14

The Binding Force in Segmental Phonology

The units of linguistic change that we have focused on so far are segmental phonemes whose targeted means shift in a continuous acoustic space. A segmental phoneme of this type, like the /ow/ of Chapter 13, is a paradigmatic assembly of the vowels in *go*, *boat*, *boats*, *hope*, *low*, *stone*, etc. Throughout the discussion, it was apparent that the vowel in *go* behaved differently from the one in *road*, but this was attributed to coarticulation with the segmental environment. At the end it appeared that, as the fronting of /ow/ advanced, the subset of *bowl*, *old*, *cold*, etc. was discretely separated from all others. The set of vowels influenced by the change included all /ow/ except those before /l/, but there was no suggestion that the prelateral phoneme was no longer an allophone of /ow/. The unit of change in this case was thus something less than a segmental phoneme. This chapter considers situations where the effects of coarticulation are strong enough to disrupt the unity of a phoneme and searches for evidence of a binding force that resists such disruption.

Table 1.1, reproduced here as Table 14.1, shows the notation used for North American English vowels in this volume, with key words that serve to identify the word classes involved. It represents an initial position from which all North American dialect patterns can be derived. The sixth short vowel, represented here as the original /o/ in *pot*, serves as a useful point of reference in considering North American English as a whole. As discussed in Chapter 7, this vowel was unrounded to a low back or central vowel [ɑ] in most North American dialects, but it remains [ɔ] in Eastern New England, Canada and Western Pennsylvania. For these dialects and for the West, the checked /o/ has merged with /oh/, while in others it merges with /ah/, becoming an integral part of one or the other long ingliding vowel.[1] Note also that, although the great majority of speakers no longer distinguish /iw/ from /uw/ – so that *lute* rhymes with *loot* and *suit* rhymes with *boot* – those who still preserve this distinction are enough to justify the retention of this fourth member of the back upgliding subset as /iw/.

This binary representation of English vowels serves a number of functions:

a It captures the major phonotactic regularity of the North American English vowel system: that all words terminate in consonants or glides. Conversely,

Table 14.1 North American English vowels in the ANAE notation

	SHORT		LONG					
			Upgliding				Ingliding	
			Front upgliding		Back upgliding			
	V		Vy		Vw		Vh	
nucleus	front	back	front	back	front	back	front	back
high	i	u	iy		iw	uw		
mid	e	ʌ	ey	oy		ow		oh
low	æ	o		ay		aw	æh	ah
high	*bit*	*put*	*beat*		*suit*	*boot*		
mid	*bet*	*but*	*bait*	*boy*		*boat*		*bought*
low	*bat*	*pot*		*bite*		*bout*	*salve*	*father*

no stressed words end with a vowel. No matter what sound changes take place in any given North American dialect, there are no dialects with short stressed vowels at the ends of words.[2]

b It defines the subsystems in which chain shifting operates to obtain maximum dispersion of the elements (Chapter 5).

c It predicts the direction of those changes that involve parallel movement and nucleus–glide differentiation.

d It shows the initial position from which North American dialects can be generated by retracing the sound changes of the nineteenth and twentieth centuries.

Though Table 14.1 represents each segment as a unit, the structure is easily decomposed into features that identify each vowel. Thus the short vowels can be rewritten as in (1):

(1)

	i	e	æ	u	ʌ	o
vocalic	+	+	+	+	+	+
consonantal	–	–	–	–	–	–
high	+	–	–	+	–	–
low	–	–	+	–	–	+
anterior	+	+	+	–	–	–

while the long vowels, each one having two morae, are represented as in (2):

(2)	iy	ey	ay	oy	iw	uw	ow	aw	æh	ah	oh
vocalic	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −
consonantal	− −	− −	− −	− −	− −	− −	− −	− −	− −	− −	− −
high	+ +	− +	− +	− +	+ +	+ +	− +	− +	− −	− −	− −
low	− −	− −	+ −	− −	− −	− −	− −	+ −	+ −	+ −	− −
anterior	+ +	+ +	− +	− +	+ −	− −	− −	− −	+ −	− −	− −

It will be observed that the short vowel /o/ in (1) and the nucleus /a/ of long vowels in (2) have the same feature sets. In this initial system they are distinguished by the redundant feature [+round], and /o/ is represented phonetically as [ɔ]. The situation is inherently unstable, as developed in Chapter 5: /o/ merges with /oh/, with /ah/ or with both.

