Cognitive Phonetics — Some of the Theory

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One of the dominant characteristics of use Lehiste's work has been that phonetics is treated as being within the rightful purview of linguistics proper: for her the phrase 'linguistics *and* phonetics' seems seldom to have any meaning. Even when inquiring as to the best way to handle a phonetic phenomenon or when investigating, say, the acoustic properties of this or that phonetic effect, the main question asked is inevitably a linguistic one: how does what is being examined fit within the general scheme of language? I do not know for certain whether for her this viewpoint is the natural approach to anything connected with speech, but I suspect it is. Alas, such is not the case for many phoneticians or indeed for most linguists today.

I simplify for brevity, but since around 1950 the tendency towards a parting of the ways has been emphasised by the election (undeniably correct) to treat language as a cognitive phenomenon. Once that election was made it is easy to see how any study connected with acoustics, aerodynamics or motor control would be thought of as being non-cognitive. At most a phonetic model might have an input derived from a cognitively oriented phonology.

An equally contributory factor to the parting of the ways has been the rapid development of the technology available for examining phonetic phenomena in the laboratory, together with the widespread acceptance of modern phonetics as a hard science oriented discipline because of those experimental possibilities. Cognitively oriented linguistics cannot be carried out in any kind of laboratory other than the psychology laboratory because the material under investigation is abstract, not real, in the sense that the phenomena which deflect dials in a phonetics laboratory are, it could be claimed, real.

Many linguists, especially phonologists, have felt nevertheless uneasy and sought to account for the detail revealed in the phonetics laboratory in the latter stages of their cognitive models. Others have sought to call upon phonetics to provide an explanatory basis for a good deal of their phonology. Both approaches fail dramatically because they make no genuine or lasting contribution toward bridging the gap between abstract and concrete. On the other hand, there has been little attempt by phoneticians to adapt their models to the new cognitive linguistics. Perhaps somehow, and again of course I oversimplify, the security of laboratory measurement is too tempting.

Ilse Lehiste's contribution to holding the two together — and they must surely be held together — has been essentially to establish linguistic hypotheses whose concrete correlates are amenable to properly conducted investigation in the phonetics laboratory. This is no mean achievement by any standards. It is very difficult indeed to abandon the self-contained experiment (e.g. 'let's go into the lab and find out how the vocal cords work') in favor of the heavily constrained experiment (e.g. 'cognitive manipulation of an abstract parameter [voice] contributes toward adequate sound encoding and decoding of sentences; let's go into the lab and see how this manipulation is revealed in how the working vocal cords are used').

In this paper I should like to add my own contribution to holding on to our linguistic roots.

It is unarguable that the encoding of thought into sound in such a way that adequate decoding of sound into thought is possible is the subject matter of linguistics. It is for me also unarguable that the mind is responsible for the linguistic phenomenon, and equally unarguable that the possibilities of the mind extend beyond what we have yet been able to describe chemically, electrically, neurally, anatomically, aerodynamically, acoustically ... It

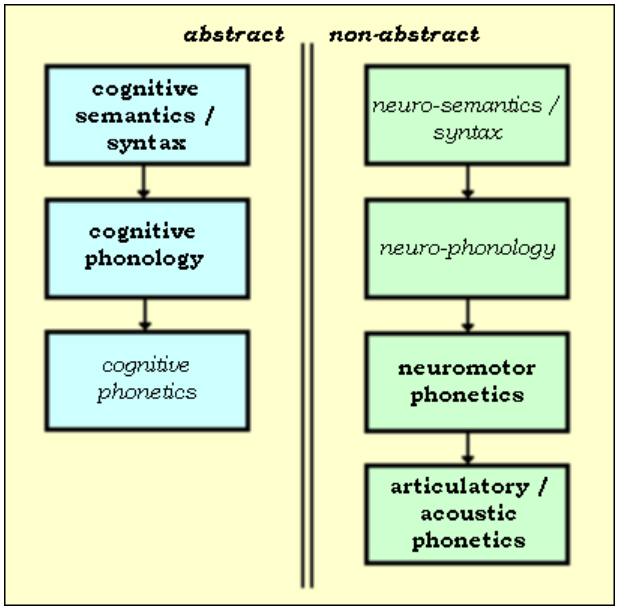
must be unarguable also that when the mind interfaces with anything which is appropriately described in one of these concrete ways then the mind is constrained with respect to the concrete implementation of its own possibilities. Despite the indefatigable effort of biopsychology (and neurolinguistics) an acceptable theory of the 'housing' of the mind is out of our grasp: we do not begin to understand how to link abstract and concrete.

