Traces of the Northern Cities Shift: An Empirical Case Study in Amherst, MA

Dissertation

vorgelegt von

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Für meine Eltern

Acknowledgments

The voices of the people of Amherst form the core of this study. Without their willingness to participate, their time and their honest contributions, this project would not have existed. I owe this community my deepest gratitude, for they not only enabled my work over the past three years, but they filled it with life. In the depth of frequencies, numbers and calculations I always had their voices and stories in my mind, which helped me keep the perspective of sociolinguistics – the analysis of how a speech community is structured – instead of turning this into a mathematical project.

The Linguistics Department at the University of Massachusetts allowed me to join their faculty as a visiting scholar for the time of my field work, which immensely facilitated my work, and I am very grateful for this opportunity.

I am indebted to Prof. Dr. Charles Boberg for his interest in the project, the fruitful conversations and his joining of the PhD advisory committee, which involves not only additional work, but also extended travel.

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Contents

1 Introduction

It is a rare chance for a linguist to be able to analyze an ongoing change in a language. For linguists with a focus on the English language who reside outside of an English-speaking country the chance is even rarer.

The Northern Cities Shift (NCS), an ongoing vowel shift in and around the northern cities of the United States, has attracted many sociolinguists and resulted in numerous studies in recent years. The complexity of the shift and the wide geographical spread, however, give cause for the number of blanks that still need to be filled in the understanding of the system and dynamic of this change in progress. The short vowels of General American (GA) are affected in that they cease to be pronounced in their traditional place in the vowel space, and rather unitedly shift to the position of a neighboring vowel, which results in a distinct regional pronunciation.

The foundation for the current study was created when in 2008/2009 I spent an academic year at the University of Massachusetts, Amherst, and for the first time encountered the American English spoken in Western Massachusetts. I was able to hear a few elements of the shift, such as a raised vowel in words like *cat* or a lowered sound in words such as *thing*. Therefore, a small study was conducted including eight informants. The results were captured in my *Examensarbeit* (equivalent of a Master's thesis). They show that elements of the shift are indeed traceable and that the speech of the community is undergoing a change in progress. Especially the youngest speakers showed considerable differences when compared to the older ones.

Since eight speakers can only give rudimentary information on the actual state of the language, and the time constraints of the *Examensarbeit* only allowed for limited analysis, the project was expanded into the current one. The theoretical framework of the current thesis resembles that of the unpublished *Examensarbeit*, but different informants were chosen to increase the corpus.

In order to choose representative informants and understand the structure of the community, four months were spent in Amherst, during which locals were contacted and interviews were recorded.

A long period of time was dedicated to the extraction of analyzable data from the speech recordings. Different methods were tried and rejected before a satisfactory extraction method was found. The interpretation of the resulting data has a rather mathematical focus, as the normalized frequencies serve as a sound basis for numerical comparison.

Chapter 2 serves as the theoretical framework of the thesis. The Northern Cities Shift is defined and described in detail, and reasons for a language change are highlighted from a sociolinguistic point of view. Background information on sociolinguistic variables is then followed by major studies that have dealt with the NCS or the region in question.

In chapter 3 the field work conducted in the community of Amherst, MA, is described in detail, from background information on the community to informant selection and the interviewing process.

The analysis of the recordings gathered is then described in chapter 4. Tools and software used for the extraction of comparable data are introduced, as well as the normalization method and choice of points of measurements. Issues and problems related to these topics are briefly mentioned; they are discussed further in chapter 6.

Chapter 5, the most extensive chapter, harbors the detailed analysis of the state of each vowel in question. Subchapters deal with each vowel individually as well as relationships between certain vowels, e.g. /ɔ/ and /ɑ/. The data set is tested for significant differences in relation to the two sociolinguistic variables Age and Gender.

Chapter 6 ties all the insights on the sociophonetic situation in Amherst, MA, together in the discussion. The influences of each sociolinguistic variable are summarized, and issues that have arisen in the course of the study are discussed. The choice of community and representative speakers is treated, as well as issues related to the subsequent analysis. Problems in relation the recording and especially issues in the further treatment of the speech recordings, i.e. the data extraction are analyzed.

The final chapter rounds off the thesis in a brief conclusion.

2 The Northern Cities Shift

2.1 Definition

Languages that are not extinct fluctuate, which leads to grammatical, lexical or phonological variation. North America can be divided into different linguistic regions that display distinctive features, thus differentiating one from the other. Speakers can be placed in their home region mainly based on their pronunciation. Despite the regional differences, however, speakers of American English are still able to understand each other (cf. Barnickel, 1982, p. 46). A regional version of speech develops gradually, and the process is of great interest to linguists. The phonological development of a speech community (Amherst, MA) and the detection of features of the Northern Cities Shift are the focus of the current project.

The name 'Northern Cities Chain Shift' indicates that a chain of movements is involved of which each movement appears to be related to the others. Other names of the phenomenon include the 'Northern Cities Vowel Shift' or simply the 'Northern Cities Shift' (cf. e.g. Labov 2001: 280; Gordon 2008: 254). In order to satisfy all three and for the sake of simplification, it is from now on referred to as NCS.

Each vowel has a distinctive place of pronunciation in the mouth, and "it is very important for languages to keep different phonemes different enough so that listeners can recognize them as different" (Wolfram/Schilling-Estes 1998: 49). Therefore, if a vowel moves into the space of another, the distance needs to be restored. As a result, a chain of movements is triggered to avoid the two vowels remaining in one space, which would result in a merger (cf. Aitchison 2001: 186). Martinet (1981: 55) draws the distinction between a push-chain and a drag-chain shift, i.e. a vowel following the moving vowel in the empty space or a vowel moving away from an approaching vowel. However, he explains that all vowels are putting pressure on each other in order to ensure their safety distance, so that often it is hard to determine whether one or the other movement is taking place.

William Labov, the pioneer (cf. Labov/Yaeger/Steiner 1972) and most prominent researcher in the context of the NCS, has identified the movement as a drag chain which contains some elements of a push chain, such that "the backing of /e/ precedes the backing of /ʌ/" (2001: 463), a movement to be discussed further. The *Atlas of North American English*, ANAE, (cf. Labov/Ash/Boberg 2006: 16) provides information on how vowels involved in a chain shift generally move. Long vowels are thus pronounced from a higher position, while short vowels are lowered and the vowels that originate in the back of the mouth move forward.

A prominent example of chain shifts is the Great Vowel Shift that English underwent in the 15th and 16th centuries. It resulted in a completely different pronunciation of the long vowels (cf. Wells 1982: 184ff). Long vowels are more prone to fluctuating, which makes the NCS especially interesting because it involves the short ones. According to Labov, "[the] short vowels in English, *pit, pet, pat*, have been standing still for a thousand years" (Siegel 2006). ANAE (cf. Labov/Ash/Boberg 2006: 190f) explains in more detail how, while the Old English /i/ and /e/ remained the same in Modern English, /æ/ underwent some movement towards and away from /ɛ/, but is most likely to have been placed in the same spot in Old English as in its current position.

The vowels affected by the NCS are displayed in Figure 2.1 with respect to the place of articulation:

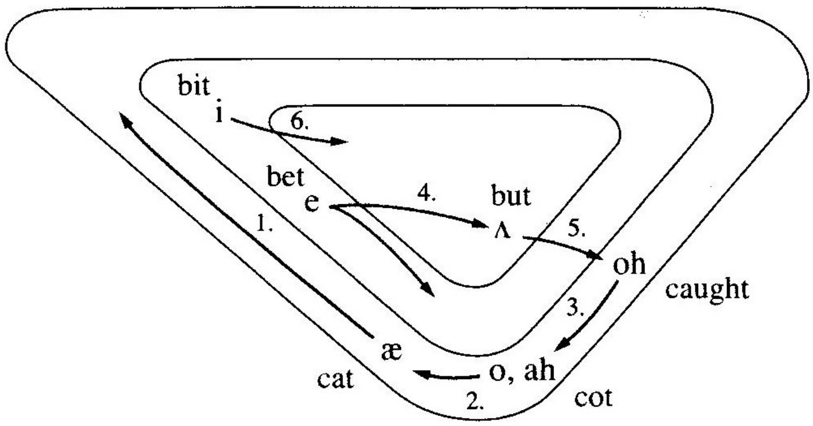

Figure 2.1: The vowel movement of the NCS (Labov/Ash/Boberg 2006: 190 figure 14.1)

Figure 2.1 shows the vowels of *cat, cot, caught, but, bet*, and *bit* involved in the shift. These correspond to the lexical sets defined by Wells (1982) as TRAP, LOT,THOUGHT, STRUT, DRESS, and KIT. For the purpose of simplicity, in the present thesis these vowels will be referred to with their corresponding phonetic symbols /æ/, /ɑ/, /ɔ/, /ʌ/, /ɛ/, and /ɪ/. When phonetic symbols were not computable in charts, they were replaced by the ARPABET symbols AE, AA, AO, AH, EH, and IH.

The chain shift is recognizable in the rotation the vowel system undergoes. Labov (1991: 14ff) has determined two crucial elements that distinguish the NCS. Communities that firstly raise /æ/, also known as *short a,* and secondly distinguish between /ɔ/ and /ɑ/ undergo the shift. The latter criterion is called the low-back distinction. Based on the data collected in 1972, Labov describes /æ/ as the trigger of the NCS since it moves towards /ɪ/. Thus, /ɛ/ is lowered and backed towards the original place of articulation of /æ/, leaving room for /ɪ/, which drops. Additionally, /ɑ/ is fronted towards the former position of /æ/, and /ɔ/ is pulled into the low back corner of the vowel chart. Finally /ʌ/ is backed into the former position of /ɔ/ (cf. Labov/Yaeger/Steiner 1972; Labov 1991). In later studies (cf. Labov 1994: 195), Labov includes the backing of /ɛ/ as a more recent development of the shift.

Gordon (2001), however, criticizes that in reality the shift displays much more complex facades, with vowels shifting in multiple directions and some lacking movement in the first place. He bases his assumption on an extensive research project conducted in rural Michigan. Figure 2.2 displays Gordon’s version of the visualization of the NCS. Movements such as the backing of /ɪ/ do “not seem to bring the vowel into the range of another vowel” (2001: 197). The motivation of such movements might therefore not be able to be traced in a drag or push chain. Although the model Gordon displays suggests further research, it shows that in reality the NCS does not form a perfect chain of movements, but is rather a more complex ‘wholesale’ short vowel change.

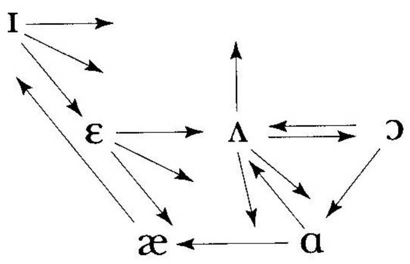

Figure 2.2: The NCS according to Matthew J. Gordon (2001: 197 figure 6.2).

As the name suggests, the Northern Cities Shift is predominantly observed in big cities of the American north. Labov (1991: 14) describes the geographical distribution of the pivot conditions for the NCS as the region “westward from the White Mountains, covering western New England, New York State, the Northern Tier of counties in

Pennsylvania, northern Ohio, Indiana and Illinois, Michigan, Wisconsin, and less well defined areas extending westward."

The map in Figure 2.3 taken from the ANAE shows linguistic features of the North, with the blue and white isogloss outlining the area in which /æ/ is not split and the low-back merger is absent.

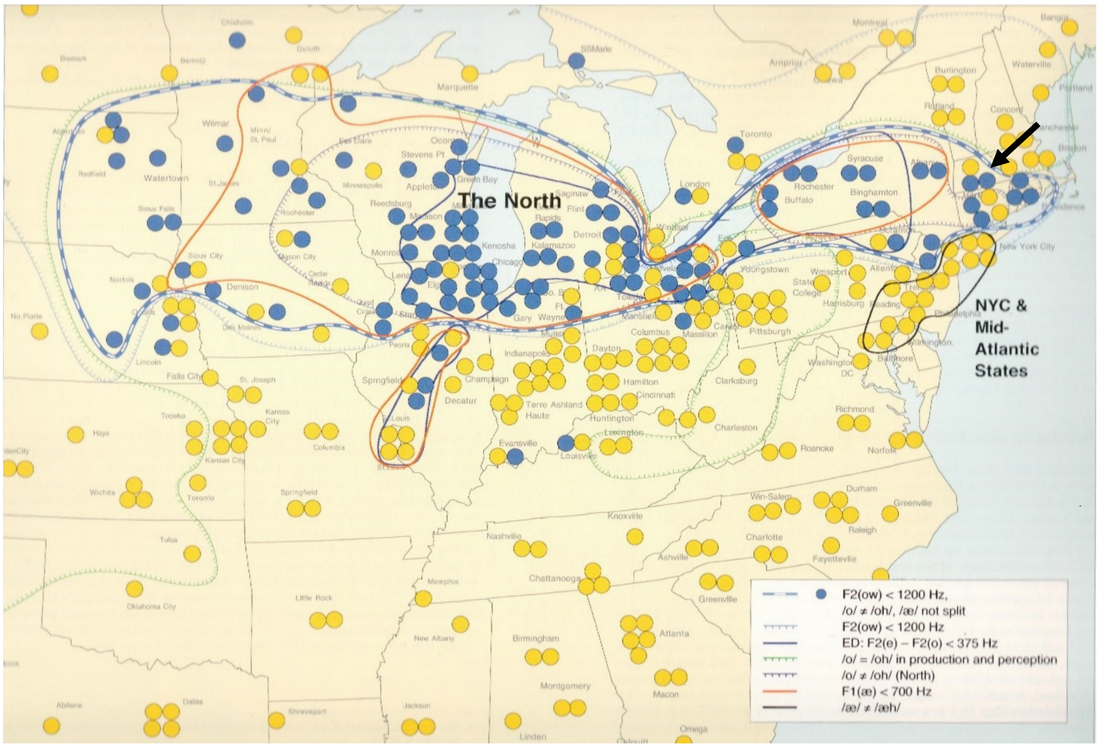

Figure 2.3: ANAE Map of the North (cf. Labov/Ash/Boberg 2006: 134 Map 11.8). (The arrow indicates the approximate position of Amherst.)

Research conducted by Callary (1975) indicates that the spread of the NCS is related to the number of speakers in a speech community. Labov explains that "[The] Northern Cities Shift is essentially an urban phenomenon. […] The larger the city, the more advanced the change" (1994: 178). Wolfram and Schilling Estes (1998), who are also prominent in the field of regional studies, confirm that the shift mainly occurs in the metropolitan areas. As a consequence, most research has been conducted in comparatively large communities (cf. 2.3/ 2.4)

However, Gordon argues that, despite the fact that the shift predominates in the bigger cities, "the influence of the shift is certainly felt in communities of various sizes throughout the region" (2001: 19), a statement that leaves room for further investigation.

2.2 Sociolinguistic Aspects

Language never changes in all speakers and subgroups of a speech community at the same time, but is influenced by social factors. The field of sociolinguistics describes these variables and their impact on a speech community.

2.2.1 Reasons for Linguistic Change

Why does language change? How can one tell that a language is changing? In order to observe language changes it is important to first acquire the structure of the language completely (cf. Fasold 1990: 227). Records of speech at any given time are therefore crucial for the full understanding of a language. Past changes determine its present form. Regional dialects are “the result of the spread of language changes through geographical space over time” (Wolfram/Fasold 1974: 75).

Martinet (1981: 229) describes language change as the result of changes in the collective, in the development of society, in settlement or customs. Additionally, contact with other languages or dialects have impact on an existing language and might result in the creation of variation.

Shuy (1967: 33ff) names similar reasons for the rise of regional dialects and thus changes in language. He bases the changes on the historical development of a region and differences in their settlement history. Furthermore, he explains that population movement which results in language contact leads to language change. Finally, he sees the roots of regional change in the physical geography of a region.

Since language can be described as cultural behavior (cf. Wolfram/Fasold 1976: 15), a change in culture will therefore result in a change in language. It is important to keep in mind that the way a language changes is not predictable (cf. Labov 2001: 503). Although some changes can give reason for the postulation of an ensuing new change, linguists should mainly focus on the description of current or past changes.

A single speaker cannot cause a change in language[1], but when a subgroup adapts a new pattern of speech, it serves as an indicator of a change. Fasold establishes that “[the] speakers who are moving the shift forward are not aware of it” (1990: 228).

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[1] According to a Northumbrian Tradition, the uvular flapped /r/ spoken in Northumberland and Tyneside was already described by Shakespeare. Harry Hotspur, the son of the Duke of Northumberland, appears in Shakespeare’s *Henry IV*, part 2 as “speaking thick, which […] became the accents of the of the valiant.” The ‘burr’ is pronounced even today in rural Northumberland.

In language change, Labov (2007) differentiates between transmission and diffusion. He describes linguistic transmission as the process of one language or dialect evolving from a previous one and being implemented by the speakers of the next generation. Diffusion, on the other hand, is the result of language contact “and the transfer of features from one to the other” language (Labov 2007: 347), mainly by adults. While both result in a change in language, they differ in their agents, and the process of transmission is needed for features changed through diffusion to have an impact over generations on the language in question.

2.2.2 The Sociolinguistic Variables

The ‘sociolinguistic variable’ (cf. Labov 1972: 7ff) is necessary for the study of language change in progress. Based on such a variable, it is possible to analyze how different versions of a language are brought to use and who uses them in what context. A variable that serves as an object of interest in the study of language change must be used frequently and belong to conversational speech, so that recordings capture it easily. “Secondly, it should be structural: the more the item is integrated into a larger system of functioning units, the greater will be the intrinsic linguistic interest of our study” (Labov 1972: 8). Finally, the variable should show a high stratification, i.e. occur in different social subgroups. These subgroups are created according to the sociolinguistic object of interest – some of which are being introduced in the following subchapters.

2.2.2.1 Social Status

The members of each society can be subdivided into groups of different rank or class. It is difficult, however, to distinguish the unique features of each class in order to identify its speakers. Social class is generally linked to a person’s power and his or her status in society. The socioeconomic status includes different indicators (e.g. education, housing, profession) and determines in a continuum scale where a speaker belongs. Nevertheless, researchers need to keep in mind that the members of a community themselves can probably differentiate best between the social groups that are developed and know how to classify individuals in such a system (cf. Wolfram/Schilling-Estes 1998: 152f).

The study of the impact social class has on a speaker is based on a model of *social stratification*. “If a variable shows class stratification, certain variants are used most frequently by the highest-status class, least frequently by the lowest-status class, and at intermediate frequency by the classes in between” (Fasold 1990: 224). Often, the most standardized form of speech is delivered by the most dominant or prestigious group of speakers (cf. Wolfram/Schilling-Estes 1998: 157).

In the context of language change, the differentiation of a speech community into socioeconomic classes yields valuable information concerning the direction of a movement. Although the hypothesis that the dominant classes will lead a society into a new form of speech suggests itself, the second highest classes tend to set the lead in language change (cf. Wolfram/Schilling-Estes 1998: 163).

An example of such linguistic force is the process of hypercorrection found in the speech of the New York lower middle class in Labov (1972: 122-141). Hypercorrection (cf. Figure 2.4) occurs when speakers are under pressure and concentrate on the way they speak (cf. Labov 1972: 39).

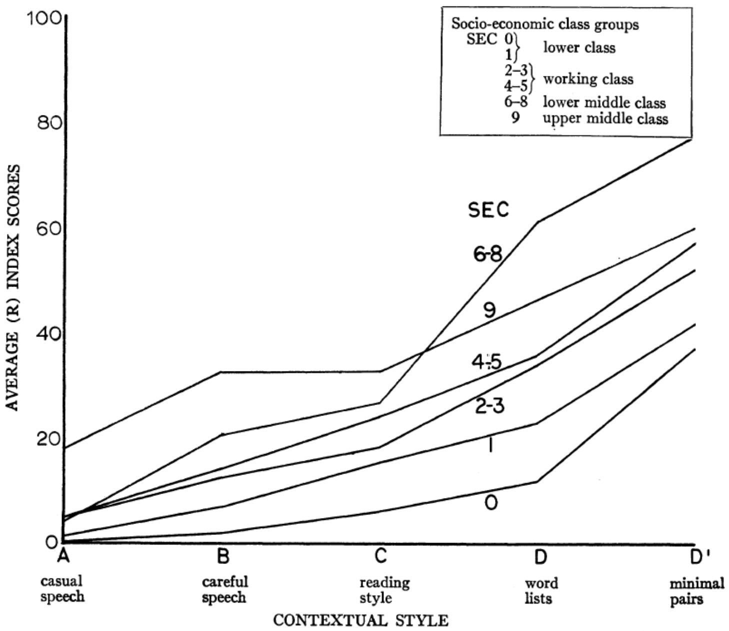

FIG. 2. Class stratification diagram for (r).

Figure 2.4: Hypercorrection of the New York lower middle class (Labov 1964: 171).

(r) is obviously a prestige marker in New York since in casual speech it is only used by upper middle class speakers (cf. Labov 1972: 124). In monitored speech, the lower middle class not only reaches the same percentage of (r), but exceeds that of the upper middle class. This fact, as well as the hypersensitivity of the lower middle class in connection with stigmatized forms, can be traced back "to a high degree of linguistic insecurity [of] these speakers" (Labov 1972: 132).

2.2.2.2 Age

A diachronic approach is expected for the analysis of language change over time. However, the sociolinguistic variable age makes synchronic research possible, for the stages of shift are recorded according to the age group of a speaker. Since a language style is formed during adolescence, about 60 years of language history can be observed in a speech community in an apparent time construct (cf. Gordon 2001: 2ff). Nevertheless, some age-related features seem appropriate at a certain stage of life (cf. Wolfram/Fasold 1974: 89ff). In the study of age and language change, Labov establishes four possible scenarios:

> [Stability], where both [the individual and the community] remain constant; age-grading, where the individual changes but the community remains constant; generational change, where the individual preserves his or her earlier pattern, but the community as a whole changes; and communal change, where individuals and the community change together (2001: 76).

The age-dependent behaviour of speakers is generally linked closely to social class. Labov relates the fact whether or not speakers vary their speech patterns over the years to their social status. While the upper middle class generally adopts a certain manner of speaking early on and preserves it especially in older years, the lower middle class would, even with increasing age, attempt to adopt the more prestigious form from younger speakers of the upper middle class. This phenomenon relates to the above mentioned linguistic insecurity of the lower middle class (cf. Labov 1972: 134).

The subdivision of informants into age groups helps determine the general direction in which a language change develops, especially, if trends affect the youngest group of speakers (cf. Labov 1972: 57). The famous department-store study for example, in which Labov ranks certain Manhattan department stores by prestige and tests specific linguistic variables includes the differentiation in age. Thus, a trend towards a certain upcoming prestige pronunciation can be derived from the data collected (cf. 1972: 58f). Most studies, however indicate that the factor ‘age’ rarely shows an impact by itself, but needs to be put in relation to other sociolinguistic factors.

2.2.2.3 Gender

Gender differences play an important role in the context of language change. Here it is crucial to distinguish between changes from above (i.e. above the level of consciousness) and changes from below. Researchers (e.g. Wolfram/Fasold 1974; Wolfram/Schilling-Estes 1998; Labov 2001) are in unison in respect to a gender-based treatment of prestigious forms of speech, stating that “men say they use a great deal more of the local (nonprestigious) form than they actually do (and that women say they use more of the prestigious one)” (Preston 2008: 46).

Labov formulates three principles to describe the female role in linguistic changes. The first one analyzes “the linguistic conformity of women: For stable sociolinguistic variables, women show a lower rate of stigmatized variants and a higher rate of prestige variants than men” (2001: 266). Principle two states: “In linguistic change from above, women adopt prestige forms at a higher rate than men” (2001: 274).

Wolfram and Schilling-Estes point out that the predominance of women in language change cannot simply be rooted in their desire to use the most prestigious forms since there are cases in which women also have more advanced shifts in which a less prestigious form is targeted. The two researchers therefore state that a number of social factors lead to the gender differences in language change (cf. Wolfram/Schilling-Estes: 189ff).

In changes from below, i.e. language changes that occur unconsciously, researchers have shown that, again, women tend to adopt more advanced signs of shifting. Principle three: “In linguistic change from below, women use higher frequencies of innovative forms than men do” (Labov 2001: 292). Labov (2001: 279ff) analyzes data taken from ANAE (cf. chapter 2.3.2) and establishes that in the NCS women also shift their vowels further or more frequently than men do. Gordon (2000, 2001) comes to the same conclusion and states that “in the vast majority of cases it was found that females lead males in the use of innovative forms” (2001: 179).

Based on the three principles established, Labov formulates a “Gender Paradox: Women conform more closely than men to sociolinguistic norms that are overtly prescribed, but conform less than men when they are not” (2001: 292f). Cheshire concludes that “many consider [gender] the main social factor driving variation and change” (2008: 439).

2.2.2.4 Ethnicity

The ethnic background of a speaker or a group of speakers can have a strong impact on their language. Ethnic background might include the second or third generation, but the effect diminishes. Labov describes the impact of ethnicity in New York City as follows: “In the development of the New York City vowel system, we find that ethnic identity plays an important role – more important than socioeconomic class, for some items” (1972: 297).

However, Labov also points out that mainly Caucasian speakers participate in sound changes while speakers of Hispanic, Native American, Asian, and especially African American descent hesitate to incorporate features of the current sound change into their speech (cf. 2001: 506f). African American Vernacular English (AAVE) has developed rules of its own that are quite distinct from the current trend of sound changes observed. Labov speculates about the reasons for such a development. The smaller size of the speech community might isolate speakers from the general shift or the group of speakers wishes to diverge from the leading group of Caucasians (2001: 508). The latter hypothesis is also advocated by Wolfram and Fasold, who establish the rule that the “extent to which ethnicity correlates with linguistic diversity is a function of the distance between particular ethnic groups” (1974: 94). They describe the continuum of linguistic differences as correlating with racial isolation.

Gordon (2000: 132) further analyzes the speech of different ethnic groups in the context of the NCS. He investigates a group of female speakers of White, Mixed, Mexican, and African American descent in the Calumet region[2] and finds that among “this sample of speakers, the NCS features are predominantly a characteristic of white speech” (2000: 132). While the mixed group displays some features of the NCS, only little evidence is detected in the Mexican and African American groups. However, some raising of /æ/ can be detected in the latter, which might indicate a beginning participation in the shift.

Gordon also mentions that the overall amount of shifting is relatively low, even among the white speakers, which he tries to explain by either the formality of the setting or the fact that the Calumet region is mainly working-class whereas the shift in nearby Chicago is associated with the middle class.

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[2] Northwestern Indiana, USA.

2.3 Major Studies

2.3.1 Linguistic Atlas of New England (LANE)

Although, as described above, only relatively few empirical projects on the NCS are recorded, some major and many minor studies have been conducted that deserve attention. The first study neither displays the NCS, nor was it intended to do so, but it serves as a basis and a means of comparison for further research.

The earliest comprehensive linguistic project mapping New England dialects was created under the supervision of Hans Kurath and with the help of field workers who conducted the interviews. It was first published in 1939 and appeared in its second edition in 1972. The *Linguistic Atlas of New England* (Kurath ^{1}1939b, ^{2}1972), henceforward LANE, "is an irreplaceable record of the usage of native New Englanders in the 1930s" (O'Cain 1979: 243) and is referenced in most of the literature concerned with dialectology. Between 1931 and 1934 the field workers set out to record both rural and urban speech as well as to collect information on regional, agricultural, and social history (cf. O'Cain 1979: 256). Over 400 speakers in 213 speech communities defined by New England townships were interviewed, and the results were summarized in "three volumes, each bound as two mammoth parts weighing about sixteen pounds apiece" (O'Cain 1979: 244). The isoglosses established are depicted in maps, and the Linguistic Atlas is accompanied by a *Handbook* (Kurath ^{1}1939a, ^{2}1973).

The speakers recorded were divided into three subgroups based on their social status. Type I were representatives of the oldest members of the community, serving as an example of the most typical elements of regional speech. Type II was younger and more socially active, therefore representing the change in regional speech. Finally, Type III represented the most educated members of the community, thus displaying the standard-nearest form of speech (cf. Kurath 1973: 41).

LANE concentrates on the recording of region-specific terms, verb forms and pronunciation and can thus be consulted for numerous purposes. Additionally, dialect boundaries were established leading to the establishment of linguistic regions, to be discussed in 2.5.

2.3.2 The Atlas of North American English (ANAE)

The Atlas of North American English (ANAE) (cf. Labov, Ash, Boberg 2006) is a phonological research project based at the University of Pennsylvania under the supervision of William Labov, Sharon Ash and Charles Boberg. The atlas "maps the phonological organization of all [American] English dialects and the extent of ongoing sound changes" (Labov 1996). The data that serve as the basis of the project were collected through a telephone survey (TELSUR) which was conducted between 1992 and 1999, covering the United States and Canada. It serves as a source of phonological features, facilitating the analysis of sound changes and mergers (cf. Labov/Ash/Boberg 2006: Preface).

ANAE establishes the dialect regions of North American and gives some regional background information as well as guidelines for empirical phonological studies and knowledge on sounds and sound change in general. Additionally, a CD-ROM is provided which contains the data of all 762 informants. The maps determining regional boundaries (cf. Figure 2.7) and feature-specific isoglosses are printed in the Atlas. "Instead of a long list of dialect features, the TELSUR telephone survey provide [sic] a small set of parameters that can be located at any given dialect in relation to others" (Labov 1996).

Not only does ANAE serve as a comprehensive record of phonological features of North American speech, it also builds a basis for further research, either comparative (e.g. Hazen 2002) or derived from the data provided in the Atlas (e.g. Boberg 2001).

2.3.3 The Social Stratification of English in New York City

In the 1960s William Labov conducted sociolinguistic research in New York City, a project that today not only serves as a source for the speech of the New York inhabitants, but also as a reference for the analysis of speech communities in general. *The Social Stratification of English in New York City* appeared in two editions, ^{1}1966, and ^{2}2006. Before this overarching research project, no comparable study covering such a huge speech community had been presented, and linguistic change had only been studied in retrospective as a past phenomenon.

Labov's research marks the beginning of quantitative sociolinguistics and has redefined the study of language change. Based on the study, research on language shift in progress is being conducted today. Many of his methods serve as a basis for empirical studies. He emphasizes the importance of randomization in the selection of speakers to ensure the best possible representation of the speech community. Labov also differentiates between formal and spontaneous speech, the latter being the better indicator of the analysis of regional dialects. Language patterns are established through social variables as well as phonological features. Ethnic groups are analyzed to create patterns of speech, and age, gender, and social status help differentiate between the groups of speakers. In the data analyzed, Labov detects indicators of language change, since "the New York City vowel system […] displays a wide variety of phonological shifts, and mergers" (2006: 376).

The study, especially after its revision and the publication of a second edition, serves as a vital guideline for any kind of sociolinguistic research and has opened up a new field of linguistic research.

2.3.4 The Quantitative Study of Sound Change in Progress

The Quantitative Study of Sound Change in Progress by Labov, Yaeger, and Steiner, conducted between 1969 and 1972 (the year it was published), is the first major study of present-time sound change; it built the basis for later studies. The data that were used derived from recordings mainly in urban areas of the United States and additionally Norwich (Great Britain). Furthermore, data collected in previous studies were consulted, and the results yielded that sound change, mainly in the northern cities of the United States, was in progress. Chain shifts were described, and the pivotal feature of the NCS, i.e. the raising of /æ/ was detected and analyzed.

The authors emphasized "that linguistic theory must take social factors into account" (1972: 3) in order to analyze change in a language. Thus, speakers were classified according to social class, and differences within a community were described (cf. 1972: 17).

The study is printed in two volumes. Volume one describes the theoretical background, the methods used, and the results. The second volume contains all figures of the study. The vowel charts are created based on formants 1 and 2 and vowel clusters.

2.3.5 Phonological Change and the Development of an Urban Dialect in Illinois

The TRAP-vowel as the initiator of the NCS has evoked extensive discussion and studies (eg. Ives 1953; Boberg/Strassel 2000; Scott 2002). One of these studies, *Phonological Change and the Development of an Urban Dialect in Illinois* by Robert E. Callary (1975), focuses on environmental and sociolinguistic aspects of the vowel in northern Illinois: "[the] informants for this study were restricted to first semester freshman females […] who had lived all their lives in the Illinois county in which they were born" (1975: 157). Callary focuses on following plosives since he had established that /æ/ displayed signs of raising only in such phonetic environments. He suggests that the place of articulation of the plosive determines the amount of raising.

According to him, the raising of /æ/ and thus the occurrence of the NCS depends on the size of the speech community. The larger the population, the further /æ/ is raised. Callary therefore anticipates an urban dialect that is spreading throughout Illinois. He concludes that the NCS is affecting "more urban areas more significantly than less urban areas and rural areas not at all" (1975: 168). Although additional studies support his argument, later work, such as Gordon's study of rural Michigan, contradict it, possibly because of more recent developments of the shift.

2.3.6 Dictionary of American Regional English (DARE)

So far, the *Dictionary of American Regional English* edited by Frederic G. Cassidy and Joan H. Hall (1993), is a six-volume dictionary that describes American regional vocabulary, pronunciation, and their social distribution. It is based on a series of interviews conducted between 1965 and 1970 and written historical records (DARE 2014). 2,777 speakers in 1,000 communities across the United States were interviewed with the help of a standardized questionnaire. Pronunciation is based on recordings or transcripts of oral speech and is presented in IPA characters (cf. Cassidy 1993: xix).

An entry includes the part of speech, pronunciation, variant spellings, and etymology if available, usage labels, geographical labels and quotations, a fact that differentiates the DARE from other dictionaries.

The maps included in the DARE indicate the communities in which a certain feature is used. Moreover, states having a larger population size than others are presented larger and with more information.

2.3.7 Studies by Penelope Eckert

Penelope Eckert has added to the research of the NCS by collecting adolescent speech and analyzing social structures in a Detroit high school. She focuses on the sociolinguistic aspects underlying phonological changes, and in her work (e.g. 1988, 2000) she describes the influence of social networks on individual speech and the dynamics of youth groups from a linguistic angle[3]. Additionally, she focuses on the importance of gender differences in the development of speech (cf. Eckert/McConnell-Ginet 2003) as a social variable that requires special attention especially in its interaction with other elements of social identity.

2.3.8 A Study of the Northern Cities Shift in Michigan

A more recent major study of the NCS was conducted by Matthew J. Gordon, printed in 2001, based on his dissertation from 1997. *Small-Town Values and Big-City Vowels: A Study of the Northern Cities Shift in Michigan* describes the comparative study of the speech of two rural communities in Michigan, Paw Paw and Chelsea. Gordon first gives an overview of the treatment of the NCS in a linguistic community and then describes his methodology in detail. He bases his study on the speech of 16 informants in each community and divides them into two age groups, i.e. 16-18 and 39-51 (cf. 2001: 40). The communities are located between Detroit and Chicago and, with a population of fewer than 4,000, represent a rural area.

Gordon categorizes the vowels affected by the NCS into lower elements (/ɑ/, /ɔ/, /æ/) and upper elements (/ʌ/, /ɪ/, /ɛ/). "This separation is suggested by the discrepancies in the apparent age of the changes (the lower changes are all much more established and, therefore, probably older)" (2001: 216).

The movement of each vowel is described in detail and depicted in numerous charts. The results are analyzed in terms of phonological, social and geographical distribution.

Phonological factors include the phonetic environment of each vowel, which is differentiated and analyzed according to its facilitation of shifting (cf. 2001: 151ff). Social class is analyzed and results in the fact that "there are class-based patterns of usage of the NCS" (2001: 176). The analysis of gender differences delivered a stronger usage of newer elements by female speakers, and the differentiation into age groups suggests that the NCS is still in progress and consistently delivers new patterns of speech. Surprisingly, despite the fact that the two speech communities were selected according to an approximate similarity, some differences between them were detected as well.

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[3] In the 1970s the social anthropologist Jeremy Boissevain introduced the study of social networks, interaction and group dynamics (1973, 1974).

2.3.9 Recent NCS Studies

Two recent studies are to be pointed out, i.e. *Dialect Boundaries and Phonological Change in Upstate New York* by Aaron Dinkin (2009) and "The Northern Cities Shift in Chicago" by Corrine McCarthy (2011). Both studies expand the scope of areas studied with respect to the NCS, and both describe the occurrence of an incomplete NCS in the areas analyzed.

McCarthy's study of 36 speakers from Chicago reveals that, while /ɛ/, /ɪ/, and /ʌ/ shift in the direction predicted by the NCS theory, /æ/, /ɔ/, and, /ɑ/ diverge from the predicted pattern and display a trend toward a shift in the opposite direction.

Dinkin's dissertation deals with the degree to which the NCS is present in the different regions of Upstate New York and their boundaries, i.e. the Inland North, the Hudson Valley and the North Country. He finds the NCS present to varying degrees. His study of the New England part of Upstate New York displays the NCS only to some degree, and he specifically points out the raised nasal /æ/ in Southwestern New England, which hinders a vowel system from shifting as predicted in the NCS model, as well as a *cot-caught* merger in progress. However, he calls for more extensive research on Southwestern New England to support his theory.

2.4 Lacunae in Research

The Northern Cities Shift has been quoted in a number of sociolinguistic and phonological works. It is the prime example of a major linguistic change in progress. However, "the NCS has attracted very little attention in the way of primary research" (Gordon 2001: 13). The major studies introduced above, of which some contain the NCS only as a byproduct, indicate "that [our] knowledge of the NCS is based on rather restricted sets of data produced by a handful of researchers" (Gordon 2001: 13).

Gordon criticizes that the large number of gaps in the understanding of the NCS derives from the fact that too few empirical studies have been undertaken in order to grasp the structure of the shift fully. In his eyes the data that linguists could base their analyses on are missing (cf. 2001: 13).

Additionally, he explains that all research projects except for Callary's work in 1975 have focused on the metropolitan areas, which displayed the highest amount of shifting (2001: 19). However, he claims that the shift also takes place in more rural regions, which would therefore require more studies to understand the spreading of the process across the whole area, not just in the isolated big cities. Dinkin's (2009) work in Upstate New York fills some of the gaps Gordon points out.

In terms of linguistic studies, Ash mentions a gap in the analysis of "vowel trajectories, glides and length" (2003: 62). She acknowledges that a single vowel value delivers a clearer picture of the linguistic situation, but complains that the additional amount of data is too demanding. In her eyes, a closer analysis of diphthongization and monophthongization processes would produce a broader knowledge of American regional speech.

Both Gordon (2000) and Ash (2003) contemplate the absence of ethnological research. Ash believes that "the greatest gap in our understanding of North American dialects is in the paucity of data on ethnic minorities" (2003: 64). She claims that the only researcher to have seriously analyzed the phonology of ethnic minorities is Erik Thomas. In Ash's eyes especially AAVE deserves extensive research since it develops independently from General American.

In the context of the NCS, Gordon maintains that almost exclusively European Americans have been analyzed, and much research is needed on the NCS in other ethnic groups, even merely the aspect of participation (2000: 116)

"First, virtually all the previous work on the NCS has examined only the speech of European Americans. Thus, very little is known about possible ethnic differences regarding participation in these innovative pronunciations" (Gordon 2000: 116).

2.5 Western New England

When studying the NCS, it is convenient to establish a field of investigation which has been relatively neglected. New England as a whole, being influenced immensely by the NCS, has been the object of a number of major studies (see above). New England is comprised of Connecticut, New Hampshire, Maine, Massachusetts, Rhode Island, and Vermont. However, the pronunciation of English in New England cannot be regarded as one distinctive accent. The English spoken in the east differs from that in the west, which leads to a separation into two distinct speech areas: "New England has two major dialect areas, an Eastern and a Western" (Kurath 1973: 8).

Kurath (1973: 93f) attributes the distinction between Eastern New England (ENE) and Western New England (WNE) to the settlement history. He claims that the availability of flat land close by the Connecticut River, as well as religious differences "led to the emigration of four groups from the Massachusetts Bay Colony in the middle of the 1630's" (1973: 93). These four groups settled in Windsor, Wetherfield, Hartford and Springfield, of which the first three today belong to Connecticut, while Springfield is one of the major cities of Massachusetts. In later years these settlers spread throughout Western New England.

Boberg (2001: 4) describes how the settlement in the area around the Lower Connecticut River Valley remained separate from towns on the coast around Boston and developed independently, which led to distinct speech communities. However, linguists do not agree on where to draw the line between the two linguistic regions. The first linguist to differentiate between the two was Kurath (1939a: 29), who graphically described his findings of distinctive features in New England speech in isoglosses of which some only stretched along the eastern part of the region. Boberg (2001: 4ff) has summarized the separation of New England according to Kurath's findings and drawn a map indicating the two speech areas based on the isoglosses of the Linguistic Atlas of New England as follows (Figure 2.5):

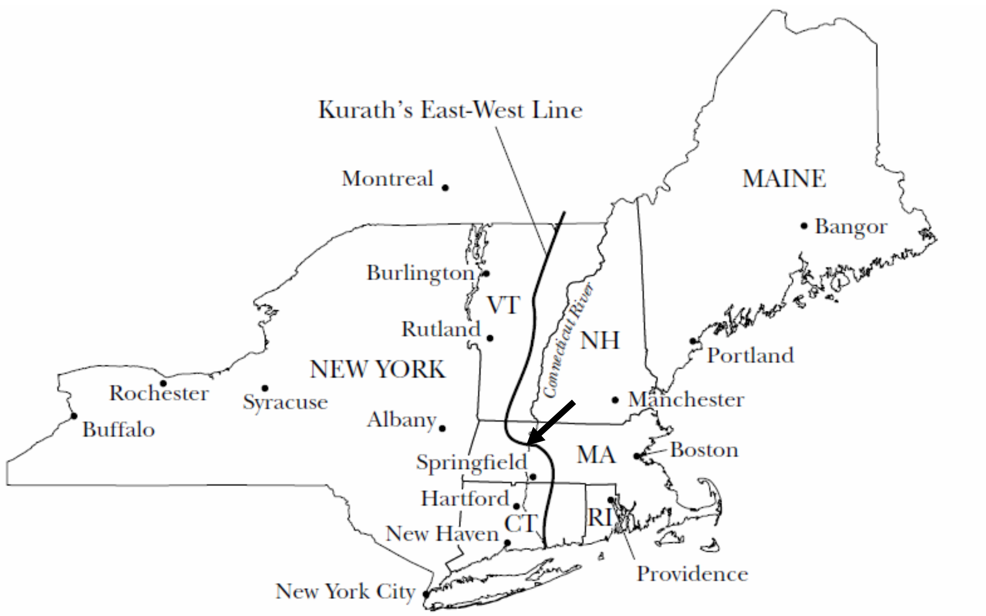

Figure 2.5: Boberg's (2001: 5 figure 1) graphic interpretation of Kurath's ENE/WNE distinction. (Arrow indicates position of Amherst, MA).

