5aSCb52. The role of duration in regional U.S. vowel shifts
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Contemporary American dialect research has produced a rich body of literature on phonetic differences in vowel production. Many studies have focused on contrasting shifts occurring in the speech of Northerners and Southerners. While such research clearly shows formant differences across dialects, the investigation of regionally variable phonetic cues beyond F1 and F2 has been under-addressed. The limited work existing on sociolinguistic aspects of duration suggests speakers do show durational differences across regions (Clopper et al. 2005, Jacewicz et al. 2007, Labov & Baranowski 2006, Tauberer & Evanini 2009). However, beyond these studies, there has been little research on the regional variability of vowel duration and on how phonemically non-distinctive durational differences found across regions may be related to the degree and type of spectral shift present in individual's systems. In this paper we consider the extent to which duration corresponds to spectral differences in the major U.S. vowel shifts. In addition to looking at overall regional patterns, we examine whether durational differences co-vary with degree of individual's participation in spectral shift. We discuss how duration, particularly of lax vowels, relates to the advancement of vowel shift features and whether such a relationship supports a physiological or grammatical explanation for duration.
INTRODUCTION

In our recently published work on vowel production and vowel perception across U.S. regional dialects, we found clear evidence of F1 and F2 distinctions among speakers of Northern, Western and Southern dialects in line with well-documented regionally diagnostic vowel shift patterns (Kendall and Fridland 2012, Fridland and Kendall 2012). In addition, perceptual distinctions were found among regions reflecting reflexes of these shifts. Our work also found substantial variability in the degree to which speakers within each region were participating in these vowel shifts, particularly those affecting the mid front vowels, and that this variability in production predicted perceptual behavior.

Figure 1 displays the (Lobanov normalized, see Thomas and Kendall 2007) F1 and F2 means for the vowel onsets for 11 vowel phonemes across the three regional groups. In addition to the primary vowel classes presented (which do not include pre-lateral, pre-rhotic, or pre-nasal environments), the plots include pre-lateral means for the high- and mid-back vowels to help illustrate the overall shape of the regional vowel spaces. Overall, these regional patterns match expectations based on the regional vowel shifts affecting each region. The Northerners show the primary reflexes of the Northern Cities Shift (NCS): generalized /æ/ raising, backed and lowered /ɪ/ and /ɛ/, no merger between the low back vowels, /ɑ/ and /ɔ/, and an /ɑ/ class that appears lower and fronter than other regions. The Westerners show lowered /ɪ/ and /ɛ/, no general raising in the /æ/ class, and a clear merger of the low back vowels, inline with common portrayals of the California Vowel Shift and the Canadian Vowel Shift, or what we have labeled the “Elsewhere Vowel Shift”. Finally, the Southerners show clear evidence of the Southern Vowel Shift (SVS), with a centralized /e/ class (approaching /ɛ/), a somewhat raised /æ/ class, and no low back vowel merger. All three regions show substantial high back vowel fronting, a shift that is rapidly advancing in most American dialects. See Labov (1994) or Gordon (2002) for fuller details and schematizations of these major regional vowel shifts.

While formant structure is often considered the gold standard for measuring socially-driven vowel variation and is certainly relevant to regional vowel variation, variation in duration among speakers in our sample led us to ask whether durational differences also pattern in sociolinguistically-meaningful ways. In addition to looking more globally at the relationship of duration to region, the current paper examines whether durational differences, like perception, co-vary with degree of participation in regional shift patterns in spectral space.

The limited work that exists on sociolinguistic aspects of duration suggests that speakers do show durational differences across regional dialects (Clopper, Pisoni and de Jong 2005, Jacewicz, Fox, and Salmons 2007). However, these papers did not examine whether duration was tied to individual production rather than overall community norms. A few researchers have begun to tease out this relationship between vowel production and duration more extensively (Labov and Baranowski 2006, Langstrof 2009, Tauberer and Evanini 2009) but have not...
systematically investigated shifted and non-shifted speakers within communities to examine the relationship of duration to vowel shift progression more specifically.

