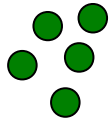


Developing Lexicons in a Continuous Meaning Space

Avril Kenney
Santa Fe Institute
11 August 2010

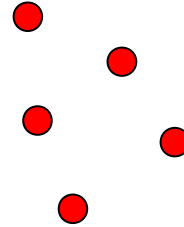
Word Learning

- Generalizing from examples

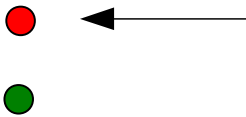


?

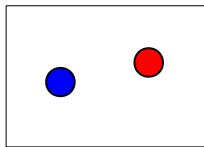
?



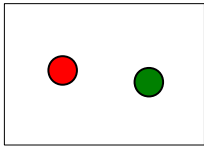
- Cues to reference



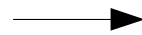
- Cross-situational learning




"dax"



"dax"

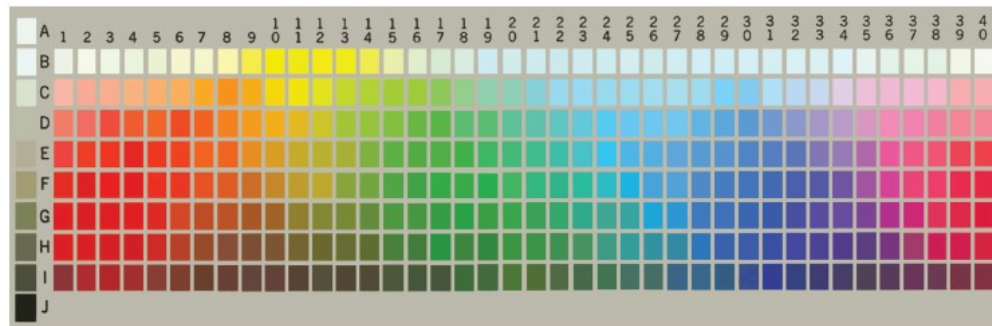


"dax" = 

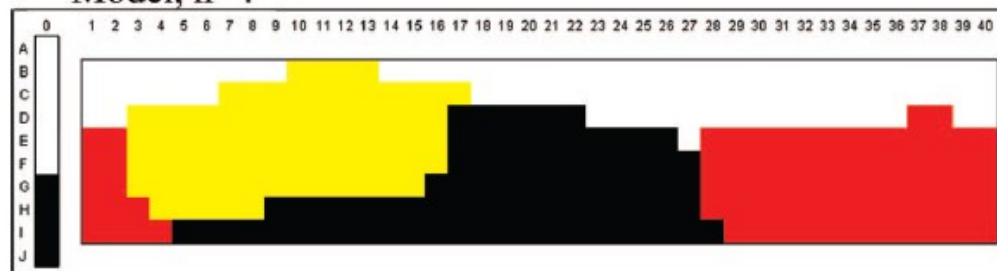
Efficiency of Language

- Exact synonyms are rare
- Polysemes are disambiguated by context
- Continuous spaces are lexicalized efficiently

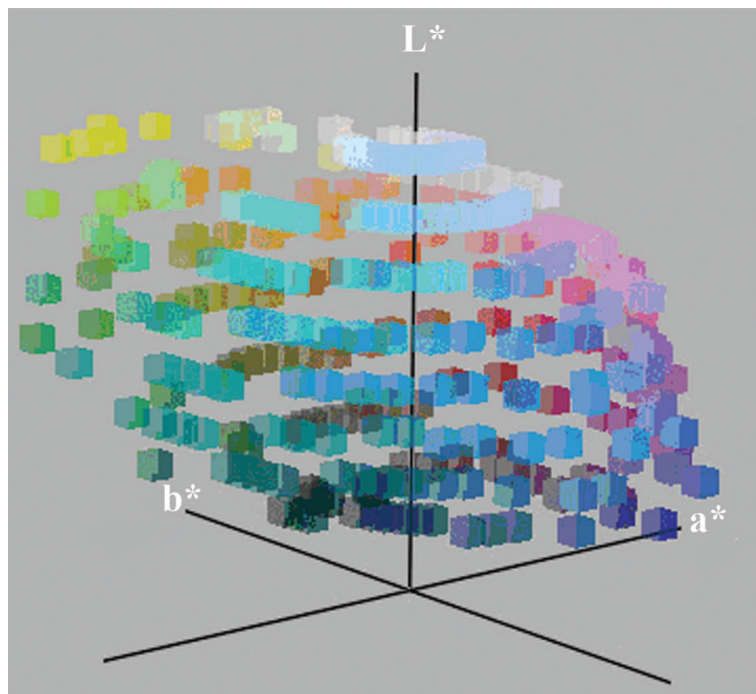
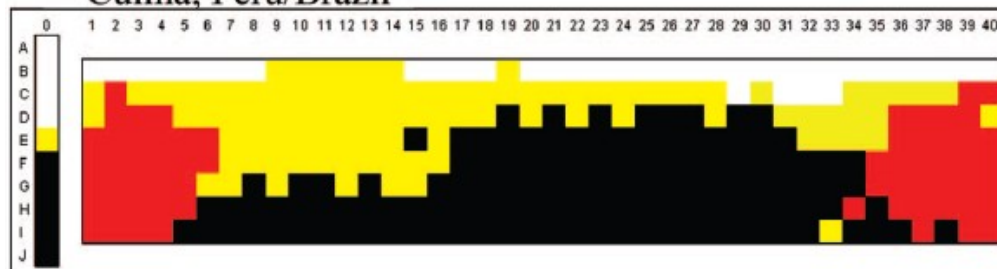
Efficiency of Language



Model, n=4



Culina, Peru/Brazil



(Regier, Kay, & Khetarpal, 2007)

Modeling Lexicons

- Mapping sounds to discrete meanings
- Agents communicating can develop a shared lexicon
- Errors enable change
- Change prevents non-optimal convergence
- Valuable meanings are lexicalized