These features, or others that are homologous with them, have been used by phonologists since Jakobson and Halle (1956) and Chomsky and Halle (1968). In one sense, they merely capture the hierarchical headings of Figure 14.1, reducing them to a binary format. Since the arrays of (1) are also elements of (2), it may be asked whether these six vectors form the basic units of sound change. This cannot be the case, since we have seen that, in the Southern Shift, /e/ and /i/ move in the opposite direction from the first morae of /ey/ and /iy/, and in Pittsburgh /o/ moves back while the first mora of /ow/ moves forward. In many dialects, the /a/ nucleus in /aw/ moves in the opposite direction from the /a/ in /ay/. The elements on which sound change seems to operate are the single morae of the short vowels, when they occur without a following glide, and the combinations of two morae, vowel and glide, as the paired features of (2).

If the units of change were only these single mora and two morae combinations, then all sound changes would be unconditioned. All instances of a single or paired feature would be selected to participate in a given change, depending to a greater or lesser extent on the neighboring features. This appears to be the case with the major chain shifts we have studied: the Northern Cities Shift, the Southern Shift, the Canadian Shift and the Pittsburgh Shift. But even more common are conditioned sound changes, where the effects of coarticulation split a phoneme into two discrete allophones. Figures 13.10–13.12 provided a graphic view of this process in the fronting of /ow/. In the nasal short-*a* system, all vowels followed by a [+nasal] feature are raised to high front position, while all others remain at low front (see Figure 5.7 for Pittsburgh; Figure 7.3 for Manchester, New Hampshire; and generally ANAE, Ch. 13). In Philadelphia, /ey/ in checked position has been rising steadily to high position for the past fifty years, while /ey/ in free position remains at lower mid (PLC, Vol. 2; Conn 2005). The fronting of /uw/ involves not only the splitting off of the prelateral allophones but, for most speakers, a clear separation of vowels after coronals from others (Figure 5.13a, ANAE, Map 12.2).

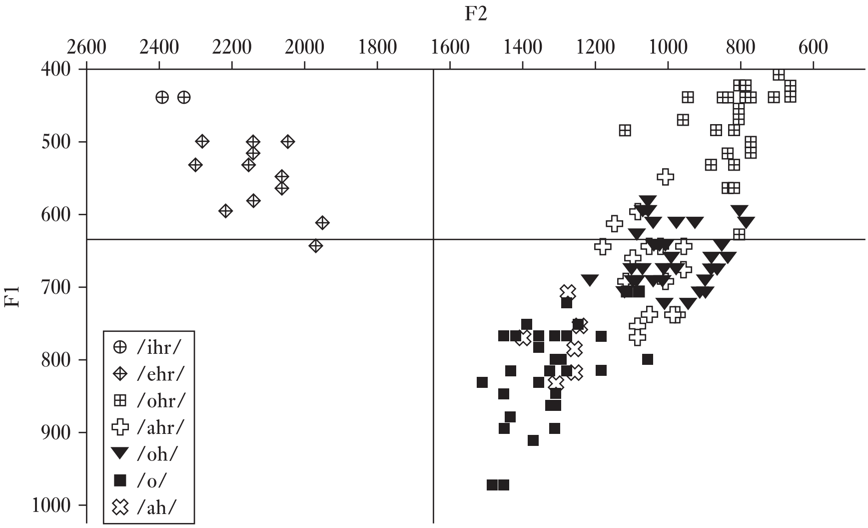

Figure 14.1 Identification of the nucleus of /oh/ with the nucleus of /ahr/ in the vowel system of Rose V., 30 [1996], Philadelphia, TS 587

In general, chain shifting maintains the unity of the segmental phoneme, while conditioned sound changes exhibit the disruptive effects of coarticulation. Given the extreme results of the nasal short-*a* system, where the two allophones are at opposite ends of phonological space, the evidence for the integrity of the phoneme is essentially that of complementary distribution: the sound [iə] before nasals fits the hole in the distribution of [æ] in the phoneme /æ/, which never occurs before nasals. Yet, when *Ann* is indistinguishable from *Ian*, one might be tempted to posit a phoneme /ih/ comprising *idea*, *Ian*, *theater*, *Leah*, *Sophia*, *Ann*, *family* and *camera*, since there are no alternations uniting [æ] and [iə].[3]

Among the conditioning effects of sound change in English, one of the most extreme is the lowering and backing of vowels after obstruent/liquid onsets, as in *grip*, *dress* and *black*.[4] This is responsible for one of the best known exceptions to regular sound change in the history of English. When Middle English (ME) ɛ: in *knead* rose to merge with ME e: in *need*, several representatives of the lowest allophones were so low that they were re-analyzed as members of the ME æ: phoneme, as it rose to [ɛ:] and finally to [e:] and [eɪ]. These words were *great*, *break* and *drain* (see PLC, Vol. 1: 297–8 for a more complete account). The same phenomenon appeared in the raising of ME ɔ: to o:, where one word was left behind: *broad*. Today this is the one exception to the phonics rule that the vowel pair *oa* stands for the phoneme /ow/: it is separated from its original cohort and is now merged with /oh/. A similar series of disruptions in the ME o: class led to the exceptional merger with /ʌ/ of the two words *flood* and *blood*.

