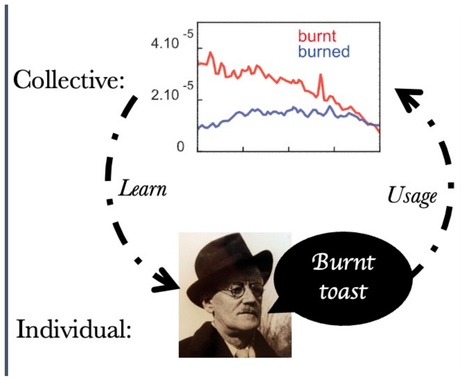
TEACHING AN OLD DOG NEW TRICKS?
LEARNING RATES, AGING, AND LANGUAGE CHANGE

Ellis Cain (*ecain@ucmerced.edu*)
University of California, Merced

BACKGROUND

- Language as a **complex adaptive system** (Beckner et al., 2009)
- Collective patterns of language use **change over time** (Bybee, 2015; Bynon, 1977; Michel et al., 2011)
- **Age-related differences** in language processing and organization (Dubossarsky et al., 2017; Federmeier et al., 2011)



OVERVIEW

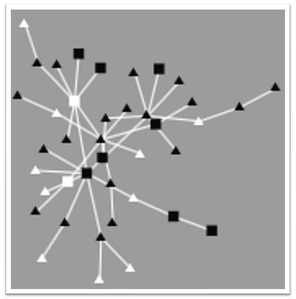
- Aim to explore how **learning rate**, **aging**, and **group membership** impact overall population-level patterns of language change
- Model the usage and spread of a grammatical variant throughout a population (Original model: Troutman et al., 2008)

MODEL ASSUMPTIONS

1. Language learning is based on **imitating** others
2. Learning rates may **change over the lifespan**
3. Language can be **influenced by external factors**
4. Language change has **multiple stable equilibria** (no set outcome)

INITIALIZATION

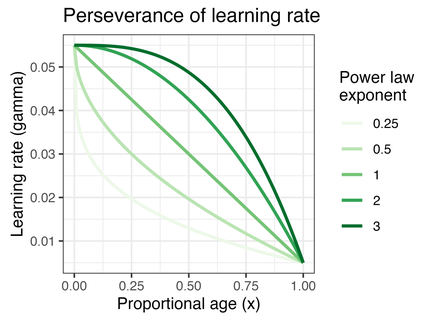
- **Preferential attachment network** with specified starting grammar usage
- Language users as **nodes**, with a **state**, **age**, **cohort**, and **learning rate**
- Able to specify number of cohorts, cohort-based grammar, and willingness to listen to out-group members



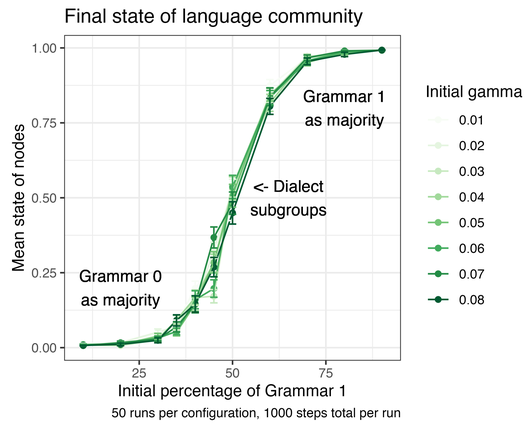
Example network

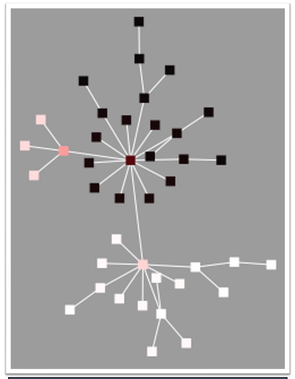
DYNAMICS

- **Speaking**: produce an utterance with a preference for a discrete grammar
- **Listening**: connected nodes listen, using a linear reward-penalty algorithm to update their state (Bush and Mosteller 1951, 1958; Yang 2002)
- **Aging**: learning rate can be determined by age, using a power law to determine perseverance

