Part C

The Unit of Linguistic Change

13

Words Floating on the Surface of Sound Change

One of the central questions of the mechanism of linguistic change concerns the unit of change: is it sounds or words that change? In recent decades it has been demonstrated that some changes proceed by lexical diffusion (Wang and Cheng 1977, Phillips 1980, Labov 1989b, Shen 1990, Krishnamurti 1998), whereby change proceeds gradually through the lexicon by the more or less arbitrary selection of individual words. In most such cases, there is a correlation of word frequency with order of selection (Fidelholtz 1975, Hooper 1976, Phillips 1984). Nevertheless, for most historical and comparative linguists the regularity of sound change is the basic working principle, and the finding that a given change follows a regular Neogrammarian path is not a publishable result.

Though there has been some critical reaction to evidence for lexical diffusion (Pulleyblank 1978, PLC, Vol. 1), there has not yet been any systematic effort among contemporary researchers in dialectology and linguistic variation to demonstrate the regularity of sound change in which the basic unit of change is the phoneme. ANAE provides a data set that renders such an exploration feasible: measurements of 130,000 stressed vowels, representing the speech of 439 subjects in 205 cities. This yields a wide range of words to examine; for example there are 610 different words in the 8,314 tokens of /ow/.

This chapter examines three changes in progress which appear to be candidates for regular Neogrammarian change. We will examine the fronting of /uw/ in all of North America; the fronting of /ow/ in the Midland and the South; and the general raising of /æ/ in the Inland North. Multiple regression will be used to determine the relative influence of phonetic environment, contextual style, social factors, lexical identity and word frequency as determined in the Brown corpus (Kucera and Francis 1967).

13.1 The Issues Reviewed

The principle of the regularity of sound change, as discussed in PLC, Volume 1, Chapter 15, is encapsulated in the original statement of the Neogrammarians: "Every sound change, inasmuch as it occurs mechanically, takes place according to laws that admit no exception" (Osthoff and Brugmann 1878) – and in the structural interpretation of this position by Bloomfield:

> Sound-change is merely a change in the speakers' manner of producing phonemes and accordingly, affects a phoneme at every occurrence, regardless of the nature of any particular linguistic form in which the phoneme happens to occur [. . .] The whole assumption can be briefly put into the words: *phonemes change*. (Bloomfield 1933: 353–4)

Yet other scholars – primarily Romance dialectologists – insisted on the word as the fundamental unit of change, as exemplified in the slogan "Chaque mot a son histoire" (see Malkiel 1967, PLC, Vol. 1: 472–4).

In recent times, the primacy of the word has been reemphasized by Wang and his associates: "We hold that words change their pronunciations by discrete, perceptual increments (i.e., phonetically abrupt) but severally at a time (i.e., lexically gradual)" (Cheng and Wang 1977: 150). Labov (1981) recognized the existence of both types of change, and attempted to resolve the controversy by defining the conditions under which each type was to be found. It was proposed that regular sound change is the result of a gradual transformation of a single phonetic feature of a phoneme in a continuous phonetic space, and that lexical diffusion is the result of the abrupt substitution of one phoneme for another in words that contain that phoneme. Nonetheless, proponents of lexical diffusion have continued to insist that the word is the fundamental unit in all sound changes, and that regularity is to be found only in the outcome (the endpoints of the last chapter). "The lexically gradual view of sound change is incompatible, in principle, with the structuralist way of looking at sound change" (Chen and Wang 1975: 257).

To make the definition of lexical diffusion more testable, the concept of "word" needs to be specified. It is not likely that the word is the basic unit in play, since we do not find cases where different inflectional forms are selected in sound change. Thus Labov (1989b), Roberts and Labov (1995), and Brody (2009) find that in the lexical diffusion of short *a* in Philadelphia, *planet* is selected for tensing in the subset before intervocalic nasals. In New York City, *avenue* is the only item where short *a* is tensed before intervocalic voiced fricatives. There has never been any indication that the plural forms *planets* or *avenues* behave differently from the singular, though singular and plural forms are different words. It appears that, when we find that change is proceeding by lexical diffusion, the unit of selection is the stem – that is, the root with all its derivational affixes, before the addition of inflectional suffixes.[1]

A second issue for lexical diffusion is the unspecified nature of the selection of such stems. Lexical diffusion through the vocabulary cannot be predictable and systematic: if it is, then the basis of that selection is the mechanism of change, not lexical diffusion. To be identified as lexical diffusion, the process of selection must have an arbitrary and unpredictable character. Phonetic constraints on stem selection may be present in this process, but they are not determinative. The same may be said for grammatical constraints like function word status or morphological composition, and for analogical patterns as well.

Frequency (of stem or lemma) is almost always associated with lexical diffusion, and indeed the presence of frequency effects is often taken as a test for lexical diffusion (Bybee 2002, Phillips 2006, Dinkin 2008). Nevertheless, frequency effects, when they do occur, do not predict which stems will be selected next, but rather establish only the probability of selection.

Finally, it is argued that the selection of particular words may be influenced by the need to preserve meaning (Gilliéron 1918). This is in direct opposition to the Neogrammarian view that sound change is a mechanical phonetic process uninfluenced by semantics or the desire of speakers to communicate. Many demonstrations of such meaning preserving events have been put forward and indeed cited at length by Bloomfield, though it has never been quite demonstrated whether such lexical adjustments occurred in the course of the sound change or after it was completed.

In contrast, regular sound change is projected as affecting every word in which the given sound occurs in the specified phonetic environment, irrespective of frequency, meaning or grammatical status.

The evidence for the basic unit of sound change – the stem or the phoneme – is asymmetrical in terms of scholarly citations. All recent papers on the topic that come to my attention are reports of lexical diffusion. Conversely, no proponent of lexical diffusion has found evidence of regular sound change. This would seem to be decisive, were it not for the consideration, noted in the first paragraph of this chapter, that the historical and comparative linguists who work on the assumption of regularity do not write papers confirming this assumption, even when all members of a given word class show the same behavior. No one body of historical evidence examined to date has been lexically rich enough to provide a decisive demonstration of one or the other viewpoint. For this reason, it seems reasonable to make use of the massive evidence of ANAE to explore this question.

13.2 The Fronting of /uw/

Map 13.1 of ANAE shows that the fronting of /uw/ after coronals (*too*, *two*, *do*, *noon*, *suit*, etc.) is characteristic of all North American English dialects, in that the mean F2 value of the nucleus is higher than 1550 Hz, the grand mean in the

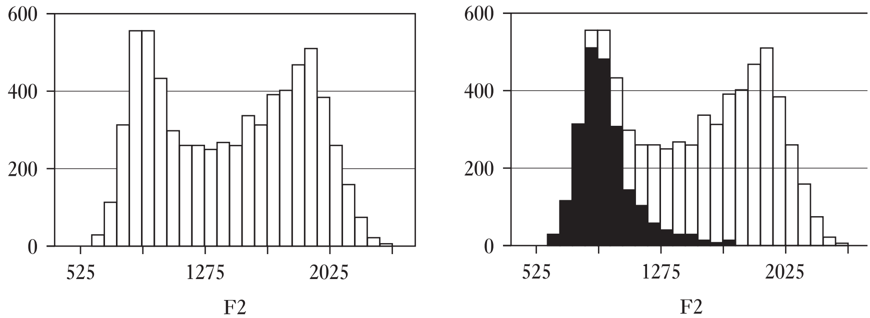

Figure 13.1 Distribution of second formant of /uw/ for all North American English dialects [N = 7,036]. Left: all tokens. Right: black = tokens before /l/s

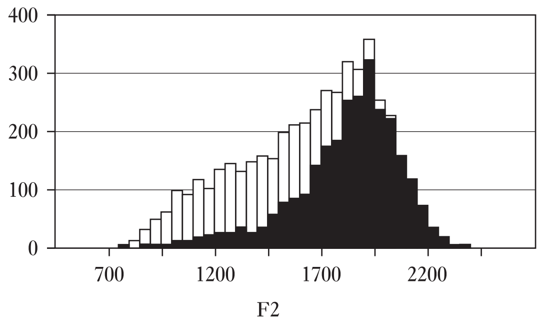

Figure 13.2 Distribution of F2 of /uw/ not before /l/ for all North American English dialects [N = 4,721]. Black = coronal onsets [Tuw]. (Mean = 1811 Hz.)

logmean normalized system. The few exceptions to this pattern are found in Minnesota, Southern Wisconsin, Northern New Jersey, Eastern New England and a scattering of eight speakers in the Inland North. Fronting of /uw/ after noncoronals (*roof*, *move*, *boot*, etc.) is more regionally delimited, as shown in ANAE, Map 12.2. These vowels are front of center only in the Midland and the South, and are well to the back (< 1200 Hz) in the North and New England. The West and Canada show an intermediate pattern.