Indeed, coarticulation can do more than disrupt a few words; it can rotate a subset of allophones so completely that their original identities are lost. This has clearly happened in French, where the four or five nasal vowels are not easily matched with oral counterparts. Such disruption has also happened in North American English dialects, where a fifth vocalic subsystem before tautosyllabic /r/ must be recognized, as in Table 14.2. Here the feature [±round] can be used to distinguish from back what would otherwise be central. The distinction between /ohr/ and /ɔhr/ is irretrievably lost for most North Americans, for whom there are only six members of this subset. The front vowels /ihr/ and /ehr/ can more or less be identified with /iy/ and /ey/, but /ʌhr/ cannot easily be matched with any of the short vowels that were originally distinct in *fir*, *her*, *world*, *fur*. In the back, /ohr/ is midway between /oh/ and /ow/ in most dialects. While /ahr/ is associated with /ah/ in some dialects, in others the Back Chain Shift before /r/ leads to an identification of the nucleus of /ahr/ with /oh/. Figure 14.1 shows this re-identification in the vowel system of a 30-year-old woman from Philadelphia. While /ah/ remains in the same region as /o/, the Back Chain Shift carries /ahr/ to mid position, so that it occupies the same region as the black triangles of /oh/. Thus the Vhr subsystem has rotated in a manner independent of the Vh subsystem.

The recognition of a subsystem of English vowels before /r/ is equivalent to recognizing that the combination Vhr is a unit of linguistic change distinct from Vh. This raises the question as to whether there are other such subsystems, in which the coarticulatory effect of the defining environment overrides the identities of the more general categories. A likely possibility for present-day North American English is a prenasal subsystem of short vowels which we might label VN, shown as Table 14.3. Here the following nasal consonant serves as a differentiating environment, much as /w/ or /y/ does for the upgliding vowels. We know that some items within this set are highly confusable, given the frequency of the merger of /i/ and /e/ before /n/. The test for the linguistic significance of such a subsystem is whether or not we observe allophonic chain shifting within it.

Table 14.2 The subsystem Vhr in North American English

Ingliding Vhr			
	front	back	
		unrounded	rounded
high	/ihr/ *fear*		/uhr/ *moor*
mid	/her/ *fair*	/ʌhr/ *fur*	/ohr/ *four*
low		/ahr/ *far*	/ɔhr/ *for*

Table 14.3 Hypothetical subsystem VN of short vowels before nasals

Prenasal VN		
	front	back
high	/iN/ *pin*, *him*	
mid	/eN/ *pen*, *hem*	/ʌN/ *pun*, *hum*
low	/æN/ *pan*, *ham*	/oN/ *pond*, *tom*

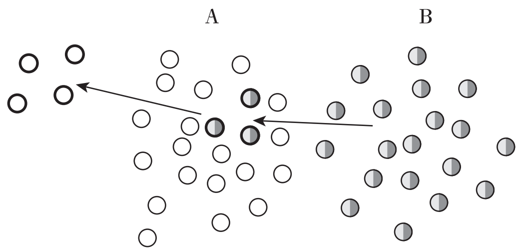

Figure 14.2 Allophonic chain shifting. Allophones of phoneme A (heavy outline) shift to front and corresponding allophones of phoneme B shift to overlap main distribution of A

The concept of allophonic chain shifting is illustrated in Figure 14.2, a modification of the original chain shifting pattern of Figure 6.16. Here the symbols with heavy outlines correspond to the shifted allophone, for example short *a* before nasals. If the prenasal allophones of phoneme A move up and away from the main distribution, then the margin of security of the prenasal allophones of B is increased. Following the argument of Chapter 6, prenasal outliers of B in the midst of the main A distribution would not then be confused with A, since the prenasal allophones of A are not in that area. The end result would be the type of allophonic chain shifting illustrated in Figure 14.2.

14.1 Is There Allophonic Chain Shifting before Nasals?

The VN subsystem is a good test case of allophonic chain shifting, since all North American English dialects show some tendency to the raising and fronting of /æ/ before nasals.[5] The general question to be posed is whether or not /oN/ will respond to the raising and fronting of /æN/ by shifting forward.

