Phonetics and the explanatory depth of phonological descriptions[1]

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My main goal in this talk is to draw attention to a significant general problem for phonetic explanations in phonology and hopefully stimulate debate about it.

I begin with some data on the typological patterning of vowels. A strong preference for sonority (open-close) over chromaticity (front-back) contrasts is found - a trend that shows up in historical vowel shifts, preferred nucleus-glide combinations in diphthongs, tense-lax oppositions and vowel inventories (Labov 1994, Schaeffler 2002, Diehl & Lindblom 2004).

From an acoustic point of view this is a rather curious asymmetry. How do we account for it? A plausible hypothesis is that it is linked to a universal constraint imposed by our hearing mechanism. It is well known that the perception of speech and other signals is remarkably robust in noise. Investigators attribute this ability to a spatio-temporal mechanism that distributes information about strong spectral components across a broad frequency range (Greenberg 1988). Accordingly, information on formants is carried, not only by channels with characteristic frequencies near the formant, but also by adjacent channels. There is no explicit 'formant tracking' but spectral peaks are nevertheless given special emphasis (Sachs et al 1982, Delgutte & Kiang 1984). When vowels are represented in this auditory space, a warping is seen that closely matches the above-mentioned typological patterns: The open-close dimension is enhanced relative to the front-back dimension (Diehl et al 2003).

This account at first appears encouraging. It is formalized, quantitative and anchored in facts independent of the phonological data to be explained. However, on closer examination, it raises questions as to the next step: How does one go about incorporating this type of "explanation" into phonological theory? Behavioral constraints on phonological structure (e.g., articulatory and perceptual factors) are most readily specified *numerically* and along *continuous* dimensions whereas phonological formalisms use *discrete* symbols. How do we address this issue?

As we ponder that question let us consider the following two approaches. The first is that of the orthodox formalist to whom '*phonology is not natural*'. According to this school of thought linguists should primarily be interested in what *cannot* be explained in terms of performance factors - that is, in those aspects that represent structures unique to *Language per se* (Anderson 1981). The second approach includes a broad spectrum of current paradigms. It *does* acknowledge the relevance of phonetic explanations, it accepts the phonetics-phonology split and treats the two disciplines as permanently "divorced", but happily so and on speaking terms (Peter Ladefoged's metaphor). In this case, phonetics is indeed used to account for phonological data but, while phonetic evidence

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and modeling are admittedly used to guide and elucidate the formal description, they do not, strictly speaking, form part of the formal machinery of the main theory.

Consequently, the first approach dismisses the compatibility issue. The second reflects it in its dual parallel organization but does not resolve it.

Could, and should, that issue be resolved? If so, how would it be done? Would resolutions entail more profound accounts of sound structure? To initiate discussion of those and other issues we turn to articulatory factors and motor control for our second and final exercise in 'phonetic explanation'. At stake here is the explanation of, not only the 'phonetic content' of phonological structures, but of the discrete units and processes themselves. Stay tuned for a sample of 'emergent phonology'.

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