Population dynamics affect the evolution of communicative conventions

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Some linguistic conventions in a community spread widely, leading to the gradual extinction of others. Several factors affect the spread of conventions: some relate to the structure of the population (e.g. Lupyan & Dale 2010), while others relate to cognitive biases that affect the individual's likelihood of adopting a given variant (content-, frequency- and model-based biases; Boyd & Richerson 1985). In this study we investigate both population dynamics and cognitive biases.

We ran computer simulations in microsocieties made up of 8 agents. At round 0, each agent produces its own unique signal; in successive rounds, agents switch partners, and each agent may produce their original variant or another variant produced by one of their partners. Because some variants disappear while others spread to multiple agents, the entropy of the variant set always decreases. Our model shows that population structures have a significant impact both on the velocity of entropy decline and on the net variant production of each agent. Furthermore, the effects of population dynamics on signal production generally emerge according to simple rules.

We systematically manipulated:

(a) Initial isolation of subpopulations: we describe 3 possible isolation levels depending on how fast agents could share the same sign system or a variant of the same system.

(b) Content bias: from no bias to strong preference for a variant.

(c) Coordination biases: from full (egocentric) preference for one's own variants to full (allocentric) preference for others' variants.

We found differences between the means of net signal production from one level of isolation to another. We also show that, in high isolation populations, entropy decreases more slowly. Once the agents potentially share the same record, the differences generated by the isolation blocks tend to decrease.

Content bias slightly amplifies the differences between isolation population types. On the other hand, when the coordination bias is allocentric the effects of the population structures tend to increase.

This model reveals how complex interactions between cognitive biases and population dynamics shape the evolution of communicative variants as they spread in a population.

References

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