4. RESULTS: (æ), (ɑ), AND (ɔ)

THE PRESENTATION OF RESULTS from this study of the pattern of vowel changes known as the Northern Cities Shift continues in this chapter with the examination of the lower half of the shift. Described are the findings regarding (æ), (ɑ), and (ɔ). These vowels exhibit a more restricted range of phonetic variation than those discussed in chapter 3, because the shifting they undergo is, for the most part, unidirectional. These variables are also distinguished from the others by the frequency of their shifting. Whereas the shifted variants of (ɛ), (ɪ), and (ʌ) were generally rare, with many speakers making little or no use of them, the shifted variants of (æ), (ɑ), and (ɔ) are quite common, in some cases appearing more frequently than the unshifted variants.

4.1. THE VARIABLE (æ)

4.1.1. PHONETIC DESCRIPTION OF THE VARIATION. The principal direction of movement for the low front vowel (æ) involves raising into the traditional range of the mid vowels /e/ and /ɛ/. According to previous accounts of the NCS (e.g., Labov 1994), this raising is preceded by a process of tensing which leads to fronting of the vowel. Also resulting from this tensing (according to Labov 1994) is the development of a schwa-like inglide, which appears when the vowel is raised. These tense, diphthongal variants of raised (æ) were observed in the present study, though not consistently. In some cases the raising produced variants sounding like lax monophthongs very near [ɛ]. Whether these lax variants serve as an alternative (with differing phonological and social distributions) to the tense forms in the same way as do, say, the directional variants of (ɛ), (ɪ), or (ʌ) is an important question but was not pursued in this study.

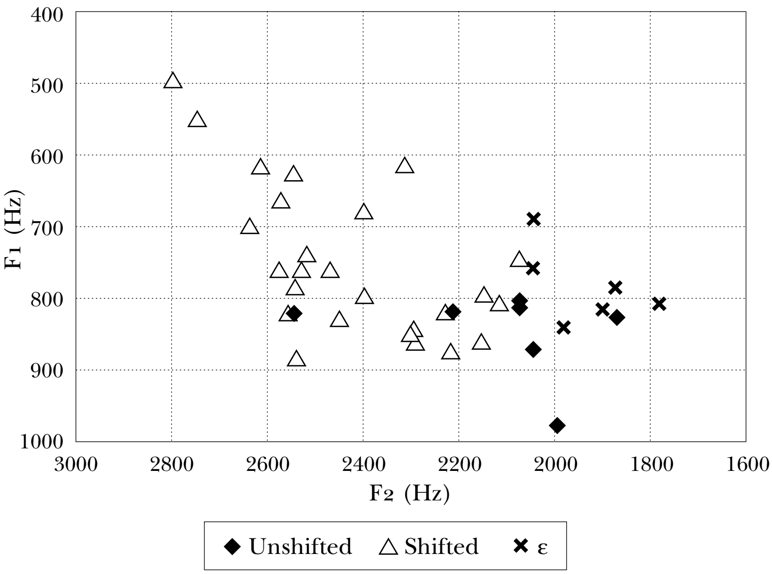
The coding scheme used for (æ) focused on raising and fronting, as the tense/lax differences (including the presence or absence of the inglide) were judged too difficult to distinguish consistently. Three degrees of shifting were recorded. Table 4.1 provides approximate phonetic representations of the variants.

An alternative means of representing the variation in the phonetic realization of (æ) is through the use of acoustic measures, as in figure 4.1. This diagram plots tokens of (æ) according to their formant frequencies (F1 × F2). The tokens were produced by speaker MN (PP, f, 18), who, in comparison with other speakers sampled, showed a high rate of shifting for this vowel. All of the tokens shown in figure 4.1 occurred in conversational speech. Most of the shifted variants are monophthongs, but there are a few diphthongal examples. In the latter cases, the measurements were

TABLE 4.1
Coded Variants of (æ)

0	*1*	*2*	*3*
[æ]	[æ^]	[ɛ˅]	[ɛ]

FIGURE 4.1
F1 and F2 Frequencies for Tokens of (æ) Produced by MN (PP, f, 18)



taken from the midpoint of the nucleus. Conservative tokens of (ε) produced by MN are also shown in this figure to provide a point of reference.

One of the most striking aspects of this acoustic picture is how little distance there is between (æ) and (ε). A good deal of intermingling is found even among the conservative variants of these vowels. When shifted, the F1 of (æ) is well within, and in many cases beyond, the range occupied by (ε). The shifted variants of (æ) are, however, pretty clearly distinguished from (ε) in terms of F2, as the raising is accompanied in almost all cases by fronting. In fact, a fair number of the tokens coded as shifted appear to involve little raising at all and instead are primarily fronted. Despite these indications, shifting of (æ) will still be referred to as a raising process in the following discussion because impressionistically this is how the shifted variants are perceived.

4.1.2. PHONOLOGICAL CONDITIONING OF (æ). From a description of how (æ) is shifting, we turn to consider factors that might influence that shifting. As with the vowels discussed earlier, we look first at the roles played by phonological factors before examining social influences in the next section.

The question of phonological conditioning was investigated, as before, by measuring the amount of (æ)-raising found in certain environments. The environments examined were those defined by the now very familiar factors related to the preceding and following consonantal contexts and to the context of the entire word (§3.1.2.1). Again, data from a subsample of the most active users of (æ) were employed in this analysis. Because shifting of this vowel is more common than with those discussed above, the pool of active users from which a subsample could be drawn was greater. The subsample included 16 speakers, representing half of the full sample.

The data from these speakers were pooled and indices were calculated to represent the amount of shifting found in various phonological contexts. These indices are provided in tables 4.2–4. An overall index, representing the amount of (æ)-shifting across all phonological environments, has also been calculated at 0.794 and is included in the tables as a reference point.

