Quantitative models of internal and social factors in sound change

Janda & Joseph (2001) present the Big Bang model of sound change, in which sound changes are initiated by phonetic factors, but spread through social factors. Baker et al. (2006), studying the retraction of /s/ in English, found that the coarticulatory motivation for /s/-retraction could be found in only a subset of /s/-retractors. This suggest that the phonetic motivation for a sound change need be present only in a proper subset of speakers: other speakers can adopt the change for social reasons, without necessarily having a phonetic motivation to do so. Computational simulations of populations of speakers presented here demonstrate that this *is* a possible scenario for sound change, given the assumptions that (1) speakers modify their speech to emulate prestigious speakers, and (2) coarticulatory bias affects production. This model builds on previous work (e.g. Trudgill 1974, Boberg 2000, Pierrehumbert 2001) by incorporating both social and phonetic factors into a single model.

Two parameters of the model represent social factors. The first is a matrix representation of the social network of the population (from Social Network Theory; Barnes 1954). This matrix determines how likely a speaker is to interact with another speaker. The representation is flexible enough to represent any social scenario—from fully-integrated communities, to communities with multiple independent groups. The second social component is a representation of prestige. Each speaker has a valuation of every other speaker's prestige, represented by a single number (positive for high prestige; negative or zero for low prestige).

A speaker's production of a word is taken to be his/her individual production target, with a possible phonetic bias, and with random noise (cf. Pierrehumbert 2001). At each time step, the speaker's production is modified by his/her own previous production, *and* a sum of the productions of people he/she has interacted with. Crucially, these productions are weighted by the speaker's estimation of the prestige of those speakers. More prestigious speakers have a greater effect on a speaker's new production target. Production targets are therefore modified by both internal and social factors.

In simulations where all speakers are given a coarticulatory bias, the mean production of the community shifts predictably in the direction of the coarticulatory bias. The same effect is observed, however, in simulations where only 10% of the population is given the coarticulatory bias. The entire population eventually adopts the coarticulated pronunciation, albeit at a lesser rate than when the entire population has the bias. These findings are in agreement with the Big Bang model of sound change.

A third class of simulations investigated the prerequisites for a dialect split: where a sub-population adopts a sound change, but another does not. This effect can be produced *only* when one group of speakers actively avoids the productions of another group. Without active avoidance, the pronunciations of all speakers drift in the direction the coarticulatory bias. This supports the hypothesis that the maintenance of social distance plays a crucial role in determining the extent of a sound change.