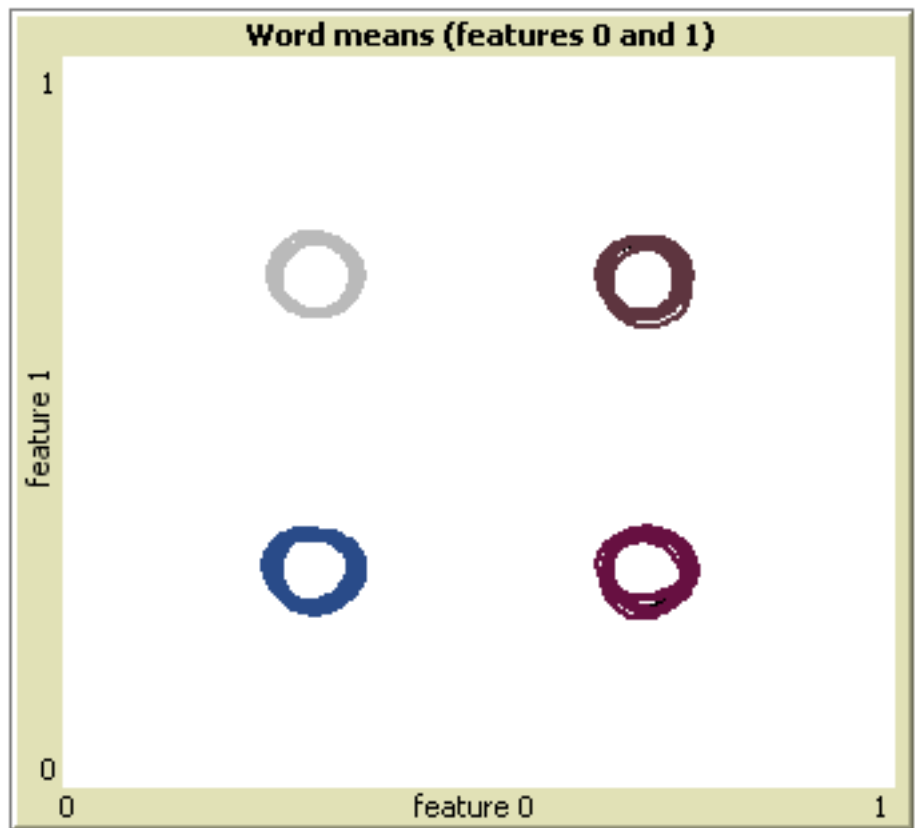
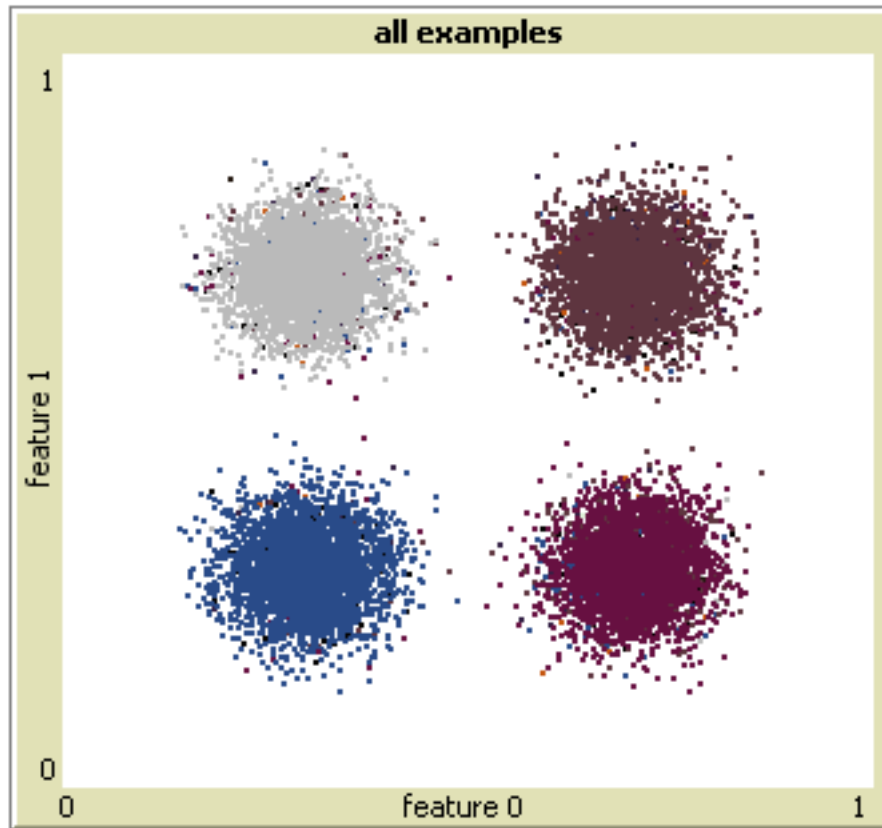
Inferring Meanings

- “Physical symbol grounding”
- Robots learning from sensory input
- Dependent on nonlinguistic structure

