The locus of variation in weighted constraint grammars

Most approaches to variation within the framework of Optimality Theory (Prince & Smolensky 1993/2004, McCarthy & Prince 1995) have adopted the hypothesis that variation is a consequence of differences in the ranking of constraints between iterations of E\(\text{VAL}\) (e.g., Anttila 1997, 2002, Boersma 1998, Boersma & Hayes 2001). Within a theory of weighted rather than ranked constraints, however, a greater range of possibilities exists. In this paper I consider two approaches to variation in weighted constraint systems: a version of Harmonic Grammar (Legendre, Miyata & Smolensky 1990, Smolensky & Legendre 2006) with constraint values normally distributed around a mean as proposed for ranking systems by Boersma (1998) and Boersma & Hayes (2001) and as implemented for Harmonic Grammar in Praat (Boersma & Weenink 2007), and Maximum Entropy Optimality Theory (Goldwater & Johnson 2003, Jäger to appear). I argue that Noisy Harmonic Grammar is more restrictive and typologically valid and therefore is to be preferred as a model of variation among weighted constraint systems.

Both Noisy Harmonic Grammar (Noisy HG) and Maximum Entropy OT (MaxEnt/OT) systems assign constraints numerical values and, unlike ranking models, allow additive interaction. Despite these similarities, the locus of variation in the two types of weighted constraint grammar differs crucially. In Noisy HG, each candidate’s harmony value is determined by simply summing the weight of its constraint violations. The total scores of the candidates are then compared and the candidate with the lowest harmony value is selected as the winner. Variation is implemented as in stochastic OT by perturbing the values of the constraints with noise. The choice of constraint values is probabilistic, with each iteration of E\(\text{VAL}\) yielding a single optimum. MaxEnt/OT is similar to Noisy HG in summing the weights of the constraints violated by each candidate. However, in MaxEnt/OT these sums are then converted into a probability distribution over the candidate set. This distribution is sampled in production (Goldwater & Johnson 2003), yielding variation with a single set of constraint values.

This difference in the locus of variation has important typological consequences. As I show, MaxEnt/OT provides a relatively unconstrained theory of variation where candidates that are never optimal in a categorical system can emerge with some probability. This is illustrated in (1) where a MaxEnt/OT syllable structure grammar generated using Praat v.4.5.24 is summarized. Three constraints are used: NO\text{CODA}, *\text{COMPLEXONSET} and FAITH. Because all candidates receive some probability in a MaxEnt system, even harmonically-bounded candidates occur here with considerable frequency (e.g., /CV/ maps to [CVC] at a rate of 14.3%). Inputs where the faithful candidate incurs a relatively high number of markedness violations are particularly subject to variation, as can be seen with the input /CCVC/ which violates *\text{COMPLEXONSET} and NO\text{CODA}, and is mapped faithfully only 40.8% of the time. More complex systems show further effects, including instances of “over-repair” where the least marked output (e.g., [CV]) is preferred despite the existence of more faithful competitors that are favoured elsewhere in the grammar. Noisy HG models using only positive constraint weights (e.g., Pater, Potts & Bhatt 2006) are unable to generate these types of perverse grammars due to the basic trading relations between constraint violations and the requirement that each output be generated by a discrete iteration of E\(\text{VAL}\). No weighting of the constraints can ever produce a harmonically-bounded optimum in HG (Prince 2002). While both Noisy HG and MaxEnt/OT can model the types of variation accounted for with ranking approaches, then, MaxEnt/OT systems also generate grammars of dubious status. These typological implications are further explored in the paper and comparisons are drawn to related ranking approaches.
(1) Possible variation in a MaxEnt/OT system

<table>
<thead>
<tr>
<th>Rule</th>
<th>CV → CV</th>
<th>CV → CVC</th>
<th>CV → CCV</th>
<th>CV → CCVC</th>
<th>CCV → CV</th>
<th>CCV → CVC</th>
<th>CCV → CCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>82.064%</td>
<td>14.337%</td>
<td>3.080%</td>
<td>0.519%</td>
<td>42.719%</td>
<td>7.524%</td>
<td>42.493%</td>
</tr>
</tbody>
</table>

References:


Pater, Joe, Chris Potts and Rajesh Bhatt. 2006. Harmonic grammar with linear programming. Ms., University of Massachusetts Amherst. [ROA-872].

