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Vocal fluency

A Practical Introduction to **Phonetics**

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J. C. Catford

Sound

A Practical Introduction to

Phonetics

Second Edition

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Preface

It may be worth drawing attention to the fact that the title of this book is, designedly, 'A Practical Introduction to Phonetics' and not 'An Introduction to Practical Phonetics', for it is, indeed, an introduction to general, or theoretical, phonetics, though it proceeds towards that goal in a highly practical way.

Readers are introduced to the phonetic classification of the sounds of speech by means of a series of simple introspective experiments carried out inside their own vocal tracts, their own throats and mouths. By actually making sounds (very often silently) and attending to the muscular sensations that accompany their production one can discover how they are produced and learn how to describe and classify them.

At first sight 'making sounds silently' may appear contradictory, but, as Abercrombie (1967) has aptly pointed out, speech is 'audible gesture' and the principal aim of this book is to enable the reader to discover and to analyse the gestural aspect of speech (upon which most phonetic classification is based) and to bring it under conscious control. This must be done, to a large extent, in silence, since the auditory sensations of loud speech tend to mask the motor sensations, which are the perceptual accompaniment of the gestural aspect of speech.

That this kind of experimentation is an effective means of acquiring a knowledge of the categories and principles of general phonetics I know from personal experience, for this was precisely how I learned phonetics as a boy, without a teacher, eagerly reading Sweet's *Primer of Phonetics* and constantly experimenting in my own vocal tract.

Although, as this reference to boyhood experience suggests, phonetics is a fascinating hobby for young people, it is primarily an indispensable tool for all those adults who have to work with language: students of linguistics, teachers and students of languages, teachers of the deaf, the hearing-impaired themselves who may be striving to acquire intelligible speech, actors, and many others. Armed with the understanding of the basic principles of phonetics which this book seeks to inculcate, they should be able to read and fully understand any specialist work on whatever aspect of phonetics is of special interest to them.

Much of the material of the book has been used for some years past at

the University of Michigan, in teaching phonetics to large groups of students of linguistics, speech pathology, anthropology, languages, education, drama, and many other fields. I am grateful to all those students who contributed comments and suggestions, and I should also like to thank Dr Harriet Mills who read most of the text and made numerous valuable criticisms.

Some readers have suggested that it would be useful to have a set of recordings of the experiments, or at least of the sounds that should result when each experiment is carried out. This might be helpful, but it also carries the risk that some readers might be induced to try and learn sounds merely by imitation of heard examples. This would tend to defeat the purpose of the book, which is to inculcate an understanding of the mechanism of speech and of phonetic taxonomy by experimentation in one's own vocal tract.

However, it may be useful for some to be able to hear examples of many of the unfamiliar sounds that they have been led to produce in these experiments.

A recording is now available of all of the sounds represented on the latest chart of the International Phonetic Alphabet, which can be found on pages 114–15 of this book. This demonstration, *The Sounds of the IPA*, spoken by John Wells, Professor of Phonetics, and Jill House, Senior Lecturer in Phonetics, at University College, London, is available on audio cassette or CD. For further information write to Listening Centre, Department of Phonetics and Linguistics, UCL, 4 Stephenson Way, London NW1 2HE, UK (Fax: +4420 7383 0752. Email: mary@phon.ucl.ac.uk).

This new edition contains additions and corrections, and most importantly, presents an expanded and updated list of items for further reading, on pages 217 to 219. I am particularly grateful to Jimmy G. Harris and Professor John Esling for the many helpful suggestions that they provided, and to John Davey and Jo Stanbridge of Oxford University Press for their guidance and careful editorial work.

J.C.C.

Ann Arbor,
August 2001

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1

Introduction

1. The uses of phonetics

Phonetics is the systematic study of human speech-sounds. It provides means of describing and classifying virtually all the sounds that can be produced by human vocal tracts. How this is done is the principal subject-matter of this book. But before we begin to investigate the sounds of speech it may be useful to say something about why it is interesting and useful to do this: in other words, to review some of the *uses* of phonetics.

Over a century ago, the great English philologist, linguist, and phonetician, Henry Sweet (who, as Shaw tells us, was in part the prototype of Professor Higgins in *Pygmalion*—perhaps better known nowadays as the musical, *My Fair Lady*) described phonetics as ‘. . . the indispensable foundation of all study of language—whether that study be purely theoretical, or practical as well . . .’ (Sweet (1877), p. v).

This is as true today as it was in the time of Sweet. Any person who works with language would do well to have a basic knowledge of phonetics. The teacher of languages, for example, including the teacher of English as a second language, must be able to diagnose the pronunciation errors made by students, and to devise means of correcting them—this is impossible without both theoretical and practical knowledge of phonetics.