Figure 13.1 displays the second formant distribution of all /uw/ in the ANAE data. The bimodal distribution on the left might appear at first sight to be evidence that only some lexical items are being selected and others are not. But this pattern is entirely a product of the major phonetic constraint, the effect of a following /l/. In Figure 13.2, which shows the distribution for all /uw/ not before /l/, the bimodal effect disappears. We do note a skewing to the left, a phenomenon that played an important role in the discussion of endpoints in Chapter 11.

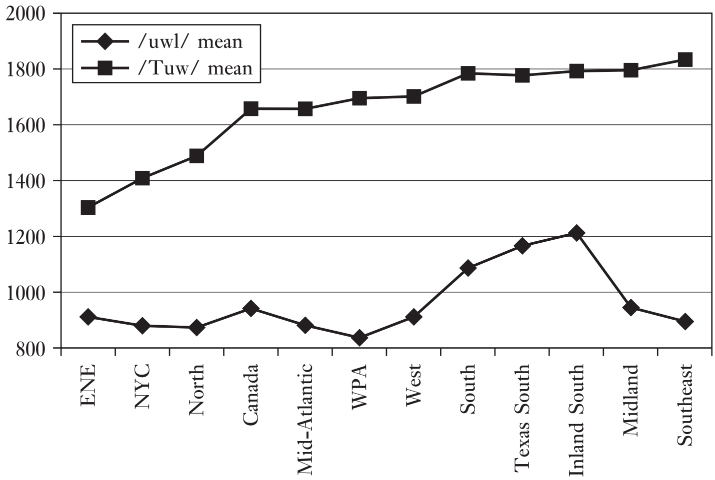

Figure 13.3 Second formant of /uw/ after coronals and /uw/ before /l/ by dialect region

Figure 13.3 charts the effect of a following lateral in retarding the fronting of /uw/ for twelve dialect regions. The upper line shows the mean value of /Tuw/, the allophone after coronal onsets, which ranges from around 1300 Hz for Eastern New England to just above 1800 Hz for the Midland and the southeast (the Southern perimeter). The lower line shows that, for 9 of the 12 regions, the F2 of /uw/ before /l/ is well below 1000 Hz. It rises slightly above that limit for the three dialects defined as members of the South by monophthongization of /ay/ before voiced obstruents.[2]

Table 13.1 examines the full range of phonetic features that influence the fronting of /uw/ as a whole. The first column of Table 13.1, Run 1, shows the result of a multiple regression analysis that accounts for a very large part of the variance – over two thirds, with adjusted r^2 at 68.5 percent. This analysis is the result of many trials aimed at achieving the maximum explanation of variance by phonetic effects alone, yielding a uniform and stable set of regression coefficients. All effects selected here show a probability of $p \leq .0001$.

The largest single effect, as one would expect, is the negative impact of a following lateral (–570 Hz). In this analysis there is only one other coda effect: the positive factor associated with final (that is, open) position, as in *do*, *two*, *too*, etc.

There are eight coefficients associated with the form of the onset, listed from the most positive to the most negative. In this detailed phonetic analysis, the large positive effect of coronal onset noted in Chapter 5 is broken up into a few positive effects and many large negative effects of noncoronal features. An initial /st/ cluster

Table 13.1 Significant regression coefficients (p < .01) of F2 of /uw/ in ANAE data. Run 1: Phonological factors only. Run 2: Social and stylistic factors added. Run 3: Lexical items added (N > 25). Runs 4, 5: Random split of Run 3

Variable	Run 1	Run 2	Run 3	Run 4 (odd)	Run 5 (even)
N	6,955	6,955	6,578	3,501	3,454
Constant	1,698	1,710	1,721	1,755	1,693
Adj r^2	68.5%	72.5%	72.5%	71.8%	73.5%
Coda					
Free	90	109	103	94	113
Lateral	–570	–569	–569	–556	–581
Onset					
/st/	271	249	244	299	185
Nasal	98	93	87	116	59
/d/	72	50	47	52	43
NonCor_NonCor	–135	–132	–130	–135	–127
Velar	–137	–132	–142	–127	–157
Labial stop	–185	–71	–74	–79	–69
Lateral	–159	–165	–179	–170	–187
Labial	–185	–194	–201	–204	–198
/h/	–249	–255	–268	–272	–262
Social					
South		189	188	192	182
Attention to speech		8	7	4	10
Age * 25 yrs		–57	–56	–78	–376
Lexical					
zoo			–172		–243
Vancouver			–148	–156	

(as in *stoop*) has the greatest influence on favoring the fronting process; it is followed by nasal onsets and by the voiced apical stop /d/. Progressively greater negative effects are shown for velars, labial stops (*pool*, *boot*), laterals, labials generally; and the most negative effect on F2 raising is initial /h/. The negative effect of labials is consistent with the low locus of labial consonantal transitions (*ca* 800 Hz). The joint effect of labials and velars is registered by the factor "NonCor_NonCor," which indicates that neither onset nor coda is coronal (that is, both are labial, velar or zero).

Among the onset effects, the favoring of /st/ and /d/ conforms to the relatively high locus of coronal transitions (*ca* 2800 Hz). Several onset influences are not so clearly predictable, for example the surprisingly large negative effect of an initial /h/ (represented primarily by *who*, *hoot*, *hoop* and *Hoover*).[3] The coefficient for

/st/ onsets is not obviously a phonological effect, since it is almost entirely represented by the word *stoop*.

Run 2 adds three social and stylistic influences on the fronting of /uw/. The effects are significant, again, at the $p < .0001$ level, but their total contribution to explaining the variation is relatively small: r^2 rises by only 4 percent. Still, the fronting of /uw/ is plainly a change in progress in apparent time, with a negative coefficient of –57 Hz for every twenty-five years of age. Across three generations the shift is considerable: /uw/ is projected to show an F2 mean 114 Hz greater for Generation III than for Generation I.

The factor "Attention to speech" is realized by stylistic ratings on the following well-known scale, used to classify the degree of formality within a sociolinguistic interview:

1 casual speech
2 careful speech
3 group
4 elicited
5 reading text
6 word lists
7 minimal pairs

It is interesting to note that the fronting of /uw/, which is occurring well below the surface of conscious attention, is favored when attention is directed to pronunciation, as in the minimal pairs *dew* and *do*.[4]

The third social factor is the speaker's location in the South (as defined by the monophthongization of /ay/ before voiced obstruents and word-finally – see ANAE, Chapter 18). This is a strongly positive effect, registering the fact that the fronting of /uw/ is more advanced in the South than in the Midland, Mid-Atlantic, or peripheral areas of the southeast.

The addition of social and stylistic factors in Run 2 produces no change in the phonological factors, which retain their significance at the level of $p < .0001$ and show only slight quantitative shifts. This result confirms the general finding that internal constraints on a sound change are normally independent of social and stylistic factors.

What will happen if we now take into account the lexical identities of the tokens and the frequency of those lexical items? If the sound change does select words one at a time, the phonological constraints should shrink or disappear, and be replaced by lexical identities. To answer this question, the stressed /uw/ words that occurred more than twenty-five times in the ANAE corpus (set thirty-one in all) were each added as a separate factor in the regression analysis of Table 13.1. The result is reported as Run 3, which shows only coefficients with a significance level of $p < .01$. Two of the thirty-one appear as significant effects at the $p < .01$ level: *zoo* (N = 25) and *Vancouver* (N = 28). None of the effects of Runs 1 and 2 disappear. There are only small fluctuations in the numbers, and the significance level of $p < .0001$ remains for all except "Attention to speech," which drops to $p < .01$.