TABLE 4.2
Effects of Preceding Phonological Factors on (æ)-Shifting: General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Voicing (χ^2 = 4.59; p = .032)				
Voiceless	0.932	260 (39.0%)	406 (61.0%)	666
Voiced	0.804	266 (45.0%)	325 (55.0%)	591
Place (χ^2 = 59.21; p < .0001)				
Labial	0.850	191 (41.5%)	269 (58.5%)	460
Alveolar	0.680	332 (51.6%)	312 (48.4%)	644
Interdental	0.798	127 (47.6%)	140 (52.4%)	267
Palatal	0.471	23 (67.6%)	11 (32.4%)	34
Velar	1.217	26 (18.8%)	112 (81.2%)	138
Glottal	0.849	130 (45.8%)	154 (54.2%)	284
Manner (χ^2 = 56.34; p < .0001)				
Stop	0.954	204 (35.9%)	365 (64.1%)	569
Fricative	0.804	322 (46.8%)	366 (53.2%)	688
Nasal	0.893	43 (38.4%)	69 (61.6%)	112
Glide	0.889	4 (44.4%)	5 (55.6%)	9
/l/	0.654	131 (53.9%)	112 (46.1%)	243
/r/	0.505	125 (60.7%)	81 (39.3%)	206
#__	0.746	175 (52.9%)	156 (47.1%)	331
OVERALL	0.794			

The high indices in tables 4.2–4 offer a striking contrast to those in comparable tables in chapter 3 and illustrate the much greater frequency of shifting found for (æ). As before, differences in the indices indicate differing influences on (æ)-raising, with some phonological categories serving to promote raising, while others discourage it.

Among the contexts preceding the vowel (table 4.2), shifting is found to be strongly favored by a preceding velar and strongly disfavored by a preceding palatal or /r/. Somewhat weaker influences are seen with preceding stops and voiceless obstruents which promote shifting, and preceding alveolars and /l/ which disfavor shifting. The category of preceding interdentals did not show an exceptional index, though it should be noted that this score was based solely on tokens of the item *that*.

TABLE 4.3
Effects of Following Phonological Factors on (æ)-Shifting:
General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Voicing (χ^2 = 7.46; p = .006)				
Voiceless	0.772	562 (49.3%)	579 (50.7%)	1,141
Voiced	0.648	232 (57.1%)	174 (42.9%)	406
Place (χ^2 = 21.13; p < .0001)				
Labial	0.790	200 (48.3%)	214 (51.7%)	414
Alveolar	0.798	637 (45.5%)	764 (54.5%)	1,401
Interdental	1.347	10 (20.4%)	39 (79.6%)	49
Palatal	0.657	16 (45.7%)	19 (54.3%)	35
Velar	0.695	141 (54.4%)	118 (45.6%)	259
Manner (χ^2 = 54.10; p < .0001)				
Stop	0.757	477 (50.1%)	475 (49.9%)	952
Fricative	0.711	317 (53.3%)	278 (46.7%)	595
Nasal	0.891	197 (35.2%)	362 (64.8%)	559
/l/	1.385	13 (25.0%)	39 (75.0%)	52
Cluster (χ^2 = 0.44; p = .508)				
Cluster	0.761	209 (47.9%)	227 (52.1%)	436
No cluster	0.803	795 (46.2%)	927 (53.8%)	1,722
OVERALL	0.794			

TABLE 4.4
Effects of Word-Level Factors on (æ)-Shifting:
General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Number of syllables (χ^2 = 17.53; p = .001)				
1	0.781	599 (47.1%)	672 (52.9%)	1,271
2	0.857	227 (42.3%)	310 (57.7%)	537
3	0.824	110 (45.1%)	134 (54.9%)	244
4+	0.566	68 (64.2%)	38 (35.8%)	106
Syllable position (χ^2 = 11.95; p = .003)				
Initial	0.818	348 (45.3%)	421 (54.7%)	769
Medial	0.587	44 (58.7%)	31 (41.3%)	75
Final	1.189	9 (24.3%)	28 (75.7%)	37
OVERALL	0.794			

The most extreme indices among the categories related to the context following the vowel (table 4.3) are those for following interdentals and /l/, both of which strongly favor raising. Following nasals, which have been identified by previous studies (e.g., Labov 1994) as key promoters of (æ)-shifting, do show a favorable influence, though it is not overwhelmingly so. None of the categories of following context appears to have an extremely negative impact on raising, although fairly low indices are found with following voiced obstruents, palatals, velars, and fricatives.

The indices for the word-level categories suggest that raising is strongly favored when the vowel appears in a final syllable and strongly disfavored in a medial syllable. A comparable disfavorable context is found in words of four or more syllables, while little difference is seen among the other word-level categories.

The statistical significance of the differences suggested by the indices was investigated through a series of chi-square tests. These tests examined the distribution of shifted and unshifted tokens across the categories of each phonological factor. As before, differences in the degree of shifting (i.e., whether a token was coded as 1, 2, or 3) were ignored to allow for a straightforward comparison of raised versus unraised tokens. The distributions and the chi-square results are shown in tables 4.2–4.

In all but one case, the statistical testing identifies the differences associated with the phonological factors as significant. The sole exception is the cluster factor where the presence or absence of a tautosyllabic cluster seems to have little effect on (æ)-raising. As regards the other factors, the categories that seem to play key conditioning roles (e.g., preceding velar, following /l/) have already been discussed based on the index data in tables 4.2–4, though it should be reiterated that the chi-square tests evaluate the significance of the whole distribution of shifted and unshifted tokens across the set of categories (e.g., labial, alveolar) under each factor (e.g., preceding place, following manner), rather than the significance of each individual category. By way of concluding this discussion, the results are summarized in table 4.5, which list those categories identified as conditioning the (æ) variation.

TABLE 4.5
Phonological Conditioning of (æ)-Shifting: Summary of Effects

Favor Shifting	*Disfavor Shifting*
Preceding voiceless	Preceding alveolar
PRECEDING VELAR	PRECEDING PALATAL
Preceding stop	Preceding /l/
FOLLOWING INTERDENTAL	PRECEDING /r/
Following nasal	Following voiced
FOLLOWING /l/	Following palatal
FINAL SYLLABLE	Following velar
	Following fricative
	4+ SYLLABLES
	MEDIAL SYLLABLE

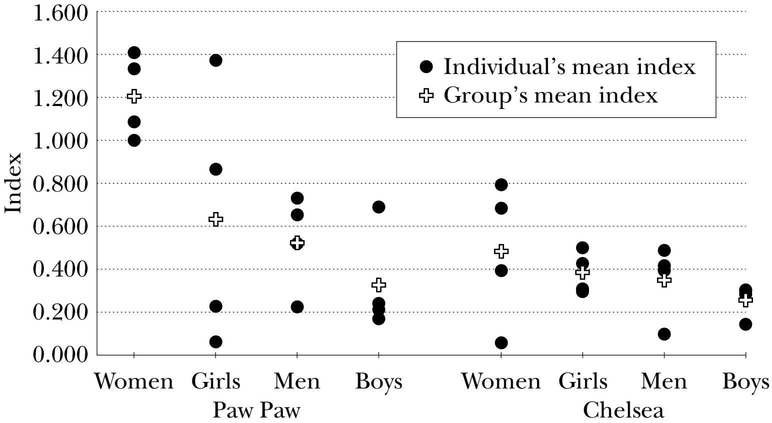
NOTE: Categories shown in small capitals strongly favored or disfavored shifting (i.e., their phonological index scores were greater than one standard deviation above or below the overall score).

