

## **Skepticism towards skepticism towards computer simulation in evolutionary linguistics**

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The evolution of human language has been a perennially controversial topic of research, with recent criticisms of research into language evolution focusing on a lack of empirical evidence behind the theories. The high-profile authors of Hauser et al. (2014), for instance, argue that "[b]ased on the current state of evidence...the most fundamental questions about the origins and evolution of our linguistic capacity remain as mysterious as ever." This pessimism runs counter to the optimism expressed by many scientists who, while acknowledging the scarcity of evidence, think we have the tools to make progress on this difficult subject matter. In particular, many argue that computer simulations allow us to "compensate for the lacking empirical evidence by utilizing methods from computer science and artificial life" (Lekvam et al. 2014; see also Cangelosi and Parisi 2002).

Skepticism about the ability of computer simulation to add substantively to our knowledge of language evolution is widespread, however. Skeptics point out that the fact that a simulation results in a realistic-seeming outcome does not entail that that simulation recapitulated the actual historical processes yielding that outcome (e.g. Templeton 2007). They argue that it's easy to establish contradictory claims on the basis of simulation (e.g. Roberts 2010), and that simulations are often tailored to support the modeler's prior theory (Martins et al. 2014). More generally, skeptics worry that simulations rely on empirical assumptions unsupported by evidence (Hauser et al. 2014), leading some to conclude that quantitative simulation should play only a reduced role in evolutionary linguistics (Martins et al. 2014).

Responses to this sort of skepticism about simulating the evolution of language have either been vague (e.g. Cangelosi and Parisi 2002) or limited in scope (e.g. the appeal to robustness analysis by Irvine et al. 2013). While acknowledging the skeptic's valuable call for the need to integrate computer modeling with empirical sources of evidence, I develop a more filled out defense of the evidential value of computer simulations to evolutionary linguistics.

I argue that although simulations do not provide evidence on their own, they can extend the inferential reach of weak empirical evidence. Data from comparative biology, archeology, historical linguistics, psycholinguistics, and so on often has weak and unclear applicability to our understanding of the origins and evolution of language. Simulation, I suggest, can aid in confirming or disconfirming hypotheses about language evolution because they draw out the inferential import of this otherwise hard to digest empirical data. This means that simulations play an important evidential role without actually constituting a source of evidence in of themselves.

Drawing on analogous uses of simulations in other areas of biology, I illustrate multiple ways in which they can play this role. First, computer models can connect the dots between observed facts and particular hypotheses. As a number of authors have observed, one reason quantitative models are valuable is that they precisify informal theories. Simulations can thus be used to test theories against evidence whose import for a theory is otherwise unclear. Second, simulations can situate contemporary evidence in otherwise hard-to-test evolutionary settings. Much of the most exciting work in evolutionary linguistics involves experiments with human and animal subjects in tasks involving, for instance, signal learning or cultural transmission. There are legitimate worries, however, about what we can extrapolate from this lab data. Here simulations can help by taking mechanisms observed in the lab, and situating them in more realistic evolutionary settings, which are drawn from the best current theories in quantitative evolutionary biology. Third, as Irvine et al. (2013) have argued, simulations can be used as part of a robustness analysis to draw out plausible actual mechanisms of language evolution.

Given these ways in which simulation can extend the inferential reach of empirical evidence, I conclude that the common forms of skepticism about simulating the evolution of language slightly miss the mark. The issue is not that simulations can't play an important evidential role, but instead that to play that role they must relate to empirical evidence in the right sort of ways. Our energies are thus better directed at improving the relationship between modeling and experimental and observational work, rather than at decrying the use of computer simulation at all.

## References

- Cangelosi A, & Parisi D (2002) Simulating the evolution of language (Vol. 1). London: Springer.
- Hauser MD, Yang C, Berwick RC, Tattersall I, Ryan MJ, Watumull J, Chomsky N and Lewontin RC (2014) The mystery of language evolution. *Front. Psychol.* **5**:401.
- Irvine L, Roberts SG, & Kirby S (2013). A robustness approach to theory building: A case study of language evolution. In the *35th Annual Meeting of the Cognitive Science Society* (CogSci 2013) (pp. 2614-2619).
- Lekvam T, Gambäck B, and Bungam L (2014) Agent-based modeling of language evolution *Proceedings of 5<sup>th</sup> workshop on Cognitive Aspects of Computational Language Learning* 49.
- Martins M, Raju A, & Ravignani A. (2014). Evaluating the role of quantitative modelling in language evolution. *The past, present and future of language evolution research*, 84-93.
- Roberts G (2010) An experimental study of social selection and frequency of interaction in linguistic diversity. *Interaction Studies*, 11(1), 138-159.
- Templeton AR (2007) Genetics and recent human evolution. *Evolution* 61(7) 1507-1519.