5. ON THE UNIFORMITY OF THE LOW-BACK-MERGER SHIFT IN THE U.S. WEST AND BEYOND

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THE CURRENT CHAPTER presents an analysis across varied sites in the Western United States, namely California, Nevada, and Oregon, to probe further the uniformity of the Low-Back-Merger Shift. As discussed earlier in this volume (Becker 2019), we refer here to a vowel system with short front vowel backing, particularly for (nonprenasal) BAT and BET, initiated by the Low Back Merger of BOT and BOUGHT.[1] Previous work has identified this vowel pattern both in California and other locales across the West (see various contributions in Fridland et al. 2016, 2017). As noted elsewhere in this volume, a similar vowel pattern is found in the English spoken across much of Canada. In line with the collective sense of this volume, we will adopt the name Low-Back-Merger Shift (LBMS) as a more accurate label to refer to this vowel system.

The larger framework in which we embed this chapter's discussion is whether such a broader designation makes sense in terms of the likelihood that the two shifts, one typically described as the California Vowel Shift and the other as the Canadian Vowel Shift, are indeed related. As groundwork to better understanding whether the California Vowel Shift, the Canadian Vowel Shift, and the shifts found in Nevada, Colorado, and Oregon, and, more marginally, in New Mexico, Arizona, and Montana (see contributions in Fridland et al. 2016, 2017) are reflexes of the same shift process, this chapter will evaluate comparable data collected from three Western states to look more deeply at how these shifts are realized in these distinct locales. We consider both the findings of previous work and the current analysis, alongside information about migration and settlement patterns, to try and shed some light on the guiding question posed in this volume's introduction.

OVERVIEW OF THE LBMS SHIFT PATTERN

Using data mainly based on speakers from Ontario, Clarke et al. (1995) first introduced the changes to the lax front vowels that have become char-

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acteristically known as the Canadian Vowel Shift. As discussed elsewhere in this volume, much recent work across varied sites in Canada (e.g., Lawrance 2002; Boberg 2005, 2008, 2019; Sadlier-Brown and Tamminga 2008; Roeder and Jarmasz 2010; Roeder and Gardner 2013; Roeder, Onosson, and D'Arcy 2018) suggests this front lax shift pattern has become the norm across most of Canada.

In the Western United States, a similar backing and/or lowering of short front vowels has been described (Hinton et al. 1987; Eckert 2004, 2008; Labov, Ash, and Boberg 2006; Kennedy and Grama 2012; Becker et al. 2016; Cardoso et al. 2016; D'Onofrio et al. 2016; McLarty, Kendall, and Farrington 2016; Fridland and Kendall 2017a; Hall-Lew et al. 2017; Holland and Brandenburg 2017). As in Canada, we find variability in how the short front vowel shifts are realized across the Western United States, with changes in just one or both F1 and F2 reported by different studies. While the low front vowel BAT is almost uniformly backed across the West, we find less consistency in the high and mid lax vowels. The BET class is often found to exhibit lowering (Kennedy and Gramma 2012; Hall Lew et al. 2015; Cardoso et al. 2016; D'Onofrio et al. 2016; Bowie 2017; Fridland and Kendall 2017a) or lowering and backing (Hall-Lew et al. 2015; Cardoso et al. 2016; Brumbaugh and Koops 2017; Holland and Brandenberg 2017), as opposed to just F2 shift. As in Canada, shift in BIT is less attested, but typically is reported as lowering (Becker et al. 2016; Cardoso et al. 2016; Fridland and Kendall 2017) if present at all. So, in the West, F1 tends to be the greatest dimension of shift for the high and mid short vowels in most work, but with variable degrees of backing also referenced. (We also note that due to the greater perceptibility of small changes at lower frequency values shifts in F1 are expected to be more perceptually important compared to the equivalent changes in F2.) Recent work in Nevada (Fridland and Kendall 2017a) and California (Grama and Kennedy 2019 [this volume]) suggests that this short front vowel movement is connected, with a positive correlation for retraction among BIT, BET, and BAT. Still, the question of what instigated this shift and the relationship between the shift patterns documented across the West (and Canada) remains a subject of debate. As made clear in the introduction to the current volume, while we have a multitude of studies showing evidence of the LBMS, it is not yet clear if we should think of the patterns existing across disparate locales as a unified shift process. As part of the larger inquiry pursued in this volume, we here consider whether we can identify what structural and/or social preconditions would provide evidence of such a linkage across geographic boundaries.