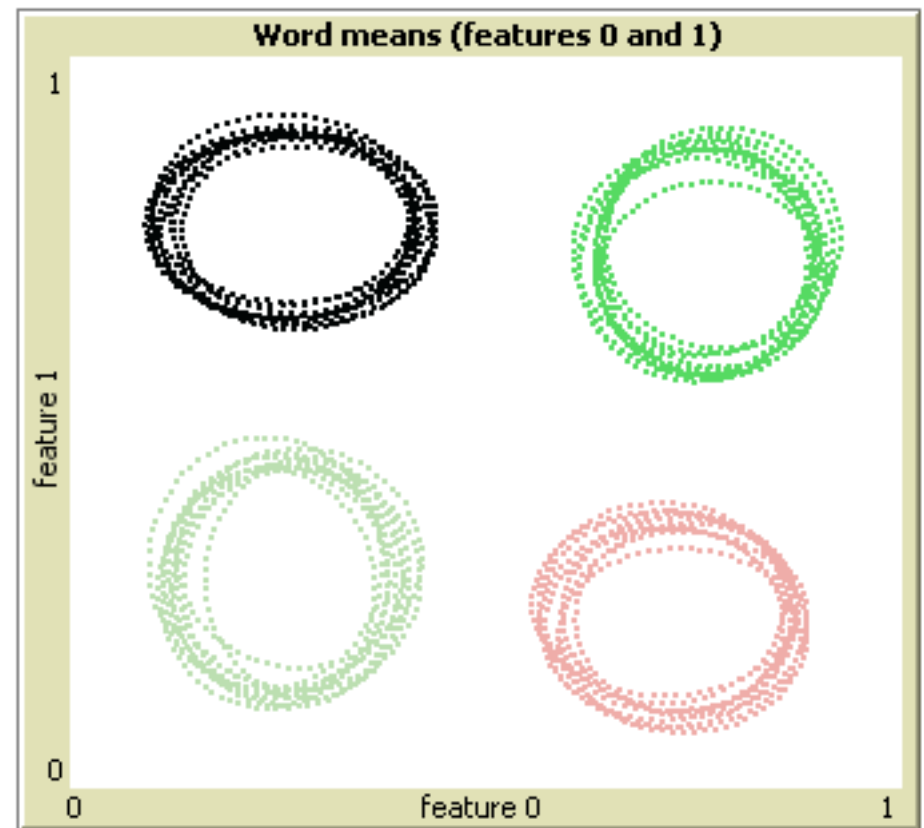
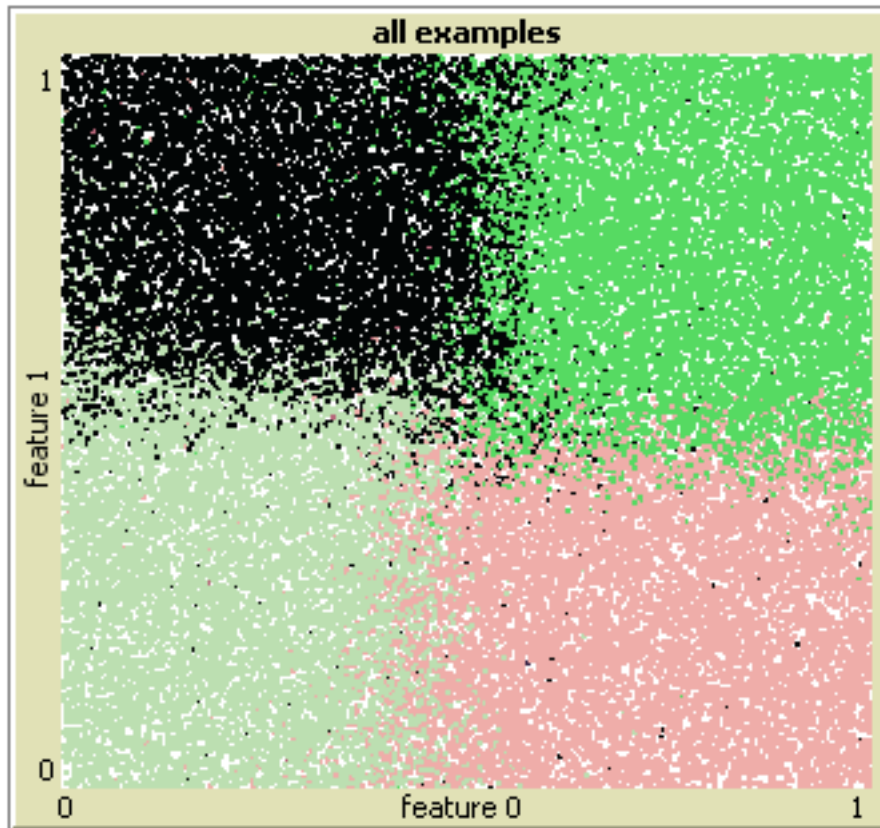
Model

- Referents are points in a continuous space
- Meanings are Gaussian distributions, computed from examples
- Cross-situational learning: agents infer referent
- Fixed probability of replacing agents

