Ordinal Phonology and phonetic uncertainty

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In phonology, researchers have characterised the content of speech segments using just a few phonological primes, such as SPE binary features or elements. The concern has been to relate phonemic segments to abstract matters of melody, markedness and weight, constituent structure, process and harmony as expounded succinctly in the chapter on melody in Harris [1]. For the most part, such concerns have been met in discrete fashion. More recently, in laboratory phonology and statistical studies of corpora, there has been a move away from discrete characterisations towards gradience patterns (e.g. Labphon [2]) - the idea that a segmental hypothesis is supported by laboratory experiments with groups of participants is tenable to a degree. The encounter of phonology with phonetics (e.g. Durand & Laks [3]) also involves incidence to a degree, approachable by statistical methods such as numerical approximation of acoustic data using artificial neural nets (e.g. Williams [4]) and cluster-analytical methods of defining acoustic signatures of primes (Ingleby & Brockhaus [5], [6]).

We argue here that gradience in pattern recognition methods deliver diagnostic decisions that are neither continuous nor discrete but ordinal: they associate a slot with a sequence of primes, ranked in descending order of degree of evidential support for of their presence in the segment. For simplicity, we develop this view in the framework of element phonology (e.g. [5], [6]) but an ordinal approach could be used with any primes, and ordinal signatures are more robust against outlier effects and noise then their continuous or discrete counterparts.

Of course noise is an inevitable part of segmental data gathered from a time segment in the speech data stream. In both live speech and corpus data, segment boundaries are matters of opinion and judgement. Thus, any use of physical data will relate not only to a target slot in the melody tier, but also to spill-over from adjacent slots. We suggest that spill-over is central to the phonological representation of coarticulation processes, and has enough explanatory power to account also for phonological fusion effects associated with incongruent speech data of the diotic type (e.g. Cutting [7], Mattys and Melhorn [8]) and the audiovisual type (e.g. McGurk & Macdonald [9], Ali and Ingleby [10]).

Our point of view is not tied to the type of spectral evidence extractable from speech recordings using a speech lab. It applies also to data from newer empirical tools: facial imaging measurements of lip-shape, contact palatography, X-ray and dielectric tomography of the vocal tract, functional magnetic resonance imaging or EEG potential mapping of speakers’ and listeners’ neurological activity. Spill-over and physical noise in older and newer tools attach to a time segment an uncertain region of an abstract pattern space, and this noise region overlaps with clusters representing phonological primes as in purely acoustic signature work ([7], [8]). The ordinal expression generated by an observed time segment consists of these prime clusters ranked by extent of overlap. We apply ordinal expression theory to account for some well-known phonological processes such as nasal assimilation: e.g. Input→Input, word-final devoicing, spirantisation etc; and we also apply the theory to account for incongruent fusion percepts: in diotic fusion, e.g. left−ear(abs)right−ear→ (mut)

Our examples are taken from congruent and incongruent speech in English, German and Arabic - to emphasise that our representations are more to do with the physics of speech than the language involved.
Exemplar References


