Language Drift:
patterns from noisy statistical learning in an agent-based model

Jeremy Needle, Linguistics

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Question and Motivation

By what mechanism do language shifts arise?

- Language shifts occur across all languages and over both short and long time scales.
- Children (and adults) use statistical learning.
- Linguistic perception and production noisy.

Why agent-based modeling?

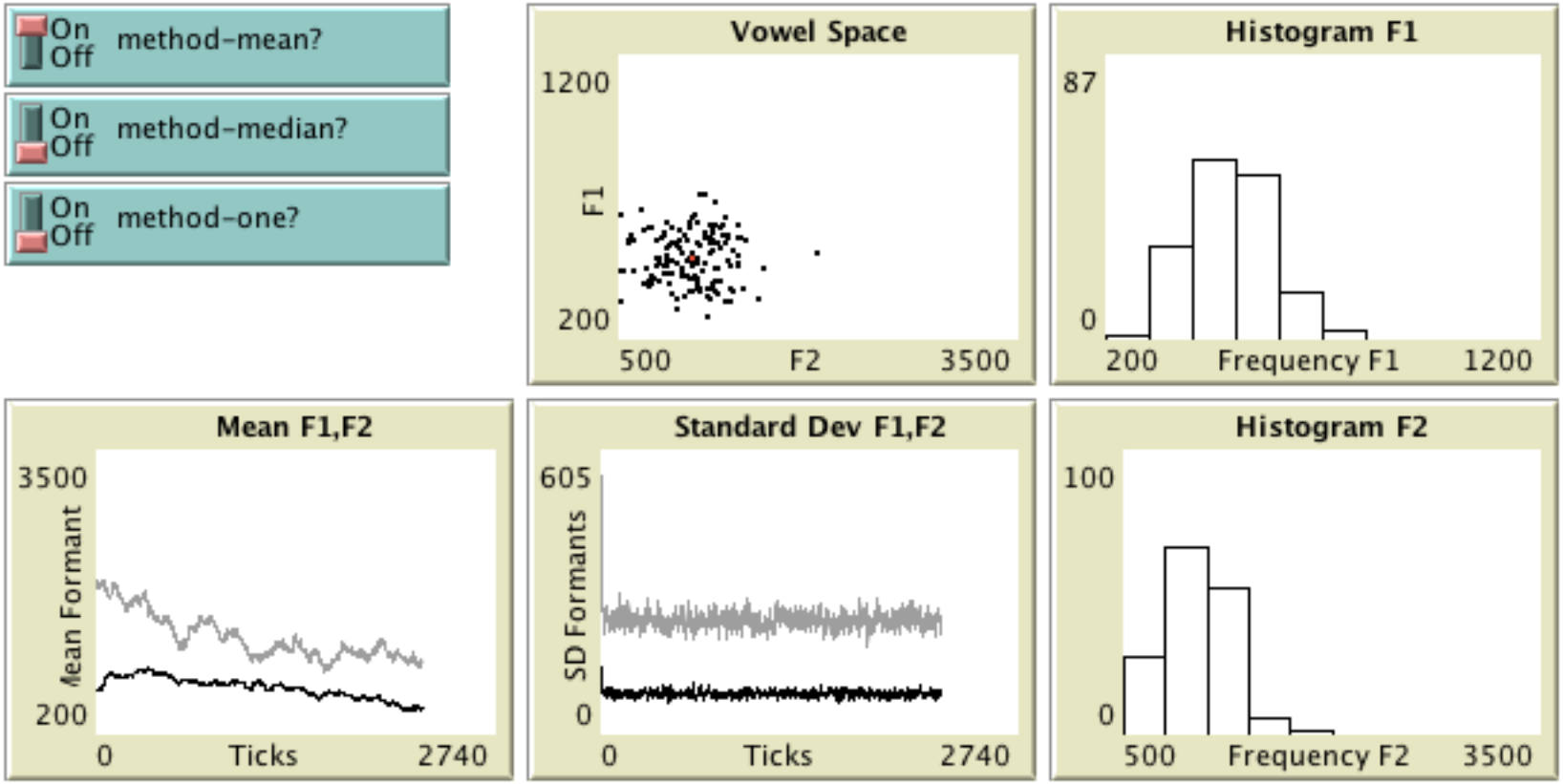
- Though dozens of factors are thought to be involved, ABM demonstrates that even a very simple model can produce shift patterns.