4.1.3. SOCIAL DISTRIBUTION OF (æ). The variation demonstrated by (æ) is shaped by social as well as phonological factors, and it is to such external influences that the discussion now turns. Differences in the social distribution of (æ) are investigated here in terms of the broad divisions upon which the sample of speakers is structured (town, age, and sex), and usage of (æ) is measured by the individual indices calculated for each speaker in the sample (see §2.3.2).

An overview of social differences in the use of (æ) is provided by figure 4.2. This graph plots the (æ) indices for all 32 speakers sampled. As in similar graphs above, the speakers are grouped according to the factors of town, age, and sex. Group means have been calculated and appear in the graph, marked by a plus sign.

The similarity between the distribution in figure 4.2 and those seen with other vowels, especially (ɛ) (fig. 3.2), is striking. The downward slope of the points from left to right across the graph is repeated here. Once again there appears to be a substantial difference between the two towns, with Paw Paw speakers generally showing greater degrees of shifting than comparable Chelsea speakers. Also evident are age- and sex-based differences, as adults are

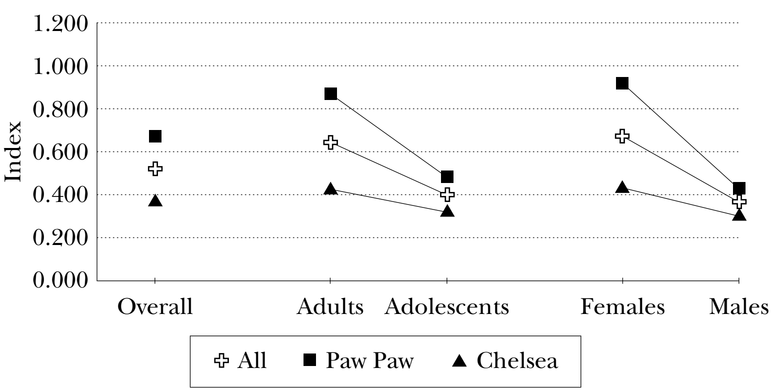
FIGURE 4.2
Indices for the Shifting of (æ) across the Sample of Speakers



seen as generally more advanced than adolescents and females as more advanced than males.

These observations are examined further by comparing the mean indices plotted in figure 4.3. This graph shows the group means for each of the three binary splits in the sample (Paw Paw vs. Chelsea, adults vs. adolescents, females vs. males). The data for the

FIGURE 4.3
Mean Indices for (æ) Comparing Social Factors: Town, Age, and Sex



latter two factors are further subdivided by town to allow for comparisons within each location.

The patterns suggested by the individual indices are confirmed by these mean data, as the lead in (æ)-shifting is found with Paw Paw speakers over Chelsea speakers, adults over adolescents, and females over males. The mean data also demonstrate the consistency of the age and sex patterns, which hold in both towns, though the differences appear to be much more pronounced in Paw Paw.

To assess the statistical significance of the observed social differences, the index data (the individual scores from each speaker) were subjected to a multiway ANOVA. The results of this analysis are listed in table 4.6.

Each of the three social factors is identified by ANOVA as significant with no significant interactional effects among them. These findings, thus, confirm the observations made throughout this discussion regarding the socially differentiated use of (æ).

The suggestions offered here will be given further consideration and elaboration below in chapter 5. For now, the discussion turns away from (æ) and toward its low, back neighbor, (ɑ).

TABLE 4.6
Multiway ANOVA Results for Social Factors in (æ) Variation

Factor	*F*	*df*	*p-value*
Town	9.04	1, 24	.006
Age	5.64	1, 24	.026
Sex	9.24	1, 24	.006
Town × Age	2.07	1, 24	.163
Town × Sex	3.12	1, 24	.090
Sex × Age	0.86	1, 24	.362
Town × Age × Sex	0.80	1, 24	.379

Multiple $r = .750$; multiple $r^2 = .562$.

4.2 THE VARIABLE (ɑ)

4.2.1. PHONETIC DESCRIPTION OF THE VARIATION. The low, back (ɑ), which is found in words of both the "short *o*" (e.g., *pot*) and "long *a*" (e.g., *father*) classes, undergoes fronting as part of the NCS. While some researchers (Eckert 1989a; Labov 1994) have reported variants as far front as [æ], such extreme forms were not observed in this study. Even the most fronted forms heard here were clearly back of the range of conservative /æ/ and were coded phonetically as central [a]. Phonetic representations of all the coded variants are shown in table 4.7.

While fronting was found to be the primary direction of shifting, there were occasional tokens heard as raised and having a schwa-like quality. Often this raising appeared to be a reduction phenomenon, though in some cases it was found in fully stressed syllables. In a handful of cases, the vowel was heard as both raised and fronted. Raised tokens were not coded as shifted unless they also involved fronting. Given the rarity of raising, the distinction will not be considered in the following analysis.

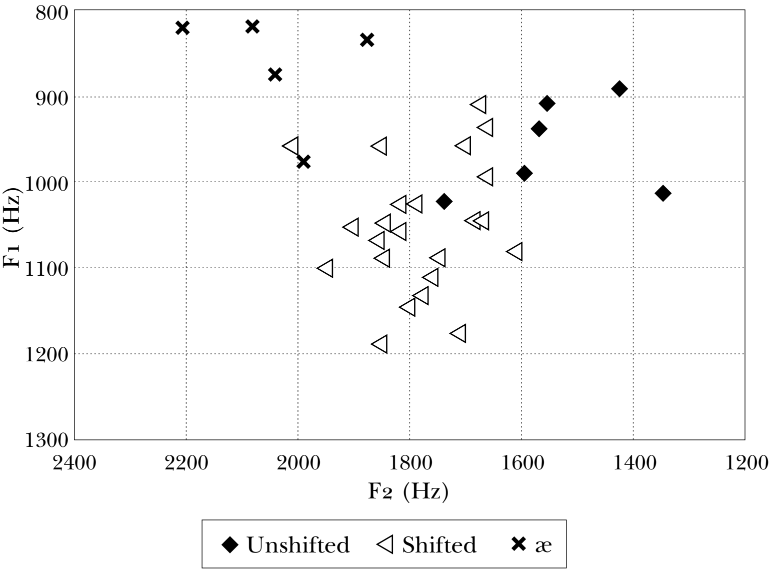
An acoustic picture of the variation in the realization of (ɑ) is provided in figure 4.4. This graph plots the formant frequencies for several (ɑ) tokens produced by speaker MN (PP, f, 18), whose (æ) data were seen above in figure 4.1. Conservative tokens of (æ) are also shown here for comparison purposes.