It is possible that the negative effect of *zoo* reflects the combined phonetic effects of onset /z/ and free position, but such a phonetic definition is indistinguishable from lexical identity. Similarly, the negative coefficient for *Vancouver* may be the result of the complex syllabic construction of this word. Since there are no other words that satisfy this description, the issue of lexical versus phonetic motivation is here moot.

As noted above, lexical frequency is a major factor in those cases where lexical diffusion has been clearly established. However, the frequency of words in the ANAE data set cannot be related directly to frequency in the language as a whole, since many of the key words were concentrated by elicitation, using techniques like the semantic differential ("What's the difference between a *pond* and a *pool?*"). Frequencies in the Brown corpus were therefore added as a factor in Run 3.[5] In this run, Brown frequency was not a factor at any level of significance.

The addition of this lexical information does not raise the amount of variance accounted for. The adjusted r^2 remains at 72.5 percent. We conclude that lexical identity has not added any substantial amount of explanation of the manner in which this sound change proceeds.

Another way to test the robustness or importance of regression effects is to split the data set and see which effects are maintained, indicating how completely they penetrate the data. Runs 4 and 5 of Table 13.1 give the results of a division that is independent of the lexical and phonological distribution. Run 4 shows results for all items spoken by speakers whose subject numbers are odd, and Run 5 for all those whose subject numbers are even.[6] The effects from Run 3 that are preserved in each split half are shown in the final two columns. Robust effects are those that are preserved in both Runs 4 and 5 (normally at the $p < .00001$ level, but minimally at the $p < .01$ level).

The ten phonological effects are preserved in both halves at the $p < .0001$ level, with only small differences in the numerical values of the coefficients. The three social factors recur in both halves, with very little change. But neither of the lexical effects is found in both halves of the data.

Figure 13.4 shows the mean F2 values for the thirty-one words with frequency greater than twenty-five, which were tested for significance in Table 13.1. Those with lateral codas are grouped at the lower left. One can recognize slight phonetic effects within this group; the one item with an apical onset, *tool*, has the highest F2. But it is a good 224 Hz lower than *coop*, the least fronted word in the other two sets. The main body of words is most neatly divided into those with coronal onsets and noncoronal onsets, although the more detailed analysis of Table 13.1 uncovered more explanatory factors.

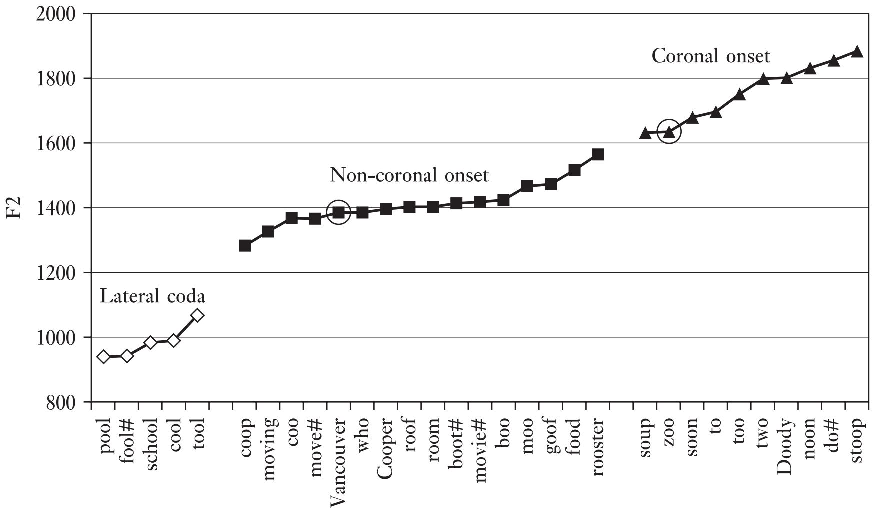

Figure 13.4 Mean F2 values for the thirty-one /uw/ words which occur more than twenty-five times in the ANAE data. Circled items show significant lexical effects in Run 3. # indicates stems with more than one inflectional form

The two circled items, *Vancouver* and *zoo*, are among the least frequent in the data set, and it is not likely that they represent linguistically significant events within the sound change. They emerge from an initial analysis in which all thirty-one items are retained without regard to their significance, with the following distribution:

$p < .0001$	$p < .001$	$p < .01$	$p < .05$	$p > .05$
school	*Vancouver*	*Cooper*	*5 items*	*15 items*
	zoo	*movie*		
		noon		
		tool		
		cool		

As the nonsignificant items are removed from the model, the probabilities of the remaining items decline, ultimately leading to the result of Run 3. Throughout this process the phonological and social factors remain stable, while the estimates of the lexical coefficients fluctuate noticeably. In another analysis in which coronal onset was substituted for the labial and velar onset factors, different lexical items emerged – *noon* and *coop* – and then disappeared in the split-half test.

Reviewing the evidence of Table 13.1 and of Figures 13.1–13.4, we can answer the question, "Does the fronting of /uw/ spread through the lexicon one word at a time?" The answer is, clearly, "No." All words which are not followed by an /l/ are selected to participate in the fronting process, and the rate of fronting is influenced primarily by their phonetic environment. Are there significant lexical effects on the fronting process? There is an indication of some kind of lexical differentiation, as a slight modification of forces that are fundamentally phonological.

13.3 The Fronting of /ow/

We can now apply the same techniques and the same logic to a parallel sound change: the fronting of /ow/ in North American English. This process differs in geographic range from the fronting of /uw/ in that it is basically confined to the Midland, the Mid-Atlantic region, the South and the peripheral southeast, a configuration named in ANAE as 'the Southeastern superregion' (Figure 13.5).

Figure 13.6 shows the distribution of the mean values of F2 for the 3,658 words measured for the Southeastern superregion. The bimodal configuration of Figure 13.1 does not emerge, but the strong effect of a following lateral is evident for /ow/ as for /uw/.

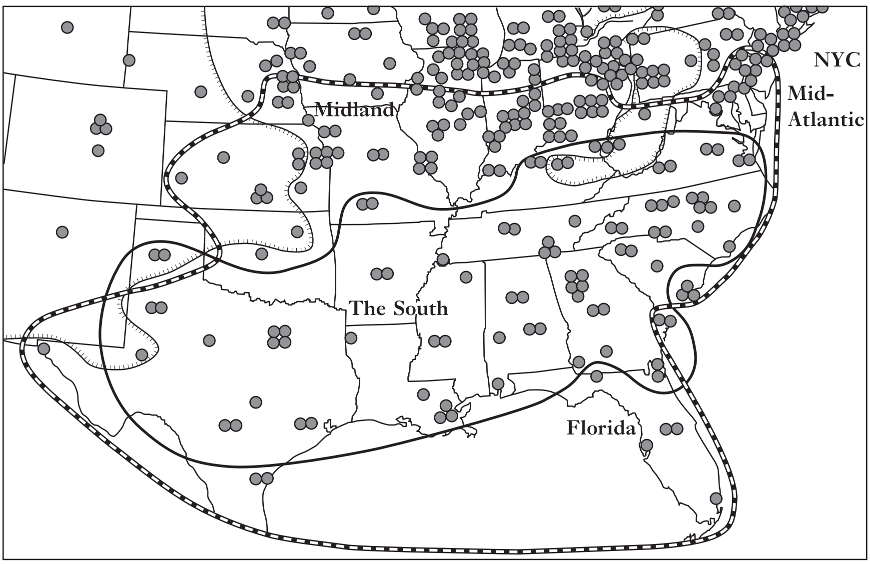

Figure 13.5 The Southeastern superregion, as indicated by the barred isogloss, including the Midland, the Mid-Atlantic region, the South and the peripheral areas outside the South proper (ANAE, Map 11.11)

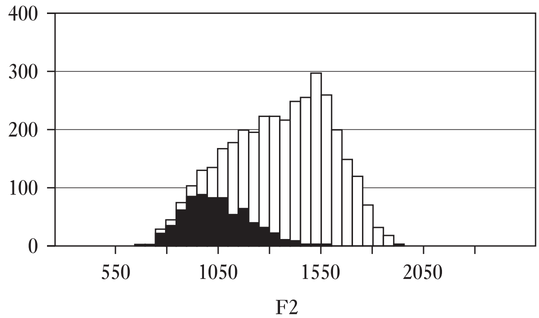

Figure 13.6 Distribution of /ow/ vowels for the Southeastern superregion [N = 3,658]. Vowels before /l/ are shown in black

Table 13.2 follows the analytic procedure of Table 13.1, applied to the fronting of /ow/ in the Southeastern superregion. Run 1 examines the twelve phonological influences on F2 for all coefficients whose t-test probability is less than .01 (in fact, $p \leq .0001$ for all). The amount of variance accounted for by phonology is 50.8 percent, somewhat less than for /uw/, since there is more regional variation for /ow/ even within the Southeastern region. Again, the largest single effect is that of a following lateral, –394 Hz. Free position favors the advancement of the /ow/ nucleus, while a following labial, velar, or nasal all retard it, with a somewhat smaller effect of following syllables.