Figure 14.3 tests this question in a display of the first two stages of the Northern Cities Shift, as seen in the vowel system of a woman from Detroit. The highlighted

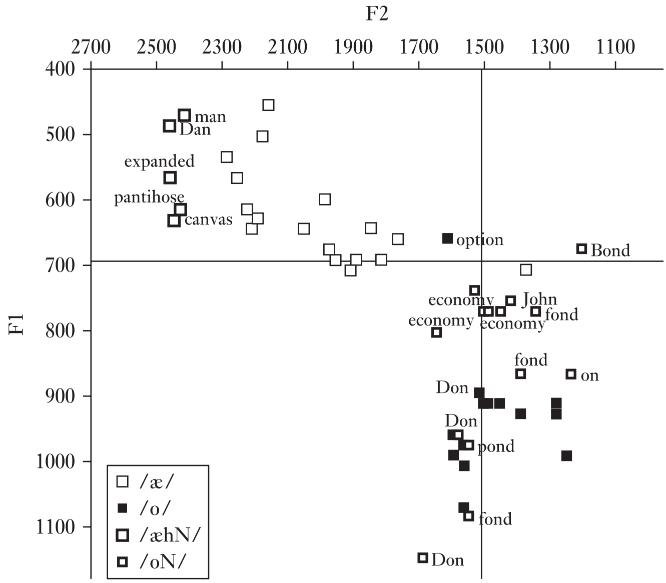

Figure 14.3 Advanced Stages 1 and 2 of the NCS for Libby R., 42 [1994], Detroit, TS 125. Highlighted symbols: prenasal vowels

Table 14.4 Mean values for prenasal and other /æ/ and /o/ for Libby R. ** denotes a difference significant at p < .01

	F1		F2	
Coda	+nas	–nas	+nas	–nas
/æ/	578	623	2305**	2044
/o/	878	913	1459	1482

/æ/ tokens before nasals are higher and/or fronter than others. Though this difference is relatively small in the Northern Cities Shift, Table 14.4 shows that F2 for prenasal /æ/ is significantly higher than for other tokens, at the p < .01 level. This pattern is not replicated in the /o/ distribution. Prenasal tokens are scattered among others, and there are no significant differences among the means. This situation is similar for all Inland North speakers. Although the general correlation between the fronting of /æ/ and the fronting of /o/ is quite high (.66) – this correlation does not extend to the prenasal allophones. No cases of allophonic chain shifting have been found in the Inland North.

While the differentiation of prenasal and other /æ/ is minimal in the Inland North, it is maximized in speakers from New England, the Midland and the West

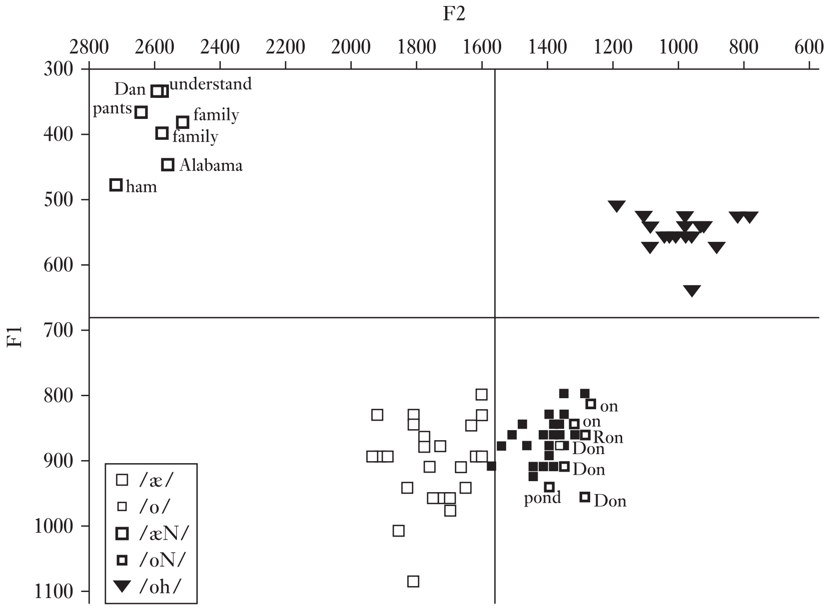

Figure 14.4 Prenasal /æ/ and /o/ of Debora L., 37 [1996], Providence, RI, TS 469

who exhibit the nasal short-*a* system. Figure 14.4 shows the /æ/ and /o/ tokens for a speaker from Providence, RI, with a nasal short-*a* system. The complete and dramatic separation of the prenasal /æ/ tokens is not matched by a corresponding front shift of the prenasal /o/ tokens. On the contrary, the /oN/ tokens – *on*, *Ron*, *don*, *pond* – occupy the back part of the /o/ distribution. The widely separated /oh/ is added to emphasize that the back position of /o/ is in no way connected to a low back merger. The absence of allophonic chain shifting is quite general for speakers with a nasal system. There are no speakers in the Telsur data set who shift prenasal /o/ tokens into the low front area when this area is occupied by /æ/ tokens before oral consonants. Furthermore, there is no correlation between the F2 of /æ/ and F2 of /o/ for the 96 Telsur speakers with a nasal system: r^2 is .06.

