From a linguistic framework to a cognitive architecture: The case of Optimality Theory (seminar)

A.k.a.: *Optimality Theory and Cognitive Science*, Yale University, spring 2014
(Preliminary) syllabus for LING 228.01 / 628.01 (S14).

Details

Meeting:	Wednesday 2.30–4.20, 370 Temple Street (DOW), room 112
Instructor:	Tamás Biró
Email:	tamas.biro@yale.edu (backup: birot@birot.hu)
Office:	370 Temple Street, room 302
Office hours:	Thursdays, 5.30–6.00, or by appointment
Websites:	Classes*v2, and backup: http://www.birot.hu/courses/2014-OT/

Description

While linguistics has been a key field in the cognitive enterprise for fifty years, linguistic theories have followed their own course independent from the rest of the cognitive sciences. Is it possible to genuinely combine the century-long scholarly traditions in linguistics with the mind-as-a-computer metaphor? This seminar invites linguists, cognitive scientists and anyone interested in the human mind to tackle this question by focusing on Optimality Theory (OT, Prince and Smolensky 1993/2004), but without expecting previous familiarity with this linguistic framework. Depending on the participants background, we shall cover philosophical, mathematical and computational aspects, discuss OT's relation to similar cognitive models, and analyze less known applications of OT in syntax, semantics and anthropology.

Optimality Theory (OT, Prince and Smolensky 1993, aka 2004) is best known as a phonological framework. It has, however, also been applied to syntax, semantics and pragmatics, as well as to non-linguistic domains, such as anthropology and religious studies. The goal of this seminar is to assess the place of Optimality Theory within cognitive sciences at large: Can OT be approached as a general model of human (higher) cognition? How does it relate to other cognitive frameworks, such as Rational Choice Theory? Which details are specific to phonology, and which details can be generalized to other domains, even beyond linguistics? How to turn an overly complicated description of simple facts into a deeper model with explanatory power? How does Optimality Theory (in the narrow sense) relate to its variants, such as Harmonic Grammar and Maximum Entropy models? Can we implement and learn OT in an efficient way, and/or in a cognitively plausible way?

The seminar shall focus on three aspects:

(1) <u>Philosophical aspects</u>: OT as a scientific model; OT as a model of the human mind/brain.
(2) <u>Computational aspects</u>: mathematical basis; symbolic and connectionist implementations; finite-state OT, simulated annealing, genetic algorithms; learnability and evolutionary models.
(3) <u>Broadening the scope</u>: OT beyond phonology (syntax, semantics); OT beyond linguistics: do the models qualify as scientific explanations? Optimization-based frameworks in other disciplines.

Additionally, students will have the opportunity to get familiarized with various pieces of software implementing Optimality Theory. Students with programming skills will be encouraged to develop their own implementations of various algorithms and present the results of their experiments.

The exact list of reading and topics to be discussed will be determined together with the students enrolling in this seminar, taking their background and interests into account.

Requirements

Class participation (15%): Students are expected to actively participate in the discussions based on the articles and chapters assigned.

Written responses (45%): Students will have to submit three written responses during the semester, each worth 15% of the final grade, responding questions related to the articles read before and discussed during classes. The expected page length of each written response is 3-4 pages.

Term paper (40%): Students will write a term paper (12-15 pages) on any topic related to the seminar, which will be due on April 30**.** A 1-2 page prospectus will be due on March 10, while an early version of the paper will be discussed in the last two weeks of classes. I encourage everyone to talk to me about possible topics as early as possible.

Academic honesty

Yale does not tolerate plagiarism, and Yale policy will be fully enforced. For more information, refer to *http://yalecollege.yale.edu/content/cheating-plagiarism-and-documentation*. Useful resources on citing include *http://writing.yalecollege.yale.edu/using-sources* and *http://writing.yalecollege.yale.edu/advice-students*. Please feel free to consult the lecturer in case of doubts.

Preliminary bibliography

Philosophical background:
Niko Tinbergen (1963). On Aims and Methods of Ethology. *Zeitschrift für Tierpsychologie*, 20(4): 410-433.
David Marr (1982). *Vision: A Computational Approach*. Freeman: San Francisco.
Fresco, Nir (2012). The explanatory role of computation in cognitive science. *Minds and Machines* 22(4): 353-380.

