	1974	ask
614	1899	badge
547	1920	banker
659	1862	bath
793	1567	black
563	1518	brag
659	1661	cabin
788	1774	cash
558	2043	Dad
508	2130	gamble
647	2184	gang
661	1776	has
574	1865	have
566	1945	jazz
561	1684	Lansing
798	1787	laugh
650	1916	mash
609	1746	mattress
509	1789	nap
827	1515	pal
708	1912	past
718	1901	Pat
578	1804	plant
663	1621	rack
650	1723	rag
594	1692	Saginaw
512	1969	Sam
602	1907	tab
511	1910	thank
631	1743	zap

Table 7.31: F1 & F2 scores of /æ/ (Chad, 41, working-class, Gladwin)

F1	F2	word
654	1535	apple
587	1613	ask
485	1627	badge
551	1612	banker
624	1518	bath
630	1333	black
547	1445	brag
541	1553	cabin
535	1610	cash
509	1638	Dad
504	1982	gamble
601	1766	gang
524	1612	has
523	1636	have
496	1520	jazz
485	1905	Lansing
634	1314	laugh
556	1607	mash
556	1607	mattress
612	1555	nap
559	1325	pal
597	1562	past
542	1498	Pat
597	1896	plant
582	1474	rack
574	1385	rag
539	1407	Saginaw
565	1525	Sam
526	1515	tab
557	1533	thank
571	1467	zap

Table 7.32: F1 & F2 scores of /æ/ (Raymond, 47, working-class, Gladwin)

F1	F2	word
625	1797	apple
643	1840	ask
522	1789	badge
559	1809	banker
621	1723	bath
691	1675	black
562	1736	brag
544	1824	cabin
574	1889	cash
532	1894	Dad
600	1978	gamble
548	2141	gang
574	1851	has
611	1754	have
504	1807	jazz
574	1996	Lansing
593	1703	laugh
647	1839	mash
622	1732	mattress
616	1866	nap
657	1662	pal
585	1821	past
653	1794	Pat
559	2042	plant
653	1668	rack
547	1755	rag
577	1690	Saginaw
601	1964	Sam
554	1915	tab
563	1934	thank
596	1718	zap

Table 7.33: F1 & F2 scores of /æ/ (Shannon, 47, working-class, Clare)

F1	F2	word
756	1816	apple
773	1826	ask
728	1924	badge
673	2172	banker
730	1928	bath
703	1781	black
699	1917	brag
669	1854	cabin
683	1825	cash
652	2107	Dad
685	2051	gamble
598	2260	gang
748	1920	has
742	1953	have
695	1918	jazz
704	1828	Lansing
750	1909	laugh
699	2078	mash
710	1917	mattress
706	1945	nap
730	1974	pal
754	1933	past
735	2074	Pat
732	1943	plant
736	1972	rack
704	1907	rag
671	1939	Saginaw
656	2087	Sam
690	1957	tab
657	1974	thank
735	1966	zap

Table 7.34: F1 & F2 scores of /æ/ (Jan, 44, working-class, Gladwin)

F1	F2	word
930	1940	apple
792	2260	ask
623	2334	badge
604	2522	banker
752	2189	bath
773	1866	black
760	1797	brag
813	1996	cabin
736	2282	cash
632	2267	Dad
744	2057	gamble
646	2445	gang
752	1987	has
743	2240	have
694	2304	jazz
773	2429	Lansing
767	1958	laugh
726	2429	mash
833	2219	mattress
795	2390	nap
866	1855	pal
761	2326	past
898	2146	Pat
815	1866	plant
761	2065	rack
742	2098	rag
753	2158	Saginaw
810	2350	tab
729	2225	thank
763	2074	zap

Table 7.35: F1 & F2 scores of /æ/
(Lily, 39, working-class, Gladwin)

F1	F2	word
722	2329	apple
936	1807	ask
742	2668	badge
732	2732	banker
701	2402	bath
874	1804	black
728	1842	brag
725	2191	cabin
725	2486	cash
612	2589	Dad
717	2497	gamble
686	2608	gang
627	2581	has
640	2269	jazz
760	2562	Lansing
979	1837	laugh
758	2393	mash
887	1927	mattress
722	2559	nap
760	2437	pal
767	2477	past
732	2365	Pat
807	2471	plant
737	1582	rack
711	2447	rag
802	2254	Saginaw
634	2597	tab
673	2639	thank
740	2070	zap

Table 7.36: F1 & F2 scores of /æ/
(Sandi, 44, working-class, Gladwin)