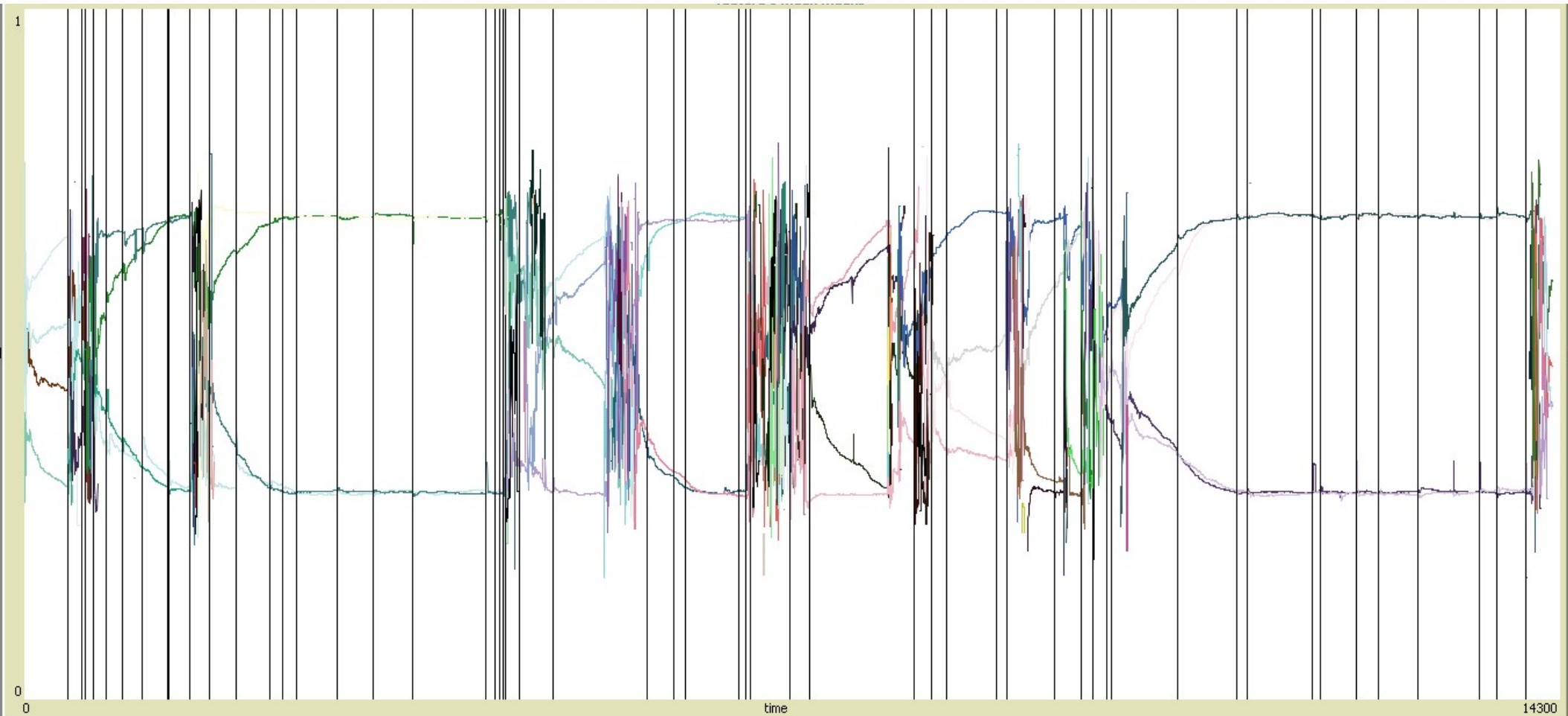
Examples



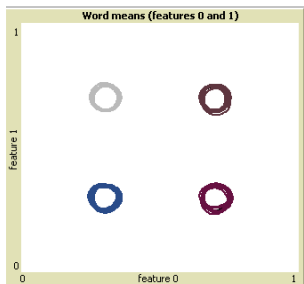
Examples



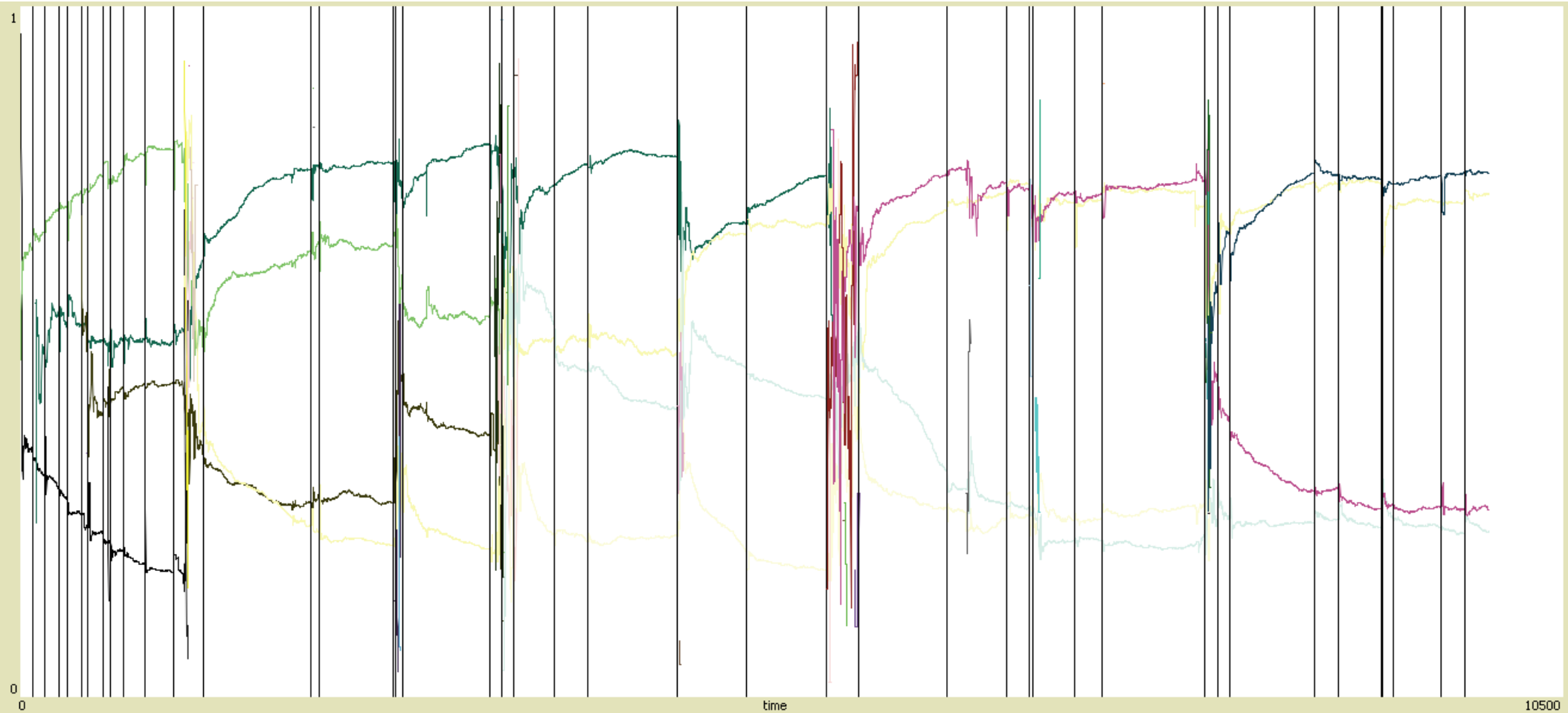
Stability