Turning to the onset conditions, we note immediately considerable reduction in the negative effect of noncoronals, a major feature in the fronting of /uw/.[7] As with the coda, the absence of any consonant favors fronting, as does the presence of an apical nasal. Four onset features retard fronting at about the same level: onset glottal /h/, lateral, stop plus lateral, and labial. All of these are expected results of consonantal articulation, traceable to tongue movements and transition shapes in the acoustic signal. However, the size of the negative effect of initial /h/, which is about twice that of other effects, is again surprising, since /h/ as a voiceless vowel should have no coarticulatory influence on a following vowel (see note 3).

Run 2 of Table 13.2 adds the significant social effects, which are somewhat different from those encountered in the case of /uw/. There is a female advantage of 40 Hz. The stylistic component is here the reverse of the one for /uw/. It is represented by the same scale of attention paid to speech from 1 to 7, where increasing attention is registered by higher numbers. The effect is –9, so that the difference between the main body of spontaneous speech (level 2) and minimal pairs (level 7) would be –45 Hz.

Finally we note that the fronting of /ow/ in the Southeastern superregion is advancing in apparent time more slowly than /uw/, at a rate of –16 Hz per 25 years of age, as compared to –57 Hz for /uw/. Again, the contribution of social factors

Table 13.2 Significant regression coefficients (p < .01) of F2 of /ow/ in the Southeastern superregion. Run 1: Phonological factors only. Run 2: Social and stylistic factors added. Run 3: 35 lexical items added. Runs 4 and 5: Random split of Run 3a

Variable	Run 1	Run 2	Run 3	Run 3a	Run 4 (odd)	Run 5 (even)
N	3,658	3,658	3,658	3,658	1,669	1,989
Constant	1,523	1,559	1,570	1,558	1,631	1,523
Adj r^2	50.8%	51.6%	52.2%	52.3%	56.0%	50.4%
Coda						
None	95	95	91	58	76	65
Polysyllabic	–53	–50	–54	–47	–104	–42
Velar	–67	–55	–57	–92		–108
Labial	–89	–85	–83	–86	–50	–111
Nasal	–110	–114	–105	–103	–104	–94
Lateral	–394	–387	–388	–377	–371	–390
Onset						
None	89	87	86	76	65	96
Apical nasal	82	78	99	106	82	130
Glottal	–101	–117	–99	–93	–123	–100
Lateral	–111	–75	–121	–103	–121	–71
Stop/lateral	–118	–124	–129	–114	–146	–98
Labial	–138	–142	–142	–134	–137	–144
Social						
Attention		–9	–10	–10	–20	
Female		40	40	39	72	
Age * 25 yrs		–16	–17	–17	–43	
Lexical						
Frequency			*–.02			
going			–253	–304	–211	–455
ocean				128	173	
doe				110		
coke				70		*77
know				57		*75
go#				53		77
goat				*61		
pole				*–65		

* p < .05

is small compared to that of phonological factors: the percentage of variance accounted for increases by only 0.9 percent.

The main focus of this examination is the /ow/ lexicon and its possible influence on the fronting of the nucleus. Figure 13.7 compares the ANAE /ow/ vocabulary to the /uw/ vocabulary by the frequency of these words in the Brown corpus.

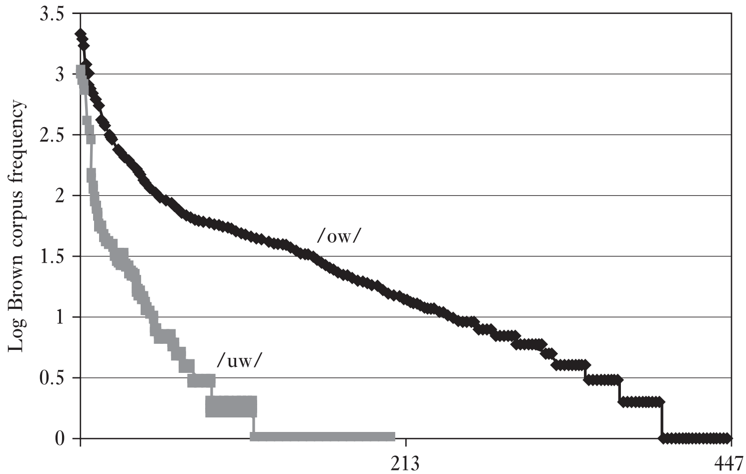

Figure 13.7 Distribution of /uw/ and /ow/ tokens in the ANAE database by Brown corpus frequency

There are twice as many items in the /ow/ set as in the /uw/ set, and a much higher range of frequencies. The total number of vowels measured by ANAE is not so much greater than for /uw/ (8,813 versus 6,578), but it is evident that the /ow/ vocabulary makes up a much larger component of the English text.

To estimate the extent of lexical diffusion in the fronting of /ow/, Run 3 of Table 13.2 considered thirty-two stems with frequency greater than twenty-five in the ANAE database. These are displayed in Table 13.3, with frequencies in the entire ANAE database and in the Southeastern superregion. They are grouped into eight items with /l/ codas, eight with coronal onsets and sixteen with neither of these features.

None of these thirty-two items appears in Run 3 of Table 13.2 as a significant effect at the $p < .01$ level. However, one inflectional form of the go# stem, *going*, significantly retards fronting. There are eleven tokens in the Southeastern data, with a mean F2 value of 1170 Hz, while the word *go* with no inflection has a mean F2 of 1548 Hz. Frequency in the Brown corpus is a marginally significant effect in this run at $p < .05$ (such marginal probabilities are indicated with an asterisk in the table). The effect of –.02 is half as large as that registered in Run 3 of Table 13.1, but here it is negative: frequency disfavors the fronting of /ow/ instead of favoring it.

So far, the criterion for a significant effect has been $p < .01$, since a search of more than twenty items is likely to produce at least one .05 effect by chance. If we relax this criterion and permit .05 effects to remain, we obtain the result of Run 3a, with seven additional lexical items, five at the $p < .01$ level and two at the $p < .05$ level. It is important to note that these are additive effects, which do not replace any of the previous findings. Comparison of the phonological and social

Table 13.3 Frequencies of thirty-two /ow/ stems entered into regression analysis in Run 3 of Table 13.2 for all ANAE data and the Southeastern superregion. # indicates a stem with several inflectional forms

Noncoronal onset			Coronal onset			Prelateral		
Word	All	SE	Word	All	SE	Word	All	SE
home#	695	284	no	348	163	cold#	270	115
go#	398	176	soda	406	148	bowl#	202	100
coat#	398	165	toast#	253	102	goal	137	67
both	218	96	sofa#	231	93	old#	209	88
coke	136	91	know#	199	97	pole#	82	45
boat#	213	109	doe	37	21	gold	60	29
most	153	77	donut#	83	20	Polish	59	23
goat#	179	88	notice#	60	22	fold#	47	25
phone#	107	38						
road#	77	38						
mostly	47	22						
over	63	21						
ago	37	18						
Minnesota	57	15						
ocean	27	13						
coast#	61	10						

variables for Runs 2 and 3 shows only small changes; in no case are phonological effects replaced by lexical effects. The amount of additional variance explained is very small: r^2 rises by only 0.1 percent.