**METHOD**

The data presented here come from a larger study investigating both production and perception across regional U.S. dialects (Kendall and Fridland 2012, Fridland and Kendall 2012). A subset of participants were recruited from universities in each of the three dialect areas studied to provide speech data from reading passage and word list recitation. For the present inquiry, we examine Northern participants recruited from the State University of New York at Oswego in New York state, Southern participants recruited from the University of Memphis in Tennessee, and Western participants recruited from the University of Nevada Reno in Nevada. Specifically, we focus here on 14 participants from the Memphis, TN (South) field site, 10 participants from the Reno, NV (West) field site, and 14 participants from the Oswego, NY (North) field site who contributed speech data to the project.

The speakers were recorded with a Tascam digital recorder and a Shure WH30XLR head-mounted microphone (or, in a few cases, a Sony MZ-R70 digital recorder and an ATR 410 head-mounted condenser microphone) in a quiet University office (with just the fieldworker and participant present).

All vowel measurements were made using Praat (Boersma and Weenink 2012). Formant measurements were taken at two time points, 1/3 and 2/3 of each vowel token’s duration. Vowel duration is normalized in the analyses below by dividing the individual duration measurement for each token by its speaker’s mean vowel duration. All speakers read the same reading passage and word list with the same instructions (to read the passage over before recitation and to pause briefly between each word list recitation) so prosodic differences should be minimal.

**RESULTS**

Figures 2 & 3 collapse all following environments and show that the Southerners have on average a shorter (or negative for /i/-/ɪ/) durational difference between their tense and lax mid- and high-front vowels in comparison to the other regions (similar trends were found when the data were separated by voicing of following coda). Duration differences between the North and West are not significant, but are significant between Southerners and non-Southerners (/ɛ/-/ɛ/, \(p < 0.05\); /ɪ/-/ɪ/, \(p < 0.00001\)).

These results appear to confirm those found in the few duration studies referenced earlier (Clopper et al. 2005, Jacewicz et al. 2007) where longer durations for lax vowels were predominately associated with Southerners. In our data, this regional difference is also primarily driven by the longer lax vowels for the Southern speakers (/ɛ/, \(p < 0.01\); /ɪ/, \(p < 0.00001\)), as our Southern speakers did not show significantly shorter tense vowels when compared to other regions. This finding is inline with those of Clopper et al. (2005), who also did not find significant differences...
among regions for tense vowels, but somewhat in contrast to those of Jacewicz et al. (2007), who found Southerners to have significantly longer durations in all tested vowel categories (which included /e/, but not /i/). However, as we discuss below, the relationship between duration and region is somewhat complicated by the individual variability in participation in vowel shifts affecting speech in the South, an aspect unexplored in these previous studies.

**FIGURE 3.** /e/ - /ɛ/ normalized durations for all speakers, organized by region.

**FIGURE 4.** Correlations between /e/ - /ɛ/ duration differences and spectral Euclidean distances.

Figure 4 displays some of our preliminary results on the relationships between region, duration, and spectral shift found in our data. Euclidean distance (in Lobanov normalized units) between /e/ and /ɛ/ is shown on the x-axis, while /e/ - /ɛ/ duration (normalized by speaker as mentioned above) is shown on the y-axis. For Southerners, we see
a significant positive correlation between spectral distance and durational difference (Pearson’s $r = 0.58, p < 0.05$), while the correlation is negative for the Northern talkers (Pearson’s $r = -0.79, p < 0.001$) and trends negatively for the Western talkers. For the Westerners the correlation is non-significant, although we still display the fit-line to indicate the negative tendency. From even this brief empirical view, it seems clear that duration is playing a different role across regional dialects in the U.S. and that this difference is tied to vowel shift patterns, at least in the South.