Kurath describes the border between the eastern and the western part as the area of the lower Connecticut valley, which "is set off rather clearly from the Eastern Margin (the counties of New London, Windham and Worcester), which was settled from Eastern New England" (Kurath 1973: 20). He also differentiates between the two southernmost states divided by the border, i.e. Massachusetts and Connecticut, and claims that the latter maintained a clearer distinction, whereas the settlers' movements towards the north and west led to a mixing of forms in Massachusetts (1973: 20).

In *A Word Geography of the Eastern United States*, Kurath divides Eastern New England and Western New England further into smaller areas. ENE is divided into Northeastern and Southeastern New England, with the border running through Massachusetts. WNE is subcategorized into Southwestern New England, which is western Massachusetts and most of Connecticut, and the more northern part is added to Upstate New York and western Vermont (cf. Kurath 1949: 91 Figure 3).

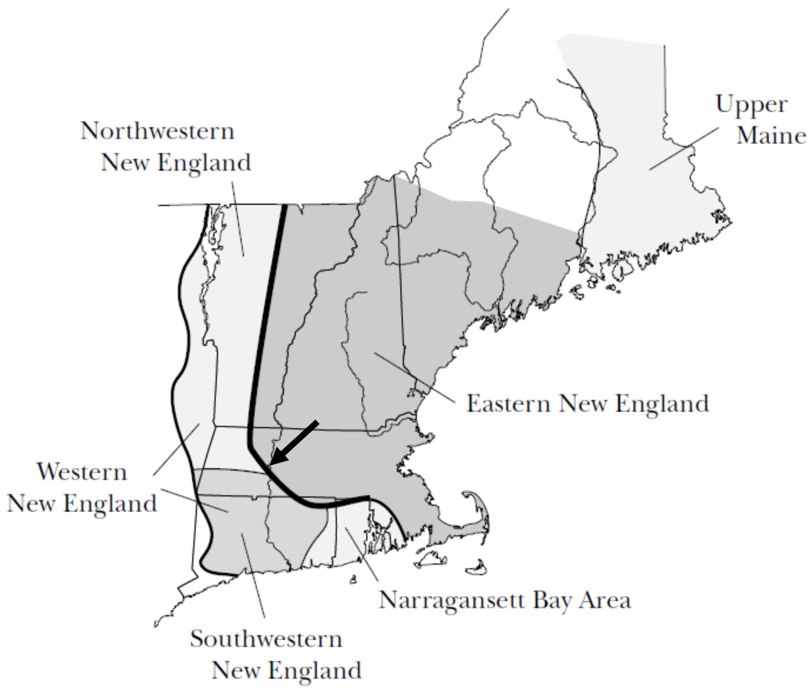

Figure 2.6: Map of New England division by Carver (1990: 31 image 2.5) reprinted by Boberg (2001: 7 figure 3) (Arrow indicates position of Amherst, MA).

Carver redefines the boundaries of New England in *American Regional Dialects: A Word Geography* (1987: 29ff). He criticizes Kurath's work in so far as it has become outdated and calls for revision. Based on data established in the context of the DARE project (cf. chapter 2.3), he creates maps showing lexical isoglosses. Figure 2.6 displays Carver's interpretation of the New England division.

The major difference between the two maps is certainly the northern part of WNE. While Kurath included the area into Upstate New York and western Vermont, Carver attributes it a separate linguistic status. He bases his division on the use of region-specific lexical terms, which creates isoglosses that are criticized by Boberg (2001: 8), who points out that some of the assumptions are based on material collected in one single community rather than on a broad overview. He therefore questions the reliability of Carver's material. Furthermore, Boberg claims that, based on the material Carver used, northwestern New England should definitely be included in Upstate New York.

The most recent sub-categorization of New England derives from ANAE (cf. Figure 2.7). It resembles Carver's division into WNE and ENE, except for Providence, but, similar to Kurath, ANAE refrains from subdividing the two linguistic regions. The map also displays the number of informants interviewed in the area.

The importance of WNE speech has gone unnoticed by the majority of Americans despite the fact that it has been of great importance in the history of American English:

> Western New England has contributed more to the speech of the northern United States (from the Hudson Valley west) than has Eastern New England. For this reason the dialect spoken here impresses most Americans as less distinctive than that of the seaboard. (Kurath 1973: 19)

According to Boberg (2001: 3) most Americans would not be able to explain what WNE speech stereotypically sounds like. Researchers from different decades, such as Kurath (1949), Carver (1987), or Boberg (2001), believe that people fail to locate a specific WNE regional accent because the speech of the Inland North originated in WNE.

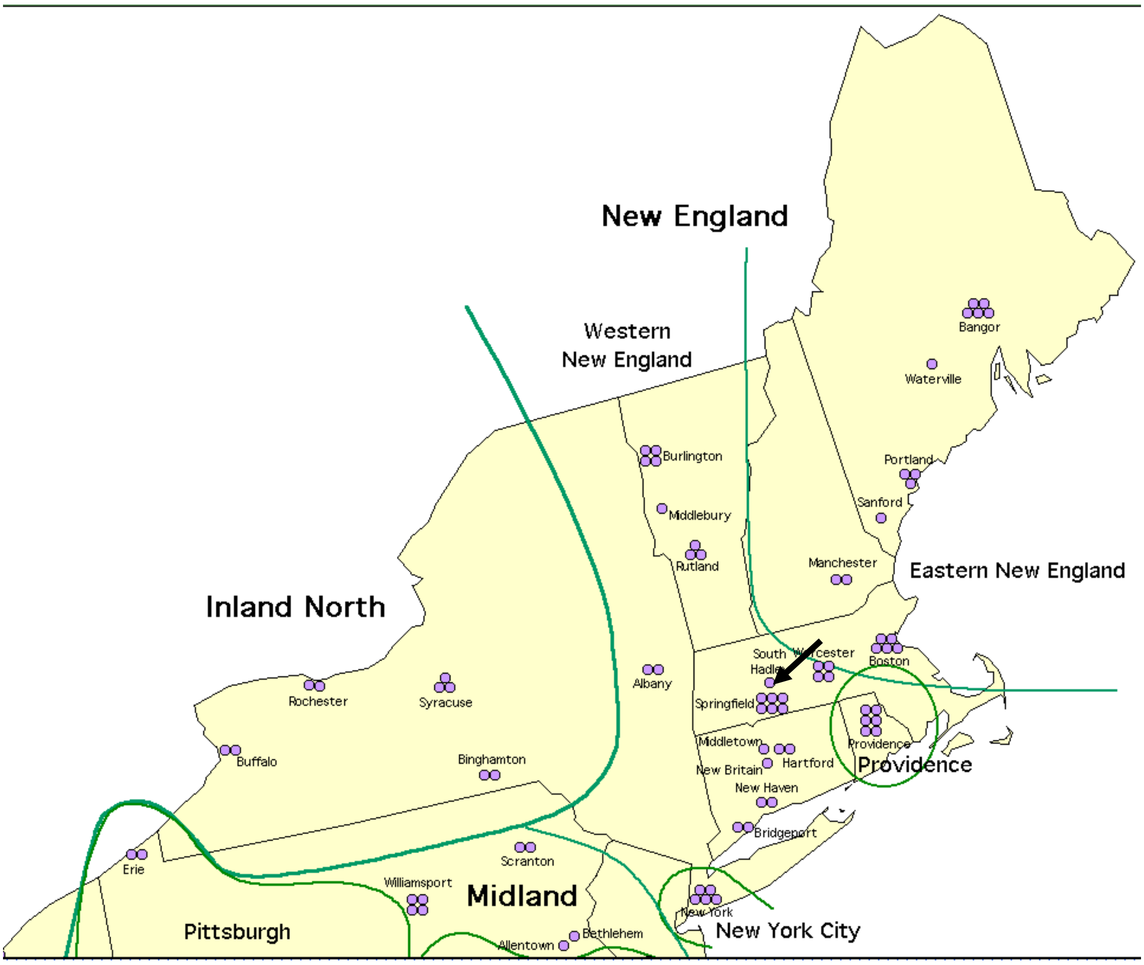

Figure 2.7: New England according to ANAE (Labov, Ash, Boberg 2006: 140/ TELSUR 2014) (Arrow indicates position of Amherst, MA).

Additionally, linguists such as Boberg (2001: 3) suggest that the NCS might have originated in Western New England, which gives reason to take a closer look at the vowels that are possibly affected by the NCS. Still, relatively little research has been conducted in the area. The studies by Kurath and Carver mainly focus on lexical items and only provide little information on phonological data. Kurath and McDavid briefly describe the pronunciation of Western New England speech and point out that, already in 1961, /ɑ/ is slightly fronted and /ɔ/ somewhat lowered. /æ/ is still pronounced in low position (cf. Kurath/McDavid 1961). More information on the region cannot be found. However, as Boberg (2001: 11) points out, phonological data show “immunity to obsolescence resulting from social and technological change,” which enables diachronic research. Boberg interprets the phonological data collected in the contexts of LANE (96 speakers in WNE) and later the TELSUR project (23 speakers in WNE) (cf. Figure 2.7) in order to determine the distinct linguistic features of WNE better. One has to keep in mind the relatively small number of speakers interviewed in the latter project since they are assumed to represent an area stretching across three states.

Absence of the *cot-caught* merger, which plays an important role in the NCS and also exists in upstate New York, can be detected in the WNE data collected for LANE (cf. Boberg 2001: 13ff), especially in southwestern New England. Some merging in the northern part can be pointed out, which could necessitate a distinction between these two areas, but "if there is little lexical evidence for a split between northern and southern subregions, there is even less phonological evidence for this division" (Boberg 2001: 15). Other material suggests a similar familiarity of regions: "In western New England […] we can set up the same pattern of /æ/ in cat, /ɑ/ in cot and cart, and /ɔ/ in caught as we can in upper New York" (Thomas 1971:66).

According to Boberg, Kurath reports only little information on the WNE realization of /æ/, "but the maps of LANE show it universally as low-front [æ] throughout New England, even before nasals" (2001: 13). Since the shift probably started with the raising of /æ/ (cf. 2.1 above), one could conclude that the NCS had not started yet at the beginning of the 20th century.

The most recent US regional linguistic project, TELSUR, displays results concerning the phonetic realization of the three vowels in question that draw a completely different picture. They are extracted and summarized by Boberg (2001: 17ff). According to him, the older speakers raise /æ/ to a medium F1 value before all consonants. Burlington forms an exception in that its local speakers show no signs of raising. Speakers of all ages raise /æ/. Boberg also detects that, except for the older speakers mentioned, everyone raises /æ/ when it is followed by a nasal. The absence of differentiation of age classes leads him to the conclusion that no progress in raising is being made, but on the contrary, some lowering of the vowel in the speech of younger people could be possible. Therefore, Boberg suggests that the complete absence of raising in LANE might be the result of faulty transcription.

The vowels /ɑ/ and /ɔ/ produce a diverse picture in WNE. In Connecticut (cf. Boberg 2001: 19f) the vowels are pronounced in a distinct way, and the speakers show no signs of merging. Further north, in Vermont, most speakers merge the vowels almost completely. Western Massachusetts, being positioned in between, displays, as expected, a mixture between the two. All speakers of Springfield, MA show "a phonetic approximation of the vowels in at least some environments, which may be the first indication of an advancing merger" (Boberg 2001: 22). However the speaker from South Hadley refrained from merging the two vowels, whatever the following consonant.[4]

In correlation with the NCS tendency of either /æ/ raising or the merging of /ɑ/ and /ɔ/, the speakers of Springfield, MA, display proximity of the latter vowels and an only slightly raised /æ/. Boberg points out that no distinction can be made between the vowel realizations of men and women; moreover age is no indicator for differentiation. This fact contrasts with his assumption that a shift in progress would lead to the merging of /ɑ/ and /ɔ/.

In addition to the three subregions described above, Boberg describes the vowel realization of Rutland speakers as contradictory to the process of the NCS. The speakers merge /ɑ/ and /ɔ/, but at the same time display a raised /æ/. The pull-chain shift is therefore lacking in consistency, for a raised /æ/ would pull /ɑ/ into a more fronted position, therefore preventing it from merging with /ɔ/.

Overall, Boberg summarizes that "WNE has four distinct subregions" (2001: 25), concluding that a distinction can be made between WNE and upstate New York, and that the *cot-caught* merger needs to be analyzed as the primary linguistic variable in the regional speech of WNE.

Based on the complexity of the WNE regional accent and the little information available, more research, such as the present project, is needed. Furthermore, the three remaining vowels involved in the NCS, i.e. /ʌ/, /ɪ/, and /ɛ/, need to be analyzed and interpreted in comparison to other linguistic regions.

[4] See also chapter 3.1, which deals with the settlement history of Amherst, MA.

3 Field Work

3.1 The Community – Amherst, MA

The town of Amherst, MA, is situated in Hampshire County, 9 miles (14 km) northeast of Northampton, MA, and 20 miles (35 km) north of Springfield, the second-largest city in Massachusetts. It lies in the Connecticut River Pioneer Valley on the foot of Mt. Holyoke.

The settlement history of Amherst begins in Hartford, Conn., which was founded in 1635 by English settlers that had emigrated from the Massachusetts Bay Colony as a result of religious reasons and the availability of fertile land along the Connecticut River (cf. Kurath 1939a: 93f.). After a political and religious dispute at Hartford in the 1650s (cf. Hitchcock 1891: 2) residents of Hartford and Windsor petitioned for land north of Springfield in Massachusetts, which was bought from the Nonotuck tribe in 1658 and subsequently inhabited by the Connecticut settlers (cf. Carpenter/Morehouse 1896: 1). This agricultural community called Hadley did not seem to threaten Springfield "since trading with the Indians was not the motive of these planters, and her settlers welcomed neighbors whom they had no reason to fear" (Kurath 1939a: 97).

In 1759 the second precinct of Hadley was incorporated and named Amherst after General Jeffery Amherst[5], who fought in the French and Indian War (cf. Carpenter/Morehouse 1896: 65ff.).

Amherst is immensely influenced by its universities. When the Massachusetts Agricultural College was founded in 1863, the number of inhabitants increased by 26% in ten years to about 4,000 in 1879. In 1947 the university became the main campus of the University of Massachusetts (University of Massachusetts History 2013), which led to an increase in population by 70%; another wave of inhabitants arrived in the 1960s, through which the Amherst population almost doubled from around 13,700 to 26,300.

According to the census of 2010 (U.S. Census Bureau 2013) the Amherst population totals 37,600. With almost 80%, the Amherst population is of predominantly Caucasian descent. The minority ethnicities include Asian (11%) and African American (5%).

[5] Jeffery Amherst was born in Sevenoaks, Kent. Thus the Kentish spelling of *Amherst.*

The main campus of the University of Massachusetts is situated in the north of the town. 22,000 undergraduate and 6,000 graduate students are enrolled in the large campus university. The age percentage of residents mirrors the accumulation of students; 62% are of the age 10-29. Therefore, only a minority of the population is not associated with the academic institution. 52% are employed in the educational, health, and social services sector; a large number work indirectly for and with the university. Additionally, the region around Amherst holds four other colleges. In the town itself around 1,700 students attend Amherst College, and the three remaining colleges lie within a radius of nine miles around the center of the town. As a result, the majority of the adult population is highly educated. Merely 14% have no college education, and 42% hold a Graduate or Professional Degree. 3,600 children are enrolled in the Amherst school system.

Linguistically, Amherst can be placed in Western New England, more precisely Southwestern New England. Although linguists are uncertain about the boundaries of the speech area of Western New England (WNE) (Carver 1987; Kurath 1949, fig. 3) - each defining different borders as boundaries - the overlapping area includes Amherst. Carver (1987: 29ff), for example, places Amherst on the border, but still in WNE, on the map discussed above.

According to the categorization of DARE (cf. Cassidy 1985: lxxxvi), in which the size of a speech community is classified, Amherst can be regarded as a small city, which the Dictionary defines as small independent city whose population lies between 10,000 and 100,000.

Linguistic research of Western New England has been insufficient, as described above; Amherst is absent in most major studies. The only speaker who was interviewed as a contribution for a major analysis of American regional speech was a male 20-year-old Amherst college student who, in 1967, was interviewed for the production of the DARE (cf. Cassidy 1985: cix) in which, nonetheless, another 127 Massachusetts residents were included. The data gathered in this research are not available; thus no comparison can be made.

These preliminaries make Amherst an interesting community for the study of the NCS. As mentioned above, members of a lower social class, i.e., often lacking an academic career, tend to use the speech form that differs more from the standard than members of a higher social class do (cf. Wolfram/Schilling-Estes 1998: 157). Additionally, they are most likely residents of major cities. If Amherst speakers, who are strongly influenced by the academic institutions located in the area and who live in a rural environment, have elements of the NCS in their speech, this provides evidence that the shift has penetrated the entire region, independent of the size of a community or the social context.

3.2 Recruitment

In the present study none of the speakers analyzed in 2009 (cf. Bause 2010) were contacted in order to ensure the gathering of independent data. The field work took place over a period of three months from August to November 2011.

Criteria for eligibility were defined previously. Participants needed to have been raised in Amherst, and received their primary and secondary education in the Amherst school system. Adult speakers needed to be residents of Amherst for most of their adult lives. Since the town's population is thus highly educated, most of the residents spent a number of years outside Amherst for their post-education or travels. Those were accepted in the study as well. All contacts that met the criteria were accepted for the study unless an age or gender group was already saturated.

Amherst locals were asked to participate in a study about life in Amherst and the changes that had occurred in the town during their residency. Participants who were skeptical about whether they would be able to contribute anything of value were told that their personal input was relevant in order to capture the many voices of the town. No further clues about a linguistic study were given.

For the recruitment, flyers were distributed in most public locations (e.g. the library) and stores in town which asked for locals who had lived in Amherst all their lives to participate in a study on life in Amherst (cf. Appendix 2). Three volunteers answered the flyer, of which two were interviewed. One (L16f) matched the final criteria of eligibility and was analyzed.

Young adults were recruited in several places. Some of them were approached in a local coffee shop. Others were found at their place of work, a local museum. Another one was contacted at a bar. Interviews were scheduled and conducted at a later date.

The recruits then recruited further and secured contacts to their peers according to the snowball technique (cf. Milroy & Gordon, 2003: 32). The technique was also applied for the recruitment of adults, but since a relatively even distribution of age and gender was sought, no more than three recruits of the same age were accepted.

Adult speakers were approached at the local farmers' market, shops and coffee shops. The success rate was often limited for several reasons. For one, interviews were not conducted on site, but scheduled at a later date since they were to last for at least 30 minutes. Some possible recruits hesitated or refused to arrange such meetings. The major reason for failed attempts, however, stems from the fact that a large group of Amherst residents were not born in Amherst, but moved to the town to work at or for the University of Massachusetts in recent years (cf. 3.1). This made the snowball technique more important, since, across ages, families that have lived in Amherst over several generations – 'townies,' are acquainted and often connected.

A number of speakers were recruited through referrals by the editor of a local newspaper. He suggested names of local families or pointed out people to approach. They were then all contacted via telephone and it was explained to them who the referral had come from. This increased the level of trust necessary to establish first conversations. Interviews were then scheduled at a later date. No interview was conducted via telephone. The success rate in these cases was very high, comparable to the snowball technique. Further adult speakers were recruited through the American Legion's bar and consequent referrals.

3.3 Speakers

In total, 32 speakers were interviewed, three of which were excluded after the interview. Two twins turned out not to have attended primary school in Amherst, and the African American speaker interviewed was excluded for the lack of comparability in the otherwise Caucasian corpus.

The corpus is made up of 13 female and 16 male speakers aged between 16 and 92. All informants are of Caucasian descent and have been Amherst residents for most of their lives. They are listed in Table 3.1. Each speaker is coded with a letter, the speaker's age and his or her gender. L16f is a sixteen-year-old girl, for example. The table also includes the participants' highest degree of schooling, or their current status if they are in the process of receiving another degree. The fourth column lists the length of each interview.

Speaker	Birth year	Schooling	Interview duration (h:m:s)
L16f	1993	in high school	00:32:28
M18f	1991	in college	00:18:34
C18f	1992	in college	00:29:23
E19f	1992	in college	00:26:44
M19f	1992	in college	00:25:08
N24f	1987	high school	00:27:32
J29f	1982	MA	00:36:44
A61f	1950	BA	01:03:39
C74f	1937	BA	01:03:39
I84f	1927	high school	01:10:56
S84f	1927	high school	00:40:22
T84f	1927	high school	00:40:22
M92f	1919	high school	00:47:12
A22m	1989	high school	00:33:19
B22m	1989	BA	00:29:17
R25m	1986	BA	00:30:53
J38m	1973	high school	00:25:12
I41m	1970	BA	00:39:44
J41m	1970	BA	00:33:41
K44m	1967	BA	00:34:17
K47m	1964	BA	00:38:09
L56m	1955	BA	00:39:13
M56m	1955	high school	00:43:43
B57m	1954	high school	00:32:37
J57m	1954	high school	00:36:03
Z58m	1952	high school	00:56:43
B65m	1946	BA	01:12:57
G77m	1934	BA	01:11:27
H82m	1928	high school	01:44:06

Table 3.1: Speakers coded with letter, age, and gender, highest degree of education, and length of the interview.

3.4 Interviews

During the recruitment, either via telephone or in person, an appointment was scheduled to conduct the interview. All interviews were done in person. The participants were given the opportunity to choose the location to increase their level of comfort. Elder participants tended to opt to be interviewed at home, whereas the younger interviewees generally chose to meet at a coffee shop or their work place. The background noise in such environments is greater than in an office or phonetics laboratory, but these locations were chosen to guarantee spontaneous speech. Since formants are generally measurable even through background noise, the error created by the background noise was preferred over the error created by careful instead of casual speech.

L16f was interviewed at an office on the UMass campus, B57m in the interviewer's home, M18f, C18f, E19f, M19f, N24f, J41m, M56m, and J57m at their work places, G77m, H82m, M92f, S84f, and T84f in their homes; the latter two were interviewed together. A61f and C74f also participated in a joint interview, which was conducted in a public place. The remaining twelve interviews were also conducted in public places, such as cafés.

Interviews were recorded with an Olympus DM-550 Recorder and, depending on the situation and the number of people, with either its integrated microphone or an Olympus ME-15 tie-clip one. At the beginning of the interview each person was told about the recording and consented. The recorder was placed on the table in front of the interviewee at less than 1m distance from his or her mouth.

The style of interviewing was open and adaptable to the person interviewed. The interview was aimed to last 30 minutes but was, at times, cut short because of the interviewee's work obligation, and at other times lasted much longer because the interviewee felt comfortable enough during the conversation to want to continue it even without probing questions. On average, the interviews lasted 00:42:54; the shortest one lasted 00:18:34 and the longest 01:44:06 (cf. Table 3.1).

A number of questions were prepared beforehand in case of stagnation and were asked at some point in most of the interviews. Common questions include:

"How would you describe Amherst to a person who has never been here before?"

"So you went through the Amherst school system? Tell me about that."

"What did you do after high school?"

"Have you ever traveled within or outside of the U.S?"

"Do you know your ancestry? Can you tell me about it?"

"Have you experienced changes around the town of Amherst?"

"What do you like about the town?"

“What would you change about the town if you could?”

“What is missing in Amherst?”

Furthermore, participants were asked if they could identify different neighborhood identities or describe their neighbors, friends or other groups they were connected to. Politics were mentioned, and the topic was expanded if the interviewee seemed interested. While some participants focused mainly on their own stages of life, their relationships or their professions, others discussed local politics or the development of the town over the last decades. Changes in store fronts, the population, or buildings were often described. Aside from questions about family, education and age, interviewees were generally asked follow-up questions about topics they had mentioned themselves or seemed passionate about. They were rarely interrupted while talking and thus developed the interview in the direction they felt most comfortable in.

Toward the end of the interview the participants were told that they were participating in a sociolinguistic study and were asked to read a word list (cf. Appendix 1). Since the elderly participants at times were not able to read well or at all anymore, they were spared this task. The word list consists of 116 words containing all the English vowels, each in the environment of a following consonant of each consonant category. A short conversation about regional accents and linguistic features followed in most cases, which concluded the interview.

4 Data Extraction

Interviews were recorded at 44.1 kHz and, depending on the use of the tie-clip microphone, in stereo or mono. Owing to manageability, they were resampled to 16 kHz, and the stereo recordings were converted to mono.

Lexical transcriptions of the interviews were written with the help of the transcription software ELAN© (Max Planck Institute for Psycholinguistics, 2012). The software matches the times of the interview to the transcription. Tiers for each speaker and additional information can be added. Each interviewee and the interviewer are transcribed in separate tiers. A tier containing the type of speech (free speech (FS) or word list (WL)) is also created. Another tier indicates background noises that might interfere with the speech. The interviews are transcribed according to the guidelines compiled by Ingrid Rosenfelder (2011). Words are transcribed according to American English spelling. If a word is begun, and then rephrased, a dash is attached to the word fragment, and in parentheses the intended word is attached. Unintelligible words are marked with double parentheses. Changes within a sentence, e.g. rephrasing, are marked with a double dash. Extralinguistic features, such as noise {NS}, laughter {LG}, or cough {CG}, are transcribed additionally.

Forced alignment is a method of segmenting manual lexical transcriptions into phonetic transcription and then mapping the transcribed phones to the corresponding sounds, i.e. setting the time boundaries of each interval of a phone. This is generally done by using a hidden Markov model[6] (HMM) that recognizes “a severely constrained phoneme sequence” (Hosom 2002: 357). Since HMM-based forced alignment tends to contain imprecisions, methods of boundary refinement are being developed (cf. e.g. Hosom 2002, Kuo et al. 2007)

In the present study, the forced aligner FAVE-align, an aligner developed by the Penn Phonetics Lab (cf. Phonetics Laboratory 2012) and by Rosenfelder et al. (cf. Rosenfelder/Fruehwald/Evanini/Jiahong 2011) was applied. From ELAN, the lexical transcripts are extracted as tab-separated files and uploaded to the FAVE website, on which transcripts are spell-checked and a list of unknown words or word fragments is returned. Individual phonetic transcriptions of the unknown elements are then composed

[6] A hidden Markov model calculates the probability changes between the entities of one system based on another system. In phonetics, based on the changes in frequencies, the model calculates the probability of a change in the corresponding phoneme. Thus, the boundaries of each phoneme can be extracted.

manually and the files are uploaded again. Lexical transcripts are then transcribed phonetically by the aligner, which uses ARPAbet[7] as transcription language. The phonetic transcription derives from a dictionary that resembles the CMU Pronouncing Dictionary (cf. Rosenfelder/Fruehwald/Evanini/Jiahong 2011). A *Praat* file containing lexicon and phone tier is returned via e-mail.

Praat is a software that facilitates spectography through the production of spectrograms. Although there is a number of softwares that produce spectrograms, *Praat* is the one that is most commonly used by linguists. It was designed by the Dutch linguists Paul Boersma and David Weenink and contains a variety of applications for the analysis of speech. Updates are constantly made available.

Spectography is a form of measurement that was developed to analyze speech sounds. The energy level of the recorded sounds is measured at different frequency levels and transformed through fast Fourier transform[8] into waves that appear visually as dark patterns. One can distinguish areas with a higher density of waves by the intensity of darkness. These areas are termed formants. They capture the characteristics of the specific sound and serve as a helpful analytical tool. For the present research, formant 1 (F1) and formant 2 (F2) deliver sufficient information about the vowels to be analyzed since they describe their place of articulation. When F1 is plotted against F2, the resulting plot indicates the position of the tongue during the production of a vowel (cf. Peterson/ Barney 1952: 177f.).

Forced alignment, since being automated, can be imprecise, so the phone boundaries were visualized through *Praat,* checked, and corrected manually (cf. Figure 4.1). Boundaries were moved when the vowel span was clearly not recognized by the FAVE software or the boundaries were placed too far beyond the scope of the phone. Boundaries were set around the interval in which the respective four to five formants were clearly visible, as can be seen in Figure 4.1. The figure displays a screenshot of the word *letters* in the *Praat* window. Visible from top to bottom: the frequencies measured, the frequency fast-fourier transformed, a tier containing the phonetic transcription with boundaries placed

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[7] ARPAbet is a phonetic code developed by the US Department of Defense. It indicates stress in numbers (primary=1, secondary=2, unstressed=0) and transcribes GA sounds using letters of the Latin alphabet (cf. Rabiner, Juang 1993).

[8] Fast Fourier transform: Fourier transforms split complex wave forms into a series of more regular ones. Fast Fourier transforms are a more efficient way of computing discrete Fourier transforms. In the context of sound signals, they describe a signal in time-frequency relation (cf. Wendler, Seidner, Eysholdt 2005:18).

automatically by the forced aligner FAVE, a tier with the manual corrections of the interval boundaries, and a lexical tier.

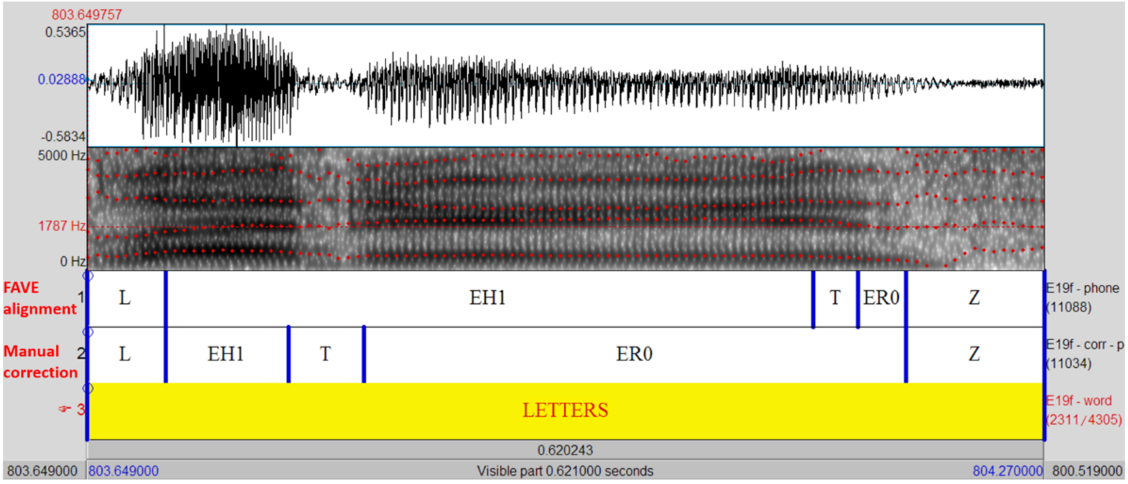

Figure 4.1: Screenshot of *Praat* window depicting FAVE alignment and manual correction.

Praat enables its users to either use the interface or program their own commands. *Praat* is written in C++, but extensions can be programmed either in C, in C++ and many commands can also be programed using a *Praat* scripting language. In the present study, several automated codes were written for the extraction of F1- and F2 values and additional information. To extract the most adequate formant measurements, several extractions were conducted and tested. Mean measurements of F1 and F2 over the entire interval, F1/F2 at 0%, 25%, 33%, 50%, 100%, F1 maximum, and F2 at F1 maximum were evaluated and finally dismissed because they did not describe the sounds uttered to a satisfactory degree. Measurements at one point of the interval are too susceptible to error caused by interference of background noises. A mean value over a span thus seemed more reliable. The mean over the entire interval, however, captures the onset and coda together with the nucleus, which distorts the results too far. Therefore, after comparing the data, mean F1- and F2 values over a shortened interval were chosen. It was concluded that the mean between 30% and 70% best represents each vowel quality for the vowels examined in the present study. By omitting the first and final 30%, onset and coda are excluded and the influence of preceding and following phones decreases. Possible error of still imprecise boundaries can also be avoided like this. By measuring the mean, the error caused by interfering background noise becomes less prevalent.

The Penn Phonetics Lab also offers an automated extraction software called FAVE extract. However, this software was not used for the present study for several reasons. It offers the extraction of F1 and F2 values at one point in the interval, which, for the reasons mentioned above, does not suffice as a measurement when the extraction is automated. To counteract the error that would arise from 1-point measurements and background noises, FAVE extract smoothes the measurement in a two-step process. Four measurements are extracted and are then compared to the corpus of ANAE measurements and the ones that most resemble the corpus are chosen. Obvious mistakes are avoided through the calculation of the Mahalanobis distance. These steps of smoothing out the data might lead to an overcorrection of possible new changes in the data, since the comparison with the existing corpus ensures only that the data matches approximately what formants are expected of a speaker in a certain region. Since finding new developments in regional dialects is an aim of sociophonetic research, this smoothing seems counterproductive.

Therefore, a new automated code was written using the *Praat* scription option, which extracts and tabulates the following information for each phone:

- Mean F1/F2 between 30% and 70% of the interval
- Start time and end time of interval
- Phonemic transcription of sound including stress
- Word
- Preceding and following consonants
- Free Speech/Word List classification
- speaker

The formant measurements were extracted from the sound file by *Praat* using the Burg method[9] with the following settings:

Time step: 0.0 (auto)

Max number of formants: 5

Maximum formant (Hz): 5500 (female) / 5000 (male)

Window length (s): 0.025

Pre-emphasis from (Hz): 50

---

[9] The Burg method estimates the parameters of the autoregressive model.

Variations of the *Praat* default settings were tested. The window length was shortened by the factor 10, (i.e. window length 0.0025). This means that in a set interval the distance between points was shortened and ten times more F1- and F2-values were measured. However, since the frequencies are in correspondence to the vibrations of the vocal cords, such a high number of measurements picked up a number of erroneous values and distorted the data. Thus, 0.025 was found to be an adequate frame of measurement.

In general the maximum frequency is set to 5500 Hz for female and 5000 Hz for male speakers. It was analyzed whether individual adaption to each speaker would make measurements more precise, but since no reliable method of adaption was found, the traditional maximum frequencies were kept.

The resulting data was then checked manually, plotted, and erroneous values that were clearly outliers resulting from measurement errors were excluded.

Since each individual mouth has a unique shape and F1/F2 constellation, and frequencies differ per person, one cannot compare vowel systems via formant values. Therefore, formant measurements have to be normalized. The normalization method chosen resembles the normalization Gerstman (1968) first introduced and creates the vowel space of each person from the maxima and minima of F1 and F2. The most extreme formant values of each person were extracted from the collected data, which then indicated the scope of the F1/F2 realization of one person. They span the area in which the speaker creates utterances, which allows an inter-speaker comparison. With these extreme values, the size, i.e. the lengths of the sides of the newly acquired rectangle, is defined, and the position of all the relevant vowels can be set into relation to the length of each side.

The maxima and minima of both F1 and F2 of each speaker were extracted from the entire corpus comprised of all General American phonemes of stress 1 and 2 in order to ensure the span of the entire vowel space. The maximum F1 and maximum F2 were each defined as 100(%), and minimum F1 and minimum F2 as 0(%). Each value measured was normalized,

$$norm(x)=100*(x - min)/(max - min),$$

which places it on a scale from 0 to 100.

When plotting the vowel measurements, normalized F2 is represented on the x-axis with reversed sequences and normalized F1 is represented on the y-axis with reversed sequences, as can be seen in Figure 4.2, which depicts the monophthongs of General American and the normalization axes.

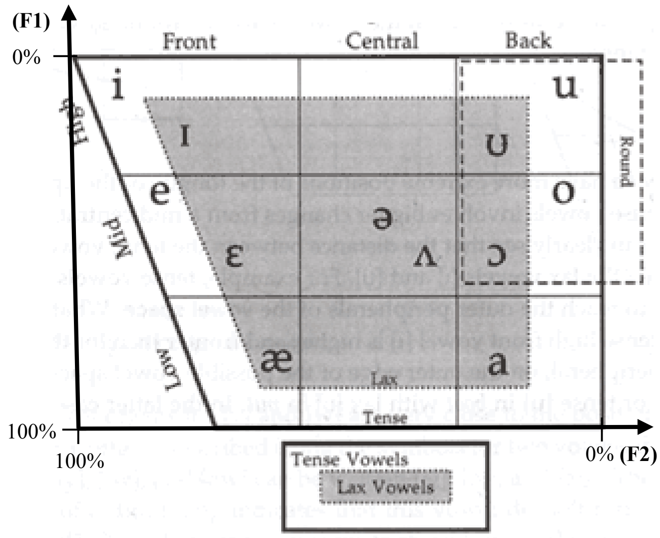

Figure 4.2: Monophthongs of GA. Chart by the University of Arizona. Normalization axes added.

This normalization method was chosen because it is straightforwardly formant-intrinsic, vowel-extrinsic, and speaker-intrinsic, which leaves the relations within the vowel space of each speaker intact while making it comparable to any other. Flynn (2011) confirms the quality of the Gerstman method in his comprehensive comparison of 20 vowel formant normalization procedures by placing it as the number one method in terms of variance, i.e. “the method [which] best minimised variance and thus equalized areas to the greatest extent” (Flynn 2011: 15).[10]

After obtaining the normalized data sets, the phonemes relevant to the current study were extracted (i.e. /ɑ/, /ɔ/, /ʌ/, /æ/, /ɛ/, and /ɪ/ of primary and secondary stress). The maximum and minimum F1- and F2 values utilized for the definition of each vowel space were listed. The mean values of each vowel, as well as the corresponding standard deviations were calculated for each speaker. Additionally, tables were created that contain extracted phones according to their following consonants and the corresponding means. Affricates, fricatives, glides, liquids, nasals, and plosives were each grouped together. This

[10] To compare the normalization methods the squared coefficient of variance ($SCV = \left(\frac{\sigma}{\mu}\right)^2$) was calculated. (cf. Flynn 2011, Fabricius et al. 2009)

information helps determine whether a consonant environment facilitates vowel movements.

Statistical tests were conducted with the normalized data to establish whether correlation between formant values and age or gender are detectable.

For the purpose of visualization a number of plots were drawn. Plots of each speaker's entire vowel space were created, as well as plots that contain the allophonic consonant subgroups of each vowel. The plots of each speaker's normalized vowel space are attached in Appendix 3. From the numerous remaining plots those that exemplify phenomena in the data are chosen and included in the data analysis (cf. chapter 5).

Speakers	Tokens	F1.min	F1.max	F2.min	F2.max
L16f	2882	372.78	1034.19	950.26	2599.89
M18f	1570	400.5	1046.86	908.44	2544.81
C18f	3446	360.21	976.32	900.29	2642.59
E19f	2611	405.58	975.36	1107.53	2443.13
M19f	1948	509.53	979.86	1149.5	2399.1
N24f	2554	337.47	814.71	882.76	2297.19
J29f	4105	359.86	1069.59	908.25	2712.12
A61f	3105	372.46	949.66	1015.87	2727.57
C74f	2306	433.55	1045.37	1014.6	2470.16
I84f	4197	400.32	999.57	920.57	2448.86
S84f	2856	320.25	944.96	800.78	2295.82
T84f	634	300.31	895.09	956.42	2607.75
M92f	3876	300.43	893.75	750.35	2699.04
A22m	2682	350.42	826.18	1003.61	2145.33
B22m	2471	305.1	749.93	752.58	2198.39
R25m	3519	420.17	878.84	866.14	2089.97
J38m	2188	330.86	756.04	753.32	2097.1
I41m	4349	350.04	947.34	828.49	2273.85
J41m	3443	351.54	799.7	956.06	2139.99
K44m	3812	323.82	770.31	869.35	2242.31
K47m	3993	312.91	799.73	852.66	2295.14
L56m	5082	281.95	843	756.73	2328.25
M56m	4020	290.03	749.18	808.53	2241.61
B57m	3285	200.34	698.4	880.7	2089.46
J57m	3607	352.47	849.76	792.3	2245.38
Z58m	4652	290.81	865.43	734.18	2142.5
B65m	5981	261.49	799.44	680.92	2144.05
G77m	5980	320.28	759.75	701.65	2319.7
H82m	7129	271.87	780.49	684.72	2259.24

Table 4.1: Number of vowel tokens measured per speaker; extreme values of all speakers, pre-normalization.

Table 4.1 depicts the number of phones with primary and secondary stress extracted from each person, as well as the extreme values that constitute the boundaries of each speaker's vowel space. The smallest sample is 634, a number that differs greatly from the average. The speaker was interviewed together with another person and was relatively hesitant to speak. The interview with the speaker with the largest data set of 7,129 tokens lasted 1h 44min. On average 3,527 tokens with primary or secondary stress were extracted per speaker.

