Optimality Theory as a general cognitive architecture

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**Optimality Theory and cognitive science**

It was exactly 25 years ago that Paul Smolensky introduced *Harmony Theory* (Smolensky, 1986), a framework that would pursue an exciting, but certainly not straight path through linguistics (namely, *Optimality Theory*) and other cognitive domains. The goal of this workshop is not so much to look back to this path, but rather to discuss its potential continuation(s).

Soon after its publication, *Optimality Theory* (OT) (Prince & Smolensky, 1993/2004) became one of the most successful frameworks for linguistic research. The number of publications submitted to the [Rutgers Optimality Archive](http://roa.rutgers.edu) exceeded one thousand in November 2008, with a large number of OT-related publications never added to ROA. The older sister of OT, *Harmony Grammar* (HG) (Smolensky, 1986) has also been the object of a recent raise in interest, especially since the publication of *The Harmonic Mind* (Smolensky & Legendre, 2006). Their key idea is that the linguistic mapping between form and meaning, or between underlying form and surface form, is realized by optimizing an abstract function: a real-valued one in HG, and a vector-valued one in OT.

By developing the [Integrated Connectionist/Symbolic (ICS) Cognitive Architecture](#), Smolensky and his colleagues worked out the connection between linguistics and a general theory of the mind/brain in a hardly precedent manner. Their approach is probably significantly closer to mainstream computational cognitive science than much of contemporary theoretical linguistics. General-purpose cognitive architectures (ACT-R) have also been combined with OT (Misker & Anderson, 2003; Rij, Rijn, & Hendriks, 2010). Learnability is addressed by, among others, Tesar, Boersma and Magri.

The authors of the *The Harmonic Mind* alluded to the possibility that ICS—that is, Optimality Theory and Harmony Grammar—may prove a useful and adequate model of much of (higher) cognition, including domains beyond language. Simultaneously, and probably independently of their remark, simply as a consequence of OT’s success in linguistics, a number of scholars have advanced Optimality Theoretic models for non-linguistic phenomena. The authors of these isolated attempts usually even did not know of each other.

Constraints applied to traffic rules (Boersma, 1998, 2003) and to a Talmudic dilemma (Dresher, 1996) aim only at illustrating the OT formalism. Parker and Parker (2004) present an analysis of ethical *decision making* in a religious context, which is clearly a first step toward an OT-style account of a non-linguistic cognitive function, despite potential criticism related to the cognitive grounding of their constraints. Although not elaborating on the connection with Optimality Theory, the “take the best” heuristics of the [ABC Research Group](#) can also be seen as an OT/HG-style approach to higher cognition (Gigerenzer, Todd, & the ABC Research Group, 1999). (Compare the *lexicographic decision rule* of Coenen and Marewski (2009) to strict domination in OT; see the discussions about the relation between OT and the ABC Research Group’s heuristics by Smolensky and Legendre (2006, vol. 1, p. 41-42) and Biró (2006, p. 225f).)

Even more explicit is the wish to view OT as a general cognitive framework for (higher) cognition in the work of Douglas Jones on kinship terminology, as well as of Tamás Biró on religious rituals. Jones (2003, 2010) developed an Optimality Theoretic model for one of the classic topics in cultural anthropology, the cross-cultural typology of kinship systems. Beside the connection to cognition in general, he also embedded his analysis in an evolutionary psychological account. His most recent article in BBS generated a vivid discussion on the applicability of OT beyond linguistics among the authors of the numerous peer-reviews. Biró (in press) has employed Optimality Theory to account for food taboos and the dynamics of different types of rituals. By the latter, he attempted computationally to underpin current theories in the cognitive science of religion.

**Goals of the workshop**

Our goals are twofold: first, to offer a meeting point to those applying OT (or HG) to non-linguistic domains, to increase the visibility of such attempts and to promote future efforts in this direction; and second, together with linguistic OT’ers, to discuss the place of OT, HG and ICS within the cognitive sciences. Collocating the workshop with CogSci offers the possibility to non-OT’ers to join the discussion, and for OT’ers to get feedback and constructive criticism from external eyes.

By developing OT/HG-style analyses for a growing number of phenomena from various domains of (higher) cogni-
tion, we obtain descriptions of many functions of the human mind within a uniform paradigm, employing a shared language and shared standards. We also may get closer to understanding how these domains are processed in the human brain, by translating symbols to connections using either Smolensky’s ICS, or future alternatives to it.

We see a distinction between OT/HG-style models, on the one hand, and utility function-based models, on the other. A huge body of literature describe phenomena by optimizing a utility-like function external to the brain (for instance, energy needed to move one’s arm during action planning), or even external to the human (for instance, monetary gain/loss). Unlike these approaches, an OT/HG-style model optimizes an abstract target function, a theoretical construct (which may or may not correspond to energy level of the network in the brain). A workshop at CogSci is a unique opportunity for those involved in the two research lines running in parallel to engage in a cross-fertilizing discourse.

We seek papers describing new results and addressing, primarily, though not exclusively, the following issues:

- Optimality Theory and Harmony Grammar as general frameworks of (higher) cognition.
- OT/HG-style analyses of phenomena belonging to (primarily, non-linguistic) domains that have not yet employed OT.
- The connection of linguistic OT/HG to the study of other (higher) cognitive functions.
- OT vs. HG, from theoretical-mathematical and cognitive-neuroscientific perspectives.
- OT/HG-style formalisms vs. utility function-based approaches from a mathematical-computational perspective; their place in explaining the brain/mind.
- Relating connectionist and symbolic approaches: the ICS Architecture and its eventual alternatives.
- Ontogenetic aspects of OT/HG approaches (learnability).
- Phylogenetic aspects of OT/HG approaches (including historical change, evolutionary models, etc.).

**Format of the full-day workshop**

The full-day workshop will consist of talks (and eventually of a poster session), with ample time for discussion. Abstracts will have been solicited from researchers known to be interested in OT, and readers of emailing lists in linguistics and the cognitive sciences. We aim at publishing (a selection of) the papers as a volume or special issue following the conference.

Paul Smolensky has accepted our invitation to feature as keynote speaker. The following people have expressed their interest in participation: Petra Hendriks (Groningen U.), Lotte Hogeweg (RU Nijmegen), Giorgio Magri (Institut Jean Nicod, Paris), and Paul Miers (Towson U.).

The likely audience include those working on linguistics and higher cognition, and on mathematical-computational models thereof. Estimated number of participants: 20-30.

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**Organizers of the Workshop**

Tamás Biró is currently a postdoc at the Amsterdam Center for Language and Communication, working on the Simulated Annealing for Optimality Theory Algorithm (Biró, 2006). Judit Gervain is a CNRS researcher at the Laboratoire Psychologie de la Perception in Paris, working on neurolinguistic aspects of syntax and its early acquisition. The two organizers have previous experience in organizing workshops together.

**References**


