

Excerpt from Tatham, M. and Morton, K. (2005) *Production and Perception of Speech*. Basingstoke: Palgrave Macmillan - uncorrected proof version

## INTRODUCTION

Until the middle of the 20<sup>th</sup> century phonetics was largely concerned with recording the sounds of languages and how they are made, together with making comparisons between the sound inventories of languages. We are still with that legacy in many ways. We compare surface events noted in one language with another, or note observations in spoken language and assign symbols with a system that requires interpretation in the act of assignment. This technique is useful, but we cannot see that it is productive in describing what speech *is*, or how it can be most usefully modelled. Our view is that we need to know *what* sounds can be produced, and then incorporate neurophysiological and acoustic modelling into the discipline. Cognitive neuroscience should be able to tell us what is possible in terms of production and perception, and acoustic modelling should be able to characterise the actual sounds made.

As experimental techniques have developed the focus has shifted toward general data gathering, and as a result we now know that there are some significant discrepancies between what phoneticians had thought was going on in speech and what the new experiments are revealing. But even more importantly, in terms of the theory of speech there has been a paradigm shift from theories about the nature of speech toward theories about how it is produced and perceived. The new paradigm attempts speech modelling from high-level cognitive processing through the acoustic signal to its high-level cognitive perception in the listener.

There are some serious problems in speech modelling. For example: there is no serious empirical basis yet for characterising with any degree of certainty the pre-motor stages of speech production. We assume a physical input - something we call the 'utterance plan', and this is a physical copy of the abstract output from prior cognitive or phonological processing. But we have no experimental evidence for the exact nature of this plan - other than that it somehow reflects earlier cognitive processes. In general we are short of coherent underlying principles for uniting the highly abstract modelling of linguistics and the accumulating mass of physical data collected in the last half century.

In this book we outline a possible underlying model, with a view to providing a basis for

showing associations between some cognitive and some physical evidence. The model is a sketch, and we are aware of many of its limitations. The intention however is to show that it is possible to realise the accepted goals of science within the theory of speech production and perception. So we have suggested a model that seems to be justified in very general terms, and according to our interpretation of work done in areas *outside* the usual domain of phonetics, such as cognitive neuroscience, which follows scientific procedures developed outside linguistics. It is important that the exchange be two-way, since not only do linguistics and phonetics import data and ideas from other sciences, we also *export* to those sciences: we emphasise the need for a common basis for this exchange. We also suggest that researchers slow down data collection for its own sake, and work more consistently within the overall concept of modelling processes and tasks designed to develop a robust core theory in the light of how it might be used.

It was suggested we discuss some possible applications of phonetic modelling to application areas such as speech disorders, second language acquisition and speech technology. With this in mind we have suggested some areas of application where our model might be useful. If it is *not* seen to be applicable by specialists in these applied areas, then the model can and should be modified.

Part I - dealing with speech production - begins with a discussion of Classical Phonetics - the basic foundation of our science. There are some shortcomings, and we suggest how the subject might develop in line with a paradigm shift away from a linear model toward a true hierarchically based model of speech production and perception. We show how the concept of *explanation* truly improves the credibility and robustness of phonetic theory. Next follows two chapters dealing with coarticulation, arguably the biggest area of research in the last 50 years or so. We discuss the phenomenon itself and give a critical review of the major models which have been developed in the area. We continue with chapters on the theory of speech motor control and prosody.

Part II - dealing with speech perception - develops the idea that perception and production are so interconnected that they have to be modelled together. Indeed much of what we have to say under this heading looks as though it is about speech production - but this is production optimised for perception: a new and important concept which was first introduced along with the 1960s paradigm shift. Prosody figures in this part too, for the same kind of reason, along with modelling expressive content in speech.

Part III - dealing with areas of focus, modelling and applications - is where we introduce the notion that speech theory should perhaps develop with applications in mind. We have discussed just three: clinical application, spoken language acquisition and speech

technology. These are intended to be examples only, since there are many areas where our science has potential relevance provided it is made fully compatible. The piecemeal application of small snippets of the theory may even be counterproductive in the long run.

Finally, this is not a textbook, though in many areas it is instructional. The point is that it assumes a great deal of the elementary material underlying the subject - there are a number of excellent books which cover this ground. But in addition the book is highly selective: this is deliberate and was done for the sake of coherence and continuity of theme. Our subject area is coming into maturity as a science, but not all of its accumulated material meets the necessary criteria of commonality of approach and purpose. We have tried to present the material in the light of the kind of thing which is necessary for a truly scientific explanatory approach; but in the end what we propose is no more than a suggestion toward this end.