Three compatible models of S-curves in language change

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Over the years, a number of models have been proposed to account for widespread observations of S-shaped curves in language change. In all instances there are at least two competing variants for expressing the same meaning or function, and the frequency of one rises slowly at first, then more quickly, and finally tapers off in the direction of full use. Niyogi and Berwick (1997) and others propose a model where a child chooses between two competing grammars during acquisition. In earlier work (Grieve-Smith 2009) I suggest two models, both based on type frequency. Most recently, Baxter et al. (2009) put forth a detailed model with differential weighting, and Blythe and Croft (2012) apply it to S-curves.

Croft (2000) and Bybee (2010) compile data from several studies showing that the learning patterns of small children do not correspond to patterns of language change. Lifelong models like those of Grieve-Smith (2009) and Blythe and Croft (2012) are more consistent with this data. These three lifelong models are in fact compatible with each other, and we can make the choice of model based on the situation at hand. In my study (Grieve-Smith 2009), I begin with the logistic model proposed by Kroch (1989), and motivate it through the relative type frequencies of the variants. I then observe that in its original field of population modeling, the logistic was extended by Lotka (1925) and Volterra (1926), who both added a term α_{ij} to indicate an advantage that term *i* may have over term *j*. Conversely, Blythe and Croft (2012) focus on the differential weighting that language users may apply to the two variants, with a "sampling rule" *f(u)* that allows the model to take type frequency into account.

All three models produce satisfactory S-curves. Grieve-Smith (2009) examined corpus data from the evolution of *ne … pas* in French theatrical texts and found that the logistic model (R^2 = 0.899) and the Lotka-Volterra model (r = 0.978). fit the data closely. Blythe and Croft (2012) do not test their model's predictions against the data, but they do use their model to generate idealized data and report that it generates "an S-shaped trajectory." They observe that it is not necessary to incorporate frequency effects because "the simplest choice of the sampling rule f(u) that implements replicator selection is sufficient to obtain an S-curve," but their model does not preclude taking frequency into account.

When examining S-curves in language change, then, we have three models to choose from. The logistic (Kroch 1989), which only uses frequency data, is the simplest and the easiest to implement, and will be sufficient for many datasets. The Lotka-Volterra model (Grieve-Smith 2009), which assigns a different competitive advantage to each variant, can be used when focusing on such advantages. The interactive model of Blythe and Croft (2012) can be used when we want to examine the interactions between language users in greater detail.