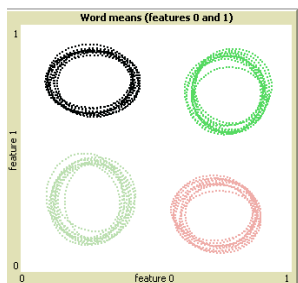
time



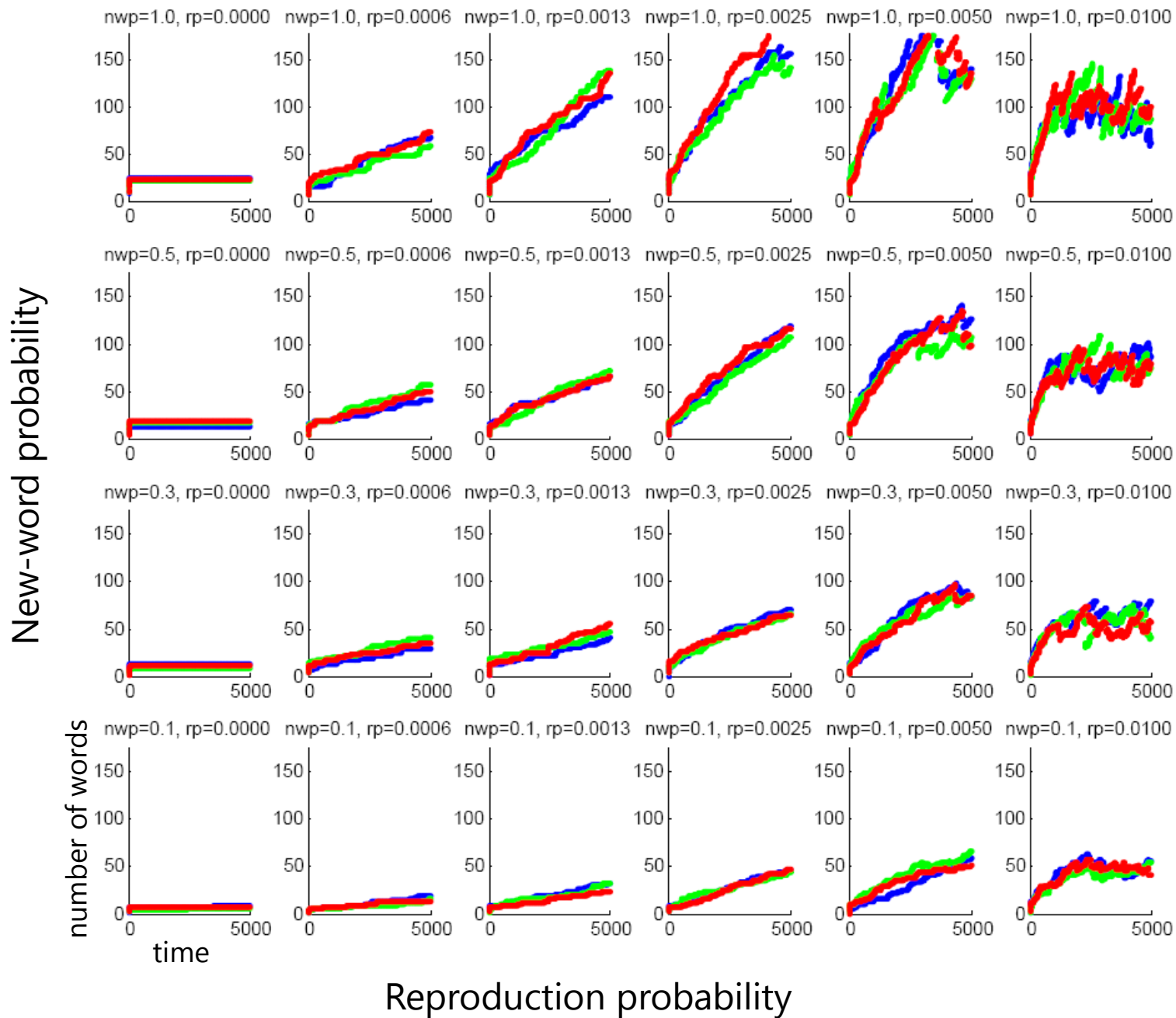
Stability



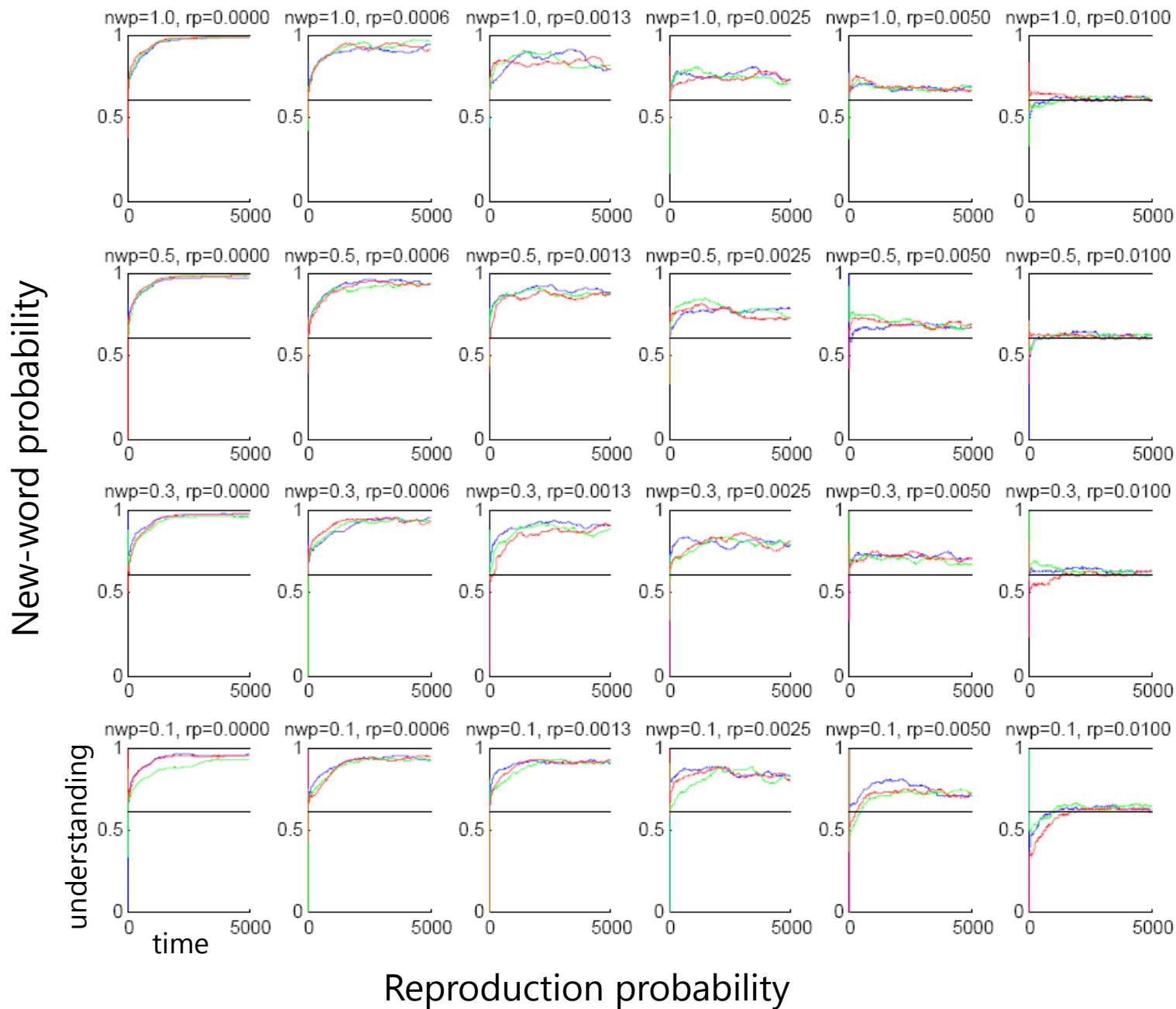
time



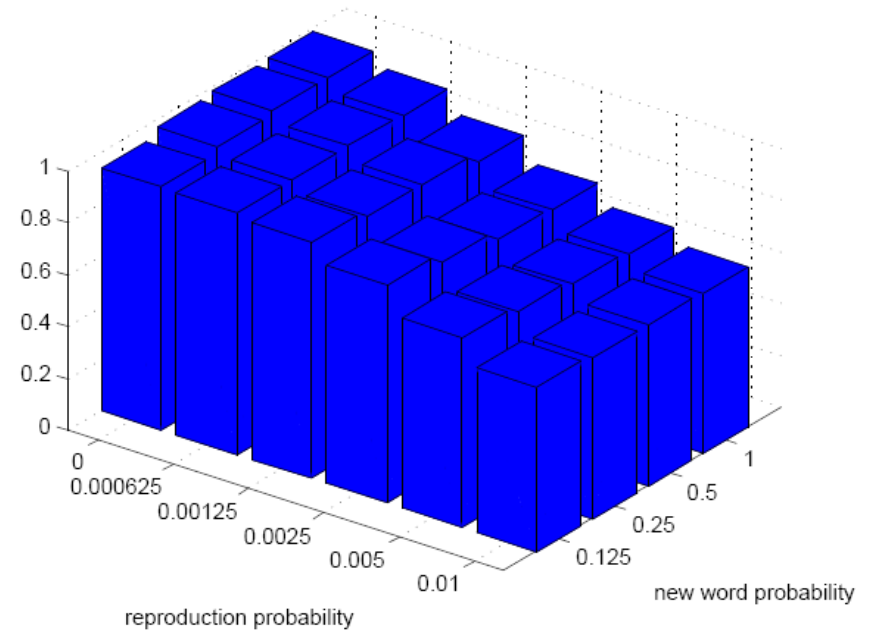
