Research seminar week 10

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This week

- Language change: a preliminary model (Niyogi ch. 5)

Language evolution

Term "language evolution" may cover:

- Emergence of language during prehistoric biological human evolution.
- Computational models of 1 (see e.g., Niyogi part IV).
- Historical linguistics: formal/computational models of language change.

Language evolution

Biological evolution vs. cultural evolution:

- Genetic change vs memetic change.
- Time scale.
- Natural selection in cultural evolution?
- Does cultural evolution has a “direction”?

Iterative learning

Hypothesis: language changes due to not perfect acquisition.
Why is acquisition not perfect?

- Learning algorithm does not converge to target.
- Learning algorithm converges slowly, and learning data set is relatively small.
- Learning data come from different languages.

Iterative learning

... grammar $\longrightarrow$ data $\longrightarrow$ grammar $\longrightarrow$ data $\longrightarrow$ ...

- Grammar: competence model.
- From grammar to data: performance model.
- From data to grammar: learning model.

NB: more agents, heterogeneous community.

Iterative learning

Restrictions of this model of language change:

- Is adults' language really constant?
- Sociolinguistic effects, language contact, etc.
- Within-generation effects. More than two generations present at the same time.
- Social structure: data from parents vs. strangers.

Nevertheless, let's use it.

Dynamic systems

$$x_{n+1} = f(x_n)$$

- Fixed point: $f(x_0) = x_0$
- Attractor: state towards which neighboring states (within $basin\ of\ attraction$) approach asymptotically.

Population dynamics

- Languages L_1 and L_2 in a population.
- α_n: proportion of L_1 users in generation n. "History" of α_n across generations.
- Data: α_n from L_1 and $1 - \alpha_n$ from L_2.
- Next generation exposed to these data. Proportion α_{n+1} become L_1 speakers.

Population dynamics

Evolution of parameter α_n as a function of the learning algorithm and other details of the model:

- What are fixed points? What are attractors?
- Different behaviors. Bifurcation.