These individual demonstrations can be followed by a view of the overall relations of the means of the vowels involved. Figure 14.5 compares the oral and nasal allophones of /æ/ and /o/ for forty-two speakers in the Inland North who have a generalized raising of /æ/ and for ninety-six speakers in North America with a nasal short-*a* system. Those with the nasal system have a mean value for /o/ before nasals that is significantly backer than before oral consonants ($t = 16.3$, $p < .0001$). For the Inland North group with the general raising of /æ/, there is no significant difference between oral and nasal allophones.

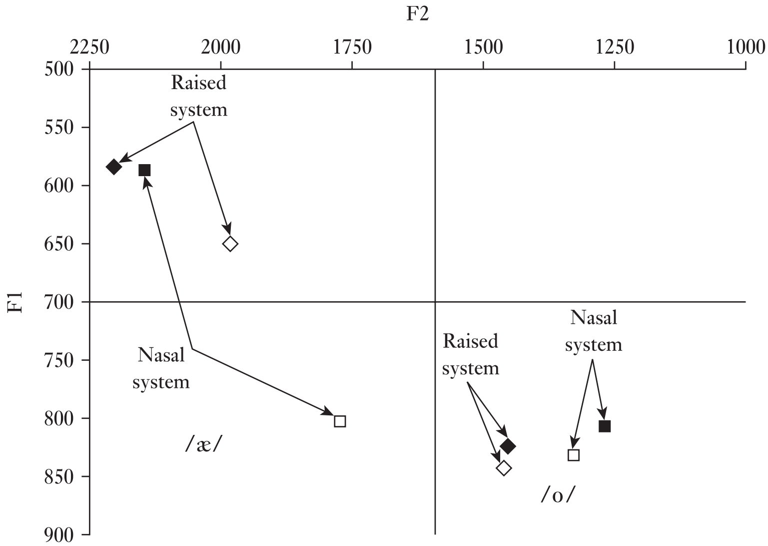

Figure 14.5 Relation of oral and nasal allophones of /æ/ and /o/ for forty-two speakers of the Northern Cities Shift with general raising of /æ/ and ninety-six speakers with a nasal short-*a* system. Solid symbols: vowels before nasal consonants

14.2 Allophonic Chain Shifting in the Southern Shift?

The Southern Shift provides the clearest example of chain shifting as distinguished from generalized sound change. This section will examine the possibility of allophonic chain shifting before voiced and voiceless finals in this process.

The triggering event of the Southern Shift is the monophthongization of /ay/, which is followed by the descent of the nucleus of /ey/ along the nonperipheral track, with more advanced tokens overlapping the monophthongal /ay/ area. As pointed out in Chapter 5, the concatenation of these two events cannot be explained as a form of parallel movement or rule generalization. No generalization of monophthongization or of lowering can account for the sequence. There are two different types of events, as shown in Table 14.5: the removal of /ay/ from the subsystem of front upgliding vowels; and the readjustment of the remaining elements. In the abstract representation in Table 14.5, two kinds of readjustment might take place: either /oy/ or /ey/ might fall to the position formerly occupied by /ay/. At this point, the general principles of chain shifting developed in Chapter 6 come into play: lax nuclei fall along the nonperipheral path, and tense nuclei rise along the peripheral path. The more concrete representation of Figure 6.18 shows the mean /oy/ for all dialects with a nucleus firmly located on the back peripheral path (solid diamonds with upper left arrow). On the other hand, the mean /ey/ for a number of dialects is seen at

Table 14.5 The Southern Shift across the Vy and h subsystems

	SHORT		LONG					
			Upgliding				Ingliding	
			Front upgliding		Back upgliding			
	V		Vy		Vw		Vh	
nucleus	front	back	front	back	front	back	front	back
high	i	u	iy ↓		iw	uw		
mid	e	ʌ	ey →	oy		ow		oh
low	æ	o		ay →		aw	æh	ah

various stages of descent along the nonperipheral path, with the Inland South [IS] in the lead. This is the acoustic image of the discrete feature shifting of Table 14.5.