These acoustic data corroborate the impressionistic description of (ɑ)-shifting as a fronting process marked by an increase in F2. However, they also indicate a sizable variation in F1, suggesting that the fronting is often accompanied by lowering.[1] Interestingly, while fronting produces F2 frequencies just short of those seen with conservative tokens of (æ), the shifted tokens of (ɑ) are, in most cases, kept well clear of the (æ) range because of the concomitant lowering. This apparent lowering tendency was not dis-

TABLE 4.7
Coded Variants of (ɑ)

0	*1*	*2*	*3*
[ɑ]	[ɑ[<]]	[a[>]]	[a]

FIGURE 4.4
F1 and F2 Frequencies for Tokens of (ɑ) Produced by MN (PP, f, 18)



tinguished in the auditory coding done here, though it seems possible that it contributed to the impression that (ɑ) was not "fronted" as far as [æ].

4.2.2. PHONOLOGICAL CONDITIONING OF (ɑ). The investigation of factors conditioning the variation described in the previous section begins by considering possible phonological influences. Such influences were examined using the familiar procedure of calculating indices of (ɑ)-shifting for each of several phonological categories. The data used for this analysis were taken from a subsample of speakers, which, as for (æ), contained the 16 most active users of the (ɑ) variable. The indices from these pooled data are given in tables 4.8–10. Also shown is the overall index of 0.664, which represents the degree of shifting across all phonological contexts.

As in earlier tables, evidence of conditioning influence is seen in the differences across categories. Among the categories of preceding context (table 4.8), high degrees of shifting are found with preceding voiceless obstruents, palatals, glottals (/h/), and nasals.

TABLE 4.8
Effects of Preceding Phonological Factors on (ɑ)-Shifting:
General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Voicing (χ^2 = 25.49; p < .0005)				
Voiceless	0.915	125 (42.4%)	170 (57.6%)	295
Voiced	0.566	170 (63.7%)	97 (36.3%)	267
Place (χ^2 = 8.67; p = .070)				
Labial	0.762	110 (54.5%)	92 (45.5%)	202
Alveolar	0.634	414 (58.9%)	289 (41.1%)	703
Palatal	0.853	31 (45.6%)	37 (54.4%)	68
Velar	0.660	169 (58.1%)	122 (41.9%)	291
Glottal	0.833	18 (42.9%)	24 (57.1%)	42
Manner (χ^2 = 66.39; p < .0005)				
Stop	0.760	235 (52.2%)	215 (47.8%)	450
Fricative	0.705	60 (53.6%)	52 (46.4%)	112
Nasal	0.885	127 (44.3%)	160 (55.7%)	287
Glide	0.125	36 (90.0%)	4 (10.0%)	40
/l/	0.508	172 (68.8%)	78 (31.2%)	250
/r/	0.467	112 (67.1%)	55 (32.9%)	167
#__	0.572	124 (63.9%)	70 (36.1%)	194
OVERALL	0.664			

By contrast, preceding /l/, /r/, and glides (which here most involves /w/) are seen as disfavoring shifting.

Among the categories of following context (table 4.9), the highest index is that of following /l/, while the opposite extreme is found with following palatals. The latter result, however, should be approached with caution, as this index is largely based on occurrences of *watch* (20/37 tokens), an item which may be less likely to be shifted because of the context preceding the vowel (see §5.1.2.4). None of the other categories appears to have a overwhelmingly negative effect on shifting, but following interdentals, velars, and tautosyllabic clusters all seem to be fairly strong promoters of the change.

Much less differentiation is evident among the word-level categories. The only notable index is that for two-syllable words, which seem to favor shifting.

TABLE 4.9
Effects of Following Phonological Factors on (ɑ)-Shifting:
General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Voicing (χ^2 = 0.007; p = .935)				
Voiceless	0.599	508 (60.8%)	327 (39.2%)	835
Voiced	0.628	135 (60.5%)	88 (39.5%)	223
Place (χ^2 = 21.59; p < .0005)				
Labial	0.688	189 (55.6%)	151 (44.4%)	340
Alveolar	0.659	590 (58.1%)	426 (41.9%)	1,016
Interdental	0.808	14 (53.8%)	12 (46.2%)	26
Palatal	0.081	34 (91.9%)	3 (8.1%)	37
Velar	0.840	39 (48.1%)	42 (51.9%)	81
Manner (χ^2 = 20.55; p < .0005)				
Stop	0.594	610 (61.4%)	384 (38.6%)	994
Fricative	0.781	33 (51.6%)	31 (48.4%)	64
Nasal	0.756	179 (53.3%)	157 (46.7%)	336
/l/	0.962	44 (41.5%)	62 (58.5%)	106
Cluster (χ^2 = 3.69; p = .055)				
Cluster	0.841	29 (46.0%)	34 (54.0%)	63
No cluster	0.656	837 (58.2%)	600 (41.8%)	1,437
OVERALL	0.664			

TABLE 4.10
Effects of Word-Level Factors on (ɑ)-Shifting:
General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Number of syllables (χ^2 = 14.38; p = .002)				
1	0.617	583 (60.9%)	374 (39.1%)	957
2	0.820	149 (48.7%)	157 (51.3%)	306
3	0.656	110 (56.4%)	85 (43.6%)	195
4+	0.643	24 (57.1%)	18 (42.9%)	42
Syllable position (χ^2 = 1.01; p = .603)				
Initial	0.764	237 (51.3%)	225 (48.7%)	462
Medial	0.604	31 (58.3%)	22 (41.5%)	53
Final	0.750	15 (53.6%)	13 (46.4%)	28
OVERALL	0.664			

In order to evaluate the statistical strength of these observations, the data were subjected to chi-square testing. As before, these tests examined the distribution of shifted and unshifted tokens within each phonological factor. These distributions and the test results are listed in tables 4.8–10.

The chi-square testing identifies as significant the factors of voicing and manner for the preceding context and place and manner for the following context as well as the word-level factor of syllable number. The results for the factor of preceding place and especially for the factor of following cluster approach significance, though with their *p*-values lying just outside the alpha level of .05, these effects are not strong enough to safely rule out the possibility that these distributions are due to chance.

