Combining longitudinal data and mathematical models of sound change
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Understanding which forces it is that shape phonological change, and by extension the sound patterns of languages, has long been a major goal of linguistic research. Because explanations for language change generally involve learning or usage by individuals, but address population-level patterns of change, a link between the two is needed to test proposed explanations. What are the population-level consequences of different assumptions about learning by individuals? I describe a case study (joint work with Partha Niyogi) addressing this question, which combines two approaches to studying change: building detailed datasets and mathematical modeling. We use the dynamical systems framework for modeling the relationship between learning by individuals and population-level change (Niyogi & Berwick 1995; Niyogi, 2006), applying it to a case of change showing dynamics significantly more complicated than previously considered in the computational literature on language change. These complex dynamics strongly constrain the desired behavior of a model, so that the task of model bulding is not "doomed to success".

The data are the stress patterns of 150 English disyllabic noun/verb pairs (*pérmit*/*permít*), as recorded over the past 400 years in 76 dictionaries. The patterns of variation and change observed in these data can be used to evaluate proposed models. The psychological and linguistic literatures provide experimental findings potentially relevant to the diachronic dynamics, for example the tendency of English speakers to misperceive final-stressed nouns as initial-stressed (Kelly, 1989). Based on these we construct dynamical systems corresponding to 15 models of language learning by individuals, and evaluate the resulting population-level dynamics against those observed in the diachronic data. One significant finding is that the only successful models of learning incorporate both transmission errors between the speaker and hearer and bias making some patterns harder to learn than others ("channel bias" and "analytic bias", resp.; Moreton, 2009), two types of proposed sources of phonological change often seen as opposed. Our results suggest that both types of bias in language learning are important factors in explaining patterns of change.