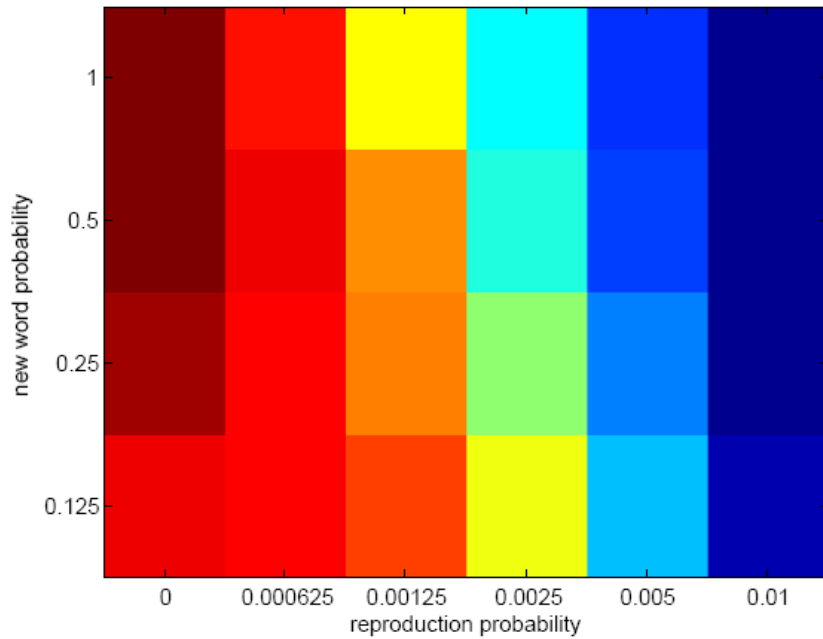
Stability



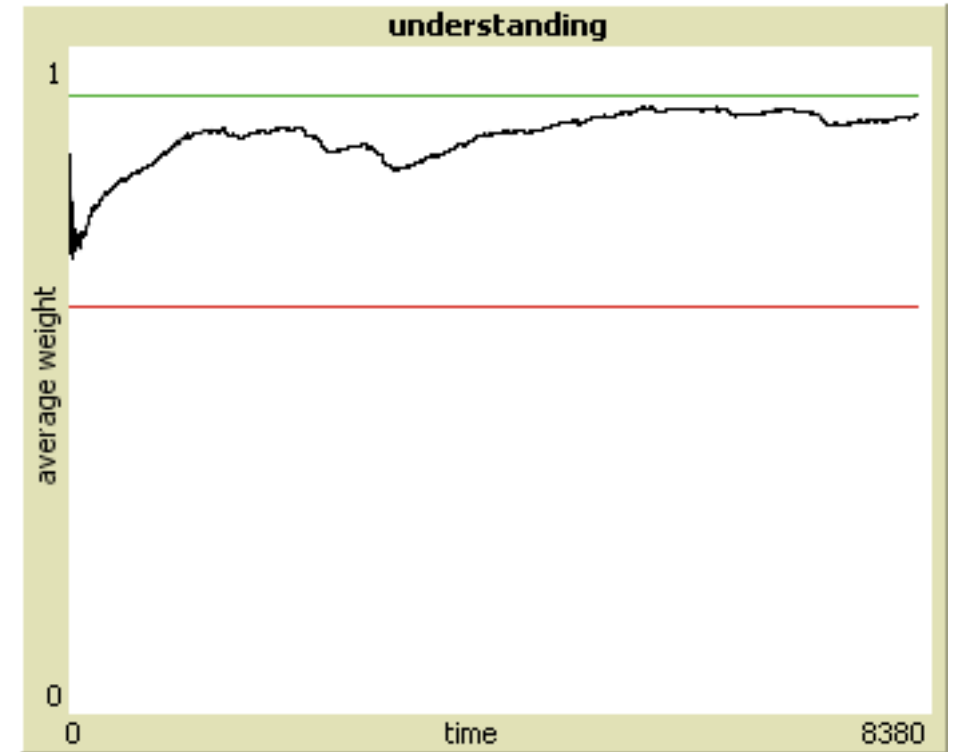
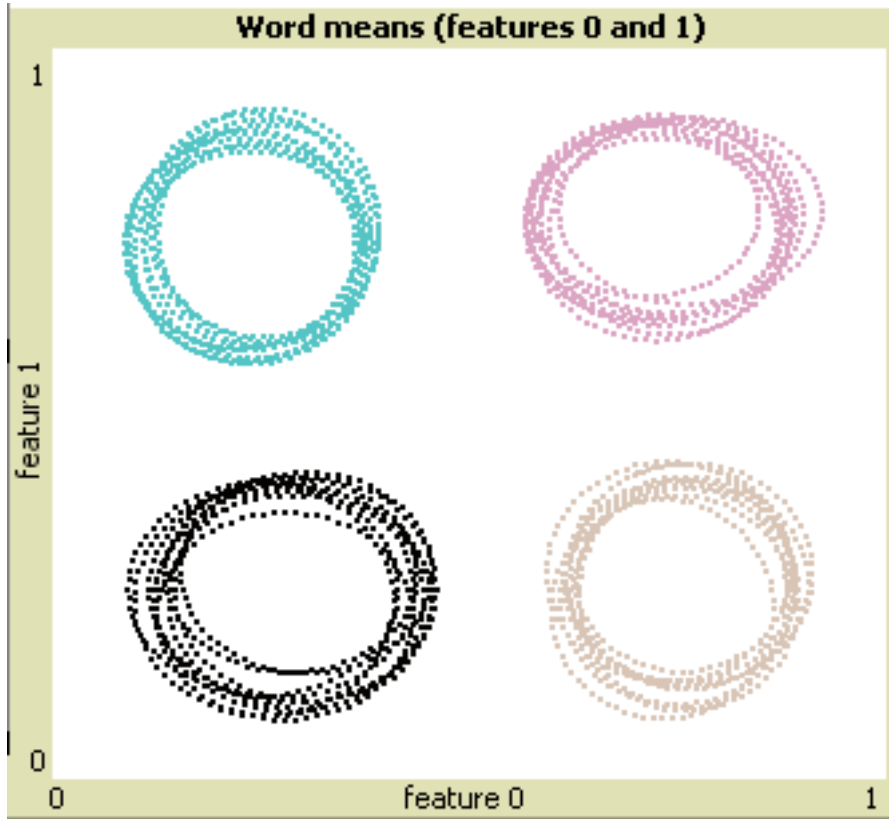
Understanding