For the most part, these statistical results reveal no great surprises. Based on the index data (tables 4.8–10), we might have expected to find the voicing and manner differences of the preceding context and the place and manner differences of the following context significant, just as we suspected the voicing differences in the following consonant and those related to the position factor to be insignificant. More unexpected were the findings on the place differences in the preceding context and those for the syllable number factor. In the former case, the index data suggest that preceding palatals and glottals promote shifting, but the number of tokens available for these categories was apparently too low to achieve statistical significance. This also appears to be the case with the cluster factor, where the chi-square results are very close to significant. In the case of the syllable number factor, the opposite situation seems to apply. While the only notable index score was that of the two-syllable category and that was still within a standard deviation of the overall index, the fact that it was based on so many tokens ($N = 306$) probably accounts for its statistical significance.

This discussion of phonological conditioning concludes with a summary list of the results. This list appears in table 4.11.

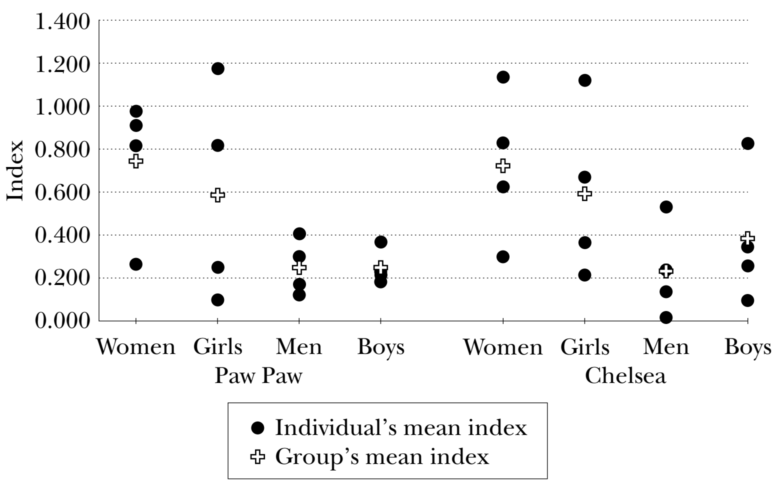
4.2.3. SOCIAL DISTRIBUTION OF (ɑ). As has been seen with the other elements in the NCS, the variation in (ɑ) involves patterns that are socially, as well as linguistically, defined. Social differences in the use of (ɑ) are examined in figure 4.5, which shows the index scores for the full sample of speakers. The speakers are grouped, as usual, by town, age, and sex, and the mean scores for each group are also shown (marked by plus signs).

TABLE 4.11
Phonological Conditioning of (ɑ)-Shifting: Summary of Effects

Favor Shifting	*Disfavor Shifting*
PRECEDING VOICELESS	PRECEDING GLIDE*
PRECEDING NASAL	Preceding /l/
Following interdental	PRECEDING /r/
Following velar	Following palatal*
FOLLOWING /l/	
Two-syllable words	

NOTE: Categories shown in small capitals strongly favored or disfavored shifting (i.e., their phonological index scores were greater than one standard deviation above or below the overall score). Those marked with asterisks are represented by a limited data set (see discussion in text here and in §5.1.2).

FIGURE 4.5
Indices for the Shifting of (ɑ) across the Sample of Speakers



The social distribution of (ɑ) offers a picture rather different than those seen with other vowels. Most notable is the absence of the usual differences between the towns. Instead of the Paw Paw lead that we have come to expect, we find a much greater balance. Also missing are the generational differences, as adults and adolescents of both sexes show roughly the same amount of shifting. The strongest social differences are between the sexes: in both towns and both age groups, females are generally found to lead males in (ɑ)-shifting.

Another view of these social differences is provided by figure 4.6. This figure plots the mean indices for each of the groups defined by the main social factors of town, age, and sex. Because the differences between the sexes are the most dramatic, the data for the town and age factors are further subdivided by sex.

The mean scores confirm the primary importance of the sex differences, which are shown to hold consistently across towns and age groups. The difference is much greater among adults, however, than among adolescents, due to an interesting reversal. Whereas among female speakers, adults (women) lead adolescents (girls), for males the opposite is true. Similarly, the female lead is greater in Paw Paw than in Chelsea, because, while little difference is found between the female means of each town, the Chelsea males show a higher average index than their Paw Paw counterparts.

FIGURE 4.6

Mean Indices for (ɑ) Comparing Social Factors: Town, Age, and Sex

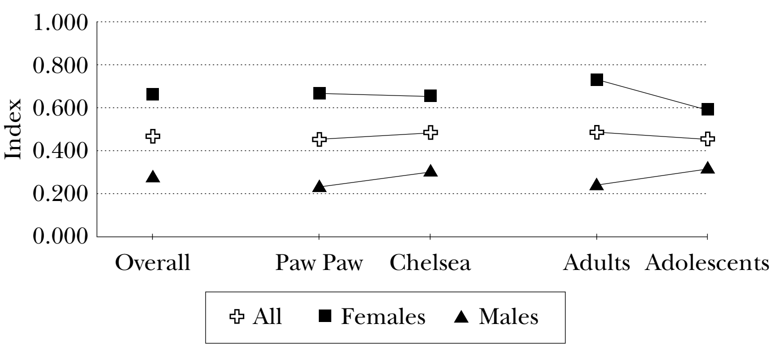


TABLE 4.12
Multiway ANOVA Results for Social Factors in (ɑ) Variation

Factor	*F*	*df*	*p-value*
Town	0.05	1, 24	.823
Age	0.09	1, 24	.726
Sex	11.56	1, 24	.002
Town × Age	0.16	1, 24	.698
Town × Sex	0.08	1, 24	.777
Sex × Age	0.94	1, 24	.342
Town × Age × Sex	0.08	1, 24	.784

Multiple $r = .592$; multiple $r^2 = .351$.

The statistical significance of the social patterning was evaluated through a multiway ANOVA of the individual index data. The results of this procedure are listed in table 4.12. The only social factor shown to be significant is sex. This finding confirms the indications of figures 4.5 and 4.6, which suggest shifting was much more common among female speakers than among males. Also, the fact that no interactional effects were identified as significant indicates the consistency of the sex-based pattern and suggests that there is general agreement across the sample that (ɑ) functions as a gender marker.

This section has examined linguistic and social factors shaping the (ɑ) variation. Further consideration of the issues raised here is given in chapter 5. For now, the discussion turns to the final NCS element to be examined, the back vowel (ɔ).