5 Results

In the following subchapters the absence or presence of the Northern Cities shift will be measured in analogy to the system used in the ANAE. The relationship between the short vowels /ɑ/, /æ/, /ʌ/, /ɔ/, /ɛ/, and /ɪ/, and their individual features will be analyzed in detail and the relationship between these vowels will be extracted and studied.

5.1 NCS-Scores

Labov (2007: 372ff) categorizes the features of the NCS as follows:

> The ED criterion, by which the difference between the mean F2 of /e/ and the mean F2 of /o/ is less than 375 Hz.
>
> The UD criterion […] defines the speakers […] for whom /ʌ/ is further back than /o/.
>
> AE1: general raising of /æ/ in nonnasal environments, F1(æ) < 700 Hz
>
> O2: fronting of /o/ to center, F2(o) > 1500 Hz[11]
>
> EQ: reversal of the relative height and fronting of /e/ and /æ/: F1(e) > F1(æ) and F2(e) < F2(æ)

For the classification of NCS markers the normalized mean values of each speaker are utilized. Since a different normalization method is used in the ANAE analysis[12], the criteria listed above needed to be adapted to the current data set.

On average, F2 measurements lie within a range of 2000 Hz (500 Hz – 2500 Hz) and F1 measurements within a range of 750 Hz (250 Hz – 1000 Hz). As /ɑ/ is checked for being less than 375 Hz fronter than /ɛ/, 375 Hz needed to be transferred to the percentage system constituting the normalization method of the current thesis. 375 Hz of a 2000 Hz span correspond to 18.75%. The ANAE criteria also check for 700 Hz on the F1 scale and for 1500 Hz on the F2 scale. These values correspond to 60% on the F1 scale and 50% on the F2 scale.

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[11] The original text states “F2(o) < 1500 Hz”, which has to be an error since fronting entails an increase in F2 values.

[12] In the ANAE the Nearey’s (1977) log-mean normalization method is used, “a uniform scaling factor based on the geometric mean of all formants for all speakers” (Labov, Ash, Boberg 2006: 39).

Thus the criteria (cf. Dinkin 2009) to be checked are:

(1) /ɑ/ fronter than /ʌ/ (/ɑ/>/ʌ/ (F2))

(2) /ɛ/ less than 18.75% fronter than /ɑ/ (/ɑ/+18.75%>/ɛ/ (F2))

(3) /æ/ 3a) fronter and 3b) higher than /ɛ/ (/ɛ/>/æ/ (F1), /æ/>/ɛ/ (F2))

(4) /æ/ higher than 60% (/æ/<60% (F1))

(5) /ɑ/ fronter than 50% (/ɑ/>50% (F2))

	/æ/.F1	/æ/.F2	/ʌ/.F1	/ʌ/.F2	/ɑ/.F1	/ɑ/.F2	/ɔ/.F1	/ɔ/.F2	/ɛ/.F1	/ɛ/.F2	/ɪ/.F1	/ɪ/.F2
L16f	59.10	61.76	56.40	37.53	69.21	26.96	56.18	16.15	41.66	62.03	21.53	68.94
C18f	67.20	56.13	59.27	35.05	69.16	24.40	56.68	18.54	55.52	54.03	32.55	65.95
M18f	61.24	61.15	58.51	41.38	68.54	29.83	53.63	18.06	51.97	56.53	29.59	67.19
M19f	67.81	64.54	59.06	44.69	74.08	33.67	66.71	22.19	57.02	65.76	37.79	75.59
E19f	59.75	56.18	58.33	42.59	72.86	33.91	63.72	21.53	51.54	57.24	33.64	63.56
A22m	56.74	66.09	57.18	34.23	72.03	26.99	58.60	20.22	43.29	61.07	24.56	67.17
B22m	68.11	58.58	64.8	35.63	75.87	23.65	60.80	29.27	56.80	57.38	38.04	66.98
N24f	65.21	58.61	58.07	42.30	72.13	34.67	66.10	29.48	51.96	57.44	35.71	65.62
R25m	60.17	63.71	52.22	39.48	63.75	31.04	49.73	21.75	42.40	60.75	26.27	70.41
J29f	59.65	58.09	56.84	31.85	72.78	25.02	58.46	16.46	44.67	53.34	25.52	63.03
J38m	63.83	58.53	59.64	35.35	77.67	29.85	63.58	23.58	49.70	51.58	32.98	58.29
J41m	62.88	53.98	57.52	33.01	71.11	24.59	63.64	24.95	48.16	50.89	28.24	58.17
I41m	56.05	59.84	52.39	37.95	71.30	30.30	50.85	23.62	39.42	57.32	22.38	67.82
K44m	64.91	54.15	58.29	35.38	71.83	29.03	59.52	18.80	52.38	49.50	31.19	59.03
K47m	62.55	58.98	64.88	33.69	73.05	31.11	64.60	24.67	51.08	53.41	35.42	62.37
L56m	61.45	56.52	52.87	34.58	70.27	34.59	56.33	18.29	48.45	53.27	29.72	64.66
M56m	53.12	62.66	55.76	35.25	63.52	36.18	58.08	18.58	47.27	48.24	31.96	61.05
J57m	56.34	54.37	47.10	37.01	62.50	34.27	53.21	25.29	38.10	52.64	28.62	60.32
B57m	56.94	59.91	58.40	37.22	62.71	34.51	62.14	27.44	47.70	52.86	37.53	65.69
Z58m	58.21	62.40	58.05	37.67	67.69	36.15	55.85	26.38	47.96	55.93	31.43	63.34
A61f	61.03	66.21	55.27	42.52	64.85	33.27	51.96	27.08	47.88	64.73	31.37	69.43
B65m	58.89	61.76	56.39	40.70	70.92	34.21	66.40	32.02	48.40	58.06	32.69	66.72
C74f	52.43	65.20	48.05	37.71	67.56	33.86	44.82	21.78	39.67	57.82	27.09	72.14
G77m	62.57	58.32	59.51	36.03	73.82	38.74	64.31	20.85	50.74	51.47	36.69	61.08
H82m	62.62	52.34	51.45	29.58	72.58	31.45	57.78	16.12	47.45	48.87	34.26	56.02
I84f	58.34	65.18	48.79	40.32	69.77	36.56	55.02	30.10	46.42	57.04	26.55	62.78
S84f	57.33	58.75	58.09	35.47	70.29	36.39	58.58	20.49	50.34	54.78	30.41	60.74
T84f	66.35	56.58	58.34	35.76	73.75	29.49	65.69	19.47	46.96	52.45	30.93	63.32
M92f	64.76	58.28	50.14	23.28	58.40	20.52	46.43	9.52	45.07	47.69	25.97	62.71
Ø	**60.88**	**59.61**	**56.26**	**36.66**	**69.79**	**31.21**	**58.26**	**22.16**	**47.93**	**55.31**	**30.71**	**64.49**

Table 5.1: Normalized mean values of all speakers and averages.

Table 5.1 lists the normalized mean values (percentages) of the vowels /ɑ/, /æ/, /ʌ/, /ɔ/, /ɛ/, and /ɪ/ of all speakers, organized by the age of each speaker. From this table, since the criteria are not immediately apparent, the NCS-relevant criteria are filtered and summarized in Table 5.2.

	(1) /ɑ/-/ʌ/ (F2)	(2) /ɛ/-/ɑ/ (F2)	(3a) /ɛ/-/æ/ (F1)	(3b) /æ/-/ɛ/ (F2)	(4) /æ/ (F1)	(5) /ɑ/ (F2)	NCS-Score
L16f	-10.57	35.07	-17.44	-0.27	**59.10**	26.96	1.0
C18f	-10.65	29.63	-11.68	**2.10**	67.20	24.40	0.5
M18f	-11.55	26.70	-9.27	**4.62**	61.24	29.83	0.5
M19f	-11.02	32.09	-10.79	-1.22	67.81	33.67	0.0
E19f	-8.68	23.33	-8.21	-1.06	**59.75**	33.91	1.0
A22m	-7.24	34.08	-13.45	**5.02**	**56.74**	26.99	1.5
B22m	-11.98	33.73	-11.31	**1.20**	68.11	23.65	0.5
N24f	-7.63	22.77	-13.25	**1.17**	65.21	34.67	0.5
R25m	-8.44	29.71	-16.77	**2.96**	60.17	31.04	0.5
J29f	-6.83	28.32	-14.98	**4.75**	**59.65**	25.02	1.5
J38m	-5.50	21.73	-14.13	**6.95**	63.83	29.85	0.5
J41m	-8.42	26.30	-14.72	**3.09**	62.88	24.59	0.5
I41m	-7.65	27.02	-16.63	**2.52**	**56.05**	30.30	1.5
K44m	-6.35	20.47	-12.53	**4.65**	64.91	29.03	0.5
K47m	-2.58	22.30	-11.47	**5.57**	62.55	31.11	0.5
L56m	**0.01**	**18.68**	-13.00	**3.25**	61.45	34.59	2.5
M56m	**0.93**	**12.06**	-5.85	**14.42**	**53.12**	36.18	3.5
J57m	-2.74	**18.37**	-18.24	**1.73**	**56.34**	34.27	2.5
B57m	-2.71	**18.35**	-9.24	**7.05**	**56.94**	34.51	2.5
Z58m	-1.52	19.78	-10.25	**6.47**	**58.21**	36.15	1.5
A61f	-9.25	31.46	-13.15	**1.48**	61.03	33.27	0.5
B65m	-6.49	23.85	-10.49	**3.70**	**58.89**	34.21	1.5
C74f	-3.85	23.96	-12.76	**7.38**	**52.43**	33.86	1.5
G77m	**2.71**	**12.73**	-11.83	**6.85**	62.57	38.74	2.5
H82m	**1.87**	**17.42**	-15.17	**3.47**	62.62	31.45	2.5
I84f	-3.76	20.48	-11.92	**8.14**	**58.34**	36.56	1.5
S84f	**0.92**	**18.39**	-6.99	**3.97**	**57.33**	36.39	3.5
T84f	-6.27	22.96	-19.39	**4.13**	66.35	29.49	0.5
M92f	-2.76	27.17	-19.69	**10.59**	64.76	20.52	0.5
	5	**7**	**0**	**26**	**13**	**0**	**Ø1.31**

Table 5.2: NCS-Score and relevant criteria (calculations of normalization percentages).

Values fulfilling the respective NCS-criteria are printed in bold. The number of criteria that are met constitute the NCS-score displayed in the rightmost column of Table 5.2. Note that .5 values are attributed when one part of criterion (3) is met. The final row counts the number of speakers who have met the respective criterion and shows the average NCS-score of all speakers.

Criterion (1) is met with a positive value, i.e. the F2 value of /ɑ/ minus the F2 value of /ʌ/; criterion (3) is met analogously. Criterion (2) is met when the value is lower than 18.75. Criterion (4) requires a value lower than 60 and criterion (5) a value higher than 50.

Criteria (3a) and (5) are not met by any of the speakers, i.e. no speaker pronounces /æ/ from a higher position than /ɛ/ and none fronts /ɑ/ to the fronter half of the vowel space. Before a closer look can be taken at the individual features, the general scores need to be analyzed.

The NCS-scores range from 0 (M19f) to 3.5 (M56m and S84f). While the mean is at 1.3, the median is 1, i.e. half of the informants score 1 or lower. Figure 5.1 displays the NCS-scores colored-coded by gender and arranged according to birth year. Thus, the NCS-scores are displayed in apparent time. Linear regression curves of the male speakers, the female speakers and all together is printed in dotted lines.

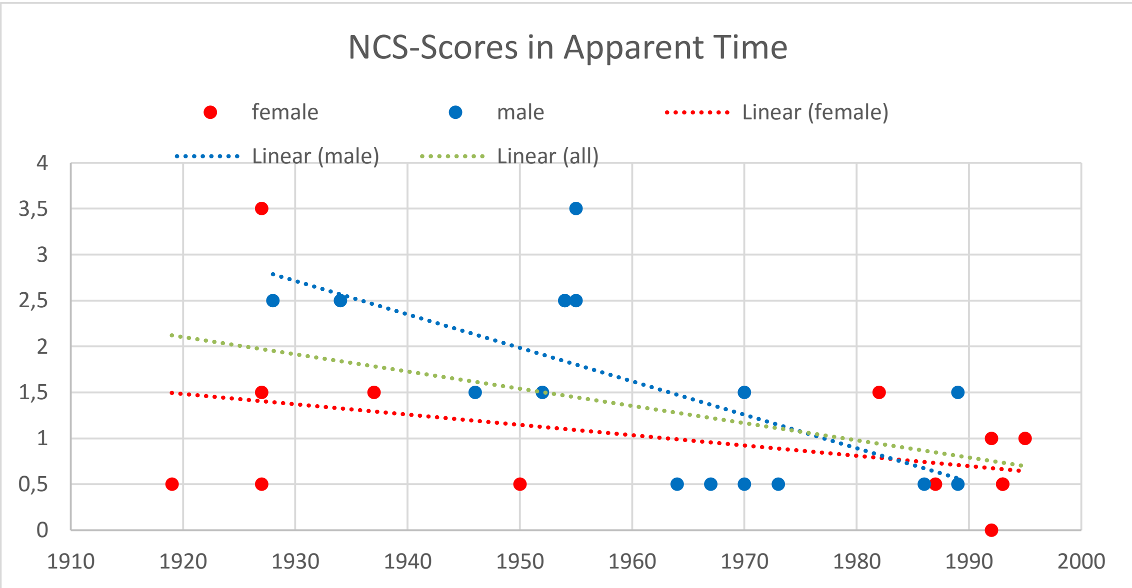

Figure 5.1: NCS-scores vs. age; color-coding according to gender; linear regression.

Correlations are measured with the Pearson correlation coefficient r[13], and its significance is checked via a t-test[14]. The positive correlation with age, (i.e. the negative correlation with birth year) is tested in a one-tailed test for the entire data set and measured as highly significant ($p = 0.0049 < 0.005$). The correlation between age and NCS-Score in male speakers is also highly significant ($p = 0.0029 < 0.005$). Both correlations are displayed in the linear regression curves in Figure 5.1.

However, the figure also shows the relatively flat regression curve of female speakers. The significance test yields $p = 0.08$, indicating no significant correlation between age and NCS-score. Additionally, the one value at 3.5 (S84f) can almost be regarded as an outlier since it is 2.8 times the standard deviation higher than the mean. The mean NCS-score of female speakers amounts to 1; that of male speakers to 1.56.

These values indicate that the NCS-scores of men decrease significantly with younger age, while women show no significant correlation between age and NCS-score, but display a constantly low score. With younger age of the participants, the scores align more strongly. All speakers born after 1960 score 1.5 or lower. However, even across all ages, the Welsh test[15] yields that the two gender groups do not differ significantly ($p= 0.12$).

For the analysis of the individual NCS criteria, Table 5.3 depicts the implication scale of the scores, which delivers the following implication with two exceptions:

If criterion (1) is met, criterion (2), (4), and (3b) are met. (2) implies (4) and (3b), and (4) implies (3b). This means that speakers who pronounce /ɑ/ fronter than /ʌ/ also pronounce it less than 18.75% further back than /ɛ/ and raise /æ/ higher than 60%, as well as pronouncing it fronter than /ɛ/. The most common feature is thus the position of /æ/ being fronter than /ɛ/.

The first exception is the missing criterion (4) when criteria (2) and (1) are met, as is the case for the three male speakers L56m, G77m, and H82m. The second one is the raising of /æ/ despite its being pronounced further back than /ɛ/ in the case of the two young

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[13] The Pearson correlation coefficient ($-1 < r < 1$) is an indicator of a linear correlation between two variables. $r = 1$ indicates 100% correlation, and $r = -1$ indicates 0% correlation. $r = (\frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\sum(y-\bar{y})^2}}$ (cf. Rodgers/Nicewander 1988).

[14] T-testing via $t = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}}$, with N-2 degrees of freedom.

[15] The Welsh-test is a t-test that probes whether two data sets with a possible difference in variance are equal.

female speakers E19f and L16f. Reasons for the occurrence of the exceptions will be discussed later on.

	3b) /æ/-/ɛ/ (F2)	4) /æ/ (F1)	2) /ɛ/-/ɑ/ (F2)	1) /ɑ/-/ʌ/ (F2)	3a) /ɛ/-/æ/ (F1)	5) /ɑ/ (F2)	NCS-Score
M56m	**14.42**	**53.12**	**12.06**	**0.93**	-5.85	36.18	3.5
S84f	**3.97**	**57.33**	**18.39**	**0.92**	-6.99	36.39	3.5
J57m	**1.73**	**56.34**	**18.37**	-2.74	-18.24	34.27	2.5
B57m	**7.05**	**56.94**	**18.35**	-2.71	-9.24	34.51	2.5
A22m	**5.02**	**56.74**	34.08	-7.24	-13.45	26.99	1.5
J29m	**4.75**	**59.65**	28.32	-6.83	-14.98	25.02	1.5
I41m	**2.52**	**56.05**	27.02	-7.65	-16.63	30.30	1.5
Z58m	**6.47**	**58.21**	19.78	-1.52	-10.25	36.15	1.5
B65m	**3.70**	**58.89**	23.85	-6.49	-10.49	34.21	1.5
C74f	**7.38**	**52.43**	23.96	-3.85	-12.76	33.86	1.5
I84f	**8.14**	**58.34**	20.48	-3.76	-11.92	36.56	1.5
L56m	**3.25**	61.45	**18.68**	**0.01**	-13.00	34.59	2.5
G77m	**6.85**	62.57	**12.73**	**2.71**	-11.83	38.74	2.5
H82m	**3.47**	62.62	**17.42**	**1.87**	-15.17	31.45	2.5
C18f	**2.10**	67.20	29.63	-10.65	-11.68	24.40	0.5
M18f	**4.62**	61.24	26.70	-11.55	-9.27	29.83	0.5
B22m	**1.20**	68.11	33.73	-11.98	-11.31	23.65	0.5
N24f	**1.17**	65.21	22.77	-7.63	-13.25	34.67	0.5
R25m	**2.96**	60.17	29.71	-8.44	-16.77	31.04	0.5
J38m	**6.95**	63.83	21.73	-5.50	-14.13	29.85	0.5
J41m	**3.09**	62.88	26.30	-8.42	-14.72	24.59	0.5
K44m	**4.65**	64.91	20.47	-6.35	-12.53	29.03	0.5
K47m	**5.57**	62.55	22.30	-2.58	-11.47	31.11	0.5
A61f	**1.48**	61.03	31.46	-9.25	-13.15	33.27	0.5
T84f	**4.13**	66.35	22.96	-6.27	-19.39	29.49	0.5
M92f	**10.59**	64.76	27.17	-2.76	-19.69	20.52	0.5
L16f	-0.27	**59.10**	35.07	-10.57	-17.44	26.96	1.0
E19f	-1.06	**59.75**	23.33	-8.68	-8.21	33.91	1.0
M19f	-1.22	67.81	32.09	-11.02	-10.79	33.67	0.0
	26	**13**	**7**	**5**	**0**	**0**	**Ø1.31**

Table 5.3 Implication scale of NCS-score.

A discussion of criterion (5) follows in subchapter 5.2.2. The remaining criteria need to be analyzed in more detail. 90% of the speakers pronounce /æ/ fronter than /ɛ/ (3b). The three speakers who pronounce /ɛ/ slightly fronter than /æ/ are L16f, M19f, and E19f, three young female speakers. The fronting of /æ/ is thus completed in the vowel system of speakers over the age of 20 and seems to be experiencing a backward movement in the speech of young women.

Interestingly, two out of three of these women fulfil criterion (4), the raising of /æ/ across the 60% line. While no speaker fulfils criterion (3a), i.e. the raising of /æ/ higher than /ɛ/, 45% meet criterion (4), the raising of /æ/ over 60%. A raising of /æ/ can thus be detected which might not be accompanied by a lowering of /ɛ/. A more complex analysis of the individual vowels can be found in the following subchapters.

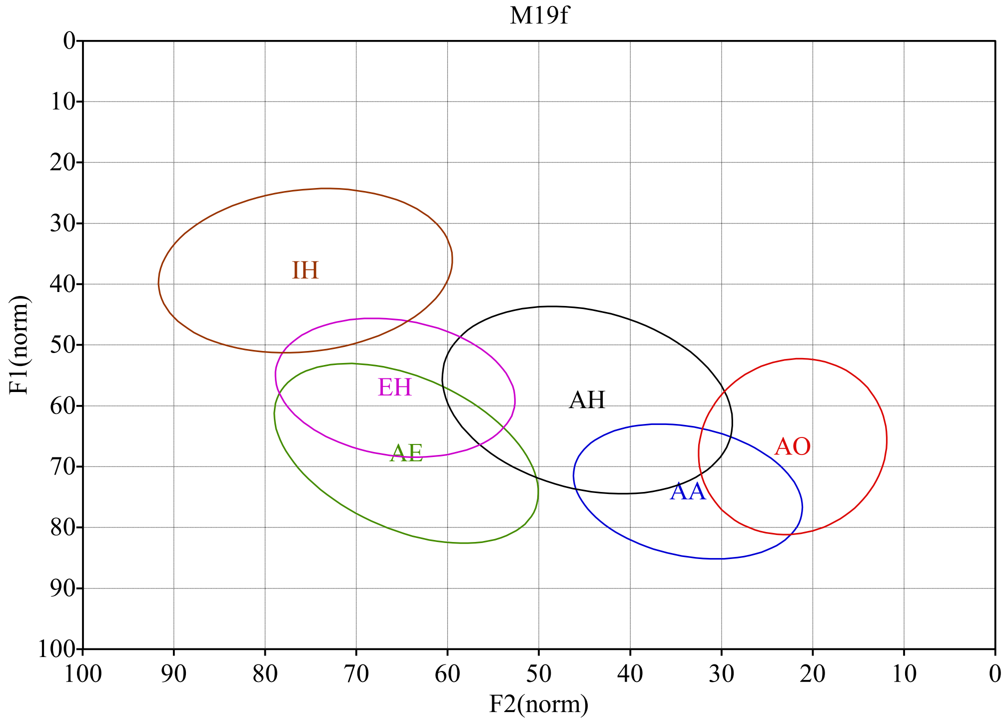

Figure 5.2: Normalized vowel chart of M19f with NCS-score 0. Ellipse based on standard deviation. IH=/ɪ/, EH=/ɛ/, AE=/æ/, AH=/ʌ/, AA=/ɑ/, AO=/ɔ/.[16]

Since the NCS-scores range from 0 to 3.5, the speakers with the most extreme values need to be highlighted. M19f matches none of the NCS-scores; i.e. according to the score system, she shows no sign of the Northern Cities Shift. As can be seen in Figure 5.2, the vowels in question approximate indeed the positions of General American. /ɪ/ is pronounced in high frontal position; /ɛ/ is positioned lower and further back, but higher and further front than the remaining vowels; while the cluster of /æ/ indicates a consonant environment-based upward movement, its mean is clearly lower than /ɪ/ and /ɛ/. Merely /ɔ/ and /ɑ/ show signs of the NCS. They are not merged (t-test renders p(F1)=0.0002;

[16] Here and in the following, typical vowel charts are selected to depict the data described. The vowel charts of all speakers are listed in Appendix 3

p(F2)=0.000); /ɑ/ is fronted and /ɔ/ lowered to some degree. Since the fronting of /ɑ/ does not reach 50%, NCS-criterion (5) is not met and the lowering of /ɔ/ represented in the score system.

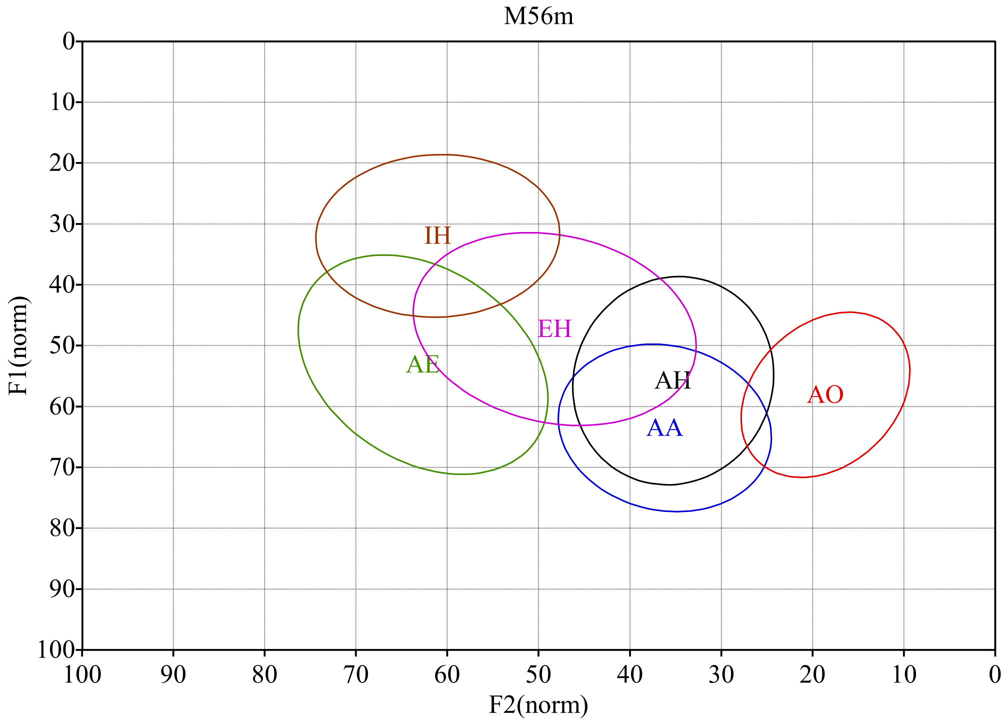

Figure 5.3: Normalized vowel chart of M56m with NCS-score 3.5. Ellipse based on standard deviation. IH=/ɪ/, EH=/ɛ/, AE=/æ/, AH=/ʌ/, AA=/ɑ/, AO=/ɔ/.

M56m and S84f, on the other hand, score highest at 3.5 each. In Figure 5.3, the normalized vowel chart of M56m, it becomes clear that the NCS has progressed. /ɪ/ is clearly backed, /ɛ/ is lowered and backed towards /ʌ/. /ʌ/ is positioned further back than /ɑ/ and its ellipse stretches downward. /ɔ/ is lowered and /ɑ/ fronted, which leaves them unmerged. The ellipse of /æ/ stretches far up into that of /ɪ/. A clear distinction between Figure 5.2 and Figure 5.3 is evident. Based on the observations derived from the two vowel charts above, the NCS-score seems reliable. However, a closer look at the vowel chart of S84f challenges this somewhat.

Figure 5.4 depicts how S84f raises /æ/, but not as far as /ɪ/; /æ/ is also positioned further back than /ɪ/. /æ/ and /ɛ/ seem merged, with a stretch along the F2 axis. While /ɔ/ reaches down to the GA position of /ɑ/ and the two vowels are clearly distinct, the range of /ɔ/ also reaches a height over 50% F1.

Although M56m and S84f reach the same score, their vowel charts are quite distinct both in the positioning of the vowel means and the shapes of each vowel cluster. An equivalence of speech thus cannot be inferred from the NCS-score.

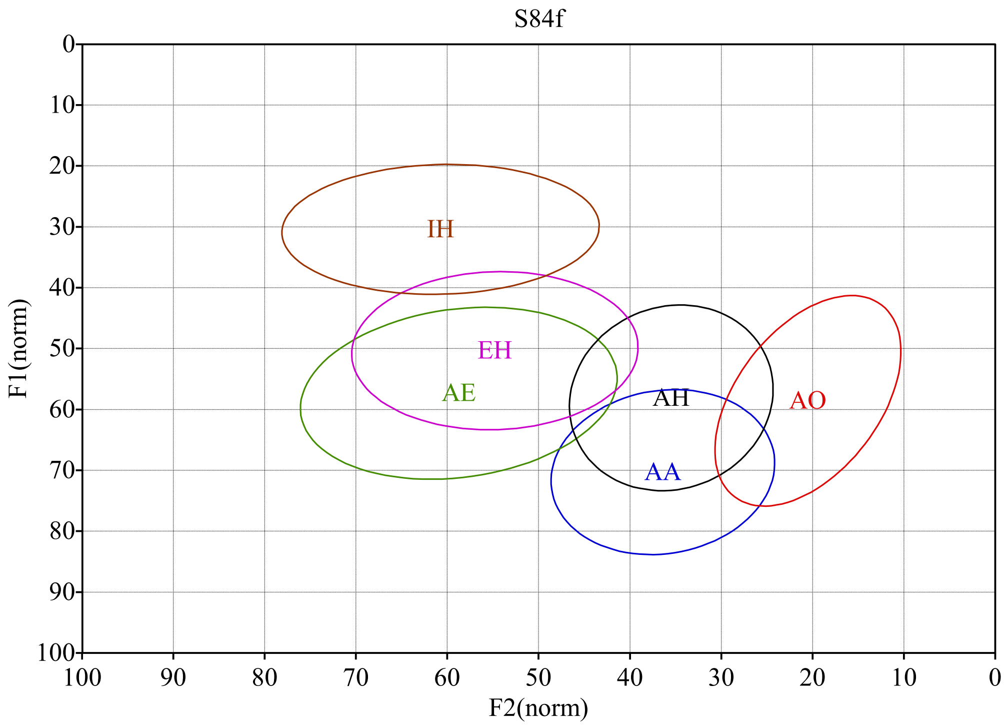

Figure 5.4: Normalized vowel chart of S84f with NCS-score 3.5. Ellipse based on standard deviation. IH=/ɪ/, EH=/ɛ/, AE=/æ/, AH=/ʌ/, AA=/ɑ/, AO=/ɔ/.

Further arguments point to the limitations of the scoring system. As Dinkin (2009: 80ff) points out, neither do the scores indicate the significance of the difference between two values, nor do they reveal the extent to which a criterion is met. For clarification, the values of speaker M19f, who scores 0, misses criterion (3b) by 1.22%. 7 out of 14 miss criterion (4) by less than 3%, including those speakers whose scores are pointed out as atypical on the implication scale. Similarly, the two speakers who score (4) but not (3b) miss the latter by less than 1.23%. On the other hand, criterion (1) is only met by less than 2.72% by all speakers who meet it. 3 out of 5 reach it even only by less than 1%. No margin of error is considered in this categorical scoring system. The level in which criterion (3b) is met reaches a range of 13.25, i.e. the values range between 1.17 (N24f) and 14.42 (M56m).

	3b) /æ/-/ɛ/ (F2)	**4) /æ/ (F1)**	**2) /ɛ/-/ɑ/ (F2)**	**1) /ɑ/-/ʌ/ (F2)**	**3a) /ɛ/-/æ/ (F1)**	**5) /ɑ/ (F2)**	**NCS-Score**
M56m	**14.42**	**53.12**	**12.06**	**0.93**	-5.85	36.18	3.5
S84f	**3.97**	**57.33**	**18.39**	**0.92**	-6.99	36.39	3.5
J57m	**1.73**	**56.34**	**18.37**	-2.74	-18.24	34.27	2.5
B57m	**7.05**	**56.94**	**18.35**	-2.71	-9.24	34.51	2.5
A22m	**5.02**	**56.74**	34.08	-7.24	-13.45	26.99	1.5
J29m	**4.75**	**59.65**	28.32	-6.83	-14.98	25.02	1.5
I41m	**2.52**	**56.05**	27.02	-7.65	-16.63	30.30	1.5
Z58m	**6.47**	**58.21**	19.78	-1.52	-10.25	36.15	1.5
B65m	**3.70**	**58.89**	23.85	-6.49	-10.49	34.21	1.5
C74f	**7.38**	**52.43**	23.96	-3.85	-12.76	33.86	1.5
I84f	**8.14**	**58.34**	20.48	-3.76	-11.92	36.56	1.5
L56m	**3.25**	61.45	**18.68**	**0.01**	-13.00	34.59	2.5
G77m	**6.85**	62.57	**12.73**	**2.71**	-11.83	38.74	2.5
H82m	**3.47**	62.62	**17.42**	**1.87**	-15.17	31.45	2.5
C18f	**2.10**	67.20	29.63	-10.65	-11.68	24.40	0.5
M18f	**4.62**	61.24	26.70	-11.55	-9.27	29.83	0.5
B22m	**1.20**	68.11	33.73	-11.98	-11.31	23.65	0.5
N24f	**1.17**	65.21	22.77	-7.63	-13.25	34.67	0.5
R25m	**2.96**	60.17	29.71	-8.44	-16.77	31.04	0.5
J38m	**6.95**	63.83	21.73	-5.50	-14.13	29.85	0.5
J41m	**3.09**	62.88	26.30	-8.42	-14.72	24.59	0.5
K44m	**4.65**	64.91	20.47	-6.35	-12.53	29.03	0.5
K47m	**5.57**	62.55	22.30	-2.58	-11.47	31.11	0.5
A61f	**1.48**	61.03	31.46	-9.25	-13.15	33.27	0.5
T84f	**4.13**	66.35	22.96	-6.27	-19.39	29.49	0.5
M92f	**10.59**	64.76	27.17	-2.76	-19.69	20.52	0.5
L16f	-0.27	**59.10**	35.07	-10.57	-17.44	26.96	1.0
E19f	-1.06	**59.75**	23.33	-8.68	-8.21	33.91	1.0
M19f	-1.22	67.81	32.09	-11.02	-10.79	33.67	0.0
	26	**13**	**7**	**5**	**0**	**0**	**Ø1.31**

Table 5.3 on page 51 are reevaluated.

Dinkin (2009: 82ff) approaches this problem by introducing a gradient variation of criterion (3a) i.e. the height of F1. He calculates the difference between the F1 means of /æ/ and /ɛ/, the EQ1-index. Since the equivalent value in the current thesis is negative, but phenomena of the NCS can still be detected in the data, the EQ1-index does not serve as an adequate method here and needs to be questioned as to its power in replacing the NCS-scores in its interpretation of the presence or absence of elements of the shift.

While it is desireable to find a method that categorically analyzes data and delivers a numerical way of reliably measuring the extent to which a speaker or community participates in the Northern Cities Shift or a comparable phenomenon, until now this seems to have been unsuccessful.

The make-up of a person's vowel system is highly complex and so is already the normalization of and the comparison between such systems (cf. Flynn 2011). As Gordon (2000) describes, the shifts occurring within the NCS are highly complex themselves (cf. Figure 2.2), with interactions between each of the vowels in question. Given the complexity of all these undertakings, a point-based scoring system or even a single gradient score can only provide a very general and error-prone interpretation of the systems to be analyzed. A detailed description of the phenomena of each vowel, an analysis of its interaction with neighboring vowels, and a summary of the resulting vowel system is necessarily to approach a satisfactory understanding of the data under scrutiny.

5.2 /ɔ/, /ɑ/, and /ʌ/

5.2.1 /ɔ/

/ɔ/ is a vowel in movement not only in the context of the Northern Cities Shift. While it is important to know whether it is pronounced differently from /ɑ/, i.e. whether or not the two vowels are merged, both in the NCS and in the merged situation /ɔ/ would be lowered. As Labov et al (2006: 192) state, "[t]he natural break map for F1 of /oh/ is not particularly informative for the NCS because the downward shift of /oh/ in the low back merger is not distinguishable from the lowering of /oh/ in the NCS."

Thus, while it needs to be checked that the lowering is, in fact, taking place, the relationship between /ɔ/ and /ɑ/ becomes central for the analysis of NCS features. Table 5.4 lists the mean values of each speaker and the allophonic subgroups of /ɔ/ according to following consonant category. It forms the basis of the analyses in the present subchapter.

	/ɔ/ F1	/ɔ/ F2	/ɔ/pl F1	/ɔ/pl F2	/ɔ/na F1	/ɔ/na F2	/ɔ/li F1	/ɔ/li F2	/ɔ/fr F1	/ɔ/fr F2
L16f	56.18	16.15	69.59	16.96	71.59	20.07	45.59	14.26	71.26	20.65
C18f	56.68	18.54	74.69	20.68	65.58	20.92	51.25	17.69	72.37	20.41
M18f	53.63	18.06	70.40	20.88	67.53	17.11	48.98	17.65	68.30	21.77
E19f	63.72	21.53	83.9	25.02	72.02	25.01	55.99	19.45	80.16	29.28
M19f	66.71	22.19	81.58	24.87	77.85	23.88	59.64	20.23	81.24	29.38
B22m	60.80	29.27	75.98	20.20	73.52	20.52	57.24	31.66	81.23	13.71
A22m	58.60	20.22	78.21	22.29	78.98	18.07	52.41	20.44	78.44	17.13
N24f	66.10	29.48	75.22	31.70	74.25	28.78	63.10	29.09	74.91	28.13
R25m	49.73	21.75	64.93	30.27	63.61	18.69	44.96	21.04	68.94	25.68
J29f	58.46	16.46	78.91	22.05	74.09	15.84	48.60	14.72	77.49	20.82
J38m	63.58	23.58	76.65	28.93	77.41	25.46	59.36	22.68	76.85	24.94
J41m	50.85	23.62	70.03	18.90	65.87	19.59	44.12	24.62	69.81	24.23
I41m	63.64	24.95	73.42	14.23	66.46	14.49	61.32	28.56	74.48	15.94
K44m	59.52	18.80	75.72	22.48	68.35	15.73	54.43	18.84	77.56	19.12
K47m	64.6	24.67	81.49	28.15	71.21	24.65	59.68	23.88	79.18	25.99
L56m	56.33	18.29	70.13	21.67	57.29	17.36	52.81	17.52	69.42	21.45
M56m	58.08	18.58	65.75	21.19	58.36	20.00	55.56	16.94	66.84	26.15
J57m	53.21	25.29	71.40	33.41	58.73	23.59	49.06	24.24	69.96	31.33
B57m	62.14	27.44	77.24	29.12	74.70	35.02	58.51	27.78	69.44	22.03
Z58m	55.85	26.38	69.88	28.89	70.26	19.79	51.53	26.18	64.89	35.10
A61f	51.96	27.08	70.57	29.89	59.10	26.90	46.38	26.26	64.75	32.22
B65m	66.40	32.02	80.15	29.87	66.15	27.91	61.30	34.21	80.29	23.89
C74f	44.82	21.78	66.05	30.19	67.42	27.34	37.10	19.48	65.71	26.22
G77m	64.31	20.85	75.15	28.23	69.72	21.13	59.73	18.46	78.49	27.87
H82m	57.78	16.12	70.96	21.64	63.22	17.48	52.94	13.94	73.73	25.25
I84f	55.02	30.10	64.35	32.07	65.92	27.09	50.66	30.12	71.99	31.28
S84f	58.58	20.49	71.55	25.91	73.26	21.39	50.45	17.21	71.39	30.52
T84f	65.69	19.47	91.48	31.9	76.09	14.06	50.86	15.70	68.52	19.41
M92f	46.43	9.52	56.98	13.00	44.70	9.09	44.17	8.86	58.47	13.93

Table 5.4: Normalized mean values of /ɔ/, general and in consonant environments.

	ØF1	ØF2
/ɔ/	58.26	22.16
/ɔ/ male	59.09	23.24
/ɔ/ female	57.23	20.83

Table 5.5: Normalized mean F1- and F2-values (in %) of /ɔ/ and both male and female.

Table 5.5 states the normalized mean values of F1 and F2 and introduces the mean values of F1 and F2 for both genders. These values are used for the calculations necessary for Table 5.6.

	Gender	**Age**	**F2(ɔ)**
F1(ɔ)	p = 0.43 (two-tailed)	p = 0.30 (two-tailed)	p = 0.07 (two-tailed)
F2(ɔ)	p = 0.22 (two-tailed)	p = 0.80 (two-tailed)	n/a

Table 5.6: p-values of Welsh-test (gender - F1, gender - F2) and Pearson-correlations (age - F1, age - F2, F1 - F2) of /ɔ/.

As Table 5.6 displays, no significant correlation between the F1/F2 values of /ɔ/ and the sociolinguistic variables age and gender can be detected, i.e. the absolute positioning of /ɔ/ does not change significantly in the speech of younger informants, nor does it vary between men and women. The only significant correlation found was between F1 and F2, i.e. a higher F1 value implies a higher F2 value. When /ɔ/ is positioned low, it is thus positioned further front than in the vowel chart of speakers that pronounce it from a higher position.

	/ɔ/pl.F1	**/ɔ/pl.F2**	**/ɔ/na.F1**	**/ɔ/na.F2**	**/ɔ/li.F1**	**/ɔ/li.F2**	**/ɔ/fr.F1**	**/ɔ/fr.F2**
Ø%	73.53	24.99	68.04	21.27	52.68	21.44	72.62	24.27
r (age)	-0.27	0.24	-0.42	-0.05	-0.18	-0.10	-0.44	0.20
p (age)	0.16	0.20	0.02	0.81	0.36	0.61	0.02	0.30
t (gender)	0.03	0.02	0.23	0.06	1.96	1.78	1.11	0.56
p (gender)	0.98	0.98	0.82	0.95	0.06	0.09	0.28	0.58

Table 5.7: /ɔ/ classification by following-consonant categories. Average normalized F1, F2 values (%); r- and p-values of Pearson-correlations (two-tailed) for Age; Welsh-test (two-tailed) t- and p-values for Gender.

In Table 5.7 the values of /ɔ/ are grouped according to the consonants that follow. The consonants are classified as plosives (pl), nasals (na), liquids (li), and fricatives (fr). Affricates and glides are neglected since the samples lack representativeness. The normalized mean (i.e. the mean of the percentage) describes the mean position of each consonant group following /ɔ/.

The mean values of F1 show that plosives (73.53%) and fricatives (72.62%) further the lowering of /ɔ/ most and almost to the same degree, whereas /ɔ/+liquid (52.68) is pronounced in the standard-nearest position, and /ɔ/+nasal (68.04), while being located in between these two poles, tends towards the lowered ones. The difference in terms of height is impressive – over 20% of the height of the total vowel space separate /ɔ/+plosive from /ɔ/+liquid – and shows that the lowering of /ɔ/ depends heavily on the consonantal environment.