THE QUESTION OF STRUCTURAL RELATIONSHIPS

To explore this question in greater detail requires us to consider the larger vowel system, as this short front vowel rotation is only part of the picture of the vowel changes that have affected speech in both the United States and Canada over the last century. A much more uniform and well-entrenched pattern, across both Canada and United States, is the widespread merger of the low back vowels. Labov (2010, 95) suggests this merger is a result of the backing and raising of the BOT class, which "moves to the long and ingliding subsystem rather than [BOUGHT] to the short subsystem." A number of scholars (Thomas 2001; Gordon 2004; Labov, Ash, and Boberg 2006; Bigham 2010) have suggested that the Low Back Merger creates instability in the vowel system, and, as a result, acts as the "triggering event" behind the front lax vowel shift. Of course, the Low Back Merger does not necessitate the backing of the short front system, as in Pittsburgh, for example, where the merger results in lowering of the mid-central vowel instead, without BAT backing (Labov 2010, 2019 [this volume]). So, even with the assumption of the Low Back Merger as a potential trigger, we can expect variation in response to such a triggering event in terms of how other vowels in the system might readjust. Positing a structural relationship between the low front and low back vowel allows for similar shift patterns to simultaneously develop in different dialect regions as one potential response, but also allows for other structural adjustments, such as that found in Pittsburgh.

Indeed, the relationship between the low front and back vowels appears to be pivotal to several of the shifts affecting contemporary regional varieties of English, despite very different acoustic positioning of the short front vowels. For example, our recent work (Kendall and Fridland 2017) comparing the position of the low front and low back vowels across the U.S. Northern, Southern, and Western dialect regions used both Euclidean distance measures between vowel classes and correlations between F1 and F2 measures to attempt to find empirical support for a linkage in the RELATIVE positioning of the low front and low back vowel, despite the fact that the regions differed significantly in ABSOLUTE position of these vowels (based on F1/F2 measures). Only speakers in our Western states showed the Low Back Merger, and the regions varied in regard to the F1 and F2 measures of BAT, BOT, and BOUGHT. However, Euclidean distance measures between BAT and BOT were not significantly different across regions, and the F2 of BOT was highly correlated with the position of BAT. Abstracted from the varied absolute positions for BAT and BOT across dialect regions, these measures suggested the same overall structural relationship was maintained between the low front vowel and the low back vowel across dialects despite these various shifts. In other words, these two vowels appear tied together in some way, and this relationship was maintained via different vowel shifts across the three regions. As discussed in Kendall and Fridland (2017), the relationship between the low front and low back system seems to hinge not on the degree of merger evidenced in the low back vowels, but on the position of the BOT vowel relative to BAT. A similar finding of a correlation between the relative position of BAT and BOT (rather than with the Low Back Merger itself) is reported in this volume for Seattle and Vancouver (Swan 2019) and in California (Grama and Kennedy 2019). These findings, confirming the accounts cited above that posit a structural relationship among the low vowels, certainly bolster the argument for the emergence of a separate but similar shift process across varied locales, unrelated to any contact-based explanation. Likewise, the lack of correlation found between the Low Back Merger and the front vowels suggests that the presence or the merger itself is not a necessary precondition to the LBMS, which instead seems to hinge on the position (whether fully merged with BOUGHT or not) of BOT.

THE QUESTION OF SOCIAL RELATIONSHIPS

The next question is whether we have any real evidence that the shifts diffused from the same source dialect(s). For this, we would need to see both substantial linguistic uniformity and a pattern of migration and social contact by which the shifts would be spread. There might be some support in the historical record for the spread of at least the Low Back Merger based on patterns of early settlement. It is possible, given the earlier onset of merger in archival speakers in Oregon compared to evidence from Nevadan and Californian archival speakers (in Fridland and Kendall 2017b, we find strong evidence of merger only among contemporary speakers, not in archival recordings), that the merger in the Pacific Northwest and Canada, found in speakers born in the mid-to-late 1800s, came from early migration into the Pacific Northwest from Canada, or, more likely, by similarity among the earliest Anglo settlers in both places. Similarly, Grama and Kennedy (2019 [this volume]) explore the idea of an inherited low vowel instability based on early immigrant dialects which themselves might have exhibited variation in word class membership and low vowel systems.