Models

- Language is modeled as a single vowel with formant (resonance) values F1, F2.
- Adults 'speak' and children 'listen' and learn.
  - Children listen to some subset of adults:
    all, nearest-N, random-N, in-radius-N
  - Children learn by some method:
    mean, median, random-1
- Adults die (lifespan), children 'grow up' to replace them.
- Over time, the overall language moves around the vowel space (sound change).

- Network Variant Model: speakers interact on a clustered or lattice network, with variable density/ link chance.

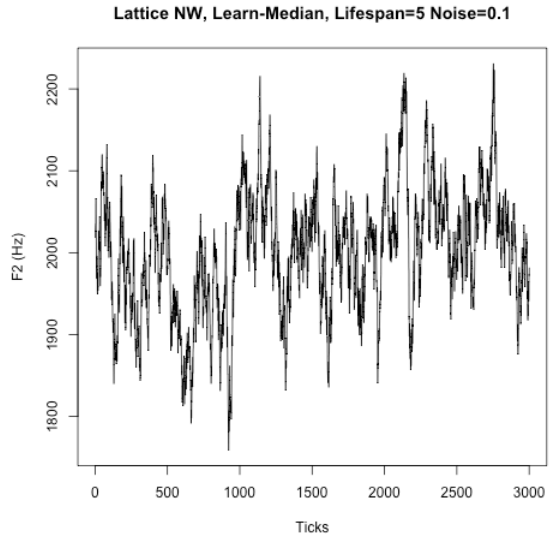
Example Model Output

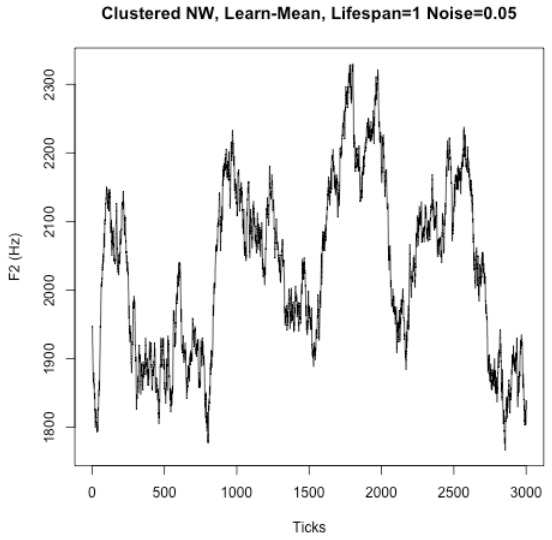


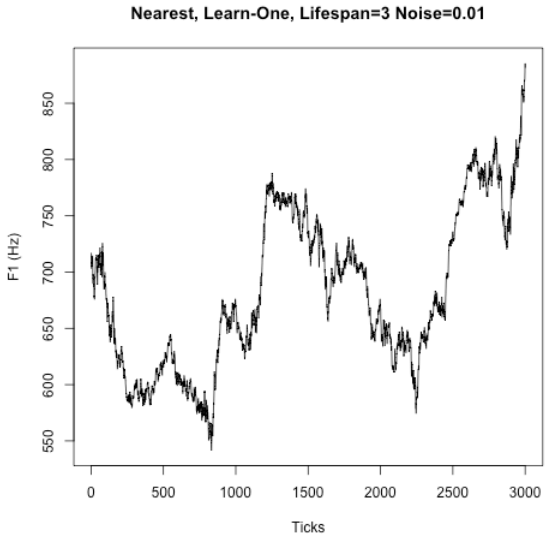
Validation and Results

What is the first stage validation for this approach?

- Demonstrate that the very simple model can produce any shifts at all.
- Demonstrate shifts across a variety of parameter settings (robust phenomenon).

