

Chapter 1

Introduction

In this dissertation, I investigate the interrelationship between phonology and phonetics, specifically with regards to phonetic change. Aided by an unparalleled body of data in the Philadelphia Neighborhood Corpus, I have been able to explore the relative timing of phonological and phonetic influences on phonetic change, and arrived at some novel and interesting results. Specifically, I found that the process of phonologization appears to happen faster, and earlier in the lifespan of phonetic change than previously assumed.

This research is unique in a number of ways. It is the first dissertation to make extensive use of vowel measurements from the Philadelphia Neighborhood Corpus [PNC]. Labov et al. (2013) is the first major publication reporting on results from the PNC, in which we discuss a broad overview of the Northernization of the Philadelphia dialect. We found that those sound changes which Philadelphia shared with the Southeastern super region have been reversing, while those which it shares with Northern dialects have been moving uninterrupted across the 20th century. In this dissertation, I take a more detailed approach to the internal conditioning of many of these changes, with the goal of understanding which conditioning factors can be considered phonetic and which can be considered phonological, and whether a difference between the two can be determined.

Secondly, few other pieces of work investigating phonologization utilize data from language change in progress, while most research utilizing data from language change in progress don't

address themselves to the problem of phonologization. As I make clear throughout the dissertation, language change in progress provides unique insights, and surprising results, that are not readily replicable looking only at the beginning and endpoints of sound change, or only at synchronic experimental results. Those lines of research, exemplified by Ohala (1981), do provide valuable information, but still leave gaps in the model which can only be filled with data from language change in progress. For example, the results from Ohala (1981) argue convincingly that many sound changes result from natural perception errors on the part of listeners. However, it still leaves open the question of *how* perceptual errors lead to sound change. Do the errors accumulate over time within a speaker, or across a speech community? Is the change phonetically abrupt and probabilistic, or phonetically gradual? Do conditioning environments become gradually phonologized, or is phonologization sudden? And at what point in the lifespan of the change does phonologization occur? Data on language change in progress fills in some of these gaps.

In trying to grapple with these issues in sound change, my results are relevant to a broader range of questions about the contested relationship between phonology and phonetics in general. On the one hand, Docherty and Foulkes (2000) and Foulkes et al. (2010) argue that sociophonetic data is best explained using exemplar models of phonetics and phonology (Pierrehumbert, 2002) whereby the primary units of representation are episodic memory traces of the phonetic production of words. In exemplar models, phonological categories emerge out of the statistical regularities of phonetics. On the other hand, the research program of phonetically based phonology (Hayes and Steriade, 2004) pursues the hypothesis that there is not a qualitative difference between phonological and phonetic competence. For example, Flemming (2001, 2004) proposes weighted Optimality Theory constraints which operate over formant transitions, and *n*-ary vowel features.

My results are challenging to both the views that phonological categories are merely codifications of statistical properties of the phonetics, and that there is not a qualitative difference between phonological and phonetic representation and computation. Rather than uncovering an inherent fuzziness to phonological categories, by increasing the volume of data we collect from speakers, the evidence for categorical phonological units has gotten sharper. It appears that cat-

egorical phonological processes which differentiate allophones enter the grammar at the *onset* of conditioned sound changes, rather than as late stage reanalyses. The consequence of this result is that phonological representations cannot simply be the codifications of robust phonetic effects, because at the onset of the change there is no robust effect to be codified. Additionally, the qualitative difference I found between the categorical conditioning of the change, and the fine grained phonetic effects overlaid on the change suggests that there ought to also be a qualitative difference between phonology and phonetics.

The dissertation is laid out as follows. In Chapter 2, I establish my minimal theoretical commitments that I must presuppose in order to make any progress in my data analysis. I first lay out the similarities between typological variation and kinds of sound changes. My point in doing so is to highlight the fact that sound change is necessarily a change in speakers' competence over time, much in the same way that typological variation is differences in speakers' competence across populations. Therefore, the ways that languages can change are strictly constrained by the ways in which speakers' competences can differ. With that in mind, the study of language change is quite clearly the study of linguistic competence. Towards the end of the chapter, I devote a considerable amount of time to describing how phonetic changes occur, in order to assure that I am operating under proper assumptions throughout the rest of the dissertation.