Figure 13.8 displays the mean F2 values of thirty high frequency /ow/ words in the Telsur data. Unlike the distribution of /uw/ words in Figure 13.4, there are here only two separate ranges: vowels before /l/ and all others. The seven circled symbols are those with coefficients listed in Run 3a. There is a concentration in the upper end of the main sequence, all positive coefficients, indicating that the lexical items are slightly ahead of what their segmental structure would predict. The one item in the prelateral group, *pole*, shows the opposite tendency to be further back than its phonology would predict.

Runs 4 and 5 follow the technique, used in Table 13.1, of splitting Run 3a into those speakers with even and with odd subject numbers, in order to determine which constraints are retained in both halves of the data set. Only one of the twelve phonological effects fails to recur in both halves: the negative effect of a velar coda. None of the three social factors survives in the even half of the data set. Finally, none of the seven marginal lexical items that were added in Run 3a

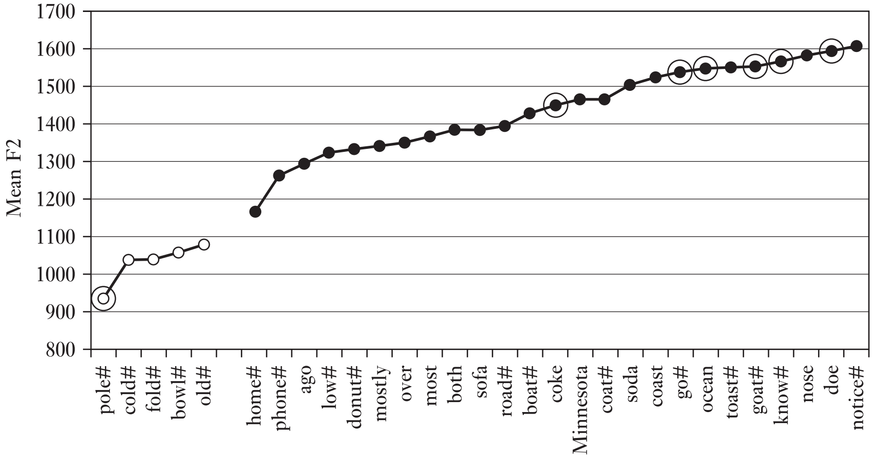

Figure 13.8 Mean F2 values of all /ow/ words submitted to regression analysis in Run 3. Open symbols = vowels before /l/. Circled symbols = words with positive coefficients, $p < .05$

is selected as significant in both halves of the data, which demonstrates that, as for /uw/, the lexical effects which appear in regression analyses for /ow/ are tenuous at best.

13.4 Homonyms

Homonyms are key elements in the search for lexical diffusion. One of the early arguments for lexical development was the split of tones for homonymous words in the Chinese dialect of Chaozhou (Cheng and Wang 1977). Two of the most frequent /ow/ words in the ANAE data are *know* and *no*, and in the /uw/ data set we can examine *two* and *too*.[8] These pairs were analyzed in the Philadelphia data of Tables 16.6 and 16.7 in PLC, Vol. 1, and no significant difference emerged. Since the ANAE data set is about ten times larger, we may be able to detect a difference. In fact, Table 13.4 shows that *no* and *two* are significantly different in the advancement of F2.

Figure 13.9 is a scattergram of all tokens of *no* and *know* in F1/F2 space. For most of the area, the two words are strongly overlapped. But one can observe a heavy concentration of *no* in the lower left corner of the diagram, where few tokens of *know* are to be found. These are the affective, emphatic tokens of the negative, which are more open and fronter than ordinary words. They suggest that prosodic rather than lexical factors are responsible for these small effects.

Table 13.4 Comparison of F2 for two homonymous pairs in all ANAE data

	know	*no*	*two*	*too*
N	179	348	825	346
Mean	1409	1497	1801	1752
Standard deviation	239	214	260	265
t-test	t = 4.327, df = 525, p < .0001		t = 2.93, df = 1,169, p < .01	

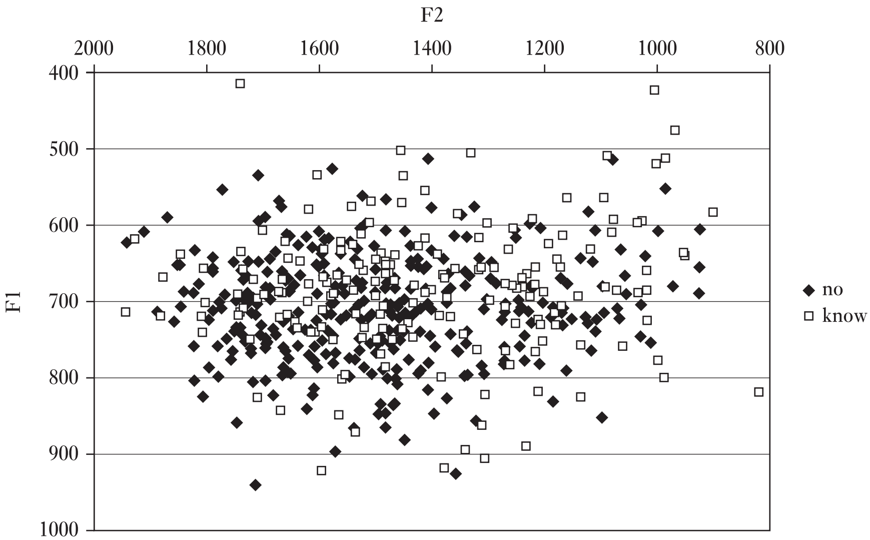

Figure 13.9 Distribution of *no* and *know* tokens in all ANAE data

13.5 The Raising and Fronting of /æ/ in the Inland North

The third examination of the extent of lexical differentiation in sound change focuses on the raising and fronting of /æ/ in the Inland North. The general raising of /æ/ is a good candidate for a regular Neogrammarian sound change. In contrast with the short-*a* split in New York City and in the Mid-Atlantic region, this raising has shown no evidence of grammatical or lexical conditioning (Fasold 1969, LYS 1972, Callary 1975). It has been proposed as the triggering event of the Northern

Table 13.5 Significant regression coefficients ($p < .01$) of the raising of /æ/ along the front diagonal in the Inland North. Run 1: phonological factors only. Run 2: social and stylistic factors added. Run 3: thirty-five lexical items added. Runs 4 and 5: random split of Run 3

Variable	Run 1	Run 2	Run 3	Run 4 (odd)	Run 5 (even)
N	2,672	2,672	2,672	1,516	1,156
Constant	2,403	21,952	1,512	1,606	2,076
Adj r^2	18.0%	23.0%	23.1%	19.8%	30.9%
Coda					
Nasal	127	129	130	146	111
Nasal cluster	50	54	53	59	
Coda complexity	–19	–10	–11	–13	–70
Following syllable	–72	–61	–66	–55	–76
Onset					
Apical	82	105	104	118	100
Labial	40	39	38	39	31
Lateral	–53	–56	–56		–68
/s/	–34	–46	–46	–39	–47
/b/	–64	–74	–73	–85	–53
Glottal	64	72	67	73	77
Social					
Attention to speech		28	27	17	38
Female		37	36		78
Age * 25 yrs		35	33		76
City size (in millions)		11	11		22
Lexical					
unhappy			31		

Cities Shift in the many studies of that phenomenon (LYS 1972, Eckert 2000, Gordon 2000, 2001, Murray 2002, Jones 2003). Throughout, the NCS has shown fine-grained phonetic conditioning characteristic of Neogrammarian change. None of these studies has searched specifically for lexical effects on this process, so it is not possible to affirm that they do not exist until this has been done.