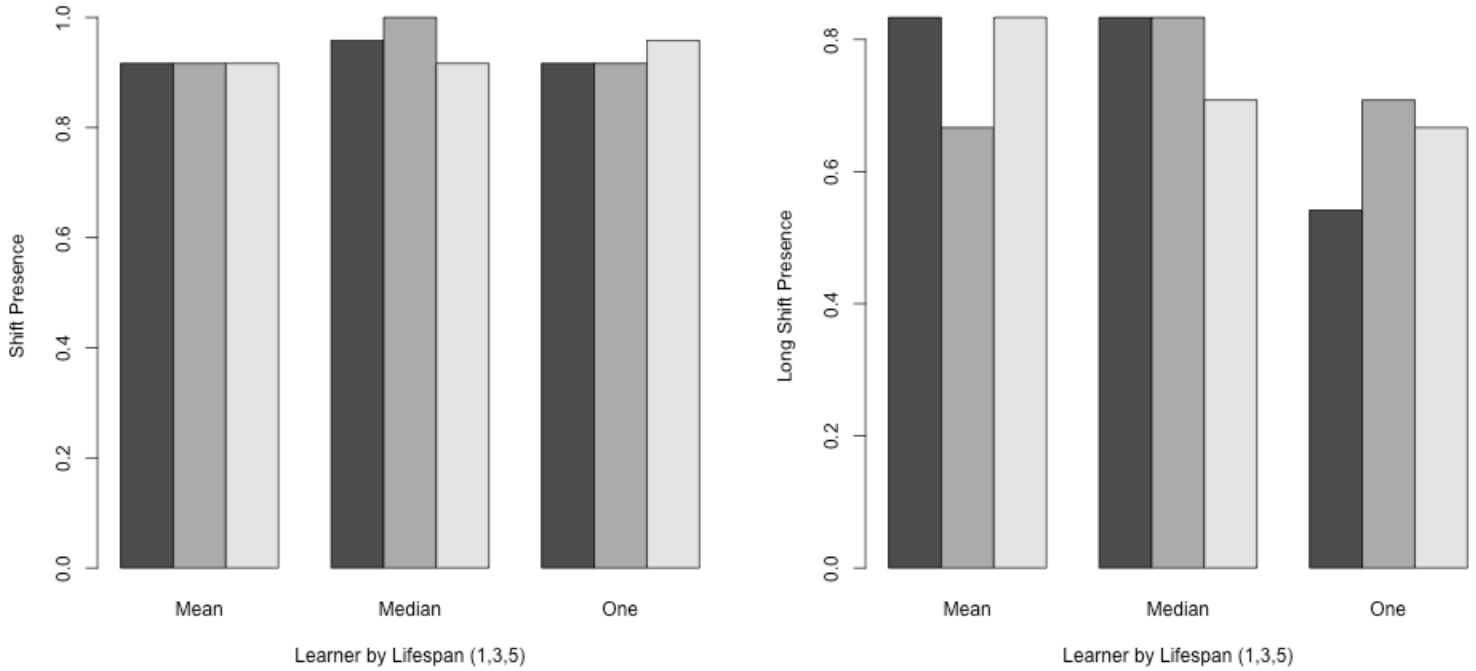




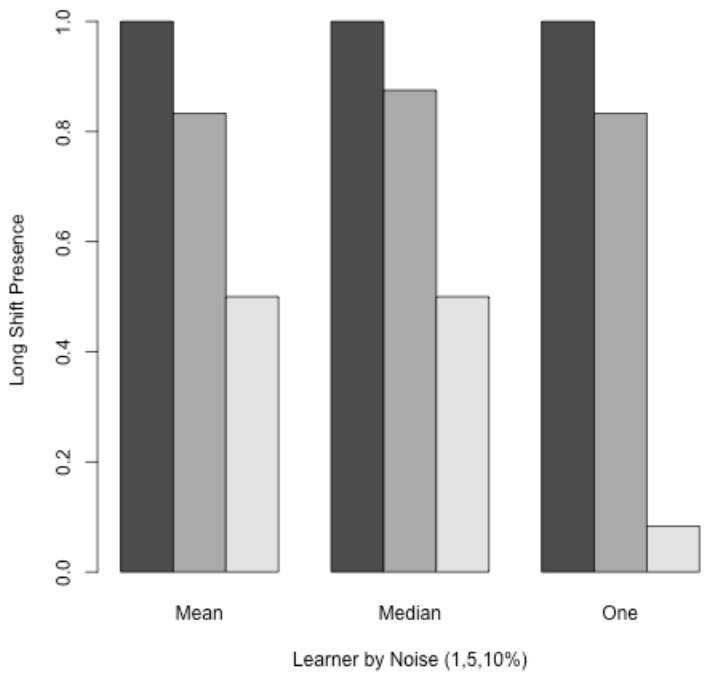


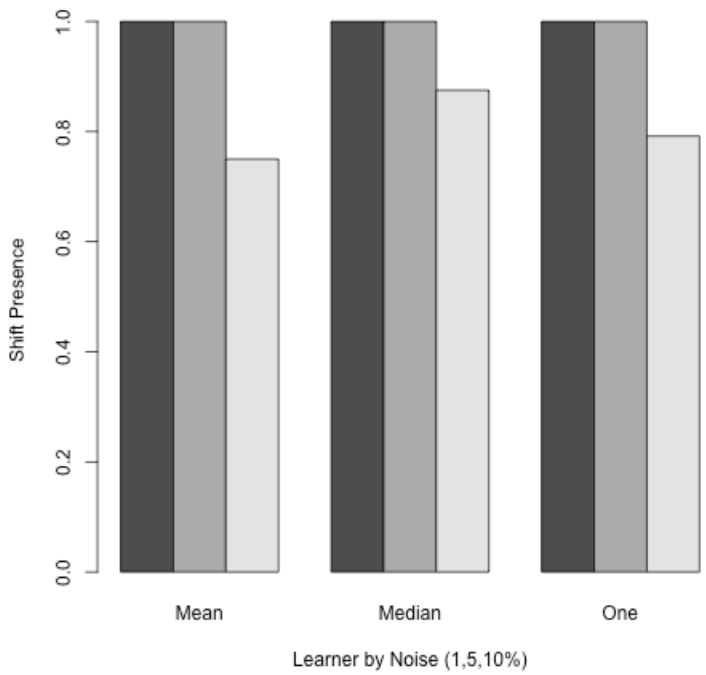