4.3. THE VARIABLE (ɔ)

4.3.1. PHONETIC DESCRIPTION OF THE VARIATION. Our tour through the vowels of the Northern Cities Shift concludes with an investigation of back rounded (ɔ). This vowel is classified by some accounts (e.g., Ladefoged 1982) as mid and by others (e.g., Kenyon and Knott 1953) as low. Regardless of how it is labeled, the vowel (in its conservative state) is distinguished from the maximally low /ɑ/ in height as well as rounding. These distinguishing features are precisely what is lost during the NCS, as the vowel is lowered and unrounded.

The coding system distinguished the usual three degrees of shifting for (ɔ), but the differences coded involved rounding as well as movement of the vowel.[2] The first degree of shifting was used to code tokens that were heard as relatively high and back but only slightly rounded. Tokens judged to be low and slightly rounded were coded as the second degree of shifting. The most extremely shifted tokens were those heard as low and clearly unrounded. These variants are represented phonetically in table 4.13.

In addition to the main path of shifting illustrated by these variants, there were several tokens that appeared to involve a process of fronting without substantial lowering. This process was often accompanied by some degree of unrounding as the vowel approached the quality of [ʌ]. These fronted tokens were coded as shifted only when they included the unrounding. Fronting of (ɔ) was a relatively rare phenomenon compared to the more frequent lowering and is not treated separately in the following analysis, though it certainly merits consideration in future research.

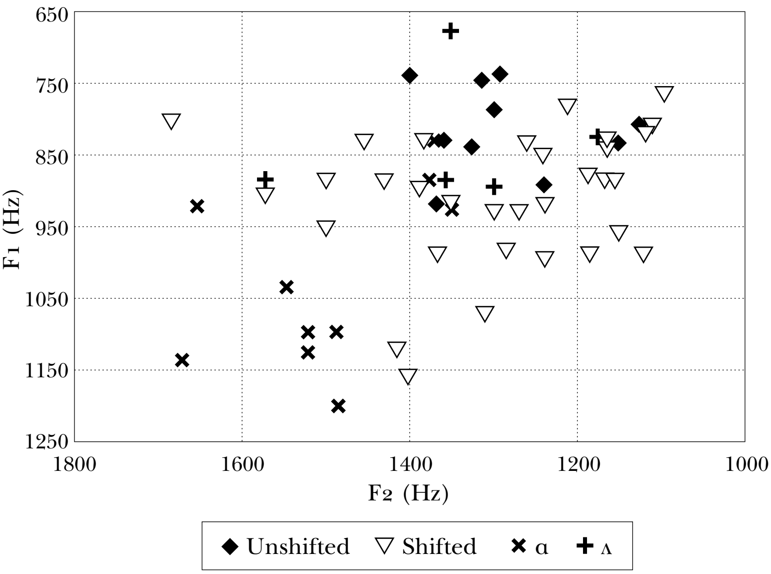
An acoustic representation of the (ɔ) variation is provided in figure 4.7. Shown are formant frequency measures for several tokens of (ɔ) produced by speaker JH (C, f, 16), who had the highest index of shifting for this vowel. For comparison purposes, tokens of (ʌ) and (ɑ) that were judged to be conservative are also shown. All of the (ɔ) tokens marked as shifted come from conversational data, but the unshifted tokens, as well as the examples of (ʌ) and (ɑ), are taken from the word-list reading because this speaker produced so few unshifted tokens in free speech.

These data show more than the usual amount of overlap among categories. The distinction between shifted and unshifted

TABLE 4.13
Coded Variants of (ɔ)

0	*1*	*2*	*3*
[ɔ]	[ɔ̜]	[ɒ]	[ɑ]

FIGURE 4.7
F1 and F2 Frequencies for Tokens of (ɔ) Produced by JH (C, f, 16)



(ɔ) is reflected primarily in the vertical dimension, as most of the unshifted tokens appear in the upper portion of the diagram with F1 values below 850 Hz. Quite a few shifted tokens also appear in this range, though many more are found below it. The distinction is less clear in terms of F2, as shifted tokens appear on both sides of the unshifted. It might therefore be concluded that, in addition to lowering, shifting sometimes involves fronting and sometimes backing. It is more likely, however, that the F2 variation shown here reflects differences in lip rounding in addition to or instead of differences in the position of the tongue body. If this is the case, then the variants showing lower F2 values may simply be (more) rounded without necessarily being more back. It should also be noted that the acoustic effects of lip rounding are commonly seen in the frequency of F3 as well. Because F3 is not represented here, this picture of tremendous overlap among variants may not accurately reflect the perceptual differences among them.

Shifting brings (ɔ) well within the range occupied by (ɑ). For this speaker, we find a few (ɑ) tokens with F1 values in the more conservative neighborhood of around 900 Hz, but most show the extreme lowering that was seen earlier (fig. 4.4). Even these very low variants, however, are rivaled by some of the shifted tokens of (ɔ).

As a final observation on this acoustic picture, we note the high degree of overlap in the (ɔ) and (ʌ) distributions. A similar situation was seen in the discussion of (ʌ)-shifting (see fig. 3.7). While the spectral (F1 × F2) data suggest there is little or no contrast between these vowels, they are perceptually quite distinct. This distinction involves lip rounding and, therefore, may not be fully reflected in the absence of F3 data. Perhaps more importantly, however, the contrast involves temporal differences between the vowels, as /ɔ/ is typically much longer.

4.3.2. PHONOLOGICAL CONDITIONING OF (ɔ). The question of possible influences from phonological factors on the shifting of (ɔ) was examined using the same procedures that were applied for other vowels. Indices representing the amount of shifting occurring in each of several phonological contexts were calculated using pooled data from a subsample of speakers. As before, the 16 most active users of this variable were selected for the subsample. The resulting indices are given in tables 4.14–16. An overall index of shifting across all categories was also calculated (at 1.308) and appears in each figure as a reference point.

For the factors involving the preceding context (table 4.14), the greatest differentiation is found with the manner categories. These indices suggest that shifting is strongly favored by preceding glides (which here are represented only by /w/) and /r/,[3] somewhat less strongly favored by preceding fricatives, and strongly disfavored by preceding nasals and /l/. The place differences appear to have less of an impact, though it does seem that preceding glottals promote shifting, while preceding interdentals have the opposite effect; still, both of these results are based on lexically restricted data sets, with most of the glottal cases involving tokens of *hall* and all of the interdental cases involving tokens of *thought*. Only minor differences are seen with the voicing factor.

