A computational investigation of the emergence of inflection class systems with non-homogeneous network structure

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Recent work suggests that inflectional systems typologically tend towards low systemic complexity in terms of predicting one form from another (Ackerman and Malouf 2013, Stump and Finkel 2013). However, interpretation of such claims about global complexity of inflection class systems are implicitly rooted in the premise that the structure of the systems is homogeneous, yet most real-world complex systems are not homogeneous (Guimerà et al. 2007) and there is growing evidence that this applies also to inflection class systems (Blevins et al. to appear; Marginal Detraction Hypothesis, Stump and Finkel 2013). Moreover, Sims and Parker (2016) show that inflection class systems form different kinds of networks and find some evidence that systems' tolerance of classes that greatly contribute to the complexity of the system depends on the type of network. Such an approach frames typological questions about inflectional systems in terms of a potential interaction between network structure and implicative structure that may arise over time as systems are learned by successive generations of speakers. In this paper we further explore the possibility that network structures depend on and may arise because of differences in implicative structure. We implement a multi-generational agent-based model in which each agent is equipped with a Bayesian learning algorithm that balances predictions based on expectations (derived from implicative structure) and observations. We manipulate the strength of implicative structure in the input and test what types of network structures emerge across generations. We thus investigate whether simple principles of learning can account for the emergence of different types of network structure in ways that model (what we know about) the real-world facts. We hypothesize that individual inflection classes that contribute disproportionately to the complexity of an inflection class system are more likely to emerge, persist, and be tolerated in systems that are less reliant on implicative structure.

References

Ackerman, Farrell, and Robert Malouf. 2013. "Morphological organization: The Low Conditional Entropy Conjecture." *Language* 89(3): 429-464.

Blevins, James P., Petar Milin, and Michael Ramscar. to appear. "The Zipfian Paradigm Cell Filling Problem." In *Perspectives on morphological structure: Data and analysis*, edited by Ferenc Kiefer, James P. Blevins and Huba Bartos. Leiden: Brill.

Guimerà, Roger, Marta Sales-Pardo, and Luís A. N. Amaral. 2007. "Classes of complex networks defined by role-to-role connectivity profiles." *Nature physics* 3: 63-69.

Sims, Andrea D., and Jeff Parker. 2016. "How inflection class systems work: On the informativity of implicative structure." *Word Structure* 9(2): 215-239.

Stump, Gregory T., and Raphael A. Finkel. 2013. *Morphological typology: From word to paradigm*. Cambridge: Cambridge University Press.