Fronting, however, is only influenced slightly by the consonants that follow. Plosives (24.99%) and nasals (21.27%), distinguish the allophones of /ɔ/ most, but they differ only by about 4%. Plosives and fricatives (24.27%) further the fronting - only minimally – by the same degree, and /ɔ/+liquid (21.44%) are pronounced at basically the same F2 position as /ɔ/+nasal.

The Pearson-correlations with age yield that the height of /ɔ/, when followed by a nasal or fricative, correlates significantly (0.02 each) with the age of the speaker. The r-value indicates a negative correlation, i.e. with increasing age the normalized percentage value decreases. Thus, the younger the speaker, the lower the absolute position of /ɔ/ when followed by a nasal or fricative. This observation surprises given the decreasing NCS-Score with decreasing age (cf. Figure 5.1). Further interpretation of such values is only possible in connection with the analysis of /ɑ/. The remaining consonant groups display no significant correlation with age.

An even stronger absence of correlation can be found in connection with gender, as was already seen in the Pearson correlations with the general means. Here p (0.98, 0.98, 0.82, 0.95) testifies to the non-existence of any correlation for following plosives, nasals and gender. Some correlation can be found only for liquids (F1 → 0.06, F2 → 0.09) both in terms of height and frontedness. The F1 mean values for men (Ø/ɔ/li.F1=54.7%) and women (Ø/ɔ/li.F1=50.2%) display that men pronounce /ɔ/+liquid lower than women, and the F2 mean values for men (Ø/ɔ/li.F2=23.2) and women (Ø/ɔ/li.F2=19.3) show that men also front /ɔ/+liquid more than women do. In terms of height /ɔ/+fricatives display the same tendency.

It is important to observe that, while the analysis of the general means of /ɔ/ yields no significant correlation between the position of /ɔ/ and age or gender, a segmentation according to groups of the following consonants, in fact, displays some significant correlation. Segmentation is thus important (cf. also chapter 6).

5.2.2 /ɑ/

	/ɑ/ F1	/ɑ/ F2	/ɑ/pl F1	/ɑ/pl F2	/ɑ/na F1	/ɑ/na F2	/ɑ/li F1	/ɑ/li F2	/ɑ/fr F1	/ɑ/fr F2
L16f	69.21	26.96	72.59	27.42	68.12	27.37	62.73	25.8	66.90	22.69
C18f	69.16	24.4	74.25	27.13	64.81	24.07	67.18	22.5	71.42	22.22
M18f	68.54	29.83	72.92	30.96	72.54	25.49	61.77	31.13	68.20	24.68
E19f	72.86	33.91	80.95	32.09	67.07	35.28	69.39	35.25	65.39	31.82
M19f	74.08	33.67	75.68	35.44	72.74	32.34	70.07	32.11	83.14	29.10
B22m	75.87	23.65	78.92	24.74	70.56	25.49	75.45	23.52	78.50	13.67
A22m	72.03	26.99	72.76	30.16	80.49	27.36	65.47	24.93	76.00	15.69
N24f	72.13	34.67	75.05	36.56	67.97	36.62	72.00	30.98	71.03	25.56
R25m	63.75	31.04	70.03	34.78	61.03	31.16	56.49	25.75	67.81	30.76
J29f	72.78	25.02	78.82	26.87	71.58	23.99	63.13	23.68	80.18	21.25
J38m	77.67	29.85	80.50	31.77	76.38	26.16	73.29	28.92	74.73	23.98
J41m	71.30	30.3	76.47	31.13	68.26	30.13	68.05	30.06	76.17	26.18
I41m	71.11	24.59	74.45	26.51	62.01	23.64	71.72	21.74	76.44	24.80
K44m	71.83	28.99	74.44	34.73	70.97	30.30	68.53	24.25	75.61	21.38
K47m	73.05	31.11	74.09	31.80	70.40	33.63	73.33	29.18	78.92	27.96
L56m	70.27	34.59	75.64	36.1	62.31	34.32	70.80	33.29	76.42	34.91
M56m	63.52	36.18	65.14	35.48	56.09	40.07	66.15	34.66	70.99	31.30
J57m	62.50	34.27	70.38	34.81	48.93	37.04	63.49	31.21	80.17	26.62
B57m	62.71	34.51	62.28	34.83	54.14	36.13	68.51	34.31	60.26	23.65
Z58m	67.69	36.15	67.03	39.52	70.64	32.48	66.28	36.65	67.11	29.05
A61f	64.85	33.27	69.38	36.87	58.96	35.85	62.07	27.54	76.50	30.42
B65m	70.92	34.21	72.43	34.66	64.74	32.95	73.95	36.41	75.26	29.22
C74f	67.56	33.86	64.58	35.43	72.81	35.18	65.93	30.97	82.40	37.67
G77m	73.82	38.74	73.38	41.40	69.81	35.36	77.11	39.2	77.05	32.66
H82m	72.58	31.45	71.54	31.44	67.54	28.96	76.53	33.56	74.63	26.89
I84f	69.77	36.56	70.89	38.3	66.63	37.56	69.07	35.11	76.27	31.53
S84f	70.29	36.39	71.76	39.86	66.63	29.91	68.57	40.74	79.28	34.41
T84f	73.75	29.49	75.87	33.55	77.28	32.66	69.19	23.38	-	-
M92f	58.40	20.52	71.66	22.09	48.24	23.85	61.55	15.5	68.37	20.07

Table 5.8: Normalized mean values of /ɑ/, general and in consonant environments.

The fronting of /ɑ/, which leads to the absence of the *cot-caught* merger can be considered the second movement of the NCS. /ɑ/, traditionally located in a low back position, is fronted toward the position of /æ/, and sometimes even further front (cf. Labov, Ash, Boberg 2006: 195). Through this movement, the lowered /ɔ/ then occupies the free low back space, and a merger does not take place.

Gordon (2001: 197) additionally observes a joined raising and fronting movement of /ɑ/ toward the position of /ʌ/ as part of the NCS. The absence or presence of these two directions of shift will be investigated in the present subchapter.

In analogy to chapter 5.2.1,Table 5.8 lists the mean values of each speaker and the allophonic subgroups; Table 5.9 shows the mean values of F1(ɑ) and F2(ɑ) and those of each gender group. The values already show a very close proximity to one another, which Table 5.10 tests.

	ØF1	ØF2
/ɑ/	69.79	31.21
/ɑ/ male	70.04	31.66
/ɑ/ female	69.49	30.66

Table 5.9: Normalized mean F1- and F2-values (in %) of /ɑ/ and both male and female.

	Gender	Age	F2(ɑ)
F1(ɑ)	p = 0.74 (two-tailed)	p = 0.14 (two-tailed)	p = 0.91 (two-tailed)
F2(ɑ)	p = 0.57 (two-tailed)	p = 0.08 (two-tailed)	n/a

Table 5.10: p-values of Welsh-test (age) and Pearson-correlations (gender, F1-F2) of /ɑ/.

Table 5.10 displays the p-values for position and age and gender, respectively, calculated from the mean values listed in Table 5.9 and Table 5.1. According to the general means, only the speakers' age influences the position of /ɑ/ only to a slight degree (p(F1)=0.14 and p(F2)=0.08), more strongly in the fronting than the height. Interestingly, the correlation between F1 and age is negative (r(F1) = -0.28), i.e. the younger the speaker, the lower the pronunciation of /ɑ/, and the correlation between F2 and age is positive (r(F2)=0.33), i.e. the younger the speaker, the further back /ɑ/ is pronounced. Overall, however, the correlation between F1 and F2 of /ɑ/ is insignificant (p=0.91).

As done for /ɔ/, the mean values of /ɑ/ segmented into groups of the consonants following (plosives, nasals, liquids, and fricatives) are calculated, the Pearson correlations for age and position and the Welsh test for gender and position are computed and displayed in Table 5.11.

	/ɑ/pl.F1	/ɑ/pl.F2	/ɑ/nas.F1	/ɑ/nas.F2	/ɑ/li.F1	/ɑ/li.F2	/ɑ/fr.F1	/ɑ/fr.F2
Ø%	72.89	32.98	66.54	31.22	68.20	29.74	74.11	26.79
r (age)	-0.42	0.36	-0.29	0.33	0.18	0.26	0.17	0.45
p (age)	0.02	0.05	0.13	0.08	0.34	0.17	0.38	0.01
t (gender)	0.57	0.47	0.50	0.43	1.96	0.73	0.02	0.67
p (gender)	0.57	0.64	0.62	0.67	0.06	0.47	0.99	0.51

Table 5.11: /ɑ/ classification by following-consonant categories. Average normalized F1, F2 values (%); r- and p-values of Pearson-correlations (two-tailed) for Age; Welsh-test (two-tailed) t- and p-values for Gender.

Fronting and lowering do not differ as much in relation to the following consonants as was the case for /ɔ/. Fricatives further the lowering most (74.11%), followed by plosives (72.89%), liquids (68.20%) and nasals (66.54%). /ɑ/+plosive is fronted most (32.98%), /ɑ/+fricative least (26.79%); /ɑ/+nasal (31.22%) and /ɑ/+liquid (29.74%) are located in between. The relationship between /ɑ/ and /ɔ/ in this context will be discussed in the following subchapter.

Gender displays no significant correlation with the positioning of /ɑ/, neither in height nor in F2-position. It will thus be neglected in this context.

The influence of following consonants on height in relation to age is only significant (p=0.02) when /ɑ/ is followed by plosives – the younger the speaker, the lower /ɑ/+plosive is pronounced, an observation that will be of further significance in the analysis of the relationship between /ɑ/ and /ɔ/.

Age plays a more significant role in the fronting of /ɑ/, as could already be observed in the general mean values. Fronting correlates significantly with the increase in age for /ɑ/+plosive (p=0.05) and /ɑ/+fricative (p=0.01), and to some degree for /ɑ/+nasal (p=0.08) and /ɑ/+liquid (p=0.17). The apparent-time analysis testifies thus to a backing movement of /ɑ/ that has been in progress in the speech community of Amherst. Figure 5.5 portrays this shift in more detail.

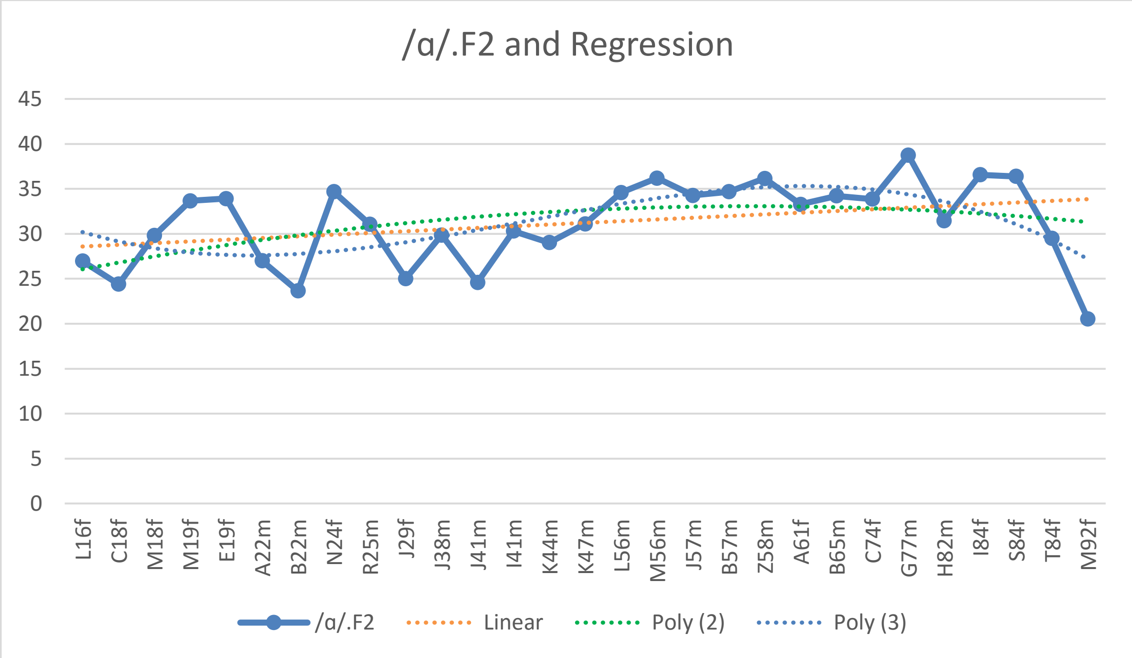

Figure 5.5: Normalized F2-values (%) of /ɑ/ ordered by age; linear and polynomial (2nd and 3rd degree) regression curves.

Figure 5.5 displays the mean normalized F2-values of /ɑ/ of each speaker, as listed in Table 5.1. To visualize the trend, polynomial regression curves of first (linear), second and third degree are deducted from the data. The linear (orange) curve visualizes the backing trend discussed in the numerical analysis above. Since the trend seems to be more complex, polynomials of higher degrees are added. The green parabola visualizes the fact that not the oldest speakers pronounce /ɑ/ furthest front, but speakers in their fifties, i.e. born in the 1950s. The third regression (third degree, blue) supports this observation and additionally visualizes the slight fronting trend among the younger speakers. The heterogeneity of these younger speakers, however, needs to be noted here and will be discussed later on.

5.2.3 /ɑ/ and /ɔ/

The absence or presence of the *cot-caught* merger is a crucial marker of the NCS. Thus, the observations above have to be combined in order to reach a better understanding of the back vowels potentially involved in the shift.

female speakers	p (t-test)
L16f	0.0000
C18f	0.0000
M18f	0.0000
E19f	0.0000
M19f	0.0002
N24f	0.0024
J29f	0.0000
A61f	0.0000
C74f	0.0000
I84f	0.0000
S84f	0.0000
T84f	**0.1874**
M92f	0.0000

Table 5.12: T-test absence of the low back merger (/ɑ/ and /ɔ/) for female speakers.

Table 5.12 shows the result of the t-test which clarifies that the low back merger is absent in most of the female speakers, except the second oldest – T84f. A more detailed analysis of the relationship between /ɑ/ and /ɔ/ can be conducted through the positioning of the two vowels, as depicted in figure Figure 5.6

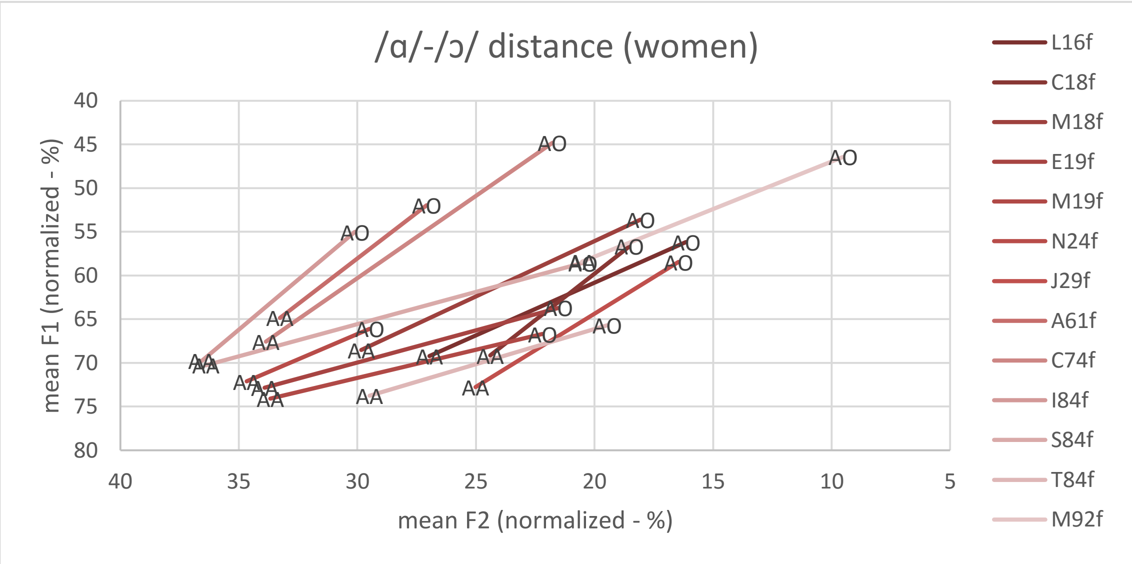

Figure 5.6: Position of normalized mean values of /ɔ/ and /ɑ/ for each female speaker. AA=/ɑ/, AO=/ɔ/.

Figure 5.6 depicts the relationship between /ɔ/ and /ɑ/ for the female speakers. The colors of the lines connecting the corresponding means get lighter with increasing age of the speakers. All female speakers pronounce /ɑ/ lower and further front than /ɔ/. The younger ones, as was already observed in the previous subchapters, tend to pronounce both vowels lower than the older speakers. The distance between the two vowels seems relatively homogenous, except for speaker N24f, who displays a very short distance.

Another speaker that displays strong differences to the remaining speakers is M92f. M92f, the oldest speaker, pronounces both vowels considerably further back than the remaining ones. Figure 5.7 depicts her vowel chart.

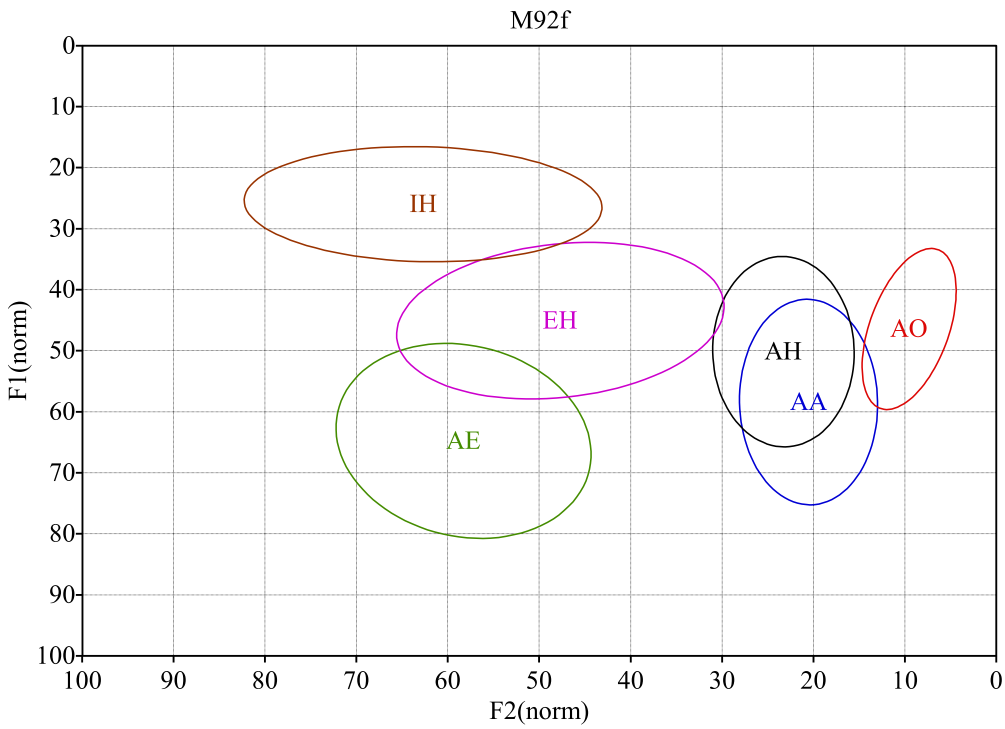

Figure 5.7: Normalized vowel chart of M92f with NCS-score 0.5. Ellipse based on standard deviation. IH=/ɪ/, EH=/ɛ/, AE=/æ/, AH=/ʌ/, AA=/ɑ/, AO=/ɔ/.

The vowel chart makes it clear that M92 has not participated in any lowering of /ɔ/. /ɔ/ is pronounced in the upper half of the vowel chart (F1<50%) in a very small space, i.e. no change in progress seems to have occurred during her adolescence (M92f was born in 1919). /ɔ/ and /ɑ/ are pronounced in separate locations, but the absence of the *cot-caught* merger does not imply the presence of the NCS. /ɑ/ is pronounced relatively far back. /ɑ/ stretches more along the F1 axis, and displays no tendency of being shifted toward the direction of /æ/. M92f's NCS-score is 0.5; she fulfils criterion (3b), i.e. she pronounces

/ɛ/ further back than /æ/. Given the low position of /æ/ and the high position of /ɪ/, this shift cannot be considered part of the NCS-cycle either. Thus, NCS-related features occur in other systems and need to be brought in connection to the remaining ones in order to ensure their validity for the NCS classification.

male speakers	**p (t-test)**
A22m	0.0001
B22m	0.0345
R25m	0.0000
J38m	0.0000
I41m	0.0000
J41m	**0.0697**
K44m	0.0000
K47m	0.0000
L56m	0.0000
M56m	0.0000
B57m	0.0463
J57m	0.0000
Z58m	0.0000
B65m	0.0145
G77m	0.0000
H82m	0.0000
A22m	0.0001

Table 5.13: T-test absence of the low back merger (/ɑ/ and /ɔ/) for male speakers.

Table 5.13: T-test absence of the low back merger (/ɑ/ and /ɔ/) for male speakers.Table 5.13 depicts the t-test conducted to analyze a possible merger between /ɑ/ and /ɔ/. As was observed for the women, only one of the men (J41m) shows the presence of the merger (t-test above 0.05).

Figure 5.8 displays the mean positions of /ɔ/ and /ɑ/ for the male informants. The corresponding vowels are connected by blue lines – the darker the line, the younger the speaker. The composition is more heterogeneous than that of the chart displaying the speech of the female speakers. While the majority of speakers pronounces /ɑ/ lower and further front than /ɔ/, as observed for female speakers, two men (B22m and J41m) do not follow the pattern.

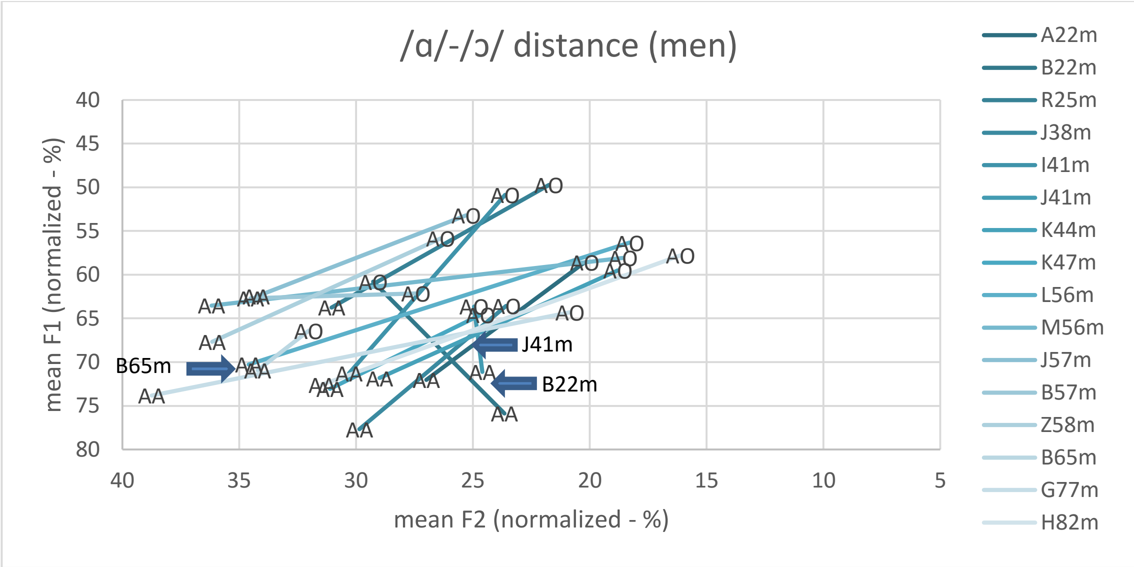

Figure 5.8: Position of normalized mean values of /ɔ/ and /ɑ/ for each male speaker. AA=/ɑ/, AO=/ɔ/.

B22m pronounces /ɔ/ higher, but considerably further front than /ɑ/. The two vowels seem unmerged. Fronting of /ɑ/ does not seem to occur. J41m pronounces /ɑ/ lower than /ɔ/, but almost in the same F2 position. He is also the one who merges the two vowels.

Figure 5.9, the vowel chart of B22m, further testifies to the position of /ɔ/ considerably further front than /ɑ/. /ɔ/ stretches along the F2-axis toward and above the position of /ʌ/. While some overlap between the two ellipses of the standard deviations can be observed, the vowels appear to be unmerged. /ɔ/ seems to be pulled upward and front, and it is interesting to observe in which environment.

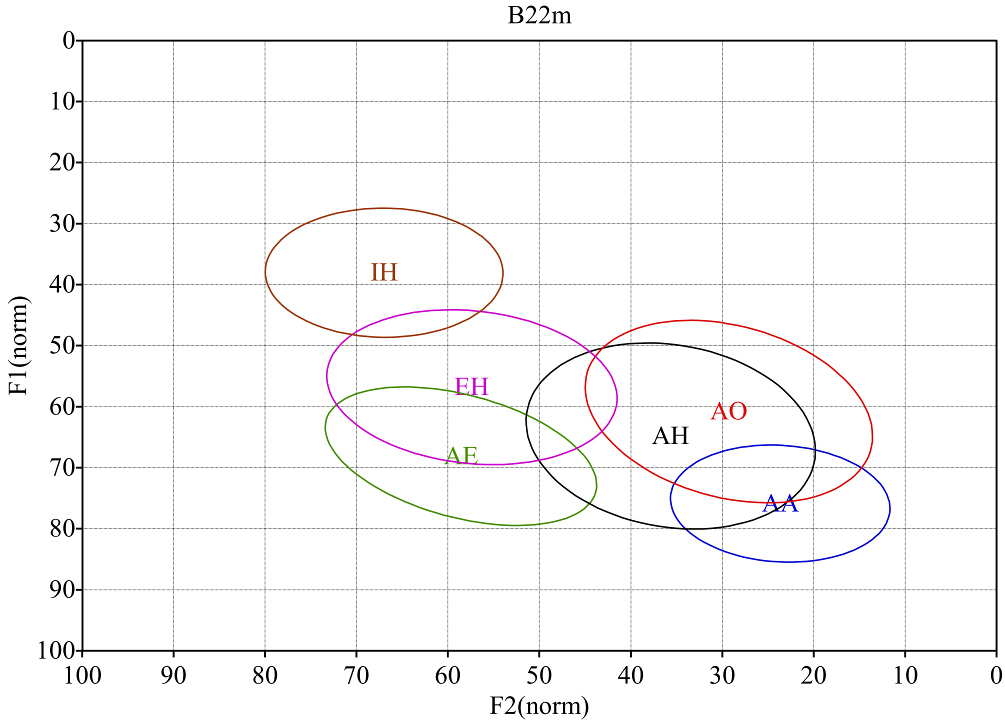

Figure 5.9: Normalized vowel chart of B22m with NCS-score 0.5. Ellipse based on standard deviation.

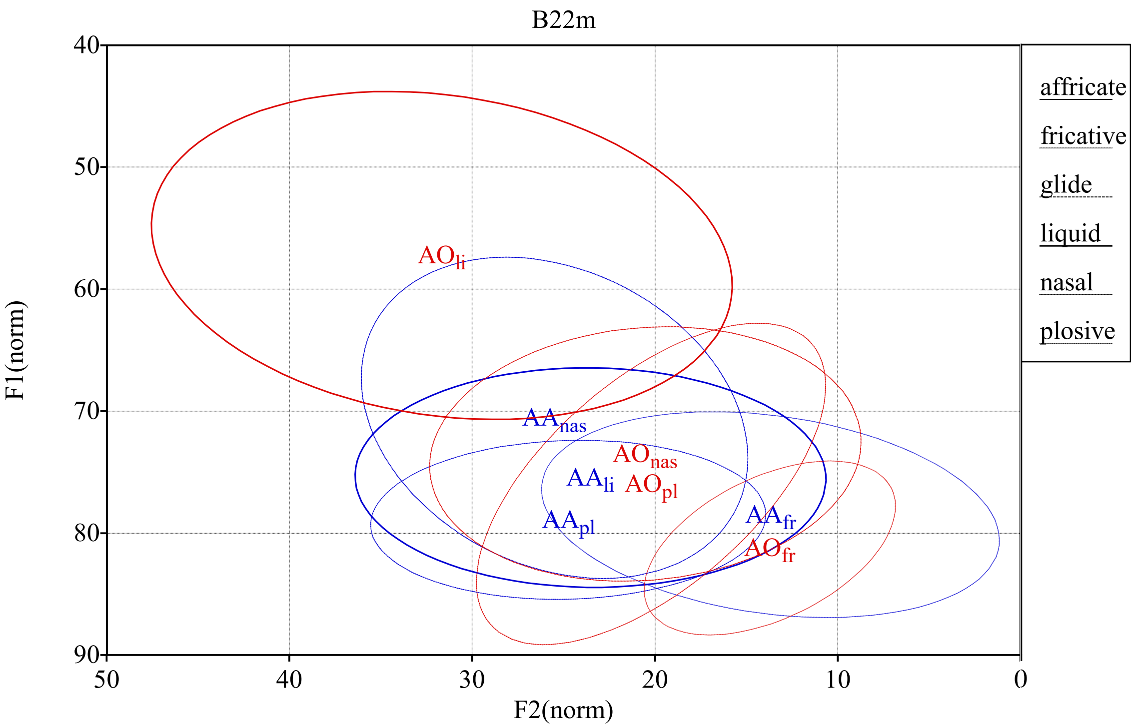

Figure 5.10: Vowel chart depicting /ɔ/ and /ɑ/ separated into groups of following consonants. Means and ellipses of standard deviation.

Figure 5.10 makes it obvious that the group of allophones /ɔ/+liquid pulls the vowel upward and front. The remaining allophones appear to be largely merged with /ɑ/. Especially /ɔ/+fricative and /ɑ/+fricative, which encompass a considerably larger space, are basically merged. The surprisingly frontal position of /ɔ/ is thus only attributed to one group of allophones and a merger of /ɔ/+liquid and /ʌ/+ liquid needs to be analyzed later on.

	ɑ-ɔ	ɑ-ɔ_pl	ɑ-ɔ_nas	ɑ-ɔ_li	ɑ-ɔ_fr
L16f	16.93	10.88	8.08	20.66	**4.81**
C18f	13.79	6.46	3.24	16.64	**2.04**
M18f	19.00	10.39	9.76	18.58	**2.91**
E19f	15.39	7.66	11.40	20.72	14.99
M19f	13.64	12.11	9.88	15.81	**1.92**
B22m	16.08	5.41	5.78	19.95	**2.73**
A22m	15.04	9.57	9.41	13.81	**2.83**
N24f	7.96	4.86	10.05	9.10	**4.65**
R25m	16.82	6.81	12.73	12.45	5.20
J29f	16.68	**4.82**	8.53	17.07	**2.72**
J38m	15.42	**4.78**	**1.25**	15.26	**2.33**
I41m	21.51	13.82	10.81	24.54	6.65
J41m	7.48	12.32	10.17	12.44	9.07
K44m	15.98	12.32	14.80	15.10	**2.98**
K47m	10.62	8.25	9.02	14.64	**1.99**
L56m	21.45	15.45	17.69	23.92	15.17
M56m	18.42	14.30	20.2	20.64	6.61
J57m	12.92	**1.73**	16.64	16.03	11.24
B57m	7.09	16.01	20.59	11.94	9.32
Z58m	15.35	11.01	12.7	18.09	6.44
A61f	14.30	7.08	8.95	15.74	11.89
B65m	5.02	9.09	5.23	12.84	7.33
C74f	25.75	5.44	9.51	31.04	20.24
G77m	20.26	13.29	14.23	27.06	5.00
H82m	21.31	9.82	12.27	30.68	**1.87**
I84f	16.10	9.03	10.49	19.07	**4.29**
S84f	19.75	13.95	10.80	29.70	8.80
T84f	12.86	15.70	18.64	19.87	-
M92f	16.26	17.27	15.18	18.61	11.65

Table 5.14: Euclidean distance between normalized means of /ɑ/ and /ɔ/, and normalized means of allophone clusters (according to following consonant groups).

The example of B22m emphasizes the need for differentiation into groups of allophones according to following consonant environment. Table 5.14 contains the Euclidean distance between the mean values of /ɑ/ and /ɔ/. It furthermore lists the distance between subgroups of /ɔ/ and /ɑ/, respectively, i.e. /ɑ/-/ɔ/_plosive, /ɑ/-/ɔ/_nasal, /ɑ/-/ɔ/_liquid, and /ɑ/-/ɔ/_fricative. The values are ordered according to the age of the speakers. Distances <5 are marked in bold.

It becomes apparent that the observation deducted from the vowel chart of B22m that the allophones of /ɑ/ and /ɔ/ when followed by fricatives lie closest together holds true for the majority of speakers (13). T84f does not offer enough data for the calculation of the Euclidean distance between /ɑ/+fricative and /ɔ/+fricative.

While it is convenient to analyze the distance between the general means of /ɔ/ and /ɑ/, the table also displays that some distances between the subgroups cancel each other out. J41m, for example, displays an /ɔ/-/ɑ/ distance of 7.48, but the means of the allophonic subgroups lie considerably further apart (12.32, 10.17, 12.44, 9.07). The same phenomenon holds true for other speakers as well (B57m, B65m, T84f). A distortion in the opposite direction, i.e. the general means lying further apart than the ones of the subgroups can be observed as well, as in the case of B22m, for example.

J38m merges the two vowels in the most consistent way. Only when they are followed by a nasal is the distance between the means above 5. The distance of the general means (15.42) does not clarify this approximation.

A bar diagram (Figure 5.11) was chosen to depict the data of Table 5.14 because it visualizes and clarifies the influence of the following consonants. Fricatives encourage the merger between /ɑ/ and /ɔ/ most, as do plosives to some degree.

Overall, liquids discourage a merger between /ɑ/ and /ɔ/. Especially the older speakers pronounce the two vowels far apart when followed by a liquid, but the separate pronunciation is taken up by the younger speakers as well. The speakers in their fifties display most consistency in their degree of merging or separating. In their speeches the influence of the following consonants does not vary as much as is the case among younger and older speakers.

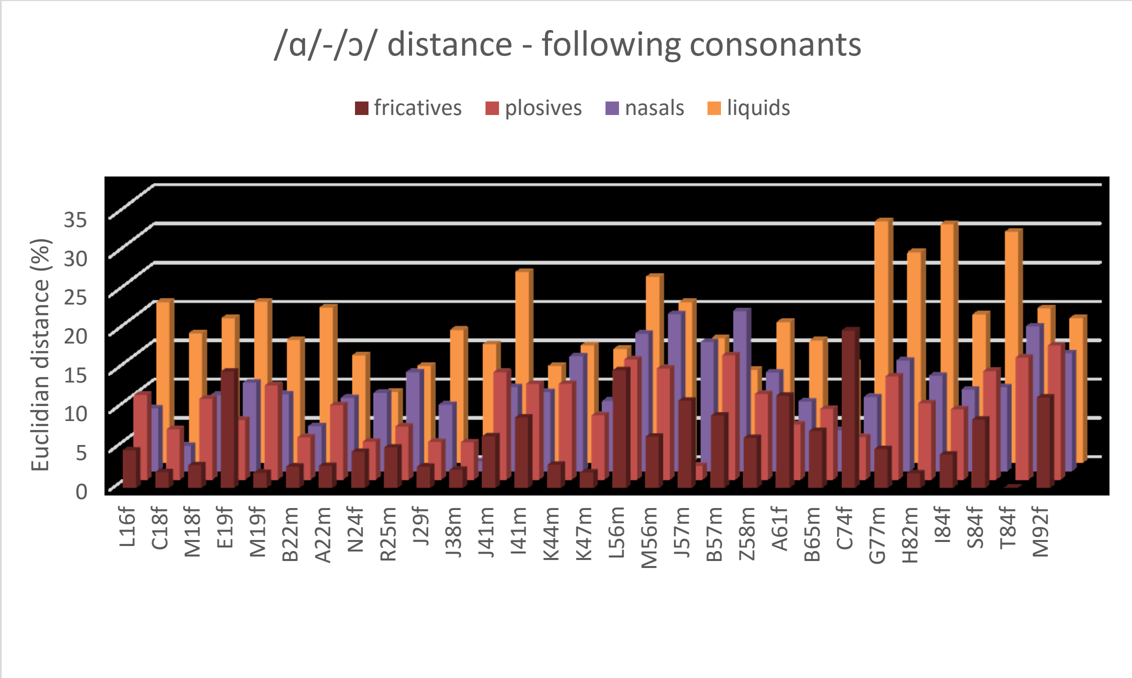

Figure 5.11: Bar diagram of values listed in Table 5.14.

	/ɑ/-/ɔ/_pl	/ɑ/-/ɔ/_nas	/ɑ/-/ɔ/_li	/ɑ/-/ɔ/_fr
r	0.40	0.43	0.47	0.38
p	0.03	0.02	0.01	0.04

Table 5.15: Pearson correlation coefficients r and corresponding p-values of the distances between /ɑ/ and /ɔ/ (subgroups) and age.

Table 5.15 displays the role of age in the distance between /ɑ/ and /ɔ/, calculated with the Pearson correlation coefficient. The correlation between distance and age is significant for all subgroups. The correlation coefficient is positive, i.e. the younger the speaker, the further the vowels are merged. The strongest correlation (p=0.01) can be found when the vowels are followed by liquids, the weakest when followed by fricatives (p=0.04).

In total, 22 speakers were asked to read words from a word list (cf. Appendix 1). The Euclidean distance of the normalized formant measurements retrieved from the minimal pair *caught/cot* are visualized in Figure 5.12.

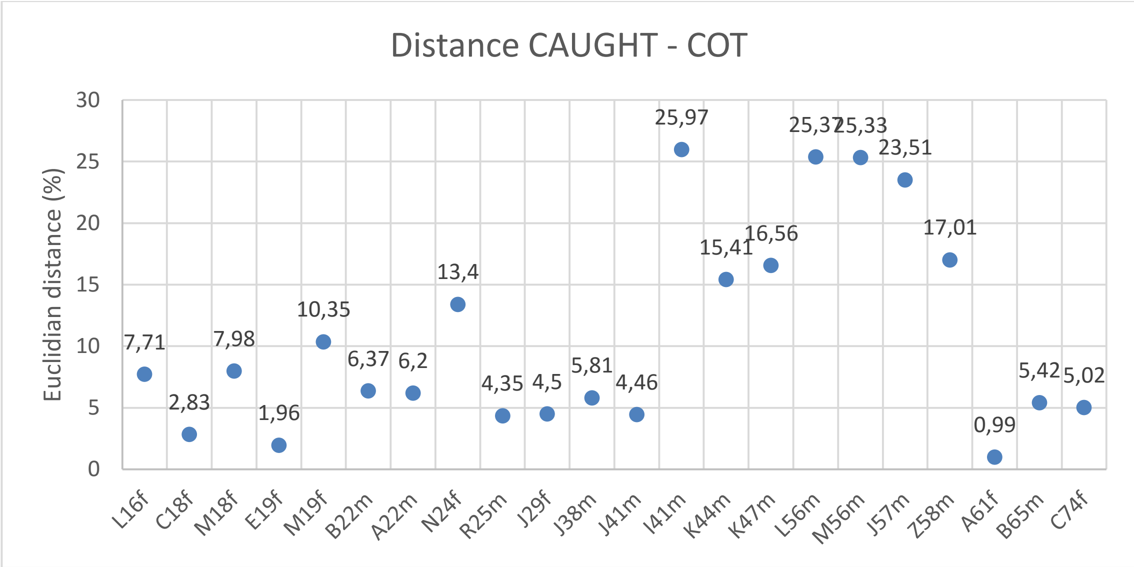

Figure 5.12: Euclidean distance between /ɑ/ and /ɔ/ in COT and CAUGHT (word list).

It becomes apparent immediately that speakers between the ages of 41 and 58 pronounce the two vowels clearly separate. Speakers above or below this age group merge or approximate the two to varying degrees. In the comparison between these values and the values measured in informal speech several phenomena emerge.

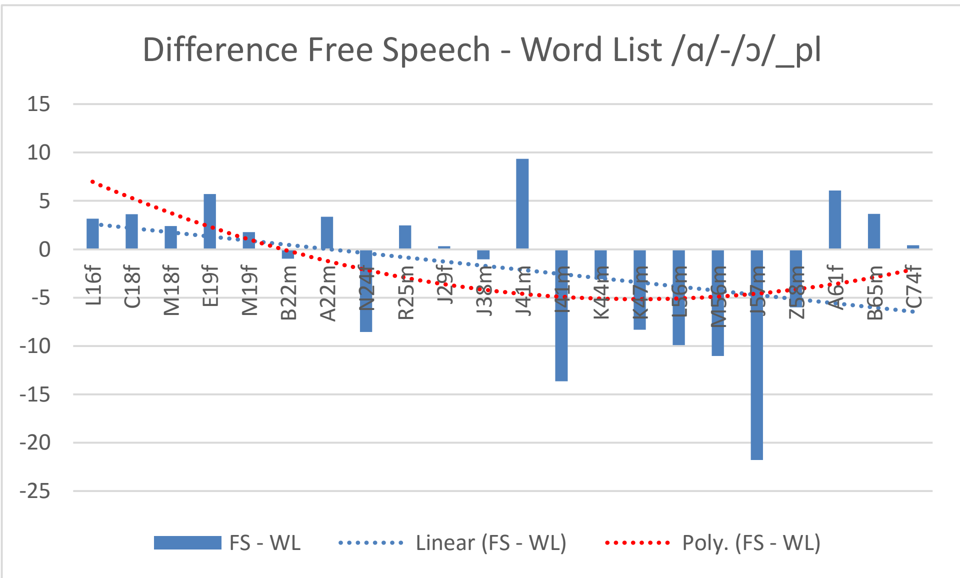

Figure 5.13: Euclidean distance of *cot/caught* (WL) subtracted from Euclidean distance of /ɑ/_pl and /ɔ/_pl. Linear and polynomial (2nd degree) regression.