TABLE 4.14
Effects of Preceding Phonological Factors on (ɔ)-Shifting:
General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Voicing (χ^2 = 1.39; p = .238)				
Voiceless	1.339	52 (15.5%)	284 (84.5%)	336
Voiced	1.235	24 (20.2%)	95 (79.8%)	119
Place (χ^2 = 3.15; p = .534)				
Labial	1.284	50 (17.7%)	232 (82.3%)	282
Alveolar	1.305	49 (15.3%)	272 (84.7%)	321
Interdental	1.219	5 (15.6%)	27 (84.4%)	32
Velar	1.333	11 (11.1%)	88 (88.9%)	99
Glottal	1.393	6 (21.4%)	22 (78.6%)	28
Manner (χ^2 = 17.85; p = .007)				
Stop	1.243	49 (17.0%)	239 (83.0%)	288
Fricative	1.431	27 (16.2%)	140 (83.8%)	167
Nasal	1.031	14 (21.9%)	50 (78.1%)	64
Glide	1.576	2 (3.0%)	64 (97.0%)	66
/l/	1.122	25 (21.7%)	90 (78.3%)	115
/r/	1.532	4 (6.5%)	58 (93.5%)	62
#__	1.324	54 (14.7%)	313 (85.3%)	367
OVERALL	1.308			

The situation with the factors related to the context following the vowel (table 4.15) is largely the reverse, as greater differentiation is found in the voicing and place categories than in those for manner. Shifting is clearly favored by following voiced obstruents, labials,[4] velars, fricatives, and clusters. As for disfavorable contexts, the lowest indices are found with following interdentals and palatals, though both of these scores are based on an unreliably low number of tokens. Though not as low as these, the score for following nasals is more reliable, and it, too, suggests a disfavorable influence on shifting. Among the categories showing little or no impact on shifting is the context of final position, an environment that has not previously been examined because the other vowels never occur word-finally.

Among the word-level categories, none appears to offer a strongly favorable context. Shifting appears to be disfavored in words of three or four-plus syllables, and in medial syllables. The indices for the latter two categories, however, are based on too few tokens to be reliably evaluated.

The significance of these suggested patterns was evaluated through chi-square testing on the distributions of shifted and unshifted tokens in each category. These data are provided in tables 4.14–16.

One important point to note about the data in these tables is that, for (ɔ), unlike for the vowels examined earlier, almost all phonological categories show more shifted tokens than unshifted, and many categories show a great deal more shifted tokens. This is, of course, a consequence of the fact that shifted variants of (ɔ), as

TABLE 4.15
Effects of Following Phonological Factors on (ɑ)-Shifting: General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Voicing				
Voiceless	1.386	51 (12.7%)	351 (87.3%)	402
Voiced	1.850	0 (0.0%)	20 (100%)	20
Place (χ^2 = 11.88; p = .003)				
Labial	1.484	13 (10.2%)	115 (89.8%)	128
Alveolar	1.238	129 (18.2%)	580 (81.8%)	709
Interdental	1.000	0 (0.0%)	1 (100%)	1
Palatal	1.000	0 (0.0%)	6 (100%)	6
Velar	1.446	21 (9.9%)	192 (90.1%)	213
Manner (χ^2 = 8.53; p = .080)				
Stop	1.343	34 (14.4%)	202 (85.6%)	236
Fricative	1.489	17 (9.1%)	169 (90.9%)	186
Nasal	1.167	19 (16.7%)	95 (83.3%)	114
/l/	1.259	93 (17.9%)	428 (82.1%)	521
__#	1.306	12 (16.7%)	60 (83.3%)	72
Cluster (χ^2 = 7.56; p = .006)				
Cluster	1.500	9 (7.1%)	117 (93.9%)	126
No cluster	1.284	166 (16.6%)	837 (83.4%)	1,003
OVERALL	1.308			

NOTE: No test was possible for the voicing factor because of the lack of unshifted tokens for the voiced category. Because there were too few tokens representing the interdental and palatal categories for reliable testing, they were omitted in the place test.

analyzed here, appear so frequently and are much more common than shifted forms of any of the other NCS variables. For this reason, it seems clear that practically all of the phonological categories examined here can be said to promote shifting of (ɔ). Therefore, this analysis indicates which environments are more strongly favorable and which are less strongly favorable to shifting.

For the most part these statistical results in tables 4.14–16 confirm the suggestions made above. In the context preceding the vowel, differences of manner are most important, as indicated by the significant chi-square result ($p = .007$) associated with these differences, while insignificant results were found for the voicing and place factors in table 4.14. In the following context, however, it is the place differences that play the greatest role, as they were significant ($p = .003$) while the manner differences were not. The differences related to the cluster factor are also shown to be significant, but those related to the voicing status of the following consonant could not be evaluated due to the low number of tokens for the voiced category. Finally, neither of the word-level categories was found to be significant.

TABLE 4.16
Effects of Word-Level Factors on (ɔ)-Shifting:
General Indices, Frequency of Shifting, and Chi-Square Results

	Index	*Unshifted*	*Shifted*	*Total*
Number of syllables ($\chi^2 = 1.67$; $p = .435$)				
1	1.314	99 (14.8%)	570 (85.2%)	669
2	1.323	67 (15.7%)	360 (84.3%)	427
3	1.067	7 (23.3%)	23 (76.7%)	30
4+	0.333	2 (66.7%)	1 (33.3%)	3
Syllable position ($\chi^2 = 2.66$; $p = .264$)				
Initial	1.265	51 (16.5%)	259 (83.5%)	310
Medial	1.000	3 (37.5%)	5 (62.5%)	8
Final	1.394	22 (15.5%)	120 (84.5%)	142
OVERALL	1.308			

NOTE: Because there were too few tokens representing the 4+ syllable category for reliable testing, these data were omitted in the test for syllable number.

The individual categories that likely contributed to the findings of significance have already been discussed. This discussion is summarized in table 4.17.

4.3.3. SOCIAL DISTRIBUTION OF (ɔ). As with all respectable sociolinguistic variables, the (ɔ) variation is shaped by social as well as linguistic factors. Social differences in the use of (ɔ) are evident in figure 4.8, which displays the index scores for the full sample of speakers. The format of this graph is familiar from the discussion of the other vowels. As before, group means are indicated by plus signs.

The social distribution of (ɔ) resembles that seen with (ɑ) and, therefore, is rather different from those of the other four vowels examined. The clear differences between Paw Paw and Chelsea that characterized the distributions of (ɛ), (ɪ), (ʌ), and (æ) are again absent here. Furthermore, the sex-based distinctions that were seen with (ɑ) are repeated in this distribution.

