



Heriot-Watt University
Research Gateway

The Effects of Generation Turnover and Interlocutor Negotiation on Linguistic Structure

Citation for published version:

Tamariz, M, Cornish, H, Smith, K, Roberts, S & Kirby, S 2012, The Effects of Generation Turnover and Interlocutor Negotiation on Linguistic Structure. in TC Scott-Phillips, M Tamariz, E Cartmill & J Hurford (eds), *The Evolution of Language: Proceedings of the 9th International Conference on the Evolution of Language*. World Scientific Publishing, 9th International Conference on the Evolution of Language, Kyoto, Japan, 13/03/12. https://doi.org/10.1142/9789814401500_0126

Digital Object Identifier (DOI):

[10.1142/9789814401500_0126](https://doi.org/10.1142/9789814401500_0126)

Link:

[Link to publication record in Heriot-Watt Research Portal](#)

Document Version:

Early version, also known as pre-print

Published In:

The Evolution of Language: Proceedings of the 9th International Conference on the Evolution of Language

General rights

Copyright for the publications made accessible via Heriot-Watt Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

Heriot-Watt University has made every reasonable effort to ensure that the content in Heriot-Watt Research Portal complies with UK legislation. If you believe that the public display of this file breaches copyright please contact open.access@hw.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

THE EFFECTS OF GENERATION TURNOVER AND INTERLOCUTOR NEGOTIATION ON LINGUISTIC STRUCTURE

MÓNICA TAMARIZ, HANNAH CORNISH, KENNY SMITH, SEÁN ROBERTS AND SIMON KIRBY

Language Evolution and Computation Research Unit, School of Philosophy, Psychology & Language Sciences, The University of Edinburgh
{monica,hannah,kenny,simon}@ling.ed.ac.uk, S.G.Roberts@sms.ed.ac.uk

Cultural transmission has a key impact on the evolution of linguistic structure (Kirby, Cornish & Smith, 2008). During transmission, new individuals learn the conventions of the language through observation and participation in communicative interactions in context. We present a series of experiments which disentangle the role of *generation turnover*, or new minds coming into the linguistic community (e.g. Kirby et al. 2008) from that of *negotiation* of shared form-meaning conventions during interlocutor interaction (studied in graphical, but not linguistic, systems by e.g. Fay et al. 2007, Galantucci 2005).

In the experimental task, two interlocutors played a communicative cooperative game using an artificial miniature language. Players were trained on a random language, which they then used to ask each other for specific objects; they scored a point for each successful interaction. The language produced by one (randomly selected) participant was then used as training data for the following training-and-usage round. We manipulated generation turnover: in *dyads*, two participants played six training-and-usage rounds; in *chains*, six different participant pairs played one round each. We also manipulated negotiation. In the *negotiation* condition there were two human players; in the *no-negotiation* condition, one of the players was replaced with a simulated computer *agent* who had perfect memory (i.e. it always used the training language without errors, and never offered or adopted suggestions during usage). The training languages in this condition came from the human player.

We examined the effects of generation turnover and negotiation on the *systematic structure* of the resulting languages (measured using the technique described in Kirby et al., 2008) and found a significant effect of both factors. Structure increased over the six rounds in chains, but not in dyads. Looking at chains only, the level of structure at the final round was markedly higher when there was negotiation between two interlocutors than when a single participant

played with the non-responding agent. However, presence/absence of negotiation in dyads had no such effect.

We also examined the effects on *communicative success*, measured as the scores obtained during the communicative task. Dyads, where there was no generation turnover, scored more points, performing at ceiling level in the last few rounds, while chains did significantly worse. Looking at chains only, while negotiating player pairs improved their scores over rounds to approach optimal communicative success, non-negotiating player-agent pairs did not show any improvement.

These results indicate that both generation turnover and negotiation facilitate communicative success and the emergence and evolution of systematic structure. At *generation turnover*, a memory pressure (only so much can be learned during the brief training stage) and an expressivity pressure (to name all objects unambiguously in order to score points) operate. Structured languages are well adapted to both pressures because they are at the same time compressible (minimal amount of information to memorize) and expressive. At each individual *negotiation*, interlocutors need to make decisions (e.g. whether to adopt their interlocutor's suggestions or stick to their own, or what to say or understand when they cannot remember language items). If both interlocutors are under the same pressures for compressibility and expressivity, then the extra pressure of coordination – for finding a common language between interlocutors – may enhance the effects of the pressures for compressibility and expressivity: the decisions during negotiation constitute extra opportunities for competition between linguistic items that may accelerate evolution.

In conclusion, investigating cultural transmission at the level of communicative interactions can give us a richer understanding of the mechanisms underlying the cultural evolution of linguistic structure.

Acknowledgments

The authors acknowledge support from ESRC Grant Award RES-062-231537.

References

- Fay N., Garrod S. & Swoboda N. (2010). The interactive evolution of human communicative systems. *Cognitive Science*, 34: 351-386.
- Galantucci, B. (2005). An experimental study of the emergence of human communication systems. *Cognitive Science*, 29(5): 737-767.
- Kirby, S., Cornish, H., & Smith, K. (2008). Cumulative cultural evolution in the lab: an experimental approach to the origins of structure in human language. *Proceedings of the National Academy of Sciences*, 105(31): 10681–10686.