The Cumulative Evolution Of An Instructional Language

KRISTIAN TYLEN[1], T. MARK ELLISON[2], RICCARDO FUSAROLI[1] & NICOLAS FAY[3]

[1]*Center for Semiotics & the Interacting Minds Centre, Aarhus University*
[2]*Culture, History and Language, Australian National University*
[3]*School of Psychology, University of Western Australia*

Contact email: kristian@dac.au.dk

Not unlike other cultural artifacts and technologies, language can be considered a tool enabling us coordinate activities and share attention and experiences with our peers (Tylén, Weed, Wallentin, Roepstorff, & Frith, 2010). From such perspectives, language evolved (and continuously develop) adaptively from pressures for ever more sophisticated means of coordination (Fusaroli & Tylén, 2012). These processes of adaptive refinement of communication systems have been studied in semiotic experiments; over repeated interactions signs become more accurate and more efficient at picking out their referents (N. Fay, Garrod, Roberts, & Swoboda, 2010; Garrod, Fay, Lee, Oberlander, & MacLeod, 2007). Furthermore, sign optimization is more strongly observed in larger populations where there is more sign variation (Nicolas Fay & Ellison, 2013; N. Fay, Garrod, & Roberts, 2008). Although experimental-semiotic studies often require that participants communicate in a novel modality (e.g., by drawing) to study the evolution of novel communication systems it is assumed that natural language evolves in the same functionally adaptive manner.

The present study uses a simple instruction task to study the cumulative adaptation of natural language across successive generations. Participants were organized into 8-person Interactive or Non-Interactive linear transmission chains (N = 408). Their task was to communicate a route on a map to a partner who tried to reproduce the route on their map. The task was completed in pairs and mediated by a chat-tool interface. Once completed the Instruction-Giver left the experiment, the Instruction-Follower became the Instruction-Giver and a new Instruction-Follower was added. The new Instruction-Giver then communicated a new route to the new Instruction-Follower. This process was repeated until each member of the transmission chain had completed the task. Transmission chains were organized in two conditions, 1) an interactive conditions where instruction-followers were allowed to give feedback and give clarification request etc., and 2) a non-interactive condition where to feedback was possible. Task performance (operationalized as the number of pixels the Instruction-Matcher's route deviated from the Instruction-Giver's route) improved across generations 1-8 in both conditions. Like concrete artifacts such as canoes and stone tools, natural language thus exhibits cumulative cultural adaptation. Furthermore, task performance was higher in the Interactive condition compared to the Non-Interactive condition. That is, beyond iterative learning, social interaction boosts task performance.

References

Fay, N., & Ellison, T. M. (2013). The cultural evolution of human communication systems in different sized populations: usability trumps learnability. *PLoS ONE, 8*(8), e71781.

Fay, N., Garrod, S., & Roberts, L. (2008). The fitness and functionality of culturally evolved communication systems. *Philosophical Transactions of the Royal Society B: Biological Sciences, 363*(1509), 3553-3561.

Fay, N., Garrod, S., Roberts, L., & Swoboda, N. (2010). The interactive evolution of human communication systems. *Cogn Sci, 34*(3), 351-386. doi: 10.1111/j.1551-6709.2009.01090.x

Fusaroli, R., & Tylén, K. (2012). Carving language for social coordination: A dynamical approach. *Interaction studies, 13*(1), 103-124.

Garrod, S., Fay, N., Lee, J., Oberlander, J., & MacLeod, T. (2007). Foundations of representation: where might graphical symbol systems come from? *Cogn Sci, 31*(6), 961-987.

Tylén, K., Weed, E., Wallentin, M., Roepstorff, A., & Frith, C. D. (2010). Language as a tool for interacting minds. *Mind & Language, 25*(1), 3-29.