Will Optimality Theory colonize all of higher cognition?

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Abstract: To establish Optimality Theory as a framework in anthropology, or as a general model of higher human cognition, researchers have to demonstrate OT is convincing in a number of ways. This commentary summarizes some of them – based on experience obtained in contemporary linguistic OT – including factorial typologies, exact formulation of candidate sets and constraints, and computational plausibility.

By concluding that "[g]rammar could grow opportunistically, colonizing any 'grammar-friendly' cognitive or perceptual domain," Jones envisages a fruitful future to OT-based approaches to culture. I certainly have shared his optimism, since I presented an attempt to apply Optimality Theory to religious rituals elsewhere (Biró, in press).

However, for this "colonizing enterprise" to be fruitful, one must establish its goal and match the strategy. OT can "conquer" anthropology and cultural studies in three different – even if not necessarily mutually exclusive – ways. Either, OT is used as a pure technique; or, an OT-based linguistic model is enlarged to also encompass cultural phenomena; or, OT becomes a general model of the underlying brain mechanisms shared by language and other realms of (higher) cognition.

In what follows, I review these three "colonizing" directions, discussing which strategies potential "conquerors" ought to follow, what pitfalls they must avoid.

1. Optimality Theory as a technique. To most linguists, OT is a model accounting for observed typologies. For an oversimplified example, imagine that the languages of the world belong to three types: some always stress the first syllable of the word, other languages stress the last one, and other again stress the penultimate syllable; none of them put the stress on the second syllable as a rule. This observation-based typology can be explained using three constraints: 1. prefer early stress; 2. prefer late stress; 3. penalize word-final stress. The six permutations of these three primitive constraints will reproduce exactly the three language types, and importantly, this model also correctly predicts the lack of the fourth type. (For a longer explanation, see Biró, in press; or Biró 2006, sect. 1.1.)

Similarly, if anthropologists decide to borrow OT as a technique to account for kinship terminologies, they should first list all attested types; then propose constraints; and finally demonstrate that all attested types correspond to some constraint permutation, but no permutation corresponds to an unattested type. Ideally, the number of types in the exhaustive typology is relatively low, and the number of documented cultures is large enough for the difference between attested and unattested types to be statistically significant. For the model to be convincing, a few primitive constraints must explain a larger number of complex types. Only by keeping this in mind can scholars of culture avoid the quick-rise-quick-fall story so typical of many theories borrowing a method from a different discipline.

As the number of constraints grows, the number of their permutations grows factorially. Yet, software tools (among many others, OTKit by Biró, available at: http://www.birot.hu/OTKit/) help exploring such *factorial typologies*. These tools force the linguist to be very concrete: the candidate set and the constraints must be explicitly defined. Unfortunately, these two basic building blocks of OT are only implicit in too many papers, including Jones'. It is even unclear to me whether he optimizes kinship terms or kinship term systems.

2. Optimality Theory as a tool to include culture into language. The history of anthropology in the twentieth century will probably discourage many cognitive scholars of culture from adopting yet another linguistic theory. Therefore, those choosing this second, "colonizing" direction, such as Jones, must make clear how the relation between "language," "thinking," and "culture" is expressed in the proposed model.

Within the OT camp, this approach corresponds to including nonlinguistic constraints into the linguistic computations, similarly to Jones, who adds vocabulary constraints based on anthropological research. However, for a linguist, the lexicon of the language is learnt and arbitrary, and it is unclear how one would apply constraints *on* the lexicon. When an adult speaker produces a sound stream for the meaning 'mother's older sibling's son,' the candidates are words in the language with already fixed meanings. True, certain logic transpires the system of kinship terminology, unlike other terminologies; and yet, do we have evidence for the distinction between a *mother* and an *aunt*, between a *noyeh* and an *ahgahuc*, being processed differently from the distinction between a *table* and a *chair*, or between a *dog* and a *monkey*? A possible research direction for this approach would be to demonstrate: a child learning the relative importance of "matrikin distinction" over "distance distinction" in the target language suddenly improves her performance even on previously unheard kinship terms, but no such effect is discernible with the relative importance of "four-leggedness" over "surface color" in other domains.

3. Optimality Theory as a shared underlying mechanism. Smolensky and Legendre (2006) demonstrate how OT can describe linguistic phenomena in a way that is not only descriptively adequate, but also computable, learnable, and most importantly, which can be implemented in a neurologically plausible network. Convinced that OT and OT-like approaches (such as Harmonic Grammar) have the potential to become a framework for research on higher cognition in general, and not only in linguistics in particular, Biró (in press) presents a model for religious rituals. Jones (2004) argued earlier for the same OT mechanism lying behind social and linguistic cognitions, and kinship constraints being neither linguistic constraints, nor technical analogues: similarly to linguistic constraints, they exemplify the general building blocks of human cognition.

This third research strategy entails that we argue for more and more cognitive domains to share OT as a formalism describing their underlying mechanism. Moreover, the interest shifts from plainly reproducing observed facts in higher cognition (language, kinship terminology, religious rituals, mathematics, arts, etc.) to other aspects of the underlying mental mechanism. For instance, to issues such as the time and memory needed to find the best candidate using psychologically realistic algorithms, or the error rate of these algorithms. It may turn out, for instance, that Harmonic Grammar is more plausible as a model than Optimality Theory, because the weights are easier to implement with (artificial or real) neurons (Smolensky & Legendre 2006), and its implementation is also less prone to error (Biró 2009).

Anthropologists adopting OT must be aware that they are aiming at a moving target: The supposedly universal theory of language currently varies from linguist to linguist. Nevertheless, I am confident

that anthropologists can contribute to establishing together a solid, OT-based model of general human (higher) cognition.