What are the effects of the model parameters?

- Learner method:



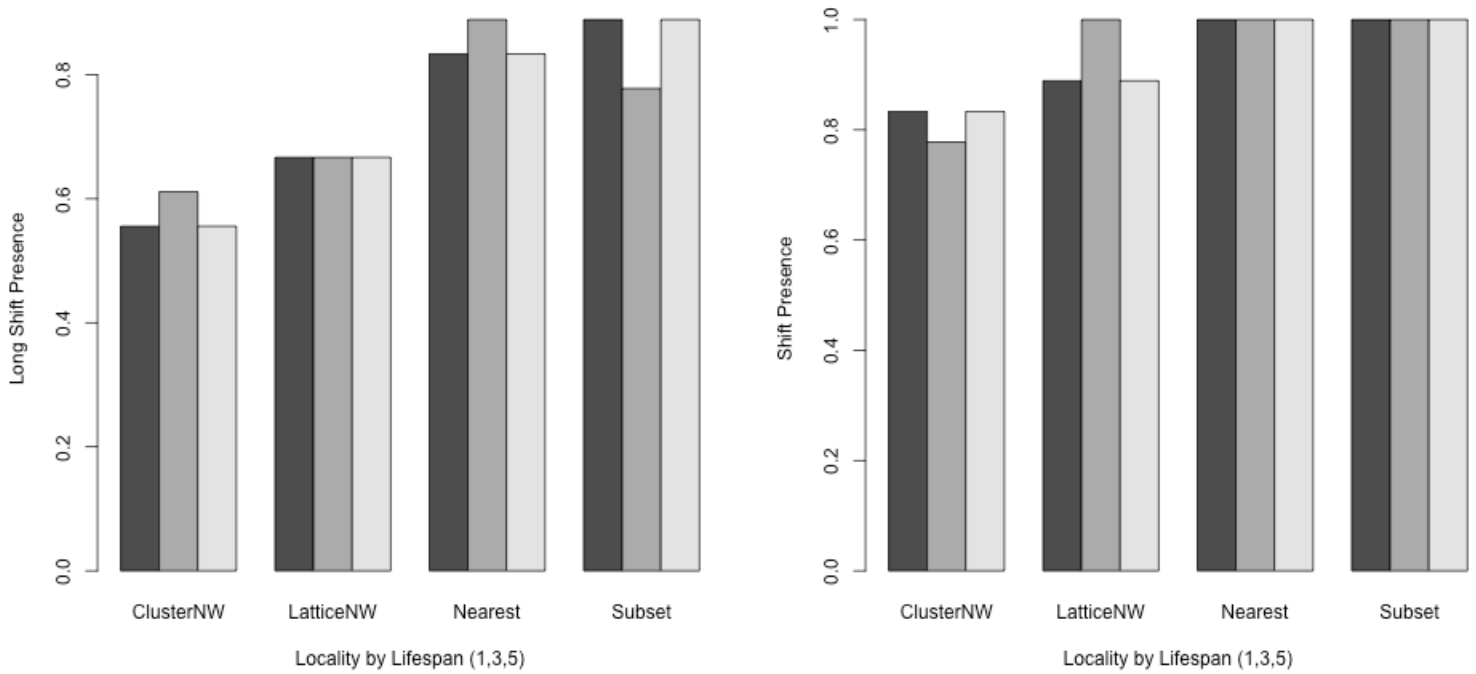
Shifts across Learners (by Lifespan)