On the other hand, for short front vowel backing, which is reported only more recently, we do not have strong evidence that contemporary social interaction, such as Canadian migration or even access due to cross-border contact, has widely diffused the LBMS into the United States or vice versa. First of all, most of the 13 states with a shared border with Canada

(Alaska, Washington, Idaho, Montana, North Dakota, Minnesota, Michigan, Ohio, Pennsylvania, New York, Vermont, New Hampshire, Maine) are not affected by the LBMS pattern, with only Washington State showing some evidence of the LBMS pattern (Swan 2019 [this volume], but see also Wassink 2016, who suggests even Washington is not greatly affected). As well, looking at the metro areas with the largest population of Canadian immigrants, Los Angeles, New York, Miami, and Seattle (Zong, Rkasnuam, and Batalova 2014), only Los Angeles and (potentially) Seattle would support an argument for diffusion, since neither of the other cities participate in short front retraction to any extent. Given this, it certainly seems counter to any argument that the widespread nature of the LBMS pattern is exclusively the result of social cohesion and contact, rather than a similar underlying structural motivation, which sets in motion similar adjustments. Now, in areas with close contact, such as Vancouver and Seattle, these adjustments might be further fed, and thus develop similarly, by social contact/diffusion. However, given the lack of consistency in finding the LBMS in Washington State, as well as the fact that we have much earlier reports of some lowering in BIT, BET, and BAT in California compared to Seattle (Hagiwara 1997; Hinton et al. 1987), a more likely explanation is that social contact only encourages the LBMS in areas that crucially share the structural relationship described in the section above.

This brings us to our current work, where we hope to contribute additional insight to this question by evaluating whether the LBMS is uniform across three contiguous states from which we have collected identical data for our larger U.S. production (and perception) study, namely, California, Oregon, and Nevada. In addition to presenting a measure of the LBMS Index, adapted from Boberg (2019) and used by other studies in this volume, we also include in our analysis the use of principal component analysis (PCA), a measure that also helps us move away from viewing change along a primary F1 versus F2 axis by taking into account the often simultaneous movement along these two axes. In this brief analysis, we compare these three sets of Western speakers to determine whether we find any variation in the realization of front vowel backing. In addition, in light of these data and of migratory data and social cohesion, we consider whether we might be able to speak, via inference at least, to the broader question of whether the patterns found in Canada and the Western United States are best thought of as results of separate or the same shift processes.

EMPIRICAL INVESTIGATION WITHIN THE WEST

Our data come from a large-scale production-perception study that we have conducted over the past 10 or so years. (See Fridland and Kendall [2012] and Kendall and Fridland [2012, 2017] for more extensive discussion of data collection and analysis methods.) For the present analyses we use data from 21 participants from the Western field sites: 6 Californians, 7 Nevadans, and 8 Oregonians. The participants examined here were primarily college-age adults who reported they resided in the region of study from early childhood (age 4) until at least adulthood (age 18). All were European American and native speakers of English. Participants were recruited for our study from the student populations at the University of Nevada, Reno, and the University of Oregon. We take advantage of the fact that both of our universities have high numbers of students from California; we consider these young adults as representatives of their home state rather than the location of their university.

For the analysis, per speaker, approximately 100 vowels were measured from a word list and 34 vowels were measured, by hand, from a reading passage. Praat (Boersma and Weenink 2012) was used for all acoustic measurements, with F1 and F2 measurements taken at one-third and two-thirds of each vowel's temporal duration. The one-third measurement point is used throughout our analysis as the vowel's nucleus. All vowel data were manipulated and, where relevant, normalized with the Vowels package (Kendall and Thomas 2009) for R (R Development Core Team 2010) using the Lobanov (1971) z-score method.

We begin by examining mean vowel plots for each state, in figures 5.1–5.3. Ellipses in the figures indicate one standard deviation for each vowel category (except for BAN, for which we have fewer tokens). A quick glance at these three plots indicates that they look rather similar to one another. All three states show a system with the Low Back Merger, the low front vowel BAT appearing as the lowest vowel in the system (with the exception of raised BAN tokens), and similarly positioned BET and BIT classes. To examine the positioning of these vowels further, we move on to a series of boxplots of SPEAKER-LEVEL means for a series of relevant measures.

To consider the short front vowels, we turn to examine the positions of BAT, BET, and BIT along the front diagonal. Analyzing the combined lowering and backing of the shift in short front vowels is complicated somewhat because the primarily movement is in one direction but the direction is not simply along F1 or F2. Typically analyses focus on whichever dimension appears to be primary, which (as discussed above in our review of prior work) can lead to disagreements about whether these vowels are lowering

FIGURE 5.1
Mean Vowel Plots for the Six Californian Speakers
(ellipses indicate one standard variation)

