

The role of community size and network structure in shaping linguistic diversity: experimental evidence

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1 Introduction

Why are there so many different languages in the world? How much do languages differ from each other in terms of their linguistic structure? And how do such differences come about?

One possibility is that linguistic diversity stems from differences in the social environments in which languages evolve. Specifically, it has been suggested that small, tightly knit communities can maintain high levels of linguistic complexity, while bigger and sparser communities tend to have languages that are structurally simpler, i.e., languages with more regular and more systematic grammars (e.g., Lou-Magnuson and Onnis, 2018; Lupyán & Dale, 2010; Nettle, 2012; Trudgill, 2009; Wray and Grace, 2007).

However, to date this hypothesis has not been tested experimentally. Moreover, community size and network structure are typically confounded in the real-world, making it hard to evaluate the unique contribution of each social factor to this pattern of variation.

To address this issue, we used a novel group communication paradigm (Figure 1). This experimental paradigm allowed us to look at the live formation of new languages that were created in the lab by different micro-societies under different social conditions. By analyzing the emerging languages, we could tease apart the causal role of community size and network structure, and see how the process of language evolution and change is shaped by the fact that languages develop in communities of different sizes and different social structures.

2 Method

During the group communication game, participants' goal was to communicate successfully

about different novel scenes, using only invented nonsense words. A 'speaker' would see one of four shapes moving in some direction on a screen, and would type in a nonsense word to describe the scene (its shape and direction). The 'listener' would then guess which scene their partner was referring to by selecting one of eight scenes on their own screen. Participants received points for every successful interaction (correct guesses), and also feedback to allow them to learn for future interactions. Participants paired up with a different person from their group at every new round, taking turns producing and guessing words.

At the start of the game, people would randomly guessed meanings and make up new names. Over the course of several hours, participants started to combine words or part-words systematically, creating an actual mini-language. For instance, in one group, 'wowo-ik' meant that a specific shape was going up and right, whereas 'wowo-ii' meant that the same shape was going straight up. With such a 'regular' system, it becomes easier to predict the meaning of new labels ('mop-ik' meant a different shape going up and right).



Figure 1: The setup of the group communication paradigm. Participants in the same group interacted in alternating pairs.

3 Community Size Study

In the first experiment (Raviv, Meyer & Lev-Ari, 2019b), we examined the role of community size by having participants play in either 'small' groups of four participants or 'large' groups of eight participants. Would the large groups invent more structured languages than the small groups?

Results showed that larger groups created languages with more systematic grammars, and did so faster and more consistently than small groups (Figure 2). This finding suggested that the number of people in the community can affect the grammar of languages. We suggest that larger groups are under a stronger pressure to create systematic languages because members of larger groups are typically faced with more input variability, and have less shared history with each member of their group.

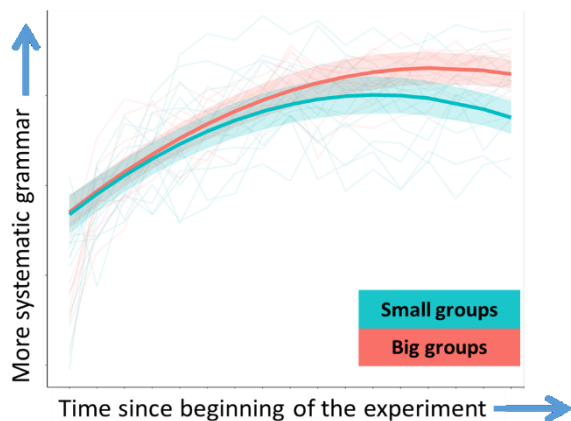


Figure 2: Results of linguistic structure over time in the community size study.

4 Network Structure Study

In contrast, in the second experiment we found no evidence for a similar role of network structure (Raviv, Meyer & Lev-Ari, 2020). We compared the performance of three network conditions (i.e., fully connected networks, small-world networks, scale-free networks) that varied in their degree of connectivity while group size constant was kept constant, and found that all groups developed languages that were highly systematic, communicatively efficient, stable, and shared across members – with dense and sparse groups reaching similar levels of linguistic structure over time (Figure 3).

Although there were no significant differences between networks with respect to their degree of systematic grammar, we found that small-world

networks showed the most variance in their behaviors. This result suggests that small-world networks may be more sensitive to random events (i.e., drift).

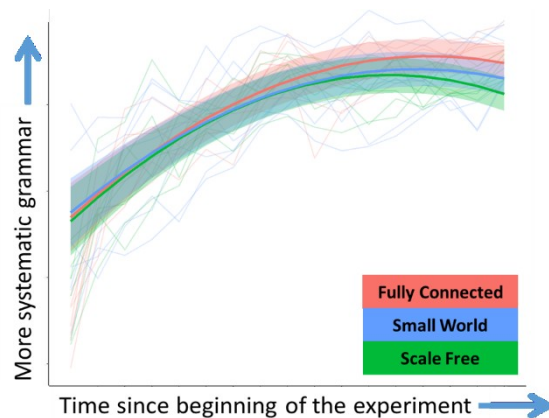


Figure 3: Results of linguistic structure over time in the network structure study.

5 Conclusion

Together, the findings from the two experiments reported above show that factors in the social environment, and specifically community size, can affect patterns of language diversity and shape the nature and structure of languages.

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