Sub-symbolism and Phonology

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The aim of this presentation is to show how computational linguistics has influenced recent renewal in grammar-based phonology. Far from the strictly implementational or eliminativist models, Smolensky [1999, 2009] proposes another vision of the relation between computational and grammar-based phonology: the purpose is to share the knowledge built from both domains and to converge toward a sub-symbolic model which establishes the link between "neural substrate" and symbolic computation.

The idea has already been developed, in a similar way, in the work of Larson G. [1992], Goldsmith J. & Larson G. [1992] in their treatment of the Sonority Sequencing Generalization. Dell & Elmedlaoui’s [1985] serial treatment of Imdlawn Tachelhit which is based on inherent sonority, as in Clements [2009], represents the static view of sonority which has been challenged by a dynamic view where sonority hierarchy and syllables emerges from the interactions of segments in a neural network (see [fig. 1] for the activation law of the network, and examples in Tachelhit [fig 2, 3] and English [fig. 4, 5]). We can consider that this treatment in turns gave rise to Goldsmith [1993] which seems deeply rooted in both autosegmental phonology and the advances in connexionnism.

Recent phonological researches [Brandão de Carvalho : 2005, 2008] seem to take a step further in the direction of mutual information. We can consider, following Klein [1993], that subsymbolic models can feed symbolic approaches. In a metaphorical way, cells in a linear network can be considered as squeletal positions, i.e. timing slots, and relations of excitation and inhibition between cells, for they are relations between positions, may be considered as contours. In the following examples in french, proximal and distant relationships, the contours, between C-positions and V-positions control the expression of laryngeal features. Hence consonants (de)voicing is not part of contoids representation but is derived form nuclei activation.

French schwa loss can be seen as an effect of PG (Proper Government) which inhibits the expression of schwas provoking voicing or devoicing of obstruents. As a consequence if we consider C/V segregation, we must establish, in the activation law, a third relation which intervenes between N+ positions, depending on their strength/transition weight, where cell k_n influences cell k_{n-2} on the N+ tier.
fig. 1

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\begin{align*}
\alpha & \quad \alpha & \quad \alpha & \quad \alpha & \quad \ldots & \quad \alpha \\
K_1 & \quad K_2 & \quad K_3 & \quad K_4 & \quad \ldots & \quad K_n \\
\beta & \quad \beta & \quad \beta & \quad \beta
\end{align*}
\]


