

Dynamical stability in speech production and sound change

Louis Goldstein

Recent work [3] has modeled temporal planning for speech production using ensembles of nonlinear oscillators (or clocks) that are coupled to one another in a lexical unitspecific fashion represented in a *coupling graph*. An appealing aspect of such a model is that coupled oscillators exhibit spontaneous, qualitative transitions from more complex to simpler modes of frequency- and phase-locking as a function of continuous variation in a control parameter (e.g., speaking rate). Evidence of such transitions in speech were found [1] in the gestural intrusion errors observed when talkers repeat utterances such as “cop top.” In this talk, I apply this framework to account for certain types of sound change. In one type of change, a transition to the simplest mode of phase locking (in-phase) will be shown to be the possible source of sound changes in which two gestures that are planned as sequential before the change become synchronous after the change. The sound changes include [nd]>[n] in Brazilian Portuguese [4], pre-aspirated to post-aspirated stops in Western Andalusian Spanish [5], and the Tone 3 sandhi rule in Mandarin [2]. Recent experiments have provided evidence in all these cases for a shift in relevant gestural phasing as a function of speech rate.

References

- [1] Goldstein, L., Pouplier, M., Chen, L., Saltzman, E., and Byrd, D. (2007). Dynamic action units slip in speech production errors. *Cognition*, 103, 386-412.
- [2] Hsieh, F-Y. (ms). Phonological Variations of Tone 3 in Mandarin Chinese—A gestural coordination account.
- [3] Nam, H., Goldstein, L., & Saltzman, E. (2010). Self-organization of syllable structure: a coupled oscillator model. In F. Pellegrino, E. Marisco, & I. Chitoran, (Eds). *Approaches to phonological complexity*. Berlin/New York: Mouton de Gruyter. pp. 299-328.
- [4] Oliveira, L., & Marin. S. (2005). Patterns of velum coordination in Brazilian Portuguese. Paper presented at the Phonetics and Phonology in Iberia Conference, Barcelona, Spain.
- [5] Parrell, B. (submitted). The role of gestural phasing in Western Andalusian Spanish aspiration. *Journal of Phonetics*.