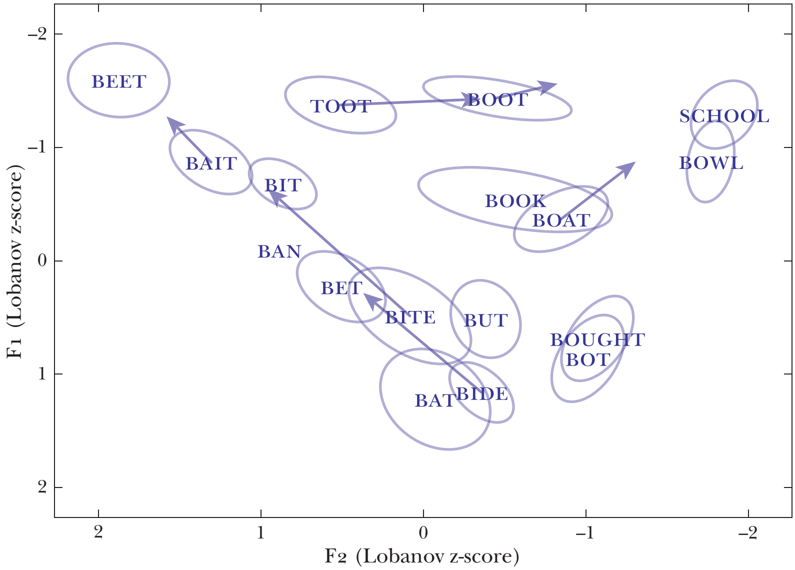


FIGURE 5.2
Mean Vowel Plots for the Seven Nevadan Speakers
(ellipses indicate one standard variation)

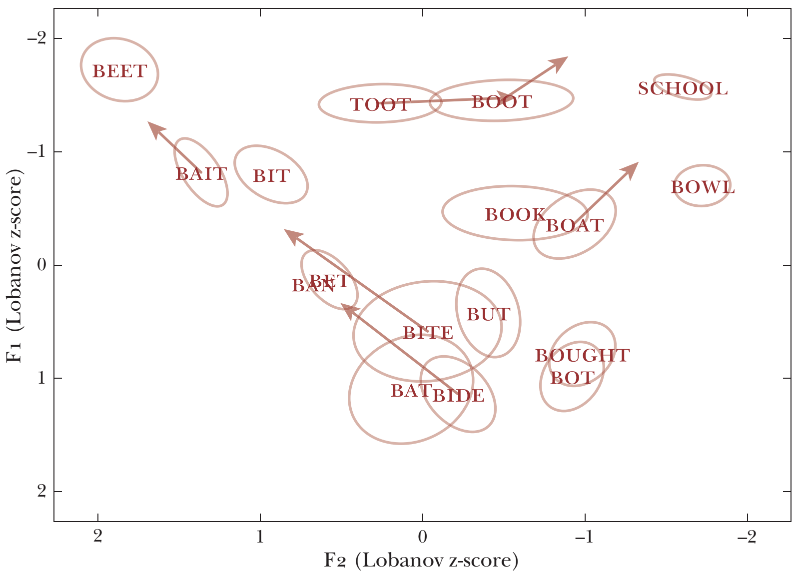
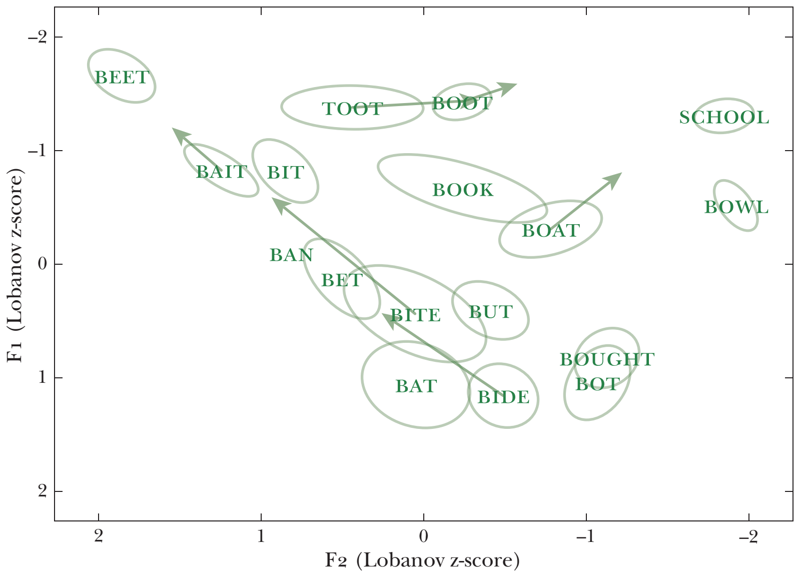


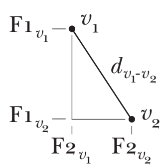
FIGURE 5.3
Mean Vowel Plots for the Eight Oregonian Speakers
(ellipses indicate one standard variation)