Table 13.5 registers the analysis of the raising and fronting of /æ/ in the Inland North. In this case, both F2 and F1 are involved in the measure of movement along the front diagonal:

$$D = \sqrt{(2 * F1)^2 + F2^2}$$

Run 1 found ten phonological constraints on the raising process at the $p < .01$ level of significance. The well-known nasal effect is the largest, even though the

Table 13.6 Frequencies of 25 /æ/ stems entered into regression analysis of Run 3 in Table 13.5 for all ANAE data and Inland North region

Nasal	ALL	IN	Voiced stop	ALL	IN	Fricative	ALL	IN	Voiceless stop	ALL	IN
pants	368	52	bag	733	147	half	179	15	Saturday	418	63
Dan	277	35	bad	813	110	last	140	15	sack	544	111
pancakes	163	23	tag	393	73	have	248	36	back	518	67
ham	251	33	sad	464	84	has	137	36	hat	335	43
man	82	19	mad	294	77				accent	233	26
Spanish	204	25	dad	222	36				jacket	211	26
family	221	25							unhappy	197	26
									black	162	11

distinguishing feature of this general raising in the Inland North is the relatively small difference between nasal and oral environments. In addition, there is an additional effect of nasal clusters, as in *pants* or *hand*. On the other hand, the existence of any kind of complex coda has a small negative effect on raising. Considerably larger is the retarding action of one or more following syllables, as in *family* or *Spanish*. The onset effects show a favoring influence of initial apicals, as reported in previous studies, and a negative influence of laterals. Labials are intermediate, with a lower positive coefficient than apicals. Not previously reported is a set of specific onset conditions: a negative influence of initial /b/ (as opposed to other labials), of /s/ (as opposed to other apicals), and the same favoring effect of initial /h/ that appeared in previous tables.

Although these phonological constraints are sizable and mostly significant at the $p < .0001$ level, the total amount of variance explained is not large, only 18 percent. Run 2, which includes social and stylistic factors, adds 5 percent more.

As with the fronting of /uw/, greater attention paid to speech leads to more raising.[9] Female speakers are ahead of males, as previous reports indicated. However, the age coefficient indicates some recession of /æ/, while ANAE reports no age effect for F1 (ANAE, Table 14.6). City size is a small but significant factor: cities with greater population than another by one million will be eleven units further along the diagonal. Again, we note only slight changes in the size of the phonological coefficients with the addition of social factors, since the latter are normally independent of internal constraints.

Run 3 makes the critical addition of the twenty-five lexical items listed in Table 13.6. These are stems with more than eighty tokens in the ANAE lexicon as a whole, and more than fifteen in the Inland North. They represent all the major classes of segmental environments, including /æ/ before nasals, voiced stops, fricatives and voiceless stops. The end result shown in the Run 3 column is that only one word survives the demand for $p < .01$ significance: *unhappy*. If we relax this criterion as we did in Run 3a of Table 13.2, and allow a limit of $p < .05$, then four more words appear in the list: *black*, *has*, *Saturday* and *pants*.[10] The random character of these lexical selections may reflect the arbitrary character of lexical diffusion, but it is more likely that they represent statistical fluctuation. Once again, we see that adding a rich store of lexical items to the statistical model has no effect upon the factors established without them in Runs 1 and 2. Finally, we note that the split-half criterion for robustness, reported in Runs 4 and 5, eliminates this one remaining word from both halves. The four social and stylistic factors all fail to appear in one half or the other, but eight of the ten phonological factors are stable under this test.

13.6 Overview

The inquiries of this chapter have examined the extent of lexical differentiation in three sound shifts that affect large areas of North American English. The investigation has used quantitative methods to define the nature of this participation and found that, in each case, there is a small number of word stems that are significantly ahead of, or behind, what would be predicted by their segmental makeup. Unlike the major phonological effects, they are not robust enough to survive the split-half test. If we were to expand the data base to ten times the current size, we can suppose that many more such small lexical effects would appear, but in most cases we would be unable to resolve the difference between fine-grained phonetic and lexical description. Only in the case of frequent homonyms like *no* and *know* is it possible to demonstrate the influence of lexical identity.

13.7 Participation in Sound Change

It seems possible that some words differ in the extent of their participation in the ongoing sound changes, adding a very small amount to our understanding of the sources of variation. However, the fundamental issue to be resolved is whether the process of sound change selects words or stems one at a time, or phonologically defined units. The regression analyses of Tables 13.1, 13.2 and 13.5 treat the entire distribution of phonemes as continuous ranges. However, all the evidence points towards a discrete rule that fronts non-low vowels that are not followed by a liquid /l/ or /r/:

[1] $[-\text{low}] \rightarrow [-\text{back}]\ /\ \_\_\sim [+\text{cons}, +\text{voc}]$

Table 13.7 Regression analysis of all tokens of /ow/ in the Southeastern superregion before /l/ and other. All: Run 3 of Table 13.2

Variable	Prelateral	Other	All
N	1,558	2,909	3,658
Constant	926	1,578	1,570
Adj r^2	9.9%	36.1%	52.2%
Coda			
None		57	91
Velar		–60	–57
Polysyllabic		–76	–54
Labial		–77	–86
Nasal		–115	–105
Onset			
Coronal	56		
None		113	86
Apical nasal		73	99
Glottal		–116	–99
Lateral		–133	–121
Stop/lateral		–145	–129
Labial		–181	–134
Social			
Attention to speech			–10
Female	–26	66	40
Age * 25 yrs	57	–43	–17
Lexical			
ocean		146	128
Pole	–60		

This rule will produce the overall break between the main body of /uw/ and /ow/, and the residual vowels before /l/ not affected by the sound change.

Table 13.7 shows separate regression analyses for /ow/ vowels before /l/ and all others. In the first column, it is evident that most phonological constraints do not apply to the vowels not affected by the sound change. The coda constraints are irrelevant by definition, and most onset constraints are missing, with only a small influence of coronal articulation. The social effects before /l/ are reversed: female gender and younger age favor backer forms of /owl/. On the other hand, constraints on the main body of /ow/ tokens, shown in the second column, are unaffected by the absence of the prelateral group, except for the lexical set. Of the five words added in Run 3a of Table 13.2, *ocean* proves to be significant for the nonlateral set and *pole* for the lateral set, with about the same values.

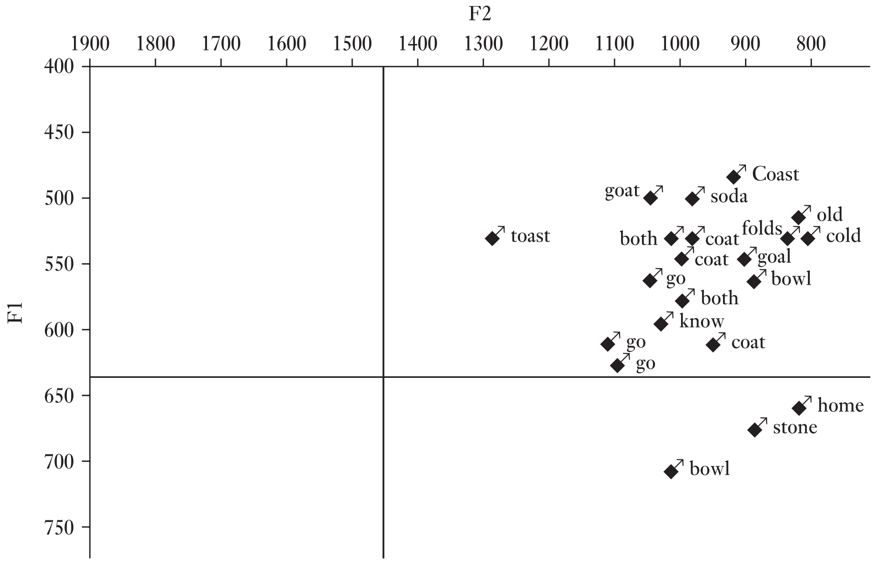

Figure 13.10 Conservative position of /ow/ in the vowel system of Alex S., 42 [1996], Providence, RI, TS 474 (double scale)

A closer view of this process can be obtained by comparing the /ow/ vowels of speakers with different degrees of advancement. Figure 13.10 is an expanded view of the conservative, unfronted pattern in the speech of a 42-year-old man from Providence, Rhode Island. Only the word *toast* is somewhat fronted; the rest are well below 1200 Hz in the F2 dimension, with a mean of less than 1000 Hz. It can also be observed that /ow/ before /l/ is backer than other allophones: thus *old*, *cold*, *bowl*, *fold*, *cold* are closer to the back periphery than the remaining tokens, with the exception of *home*.

