On the basis of sonority restrictions

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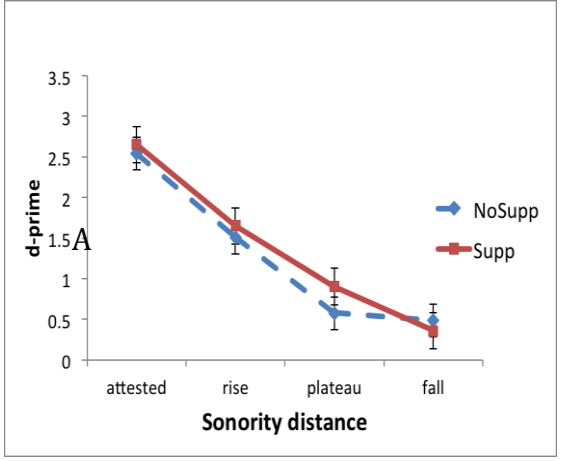
Sonority is frequently used to capture the restrictions on syllable structure. It's precise nature, however, is controversial (Parker, 2012). Central to the sonority controversy are two key questions. First, what is sonority—is it an attribute of the phonological grammar or only of the phonetic system? Second, what are the scope of sonority restrictions—are they only induced from linguistic experience, or are some sonority restrictions universal?

This talk evaluates these questions in light of an ongoing research program using behavioral and brain responses from several populations (adults and infants). To examine the articulatory phonetic basis of sonority restrictions, I present findings from recent experiments that evaluate the role of subvvocal motor activity in sonority-related preferences. Research on embodied cognition asserts that speech perception requires motor action—the perception of labial sounds, for instance, triggers articulatory motor activity in the lip motor area of the brain, whereas coronal sounds trigger the tongue motor area (e.g., D'Ausilio et al., 2009; Pulvermüller et al., 2006). These observations open up the possibility that the sonority hierarchy is directly based on tacit motor action. Specifically, when presented with a syllable (e.g., *lbif*), listeners might engage in a tacit motor simulation of its articulation. Sonority-related preferences, in this view, reflect not abstract grammatical restrictions, but rather the difficulty of motor simulation.

To test this proposal, we examined whether English speakers maintain their sensitivity to the syllable hierarchy in perception (e.g., *blif* ≻*bnif* ≻*bdif* ≻*lbif*) while their articulatory activity is suppressed, either mechanically (by having them bite on tongue depressors) or by disrupting the lip motor area using Trascranial Magnetic Stimulation (TMS). Both sets of experiments used the syllable count task (e.g., does *lbif* have one syllable or two?). In line with the embodied motor account, disruption of articulatory motor activity impaired speech perception (i.e., the discrimination between one syllables and two, e.g., *blif* vs. *belif*). However, sensitivity to the syllable hierarchy was observed in all cases, irrespective of articulatory suppression (see Figure 1).

Further challenge to the articulatory motor account is presented by another set of studies that traces the developmental origins of the sonority hierarchy close to birth. These studies used Near Infrared Spectroscopy to determine whether neonates (1-3 days old) are sensitive to syllable structure. Results (see Figure 2) showed that ill-formed syllables (e.g., *lbif*) elicit stronger hemodynamic brain activity compared to better-formed syllables (e.g., *bdif* or *bdif*). These findings suggest that some precursors of the sonority hierarchy are present at birth, despite having only minimal linguistic experience and articulatory activity.

Taken as a whole, these results are consistent with the possibility that sonority forms part of a phonological system that is both abstract and putatively universal, yet, intimately grounded in the phonetic system. I suggest that the capacity to use algebraic means to optimize phonetic pressures is an adaptive design feature of the phonological mind (Berent, 2013).



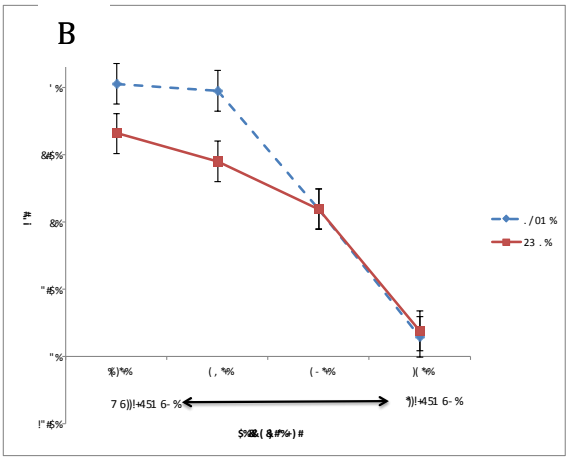
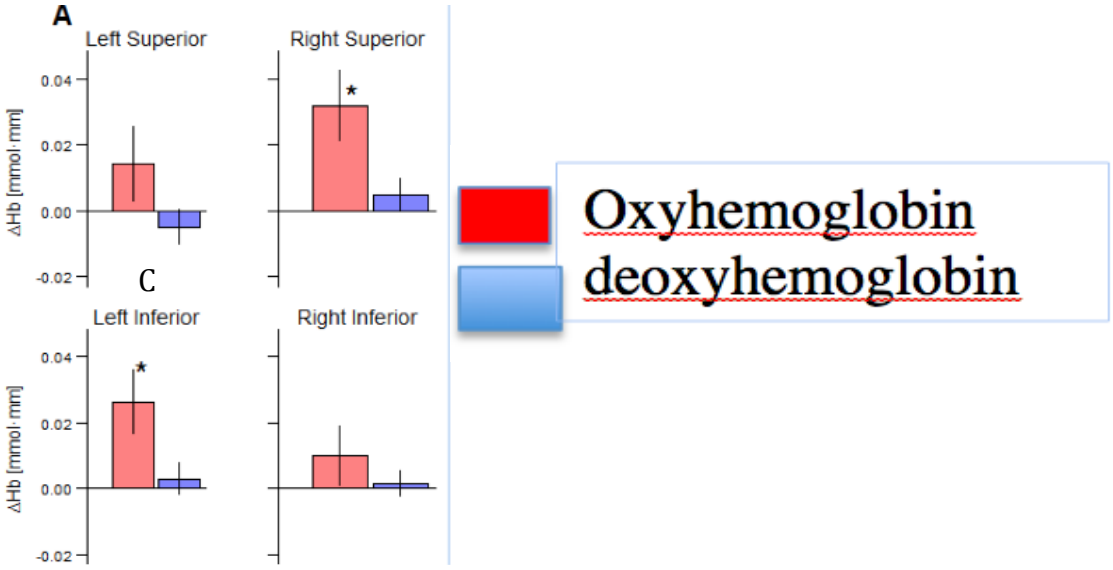


Figure 1. The effect of mechanical articulatory suppression (a) and TMS (b) on the sonority hierarchy. The dependent measure (d') is a measure of sensitivity to the distinction between one syllable and two (high d' indicates better discrimination). Panel B is from (Berent et al., 2015).



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