(increasing in F1) or backing (decreasing in F2), or they examine F1 and F2 as separate dependent measures. Some studies have helpfully computed a diagonal measure (e.g., Labov, Rosenfelder, and Fruehwald 2013) by constructing an arithmetic combination of F1 and F2 to track movement along these vowels' diagonal path. We have examined such a diagonal measure in previous work but found that it did not perform significantly better than other measures, such as F1 or F2 alone (Kendall and Fridland 2017, n. 3). Boberg (2019) proposes an LBMS Index measure that involves the average of the Euclidean distances between BEET and BIT, BEET and BET, and BEET and BAT. We implement this measure for our speakers, using Lobanov-normalized z-scores:

1. $d_{v_1\text{-}v_2} = \sqrt{(F2_{v_1} - F2_{v_2})^2 + (F1_{v_1} - F1_{v_2})^2}$

2. $\text{LBMS Index} = \dfrac{d_{\text{BEET-BIT}} + d_{\text{BEET-BET}} + d_{\text{BEET-BAT}}}{3}$



In addition to Boberg's LBMS Index measure, we also suggest an approach that seems quite logical here but that we have not seen used to analyze front lax vowel lowering and backing: principal component analysis. PCA is a standard technique for reducing the dimensionality of higher dimensional data, but it is also useful for rotating two-dimensional data around the axis of its primary variability. A PCA-based rotation of F1 and F2 allows us to conceptualize the front lax shift along a single dimension of movement that captures the simultaneous (diagonal-like) movement in both F1 and F2. This is displayed here in figure 5.4, which shows all of the front lax vowels for our speakers. For the front lax vowels, especially for BET and BIT, PC1, the first principal component, captures the combined lowering and backing and allows us to measure speakers', or vowels', relative positions using a single (most appropriate) dependent variable. PC2, the second principal component, represents variation along the less primary dimension. (Dashed lines in the plot on the right show the mean PC1 for each vowel and state; based on these means, Californians appear slightly more advanced than Nevadans and Oregonians.)

To examine the patterns across the short front vowels for our three data sets, we turn to examine the data as boxplots. Figure 5.5 displays boxplots for BIT and BET, showing F1 in the left panels and PC1 in the right panels. Figure 5.6 displays BAT, where we also include F2, since BAT variability, at the bottom of the vowel space, is less well captured by PC1 alone (see figure 5.4). Figure 5.7 displays boxplots for the LBMS Index measure, calculated for the normalized data, with the summary values by state provided in table 5.1.

For BIT we see some evidence that California and Oregon might be slightly more advanced than Nevada, but the differences are not significant.