In Chapter 3, I briefly outline the data I use in this dissertation, which is entirely drawn from the Philadelphia Neighborhood Corpus. This chapter is brief so as to avoid considerable overlap with already published descriptions of the PNC (Labov et al., 2013) and of Forced Alignment and Vowel Extraction (Yuan and Liberman, 2008; Evanini, 2009; Labov et al., 2013). I did enhance the data from the output of the FAVE-suite, however, and those enhancements are described there.

Chapter 4 is the first heavy data analysis chapter where I attempt to differentiate between phonological and phonetic conditioning of sound change. The core idea presented in this chapter is that if two variants of a vowel are created in the phonetics, their trajectories over time are yoked together, and are not independent, but if they are created in the phonology, then in principle they can have independent trajectories. The way I evaluate the dependence or independence of vowel variants' diachronic trajectories is to compare their rate of change. This is an extension

of Constant Rate Effect reasoning (Kroch, 1989) frequently utilized in historical syntax. Because the particular changes I examine in Chapter 4 overall have complex diachronic patterns (they moved in one direction, then reversed, as described in Labov et al. (2013)), and because I wanted to investigate the relative timing of phonologization in these changes, I could not rely on standard statistical tools like mixed-effects linear regression. Instead, I construct a custom Bayesian hierarchical model, which is estimated via Hamiltonian Monte Carlo simulation (Stan Development Team, 2012). Of course, a number of complications arise when looking at naturalistic data, but after taking into account possible confounding factors, it appears as if conditioning factors on these vowel shifts fall into two broad categories: those which move in parallel throughout the entire change, and those which were divergent from the outset. At least for these cases, it appears as if categorical phonological conditioning is in place from the outset of the change, and that phonetic conditioning factors were not eventually reanalyzed as being phonological.

In Chapter 5, I examine a number of cases where phonological factors appear to have the greatest explanatory power for both cases where vowel variants have divergent trajectories, and for where multiple vowel categories have parallel trajectories. First, I look at /ay/ and /ey/ raising. These vowels were, for various reasons, imperfect candidates for the rate of change analysis in Chapter 4. However, a close examination of their internal conditioning reveals surprising results. In the case of /ay/, I found that despite the differences in the phonetic contexts of preceding [t] and [d], and flaps corresponding to underlying /t/ and /d/, the raising of pre-voiceless /ay/ took place before underlyingly voiceless contexts, despite their surface realizations. That is, the opaque relationship between raising /ay/ before voiceless consonants and the flapping of /t/ was in place from the very beginning of the change. In the case of /ey/ raising, I find that even though the context of a following /l/ appears to phonetically favor the direction of the change, it does not itself participate. Even other phonetically similar following segments, like /r/ and /w/, condition /ey/ raising, but a following /l/ does not. An explanation for why /l/ would phonetically favor, but not actually condition the change is not forthcoming on strictly phonetic grounds. After looking at /ay/ and /ey/ raising, which exhibit phonologically conditioned divergence, I look at a few cases of parallel shifts. There are two cases of parallel shifts I observe in the PNC. First is

the parallel fronting of /aw/, /ow/ and /uw/, followed by their parallel retraction. Second is the parallel lowering of /æ:/ (tense /æ/) and /ɔ:/. I do my best to address the concern voiced by Watt (2000) that these parallel shifts share a social, rather than phonological source, and still find that their parallelism holds.

In Chapter 6, I take the results from the preceding chapters to argue against a model of gradual phonologization. I argue that in each case I examined, evidence of categorical phonologization was observed at the outset of the change, not as a reanalysis later in the change. This result carries with it a number of complications. First, it must be the case that phonetic differences which are small at the beginning of a change correspond to a categorical phonological difference, casting doubt on the hypothesis that phonological categories emerge from reliable statistical properties of the phonetics. Second, it must be the case that new phonological processes are spontaneously hypothesized by language learners. Both of these conclusions may be controversial, so I devote most of Chapter 6 arguing for their plausibility.

In chapter Chapter 7, I provide conclusions, which will largely be a recapitulation of this introduction chapter.

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