Philosophical foundations of Optimality Theory; connectionist implementations, OT syntax:
Paul Smolensky and Geraldine Legendre (ed., 2006). *The Harmonic Mind: From Neural Computation to Optimality-Theoretic Grammar.* MIT Press: Cambridge, MA. [selected chapters]

Mathematical background of Optimality Theory:
Bíró, T. (2006). *Finding the right words*. PhD dissertation, University of Groningen. Chapter 3.
Biró, T. (2013). Towards a Robuster Interpretive Parsing: Learning from overt forms in Optimality Theory. *Journal of Logic, Language and Information*, 22 (2): 139–172.

OT and cognitive architectures:
Misker, J. M., & Anderson, J. R. (2003). Combining Optimality Theory and a cognitive architecture. In F. Detje et al. (Ed.), Proc. 5th International Conference on Cognitive Modeling (Vol. 5, p. 171-176). Universitaets-Verlag Bamberg.
Rij, J. van, Rijn, H. van, & Hendriks, P. (2010). Cognitive architectures and language comprehension. *Journal of Child Language*, 37(3), 731–766.

Finite-state implementations of OT (and possibly further papers):

Frank, Robert and Giorgio Satta (1998). Optimality Theory and the Generative Complexity of Constraint Violability. *Computational Linguistics*, 24(2): 307-315.

Karttunen, Lauri (1998). The Proper Treatment of Optimality Theory in Computational Phonology: *Finite-state Methods in Natural Language Processing*, Ankara, pp. 1-12.

Gerdemann, Dale and Gertjan van Noord (2000). Approximation and Exactness in Finite State Optimality Theory- In: Jason Eisner, Lauri Karttunen and Alain Thériault, SIGPHON 2000, Finite State Phonology.

Jäger, Gerhard (2003). Recursion by optimization: On the complexity of bidirectional Optimality Theory. Natural Language Engineering 9(1): 21-38.

Heuristic implementations of OT:

Bíró, T. (2006). *Finding the right words*. PhD dissertation, U of Groningen [selected chapters].

Pulleyblank, Douglas and William J. Turkel (2000). Learning Phonology: Genetic Algorithms and Yoruba Tongue-Root Harmony. In: Joost Dekkers, and Frank van der Leeuw and Jeroen van De Weijer (eds.) *Optimality Theory: Phonology, Syntax, and Acquisition*. Oxford University Press: Oxford, 554-591.

Learnability of OT (and possibly further papers):

Tesar, Bruce (2007). Learnability. In: Paul de Lacy (ed.). *The Cambridge Handbook of Phonology*, 555-574. New York City: Cambridge University Press.

Tesar, Bruce and Paul Smolensky (1998). Learnability in Optimality Theory, *Linguistic Inquiry*. 29(2), MIT Press: Cambridge, MA, pp. 229-268.

Tesar, Bruce and Paul Smolensky (2000). *Learnability in Optimality Theory*. MIT Press: Cambridge, MA - London, England.

Boersma, Paul and Bruce Hayes (2001). Empirical tests of the Gradual Learning Algorithm. *Linguistic Inquiry*, 32:45-86.

Magri, Giorgio (2012). Convergence of error-driven ranking algorithms. *Phonology* 29: 213-269.

OT beyond linguistics, OT and anthropology:

Biró, T. (2010). Will Optimality Theory colonize all of higher cognition?. Commentary on Doug Jones: 'Human kinship, from conceptual structure to grammar'. *Behavioral and Brain Sciences (BBS)*, 33(5): 383-384.

Biró, T. (2014). A Biological/Computational Approach to Culture(s) is Cognitive Science. Commentary on the debate 'Does Cognitive Science Need Anthropology?' *TopiCS in Cognitive Science* 6:1.

Parker, S., & Parker, M. (2004). Optimality Theory and ethical decision making. *Work Papers SIL*. Available from http://www.und.edu/dept/linguistics/wp/2004ParkerParker.PDF.

Jones, D. (2003). The generative psychology of kinship. Part 2. Generating variation from universal building blocks with OT. *Evolution and Human Behavior*, 24, 320-350

Jones, D.: 'Human kinship, from conceptual structure to grammar'. *Behavioral and Brain Sciences (BBS)*, 33(5) 367-416.

Biró, T. (2011). Optimal religion: OT accounts for ritual dynamics. In I. Czachesz & T. Biró (Eds.), *Changing Minds: Religion and cognition through the ages*. Peeters.