Figure 13.11 shows a moderate degree of fronting in the speech of a 32-year-old woman from Cleveland, Ohio. The distribution is now bimodal. Ten /ow/ nuclei have F2 above 1200 Hz, but vowels before /l/ remain below 100 Hz, along with two tokens of *home*.

In Figure 13.12, the difference between prelateral and other tokens has become a gulf of 400 Hz. This is a arche typical Midland pattern, in this case of a 37-year-old woman from Columbus, Ohio. We see that the process of fronting fails categorically to apply to /ow/ before /l/. It makes no difference whether we are dealing with a common word like *gold* (Brown frequency 52) or a less common word like *colt* (frequency 18). No words before /l/ are selected, and no words not before /l/ fail to be selected.

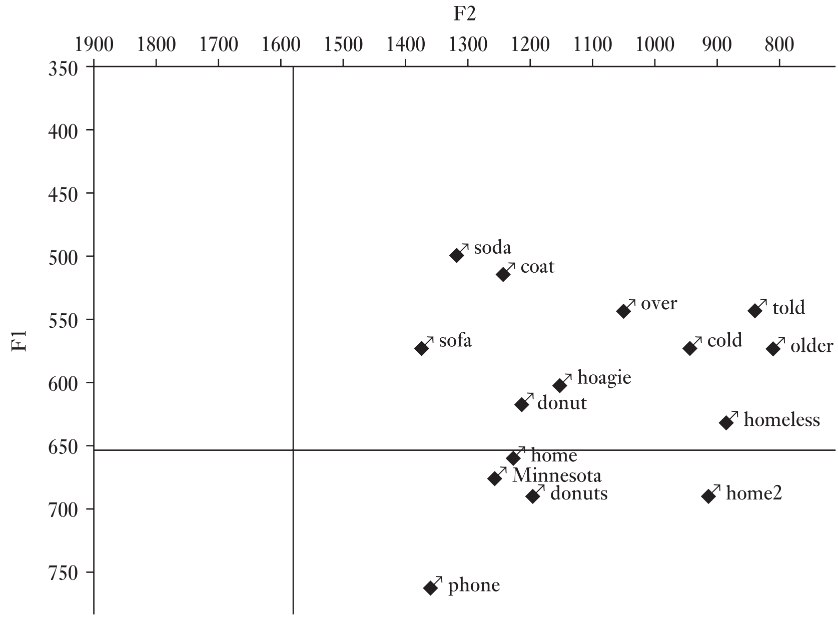

Figure 13.11 Moderate fronting of /ow/ in the vowel system of Alice R., 32 [1994], Cleveland, OH, TS 110

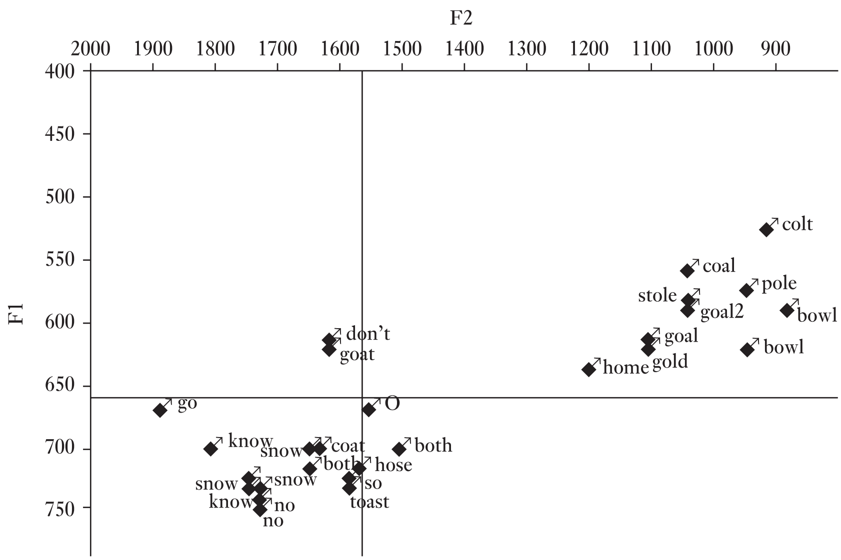

Figure 13.12 Advanced fronting of /ow/ in the vowel system of Danica L., 37 [1999], Columbus, OH, TS 737 (double scale)

Table 13.8 Mean F1 and F2 values of /ow/ words with onset /h/ and coda /m/

	N	F1	F2
/ow/ not before /l/	5,950	616	1304
All /owl/	2,576	575	1010
home	775	669	1068
Oklahoma	14	589	1045
homebody, etc.	28	641	1037
Omaha	10	655	1119
hoe	26	621	1233

Not quite. One word not before /l/ remains in back position in this figure: *home*. Though this is slightly fronter than the prelateral words, it appears to be a part of the unfronted distribution. The back position of *home* is evident in Figure 13.11, and is a repeated pattern throughout the Telsur vowel charts (see ANAE, Figures 12.13, 12.14). It seems that *home* is not selected by the rule in [1], which might have to be modified to exclude this and perhaps other lexical items.

However, it is also possible that the behavior of the vowel of *home* is predictable from its phonetic environment. In Table 13.7 we see that an initial /h/ has a coefficient of –116, and a following labial has one of –77. The combination of the two might well produce the effect seen in Figure 13.12. Here again, we may have a moot situation in which lexical identity and phonetic motivation cannot be distinguished.

Fortunately, we can attack the problematic status of *home* in a different way. There is another word in the ANAE corpus in which initial /h/ precedes and /m/ follows a stressed /ow/ vowel, and that is *Oklahoma*. As indicated in Table 13.8, there are fourteen tokens of this word in the data set. The words *home* and *Oklahoma* share nothing but the phonetic environment of /ow/.

Table 13.8 shows the mean F1/F2 values of the relevant words. Besides *home* and *Oklahoma*, we have a few derived forms like *homely* and *homeless*, and compounds like *homebody*, *homemaker*, *homestead*, *homework* – twenty-eight in all. To illustrate the effect of a following /m/ without initial /h/, I have included *Omaha*. The effect of initial /h/ without coda /m/ can be assessed with *hoe*.

Figure 13.13 displays the mean values of Table 13.8. It is evident that *home* and its derivatives are aligned with /ow/ before /l/ on the F2 dimension, but so is *Oklahoma*. *Omaha* is slightly fronter than this, but *hoe* is much fronter – only 71 Hz less than the mean for nonlateral /ow/.

If phonetic factors are indeed wholly responsible for the back position of *home*, it follows that the influence of a following /m/ is greater than the figures in Table 13.7 would lead us to predict. In fact, if we add an interactive factor of "Coda: Labial nasal" to Table 13.7, it contributes to the explanatory power of the model, with a

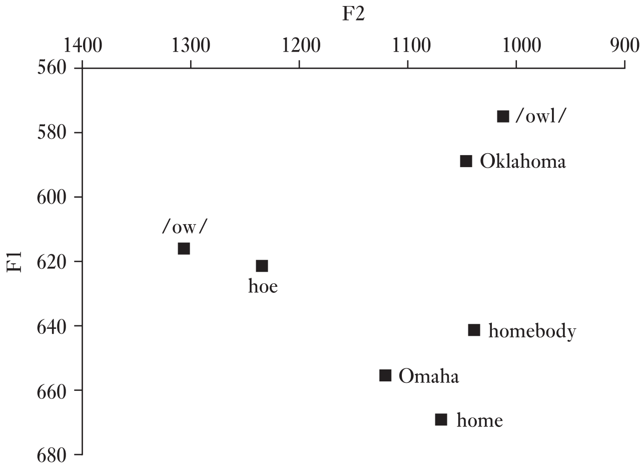

Figure 13.13 Mean values of words relevant to the *home* problem

coefficient of –79 and p < .01. The more general factor "Coda: Nasal" declines from –115 to –96, and "Coda: Labial" from –76 to –60. The expected value of F2 for *home* is then derived as follows:

[2] Constant + Coda: Nasal + Coda: Labial + Coda: Labial nasal + Onset: Glottal
1519 + (–70) + (–89) + (–79) + (–69) = 1212

The combined effect of labial and nasal features in the coda thus brings the prediction for /ow/ in this context close to the 1200 Hz line, which marks the limiting boundary of the unfronted allophones. The F2 value of 1068 for *home* in Table 13.8 is still lower, but the close grouping of *home*, *homebody* (*homeless*, etc.) and *Oklahoma* makes it seem most probable that this is the result of phonetic rather than lexical factors.