FIGURE 5.4
Comparison of Raw Formant Values vs. PCA Transformation

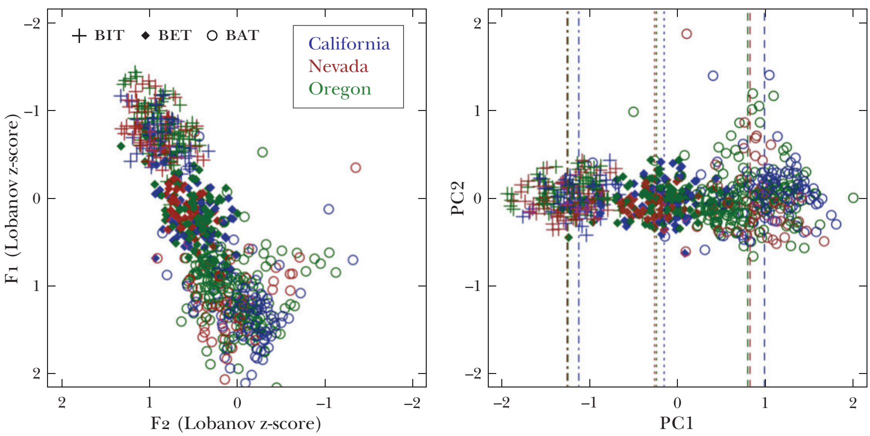


FIGURE 5.5
BIT and BET F1 and Principle Component 1 by State

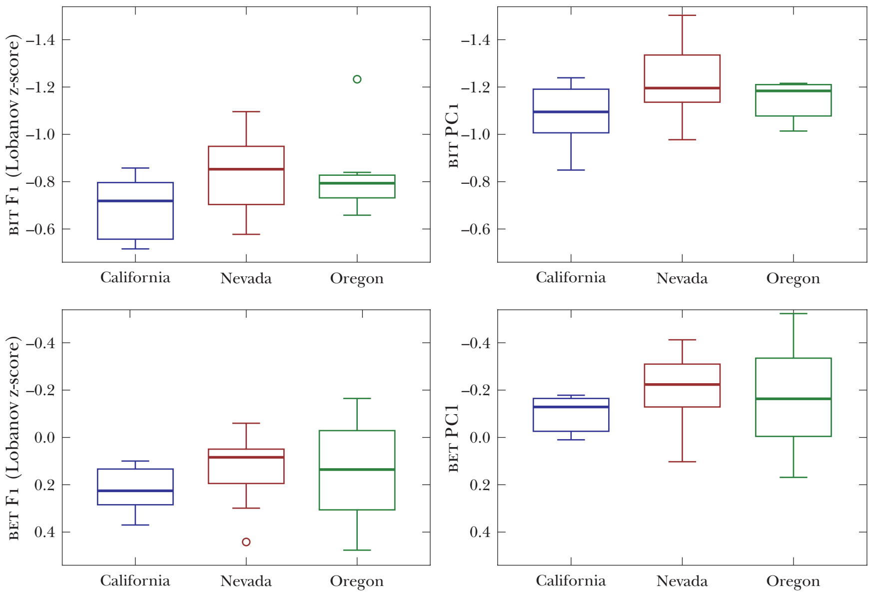


FIGURE 5.6
BAT F1, F2, and Principle Component 1 by State

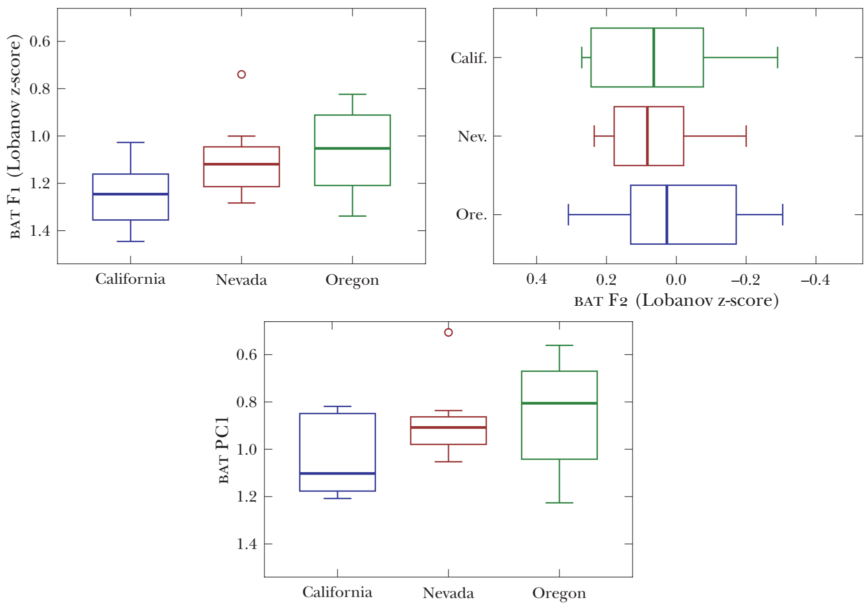


FIGURE 5.7
LBMS Index by State

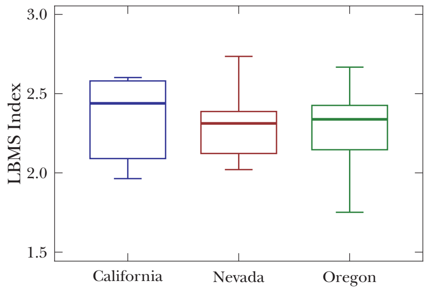


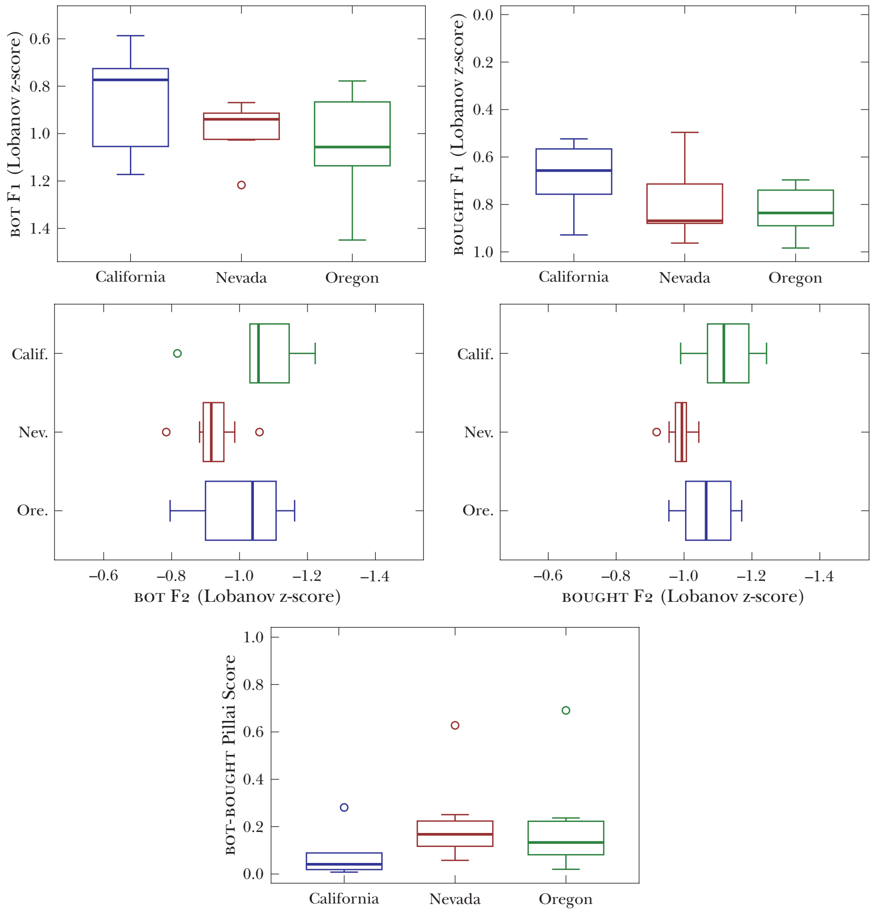
TABLE 5.1
LBMS Index Means (standard devs.) and Medians by State

State	*LBMS Index Mean (st. dev.)*	*LBMS Index Median*
California	2.35 (0.27)	2.44
Nevada	2.30 (0.24)	2.31
Oregon	2.28 (0.27)	2.34

For BET the three states are even more similar (and again there no significant differences). For BAT it appears that California might be a bit ahead of Nevada and Nevada slightly ahead of Oregon in terms of the vowel's lowering and backing, although again none of the differences are significant. The LBMS Index shows a slightly larger value for California in comparison to Oregon and Nevada, but this difference too is not significant. So, on the basis of all of these measures, the small (nonsignificant) differences across these states appear to be, if anything, more a matter of slight degrees of advancement than of any substantive difference in vowel realization. Though a weak trend, California shows a slight lead in advancement.

Finally, figure 5.8 displays data for the low back vowels for our speakers, providing a view of F1 and F2 patterns, as well as Pillai values, a measure of distributional overlap (with values closer to zero indicating overlap and values closer to one indicating distinctness; see Kendall and Fridland 2017). As with the short front vowels, we observe only small differences among the three groups. Here significant differences emerge but only for the F2 of BOUGHT (ANOVA: $F = 6.664$, $p = 0.0068$), where the difference between Oregon and Nevada is significant (Tukey HSD: $p = 0.005$). Beyond that, Oregon BOT and BOUGHT appear to be a bit backer than for California and Nevada, the most substantial observation we can make from these plots is that California appears to be a bit more complete in the spectral merger of BOT and BOUGHT and these (merged) classes appear slightly higher than