F1	F2	word
740	2220	apple
683	2337	ask
693	2403	badge
629	2564	banker
745	2274	bath
890	2131	black
719	1969	brag
795	2020	cabin
646	2335	cash
638	2184	Dad
677	2020	gamble
623	2409	gang
768	2207	has
712	2240	have
626	2241	jazz
674	2409	Lansing
816	1846	laugh
752	2383	mash
781	2288	mattress
619	2373	nap
691	2145	pal
753	2256	past
815	2086	Pat
715	2085	plant
754	2038	rack
738	1951	rag
730	2176	Saginaw
638	2476	Sam
612	2383	tab
819	2213	thank
739	2171	zap

APPENDIX G: RESULTS OF ANOVA TESTS

ANALYSES OF VARIANCE (significant results only)

dependent variable: F1

independent variables: H$=preceding segments

	SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
John	H$	62065.080	4	15516.270	2.786	0.058
Linda	H$	360861.739	4	90215.435	5.748	0.004
Shannon	H$	16341.359	4	4085.340	4.573	0.010

dependent variable: F2

independent variables: H$=preceding segments

	SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
Dennie	H$	812582.714	6	135430.452	5.452	0.002
Lisa	H$	466849.381	6	77808.230	3.773	0.010
Pete	H$	687664.631	6	114610.772	4.501	0.004
Linda	H$	1180489.296	6	196748.216	7.828	0.000
Kate	H$	555743.929	6	92623.988	4.006	0.008
Jonathan	H$	333208.190	6	55534.698	2.677	0.043
Violet	H$	1028337.083	6	171389.514	2.645	0.047
Beth	H$	540446.717	6	90074.453	4.435	0.007
Bill	H$	372720.881	6	62120.147	3.351	0.018
Bob	H$	281825.095	6	46970.849	6.331	0.001
Brian	H$	387799.881	6	64633.313	2.591	0.049

dependent variable: F1

independent variables: J$=Manner of articulation

	SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
Colin	J$	77166.4795	4	19291.6199	3.3266	0.027
Dennie	J$	77186.2332	4	19296.5583	5.3676	0.003
Ray	J$	44453.2357	4	11113.3089	2.6705	0.058
Alison	J$	118152.0357	4	29538.0089	6.1225	0.002
Janet	J$	75856.5033	4	18964.1258	3.8699	0.015
Lisa	J$	138593.9122	4	34648.4780	5.1265	0.004
Rick	J$	54070.5296	4	13517.6324	2.9113	0.043
Mike	J$	79220.8768	4	19805.2192	10.9003	0.000
Kate	J$	129048.4007	4	32262.1002	4.5417	0.007
Amily	J$	128369.7906	4	32092.4477	4.4413	0.008
Nina	J$	121487.2381	4	30371.8095	5.0948	0.004
Bill	J$	47528.7135	4	11882.1784	10.5800	0.000
Bob	J$	29042.5821	4	7260.6455	3.1508	0.032
Brian	J$	126560.9532	4	31640.2383	6.6839	0.001
Jonathan	J$	32245.6502	4	8061.4126	3.2615	0.029
Nevin	J$	55378.300	4	13844.575	4.940	0.005
Chad	J$	21467.5312	4	5366.8828	4.0730	0.012
Violet	J$	121704.050	4	30426.013	6.195	0.002
Raymond	J$	30510.280	4	7627.570	8.951	0.000
Shannon	J$	19953.286	4	4988.321	5.255	0.003
Jan	J$	40396.988	4	10099.247	2.712	0.055

dependent variable: F2

independent variables: J$=Manner of articulation

	SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
Colin	J$	158670.622	4	39667.656	3.785	0.016
Pat	J$	134333.019	4	33583.255	7.079	0.001
Ray	J$	438703.143	4	109675.786	2.894	0.046
Janet	J$	284570.838	4	71142.710	2.915	0.043
Mike	J$	307548.999	4	76887.250	5.329	0.003
Ned	J$	347601.343	4	86900.336	4.553	0.007
Jonathan	J$	328048.710	4	82012.178	4.556	0.007
Nevin	J$	392548.800	4	98137.200	6.223	0.002
Adam	J$	439736.376	4	109934.094	14.610	0.000
Amily	J$	1629443.854	4	407360.963	15.381	0.000
Nina	J$	685867.976	4	171466.994	7.304	0.001
Chad	J$	299701.830	4	74925.458	4.708	0.006
Raymond	J$	214411.314	4	53602.829	7.784	0.000
Lily	J$	851271.939	4	212817.985	2.683	0.058

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