This finding of decreased duration difference with increased spectral overlap for the Southerners in our study is intriguing, as earlier research has suggested that duration tends to become more important as a disambiguating cue when spectral distinctions are small (e.g. Ainsworth 1972, Bennett 1968, Labov and Baranowski 2006, Stevens 1959). So, we should expect shifted speakers to show durational shifts that maintain, not decrease, contrasts. However, as discussed above, most work on regional differences in duration (Clopper et al. 2005, Jacewicz et al. 2007, Tauberer and Evanini 2009) has suggested that Southerners show longer lax vowels (effectively decreasing /e/ - /ɛ/ durational contrasts) compared to other regions. Most of these researchers have suggested that other cues, such as formant distinctions, maintain contrasts. However, in our data, we do not see spectral differences – at least in terms of F1 and F2 of the vowel onsets – maintaining the contrasts either. It seems likely that the distinctions might be tied to vowel trajectory, not just onset position, and we are planning to examine spectral dynamics as an ongoing part of this project. The common stereotype of the Southern drawl may, in fact, be an indicator of what in Southern speech in particular maintains contrasts among vowels that are not showing much in terms of formant onset or durational differences such as /e/ and /ɛ/.

What is not entirely clear is whether durational differences are perceptually meaningful to speakers and how they factor into regional vowel shifts. Durational differences across regions could be simply mechanically related to regional shift advancement due to relative differences in vowel openness, since, for example, Southern lax vowels are less open relative to Northern and Western lax vowels given the current shift patterns. However, based on the finding that open vowels are typically longer than close vowels (Peterson and Lehiste 1960) we would expect Southern lax vowels (which are relatively peripheral compared to other regions) to be shorter – the opposite of what we found, namely that Southern lax vowels (less open) are actually longer than non-Southern lax vowels (which are lowering and, therefore, becoming more open). Similarly, Tauberer and Evanini (2009) did not find an openness-duration correlation in NCS-related shifts where, instead, Labov and Baranowski (2006) suggest duration has taken on phonological significance in maintaining distinctions between spectrally non-distinct vowel tokens. Such results suggest that durational differences across dialects are not physiological in nature – or at least not merely physiological in nature. It also seems that duration, like formant structure, is not uniform in how it affects, and is likely perceived across, dialects so that durational differences may be phonologized in one dialect (such as NCS-affected /e/ and /ɛ/ in the North), but phonetic (and more available for social manipulation) in another. In other words, how speakers assign meaning and the type of meaning different speakers assign to different phonetic cues may be sensitive to larger patterns of dialect variation. Ultimately this is something that is not well understood yet and which calls for further research.

**CONCLUSION**

Our vowel production data from Northern, Western, and Southern speakers shows a difference in vowel duration both across and within regions. For the vowel classes examined – primarily the mid- and high-front vowels, our results indicate that Southerners have on average smaller (or negative for /i/ - /ɪ/ durational contrasts between their tense and lax vowels than the other regions. In particular, Southern speakers showed significantly longer lax vowels for these classes compared to other regions. These results bolster the findings of Clopper et al. (2005) and Jacewicz et al. (2007) that suggest that duration is systematically variable by region. What these previous studies did not examine is why duration differences may exist and how they are tied to variable production. In our work, systematic duration differences were found not only between regions but also between speakers, with Southern Shift participation being the correlate to decreased duration differences in tense and lax vowels. That is, our findings indicate that durational overlaps go hand in hand with spectral overlaps in the SVS. This perhaps seems like a straightforward observation, but there has been limited systematic work on sociolinguistic aspects of vowel duration and production.

As discussed, it is unlikely that this relationship is primarily a reflection of the widely-attested vowel intrinsic property of increasing duration with vowel openness as neither our results nor others have found much support for this explanation. An interesting possibility is that the spectral movement of tense and lax vowels in the SVS could be driven by durational shift, as recent work by Koops (2013) investigating the relationship of Southern drawl features and the SVS has begun to explore and which we hope to examine further in our data. What is clear is that
while all three regions are undergoing vowel formant shifts that lead to great distinctions across dialects, Southerners are much more distinct from other dialects, both in formant position and duration, suggesting there is much going on that may be socially-relevant. Our preliminary findings have raised more questions than answers, but we think such results suggest that duration must become a better studied aspect of linguistic production, especially within sociolinguistics.

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REFERENCES