Aging and Language Change

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Introduction

Aging

Language change

Verb bias example

Model

Overview

I aim to explore how potential changes in learning rates across the lifespan may impact overall population-level patterns of language change.

Assumptions, modified from Beeksma et al.:

1. Language learning is based on imitating others, **though this may change over the lifespan and may depend on group membership**.
2. Variability of an individual's language model is limited.
3. Language can be influenced by external factors.

Outcome patterns that from Troutman et al.:

1. S-shaped curve: "Change happens slowly, then proceeds rapidly before slowing down again."
2. Intraspeaker variation: "Change is gradual and there is a period of intraspeaker variation"
3. Categorical norms: "With competition, speakers move toward categorically using just one of the competing variants"
4. Multi-stability: "Language change can have multiple stable outcomes"
5. Threshold problem: "Initially rare variants may manage to spread through entire speech communities"

Modifications: Some instances of syntactic variation, such as verb biases (citations) may co-exist over time within a speech community.

Description

Agents have:

- State (current grammar state, ranges from 0 to 1)
- Original state (initially assigned grammar state)
- Spoken state (output of each agent's speech, 0 or 1)
- Age (current age of an agent)
- Gamma (learning rate)
- Cohort (group of the agent, 1 or 2)

Initialization:

- Preferential attachment network
- Grammar is distributed throughout the network based on the specified percentage of grammar 1
- Specify the number of cohorts
- Cohorts are initialized, such that their ages are either deterministic (set to the specified age) or probabilistic (centered around the specified age, with a specified standard deviation)
- Gamma is initialized, such that it is either deterministic (set to the specified gamma) or probabilistic (centered around the specified gamma, with a specified standard deviation)