Figure 5.13 depicts the subtraction of the distances of *cot* and *caught* calculated from the values retrieved from the word list and /ɑ/-/ɔ/_pl retrieved from free speech. Values >0 indicate that the speaker corrects towards a merger in reflected speech (WL); <0 indicates the opposite. Again age plays an important factor. Speakers of the ages 22 and younger correct towards the merger.

N24f is an exception in that she strongly corrects toward a separation of the vowel. During the process of reading the word list, which occurred after the interview, the speaker, who did not pursue an academic career after high school, displayed strong self-consciousness and uncertainty in regard to the reading task at hand. The interview, on the other hand, was conducted in a very relaxed and informal conversation. It is thus to consider if N24f actually presented her standard pronunciation of the two sounds or wanted to emphasize the difference between the written words. During the task that followed ("Do *taller* and *dollar* rhyme?") it was stated that rhyme depends on the spelling of the word. An acute focus on spelling can therefore be noted.

While the chart depicts how middle-aged speakers correct toward the differentiation between the two vowels in a reading task, J41m is an exception that cannot be accounted for as was the case above, but is quite surprising. Speakers above the age of 56 return to the correction toward the merger. Thus, while linear regression visualizes the overall trend of stronger correction toward the merger among younger speakers, polynomial regression was added to incorporate the tendency of the older speakers toward the merger as well.

The trend described coincides with the phenomena already pointed out for the group of middle-aged speakers, i.e. a stronger degree of fronting of /ɑ/ and a relatively stable distinction between /ɑ/ and /ɔ/ regardless of consonant environment. Not only is the *cot-caught* merger absent for this group, the separate pronunciation is also perceived to be the correct form.

This important feature of the NCS thus seems to have started to be present in the 1950s to '70s (adolescence of speakers born in the 1950s) and to have disappeared in the decades that followed.

5.2.4 /ʌ/

In the NCS /ʌ/ is traditionally backed toward the position of /ɔ/ which is freed as a result of the lowering of the latter. Gordon (2001:102ff) observes backing as well as lowering of /ʌ/. Both directions are analyzed in the present subchapter.

	/ʌ/ F1	/ʌ/ F2	/ʌ/pl F1	/ʌ/pl F2	/ʌ/fr F1	/ʌ/fr F2	/ʌ/li F1	/ʌ/li F2	/ʌ/na F1	/ʌ/na F2	/ʌ/af F1	/ʌ/af F2
L16f	56.40	37.53	50.69	40.26	51.86	43.06	46.10	18.65	63.16	34.26	49.44	49.10
C18f	59.27	35.05	55.11	36.34	57.46	38.10	45.76	17.23	65.00	31.97	53.03	43.18
M18f	58.51	41.38	49.50	45.79	48.96	39.84	47.25	23.46	64.61	41.22	59.72	39.05
E19f	58.33	42.59	55.34	45.60	50.67	41.78	50.33	21.52	61.36	41.71	61.61	49.72
M19f	59.06	44.69	50.26	53.95	53.70	48.19	51.26	16.13	62.47	41.36	59.67	65.57
B22m	64.80	35.63	59.76	38.19	55.79	35.99	68.75	17.46	71.73	33.91	55.84	42.07
A22m	57.18	34.23	46.58	36.96	50.48	34.15	63.50	26.69	65.40	31.98	64.36	36.54
N24f	58.07	42.30	52.96	46.91	53.60	43.89	59.81	30.66	63.83	38.16	56.99	51.93
R25m	52.22	39.48	47.59	38.87	44.06	41.42	48.09	35.41	60.97	37.28	40.28	41.92
J29f	56.84	31.85	50.13	32.96	51.22	34.47	49.65	28.22	61.87	30.35	53.68	35.16
J38m	59.64	35.35	59.20	34.86	57.11	37.22	56.49	21.51	59.31	31.95	55.73	40.77
I41m	52.39	37.95	46.27	42.03	46.19	40.99	49.93	27.91	59.37	34.47	39.10	51.69
J41m	57.52	33.01	49.41	34.90	52.15	36.77	62.82	24.33	61.33	29.24	57.10	38.27
K44m	58.29	35.38	50.37	35.45	55.96	36.48	59.89	19.16	63.59	34.00	54.53	43.73
K47m	64.88	33.69	57.67	33.75	60.34	33.44	62.62	34.98	68.55	31.88	58.96	48.29
L56m	52.87	34.58	48.45	37.12	53.48	34.99	58.30	27.79	56.48	30.89	48.97	39.00
M56m	55.76	35.25	51.88	33.20	51.38	36.69	59.01	38.19	56.68	34.01	54.76	37.54
B57m	58.40	37.22	56.57	38.98	55.34	37.57	51.62	29.75	58.14	34.57	48.32	49.99
J57m	47.10	37.01	43.01	37.68	44.44	40.98	44.34	29.50	48.43	34.87	45.98	43.95
Z58m	58.05	37.67	52.95	40.38	52.69	40.94	56.76	21.63	62.10	34.01	47.00	43.60
A61f	55.27	42.52	52.83	43.17	51.49	49.24	49.82	29.12	59.46	39.30	46.93	48.61
B65m	56.39	40.7	53.82	42.47	54.19	41.65	51.22	39.23	60.44	38.06	54.08	41.45
C74f	48.05	37.71	46.52	41.38	44.63	39.78	45.9	20.80	52.26	32.79	46.88	45.48
G77m	59.51	36.03	54.93	35.83	56.88	35.69	60.36	28.45	62.23	34.03	64.02	39.54
H82m	51.45	29.58	45.01	29.96	47.74	30.71	57.43	19.42	61.51	27.86	44.82	30.28
I84f	48.79	40.32	44.96	41.00	44.40	40.74	37.40	37.13	54.69	39.28	50.14	39.70
S84f	58.09	35.47	53.53	33.83	56.41	36.29	31.50	25.00	62.75	34.67	57.14	49.66
T84f	58.34	35.76	58.97	39.02	58.10	35.70	32.23	21.69	58.18	37.02	-	-
M92f	50.14	23.28	46.20	22.23	45.02	26.03	44.47	14.93	54.4	22.85	46.63	28.92
Ø%	**56.26**	**36.66**	**51.40**	**38.38**	**51.92**	**38.37**	**51.81**	**25.72**	**60.70**	**34.41**	**52.70**	**43.38**

Table 5.16: Normalized mean values of /ʌ/, general and in consonant environments.

Table 5.16 lists the mean values of all speakers of the vowel /ʌ/, both the general means and the subgroups according to following consonant. The last row lists the means of each environment calculated from all speakers. It shows that the overall mean of /ʌ/ is located slightly below and about 13% behind the center of the vowel space. The overall figures suggest that the following consonants influence the shifting; this will be analyzed further below. The general means of each speaker is plotted in Figure 5.14. Male speakers are marked blue, female speakers red. Age is indicated by an increasing degree of fading of the color with older age of the speaker. Note the scaling of the axis. A small window is chosen to aptly depict the influence of age and gender.

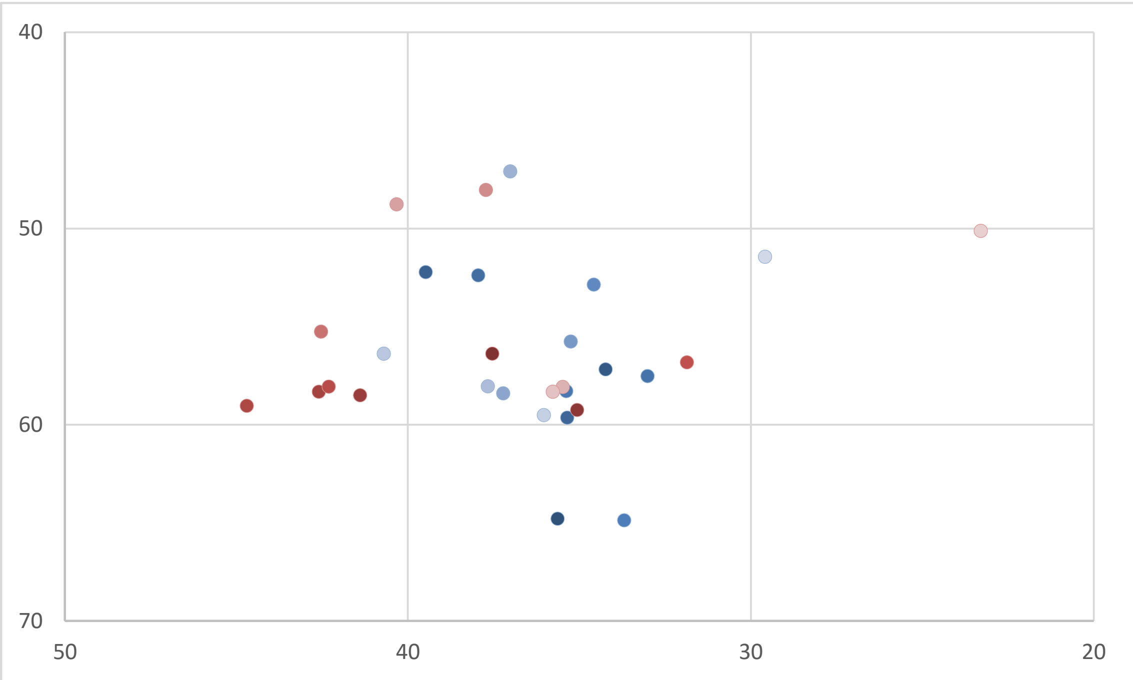

Figure 5.14: Normalized mean values of /ʌ/ (x-axis F2, y-axis F1). Dots represent speakers. Female = red, male = blue. Fading with increasing age.

While gender and position yield no significant variation in the Welsh-test, it is apparent that women show much wider variation of F2-values, while men differ more strongly than women on the F1-scale. Young female speakers articulate the sound lower and further front than the remaining speakers. Younger male speakers tend to pronounce /ʌ/ lower than the remaining speakers as well. Age thus has a significant effect on the place of articulation. The Pearson correlation yields the values listed in Table 5.17.

The younger the speaker the further front and lower the pronunciation of /ʌ/. The two oldest speakers clearly pronounce the /ʌ/ the highest and furthest backed. Possible merging with /ɔ/ will be discussed.

	/ʌ/.F1	/ʌ/.F2
r	-0.437	-0.381
p	**0.018**	**0.041**

Table 5.17: Pearson correlation coefficient r and p-value for normalized mean F1- and F2 values of /ʌ/.

The influence of following consonants is apparent in the pronunciation of /ʌ/. For the purpose of clarification the mean of all speakers for each consonant subgroup (cf. Table 5.16, last row) is plotted in Figure 5.15. Following affricates are included because, except in the case of one speaker (T84f), it was possible to gather comparable data.

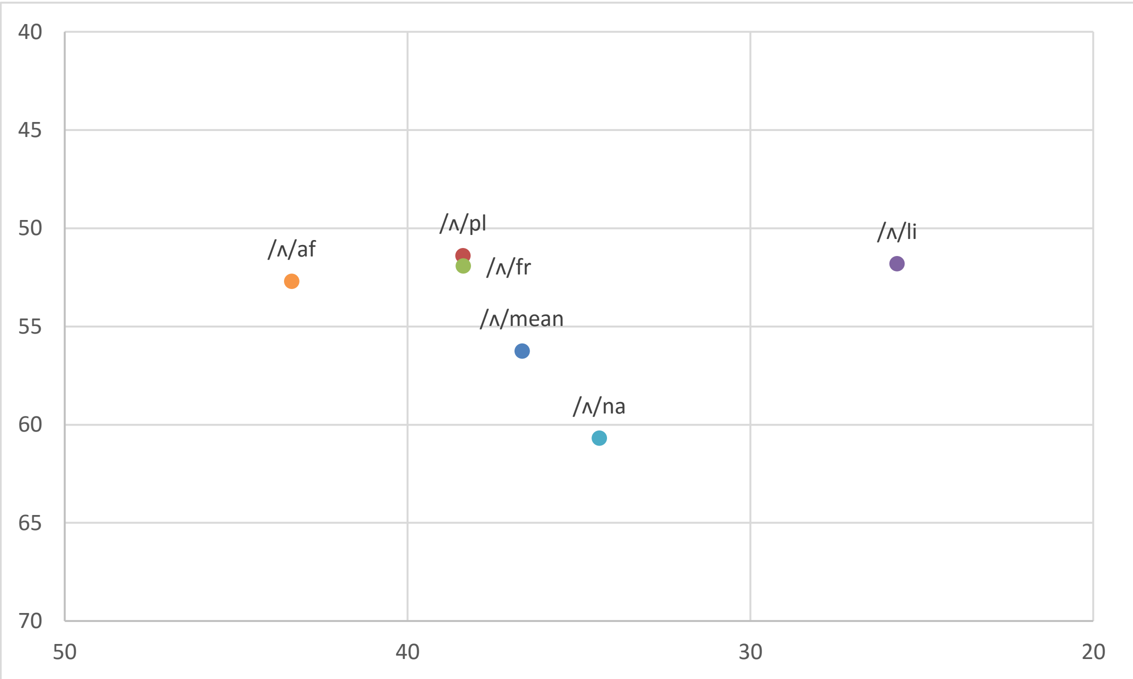

Figure 5.15: Mean values of consonant subgroups of /ʌ/ and general mean of /ʌ/.

Plosives and fricatives show no shifting effect. The mean values of their subgroups are located at almost the exact spot in the vowel space. Affricates inhibit backing and rather encourage a slight fronting movement. Following liquids, however, clearly favor the backing of /ʌ/. The four subgroups mentioned show no effect on the height of the vowel. Nasals, however, strongly affect the height in that they further the lowering and light backing of /ʌ/.

Male and female speakers do not differ much in the way following consonants affect their pronunciation of /ʌ/. The only consonant group that displays a difference in regard to gender are liquids. Women pronounce /ʌ/+liquid considerably higher than men do. The mean F1 value of /ʌ/+ liquid is 45.5% for women and 56.95% for men. A Welsh-test thus renders a p-value of 0.0003.

Liquids, as well as other following consonants, affect /ʌ/ in differing degrees when age is considered (cf. Table 5.18: Pearson correlation coefficients and p-values for consonant subgroups of /ʌ/.Table 5.18). The younger the speakers, the less /ʌ/+plosive and /ʌ/+fricative are backed. A similar trend can be observed for /ʌ/+affricate. /ʌ/+nasal and /ʌ/+liquid are lowered further the younger the speakers.

	/ʌ/.pl F1	**/ʌ/.pl F2**	**/ʌ/.fr F1**	**/ʌ/.fr F2**	**/ʌ/.li F1**	**/ʌ/.li F2**	**/ʌ/.na F1**	**/ʌ/.na F2**	**/ʌ/.af F1**	**/ʌ/.af F2**
r	-0.153	-0.454	-0.126	-0.377	-0.376	0.154	-0.545	-0.306	-0.298	-0.355
p	0.428	**0.013**	0.514	**0.044**	**0.045**	0.427	**0.002**	0.106	0.123	0.064

Table 5.18: Pearson correlation coefficients and p-values for consonant subgroups of /ʌ/.

While the mean values of the subgroups display a larger spread on the F2-axis, the standard deviations show a different trend. The mean standard deviation of all speakers for /ʌ/.F1 is 15.31%, whereas /ʌ/.F2 only amounts to 10.72%

Figure 5.16, the /ʌ/ chart of C18f, serves as an exemplary visualization of the way following consonants affect the position of /ʌ/ and the direction of its spreading. /ʌ/+liquid is pronounced clearly further backed than the remaining allophones and the cluster stretches along the F1-axis. As observed above, the female speaker pronounces /ʌ/+liquid in a relatively high position. /ʌ/+plosive and /ʌ/+fricative are completely merged. Nasals encourage the lowering of /ʌ/, and the cluster stretches on the F1-scale as well. Not enough values of /ʌ/+glide were measured to enable calculating the standard deviation and drawing a corresponding cluster. Affricates discourage backing most. /ʌ/+affricate is pronounced from the position nearest to the center.

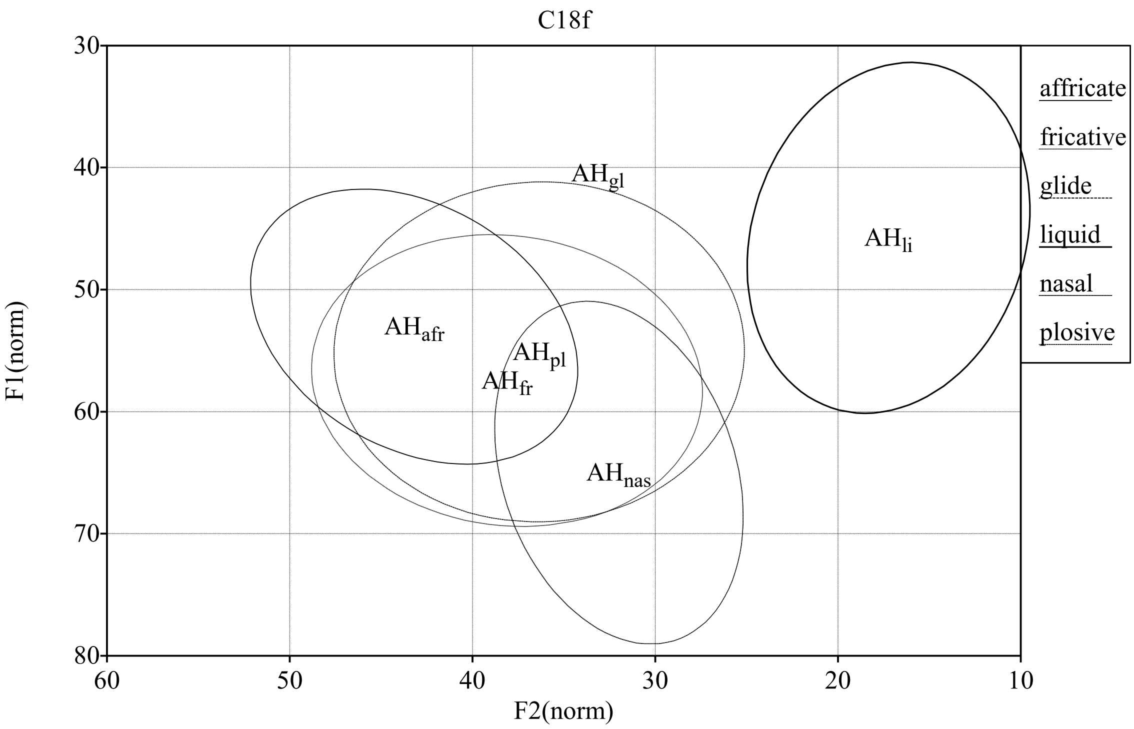

Figure 5.16: /ʌ/ chart of speaker C18f. /ʌ/ split into consonant subgroups.

Since /ʌ/ is backed and lowered in certain consonant environments, merging with the neighboring vowels becomes possible. Table 5.19 lists the mean values of the subgroups of the three vowels in question.

	pl.F1	pl.F2	nas.F1	nas.F2	li.F1	li.F2	fr.F1	fr.F2
/ɔ/	73.53	24.99	68.04	21.27	52.68	21.44	72.62	24.27
/ʌ/	51.40	38.38	60.70	34.41	51.81	25.72	51.92	38.37
/ɑ/	72.89	32.98	66.54	31.22	68.20	29.74	74.11	26.79

Table 5.19: Normalized mean values of consonant subgroups of /ɔ/, /ʌ/, and /ɑ/.

The Euclidean distance between the means of /ɔ/+liquid and /ʌ/+liquid only equals 4.37. Merging in this consonant context therefore seems to have taken place. A closer look at the means of the individual speakers, however, yields that the mean of their individual Euclidean distances is 10.61. In fact, only young female speakers seem to merge /ɔ/+liquid and /ʌ/+liquid. The remaining speakers either pronounce /ʌ/+liquid higher or /ɔ/+liquid lower, according to the means. The spread of the clusters, however, needs to be kept in mind, as can be seen in the vowel chart of A22m (Figure 5.17).

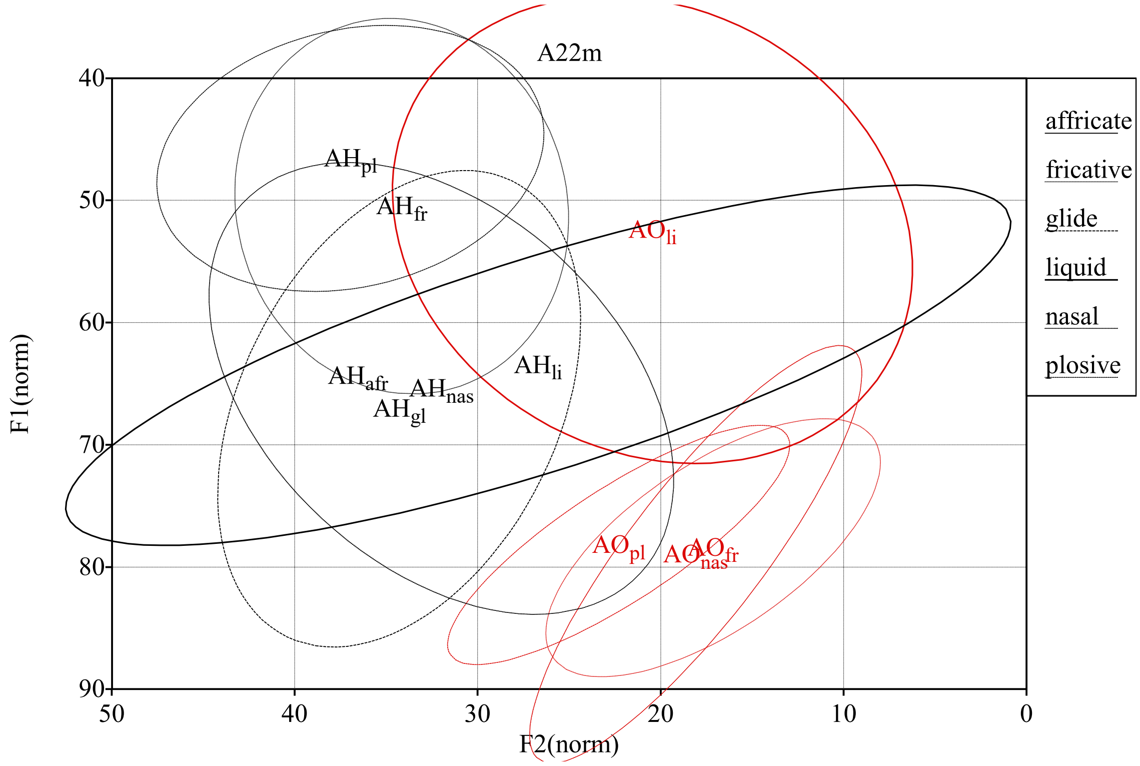

Figure 5.17: Vowel chart of /ʌ/ and /ɔ/ of A22m; vowels split into consonant subgroups.

Following liquids have the effect of a merger to a certain degree. Plosives and fricatives inhibit a merger, and nasals, since the /ʌ/+nasal cluster spreads over such a large area, favor a merger slightly as well.

Owing to the lowering of /ʌ/+nasal, a merger with /ɑ/+nasal seems likely. The Euclidean distance between the two mean values is 6.65. While the mean of the individual Euclidean distances is higher (9.49), merging of /ʌ/+nasal and /ɑ/+nasal can be observed for several speakers. A few speakers pronounce them clearly separately (e.g. C74 with a Euclidean distance of 20.69), but no sociolinguistic pattern can be observed.

In summary, /ʌ/ is backed more strongly by older speakers and lowered more by younger ones. Liquids encourage backing to a degree that some merging with /ɔ/ occurs. Nasals encourage lowering, which leads to a general tendency towards a merger with /ɑ/ when both are followed by a nasal.

5.3 /æ/, /ɛ/, and /ɪ/

5.3.1 /æ/

The traditionally low front vowel /æ/ is highly important in the analysis of a regional dialect of American English. Labov (1991:12) points out that the position of /æ/ as well as the merging or non-merging of the vowels /ɔ/ and /ɑ/ are the two crucial distinguishing factors for the classification of the regional dialects.

	/æ/ F1	/æ/ F2	/æ/pl F1	/æ/pl F2	/æ/fr F1	/æ/fr F2	/æ/li F1	/æ/li F2	/æ/na F1	/æ/na F2
L16f	59.10	61.76	67.17	54.33	71.54	50.63	82.18	43.01	43.50	74.68
C18f	67.20	56.13	76.93	48.17	76.41	43.02	73.97	50.29	54.85	67.34
M18f	61.24	61.15	69.87	54.46	68.53	53.66	62.67	49.38	50.63	68.27
M19f	67.81	64.54	68.11	62.22	76.01	51.94	85.43	48.20	62.59	73.90
E19f	59.75	56.18	68.36	51.11	61.97	52.03	78.47	39.40	45.37	64.07
A22m	56.74	66.09	59.76	60.40	62.79	58.43	-	-	50.07	75.10
B22m	68.11	58.58	73.72	50.28	72.44	50.19	76.64	42.92	63.11	67.76
N24f	65.21	58.61	71.02	53.70	70.83	53.75	73.29	48.32	53.41	68.89
R25m	59.17	63.71	63.47	59.94	63.79	53.42	58.28	46.78	53.21	72.74
J29f	59.65	58.09	68.95	50.73	70.05	46.38	79.54	54.27	47.20	68.66
J38m	63.83	58.53	69.75	53.58	72.07	53.36	-	-	53.36	67.29
J41m	62.88	53.98	68.75	51.30	66.71	45.01	76.51	51.10	54.67	62.38
I41m	56.05	59.84	61.41	55.97	63.79	54.35	75.88	51.63	44.75	67.42
K44m	64.91	54.15	66.82	50.72	71.73	47.25	73.78	48.36	59.60	61.57
K47m	62.55	58.98	67.31	53.44	68.20	47.65	58.25	54.55	55.80	68.83
L56m	61.45	56.52	68.18	51.44	68.90	48.54	69.71	51.82	45.19	69.61
M56m	53.12	62.66	61.87	57.71	58.20	55.00	57.24	48.76	41.52	74.03
J57m	56.34	54.37	59.73	52.08	61.33	48.39	64.15	55.09	39.26	70.58
B57m	56.94	59.91	62.22	55.09	56.75	49.70	62.14	53.56	53.04	68.50
Z58m	58.21	62.4	60.92	58.63	63.99	54.11	55.79	53.77	50.72	73.23
A61f	61.03	66.21	66.61	61.14	66.36	57.17	63.63	49.03	53.99	75.23
B65m	58.89	61.76	69.95	57.07	67.66	53.85	63.2	55.99	44.55	70.77
C74f	52.43	65.20	53.70	61.93	59.23	61.75	71.12	63.87	48.49	73.40
G77m	62.57	58.32	67.67	57.80	69.28	57.52	57.75	53.35	56.08	60.86
H82m	62.62	52.34	66.26	46.30	67.35	49.02	71.62	45.22	55.82	61.82
I84f	58.34	65.18	58.53	63.74	61.29	61.29	41.74	68.15	56.69	69.58
S84f	57.33	58.75	61.79	60.14	67.31	56.94	-	-	51.14	57.81
T84f	66.35	56.58	70.86	57.42	67.01	53.73	79.30	49.19	56.35	62.62
M92f	64.76	58.28	68.11	54.45	63.63	53.63	52.95	56.82	61.49	64.99
Ø%	**60.85**	**59.61**	**66.13**	**55.35**	**66.73**	**52.47**	**67.89**	**51.26**	**51.95**	**68.34**

Table 5.20: Mean F1 and F2 values of /æ/ in subcategories of following consonant groups.

Boberg and Strassel (2000:109) describe the categorization into tense and lax /æ/ and its distribution in the American dialects. While /æ/ is tense when followed by a nasal (except /ŋ/) in all dialects, only the NCS has raised /æ/ in both fricative and plosive environments. Voiceless plosives discourage raising in the Mid-Atlantic and the West; fricatives discourage raising in the West.

Table 5.20 depicts the normalized mean values of /æ/ overall and in subcategories of following consonant groups. The subgroups of glides and affricates are omitted for lack of comparable data.

When the general mean values of /æ/.F1 and /æ/.F2 are analyzed, neither on the F1- nor on the F2-scale do age and gender play a significant role (p-age: 0.26; 0.69/p-gender: 0.43; 0.26) in the absolute mean position of /æ/. The data need to be subdivided in order to analyze the changes present in the community's speech.

Thus, a closer look needs to be taken at the allophones. Figure 5.18 displays the mean values of each speaker for each subgroup. Color coding is chosen according to the consonants that follow.

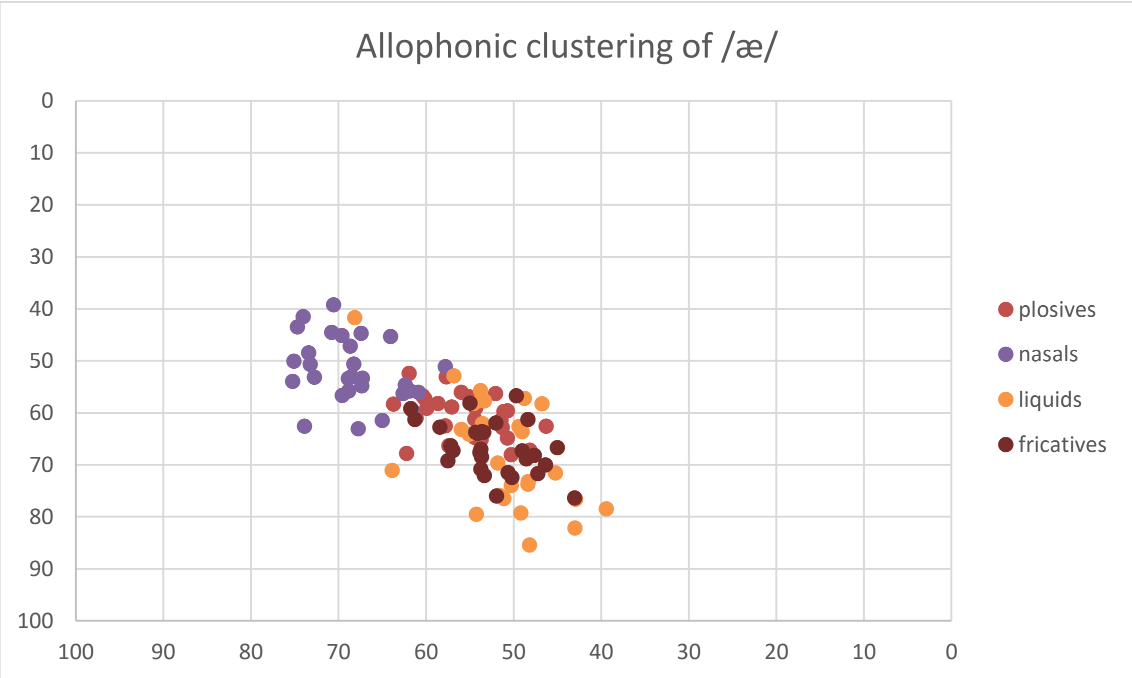

Figure 5.18: Distribution of /æ/. Each dot equals a speaker's mean /æ/+cons.

Figure 5.18 clarifies how nasals encourage the raising and fronting of /æ/ for all speakers. /æ/+plosive and /æ/+fricative are located in a raised and somewhat fronted position, while

/æ/+liquid are spread throughout the space of /æ/. The most front and raised mean value of /æ/+liquid belongs to speaker I84f. It needs to be kept in mind here that only four values were measurable for /æ/+liquid in her speech.

	/æ/ F1	**/æ/ F2**	**/æ/pl F1**	**/æ/pl F2**	**/æ/fr F1**	**/æ/fr F2**	**/æ/li F1**	**/æ/li F2**	**/æ/na F1**	**/æ/na F2**
r	-0.214	-0.075	-0.377	0.265	-0.418	0.393	-0.539	0.593	0.094	-0.348
p	0.264	0.699	**0.044**	0.165	**0.024**	**0.035**	**0.005**	**0.001**	0.628	**0.064**

Table 5.21: Pearson correlation coefficients for age and mean F1-, F2 position of /æ/+cons subgroups.

The t-test renders no significant correlation between gender and the position of the subgroups. However, several significant correlations are observed between age and the subgroup positions. Vertically, a decrease in age leads to a lowered pronunciation (higher F1-value) of /æ/+plosive, /æ/+fricative and /æ/+liquid, while the F1-position of /æ/+nasal remains independent of a change in age. Correspondingly, a significant correlation between backing and a decrease in age can be detected for /æ/+fricative and /æ/+liquid, and a backing trend for /æ/+plosive (p: 0.165). Unlike the general backing, younger speakers pronounce /æ/+nasal further front than older speakers.

The influence of following nasals is therefore of particular importance. Is /æ/ raised and fronted only when followed by nasals? How much does the position of /æ/+nasal differ from those of other allophones?

Since Figure 5.18 can only give a general overview of the placement of the allophonic clusters, and Table 5.21 hints at a complex relationship between the/æ/+nasal and the other subgroups of /æ/, the Euclidean distances between /æ/+nasal and /æ/ followed by other consonants are calculated and the correlations analyzed. While no significant correlation between gender and the Euclidean distances can be detected, the correlation between age and gender turns out to be highly significant.

	æ.nas-æ.plos	**æ.nas-æ.fric**	**æ.nas-æ.liq**
r	-0.5105	-0.6016	-0.6100
p	0.0055	0.0007	0.0012

Table 5.22: Pearson correlation coefficients r and p-values for age and Euclidean distance.

Table 5.22 displays the r- and p-values for the correlation between age and the distance of /æ/+nasal and any of the other allophonic subgroups. The correlation is highly significant in all cases, and strongest in the case of /æ/+nasal-/æ/+fricative and age. As the negative r-values indicate, in all cases the distance between /æ/+nasal and /æ/+'other consonant' increases with decreasing age. At the beginning of the present subchapter it was mentioned that, while /æ/+nasal is raised and fronted in all dialects of American English, whether or not the remaining following consonants encourage tensing of /æ/ serves as an indicator of the NCS. Again a decrease of the NCS-feature is displayed with decreasing age.

Since Table 5.21 shows that younger speakers pronounce /æ/+nasal further front than older speakers, such distance between the means of the subgroups might already be accounted for on the F2-scale. Figure 5.19 and Figure 5.20 show how age and gender influence the height of the /æ/+nasal pronunciation in relation to the general F1-position of /æ/. The F1-value of /æ/+nasal is deducted from the normalized mean F1-value of /æ/. The positive values indicate that /æ/+nasal is pronounced higher than mean /æ/.F1. The data is arranged according to the age of the speaker; Figure 5.19 displays the male speakers and Figure 5.20 the female speakers. A linear regression curve is added to clarify the data trend.

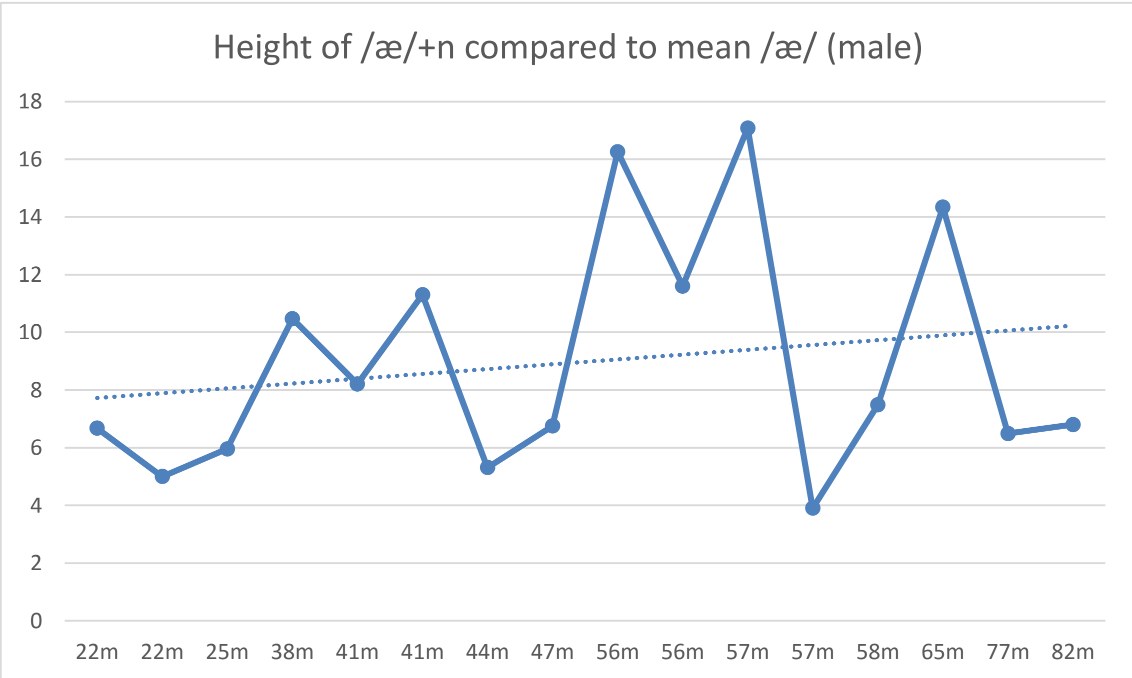

Figure 5.19: Height of /æ/+nasal in comparison to general height of /æ/ for male speakers. (/æ/.F1) - (/æ/+nasal.F1). Linear regression.

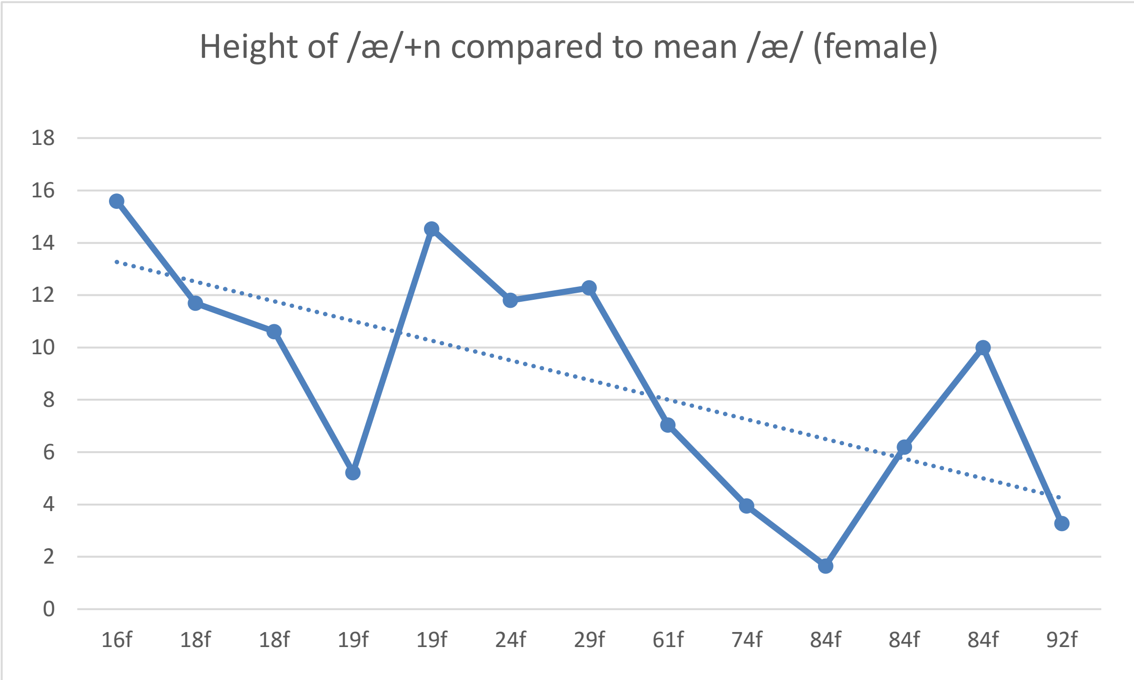

Figure 5.20: Height of /æ/+nasal in comparison to general height of /æ/ for female speakers. (/æ/.F1) - (/æ/+nasal.F1). Linear regression.

A surprising trend can be observed. Younger women pronounce /æ/+nasal significantly higher than mean /æ/.F1, and this distance decreases with increasing age. Men, however, do not follow the expected trend. Young men do not pronounce /æ/+nasal.F1 as far separate from mean /æ/.F1 as their female peers. They rather do so at almost the same height as the F1 mean. The previous study of the pronunciation in Amherst (Bause 2010) reflected the same trend in males, but no data of young female speakers was available then.

As several studies (e.g. Labov 1966) show, /ŋ/ does not encourage tensing as much as the remaining nasals do. The current data set yields the following observations (Figure 5.21).

The mean F1-value of /æ/+/m/ and /æ/+n combined was deducted from /æ/+/ŋ/. Values above zero indicate that /æ/+/ŋ/ is pronounced lower than /æ/+/m/,/n/, as is usually the case. However, a number of women and three men score below zero, i.e. pronounce /æ/+/ŋ/ higher than /æ/+/m/,/n/. In fact, a trend can be observed in which older men pronounce /æ/+/ŋ/ relatively lowest, and with younger age men pronounce all /æ/+nasal more and more at a similar height. Women, on the other hand, display strong variation and only a slight trend can be observed toward a relatively lower position of /æ/+/ŋ/ with increasing age. It can be stated, however, that none of the women below 20 pronounce

/æ/+/m/,/n/ higher than /æ/+/ŋ/. This is especially surprising since, as described above, young women pronounce /æ/+nasal much higher than the mean /æ/.F1. While a lax pronunciation of /æ/ obviously exists in the speech of young women, /æ/+/ŋ/ is clearly part of the tense version.

