THE CO-EVOLUTION OF VALUE SYSTEMS AND INSTITUTIONS: A MICRO-SCALE MODEL OF DISSEMINATION OF COMMUNICATIVE VARIANTS

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The idea that different value systems can lead to different distributions of variants in a population affecting cultural diversity has been explored in the past. For example, Axelrod's (1997) model of dissemination of culture was based on the assumption that people are more likely to interact with others who share the same cultural variants, and this in turn tends to increase the number of variants they share. Expanding on Axelrod (1997), researchers have found factors that affect the dynamics of the spread of variants: for example, globalization (Greig, 2002), mass media (Shibanai, Yasuno, & Ishiguro, 2001) and political institutions (Bhavnani, 2003). However, the complex network of interactions between value systems, population biases and institutional reinforcement has received comparatively little attention, in particular, when applied to micro-scale modelling of experimental designs of language evolution. How does the introduction of institutions that are sensitive to individuals' choices affect the maintenance of the diversity of variants (signals that represent one meaning) within the communicative system under enforced global connectivity? We develop an agent-based model to simulate micro-societies where we systematically manipulate:

1. Content bias (β): is a parameter identifying agents' sensitivity towards variants value (s). We examined values from 0 (no sensitivity) to 1 (full sensitivity) in steps of 0.1.

2. Value systems (S): it is a vector of floating-point numbers that correspond, for each agent, to the value (s) assigned to each cultural variant (σ) and indicates to what extent the variant is preferred over the other variants. We examined the evolution of the diversity of variants under two initial conditions of S: One takes all (OTA), where there is one preferred variant with value 1 and the rest with value 0; Pseudo random (PR), where each agent is assigned a value system S so that the value of each variant is a random floating point number N such that $0 \leq \mathrm{N} \leq 1$.

3. Institution (G). It is a vector that consists of the arithmetic mean of individual value systems S in the micro-society. G is weighted by two parameters:

institutional power (ε), that is, the capacity of the institution to effectively communicate its values to the agents (it takes values from 0 (no capacity) to 1 (full capacity) in steps of 0.1); and *conformity bias* (κ), which identifies agent's bias to conform to institutional values (it takes values from 0 (no conformity) to 1 (full conformity) in steps of 0.1.

In the initial state each agent i is randomly assigned a cultural variant σ_i and a value system S_i. At the beginning of each round, agents are paired randomly. Once agents are paired, at each round, they interact by presenting and observing one cultural variant. Within each pair, each agent in turn samples its history to produce a variant according to a probabilistic function that includes the parameters explained above. Then, both agents add both variants to their memories. After each interaction, agents' S, agents' probabilistic function of variant choice and G are updated according to the produced and observed variants, agents' biases, agents' record of variants, and the prior state of S and G.

Our results show that the maintenance of diversity in the communicative system is highly dependent on institutional performance. ε has the quantitative effect of decreasing diversity. However, this positive correlation is non-monotonic across β and κ. We show that institutional power reduces diversity both under OTA and under PR. In general, this effect is amplified by β. In both cases, especially under PR, the effect of institutions is stronger for intermediate values of κ (Figure 1). The latter point is important, for it means that in a context of high diversity of value systems, institutional intervention may cause stronger convergence on shared communicative variants when agents' behaviours are not extreme (not fully biased towards conformity). This is because full conformity with institutions might prevent agents from a faster alignment with their partners in their local interactions, slowing down convergence. Null institutional power is associated with higher diversity of variants. Our model can help to understand how institutions (e.g. prescriptivist vs. non prescriptivist institutions) direct the dynamics of communicative conventions, which might be useful for policy makers.

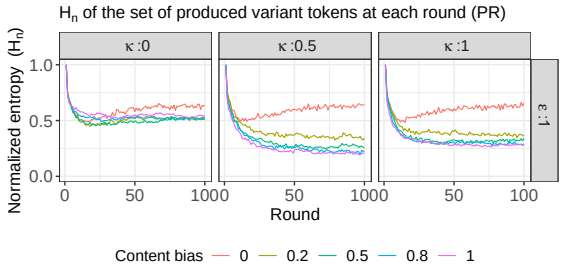

Figure 1. Diversity (measured as Normalized Shannon Entropy) over variants in the population. For each condition we performed 500 runs.

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