Effects of transmission perturbation in the cultural evolution of language

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Major factors in language evolution

- Efficient information transfer
- Learnability

Past research

Cognitive learning biases effect explanatory perturbations in language transmission

(cf. Kirby et al 2007;2014)

But

We expect class of relevant transmission perturbations to be larger

(Iterated) Bayesian Learning

learners consider the posterior probability of τ given a data sequence d of ⟨s, m⟩ pairs

$$P(\tau \mid d) \propto \underbrace{P(\tau)}_{\text{prior}} \quad \underbrace{P(d \mid \tau)}_{\Pi_{\langle s,m\rangle \in d} P(m|s,\tau)}$$

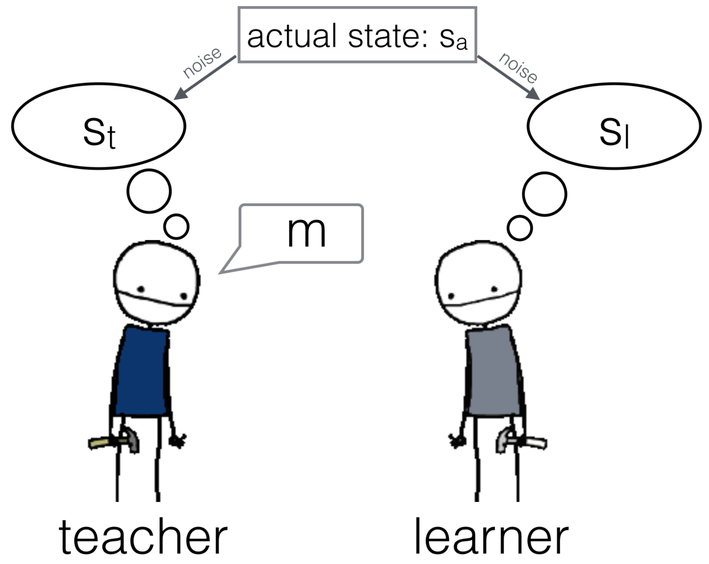
With a parametrized posterior:

$$F(\tau \mid d) \propto P(\tau \mid d)^l, \quad l \geq 1$$

The probability that a learner acquires type j when learning from type i is then:

$$P(\tau_j \rightarrow \tau_i) \propto \sum_{d \in D_k} P(d \mid \tau_j) F(\tau_i \mid d)$$

Iterated learning with state-noise



The probability that s_a is the actual state when the learner observes s_l is

$$P_N(s_a \mid s_l) \propto P(s_a)\, P_N(s_l \mid s_a)$$

The probability that the teacher observes s_t when the learner observes s_l is

$$P_N(s_t \mid s_l) = \sum_{s_a} P(s_a \mid s_l) P_N(s_t \mid s_a)$$

The probability that type t produces a perceived sequence d_l is

$$P_N(d_l \mid \tau) = \prod_{\langle s_l, m\rangle \in d_l} \sum_{s_t} P_N(s_t \mid s_l)\, P(m \mid s_t, \tau)$$

Noise

The probability that a learner acquires type j when learning from type i is then:

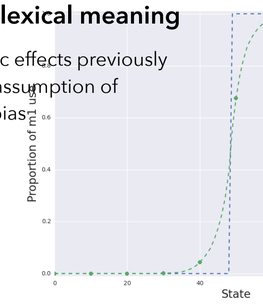
$$P_N(\tau_j \rightarrow \tau_i) \propto \sum_{d \in D_k} P_N(d_l \mid \tau_j) F(\tau_i \mid d)$$

Vagueness

Meaning deflation

Underspecified lexical meaning

state-noise can mimic effects previously reported under the assumption of semantic simplicity bias



This can lead to inferring the "wrong" teacher type if noise makes some types err in a way that resembles the noiseless