Josef Fruehwald (University of Pennsylvania)

Poster Session I
Friday 2:45 - 4:45

Phonology has an early influence on sound changes

The consensus view of conditioned sound changes is that they begin as low-level phonetic biases which become compounded in the production-perception feedback loop (Ohala, 1981; Pierrehumbert, 2002; Blevins, 2004; Bermúdez-Otero, 2007, *inter alia*). We argue against this consensus view that, instead, the conditioning on sound changes is phonological from the very onset of the change. To support this argument, we present a detailed analysis of a conditioned sound change, the raising of /ay/ before voiceless segments in Philadelphia.

Background on /ay/ The raising of /ay/ in Philadelphia was reported as a new and vigorous sound change in the 1970s (Labov, 2001). It occurs only before voiceless segments, including flaps which underlyingly correspond to /t/ (a classic case of opacity). It has been suggested that there is a phonetic bias for /ay/ to raise before voiceless segments, either due to pre-voiceless vowel shortening (Joos, 1942; Chambers, 1973) or pre-voiceless offglide peripheralization (Moreton and Thomas, 2004). Neither of these phonetic biases are sufficiently maintained in the pre-flap context to produce a distinction between /ay/ before flapped /t/ and /ay/ before flapped /d/, making the contemporary raising in words like *writer* and non-raising in words like *rider* phonetically unnatural (Rosenfelder, 2005, and this study). We should therefore expect that if /ay/ raising began as a natural phonetic bias, then raising before flapped /t/ would emerge as a generalization later, diachronically.

Data and Analysis Our data is drawn from the newly developed Philadelphia Neighborhood Corpus, which consists of automated vowel measurements drawn from sociolinguistic interviews conducted between 1973 and 2010 with speakers whose dates of birth range from 1888 to 1991 . This study focuses on the subset of 255 white, adult speakers, their 12,576 pre-obstruent /ay/ vowel measurements, and their 2,179 pre-/t,d/ /ay/ vowel measurements.

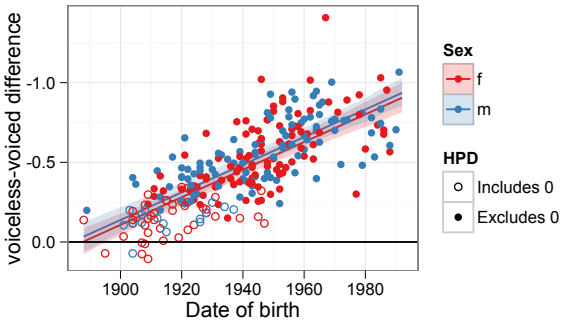

FIGURE 1. Diachronic change in pre-voiceless /ay/

First, we establish that the onset of the the sound change is included in the data. We do this by means of a Bayesian hierarchical model, estimated via Markov Chain Monte Carlo (MCMC) simulation. We model the difference in normalized F1 between pre-voiced and pre-voiceless /ay/ as a function of speakers' dates of birth, obtaining estimates for both community and individual level parameters. Figure 1 displays the predicted vector of change and 95% Highest Posterior Density (HPD) intervals for the community, as well as individual speaker estimates. Filled symbols represent speakers whose 95% HPD interval did not include 0. Most speakers don't exhibit a reliable difference between pre-voiceless and pre-voiced /ay/ until around a DOB of 1920.

Next, we fit a model using only /ay/ measurements in pre-/t, d/ contexts. We again modeled the effect of a surface /t/ relative to a surface /d/ as a function of DOB. For every speaker, we also estimated the effect of flapping on /t/, and on /d/. We would expect, if /ay/ raising was strictly phonetically conditioned in its early stages, that some speakers would raise /ay/ before surface /t/, but not before flapped /t/, since the phonetic bias of surface /t/ does not carry over to the flapping context. This would result in a reliable difference between /ay/ in the two /t/ contexts for that speaker. The results of this model are presented in Figures 3 and 4.

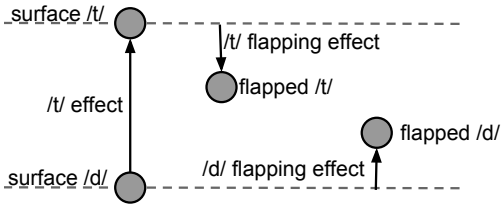

FIGURE 2. Data and speaker-level parameters

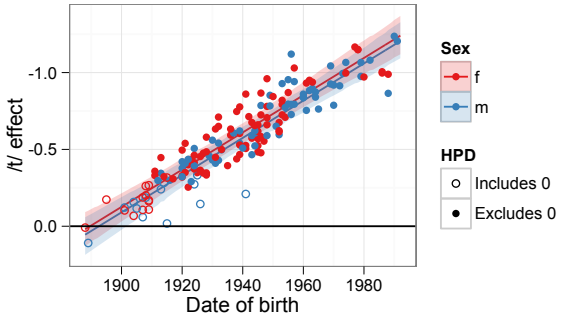

FIGURE 3. /t/ effect

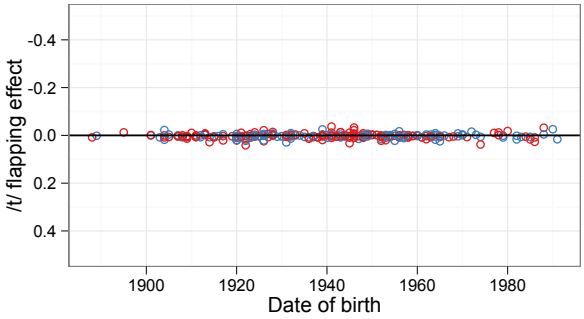

FIGURE 4. /t/ flapping effect

The fact that most speakers have no reliable difference between pre-voiced and pre-voiceless /ay/ until about 1920 is replicated for this subset of of the data. Contrary to the expectations of a purely phonetically conditioned sound change, no speakers at any time exhibit a reliable difference between /ay/ in pre-surface /t/ and pre-flapped /t/ contexts. That is, at all points in time, if a speaker raises /ay/ before a surface /t/, they also raise it before a flapped /t/.

Conclusions On the basis of the results above, we conclude that /ay/ raising has always been triggered by the underlying phonological voicing of the following segment, not by the phonetic properties of the context. Instead of a phonological process developing from an increasing phonetic bias, it appears as if the phonological process raising pre-voiceless /ay/ was in place from the very onset of the change, but it corresponded only to a small phonetic difference. The size of the phonetic difference corresponding to the phonological difference between raised and unraised /ay/ then grew steadily over the following century. We propose that sound changes are then best analyzed as changes in the language specific phonetic implementation of relatively stable phonological representations.

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