

What Language Change Modeling Can Do for Acquisition Theory

Our work demonstrates how modeling language change can constrain theories of acquisition. We provide support for two proposals in the language acquisition literature, using a mathematical model inspired by Yang's (2003, 2000) view of language change. This model works as a changing distribution of competing grammars in a population of speakers, and we specifically model the change in distribution of Object-Verb (OV) and Verb-Object (VO) order in Old English. The time period of interest is 1066 A.D. – 1122 A.D., where the literature (Lightfoot 1991, Bean 1983, among others) notes a shift from a distribution strongly favoring OV order to a distribution strongly favoring VO order.

The model we use works as follows. For simplicity, we posit an OV/VO parameter value which ranges between 0.0 and 1.0. The parameter value itself represents a probabilistic access function (Bock & Kroch 1989) which is used to choose one of the two orders – OV or VO. A child begins with a default, unbiased value of 0.5, so there is a 50% chance the child will choose OV and a 50% chance the child will choose VO order before any input is heard. Then, input from the primary linguistic data (PLD) is used to push the value towards one extreme (0.0 or 1.0). At the end of the critical period, the child's value is set and not altered by any further input. The current population, based on their average parameter value, creates the PLD for the new learners. A population consists of individuals from ages 0 to 60, where those individuals aged 0-1 are the new learners. Every two years, individuals aged 59-60 die off, all other individuals age by two years, and the new individuals listen to the PLD to set their parameter value. Thus, the average parameter value of the population changes through time, based on the new individuals acquiring their parameter value.

We examine two theories which might govern a child learning Old English in this period. Dresher (1999) and Lightfoot (1999) have proposed a trigger-based theory of acquisition, which claims that children use only **unambiguous** triggers (Fodor 1998) in the PLD to set grammatical parameters. In this case, an unambiguous trigger would be an object either directly to the left (OV) or directly to the right (VO) of either a verb or a word that marks the original placement of the verb, such as a verb-particle or negative (Lightfoot 1991). A shifting distribution of these triggers would then result in the change from a strongly OV-favored distribution to a strongly VO-favored distribution. In addition, Lightfoot's (1991) **degree-0 learnability** theory restricts the PLD to unembedded clauses. Given the sparseness of the triggers which fit both these criteria, one might think that children relying on such triggers would have insufficient evidence to alter their default parameter value much at all – let alone that a population would be able to shift its OV/VO distribution so dramatically based on such triggers. Thus, historical change is a very strong testing ground for these theories.

Our results do, in fact, support both theories. A model of a population restricted by unambiguous triggers and degree-0 constraints can rapidly shift its distribution from strongly OV to strongly VO. Moreover, the logistic "S-shaped" curve often seen in historical change literature falls out naturally. Perhaps more surprisingly, the restriction to degree-0 data turns out to be crucial. We show that the quantity of degree-1 data necessary to inhibit this swift change in OV/VO distribution in Old English is *lower* than the estimates of degree-1 data in an average child's experience. In fact, the model shows that a surprisingly small advantage (approximately 5%) of OV triggers over VO triggers in the PLD would be sufficient to prevent the observed shift. Thus, it must be that children ignore degree-1 data. Pre-theoretically, this assertion gains support since degree-1 clauses remained strongly OV until the shift to a strongly VO distribution occurred for both degree-0 and degree-1 clauses. Without an actual model and quantified data, however, one could not have determined whether the relatively small amount of degree-1 data in the PLD would counterbalance the strongly OV distribution of the degree-1 clauses. Thus, as we have shown here, modeling language change can offer fertile testing grounds for theories of acquisition.

References:

- 1) Bean, M. (1983). *The Development of Word Order Patterns in Old English*. Totowa, NJ: Barnes & Noble Books.
- 2) Bock, J. and A. Kroch. 1989. The Isolability of Syntactic Processing. In *Linguistic Structure in Language Processing* . Edited by G. Carlson and M. Tannenhaus. Boston: Kluwer.
- 3) Dresher, B. E. (1999). Charting the Learning Path: Cues to Parameter Setting. *Linguistic Inquiry*, 30(1), 27-67.
- 4) Fodor, J. (1998). Unambiguous Triggers. *Linguistics Inquiry*, 29, 1-36.
- 5) Lightfoot, D. (1991). *How to set parameters*. Cambridge, MA: MIT Press.
- 6) Lightfoot, D. (1999). *The Development of Language: Acquisition, Change, and Evolution*. Oxford: Blackwell.
- 7) Yang, C. (2000). Internal and external forces in language change. *Language Variation and Change*. 12, 231-250
- 8) Yang, C. (2003). *Knowledge and Learning in Natural Language*. New York: Oxford University Press, Inc.