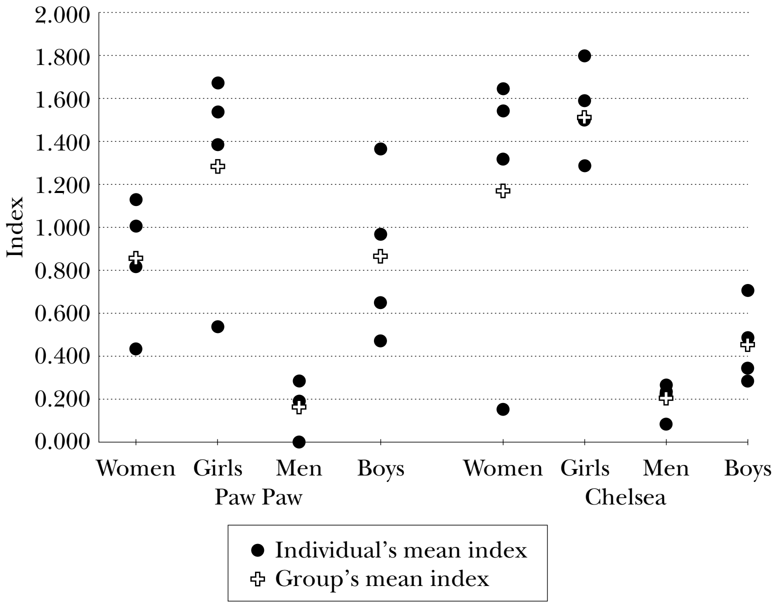
TABLE 4.17
Phonological Conditioning of (ɔ)-Shifting: Summary of Effects

Favor Shifting	*Disfavor Shifting*[a]
Preceding fricative	PRECEDING NASALS
PRECEDING GLIDES*	PRECEDING /l/
PRECEDING /r/	
FOLLOWING VOICED*	
FOLLOWING LABIALS	
Following velars	
FOLLOWING CLUSTERS	

NOTE: Categories shown in small capitals strongly favored or disfavored shifting (i.e., their phonological index scores were greater than one standard deviation above or below the overall score). Those marked with asterisks are represented by a limited data set (see discussion in text here and in §5.1.2).

a. These categories are more properly interpreted as less strongly favoring shifting rather than actually disfavoring it since shifted variants of (ɔ) are more common than unshifted even in these contexts.

FIGURE 4.8
Indices for the Shifting of (ɔ) across the Sample of Speakers

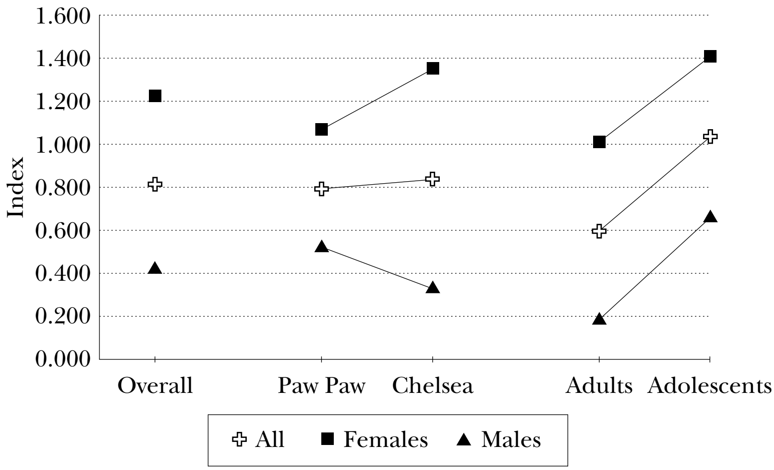


There is, however, one major way in which the (ɔ) distribution differs from that of (ɑ), and that relates to the age factor. Whereas no significant generational differences were found with (ɑ), such differences are evident here. Interestingly, these differences are the reverse of those seen with (ɛ) and (æ), as adolescents generally show greater degrees of (ɔ)-shifting than comparable adults.

These social differences are further explored in the mean indices presented in figure 4.9. As in similar graphs, the means for each of the main divisions (Paw Paw vs. Chelsea, adults vs. adolescents, females vs. males) are plotted, and the town and age data are further subdivided by sex.

These mean scores confirm the earlier observations regarding the sex and age factors. Females consistently lead males. The extent of this lead is roughly the same among adults as among adolescents, though the latter show higher rates of shifting. Comparing the two towns, we find indications of an interesting sex-based reversal. When female speakers are compared, Chelsea is

FIGURE 4.9
Mean Indices for (ɔ) Comparing Social Factors: Town, Age, and Sex



found to lead Paw Paw, but when males are compared, it is Paw Paw speakers who lead. As a result of this reversal, the sex differences are more pronounced in Chelsea.

The individual indices were examined through a multiway ANOVA in order to assess the statistical strength of the patterns suggested by their social distribution. The results of this procedure are summarized in table 4.18.

TABLE 4.18
Multiway ANOVA Results for Social Factors in (ɔ) Variation

Factor	*F*	*df*	*p-value*
Town	0.13	1, 24	.724
Age	11.09	1, 24	.003
Sex	36.34	1, 24	< .0005
Town × Age	0.95	1, 24	.340
Town × Sex	3.12	1, 24	.090
Sex × Age	0.09	1, 24	.768
Town × Age × Sex	0.54	1, 24	.468

Multiple r = .592; multiple r^2 = .351.

The age and sex patterns described here are confirmed as significant through the ANOVA procedure. These results also confirm the insignificance of the differences between the towns; however, there is a hint ($p = .090$) of an interactional effect between town and sex. This effect was evident in the reversal discussed above, whereby Chelsea females lead Paw Paw females, but Chelsea males show less shifting than their Paw Paw counterparts.

With this discussion of (ɔ), the tour through each of the Northern Cities vowels is completed and with it the main presentation of results. The implications of the observations made in this chapter and in chapter 3 are addressed in the following chapter, which attempts to bring together findings on all the NCS elements.

NOTES

1. The minor tendency of (ɑ)-raising (mentioned above) was not demonstrated by the speaker whose data are represented in figure 4.4.
2. The question of whether the coding scheme for (ɔ) is comparable to those used for the other vowels is addressed in chapter 6.
3. The effect indicated for preceding /r/ may be related to the influence of the environment following the vowel in these items, many of which contained velar nasals or fricatives (e.g., *wrong, strong, cross*), both of which promote shifting (see §5.1.2.2).
4. The effect of following labials is almost certainly related to the effect of following fricatives, since all but 1 of the 128 labial tokens involved the fricative /f/ (e.g., *sophomore, offer*).