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THE EFFECT OF NETWORK STRUCTURE ON LEXICAL VARIABILITY IN SIGN LANGUAGE COMMUNITIES

Katie Mudd[1], Marnix Van Soom[1], Connie de Vos[2], and Bart de Boer[1]

[*]katie.mudd@ai.vub.ac.be
[1]AI lab, Vrije Universiteit Brussel, Belgium
[2]Department of Communication and Cognition, Tilburg University, the Netherlands

The study of sign languages allows us to observe what features characterize a language in its early stages. The initial phase of emergence is characterized by a high degree of lexical variability, where synonyms for a concept appear to coexist in a community. Overtime, lexical variation may persist; for example, it was found that Kata Kolok, a sign language used in a small community in a Balinese village with a tightly knit social network, exhibits a high degree of lexical variability (Mudd et al., 2020). Meanwhile, in communities with different social configurations, we suggest that lexical variation may decrease within groups of frequent interlocutors (i.e. on the *local* level) but remain high across the entire population (i.e. on the *global* level). For example, British Sign Language (BSL), used by the large Deaf community across the UK, was found to be lexically uniform at the local level (i.e. within regions), but at the global level BSL actually has a higher degree of lexical variability than Kata Kolok (Mudd, Lutzenberger, Schembri, Ohanin, & Stamp, 2022).

Several factors have been proposed to explain the retention of lexical variability in sign language emergence: de Vos (2011) suggests that populations that retain a high degree of lexical variability typically have frequent face-to-face interaction, are small and lack formal deaf education. Previous models have investigated population size (Thompson, Raviv, & Kirby, 2020) and the role of shared context (Mudd, de Vos, & de Boer, 2022), but the role of *network structure* on lexical variation has yet to be explored. In addition, variation at the local and global levels has yet to be considered, with previous models implicitly considering variation only at one, unspecified level.

Building on the shared context model by Mudd et al. (2022), which formalizes the hypothesis that social and psychological information shared within groups of signers affords the use of iconic signs and thus the retention of lexical variability, we investigate if network structure can explain differences in the degree of lexical variation at the local and global levels. In more detail, in the initial phase of the model, agents improvise signs to refer to different concepts based on their social

and psychological information, such that agents in the same groups are likely to produce similar signs. However, we made the arguably unrealistic assumption that group membership does not influence interaction patterns. Here, we generalize our previous model by allowing the interaction probability between pairs of agents to depend on their group membership through Newman (2003)'s assortativity coefficient r. A continuous spectrum of *assortative network structures* can thus be probed by varying r, from agents interacting completely at random ($r = 0$) to interacting only with others in the same group ($r = 1$).

To study the effect of assortative network structure on lexical variability at the local (i.e. within group) and global (i.e. across the entire population) levels, we keep a fixed set of parameters[1] and vary the value of r, as shown in Fig 1. We observe that r correlates with the lexical variability at both levels. Interestingly, the local and global levels decouple only at high values of r, i.e. for strongly assortative networks.

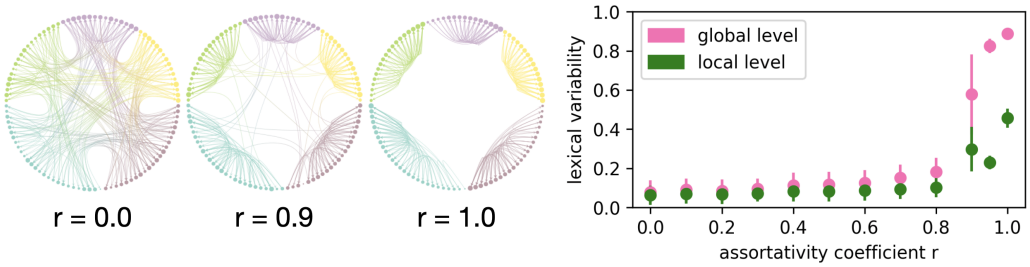

Figure 1. Network visualizations (left) depict interactions (edges) between groups (nodes colored according to group membership) for different values of r. The plot (right) shows the effect of assortative network structure on local and global lexical variability. For high values of r, the degree of variation at the global level is much higher than at the local level.

Social networks tend to high values of r (Newman, 2003), and if we suppose that the interaction between BSL signers living in different regions can be modeled by a strongly assortative network structure, our result may help explain the observed difference between local and global levels. Network structure is likely one suitable candidate in determining the degree of local and global lexical variability in languages, most pronounced for communities consisting of several locally tightly knit groups (where r is high). Finally, with this model, a range of assortative network configurations can be considered, without needing to compare different categorizations of sign languages (Hou & Vos, 2021).

[1]The fixed model parameters are: number of agents = 100, number of groups agents are randomly assigned to = 5, number of concepts = 10, number of bits for the form and culturally salient features = 10, overlap between the culturally salient features and the form = 0.9. The model is run for 2000 time steps. 100 iterations of the run are averaged, shown as mean $\pm$ standard deviation in Fig 1.

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