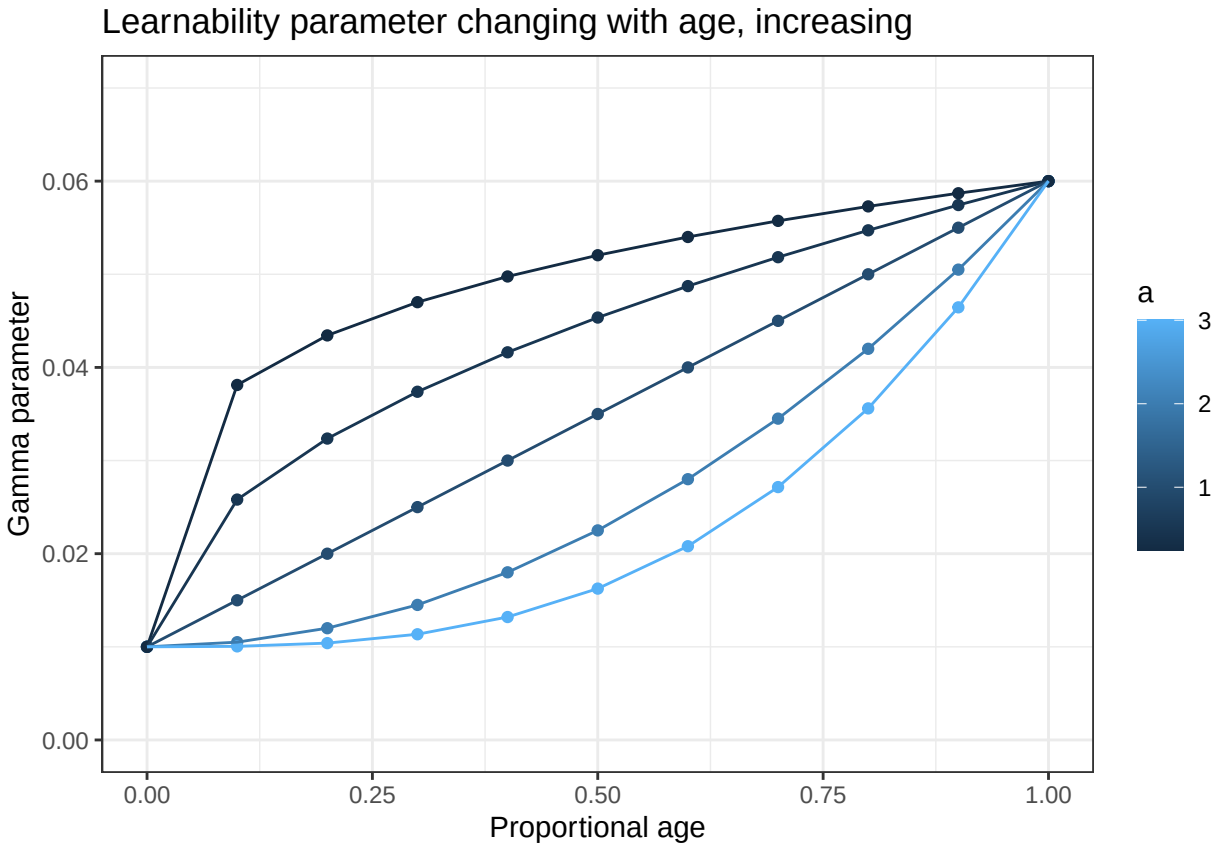
Dynamics

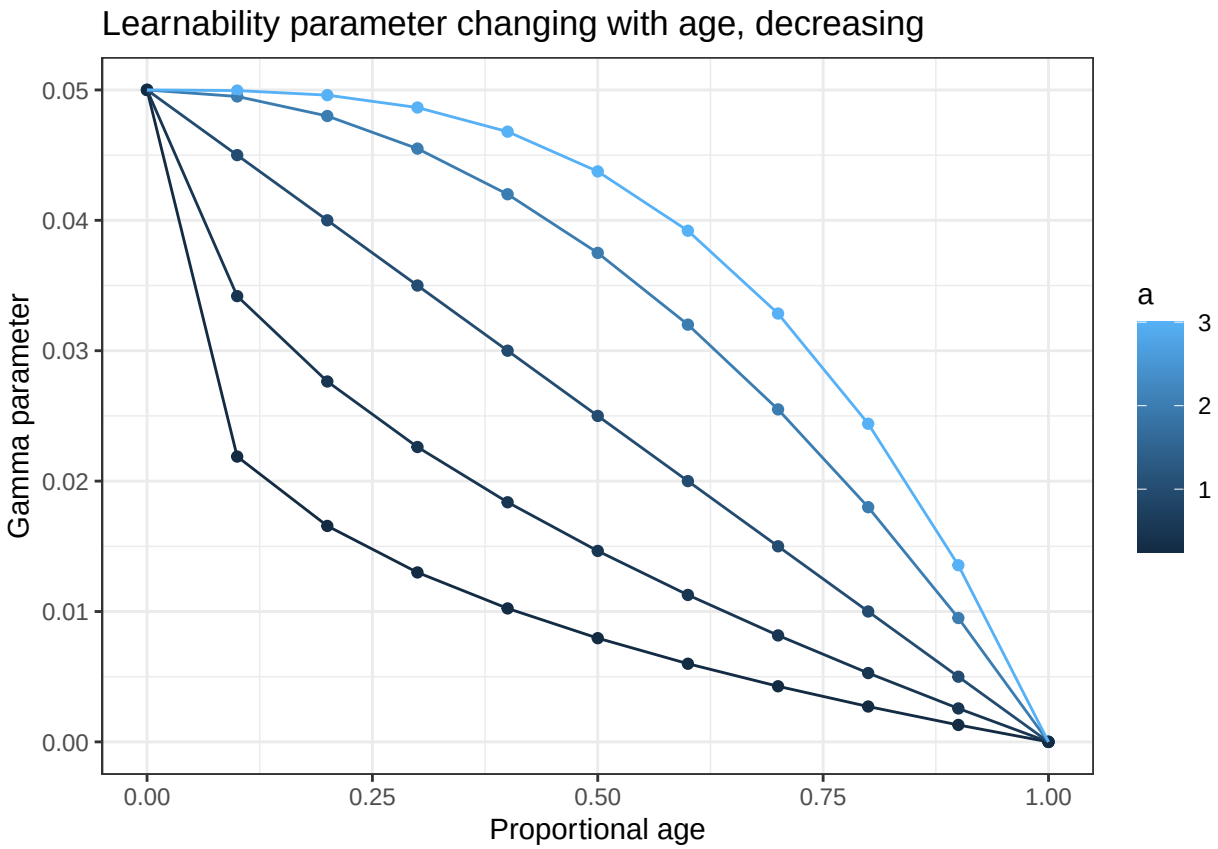
Go procedure:

- Communication
- Aging
  - Age increases by 1 each tick
  - Gamma is modified by the specified parameters

Gamma modification:

- Influence is specified at the start: increases, decreases, remains constant
- Every 100 ticks, the gamma is modified by a specified constant, based on the direction
- Minimum gamma is 0; potential for some agents to stop learning