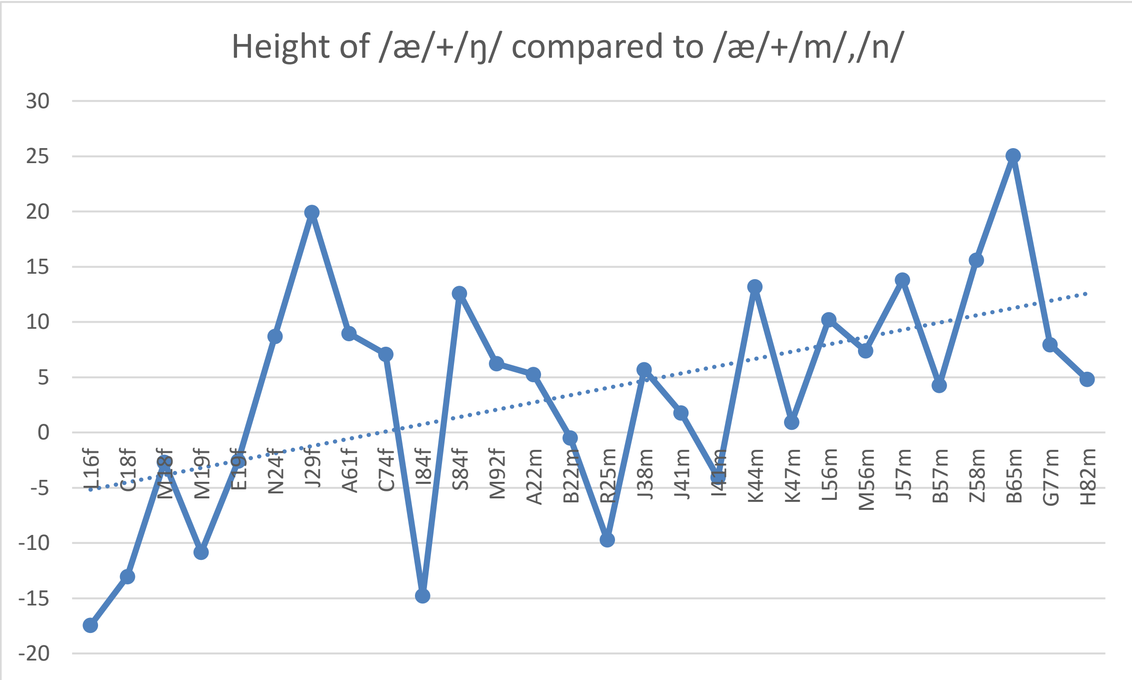

Figure 5.21: Height of /æ/+/ŋ/ in comparison to height of /æ/+/m/,/n/. (/æ/+/ŋ/)-(/æ/+/m/,/n/). Linear regression.

Overall, the status of /æ/ is quite complex. The general trend indicates that the number of tense allophones decreases with decreasing age, and the role of following nasals is complex and differs with age and gender.

5.3.2 /ɛ/

In the NCS /ɛ/ moves down and back toward the positions of /ʌ/. Gordon (2001:53ff) describes a multidirectional shift with elements moving toward the positions of /ʌ/, /ə/, or /æ/.

	/ɛ/ F1	/ɛ/ F2	/ɛ/pl F1	/ɛ/pl F2	/ɛ/fr F1	/ɛ/fr F2	/ɛ/li F1	/ɛ/li F2	/ɛ/na F1	/ɛ/na F2
L16f	41.66	62.03	50.47	61.98	51.18	56.61	32.86	64.50	43.83	62.89
C18f	55.52	54.03	59.41	59.11	61.68	53.67	51.31	53.00	56.26	53.31
M18f	51.97	56.53	58.45	60.59	54.78	52.69	47.22	56.75	54.55	56.47
E19f	51.54	57.24	58.61	57.31	55.63	55.65	47.28	61.49	49.66	53.95
M19f	57.02	65.76	57.77	73.08	57.13	61.59	53.20	67.33	60.45	63.23
B22m	56.80	57.38	57.83	60.87	58.92	58.27	52.04	56.36	61.19	56.57
A22m	43.29	61.07	44.86	61.82	42.84	61.37	40.63	61.59	47.23	59.65
N24f	51.96	57.44	54.58	58.64	56.75	55.50	46.66	58.42	54.05	57.02
R25m	42.40	60.75	45.31	59.93	48.24	62.64	36.18	58.79	46.47	62.82
J29f	44.67	53.34	52.59	53.83	60.97	47.04	36.79	55.96	49.13	50.91
J38m	49.70	51.58	51.90	51.51	55.70	49.25	43.45	52.05	57.66	51.91
I41m	39.42	57.32	44.27	58.23	43.08	56.01	34.92	56.99	40.63	57.89
J41m	48.16	50.89	51.48	53.26	53.58	51.51	43.83	49.19	50.80	52.72
K44m	52.38	49.50	54.66	52.94	56.18	50.11	47.73	48.65	54.53	48.84
K47m	51.08	53.41	54.73	55.24	56.00	52.68	44.86	53.46	54.24	52.89
L56m	48.45	53.27	50.88	56.75	54.01	51.89	44.74	50.99	48.22	54.34
M56m	47.27	48.24	51.90	52.56	53.04	47.14	43.39	44.56	44.01	51.94
B57m	47.70	52.86	52.08	49.64	47.31	52.85	46.97	52.67	47.56	54.83
J57m	38.10	52.64	44.64	52.56	45.05	53.77	32.24	52.12	38.57	52.60
Z58m	47.96	55.93	49.91	58.98	53.60	52.72	40.20	54.75	52.23	57.78
A61f	47.88	64.73	56.15	62.93	55.36	63.82	39.42	64.13	54.27	67.27
B65m	48.40	58.06	53.28	56.61	54.10	55.61	43.55	59.61	49.48	58.26
C74f	39.67	57.82	45.03	64.56	41.32	63.25	33.67	50.44	46.47	65.05
G77m	50.74	51.47	50.32	58.72	51.28	52.31	50.96	48.74	50.32	51.96
H82m	47.45	48.87	47.82	50.09	46.98	48.90	44.63	49.43	51.07	47.91
I84f	46.42	57.04	46.99	60.49	47.57	54.53	41.60	54.04	51.48	60.56
S84f	50.34	54.78	55.58	55.69	56.58	55.43	47.29	53.27	48.38	56.14
T84f	46.96	52.45	46.90	57.85	50.94	49.49	46.64	47.41	44.01	60.53
M92f	45.07	47.69	45.20	58.75	49.95	49.54	41.65	42.40	46.80	47.75
Ø%	**47.93**	**55.31**	**51.50**	**57.74**	**52.41**	**54.34**	**43.31**	**54.45**	**50.12**	**56.14**

Table 5.23: Mean F1 and F2 values of /ɛ/ in subcategories of following consonant groups.

As Table 5.23 shows, /ɛ/ is located in an almost central position in the vowel space; i.e. it is lowered and backed. Differences in the general means between the genders are insignificant, but with decreasing age a change in the F2 position can be observed:

	/ɛ/.F1	/ɛ/.F2
r	-0.262	-0.449
p	0.170	**0.014**

Table 5.24: Pearson correlation coefficients for age and mean F1-, F2-position of /ɛ/.

The backing of /ɛ/ is reversed with decreasing age; a tendency toward the traditional position of /ɛ/ is in progress. A tendency toward the traditional height is also visible, but the p-value (0.17) indicates that this can only be considered a slight trend.

The means of the consonant subgroups lie extremely closely together so that a plot becomes unnecessary at this point. It only needs to be noted that /ɛ/+liquid is located considerably higher than the remaining subgroups. Affricates and glides are omitted again for the lack of comparable data, but where data are available, /ɛ/+affricate is pronounced further front than the remaining subgroups. Figure 5.22 depicts the /ɛ/ chart of R25m, whose /ɛ/+affricate was measurable.

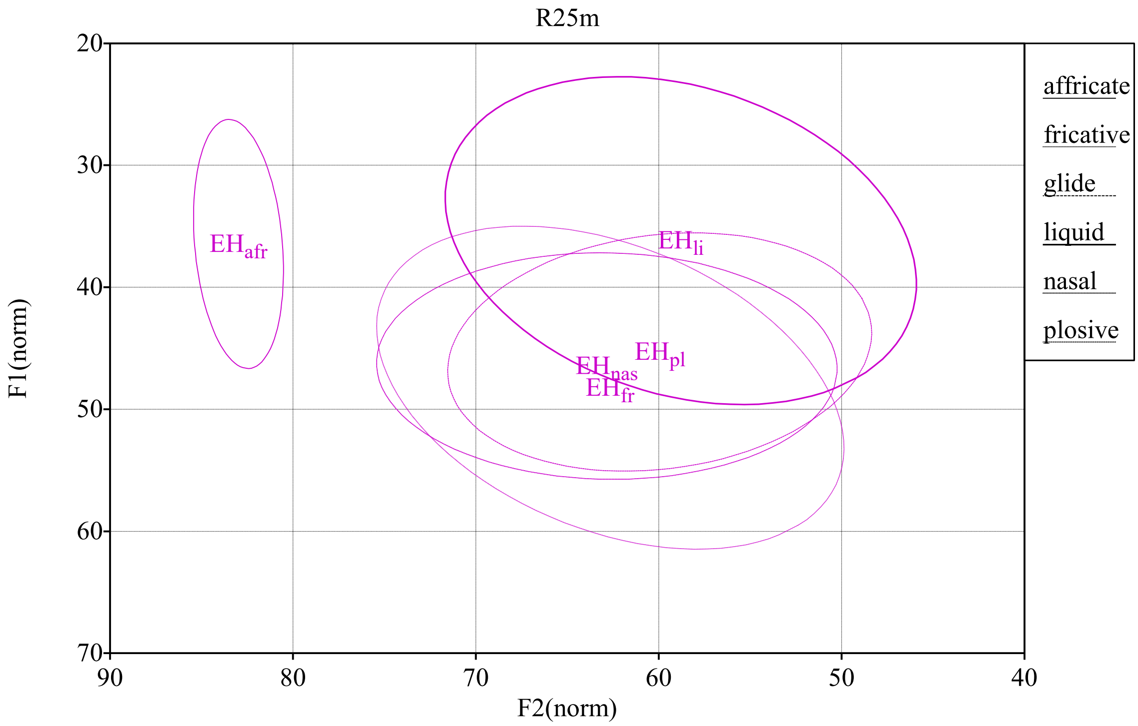

Figure 5.22: /ɛ/ chart of speaker R25m. /ɛ/ split into consonant subgroups.

It becomes apparent that his affricates are pronounced further front than the remaining subgroups, which are backed to almost the same degree. Here, as well as in the speech of other informants, the /ɛ/+affricate cluster stretches along the F1-axis. Plosives, nasals, and fricatives affect /ɛ/ in the same way. Their clusters overlap greatly. The shape of the clusters shows more variation on the F2-scale than on the F1-scale. R25m was chosen because the shape of his clusters resemble the general trend best. The /ɛ/+liquid and /ɛ/+fricative clusters are tilted; the backed phones are pronounced lower than the unbacked ones. For most speakers the standard deviation of /ɛ/+liquid is larger than those of the remaining subgroups.

The means of the subgroups are located very closely together; however, there is sociolinguistic variation. Women pronounce /ɛ/+plosive significantly (p=0.0083) further front (/ɛ/pl.F2=60.37%) than men (/ɛ/pl.F2=55.26%). No such trend can be observed with a change in age.

Age leads to other significant changes. While the height of the mean F1 value is only affected marginally, Table 5.25 shows that /ɛ/+liquid is responsible for that. Plosives, fricatives and nasals trigger a lowering of /ɛ/ for the younger speakers. Age also affects the F2-position of /ɛ/+liquid significantly. The younger the speakers, the more the backing is reversed.

	/ɛ/pl.F1	**/ɛ/pl.F2**	**/ɛ/fr.F1**	**/ɛ/fr.F2**	**/ɛ/li.F1**	**/ɛ/li.F2**	**/ɛ/na.F1**	**/ɛ/na.F2**
r	-0.452	-0.255	-0.364	-0.264	-0.083	-0.6151	-0.324	-0.140
p	0.014	0.182	0.052	0.166	0.670	0.0004	0.086	0.470

Table 5.25: Pearson correlation coefficients for age and mean F1-, F2 position of /ɛ/+cons subgroups.

Thus, while overall the different subgroups of /ɛ/ are pronounced very closely together, but each cluster spreads along the F2-axis, it seems to be a recent trend that the centers of the subgroups diverge more and more. /ɛ/ moves away from a tight center of the vowel space and spreads more strongly along the mid and lower front.

The standard deviations of /ɛ/ show that, with decreasing age, the size of the /ɛ/ cluster changes. On the F2-scale the width of the cluster decreases highly significantly with age. The p-value of the correlation between decreasing age and decreasing width equals 0.0008.

5.3.3 /ɪ/

/ɪ/, traditionally located in the upper front of the vowel space, has experienced a downward and backward shift toward the position of /ɛ/ in the NCS. In some cases it shifted more backward than it is lowered. In the complete NCS the traditional position of /ɪ/ is replaced by phones of /æ/.

	/ɪ/ F1	/ɪ/ F2	/ɪ/pl F1	/ɪ/pl F2	/ɪ/fr F1	/ɪ/fr F2	/ɪ/li F1	/ɪ/li F2	/ɪ/na F1	/ɪ/na F2	/ɪ/af F1	/ɪ/af F2
L16f	21.53	68.94	21.17	69.50	18.66	65.06	22.03	56.33	23.77	77.22	17.54	70.79
C18f	32.55	65.95	32.90	63.76	29.71	64.89	30.96	59.07	35.03	72.18	17.52	51.28
M18f	29.59	67.19	29.51	69.04	25.93	60.75	29.06	64.52	32.44	71.40	27.06	63.57
E19f	33.64	63.56	34.75	65.01	31.29	59.65	32.43	57.79	35.26	68.27	27.16	62.06
M19f	37.79	75.59	36.22	77.91	33.57	71.44	33.12	67.87	45.33	81.29	44.16	84.65
B22m	38.04	66.98	35.51	67.54	33.19	62.71	32.30	62.39	43.35	70.26	30.58	66.12
A22m	24.56	67.17	22.18	70.18	21.51	61.98	25.52	61.38	30.51	73.23	24.78	61.28
N24f	35.71	65.62	35.43	65.76	33.51	62.17	38.42	62.47	34.79	71.17	32.66	65.50
R25m	26.27	70.41	24.69	74.17	24.68	71.33	25.41	58.61	30.74	75.47	21.53	59.76
J29f	25.52	63.03	28.16	65.20	24.20	58.82	22.23	54.16	26.36	69.96	17.85	45.16
J38m	32.98	58.29	30.86	59.17	30.42	55.04	34.22	56.44	35.71	61.35	27.36	54.12
I41m	22.38	67.82	23.7	65.76	19.75	62.89	20.85	62.76	24.28	74.81	17.27	72.02
J41m	28.24	58.17	26.77	57.92	26.85	53.75	28.59	52.64	31.45	65.83	15.89	52.39
K44m	31.19	59.03	28.44	63.70	29.79	54.45	30.50	50.40	36.59	63.70	23.89	54.17
K47m	35.42	62.37	33.92	63.60	31.13	58.01	33.21	54.67	41.62	70.23	30.61	65.84
L56m	29.72	64.66	29.75	65.74	26.17	61.62	27.40	56.18	34.13	69.35	22.96	61.02
M56m	31.96	61.05	31.33	61.93	30.89	57.09	29.03	58.62	35.29	64.53	26.54	63.73
B57m	37.53	65.69	38.50	69.72	37.22	61.24	36.79	51.76	36.81	68.02	32.37	56.60
J57m	28.62	60.32	26.32	59.50	26.92	54.43	28.29	51.10	31.14	65.97	27.08	57.98
Z58m	31.43	63.34	30.25	62.83	28.92	60.71	30.61	57.43	35.92	69.03	22.81	68.99
A61f	31.37	69.43	28.23	71.11	29.48	69.54	29.88	58.20	36.42	74.66	30.15	64.03
B65m	32.69	66.72	32.80	68.46	31.61	66.00	32.70	60.92	33.56	69.50	33.85	68.62
C74f	27.09	72.14	26.55	75.20	20.52	71.17	25.23	59.87	31.30	74.99	24.24	64.6
G77m	36.69	61.08	35.75	62.84	34.66	57.48	31.40	60.77	43.34	61.45	24.05	66.99
H82m	34.26	56.02	31.87	59.06	29.75	47.08	31.70	56.77	42.04	59.34	22.69	58.87
I84f	26.55	62.78	25.62	68.69	22.06	59.47	23.39	56.91	32.61	63.97	20.74	57.45
S84f	30.41	60.74	32.24	64.98	27.14	57.21	29.04	59.59	32.30	59.69	23.05	57.45
T84f	30.93	63.32	30.26	62.70	26.99	62.07	35.29	66.70	33.82	63.65	-	-
M92f	25.97	62.71	25.16	65.48	22.73	57.26	25.32	51.77	29.74	70.37	18.25	54.66
Ø%	**30.71**	**64.49**	**29.96**	**66.08**	**27.91**	**60.87**	**29.48**	**58.21**	**34.33**	**69.00**	**25.17**	**61.78**

Table 5.26: Mean F1- and F2-values of /ɪ/ in subcategories of following consonant groups.

Table 5.26 lists the mean values of each speaker for the general mean and the consonant subgroups, as well as the mean value of all speakers for each subgroup in the last row. /ɪ/+affricate is part of the list since only for speaker T84f were there no data to be measured.

The influence of the sociolinguistic variables on the general F1- and F2-means is tested (cf. Table 5.27), and significant differences and changes are observed.

	/ɪ/.F1	/ɪ/.F2
r (age)	0.004	-0.390
p (age)	0.985	0.036
p (gender)	0.391	0.057

Table 5.27: Correlation coefficients r- and p-values for age and /ɪ/.mean; p-value for t-test on gender.

While age has absolutely no effect on the height of /ɪ/, it affects the F2-position significantly. The younger the speaker, the further front /ɪ/ is pronounced, i.e. /ɪ/ used to be backed and is experiencing a receding trend toward the front of the vowel space. Gender has an influence on the degree of backing as well. Women pronounce /ɪ/ significantly further front (/ɪ/.F2(female)=66.23%) than men (/ɪ/.F2(male)=63.07%).

Again, the influence of the following consonants needs to be taken into account for a better understanding. As the distances between the means of the subgroups are greater than in the case of /ɛ/, i.e. following consonants have a greater impact on this vowel, the following plot (Figure 5.23) depicts the direction of shifting that the influence of the consonants results in.

/ɪ/+nasal occurs very frequently in free speech, which explains the impact this subgroup has on the mean value. It is the only subgroup located below the general mean. Nasals thus favor the lowering of /ɪ/ and disfavor any backing. Liquids, on the other hand, favor the backing of the vowel more than the lowering. The mean of /ɪ/+liquid is located almost centrally on the F2-scale, far from the traditional position of /ɪ/. /ɪ/+ nasal is pronounced further front than the remaining subgroups. While affricates move the vowel backward to a certain degree, they strongly disfavor any lowering. Located at about 25% on the F1-

scale, /ɪ/+affricate approaches the traditional height of /ɪ/[17]. Fricatives encourage the backing and little lowering. Plosives, on the other hand, have little backing and some lowering effect on the vowel.

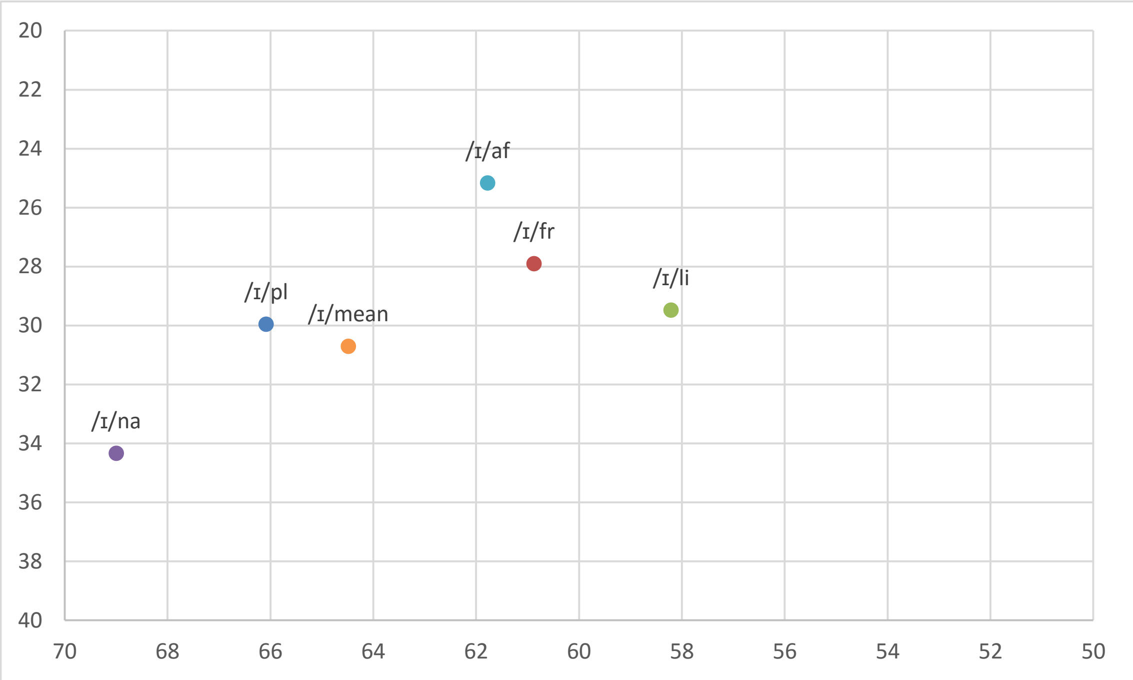

Figure 5.23: Normalized mean values of /ɪ/ and consonant subgroups of /ɪ/.

The distances between the mean values of the subgroups are considerably larger on the F2-scale, i.e. /ɪ/ seems to stretch horizontally. In fact, the clusters further this trend, as can be observed in the vowel chart of L56m (Figure 5.24).

Horizontally, all clusters stretch far more widely than vertically. The /ɪ/+liquid cluster even stretches across the center of the F2-scale into the back half of the vowel space. While the mean of the /ɪ/+affricate cluster lies further front and higher than that of /ɪ/+liquid, it largely overlaps with the front half of the latter cluster. All backed elements have a slight lowering tendency.

/ɪ/ is the only phoneme whose standard deviations are greater on the F2-scale than on the F1-scale. On average, the standard deviation for /ɪ/.F1 equals 10.52; that of /ɪ/.F2 equals 14.6. Age influences the standard deviation of /ɪ/.F1 in that the younger the speakers, the smaller the standard deviation of /ɪ/.F1 ($p=0.05$).

[17] Note that the normalized vowel space is created from all sounds uttered, including allophones of /i/, which define the upper front corner of the vowel space.

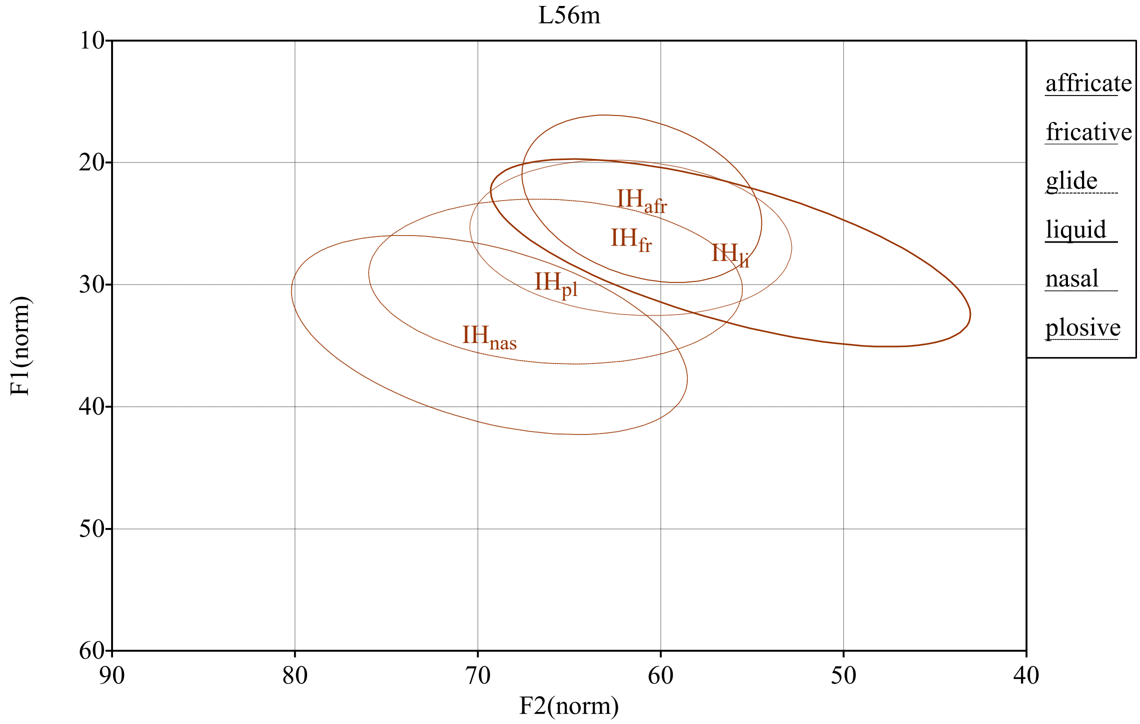

Figure 5.24: /ɪ/ chart of speaker R25m. /ɪ/ split into consonant subgroups.

The sociolinguistic variables are tested for their influence on the subgroups of /ɪ/. Other than in the case of the remaining vowels, gender has a greater influence than age (cf. Table 5.28)

	/ɪ/pl F1	/ɪ/pl F2	/ɪ/fr F1	/ɪ/fr F2	/ɪ/li F1	/ɪ/li F2	/ɪ/na F1	/ɪ/na F2	/ɪ/af F1	/ɪ/af F2
r (age)	-0.007	-0.236	-0.045	-0.305	-0.002	-0.192	0.081	-0.5565	-0.147	-0.155
p (age)	0.972	0.218	0.816	0.108	0.988	0.317	0.676	0.0017	0.457	0.432
p (gender)	0.790	0.050	0.190	0.059	0.586	0.132	0.231	0.145	0.929	0.996

Table 5.28: Correlation coefficients r and p-values for age and /ɪ/.mean and /ɪ/.cons; p-value for t-test on gender.

Age only affects the F2-position of /ɪ/+nasal significantly. The younger the speakers, the further front /ɪ/+nasal is pronounced. Gender, on the other hand, significantly influences the positions of /ɪ/+plosive and /ɪ/+fricative on the F2-scale. Men pronounce both allophonic subgroups further backed than women do (cf. Table 5.29). A similar trend, to a smaller degree, however, can be observed for /ɪ/+liquid and /ɪ/+nasal.

	/ɪ/pl.F2	/ɪ/fr.F2	/ɪ/li.F2	/ɪ/na.F2
Ø% female	68.03	63.04	59.63	70.68
Ø% male	64.51	59.11	57.05	67.63

Table 5.29: Gender-based mean F2-values of /ɪ/.pl, /ɪ/+fr, /ɪ/+na, /ɪ/+li.

In summary, /ɪ/ is lowered as a whole; the degree of backing largely depends on the following consonant. The F2-values of the phones differ much more strongly than the F1-values. Gender influences the degree of backing in the general mean and especially in some consonant environments. Age has an impact on the degree of backing when /ɪ/ is followed by a nasal. The height of the vowel is not influenced by any of the sociolinguistic variables.

5.3.4 /æ/, /ɛ/, and /ɪ/

/æ/, /ɛ/, and /ɪ/ influence one another and shift among their traditional positions. A description of their individual positions in relationship to one another thus seems apt. Table 5.30 restates the mean values of these three vowels.

	F1	F2
/æ/	60.85	59.61
/ɛ/	47.93	55.31
/ɪ/	30.71	64.49

Table 5.30: Normalized mean F1- and F2-values of /æ/, /ɛ/, and /ɪ/.

Based on the mean values, overlap seems improbable since the vowels differ considerably in height. Since the cluster of /ɪ/ varies only slightly on the F1-scale, overlap with /ɛ/ in fact remains marginal. However, /ɛ/ has a wider range of height, and /æ/ even more so. Thus, overlap becomes possible and needs to be considered. On the F2 scale, /ɪ/ remains in the frontmost position, whereas /ɛ/ and /æ/ reverse their traditional positions because /ɛ/ is backed and /æ/ fronted. /ɛ/ moves into central position and /æ/ is raised and fronted toward the traditional position of /ɛ/.

However, an interesting observation about the F2-position of /æ/ in relation to the pronunciation of /ɛ/ in connection with age can be made. NCS-criterion (3b) checks whether /æ/ is pronounced further front than /ɛ/. The difference between /æ/.F2 and /ɛ/.F2 is calculated and a positive value indicates /æ/ being located further front. Strong positive correlation between age and the distance values can be observed (r= 0.5322; p=0.0035), i.e. the older the speakers, the further /æ/ is fronted. To specify this statement, more speakers below 30 were omitted to see whether this phenomenon can be considered a recent trend. The hypothesis is supported by the complete absence of correlation between age and /æ/.F2-/ɛ/.F2 positioning for speakers between 30 and 92 (p=0.89). The backing of /æ/ must thus be a rather recent trend.

Figure 5.25 depicts the mean values calculated from all speakers of the consonant subgroups of /ɛ/ and /æ/. /ɪ/ is omitted because, as can be seen in Figure 5.23, the lowest mean value of /ɪ/ is located at around 35% (F1) and is thus distanced so far from the other two vowels that merging is unlikely. /æ/+nasal approaches the height of /ɛ/ most closely, but is located considerably further front than /ɛ/+nasal. /ɛ/+fricative and /æ/+fricative are located to one another similarly to /ɛ/+plosive and /æ/+plosive. Their F2-values approach one another, and distance is only ensured through the lower height of /æ/. Liquids seem least problematic when it comes to the merging of the two vowels.

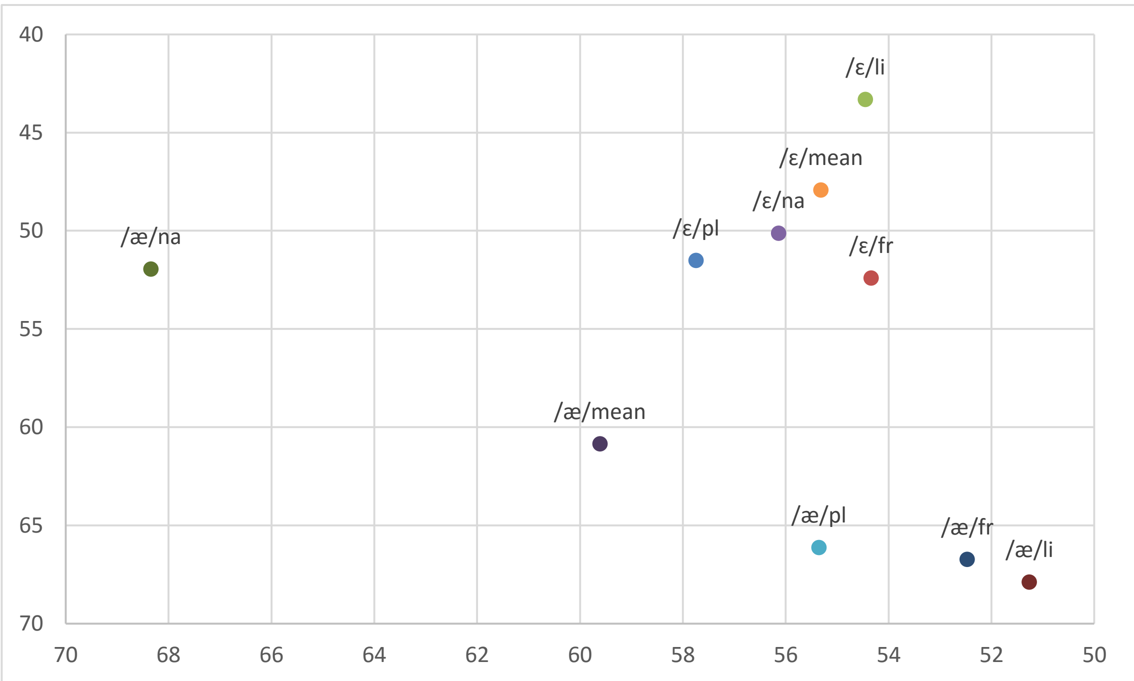

Figure 5.25: Mean values of consonant subgroups of /æ/ and /ɛ/.

The mean values of the subgroups of /ɛ/ are located very closely together. Yet the standard deviation of /ɛ/ shows that the cluster spreads across a considerable part of the vowel space. Thus the clusters of the subgroups need to be analyzed before a statement about merging can be attempted.

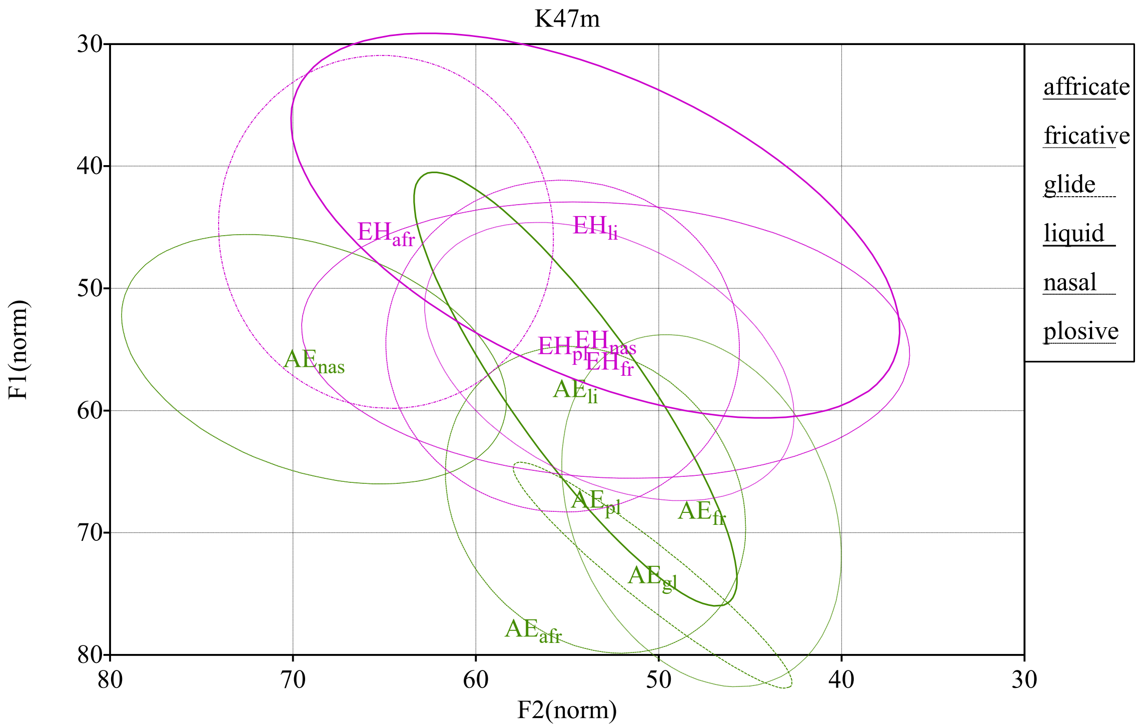

Figure 5.26: Vowel chart of /ɛ/ and /æ/ of K47m; vowels split into consonant subgroups.

The vowel chart of /ɛ/ and /æ/ of K47m was chosen as a typical depiction (cf. Figure 5.26). His vowel clusters overlap, and it needs to be discussed whether the subgroups, i.e. the vowels in the same consonant environment, merge as well. At first glance Figure 5.26 gives the impression that the two vowels have merged completely. If the subgroups are analyzed separately, it becomes apparent that all of the subgroups overlap, but none of them are merged completely.

As a contrast, the same plot was created for a young female speaker, E19f (Figure 5.27). With a lower pronunciation of /æ/ and a smaller divergence of many of the subgroups, overlap is diminished greatly.

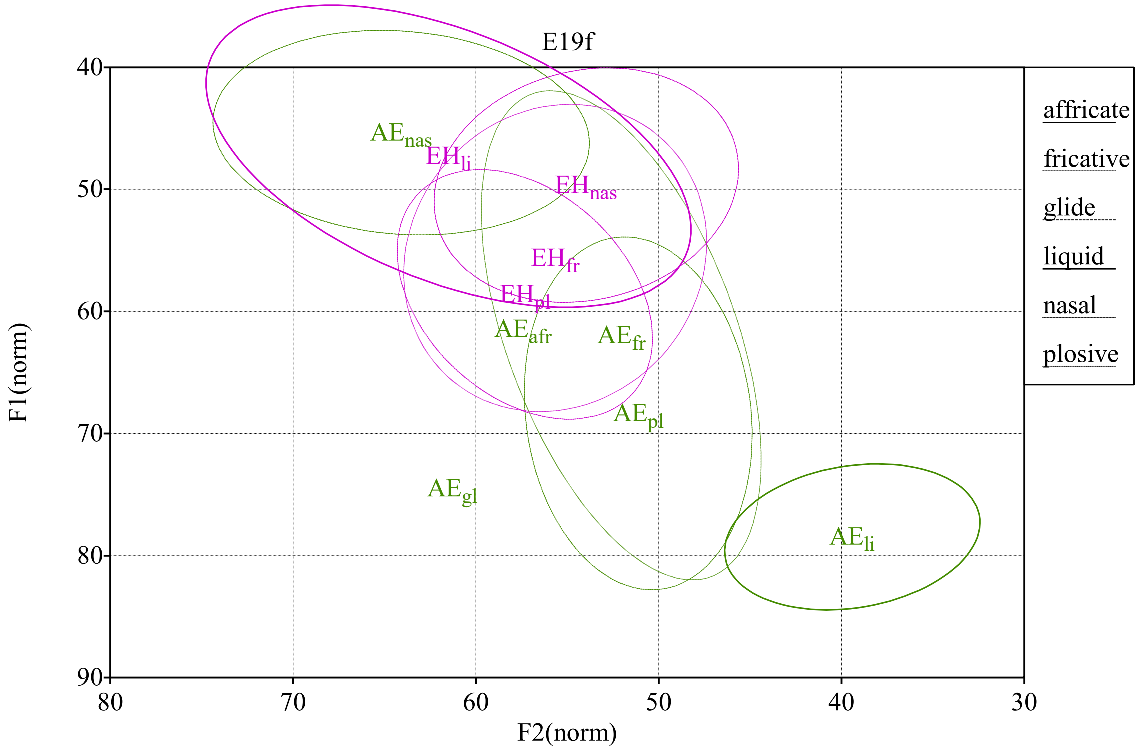

Figure 5.27: Vowel chart of /ɛ/ and /æ/ of E19f; vowels split into consonant subgroups.

Following liquids disfavor any merging. Since /æ/+plosives is made up of a wide range of F1-values, it merges with /æ/+fricative to a high degree. /æ/+nasal is pronounced even higher than /ɛ/+nasal, which causes a certain degree of overlap.

As it was observed in subchapter 5.3.2, /ɛ/+plosive is pronounced further front by women (/ɛ/pl.F2=60.37%) than by men (/ɛ/pl.F2=55.26%). In comparison, the F2 position of /æ/+plosive equals 55.35%. Interestingly, no significant difference between men and women can be observed in the pronunciation of /æ/+plosive. The two figures above aptly visualize this phenomenon.

In summary, /ɪ/ does not show any signs of merging with /æ/ or /ɛ/. The latter two, however, merge to a certain degree, depending on the age and gender of the speaker as well as the consonant following the vowel. Fricatives and plosives favor the merger, while liquids generally disfavor it. The degree to which nasals favor the merger depends on the age of the speaker.

6 Discussion

6.1 The Influence of Age

Based on the analysis described in chapter 5, summarizing statements can be made on how the sociolinguistic variable age influences the dialect spoken in Amherst. Apparent-time analysis shows how the vowel system of the speech community has changed over the last 75 years.

At the beginning of the data analysis it was observed that the NCS score decreases with decreasing age, i.e. fewer traces of the NCS can be found in the speech of the younger informants.

When the position of /æ/, one of the major markers, is considered, it becomes apparent that the general observation derived from the NCS score indeed describes the trend of the vowel. The younger the speaker, the lower and further back the vowel is pronounced. It is shifted back toward its GA position. The split of the allophonic subgroups into lax elements when followed by fricatives, plosives and liquids and tense tokens before nasals further indicates that the overall raising of /æ/ is receding and a pronunciation nearer to the GA standard is approached. The only surprising issue in this context is the fact that /æŋ/ is pronounced higher in relation to /æ/+/m/,/n/ among younger speakers than among the older ones.

Correspondingly, the backing of /ɛ/ which can be found in the speech of older informants is reversed with younger age and approaches the F2 position of GA. However, surprisingly, younger speakers also lower /ɛ/ before plosives, fricatives and nasals. When followed by fricatives and plosives, this remains unproblematic, but when /ɛ/ is followed by a nasal, it approaches the position of /æ/+nasals. Some degree of merging is thus taking place. A complete merger is avoided by the fronting of /æ/+nasal that can be found with decreasing age.

The height of /ɪ/ is not affected by age but, like in the case of /ɛ/, considerable fronting can be observed with decreasing age, especially, when /ɪ/ is followed by a nasal.

