Agents and Evolution
Ling 496

Robin Clark
Department of Linguistics
319C 3401 Walnut Street
rclark@ling.upenn.edu

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Office Hours: TTh: 9:15am - 10:30am

Course Description: Language is an example of a self-organizing biological system; its patterns emerge from the complex push and pull of a variety of social, psychological, biological and physical forces. In this course we will explore the hypothesis that languages are a population-level biological phenomena that has co-evolved with human culture. We will begin by surveying self-organization and evolution, then turn to the formal analysis of the cultural evolution with particular reference to the evolution of cooperative behavior and complex signaling behavior. After establishing a foundation in physics, biology and linguistics, we will explore a number of case studies. In the course of doing so, we will develop a set of interactive python notebooks that will be made available online.

Our main focus will be gene-culture coevolution: how culture influences our genes and how our genes influence our culture. To this end, we will read some of the primary literature in biology, anthropology and linguistics. Homeworks will involve readings articles and summarizing their argument, perhaps commenting on their methods and results.

Grading: Grades will be based on a project, and homeworks. Projects can either be a paper (up to 15 pages, double-spaced) or a mathematical model or programming project, depending on the approval of the instructor. Projects will be developed in consultation with the instructor. Homeworks will be short written assignments.

Table 1: Course Grading

Project	40%
Homework	60%

Topics and Readings

Self-Organization and social physics

Scott Camazine, Jean-Louis Deneubourg , Nigel R. Franks, James Sneyd, Guy Theraulaz, and Eric Bonabeau. 2001. *Self-Organization in Biological Systems*. Princeton Studies in Complexity. Princeton University Press. (excerpts)

Charles L. Nunn (2011). *The Comparative Approach in Evolutionary Anthropology and Biology*. University of Chicago Press, Chicago, IL.
Chapter 5, "Modeling evolutionary change"

Alex Messoudi (2011). *Cultural Evolution*. The University of Chicago Press. Chicago, IL.
Chapter 2, "Cultural Evolution"

Richard McElreath and Robert Boyd (2007). *Mathematical Models of Social Evolution: A Guide for the Perplexed*. University of Chicago Press, Chicago, IL.
Chapter 1, "The theoretician's laboratory"

An Evolutionary Theory of Language and Culture

Alex Messoudi (2011). *Cultural Evolution*. The University of Chicago Press. Chicago, IL.
Chapter 3, "Cultural Microevolution" Chapter 4, "Cultural Macroevolution I: Archaeology and Anthropology" Chapter 5, "Cultural Macroevolution II: Language and History"

Richard McElreath and Robert Boyd (2007). *Mathematical Models of Social Evolution: A Guide for the Perplexed*. University of Chicago Press, Chicago, IL.
Chapter 3, "Altruism and inclusive fitness"

Charles L. Nunn (2011). *The Comparative Approach in Evolutionary Anthropology and Biology*. University of Chicago Press, Chicago, IL.
Chapter 10, "Human cultural traits and linguistic evolution"

Charles L. Nunn (2011). *The Comparative Approach in Evolutionary Anthropology and Biology*. University of Chicago Press, Chicago, IL.
Chapter 6, "Correlated evolution and testing adaptive hypotheses"
Chapter 7, "Comparative methods to detect correlated evolutionary change"
Chapter 8, "Using trees to study biological and cultural divsersification"

Kevin N. Laland, John Odling-Smee and Sean Myles. 2010. "How culture shaped the human genome: bringing genetics and the human sciences together." *Nature Reviews: Genetics* 11: 137-148.

Melissa A. Ilardo, Ida Moltke, Thorfinn S. Korneliussen, Jade Cheng, Aaron J. Stern, Fernando Racimo, Peter de Barros Damgaard, Martin Sikor, Andaine Seguin-Orlando, Simon Rasmussen, Inge C. L. van den Munckhof, Rob ter Horst, Leo A. B. Joosten, Mihai G. Netea, Suhartini Salingkat, Rasmus Hielsen, and Eske Willerslev. 2018. "Physiological and Genetic Adaptations to Diving in Sea Nomads," *Cell* 173, 569-580.

Pascale Gerbault, Anke Liebert, Yuval Itan, Adam Powell, Mathias Currat, Joachim Burger, Dallas M. Swallow, and Mark G. Thomas. 2011. "Evolution of Lactase Persistence: an example of human niche construction." *Philosophical Transactions of the Royal Society B* 366: 863-877.