We can now investigate the consequences of the allophonic distribution of monophthongization. Figure 14.6 shows the outer limit of the South, defined as the region where /ay/ is monophthongized to some degree before obstruents.[6] Within the South there is often a sharp difference between monophthongization before

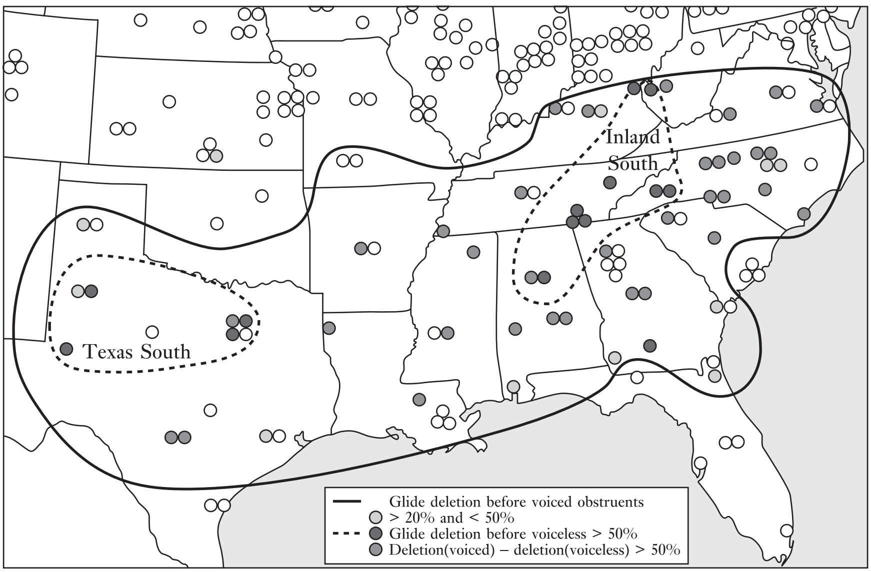

Figure 14.6 Monophthongization of /ay/ before voiceless obstruents and elsewhere in the South

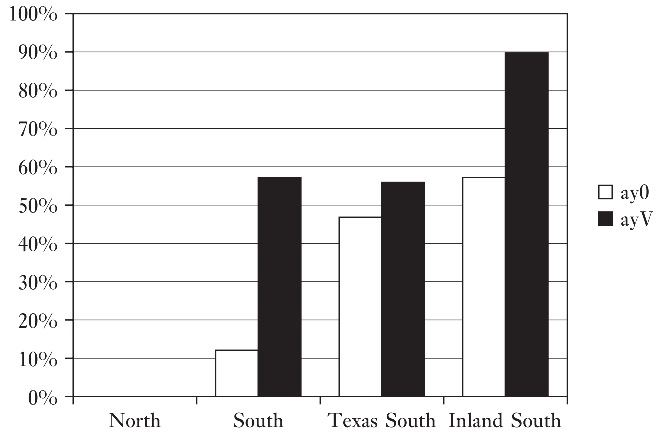

Figure 14.7 Differentiation of monophthongization of (ay0) and (ayV) in three regions of the South: Inland South, Texas South and the South outside of these two areas

voiceless obstruents (ay0) and monophthongization before voiced consonants and final (ayV).[7] This is not true for the speakers designated by empty symbols, who have a frequency of monophthongization of (ayV) less than 20 percent, or for the light grey symbols, with monophthongization of (ayV) more than 20 percent but less than 50 percent. Nor is it true for the across-the-board types – the thirteen speakers indicated by dark grey symbols, for whom monophthongization of both (ay0) and (ayV) are more than 50 percent.[8] These speakers are concentrated in the Inland South (the Appalachian area) and the Texas South.

For the majority of the forty-nine Southern speakers indicated by medium grey symbols, the difference between (ayV) and (ay0) is more than 50 percent (N = 34). The overall differentiation of the two allophones is displayed in Figure 14.7.

The basic relationship behind the chain shift is shown in Figure 14.8, which plots the mean values of /ey/ and /ay/ for twenty-one North American dialects. The Inland South mean for /ey/ is shifted strongly towards the /ay/ distribution, and, as Figure 14.7 shows, it is the Inland South that comes closest to the complete monophthongization of /ay/.

Within the Southern region as a whole, individual speakers show the same relationship, displayed in the scattergram of Figure 14.9. The trendline shows that, for each 10 percent increase in the monophthongization of (ayV), one adds 6.3 Hz to the expected value of F1 of (ey): that is, /ey/ lowers as monophthongization of /ayV/ increases. The relationship is significant, accounting for 27 percent of the variance. Now the question to be addressed is whether the difference in the monophthongization of the two allophones of /ay/ is reflected in a parallel shift of the corresponding allophones of /ey/.