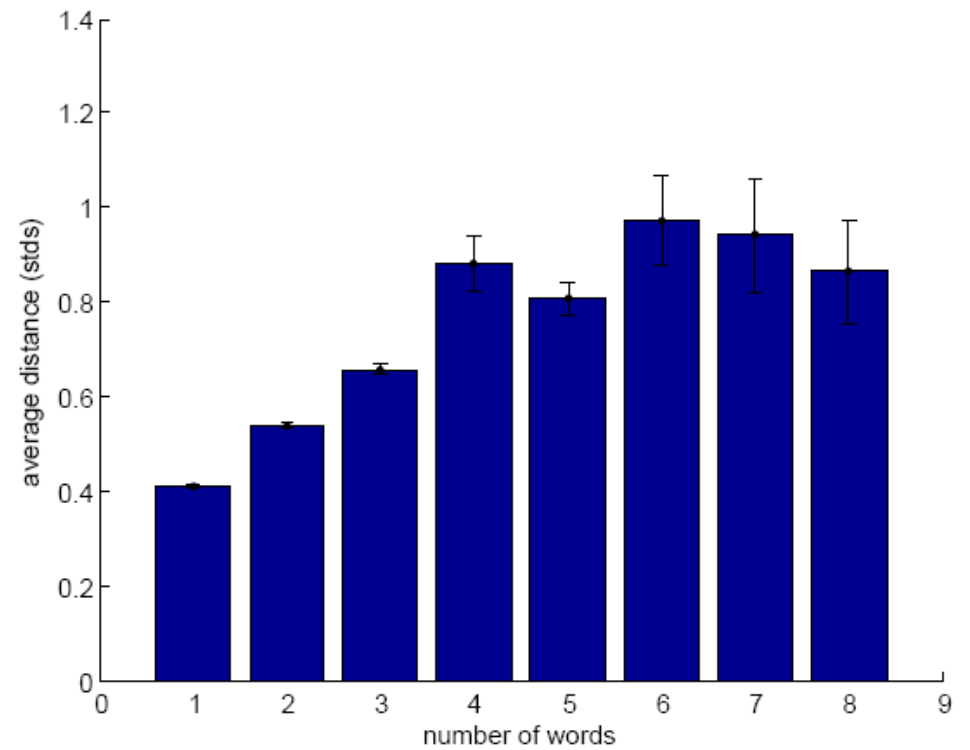
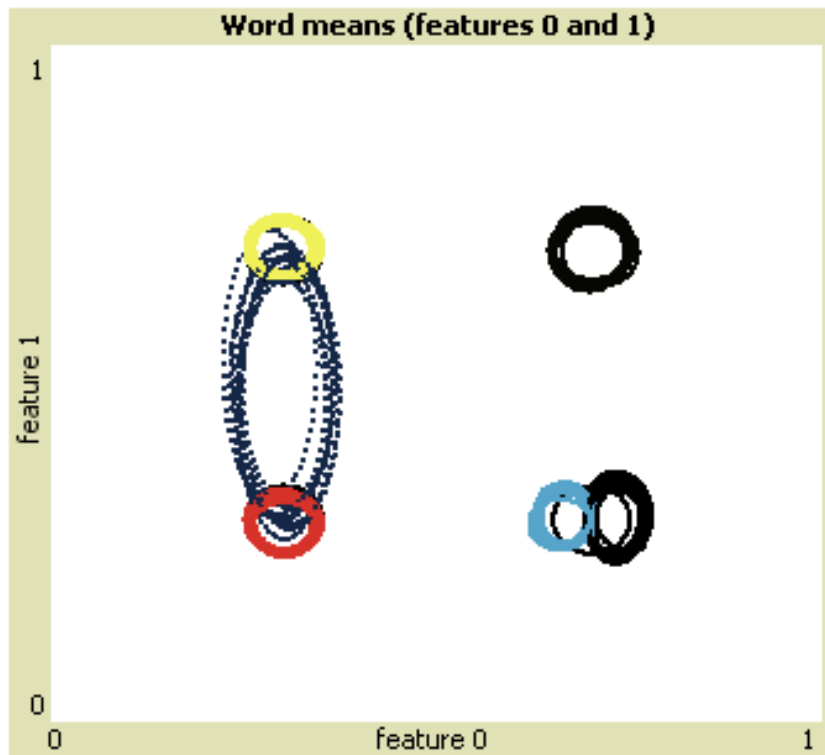
Understanding