As /ɛ/ has recently been pronounced further front, /ʌ/ is similarly less and less backed, especially when followed by plosives and fricatives. Merely tokens of /ʌ/+liquid remain in backed position and cause a merger with /ɔ/+liquid, especially among young women.

In correspondence with the trends described so far, /ɑ/ is experiencing a backing trend toward the GA position as well. However, the movement is not linear. Speakers born in the 1950s pronounce /ɑ/ furthest front, almost at the GA position of /æ/. In the years before, /æ/ was pronounced further back, similar to the most recent trend. The youngest speakers differentiate themselves additionally with a lower pronunciation of the vowel in comparison with the remaining vowels analyzed. Furthermore, their age influences /ɔ/ in that it is also pronounced lower. The F2-position of /ɔ/ among younger speakers is largely influenced by following liquids. They favor fronting, which causes the merger with /ʌ/ described above. Thus, /ɔ/+liquid and /ɑ/+liquid are pronounced furthest apart in recent trends.

The influence of following consonants on the relationship between /ɑ/ and /ɔ/ varies least among speakers born around the 1950s. They pronounce the vowels separately, but not at a far distance from each other. The oldest and the youngest speakers vary much more strongly in their pronunciation of the two vowels depending on the consonant environment.

Perception was largely omitted in the present study. However, through the reading of word lists and the related corrections, the following statements can be made about the relationship between free speech and the word list reading of /ɔ/ and /ɑ/. The distance between the word list tokens of *cot* and *caught* indicates that the youngest and the oldest speakers correct toward a merger of the two phonemes, i.e. in free speech the two are pronounced more separately than when read off a word list. Informants born around the 1950s, however, correct toward a pronunciation that is even further separate than in their natural speech. A development away from the merger and then back toward the merger can thus be observed in the apparent-time analysis, but the merger has not been completed yet in the speech of the youngest informants.

Thus, some elements of the NCS had already infiltrated the Amherst speech community in the first half of the 20th century. In the second half further NCS-features were introduced, but the youngest generations are moving away from the NCS and return to a pronunciation similar to GA.

6.2 The Influence of Gender

In the analysis of the NCS-score it became apparent that women score lower than men, i.e. display fewer features of the NCS than men do. Neither do they vary as strongly in relation to age as men, but consistently score around 1.

During the analysis of the individual vowels, however, it turned out that men and women do not differ significantly in many cases. In the individual analysis of /ɔ/ and /ɑ/ no significant correlations could be detected, and in the relationship between the two vowels it can merely be stated that the relative position of /ɔ/ to /ɑ/ does not vary as much among women as it does among men.

In the pronunciation of both /ɪ/ and /ɛ/ women tend to pronounce the vowels further front than men do, i.e. closer to the traditional position of GA.

Differences in the pronunciation of /æ/ in relation to gender can be observed when the sound is followed by a nasal. Young women pronounce /æ/+nasal significantly higher in relationship to the means of /æ/ than young men do, but the distance decreases with increasing age. Among men, however, the distance between /æ/.mean and /æ/+nasal stays relatively stable with increasing age, and rather shows a slight increasing trend.

The strongest impact gender has on a vowel is in the case of /ʌ/. Women spread the allophone cluster much more widely on the F2-scale, and men differ much more in height than women do. Young men tend to pronounce the vowel more closely to the position of /ɑ/ than the remaining speakers, and women of all ages pronounce /ʌ/+liquid considerably higher than men do.

Thus, the sociolinguistic variable gender shows much less effect on the local dialect than age does. The vowel system of women tends more toward the standard pronunciation of American English, whereas men tend more toward a system with NCS-features.

6.3 Issues Related to the Speech Community

The approach to a speech community which the fieldworker is not a part of is a challenge on a number of layers. Who are the residents of Amherst? Which informants should be chosen to represent the speech of the community best? Unless every speaker of a community is recorded for a long period of time, all data collection of a speech community remains fragmentary and, to a certain degree, unsatisfactory.

During the recruitment it became obvious how many of the residents of Amherst had moved to the town during their adult lives. Thus, at times, it felt like the criterion of participants having to have lived in Amherst for almost all their lives excluded the majority of members of the speech community. Throughout the interviews, however, the ‘townies’, as the long-time residents call themselves, pointed out that a townspeople community exists separately from the university and its academic staff. Many of the interviewees complained about the relationship between the townies and the university people:

> There's sort of the old uh Amherst um natives, you know, who've been here for many years and their families are multi-generational. And uh we're pretty much, you know, quiet and non-controversial and uh just sort of enjoy living in Amherst. And then there's um, sort of this real active uh political uh segment in town and they sometimes don't have the best interest of all citizens of Amherst, you know, in in their heart I guess. (K47m)

> But […] there isn't many, there used to be old townies. And we would call him not a townie, right? Wonderful person, supports the town, wonderful town meeting member, uh, but there isn't that many of us townies left, old guard, I would say. You know, we're very, very few anymore. And so there's a lot of um, obviously people that come here to work at UMass and Amherst College that may not stay for long periods of time. One of the things that I think that is bothersome is that these people feel that they wanna engage themselves in the process of Amherst. But they don't have the history of Amherst. And they get themselves on some of these boards and they put their initiatives forward. And they're gone. And we're stuck with some of these things that may not be the best for Amherst because they don't have the history and the understanding of what Amherst really needs. (B65m)

The sentiment described above was a common tenor among informants above the age of 25, i.e. the ones born before 1985. Many parents of the younger speakers do not belong to the long-time residents, but moved to the town for work. Still, their children identify as Amherst townies.

Thus, the community analyzed is represented in the informants chosen, but the definition of the community, i.e. the separation between Amherst townspeople and university staff changes in the eyes of the younger Amherst residents. As the majority of them enter the town through the university, and some of them stay for longer periods of time, the new generation replaces the image of who makes up the members of the speech community.

The limited number of long-term residents influenced the choice of informants and the number of speakers of a certain age or gender. While the focus lay on finding speakers of different ages to be able to describe a continuous apparent-time study, it would have been desirable to recruit the same number of people of a certain age to define separate age groups, i.e. young, middle-aged and old speakers. This would have allowed for ANOVA-results that were impossible to obtain with the current data set. Nevertheless, with a span of 76 years, i.e. the youngest speaker being 16 and the oldest 92, the recruitment has been successful in representing the community in question.

The overwhelming majority of Caucasian residents also eliminated the sociolinguistic variable Ethnicity. While the NCS is a phenomenon commonly found among Caucasian speakers, it would be interesting to analyze the speech of the ethnic minority groups currently living in Amherst as part of future research.

Education had to be excluded as a sociolinguistic variable as well since the majority of Amherst residents are highly educated. However, the impact of university education and the corresponding exposure to other dialects and languages would certainly make for another insightful study.

For further research, a comparative study between Amherst and one of the neighboring communities seems adequate. Despite the fact that Amherst is surrounded by colleges, a number of farming communities still exist in the area. Contrasting these speech communities might yield significant results.

In order to include ethnicity, the frame of the study could be broadened to a wider radius, and the speech community could be redefined as a regional one. Thus, the pool of possible informants could be expanded to allow for an ethnicity-based analysis.

6.4 Issues related to the Recording

During the analysis of the data it became apparent that the recording devices used could be improved. Where the integrated microphone of the Olympus DM-550 recorder was used, a number of background noises were captured. Despite the fact that the recorder was placed as closely to the informant as possible, it was still too far away from the speaker’s mouth and captured surrounding speech and other background noises. Nevertheless, it was a better option than using a tie-clip microphone in some of the interviews because it is a lot less invasive. Insecure or hesitant informants would have felt more uncomfortable. Since it is an unfamiliar and, at first, uncomfortable situation for some to be interviewed by an unknown person, placing the recording device on the table was the right choice for many of the interviews and is recommended for future interviews. However, it would be recommendable to use a device with a stronger microphone or a better filter.

The Olympus ME-15 tie-clip microphone was used when it seemed adequate. It captured fewer background noises than the integrated one, but a constant white noise was detectable throughout all the interviews conducted with this. It had to be filtered out before data extraction was possible. A microphone of higher quality would decrease the work load considerably and improve the quality of the recording.

Background noise is an unavoidable general issue. The difference in quality between a sound file recorded in a phonetics lab and during a sociolinguistic interview in a random place is immense. During data extraction the former delivers results with a much smaller error. However, the sociolinguistic quality of an interview conducted in a comfortable situation for the interviewee is of much greater value. During most of the interviews, it became apparent that the interviewee had forgotten about the microphone. Most of the interviews developed as a genuine conversation and, since generally issues that triggered an emotional response were discussed, the speech uttered was quite natural. The setting made it possible to dive into such issues. To support this theory, several interviews can be contrasted.

The interview with L16f was conducted in the interviewer's office at the university, a setting that was relatively formal. At no time during the interview did the interviewee relax completely, and the flow of the conversation did not compare to that of any of the other interviews. The quality of the recording was by far the best, but throughout the interview the informant never went beyond careful speech. On the other hand, two interviews were conducted with pairs of informants.

S84f and T84f were interviewed in the home of one of the women, and a discussion among the two of them developed in which developing questions were almost unnecessary. The data extraction, however, was quite difficult because one speaker sat further away from the microphone than the other.

The other interview with two speakers (A61f and C74f) was conducted at a coffee shop. The two sisters participated in a lively discussion. However, background noises, such as coffee cups, other patrons, and even traffic were captured. Additionally, the two interviewees constantly interrupted each other and spoke at the same time. The transcription and data extraction of this interview was a true challenge.

Thus, while none of the settings of an interview will ever yield completely satisfactory results, the choice of setting by the interviewee will lead to the most natural speech, which should be the aim of a sociolinguistic interview. Overall, sound sociolinguistic interviews were conducted for the present study, and the speech captured approaches natural speech as well as can be. The best possible equipment can help decrease the accompanying error caused by background noise.

6.5 Issues in Dealing with Data

The phonetic transcription of interviews is very time-consuming work. The software FAVE-align is an invaluable transcription tool in that it creates the phonetic transcription before the forced alignment. Lexical transcriptions are written fast and well-structured with the software ELAN and the phonetic transcription supplied by FAVE-align is reliable.

Forced alignment, i.e. the setting of the boundaries in the sound file, can also be considered a very helpful tool. However, the current tools available still yield relatively imprecise results. Interval boundaries are either placed too far into the neighboring consonants or, at times, set at a completely different time in the sound file. When background noise is captured, it is sometimes mistaken for the next sound and vice versa. The intervals set during the lexical transcription need to be rather short in order to improve precision since the alignment takes place within these boundaries. Additionally, it is crucial that all boundaries be manually checked and, if necessary, corrected. This, in turn, requires numerous hours of work. If this step is omitted, however, the errors increase drastically. There are different mindsets to the approach of data extraction. The most accurate formant measurements can, no doubt, be gathered manually, but the number of phones analyzed then has to remain much smaller than when automated. As Labov has mentioned (plenary address during NWAV conference 2011) multiplication of size of the data sample equalizes the error that is a result of automatized extraction.

In my view, the imprecisions of automatized data extraction are still too great to enable complete reliance on automatized processes. As described above, the collection of errors that infiltrate the data already starts during the interview itself. The next point of error is the fast Fourier transform of the sounds which makes the frequencies visible and measurable. While, as the name says, it is a fast and economic way of transforming sound waves into data, its mathematical error is significant. The point of measurement is another critical issue in the aim of error minimization. Is the sound represented most precisely by one point of measurement or by a mean value? Surely, if the point of measurement is selected by hand, background noise is excluded and the result can be double-checked by an auditory analysis of a trained phonetician, the result comes closest to the desired one. If, however, any kind of automation is used, a single point of measurement is either too prone to error or needs to be smoothed out so far that the result becomes questionable. On the other hand, means are only calculated because it is known that a certain amount of error is present. While it decreases the probability of error, it is still far away from the optimum.

In the present study a combination of automation and manual correction was chosen in order to extract as many tokens as possible while at the same time decreasing the error caused by standardized extraction through software. With 29 informants and an average of 3,527 tokens per speaker whose boundaries were corrected and outliers were excluded manually, a limit of practicability was reached. Through this combination of automation and manual correction a large corpus consisting of verified and thus reliable data could be developed, which increases confidence in the correctness of the analysis at hand.

In the future, in order to be able to compile large corpora, automation processes need to be developed further so that the resulting error can be decreased. Only then will the importance of manual corrections decrease.

Large data sets lead to another issue that needs to be discussed. Ideally each phone recorded should be analyzed individually in its environment and in relation to other allophones. When the number of tokens measured becomes so large that they are not plottable anymore, they need to be clustered. As could be observed throughout the data analysis, relying on the general means of a vowel can lead to wrong conclusions. Standard deviation and the subdivision according to following consonants lead to more reliable results. Still the results are generalized. Further subdivisions into voiced vs. unvoiced following consonant groups, for example would be desirable, but exceed the scope of the current thesis. Lexical conditioning of the place of articulation would be another interesting phenomenon to analyze. Further research on the lexicon would be interesting as well.

The extraction of formant measurements only helps in understanding a speech community when an adequate normalization method is chosen. Until now, sociolinguists do not agree on a method. Flynn (2011) evaluates 20 prominent methods used in the field of linguistics and, surprisingly, one of the oldest methods, Gerstman's normalization from 1968, scores highest in the equalization of vowel space area. The normalization method used in the present thesis shares Gerstman's basic principle in that it defines the boundaries of each speaker's vowel space by the most extreme F1- and F2-values measured. The normalization method used for the present corpus then defines each token as a percentage of the span of the vowel space. Thus, individual shapes of vowel space and higher or lower F1- and F2-values overall become irrelevant. This normalization has shown to be a reliable method for making the data comparable.

7 Conclusion

In the present study the effects of the Northern Cities Shift are being analyzed in a community that is located on the border of the area the shift has affected. Amherst, MA, as a small town with strong academic influence does not appear to harbor a speech community that shows elements of the shift. Yet, traces of the shift were already found in a pilot project conducted in 2009/2010. The present study expands the previous study both in the number of informants and the extent to which the data collected are analyzed.

The extraction of data from speech samples is a complex and highly discussed endeavor, as a reliable way of numerically representing spoken sounds is sought. Different methods have been tested and are discussed, and the most reliable one, in the eyes of the present author, has been discussed. In order to achieve the best possible result, extensive time was invested in the combination of automation and manual correction, which rendered a quite reliable numeric representation of the recorded language. A functioning normalization method that leaves the data undistorted and reliable was sought and, after careful consideration, chosen.

It can be said that special emphasis was put on the best possible extraction and normalization of representative data. The time invested in decreasing unnecessary errors that could be the result of unreflected automation was time well spent. Despite the fact that errors can never be excluded completely, the interpretation could be executed with confidence in the underlying data.

When large amounts of data need to be analyzed, working with mean values becomes attractive. However, the present study has shown that overall mean values can make subgroups cancel each other out, which can lead to false generalization. It is therefore crucial to analyze tokens in their respective contexts in order to gather a more complete and precise understanding of the linguistic situation at hand.

The interpretation of the data in context of the sociolinguistic variable Gender yields that women tend more toward the standard pronunciation of American English, i.e. men display more features of the Northern Cities Shift.

The sociolinguistic variable Age shows strong variation. Based on apparent-time analysis, it can be deducted that elements of the NCS infiltrated the Amherst speech community already in the first half of the 20th century and the shift progressed in the second half. However, the youngest informants show that recently there has been a trend away from the shifted variety back toward the standard pronunciation.

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Appendix

1. Word List

mine	flow	aid	beaver	bit
balance	hull	about	eight	fail
Beverly	moose	geezer	bough	lousy
bat	bud	Dave	rude	ooze
small	Bob	thing	body	feisty
Bambi	bath	doom	sung	lung
gone	barn	beast	huff	born
cut	ban	best	hung	hug
pawned	bowl	bead	condo	bean
rock	bun	moist	bed	beet
bang	coin	sled	gong	talk
diss	father	bass	book	sing
bite	bully	boat	school	sang
buzz	baffle	gaze	but	bog
safe	Bengal	moan	Bill	bother
dawn	mouth	balm	boast	bet
caught	cause	loud	bid	stalk
boy	bare	beer	boot	Don
cot	ambivalent	wuss	fair	Beth
bomb	boff	dizzy	beef	cane
pond	stock	bad	hush	
different	void	cop	must	
bawdy	bell	bohemian	bin	
Ben	ace	long	sure	

2. Recruitment Flyer

Have you grown up in Amherst/ lived in Amherst for most of your life?

Participate in a **30-minute interview** on your life in Amherst

Looking for participants of all ages

If you are interested, please contact

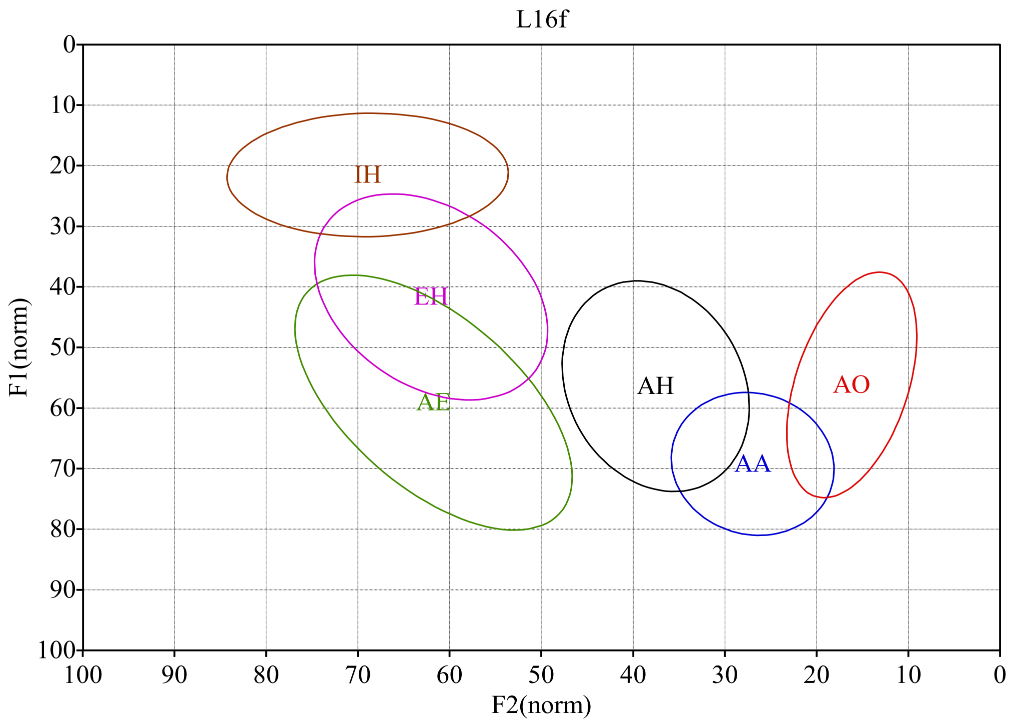
Tatjana Bause Department of Linguistics

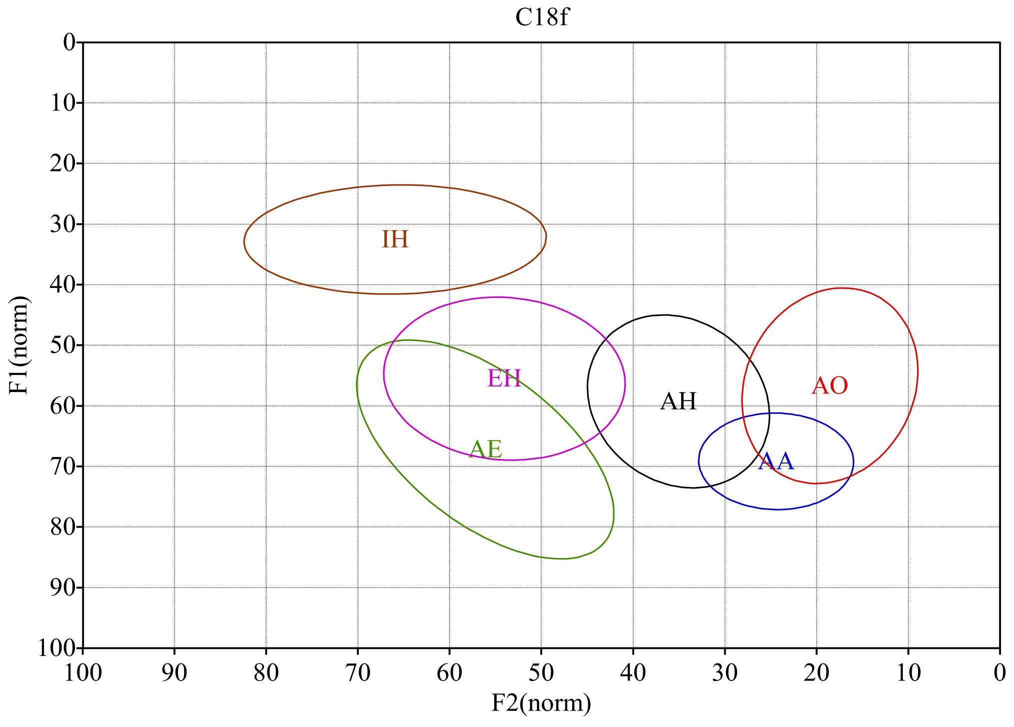
[Contact Information]

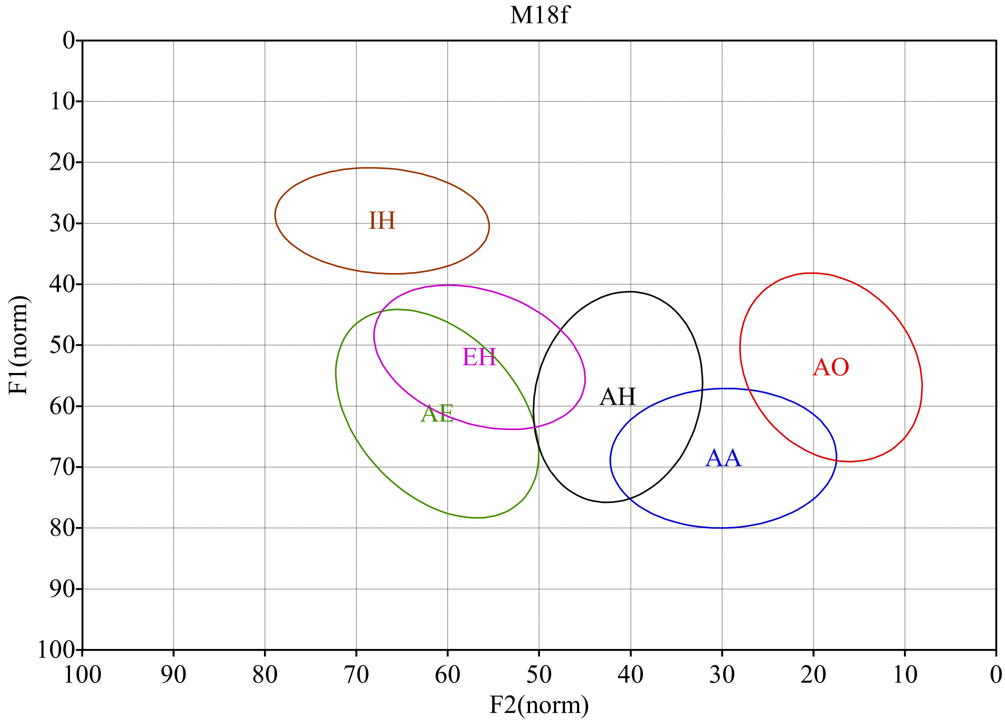
3. Vowel Charts

Key to ARPABET symbols:

AA - /ɑ/; AE - /æ/; AH - /ʌ/; AO - /ɔ/; EH - /ɛ/; IH - /ɪ/.



