Sequential Coordination: How Language Enables Complex Innovation Discovery

Amirhossein Sarkaboudi
Arizona State University, Glendale, Arizona, United States

James Benjamin Falandays

Arizona State University, Glendale, Arizona, United States

Abstract

Cultural evolution research demonstrates that population size and network structure affect cumulative innovation (Moser & Smaldino, 2023). However, few models examine how linguistic categories enable coordination in multi-step innovation tasks on dynamic social networks. We extend the Potions Task framework (Derex & Boyd, 2016) by integrating naming game dynamics (Steels, 1995; Puglisi et al., 2008), where agents must coordinate sequential potion selections to discover innovations. Bayesian agents develop shared 2D Gaussian mixture categories through communication, learning potion-label associations while tracking combination effectiveness. Connection weights increase with communicative success and partner innovation performance, driving co-evolution of linguistic categories, innovation trajectories, and network structure. We varied population size, initial network structures, and critical period constraints. Our findings indicate that pressures for linguistic coordination shape the emergence of network structures that facilitate cumulative innovation, and that the equilibrium architecture depends on the balance between categorical diversity and information transmission.

In G. Boleda, I. Dautriche, M. Maldonado, C. Saldana and T. Torrent (Eds.), *Proceedings of the 48th Annual Conference of the Cognitive Science Society*