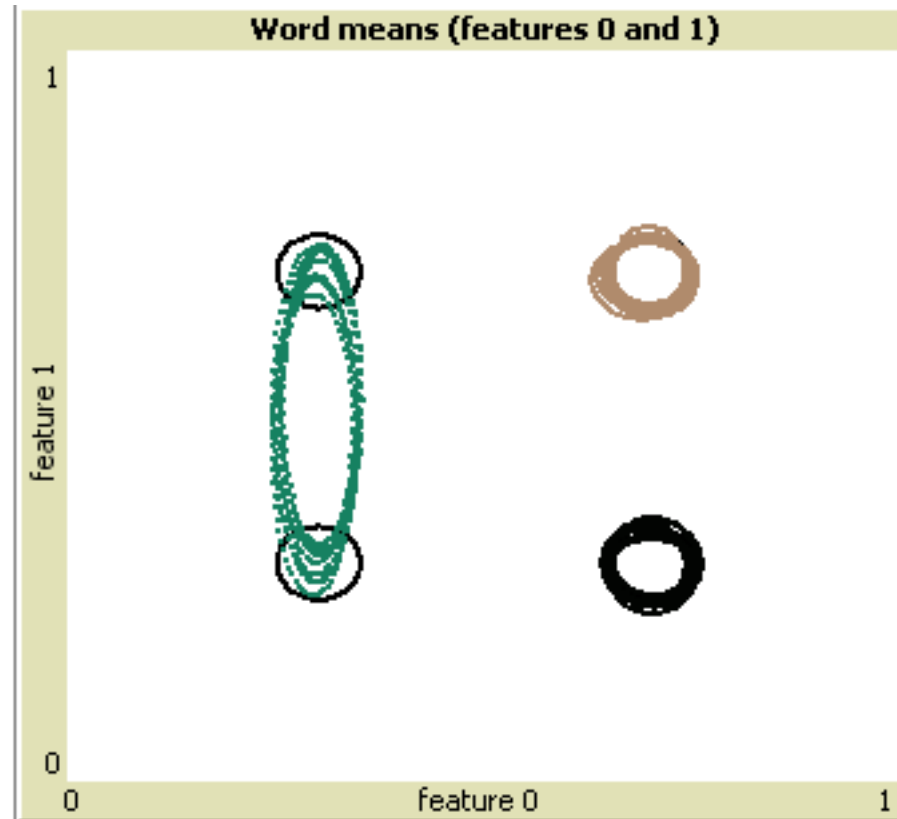
Partitioning Meaning Space



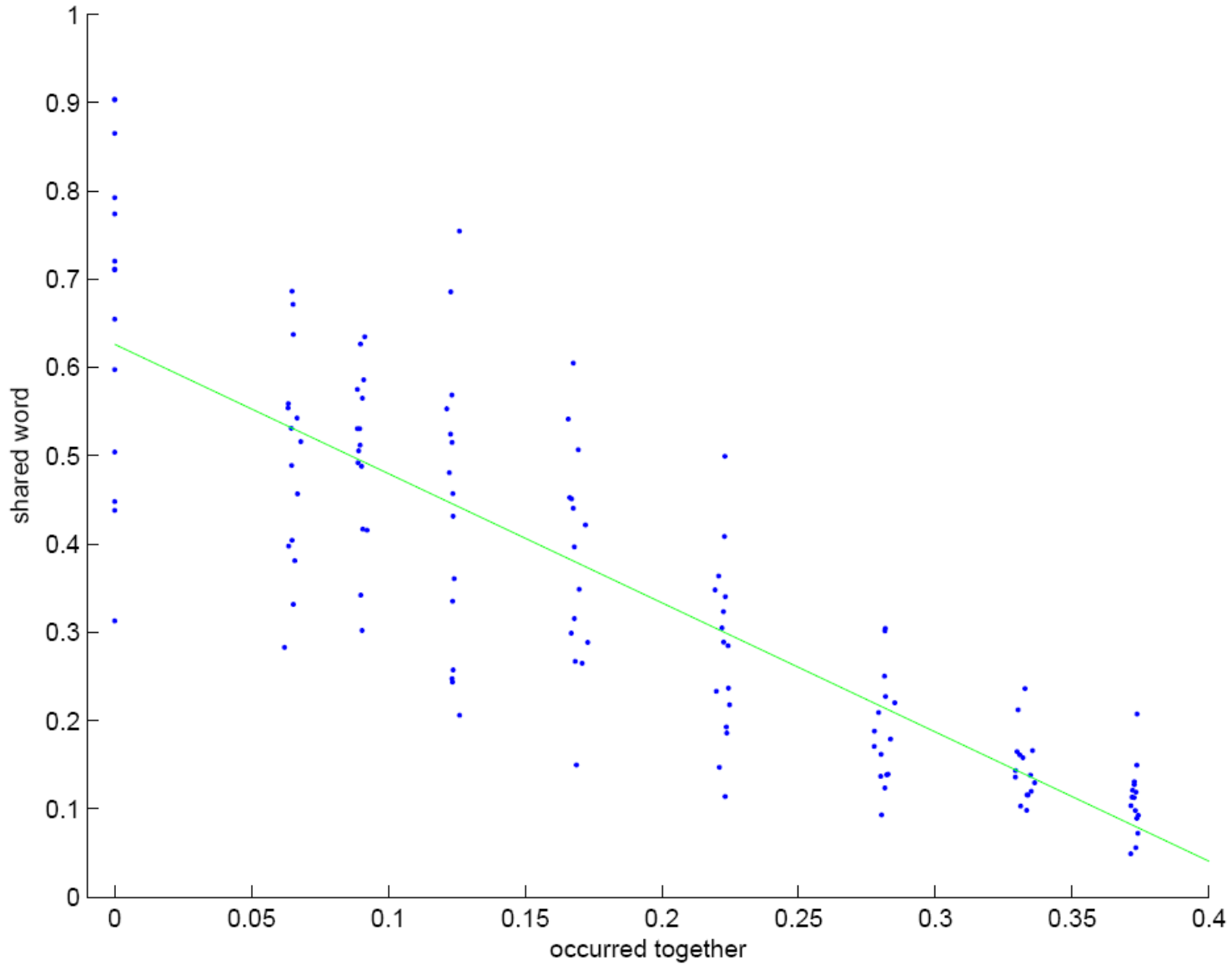
Synonyms



Polysemes



Polysemes



Conclusions

- Agents can develop a shared lexicon even when they all see different examples and the referent is not always specified
- The structure of the world affects the dynamics of lexical change
- The space of meanings gets divided efficiently