The study of language is now properly and securely cognitively oriented, and linguistics currently contributes toward our understanding of the mind and how it works. At best in the contemporary study of language an operative phonology outputs a string of abstract objects which are captured by a phonetics whose job it is to render these objects as sounds. In the clearest current model this is done by translating the abstract object into some concrete motor specification which is then implemented. At the present time there is a comparatively trivial argument in progress as to just how much of what eventually happens at the periphery is underpinned by the specification translation process and just how much is a property of how the peripheral system actually works. The argument is characterized by the usual extremist positions exemplified in this case by 'almost everything' and 'almost nothing'.

Although I myself have long tried to contribute something toward the development of the theory's current position, I among many others have also pointed out a feeling of unease at the way phonetics is just tacked onto phonology. I think, as phoneticians, we have made a mistake, and, as linguists, we have failed to understand the implications of our own theory.

The mistake we have made as phoneticians was not to move our theory into the formal abstract cognitive realm along with the rest of linguistics. The mistake we have made as linguists was not to realize that we do not know how to properly conjoin theories of the abstract with theories of the non-abstract. Put quite simply: a concrete phonetics does not and cannot (in the way we have tried it) interface with a cognitive linguistics, or specifically with a cognitive phonology. A concrete phonetics (which is what we currently have) does interface with a concrete phonology (which is what we currently do not have — *pace* the neurolinguists). A cognitive phonetics (which we do not have) does interface with a cognitive phonology (which we do have).

A diagram expresses this much better:



In the diagram boldface type indicates labels of areas of comprehensive study in contemporary linguistics. Lighter type indicates potential or less comprehensively studied areas. The double vertical line separating the two halves of the diagram represents the great divide between abstract and concrete which cannot yet be crossed with safety. The arrows

indicate that in some way what is below follows on from what is above. In some vague way (which we feel must be so) what is to the right of the vertical double line both 'houses', or 'constrains' and 'realises', 'implements' or 'mediates' what is to the left. This is of course an extremely stated dualist view, which is arguable. But because it is arguable we have no recourse to convenient established metatheory to produce a better diagram.

The mistake I referred to earlier is to take an arrow from cognitive phonology and direct it toward neuromotor phonetics. The drawing of such an arrow may well be both scientifically and philosophically unsound. That is what has nevertheless been done.

It may well be agreed that that arrow should not be drawn, but of course that agreement in itself does not justify the new label which has appeared on the left: 'cognitive phonetics'. Katherine Morton's paper in this collection discusses what constitutes the data underpinning a theory of cognitive phonetics. Here I will confine myself to a brief consideration of what I think a cognitive phonetics is about.

We can be clear what we want in a phonology. Transformational Generative Phonology along with its derivatives envisages a set of rules for deriving an output level from an input level. Broadly speaking an input consists of a string of abstract objects minimally specifying the potential sound shape of sentences such that previously encoded objects representing thought are uniquely re-encoded to facilitate transmission beyond the individual's mind. Since it turns out that speakers of particular languages idiosyncratically re-encode minimal sound shapes (although for effective communication purposes they need not) and that the design and operation of the actual speaking apparatus constrain what the physically unfettered mind might ideally do, additional adjustment to this input level is required to produce a final output string of abstract objects. This adjustment is the phonology proper with constraints which are some psychologically and some physically based. The output of the phonology contains all the information required for a phonetics to proceed to actualize corresponding sound for transmission to another individual. It is this idea of actualization with no further cognitive intervention that places contemporary phonetics to the right of the diagram's vertical line.

There seems clear evidence, however, that this actualization is by no means automatic. Others have sensed this and drawn attention for example to the systematic manipulation of degree beyond binary in the production of articulatory or acoustic features correlating with the abstract phonological features. Some have noted anomalies in measured phonetic output when rate of utterance is varied, or rhythm altered in some way, and so on. In such examples it is hard to maintain the notion of an automatic, purely physical phonetics without a good deal of low-level adjustment to the phonology —adjustments which seem to be somewhat non-phonological in nature. Is the apparently greater 'nasalization' of otherwise oral vowels in some dialects of English really a phonological phenomenon? Or is it a cognitively adjusted phonetic phenomenon?