Learnability parameter changing with age, increasing
Gamma parameter
0.06
0.04
0.02
0.00
0.00
0.25
0.50
0.75
1.00
Proportional age
a
3
2
1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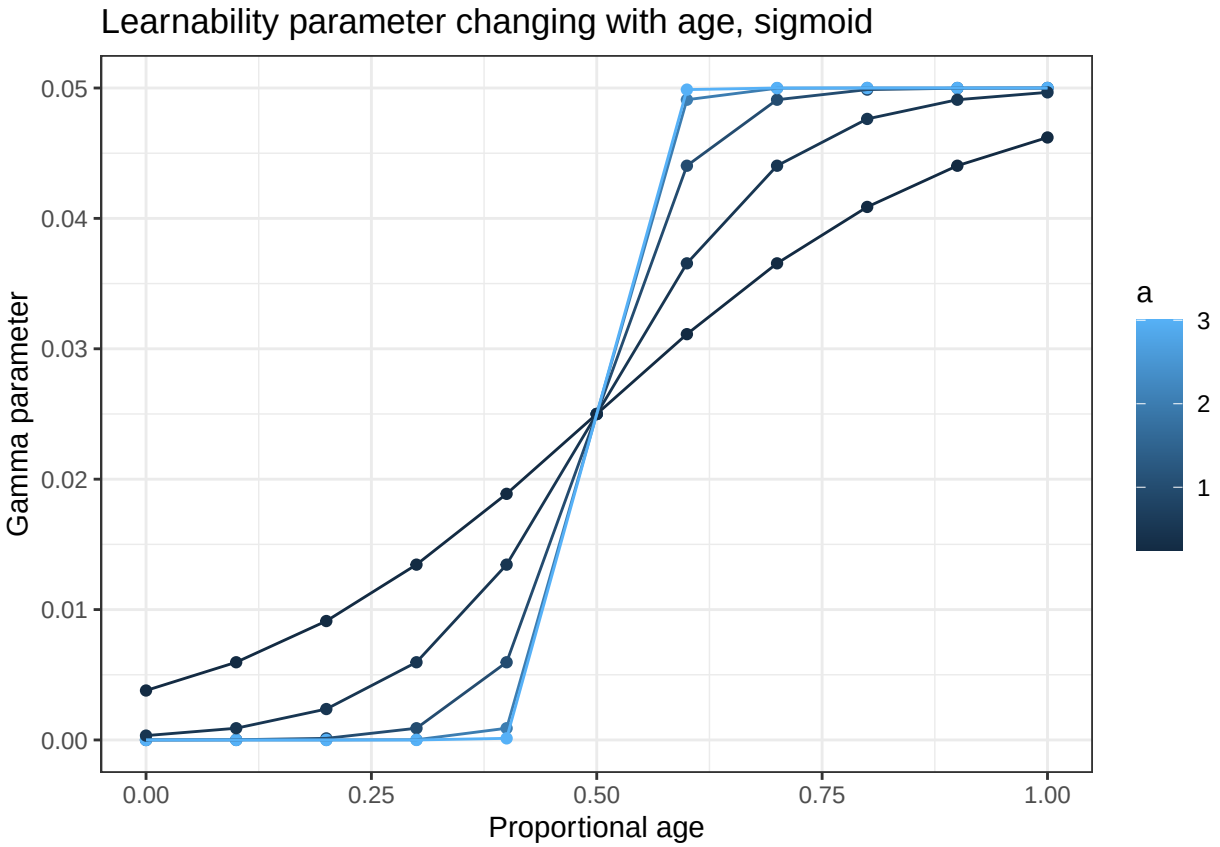

Communication:

- Speaking
  - Original model had variation in whether or not the agents preferred a discrete grammar; this model will take that as granted
  - Use a logistic curve, such that agents will produce an utterance that is either 0 or 1.
- Listening
  - Original model had variation in the listening function, either threshold (if neighbors above a threshold value, switch to that grammar), individual (select one neighbor, choose that grammar), or reward (explained below)
    - This model will take the third, reward-based algorithm as granted
  - Hearing node will pick a grammar that will be used to interpret utterances, either 0 or 1
  - If the selected grammar matches the heard grammar, it will update its grammar towards the heard state
  - If it fails, it will be updated away from the heard state

Results

Influence of gamma with only one group:

- Low vs high gamma

- Probabilistic gamma
- Gamma increasing/decreasing with age

Select a gamma parameter setting for second part.

Influence of two groups:

- One group vs two groups
- Difference in ages

Discussion

Summarize the results, in the context of previous literature

Comparison with previous model results

Life-long learning, language change

Conclusion.