Kara C. Hoover, Omer Gokcumen, Zoya Qureshy, Elise Bruguera, Aulaphan Savangsuksa, Matthew Cobb, and Hiroaki Matsunami. 2015. "Global Survey of Variation in a Human Olfactory Receptor Gene Reveals Signatures of Non-Neutral Evolution." *Chemical Senses* 40:481-488.

Nathan Nunn and Leonard Wantchekon. 2011. "The Slave Trade and the Origins of Mistrust in Africa." *American Economic Review* 101:3221-3252.

Chang, Will, Chundra Cathcart, David Hall, and Andrew Garrett. 2015. Ancestry-Constrained Phylogenetic Analysis Supports the Indo-European Steppe Hypothesis. Language 91 (1): 194244. doi:10.1353/lan.2015.0005.

Fitch, W Tecumseh. 2011. Genes, Language, Cognition, and Culture: Towards Productive Inquiry. Human Biology 83 (2). Wayne State University Press: 32329.

Henn, Brenna M, L L Cavalli-Sforza, and Marcus W Feldman. 2012. The Great Human Expansion.. Proceedings of the National Academy of Sciences of the United States of America 109 (44). National Acad Sciences: 1775864. doi:10.1073/pnas.1212380109.

Holden, C J. 2002. Bantu Language Trees Reflect the Spread of Farming Across Sub-Saharan Africa: a Maximum-Parsimony Analysis. Proceedings of the Royal Society of London 269 (1493): 79399. doi:10.1098/rspb.2002.1955.

Nichols, Johanna. 1992. *Linguistic Diversity in Space and Time*. University of Chicago Press. Chicago. (excerpts)

Reesink, G, R Singer, and M Dunn. 2009. Explaining the Linguistic Diversity of Sahul Using Population Models.

Scheinfeldt, L B, S Soi, and S A Tishkoff. 2010. Working Toward a Synthesis of Archaeological, Linguistic, and Genetic Data for Inferring African Population History. Proceedings of the National Academy of Sciences 107 (Supplement 2): 893138. doi:10.1073/pnas.1002563107.

Case Study: Domestication

Lyudmila N. Trut. 1999. "Early Canid Domestication: The Farm-Fox Experiment: Foxes bred for tamability in a 40-year experiment exhibit remarkable transformations that suggest an interplay between behavioral genetics and development." *American Scientist* 87(2): 160-169.

Anna V. Kukekova, Jennifer L. Johnson, Xueyan Xiang, Shaohong Feng, Shiping Liu, Halie M. Rando, Anastasiya V. Kharlamova, Yury Herbeck, Natalya A. Serdyukova, Zijun Xiong, Violetta Beklemischeva, Klaus-Peter Koepfli, Rimma G. Gulevich, Anastasiya V. Vladimirova, Jessica P. Hekma, Polina L. Perelman, Aleksander S. Graphodatsky, Stephen J. OBrien, Xu Wang, Andrew G. Clark, Gregory M. Acland, Lyudmila N. Trut and Guojie Zhang. 2018. "Red fox genome assembly identifies genomic regions associated with tame and aggressive behaviours." *Nature: Ecology & Evolution* `https://doi.org/10.1038/s41559-018-0611-6`.

Brian Hare, Victoria Wobber, and Richard Wrangham (2012). "The self-domestication hypothesis: evolution of bonobo psychology is due to selection against aggression." *Animal Behavior* 83: 573-585.

James Thomas, and Simon Kirby (2018). "Self domestication and the evolution of language." *Biology & Philosophy* 33(9). `https://doi.org/10.1007/s10539-018-9612-8`

Constantina Theofanopoulou, Simone Gastaldon, Thomas ORourke, Bridget D. Samuels, Angela Messner, Pedro Tiago Martins, Francesco Delogu, Saleh Alamri, and Cedric Boeckx. (2017). "Self-domestication in Homo sapiens: Insights from comparative genomics". PLoS One. `https://doi.org/10.1371/journal.pone.0185306`

Antonio Benitez-Burraco, and Vera Kempe. (2018) . "The Emergence of Modern Languages: Has Human Self-Domestication Optimized Language Transmission?". *Frontiers in Pyschology*. `https://doi.org/10.3389/fpsyg.2018.00551`

Amy Niego, and Antonio Benitez-Burraco (2018). "Williams syndrome, human self-domestication, and language evolution." ms.