13.8 The Modular Separation of Phonological and Social Factors

Throughout this analysis it has been evident that, whatever lexical effects are found in the three sound changes studied, they are independent of the phonological and social factors. Addition of lexical items in the regression analysis did not affect the significance, direction or size of the phonological and social factors. This is not

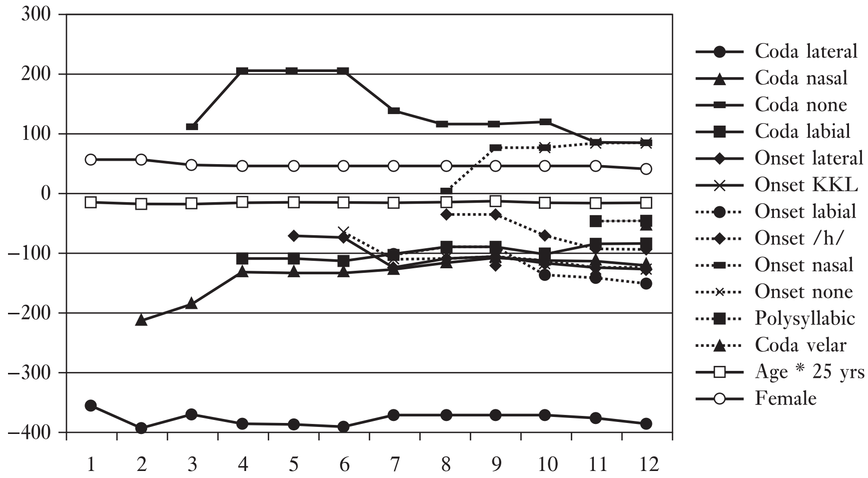

Figure 13.14 Progressive addition of phonological factors for /ow/ for the Southeastern superregion, with social factors included

what would be expected if the lexical and social information were stored in association with phonological information in the same set of memories. It also indicates that lexical differentiation (say, of *no* versus *know*) will be implemented at a different stage of production from that which realizes the phonemes /now/.

Such independence or modularity has been found to be characteristic of internal structural versus social and stylistic factors in previous studies (D. Sankoff and Labov 1979; Weiner and Labov 1983). The lexical influences we have detected in this chapter are too small and unstable to demonstrate this independence as clearly as if we had been studying a true case of lexical diffusion, such as the tensing of short *a* in Philadelphia. We do, however, obtain a clear view of the independence of phonological and social factors in these data, as displayed in the successive runs in Tables 13.1, 13.2 and 13.5.

The modularity of internal and external factors is displayed more directly in Table 13.9 and in Figure 13.14. Here the phonological factors that influence the fronting of /ow/ are added serially, beginning with the largest and proceeding to the smallest – the basic operation of stepwise regression. The two main social factors, age and gender, are maintained throughout. The amount of variation explained rises from 34.6 percent to 51.6 percent. As each new phonological factor is added, we observe changes in one or more other phonological factors. For example, when "Coda: Nasal" is added in Run 2 at a value of –212, the negative value of "Coda: Lateral" increases from –356 to –395. When "Coda: Labial" is added in Run 4 at –112, the value of "Coda: None" (free syllables) jumps from 109 to 207. This is equivalent to saying: "Free position favors fronting; but, if we now take into account

Table 13.9 Progressive addition of phonological factors for /ow/ for the Southeastern superregion, with social factors included

Run	1	2	3	4	5	6	7	8	9	10	11	12
Adjusted r	34.6	42.7	44.8	46.5	46.7	46.9	49.5	50.0	50.1	50.9	51.4	51.6
Coda: Lateral	–356	–395	–371	–387	–389	–391	–372	–371	–371	–373	–377	–388
Coda nasal		–212	–184	–129	–131	–132	–123	–109	–109	–103	–111	–115
Coda none			109	207	206	207	139	116	116	123	84	85
Coda labial				–112	–113	–115	–104	–93	–93	–101	–80	–86
Onset Lateral					–68	–71	–130	–120	–120	–120	–126	–118
Onset KKL						–63	–121	–111	–111	–112	–123	–124
Onset labial							–102	–92	–92	–135	–144	–142
Onset /h/								–35	–35	–68	–87	–95
Onset nasal									77	77	78	78
Onset none										77	78	88
Polysyllabic											–48	–50
Coda velar												–56
Age * 25 yrs	–16	–17	–17	–15	–15	–16	–17	–16	–16	–17	–16	–17
Female	55	54	47	46	46	46	46	46	46	45	43	41

that some of the low values of checked forms have prelabial lowering, then the effect of free position must be even greater to predict the observed values." Major shifts of this type can be observed throughout the twelve runs, even for the smaller effects at the end. The negative effect of onset /h/, added first at –35, increases to –95 as more small constraints are added.

On the other hand, the two social factors, indicated with open symbols, remain constant, with only slight fluctuations throughout the twelve runs. The negative factor "Age * 25 years" enters at –16, and nowhere does it rise above –17 or fall below –15.

13.9 Conclusion

These results confirm the view of sound change as a phonetically driven process that affects all words in a phonologically defined set. The close study of these regular sound changes in progress reveals them to be just as Paul, Leskien, Osthoff, Brugmann, Saussure and Bloomfield described them. When we engage the data directly, there are tantalizing glimpses of lexical peculiarities. But these are not the stable, robust parameters of phonetics and phonology. They hover at the edges of statistical significance, appear and disappear with changes in the analysis or sample size, and rarely repeat themselves. Some of this fluctuating behavior can be attributed to the arbitrary nature of the linguistic sign, but on the whole they seem to be statistical accidents.

That is not to say that all sound changes proceed like this. Part C of Volume 1 documented the solid case for changes that proceed word by word. Further progress is being made on defining the conditions that lead to lexical diffusion. Fruehwald (2007) argues that what was thought to be a regular sound change, namely Canadian raising of /ay/ in Philadelphia, is now showing unmistakable signs of lexical diffusion, probably as a result of the opacity of the *rider* ~ *writer* merger. We continue to trace lexical diffusion in the short-*a* tensing of Philadelphia, where tensing before /l/ has moved towards completion while tensing before intervocalic /n/ has retreated to a single lexical item, *planet* (Brody 2009).

The most likely hypothesis is that regular sound change is the unmarked case. As with any negative demonstration, establishing the absence of lexical diffusion is a difficult undertaking, and in principle it will never be completed. The lexical identities that we have been pursuing are epiphenomena; they will not stay still long enough to be captured and labeled. But, to the extent that they do exist, they seem to represent influences on a late stage of production, a fine-tuning of the output of well-established rules, constraints and categories. This implies the existence of several cycles in the process of speech production, where the influence of stored memories and affective associations is exerted on an unmarked output. Thus the output of *home* in [2] may be further determined by social and stylistic parameters that come into play at a different level of linguistic organization from that engaged in the mobilization of phonemic categories.

Sound change is defined here as a shift of targets within the continuous parameters of phonological space. It is opposed to changes in the membership of phonological categories at a higher level of abstraction. It is also opposed to fluctuations that respond to frequency and lexical identity. But, as we have seen in previous chapters, sound change is not isolated from the rest of the phonological system. Sound change is governed by the intricate interplay of systemic relations within and across subsystems and by the functional economy of the system as a whole.