FIGURE 5.8
Low Back Vowels, F1, F2, and Pillai Measure by State



those of Oregon and Nevada. However, we note that this difference is once again not significant.

Altogether, we close our empirical survey by noting a general similarity in the patterns in production across these three Western states. While not significant, our data show a slight trend of more advancement in the shift of the short front vowels and in BOT-BOUGHT merger and height for California. If we do interpret this as showing a California lead, the similarity in the pattern would suggest that contact based diffusion of the LBMS, fueled by shared underlying structural preconditions, is quite possible in those states, particularly given both Nevada and Oregon have their largest migration inflow from California natives (Perry 2003). We might assume diffusion would be aided by similarity in the type of early settlers (from the Midwest and North, and a large British component (Bright 1967; Reed and Reed 1972; McBride 2002; Robbins 2002) and high level of contemporary immigration from California (Perry 2003), making competing options in terms of stabilizing the relationship between the low front and back vowels less likely. Given this high degree of contact in these states, diffusion of the front shift in response to the shared low system instability is a very plausible option.

UNIFORMITY BEYOND THE WEST

The question now becomes whether we would want to say this unified pattern we find in the West is the same shift as that occurring in Canada? Or is it simply a similar manifestation of the principle of maximal dispersion in response to the same structural input (the Low Back Merger)—in other words, a separate (though similar) development? And what is the distinction here that would determine if there are two separately developing shift patterns, or, instead, the expansion of the Canadian shift to the United States or vice versa? It would seem that we would need two types of evidence: (1) a high degree of linguistic similarity in the nature of the shift pattern, and, with that, (2) evidence of high levels of social interaction coinciding with those areas in which we find linguistic similarity, as we find with our three Western states.

