NETWORK STRUCTURE AND THE CULTURAL EVOLUTION OF LINGUISTIC STRUCTURE: A GROUP COMMUNICATION EXPERIMENT

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Social network structure has been argued to shape the structure of languages, as well as affect the spread of innovations and the formation of conventions in the community. Specifically, theoretical and computational models of language change suggest that sparsely connected communities develop more regular and more systematic languages, while tightly knit communities can maintain high levels of linguistic complexity (e.g., Meir, Israel, Sandler, Padden & Aronoff, 2012; Trudgill, 2009; Wray and Grace, 2007; Lou-Magnuson and Onnis, 2018). This is because sparser communities are typically more diversified (e.g., Bahlmann, 2014) and tend to converge more slowly (e.g., Zubek et al., 2017). Importantly, sparser networks' greater variability and convergence difficulty can trigger a stronger need for generalizations and regularizations, leading to the creation of more systematic languages (Raviv, Meyer & Lev-Ari, 2019; Wray and Grace, 2007). However, this hypothesis has not yet been tested experimentally.

The goal of the current study is to fill in this gap in the literature, and experimentally test the effect of network structure using a group communication paradigm (Raviv et al., 2019). We examined the formation of new languages developed by different micro-societies, in which participants interacted face-to-face about novel scenes in alternating pairs. Groups varied only in their network structure (Fig 1), while keeping community size constant: All networks were comprised of eight participants, yet differed in their degree of connectivity (i.e., how many people each participant interacted with) and homogeneity (i.e., whether all participants are equally connected). Specifically, we contrasted three types of networks (seven groups per condition), which are typically used in computational models and echo early and contemporary human societies:

- **Fully connected network (Fig 1A):** a maximally dense and homogenous network (global clustering coefficient = 1) where all participants interact.

- **Small-world network (Fig 1B):** a sparser network with only half of the possible connections (global clustering coefficient = 0.17). "Strangers" are indirectly linked via short paths (max 2).
- **Scale-free network (Fig 1C):** similar in sparsity to the small-world networks, except that its distribution of connections follows a power law: most agents have few connections, but some have many (“hubs”, e.g., node A; global clustering coefficient = 0.42).

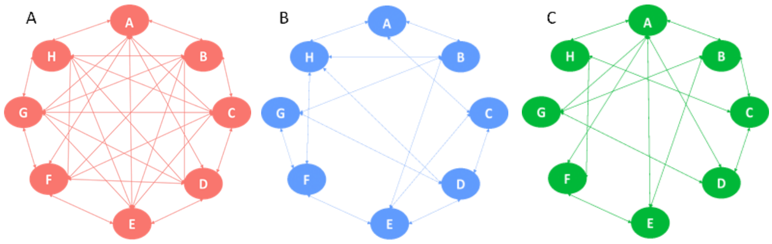

Figure 1. Network structure conditions. We tested group of eight participants who were connected to each other in different network setups: fully connected (A), small-world (B), and scale-free (C).

Across conditions, languages became more communicatively successful, more systematically structured (i.e., higher correlations between string distances and sematic distances; Fig. 2), more stable (i.e., fewer changes over time), and more shared (i.e., higher similarity between different participants’ variants) over time. There was no significant effect of network structure for any measure. We hypothesize that these null results can be traced back to the fact that, surprisingly, the networks did not differ in the amount of input variability. At the same time, small-world networks showed the greatest variation across all measures. This greater variability suggest that network structure can influence susceptibility to random linguistic changes (i.e., drift).

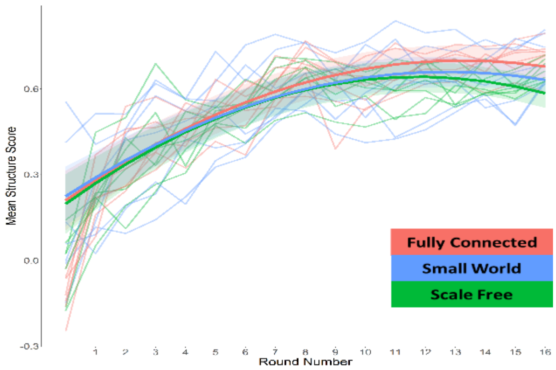

Figure 2. Changes in linguistic structure over time by network structure condition.

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