The Linguistic Control of Speech Production

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Reproduced from *Occasional Papers* 23, University of Essex UK, April 1980, pp. 117-120. Version of a discussion paper presented at the *International Symposium on the Cognitive Representation of Speech,* Edinburgh, July 29 to August 1st, 1979.

The mechanisms described so adequately by MacNeilage (1979) and by Perkell (1979) form part of a device operating somewhere near the end of the encoding system we call language. That system is designed to encode our thoughts into a soundwave able to be decoded by a complementary system back to some copy of the original thoughts. Linguistics is properly concerned with this encoding system, and finds it convenient to subdivide the system into various stages or components. Thus in initial stages thoughts are encoded symbolically and according to their internal logical structure (semantics), and subsequently into symbols recognisable as words together with an ordering of those symbols which encodes much of the logical structure (syntax). Even a cursory examination of the output of these initial stages reveals that encoding is not a matter of correct selection of sentences to match the underlying thoughts from a store of some set of such sentences, but rather, for the most part, a process of creation of novel sentences encoding thoughts on a one-off basis. Such a system could only operate if for the encoding of any one particular thought a set of rules were employed (or consulted) which together for the means of creating all possible sentences of the language. That set of rules embodies of course the potential of the entire language, and is by definition unimpeded by locally operating constraints on its actual use for any one encoding operation. This system is mental, and any theory describing it is called psychological.

Also mental is that part of the encoding device which accepts such sentential encodings and conditions them such that they can be used to drive the mechanisms described by MacNeilage and Perkell. This stage of encoding must clearly look back to consider aspects of just how the semantic and syntactic encoding was done, and of course look forward to see what are the capabilities of the final stages (the phonetics). This all is the business of phonology - itself a mental component of the encoding system. Access to the nature of constraints deriving fro the mechanisms of articulation, the nature of acoustics and the control of the neuro- muscular/mechanical system we include under the heading phonetics enables a phonology to produce an output for all possible sentences (as a potential encoding), ant for one single sentence (as an actual encoding), which is both a satisfactory rendering of the input sentence and a satisfactory trigger for control of the vocal apparatus.

The output of the phonology (as a potential, or on any actual occasion) has so-e interesting properties which are by no means apparent from inspection, however close, of the *final* output of the entire system (the potential or actual soundwaves). The discovery of these properties has to do with their psychological reality, and anything beyond this level has no psychological reality. The most striking (for the purposes of this paper) property here is the reality of identifiable objects which make up the sound patterns of words or sentences and the *smallness* of that set. Mere tens of objects only are discoverable, and therefore, since they participate in the encoding of an infinite number of sentences, invariance is the order of the day. Invariance has two aspects: a same phonological object may occur in different contexts to contribute to the encoding of different words, and the same phonological object may occur in the same context to form encodings of the same word on different occasions.

No-one at our present state of understanding of neurology would claim that there was neural sameness for these objects, but it must surely by unarguable that there *is* psychological sameness. But even if there is neural variability for some representation of these objects at the

output level of the phonology, that variability is minute compared with the variability readily observed during and at the output of the phonetics.

The variability generated in MacNeilage's and Perkell's mechanisms and in the mechanical and any other mechanisms involved in the conversion of the psychologically real phonological output into soundwaves can in principle be attributed to those mechanisms and their control: it need not be attributed to the input to that control. Indeed if it *is* then the variability we know to be attributable to such mechanisms would be denied — and that is impossible.

We can examine these systems in the manner of MacNeilage and Perkell; but we can also determine how they must operate in language by hypothesising their role in their immediate task — the encoding of what is mental into something physical.

Psychologically real objects relate to each other in a space. It is worthwhile to associate this space (which is abstract) with the space (which is not) in which articulations find the selves. One thing is apparent: discrimination within the psychological space is finer than that within the articulatory space. This is because constraints on location and precision of location within the spaces are severer physically than mentally. Because the psychological space is destined (as part of the encoding which is language) to be realised as physical space it must be constrained beyond it intrinsic limitations. And that is why phonology must look forward to phonetics to determine what is possible.

But under certain conditions the physical constraints can be tamed. Whether they *need* to be to provide an adequate set of locations in the underlying psychological space is arguable: but the fact remains that they can be and are both inhibited and enhanced. In other words MacNeilage and Perkell have described systems which have intrinsic limiting properties: the phonology can and does inhibit and enhance those properties to its own ends. Specific examples of this inhibition and enhancement have been given elsewhere (Morton and Tatham, 1980a), but suffice it to say here that *for linguistic purposes* intrinsic variability (which might perhaps under other circumstances be considered a defect) is manipulated.

It has been proposed that such manipulation be characterised in the linguistics as a set of **Production Instructions** (Morton and Tatham , 1980b). This set is, of course, static in the spirit of the overall model of language favoured (**Transformational Generative Grammar**), and exists aside from the phonological and phonetic rules, at a phonetic level (and therefore not deriving psychologically real objects), with an input derived fro the phonology's output level and with an output intervening in phonetic processes (Fig.1). A phonetic output is thus the result of an invariant input, whose invariant realisation is rendered impossible by phonetic constraints, but whose potential variance has been somewhat inhibited or somewhat enhanced by the application of phonologically-driven **Production Instructions**. These **Production Instructions**, *for linguistic purposes*, stabilise or govern phonetic realisations and are candidate users of the feedback stabilising mechanisms described by MacNeilage and by Perkell.

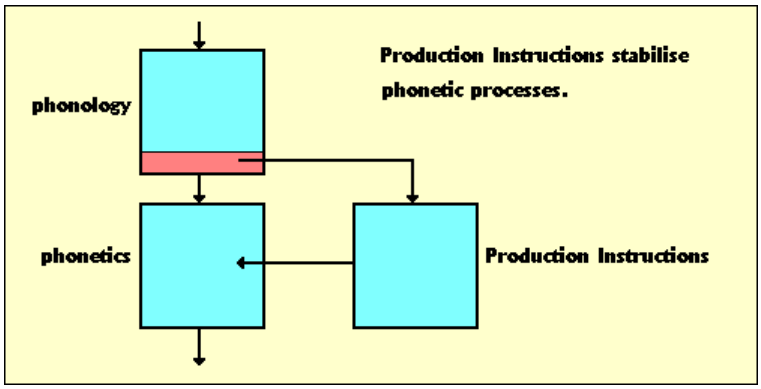

Fig. I Production Instructions in the speaker.

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