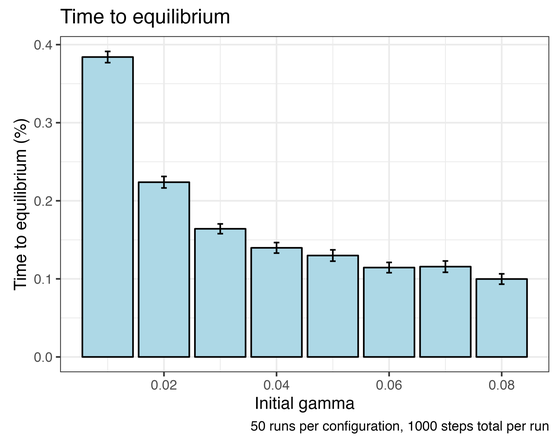


IMPACT OF LEARNING RATE

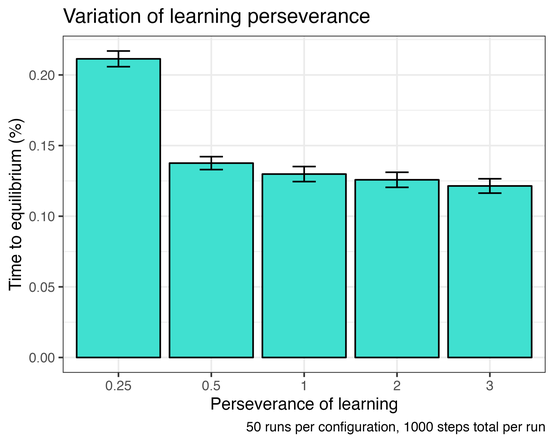


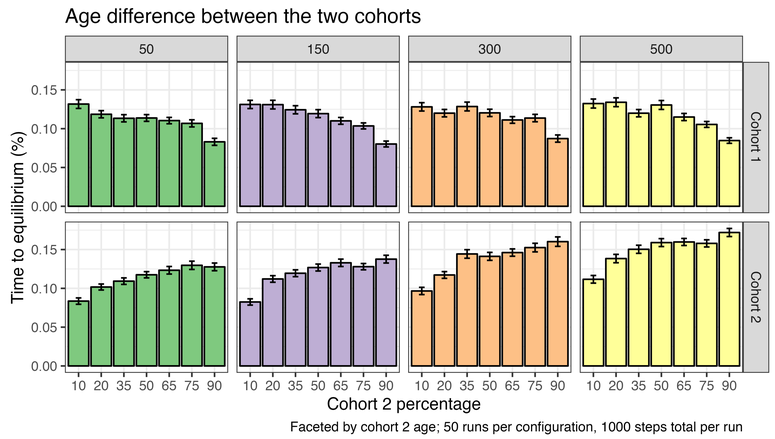


Example run that ends with dialect subgroups

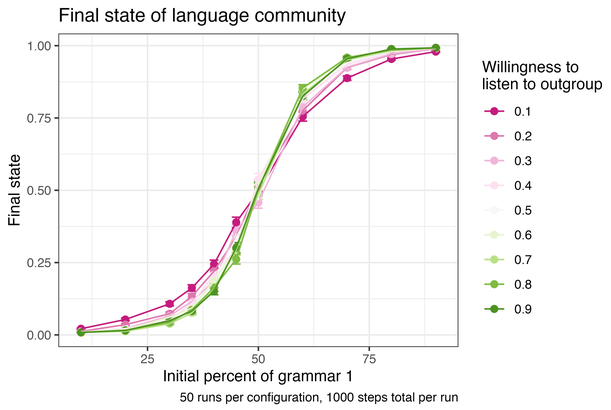


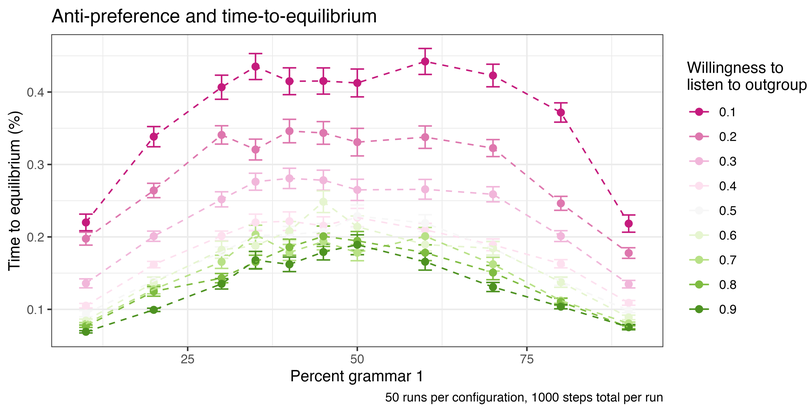
AGING: PERSEVERANCE AND COHORT EQUILIBRIA





COHORT ANTI-PREFERENCE





CONCLUSION

- Learning rate impacts time to equilibrium, but not the final system outcome
- Except for extreme decay (0.25), majority of learning perseverance curves have similar time to equilibrium
- Older cohort delays group equilibrium
- Cohort anti-preference increases the threshold for full spread

FUTURE MODIFICATIONS

- Vary network structure (such as small world or random)
- Cohort-based network structure (cohort 1 nodes prefer to connect to other cohort 1 nodes)
- Multiple generations and node death