If we want to say the patterns referred to as the Canadian and California Vowel Shifts are, in fact, the result of social diffusion of a singular shift process, we also need to be able to discount the likelihood that such shifts could occur, instead, as independent developments. And, it would seem, that we have the structural preconditions (the Low Back Merger) in both places that could, simultaneously, but separately, set in motion subsequent shifts that would share surface similarity. Certainly, the most uniform process reported across the recent PADS volumes on the Western United States (Fridland et al. 2016, 2017), affecting all studied communities, is the Low Back Merger. In Canada, we also find widespread merger across varied locales. In terms of time-depth, Chambers (1993, 11–12) suggests the Low Back Merger was present in Canada as early as the 1850s. As well, early data in the West indicates the merger was present in the early 1900s in Utah (Bowie 2012, 2017) and Oregon (McLarty et al. 2016), suggesting an onset in those states by the turn of the century, if not earlier. In both regions, based on what evidence we have from archival speakers, the Low Back Merger appears to predate the onset of the LBMS pattern. It would seem, then, that the foundation for the merger was set into play in the early years of what we would like to call Western Koinéization. This period of westward settlement and the gold and silver mining booms in California and Nevada brought together vast numbers of migrants both from outside and within America. Certainly, one possibility is that the Low Back Merger is a structural leveling set in motion by varied low vowel systems in early settlement groups (a leveling in favor of merger, e.g., Herold 1990) or from other internal pressures that such contact promoted (e.g., Johnson 2010), a possibility also suggested by Grama and Kennedy (2019 [this volume]). However the Low Back Merger began, the LBMS, a much later development, appears likely to have been instigated by the readjustment of BOT and BOUGHT brought about by this merger and could develop separately in response to the same underlying structural instability among the low vowels. While both Swan's (2019 [this volume]) current work and ours in this chapter do suggest that areas with substantive social contact seem to exhibit very similar instantiation of the LBMS, this would make sense set against a backdrop of a structural relationship that encourages phonetic adjustments; that is, areas in close proximity with significant social contact would foster diffusion of similar instantiation of such adjustments, but disparate areas with similar systems might also separately respond to the instability in ways that replicate that found elsewhere. As a result, the broad expanse geographically of the LBMS across Canada and the Western United States appears to be both independently motivated on a global scale, but potentially socially cohesive on a local scale.

CONCLUSION

In summary, while we have no smoking gun, we do have a substantial number of supporting studies and historical records that suggest that similar structural input (the Low Back Merger) was present in early English in both Canada and the Western United States. In regard to the short front vowel pattern, we suggest there is little evidence that this similar contemporary system in large scale was due to extensive social contact or migration. The longer time-depth of the Low Back Merger in both areas and the lack of evidence of much social connectedness across varied LBMS affected communities seems to support the hypothesis of a structural explanation behind the shared pattern, at least at the global level. This is reinforced by our recent work (Kendall and Fridland 2017), which found that U.S. regions appear to maintain the same distance between the front and back low vowels, despite differences in the shift patterns affecting those areas. As a result, we would suggest the LBMS results as, quite likely, a similar response to the same triggering event in both regions. It may not be a NECESSARY result from the Low Back Merger, but it appears to be a likely one.

Finally, we leave with a note on work that remains for the future. While our focus in this chapter has been on the similarity of the shift pattern found across Canada and the Western United States, we do want to draw attention to the fact that the apparent similarity in F1/F2 measures alone may miss other phonetic distinctions that maintain differences across regions and speakers. For example, in Fridland, Kendall, and Farrington (2014), we found that durational differences between the low back vowels appear to increase as spectral differences decrease. We also found that regional differences existed in the extent to which this inverse relationship obtained, suggesting overall that more detailed work on the Low Back Merger is needed in terms of how other aspects may distinguish what appear, based only of F1/F2 measures, to be similar patterns. While we have only made cursory comparisons in our current data, we also find durational differences are maintained across the three short front classes, suggesting other cues may be utilized by listeners for perception of vowels that are highly variable based on F1/F2 measures. In other words, the similarity we find in F1/F2 measures in the studies reported here (and many studies before) may obscure distinctions along other dimensions that may be distinguishing the dialects perceptually for speakers within these communities.

NOTE

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1. Here, we use a variation of Wells (1982) keyword notation, using B_T frames to represent phonetic classes.

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