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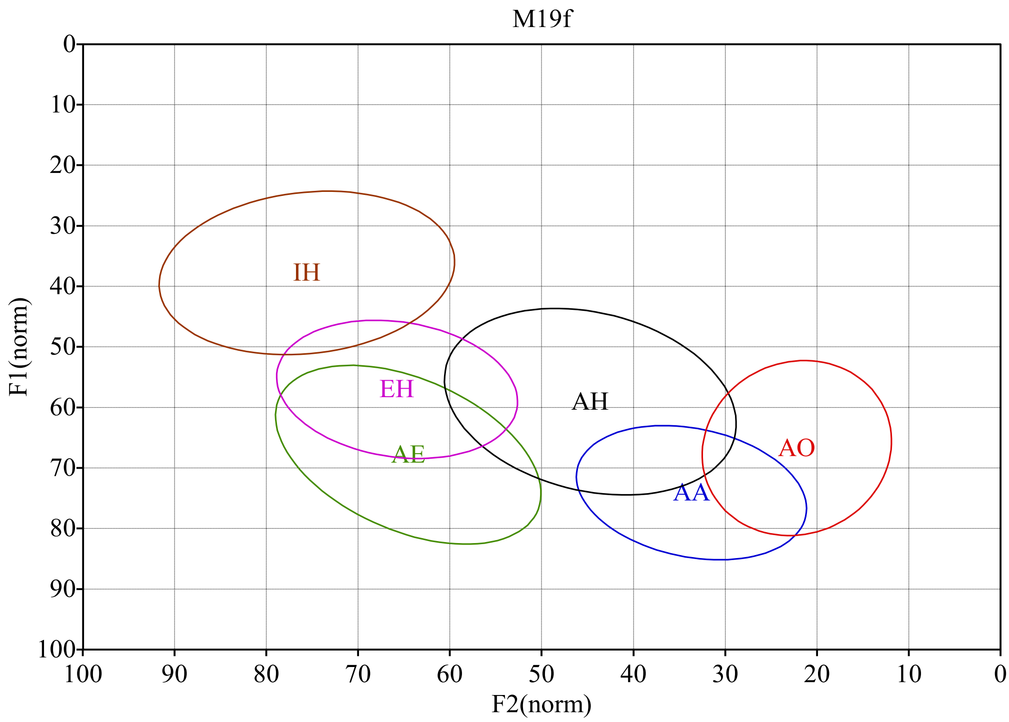
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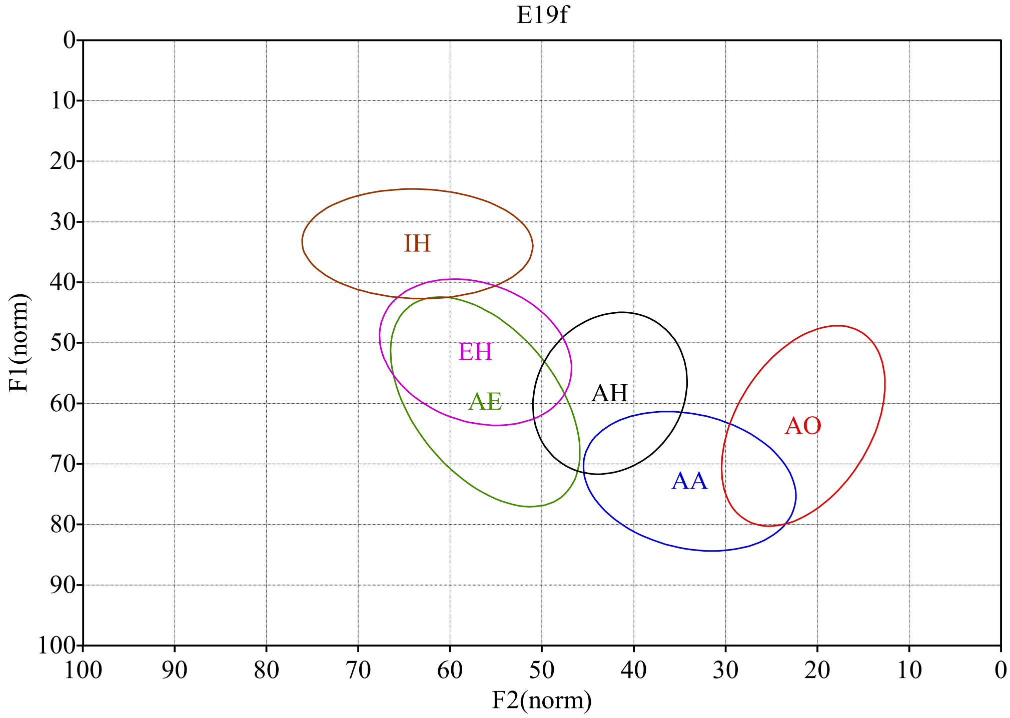
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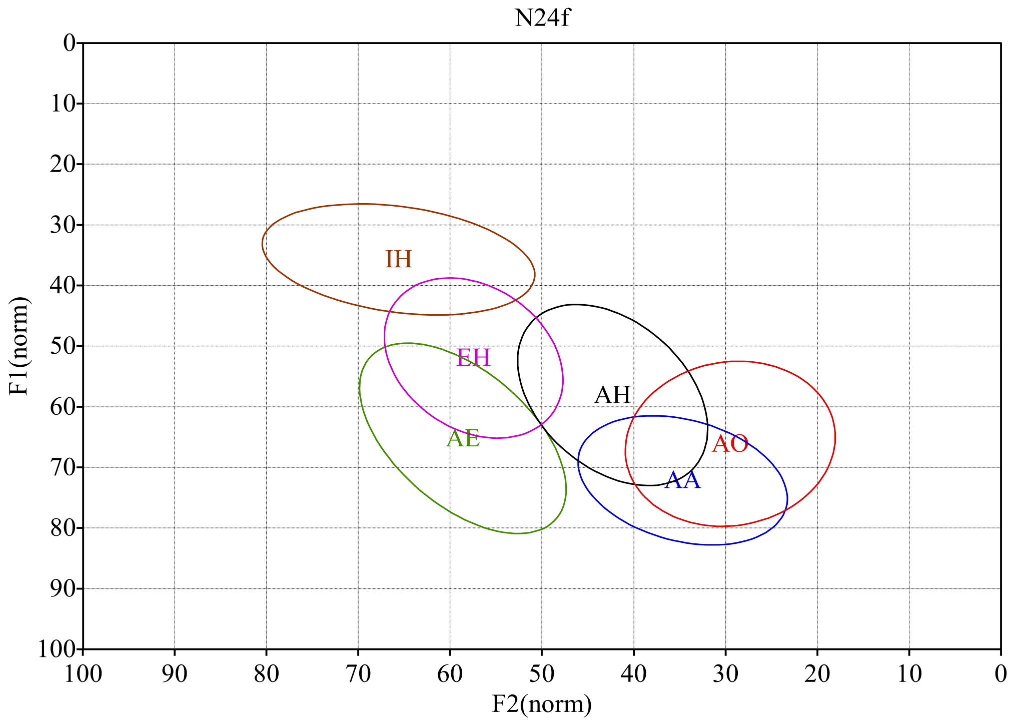
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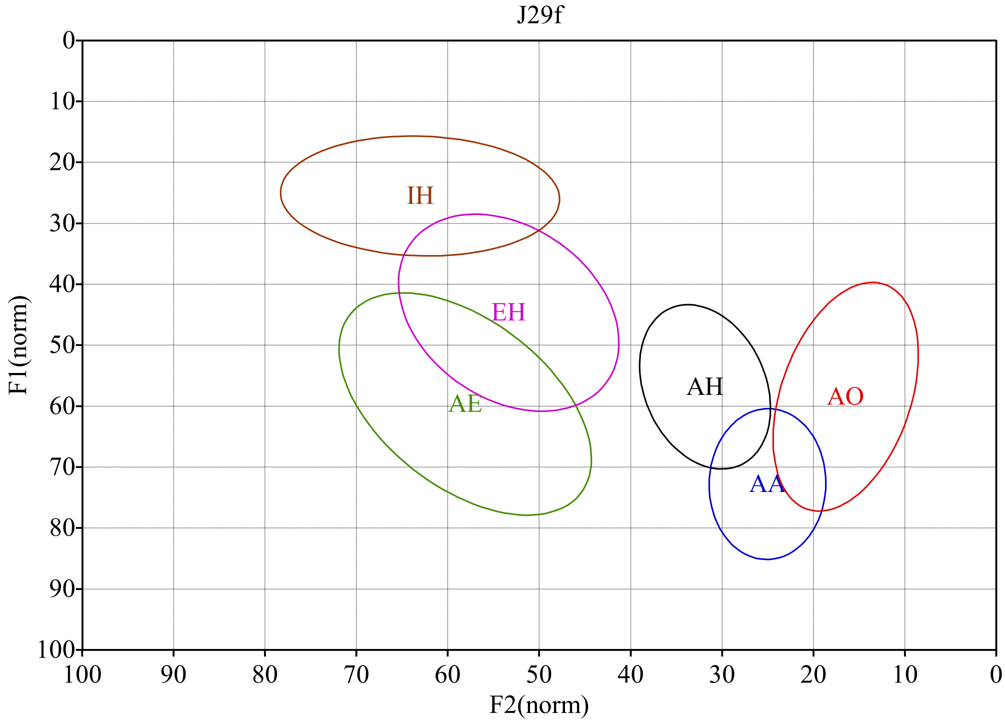
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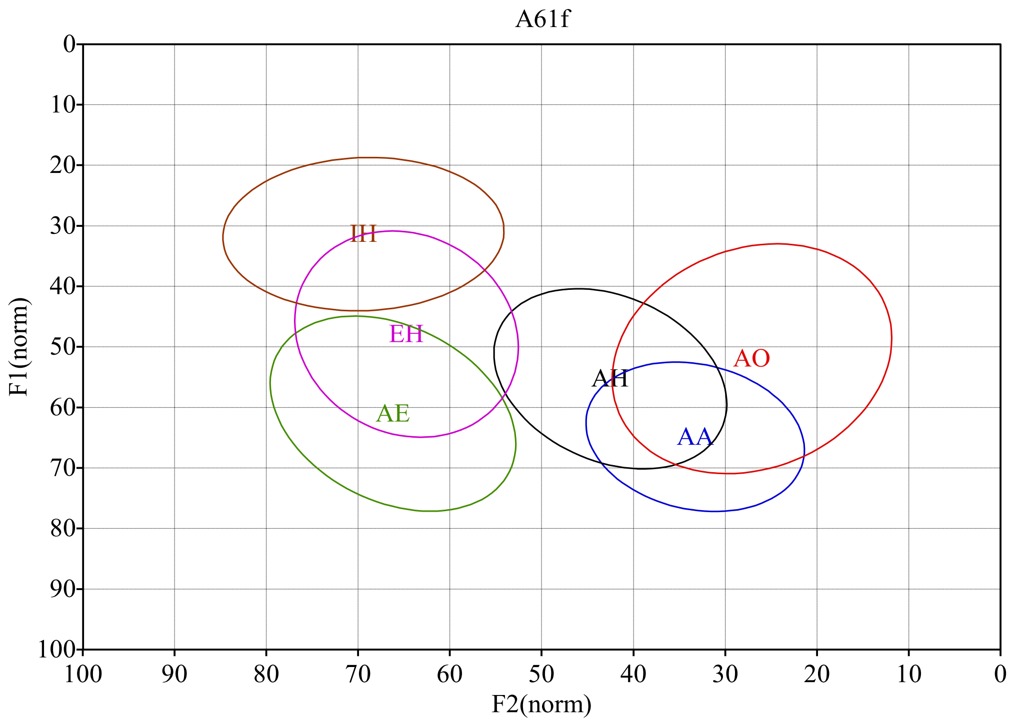
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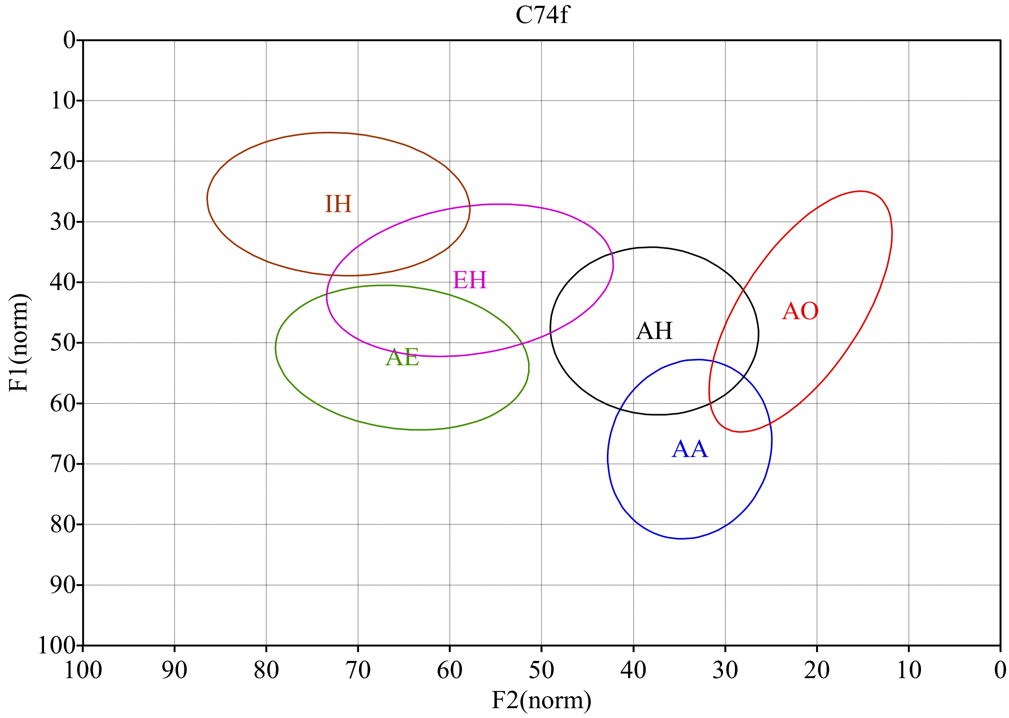
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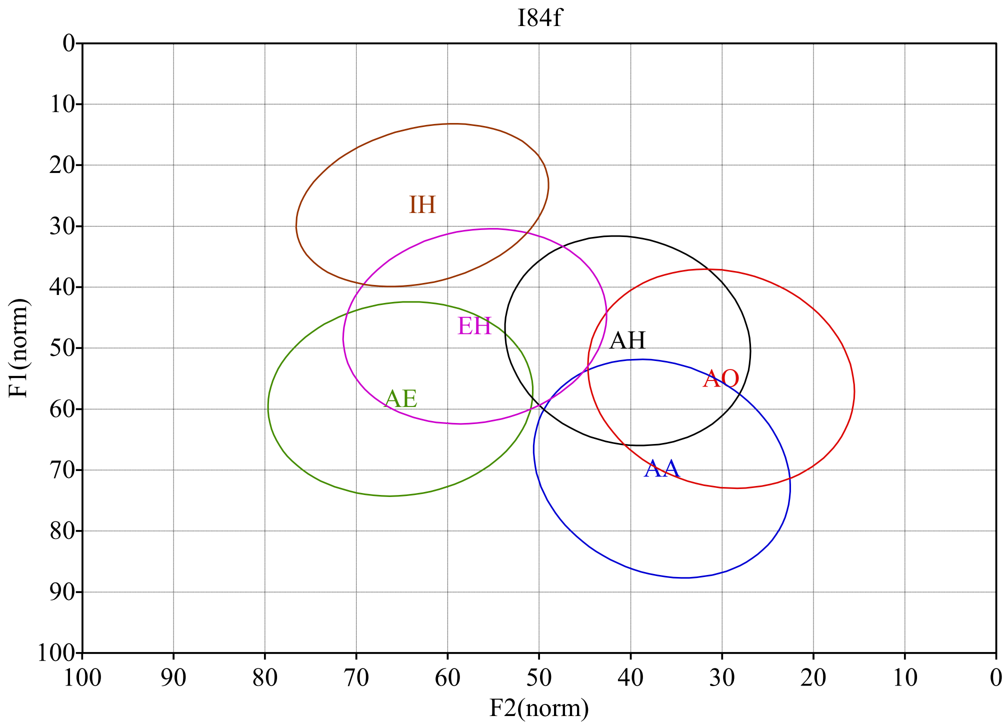
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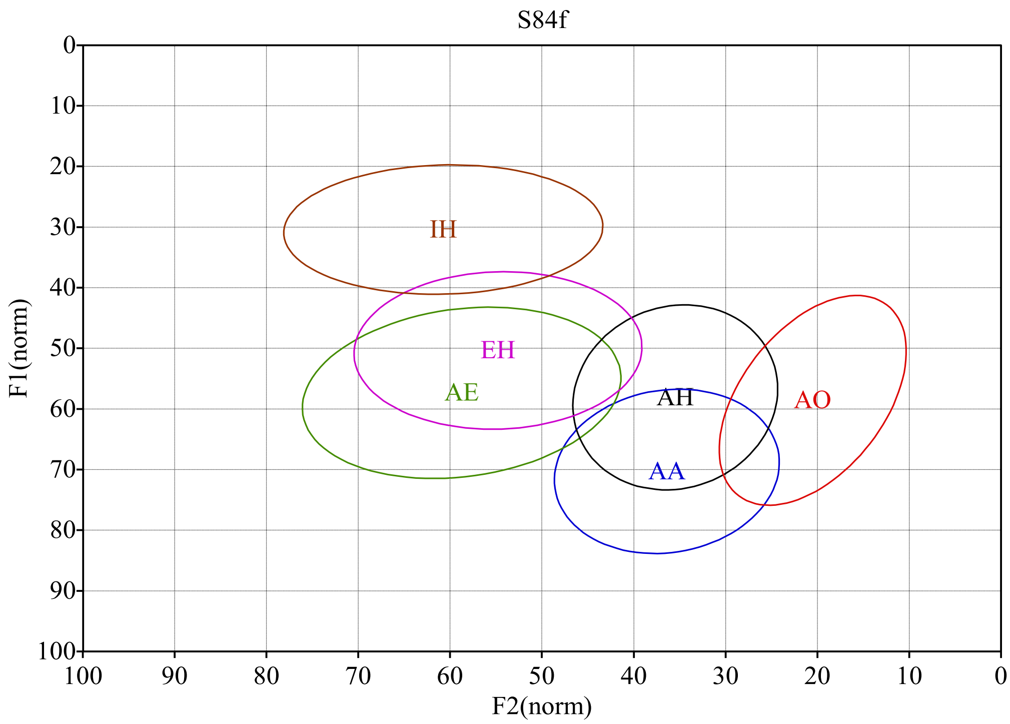
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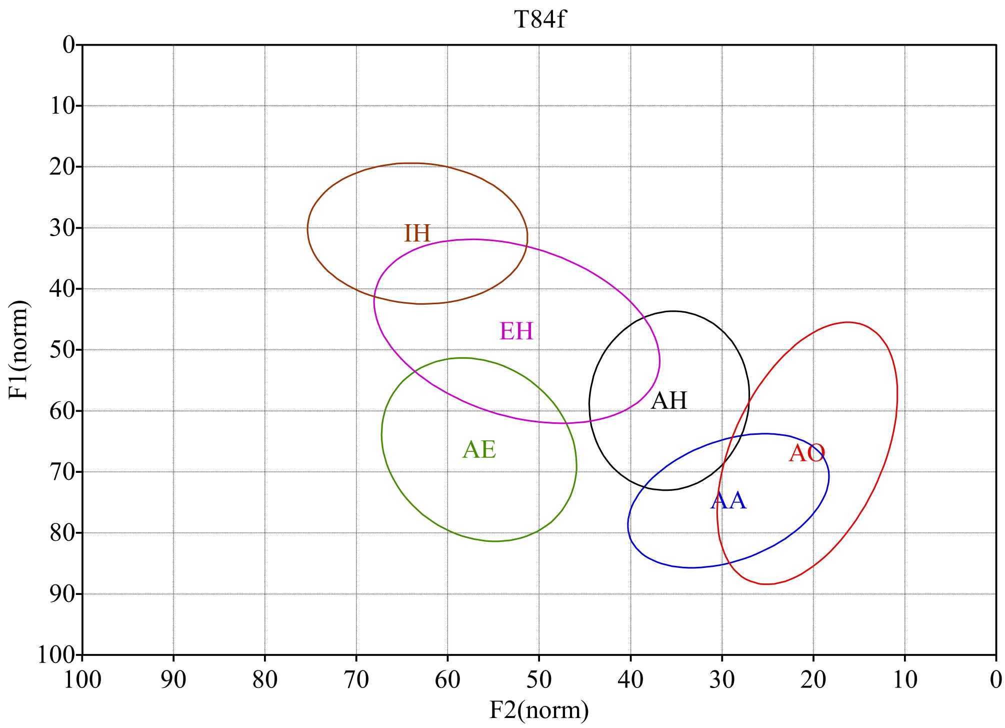
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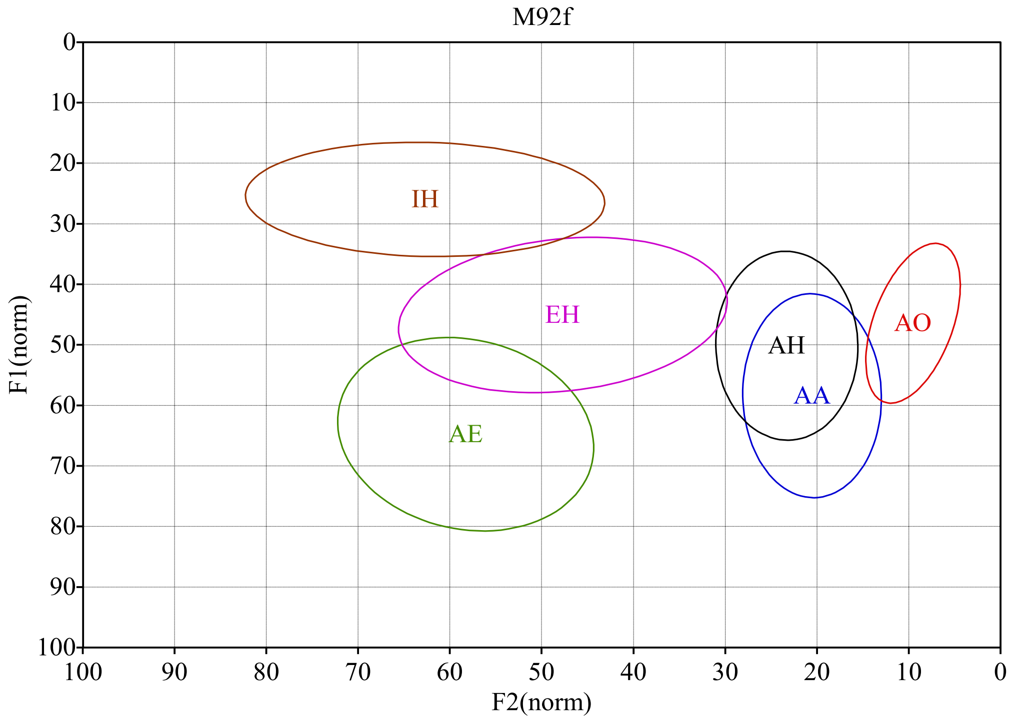
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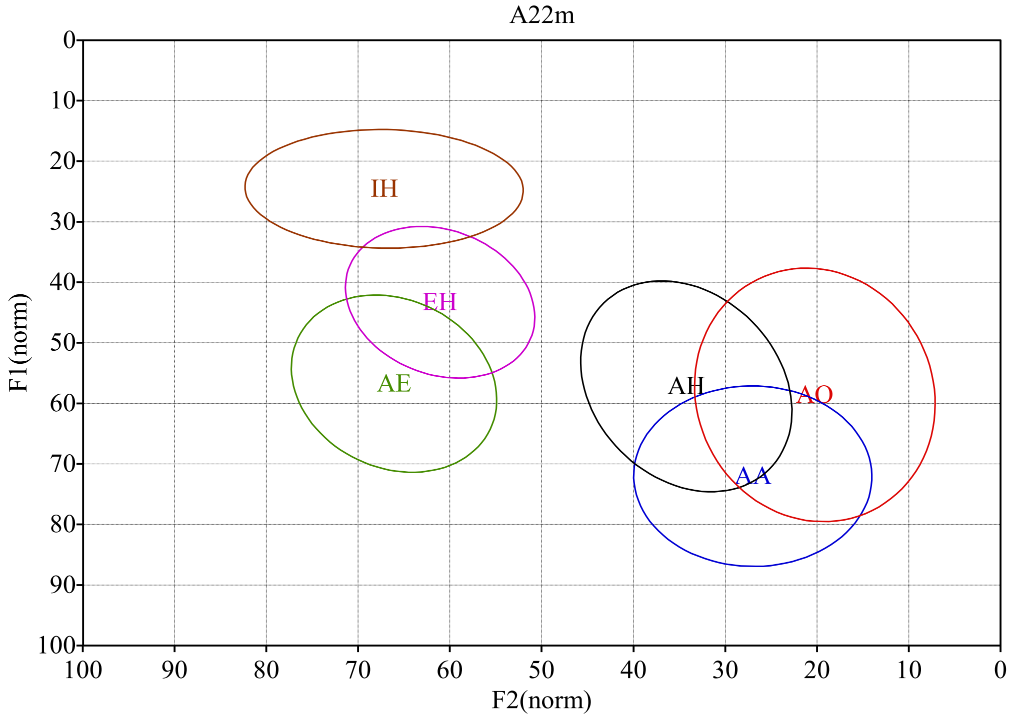
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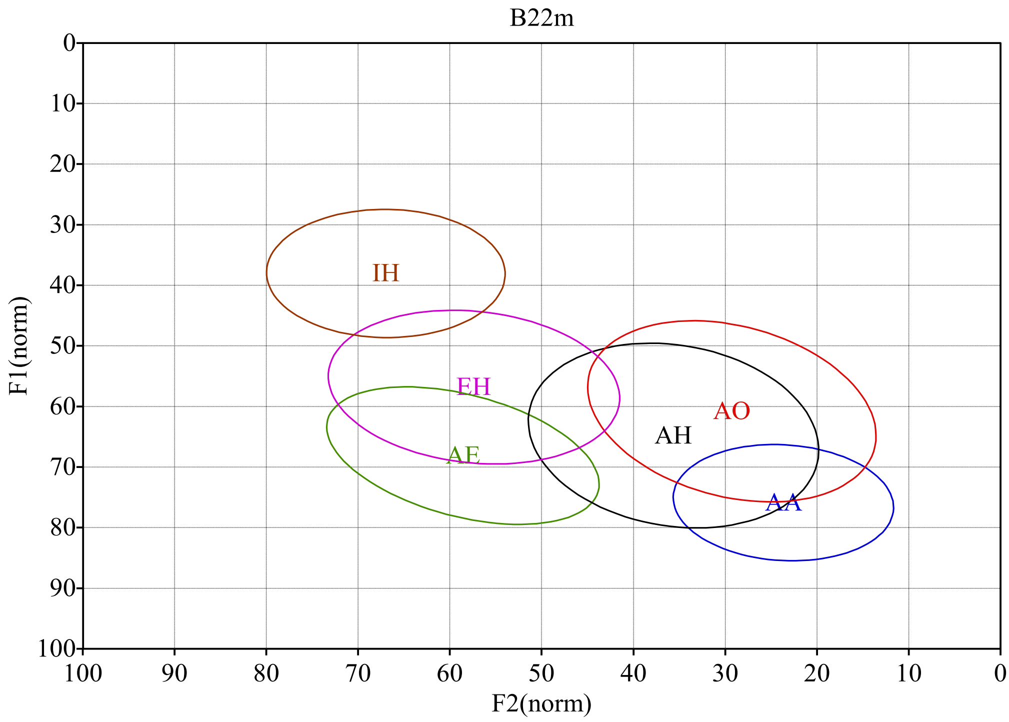
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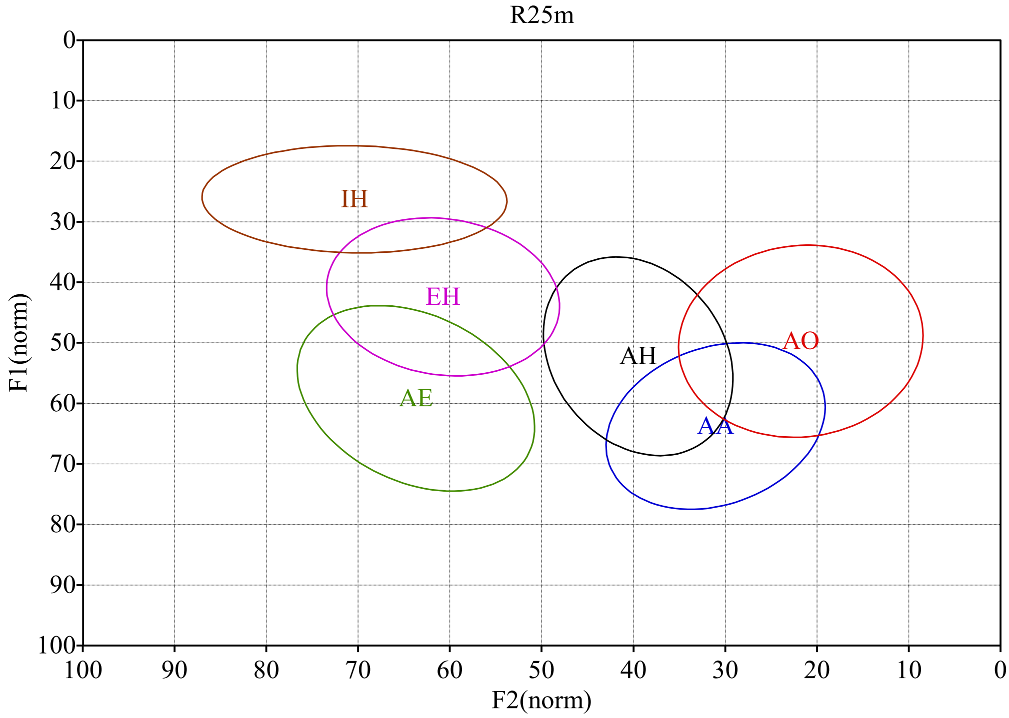
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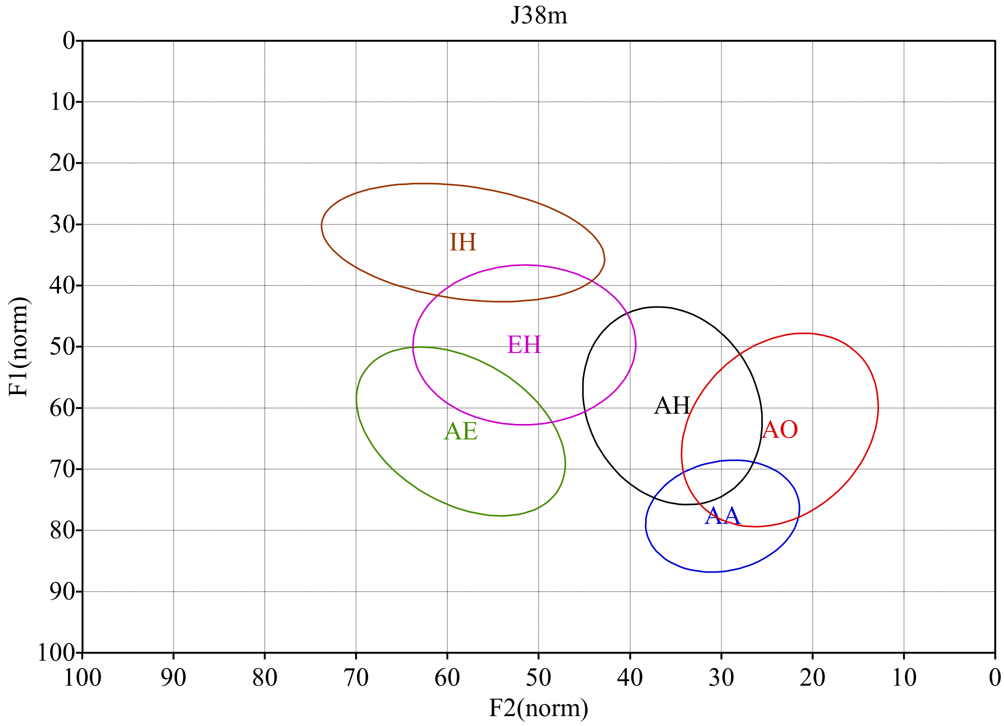
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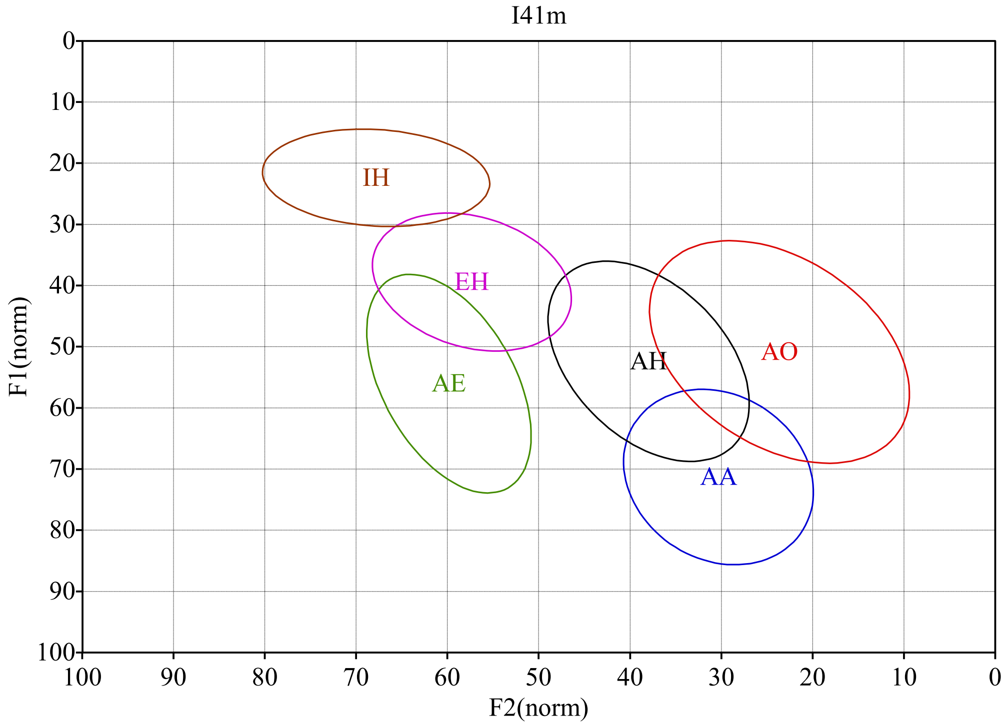
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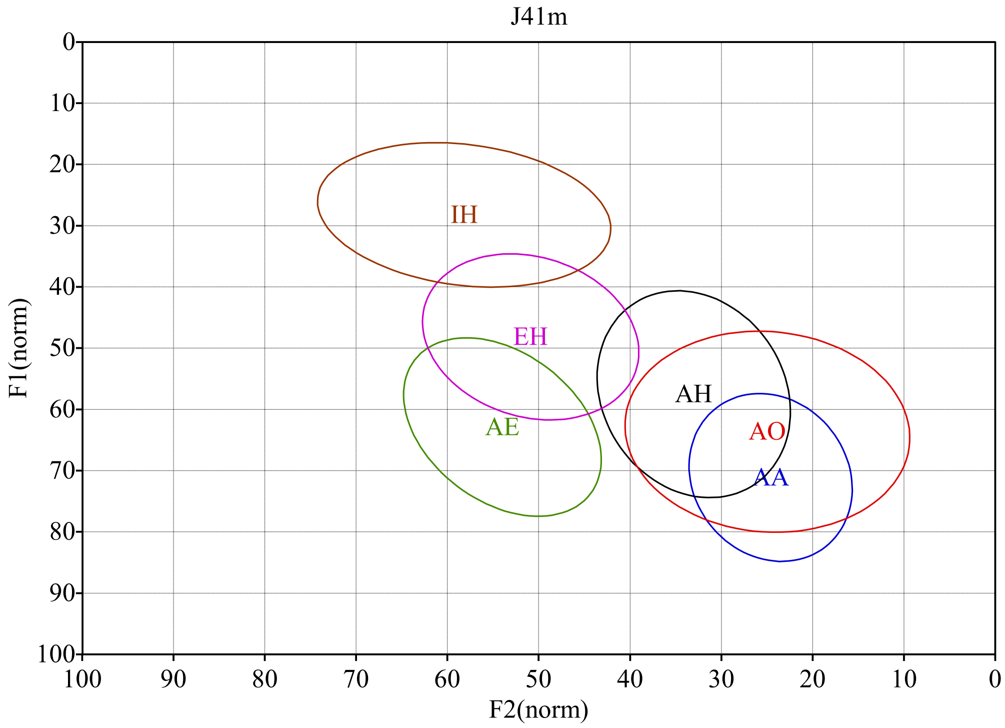
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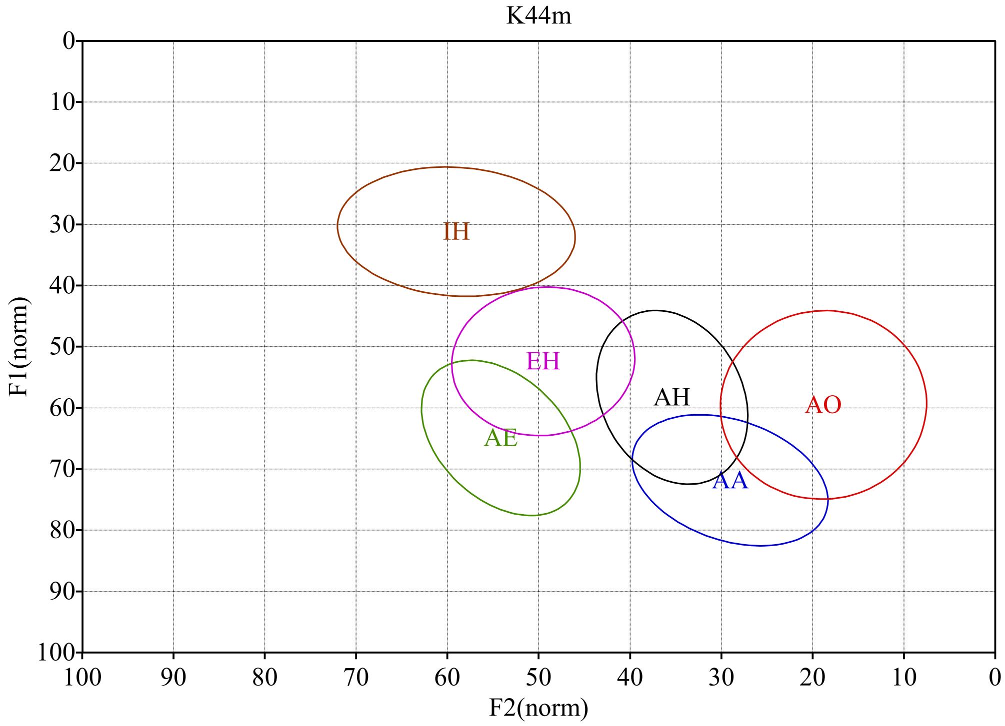
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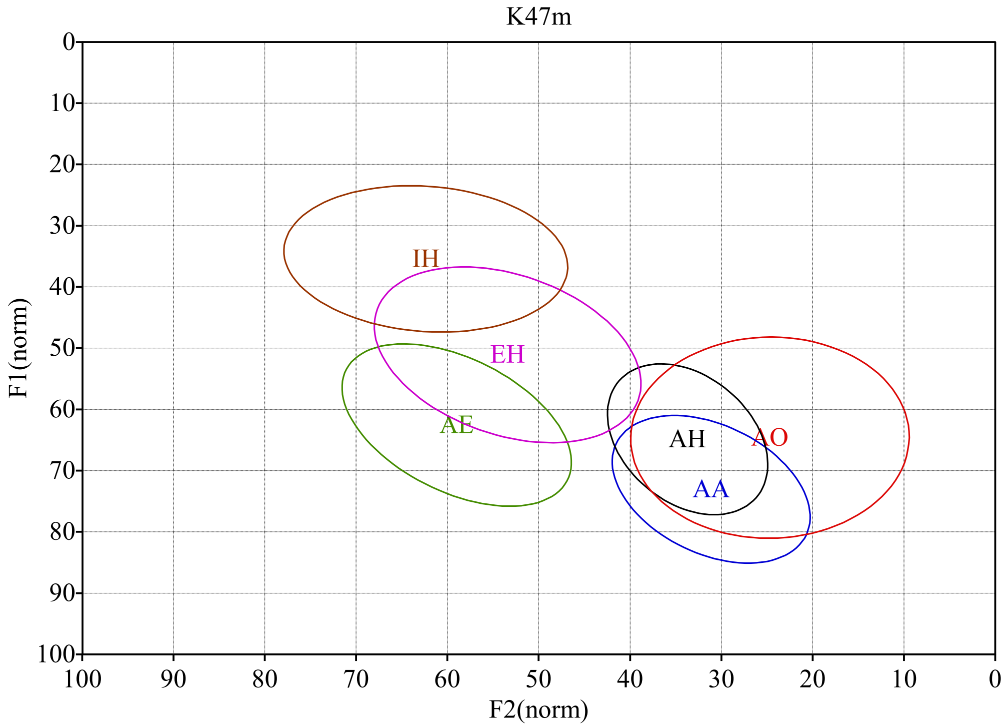
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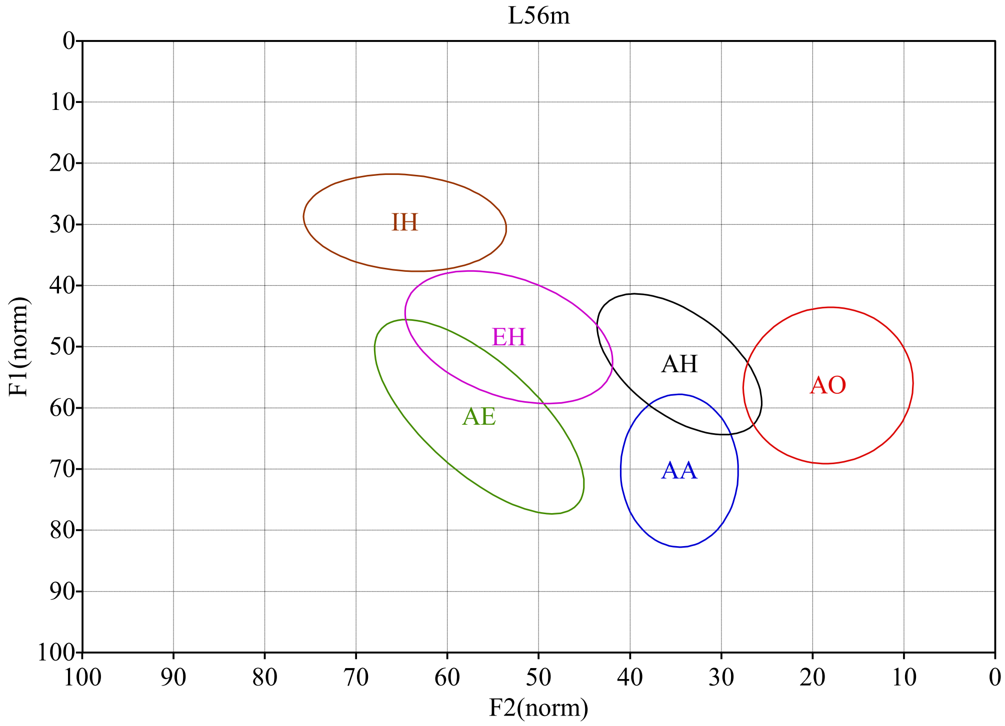
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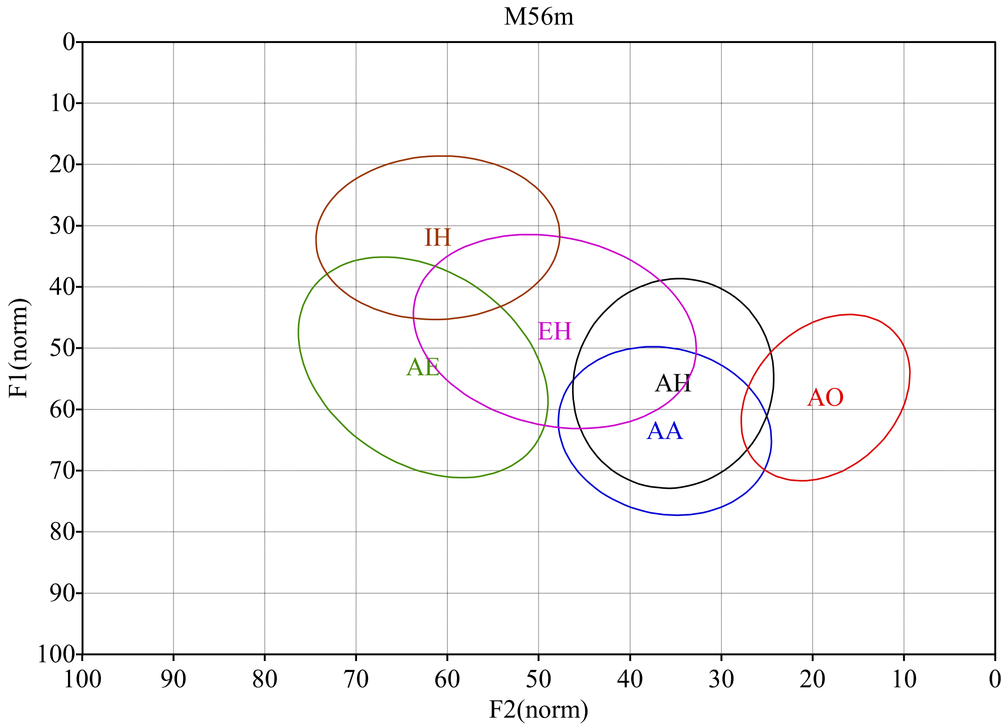
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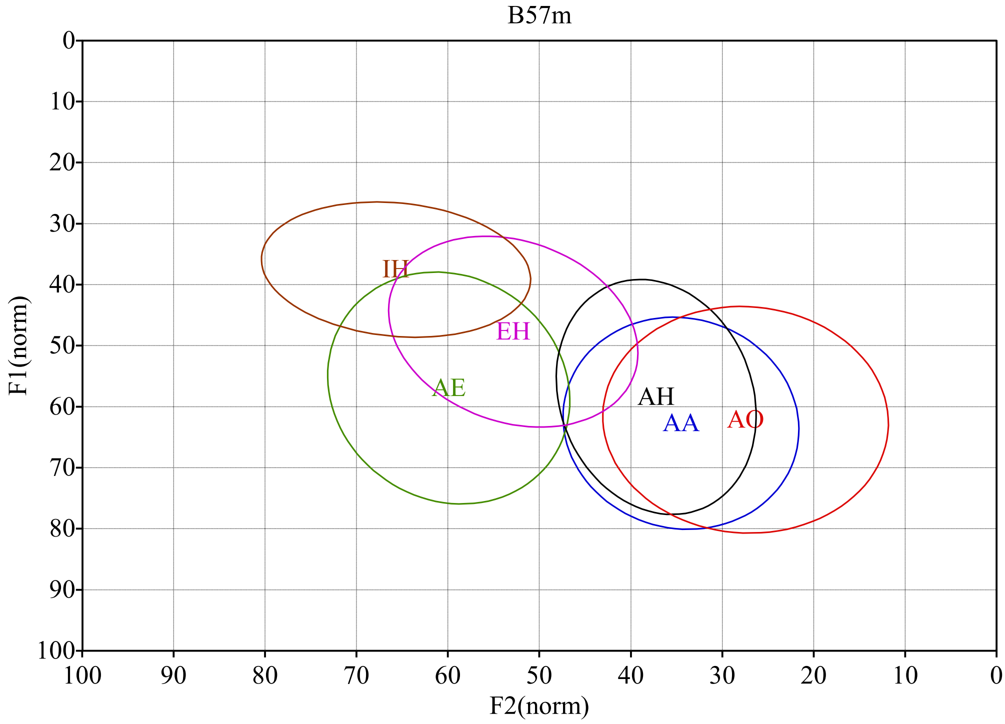
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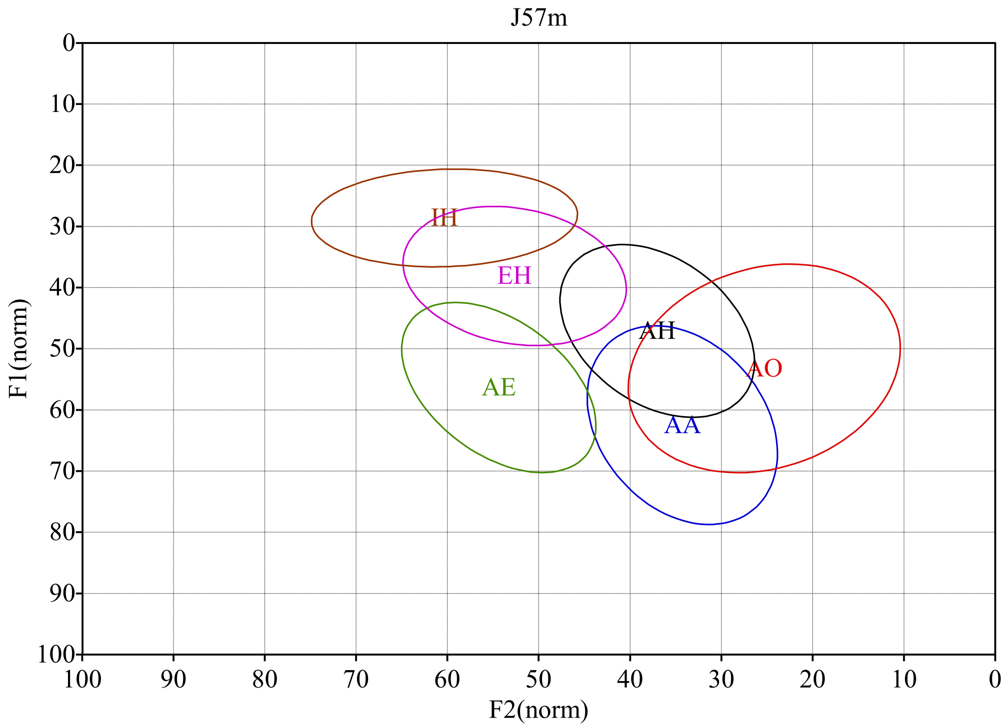
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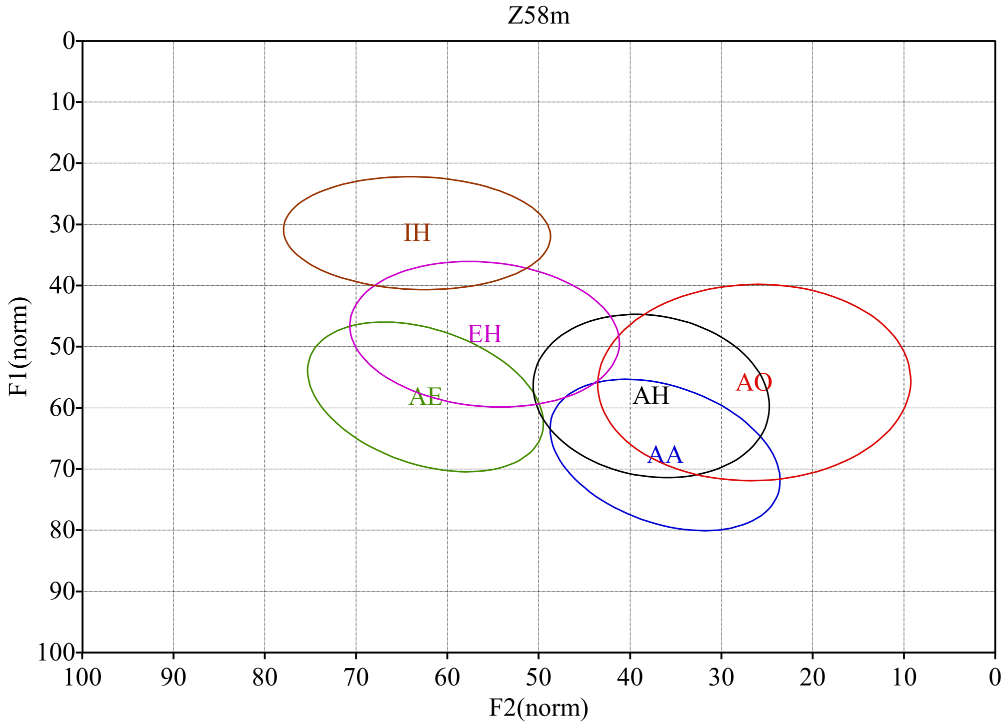
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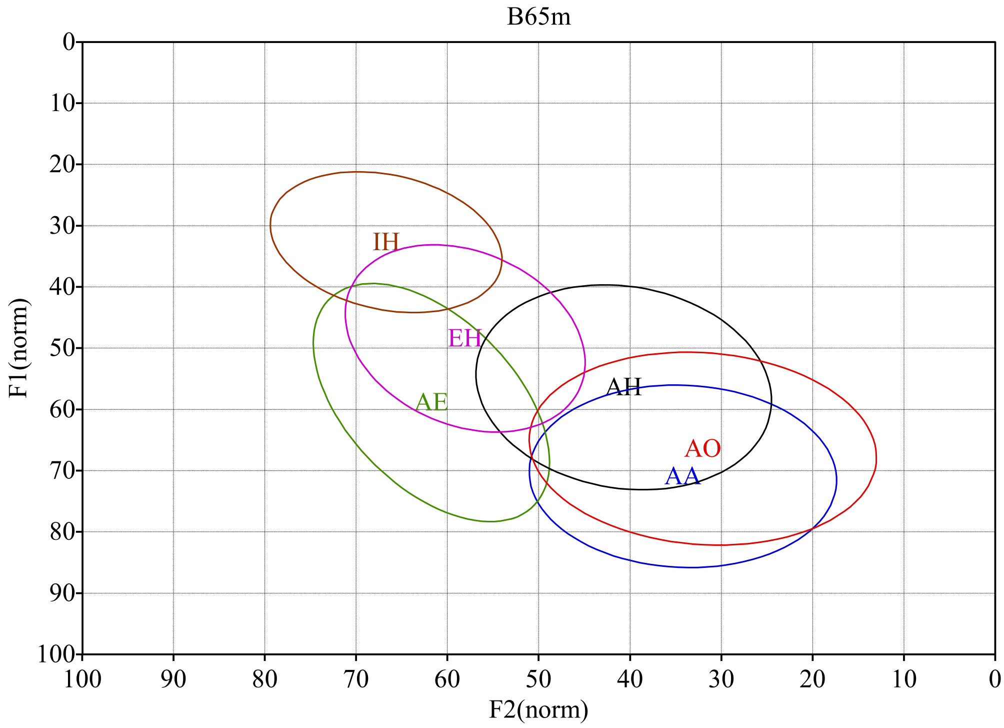
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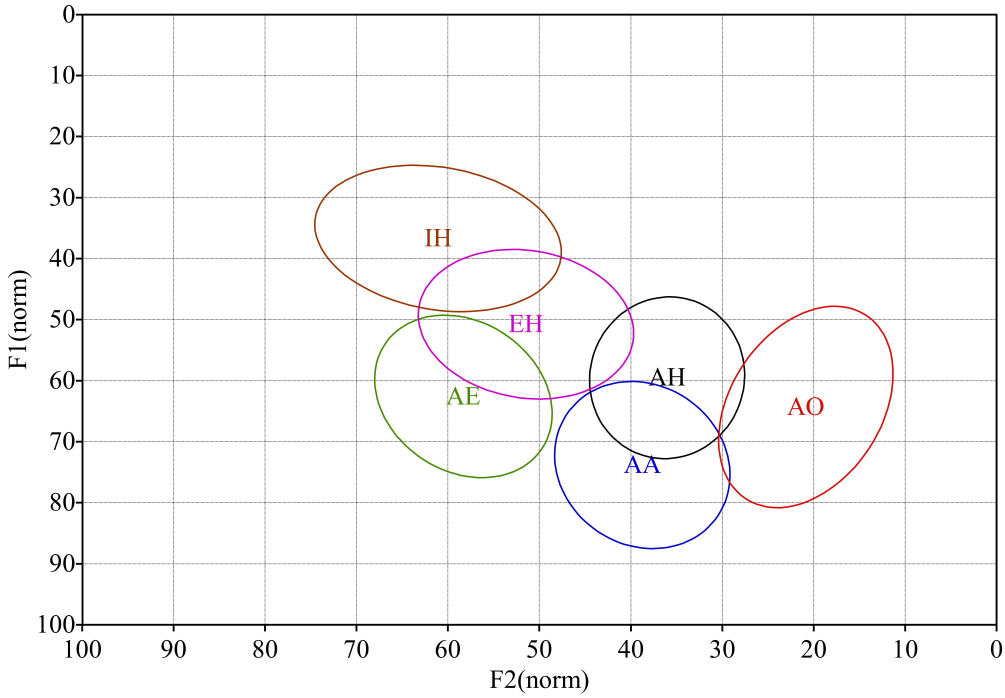
G77m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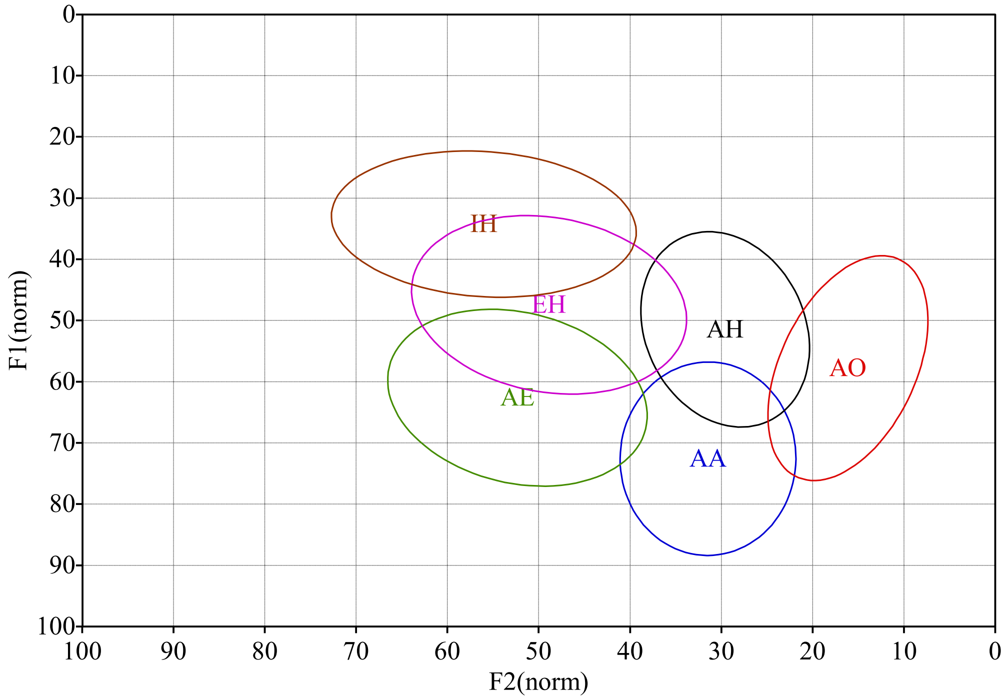
H82m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