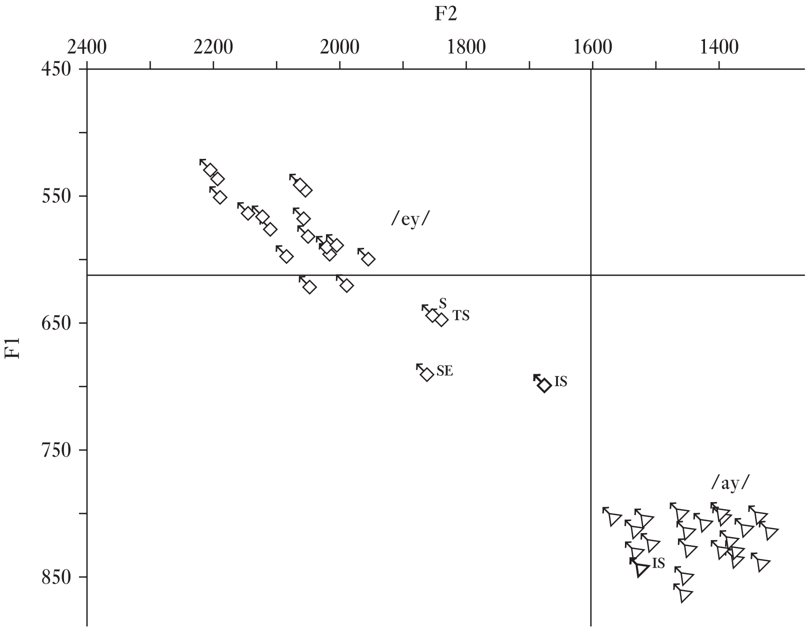

Figure 14.8 Mean positions of /ey/ and /ay/ for twenty-one North American dialects. IS = Inland South; TS = Texas South; S = South; SE = Southeastern areas not included in the South (Charleston, Florida . . .)

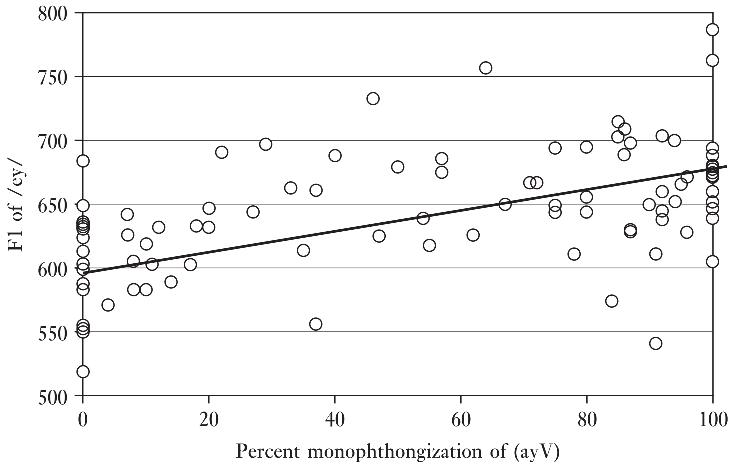

Figure 14.9 F1 of /ey/ against monophthongization of (ayV) for all speakers in the South

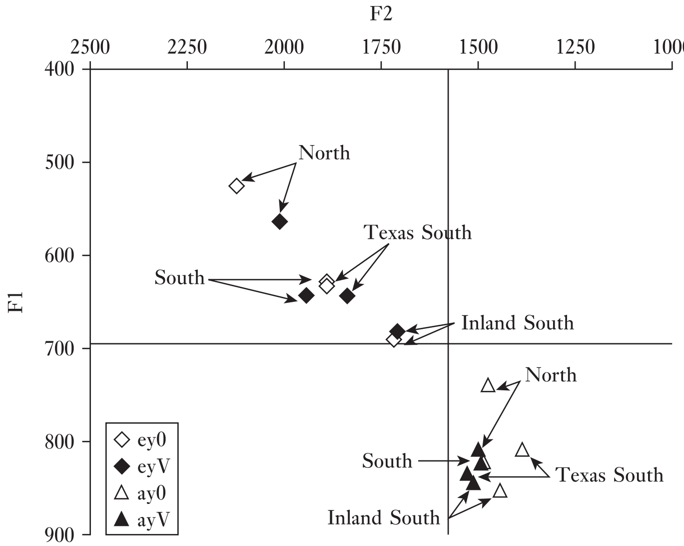

Figure 14.10 Mean values of /ay/ and /ey/ before voiceless consonants and elsewhere for the North, South, Texas South and Inland South

Allophonic chain shifting would be realized as a lower position for /ey/ in pre-voiced and final position (eyV), and as a higher position for /ey/ before voiceless consonants (ey0). Figure 14.10 plots the mean values of these allophones of /ey/, as well as the positions of (ay0) and (ayV) for the various Southern dialects. If allophonic chain shifting were taking place, we would expect to find distinct (ey0) and (eyV), corresponding to a difference in monophthongization for (ay0) and (ayV), for the South generally – but not so much for the Texas South or the Inland South dialects, where that difference is diminished. No such pattern appears in Figure 14.10: the F1/F2 positions for (ey0) and (eyV) are not significantly different for any region of the South.