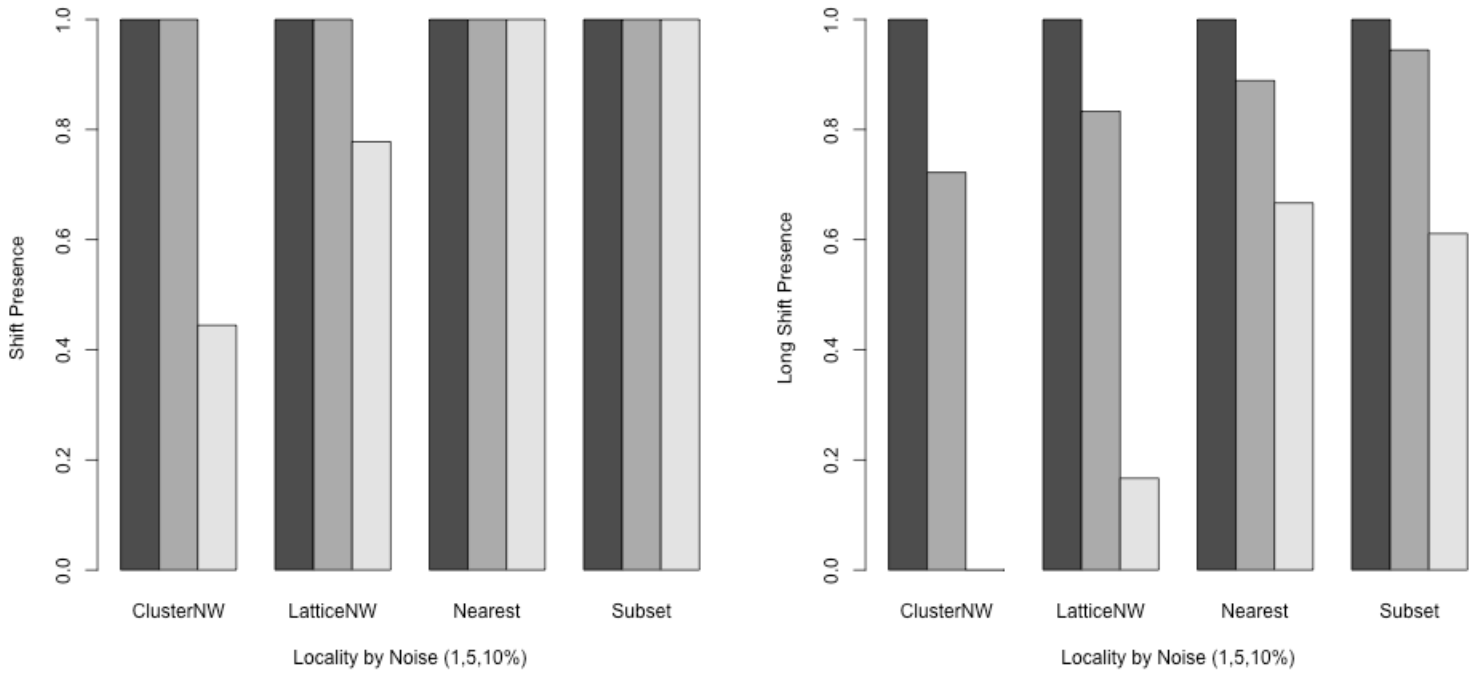


Shifts across Learners (by Noise Level)

- Locality method:



Shifts across Locality (by Lifespan)



Shifts across Locality (by Noise Level)

Discussion

- Shifts resulted from the simple models, and across almost every parameter setting.
- Learner: all learners performed similarly and without interactions.
- Locality: clustered NW and lattice NW slightly inhibited shifts.
- Lifespan: lifespan had no effect.
- Noise Level: too much noise actually *inhibited* shifts (noise ≥ 10%)