Notwithstanding the imposition within the phonology of some physically derived constraints on the abstract sound encoding of sentences there are severe physical phonetic constraints for which no adjustment seems to be made. Many coarticulatory effects fall into this category. For the most part (but there are exceptions) there are seldom phonological rules which anticipate coarticulation and avoid or completely counteract the effect. But there are nevertheless many systematic manipulations of coarticulatory effects, an example being the variable nasalization mentioned above. An opponent adherent to the contemporary model might reply: 'Yes, and we continue to discover finer and finer low level phonological detail rules — this may just be another'.

I want to reinterpret that use of the word 'phonological' and substitute 'cognitive'. There can be no doubt that such systematic manipulation of physical phonetics is cognitive, and since for my fictitious opponent phonetics is not cognitive, then anything which is cognitive must be phonological. But that may be going about the classification in the wrong way. For me there is a difference between the systematic substitution of one abstract segment for another or the systematic changing of the sign on an abstract feature and the systematic

reduction or enhancement of a necessary physical artefact (which is what manipulation of coarticulation is). In other words, the prime distinguishing mark between phonology and phonetics is not that the one is cognitive and the other is not, for they can be each modelled cognitively or physically depending on which side of the vertical line you stay. It is in type of change which the rules specify. On the one hand what is being changed is abstract and comparatively free of physical constraint, on the other physical constraint dictates change to the effect of a physical phenomenon (which is bound to occur anyway). Although in the phonetics the rule represents a potential cognitive act, that act is not psychologically free; it is utterly dominated by a physical inevitability. Extending my earlier example, consider the difference between systematic enhancement of the coarticulatory nasalization phenomenon and the decision to have a set of nasal vowels as part of the phonological inventory. The former is a cognitive phonetic act, the latter a cognitive phonological act. Internasal nasalization of vowels is a phonetic coarticulatory artefact and as such might well fit within some current automatic phonetics theories, but we can decide to have more or less of it (though never none at normal rates of articulation). That decision is not automatic and does not fit those theories. Nasal vowels as abstract phonological objects are not physical artefacts and we can choose entirely whether to have them or not. For me there is a major difference here in basis for the rule sets. Inventory selection, etc. for phonology is choice from within the available set of phonetically realisable abstract objects (or segments); inventory selection, etc. for phonetics is choice from possible modifications, within the limits set physically, of the physical realization of the phonologically selected objects. It is choice which makes both cognitive.

A subset of the rules of a cognitive phonetics might be called ‘production instructions’. ‘Production’ because it is the speech production side of the encoding/decoding coin we are considering; ‘instructions’ because eventually motor control instructions are either to be added or subtracted to adjust an artefact. Decisions to evoke particular instructions depend on a store of information concerning motor, aerodynamic and acoustic possibilities and effects. Such a store of knowledge must, of course, be held actually in the mind and treated in the theory within the cognitive purview. The facts of physical phonetics are described by that knowledge although they may be properties of the mechanics of the motor system: this is a distinction which the action theorists fail to make explicit enough. There is a great difference between physical facts, their abstract description by a scientist and their abstract mental image for the organism. It is just not enough to say (and I simplify) that after an initial mentally derived triggering the system takes care of itself. For if we manipulate how the system behaves after the trigger, then we must possess a mental representation of the system’s potential behavior. Even physical phonetics is just not that automatic.

To summarize: I have asserted that both linguists and phoneticians seem to have made a conceptual error resulting in a drifting apart of their respective theories and consequently in a general unease concerning the interface of their models. Phonetics failed to accompany linguistics in going cognitive, but linguistics did not notice since it regarded phonetics as exclusively physical anyway. I have tried to show that a great area of speech production sub-phonologically is cognitive and should be treated along the same lines as contemporary linguistics. The other part of speech production is physical and should be treated along the lines of neurology or neurolinguistics, aerodynamics, acoustics, etc. Both treatments of course result in abstract theories, though I can see nothing but clumsy methods for bringing the two together.