Figure 14.10 does show a differentiation of (eyV) and (ey0) for the North. This is parallel to the "Canadian raising" of /ay/, which is characteristic of the North and North Central regions (Eckert 2000, ANAE, Map 13.10). This parallelism has not been noted in previous descriptions of the Northern dialect area. It can be considered either as allophonic chain shifting or as a case of generalized movement, as suggested at the beginning of this chapter.

The mean values on which this diagram is based are displayed in Table 14.6. The first section of the table compares the possible differentiation of (ey0) and (eyV) for the speakers with the most extreme monophthongization in the South: the seventeen subjects with 100 percent (ayV). No significant difference between (ey0) and (eyV) is found for either F1 or F2. The second section presents the results

Table 14.6 Means and standard deviations for F1 and F2 of /ay/ and /ey/ before voiceless consonants and elsewhere for the South and the North

South: (ayV) = 100%	F1 (Hz)	F1 Stdev	F2 (Hz)	F2 Stdev	N
(ey0)	679	66	1738	196	89
(eyV)	673	77	1709	209	297
Prob	0.5		0.24		
t	0.67		1.16		
South: (ayV) – (ay0) > 50%					
(ey0)	651	64	1827	199	192
(eyV)	656	79	1797	218	571
Prob	0.56		0.09		
t	0.58		1.68		
North					
(ey0)	526	70	2122	202	573
(eyV)	565	75	2014	200	1,307
Prob	< .0001		< .0001		
t	9.7		10.7		
(ay0)	738	90	1475	184	473
(ayV)	809	94	1503	144	1,215
Prob	< .0001		< .001		
t	10.6		3.3		

for the subset of Southern speakers who are most likely to show allophonic chain shifting: those who show the greatest difference between (ay0) and (ayV). Again, we find no difference in the mean values of (ey0) and (eyV).

The last two sections of Table 14.6 show the mean values of the /ay/ and /ey/ allophones in the North. The F1 difference between (ay0) and (ayV) is 71 Hz, which is above the 60 Hz criterion adopted for Canadian raising in ANAE, Map 13.10. The F1 difference between (ey0) and (eyV) is 39 Hz: it is smaller, but also significant at the $p < .0001$ level. This parallel allophony indicates the potential for a disruption of the unity of the phoneme; but it is hardly noticeable, both to native speakers and to phoneticians. It is quite remote from the disruption produced by the migration of (ayV) into the long and ingliding subsystem, which opposes *white* [waɪt] to *wide* [wa:d]. It is more akin to the Philadelphia raising of checked /eyC/ discussed in Chapter 2, by which the vowels in *paid* and *main* overlap with the vowels in *peed* and *mean*, while the free allophones remain in lower mid position. In the North the two phonemes move upward before voiceless consonants without any overlap, a movement that does not threaten to disrupt either phonemic unity.

14.3 The Binding Force

Much of this chapter concerns the coarticulatory disruption of phonemes – as an accomplished fact, as in the case of *great*, *break* and *drain*, or in the English subsystem before /r/; or as an unrealized possibility, as in the nasal subsystem or the Southern Shift. The unrealized possibilities are in fact the great majority. The binding force which counters these disruptive forces is strong enough to ensure the long-term identity of most phonemes. Its effects may be seen in two general tendencies that we observe in the course of the linguistic changes studied here. The absence of allophonic chain shifting has a positive consequence: we observe that a phoneme responds to the movement of a neighboring phoneme only when all the allophones of the latter have vacated the neighboring space.

In cases of lexical diffusion, where change proceeds word by word, the binding force is overridden from the outset, and a restoration of the original phoneme can be accomplished only by external factors. In the course of a regular conditioned sound change, the integrity of a phoneme may be threatened, and extreme allophones may be reinterpreted as, and merged with, other phonemes. Yet most historical word classes are preserved over time in the process of reintegration that has been documented at many points in previous chapters: the reassembly of (Tuw) and (Kuw) examined in Chapter 5; the parallel integration of (ow) in the most advanced stages of fronting seen in Chapter 12; and the general raising of /æ/ in the Northern Cities Shift. Despite some losses and disruptions, it can be recognized that a phoneme is more than a collection of allophones; it is rather an entity that responds to historical processes in a unified manner. This observation gives support to the linguistic construction of categories based on complementary distribution and aligns linguistic change with other evidence for the psychological reality of the phoneme.