Sound change as epigenetic regulations

Phonological systems are dynamic and self-organized systems, i.e. systems in which time and the timing of elements play a crucial role. An important aspect involved with self-organization is the notion of feedback and regulations. Feedback processes are continuously used in speech, both to control production and in the correction procedure involved in speech perception. Regulations are defined are constraints that adjust the rate of production of the elements of a system to the state of the system and of relevant environmental variables. The main operators of these adjustments are feedback loops (Thomas et al. 1995). Two types of processes can be distinguished in regulatory networks, homeostatic and epigenetic. Homeostatic regulations account for the correction procedure involved to prevent sound change in speech. In nature a lot of variables are subject to homeostatic regulations (temperature of homeothermic vertebrates, chemical composition of the inside medium). Depending on the case, the variable is maintained at a desired value, or oscillates around this value. In fact, the same process is likely to happen in speech, in order to regulate the variations and the distortions of a signal sent by a speaker and perceived by a listener. Variations exist both at the articulatory (the timing and the trajectory of gestures) and at the acoustic level (the greater or shorter duration of elements, variations in amplitude…), not to mention other levels involved in speech production and perception. Despite these variations and the so-far unresolved issues of phonetic invariance and segmentation, phonological systems work efficiently as more or less stable entities in speech communities. Homeostatic regulation accounts for the stability of phonological systems but not for other fundamental issues in speech, such as phonemic coding and sound change. The mechanism at work in the two latter points is epigenetic or differentiative regulations. The fundamental difference between the two types of regulations is that homeostatic regulations stabilize a variable (with or without oscillation) between the minimum level and the maximum level; epigenetic or differentiative regulations force a variable to a stable choice, either to the minimum level or to the maximum level. Differentiation is mainly of epigenetic nature and is a biological modality of the more general phenomenon of multistationarity. Such differences are not linked to differences at the level of genetic inheritance even if in biological organisms they are transmissible through cell generations. What epigenetic differentiation brings to the study of speech is the importance of environmental factors, in this case, the role of the linguistic community. The mechanisms which shape and regulate a phonological system are homeostatic and epigenetic regulations. The first accounts for the apparent stability of the system and the second for the evolution of the system which can be observed in the study of sound change. Many instances of sound change where the amplification of a feature makes the system shift to another state can be explained in this way. This accounts for the source of sound change. At the collective level, the propagation of amplified variations can be explained in the same way. This last case is however more easily formalized by using a logistic equation in which the inhibition factor may be taken as the perceptual distinctiveness between elements of the system.