Towards a Probabilistic Model of Syntactic Change

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SHES9, 16 April 2011

Yang's (2000) Theory of Language Change

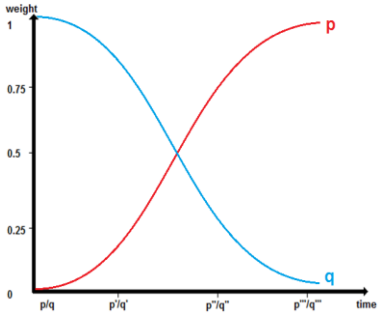
- children can acquire multiple grammars that compete with each other, say G_i and G_j
- expressions produced as an adult are generated by two different sources, p% G_i, q% G_j
- p and q are the weights of the grammars G_i and G_j respectively
- a proportion α% of all expressions can only be analyzed with G_i, a proportion β% can only be analyzed with G_j
- one grammar has an advantage if it can (exclusively) analyze more sentences than the other (β>α)
- penalty probability = pα, qβ, the probability that G_i / G_j encounters a sentence it cannot analyze
- the penalty probabilities determine the weight of the grammars in competition of the next generation (p', q', (1)), so that one grammar gets replaced by another (2) if one grammar has an advantage (3):

(1)

$$p' = \frac{\alpha p}{\alpha p + \beta q}$$

$$q' = \frac{\beta q}{\beta q + \alpha p}$$

(2)



(3) *The fundamental theorem of language change*

G_j overtakes G_i if β > α

Modification

- instead of grammars in competition, assume rules in competition
- advantages: simplicity, allows modelling interaction of various changes, context dependency
- write: R*c* = {R1...R_n} for a set of rules R1...R_n that are in competition

Context Dependency: Conditional Constraints on Rules

(4)

$$Rc = \left\{ \begin{array}{lll} X \rightarrow \gamma & & p=x \\ (\uparrow=\downarrow) & & \\ \text{if: } (\downarrow a)=v, & & p=p+p_c \\ & & \\ Y \rightarrow \delta & & p=1-x \\ (\uparrow=\downarrow) & & \\ \text{if: } (\downarrow a)=v, & & p=p-p_c \end{array} \right\}$$

(x<1.0)

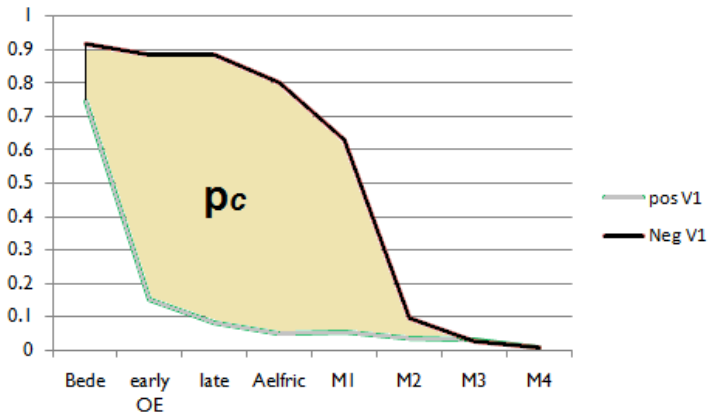
<------ if a certain feature a=v is present increase/reduce the weight of the rule

$$\sum_{x \in Rc} P(x) = 1$$

Example: NegV1

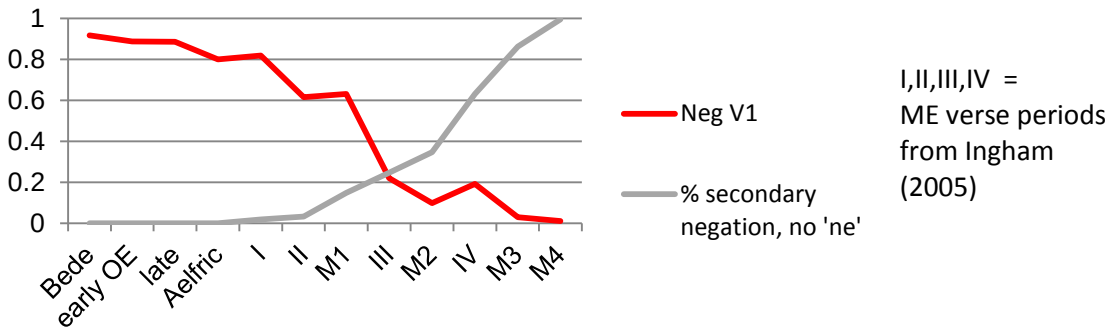
- two rules in competition: one that places the finite verb in C°, the other that places it in I°
- conditional constraint on the rules that checks for the presence of a NEG feature below C°/I° and, if true, increases/decreases the weight of the rule (by p_c %)

(5)



- as the NEG feature is introduced in a different domain of the structure, the conditional constraint will never be true, and so NegV1 becomes just as frequent as V1 in general
- "[i]t was not the presence of the overt morpheme *ne* itself which triggered NegV->C but rather the association with it of the interpretable feature [+neg]" (Ingham 2005: 210)
- As the model predicts, NegV1 is lost inversely proportional to the rise of secondary negation

(6)



Functional Constraints as the endpoint of syntactic change

- When a syntactic change is "conditioned", i.e. progressing at different rates in different contexts (7a), the base probability of one rule goes towards zero and the probability of the conditioning factor towards 1 (7b). At the end of a change, there are two mutually exclusive rules for different contexts (7c).

(7a) Rc= { R1[p=x, p+p_c=y], R2[q=1-x, q-p_c=1-y] }

(7b) Rc= { R1[p=0, p+p_c=1], R2[q=1, q-p_c=0] }

(7c) R1 [p=1] R2 [q=1]

Conclusion

syntactic variation can be seen as probabilities of rules in competition; change is directed by the penalty probability of such rules (cf. Yang 2000); context dependency and perhaps more complex interaction can be modelled with conditional functional constraints

References

Ingham, Richard (2005) 'The loss of Neg V->C in Middle English.' *Linguistische Berichte* 202*:* 171- 206. **Kroch, Anthony & Taylor, Ann** (2000)[2] *Penn-Helsinki Parsed Corpus of Middle English* **Taylor, Ann et al.** (2003) *The York-Toronto-Helsinki Parsed Corpus of Old English Prose* **Yang, Charles** (2000) 'Internal and external forces in language change.' *Language Variation and Change*, 12: 231-50.