Phonetics is also useful to those concerned with various aspects of the mother tongue: the phonetically trained teacher of reading will have a better understanding of orthographic problems and the relationship of spelling to the spoken language; in the teaching of speech-production phonetics is obviously essential—actors, particularly those who wish to master numerous dialects and foreign accents, certainly ought to have a thorough knowledge of phonetics, which, alas, they usually lack.

Speech pathologists have an obvious need for phonetics, which they

readily acknowledge, both for a general understanding of how the vocal apparatus works and for the diagnosis and treatment of minor articulatory defects.

Communication and computer engineers and other 'speech-scientists' working on the improvement of speech transmission systems, on speech synthesis, and on automatic speech recognition, also need to have a considerable knowledge of phonetics.

Another important application of phonetics is to what Sweet calls 'scientific philology'—or what we would now call 'comparative-historical linguistics'. In his words: 'Without a knowledge of the laws of sound-change, scientific philology . . . is impossible, and without phonetics their study degenerates into a mere mechanical enumeration of letter-changes' (p. v).

And of course phonetics is absolutely essential to the student of linguistics. It is virtually impossible to do serious work in linguistics without a thorough knowledge of phonetics. Clearly, without phonetics, field-work, the most important source of linguistic data, is impossible, and phonological rules become (like the sound-laws referred to above) meaningless and unmotivated rules of letter-substitution. Even in the study of syntax and morphology questions of phonetics frequently arise.

Now, it is perfectly possible to acquire a good *theoretical* knowledge of phonetics by reading, and even more so by working in a phonetics laboratory where aspects of the physiology and acoustics of speech are investigated instrumentally. But the kind of superficial, purely intellectual, knowledge of phonetics that is acquired in this way is quite inadequate as a basis for carrying out many of the activities referred to above. What the competent phonetician *must* acquire is a deep, internally experienced, awareness of what is going on within the vocal tract—an ability to analyse, and hence describe and ultimately control, the postures and movements of organs that produce the sounds of speech. It is fairly obvious that this kind of practical ability is essential for those, like language learners and teachers, or actors, who have to identify and produce exotic or unaccustomed sounds. What is not so obvious, but is undoubtedly the case, is that the acquisition of these 'practical' skills is by far the best way of acquiring a deep understanding of phonetic theory—of the principles underlying the description and classification of the sounds of speech—and is consequently of the greatest importance also for more 'theoretical' uses of phonetics.

Thus, the nature of a historical sound-change can usually best be under-

stood by those who can actually carry through the change in their own vocal tracts and internally, introspectively, *experience* its mechanism; and the interpretation of physiological or acoustic instrumental records of speech is most efficiently carried out by speech-scientists who possess the same kinds of skill—investigators who cannot themselves pronounce, and internally experience, most of the phenomena they are investigating sometimes misinterpret their data.

It is because of the great importance of this kind of introspective awareness of the phenomena of speech that in this book we introduce the reader to the principles and categories of phonetic classification not only by means of descriptions, which can produce a merely intellectual comprehension of phonetic theory, but by means of *experiments* which readers are asked to carry out in their own vocal tracts. In this way, they will acquire that deep understanding of phonetic theory which is the indispensable stock-in-trade of the competent phonetician.

2. The phases of speech

Before we begin the experimental approach to the subject, in Chapter 2, it will be useful to consider the nature of the speech-event, and what particular aspects of it are, or may be, the domain of phonetics.

When someone speaks to someone, the sequence of events is, in outline, as follows. In response to the need to communicate about some *event* (which may either be in the world at large or within his own consciousness) the speaker *conceptualizes* the event in a particular way and then *encodes* that conceptualization in a form laid down by the grammar of his language. The linguistically encoded utterance is *externalized* and apprehended by the hearer through the agency of a series of events that we term the *phases* of speech. These phases start in the speaker, and culminate in the hearer *decoding* the utterance and arriving at a *conceptualization* which, assuming he is familiar with the speaker's language, closely matches the speaker's conceptualization, which was the start of the process.

The processes of conceptualization and coding/decoding are outside the domain of phonetics. The purely phonetic part of the speech process begins, we assume, with the execution of a short-term neural programme in the central nervous system, which is triggered by the lexico-grammatical structure of the utterance and determines the nature and the sequencing of

everything that follows. We may call this the *neurolinguistic programming* phase of the utterance.

Thereafter, in a sequence no doubt determined during the stage of neurolinguistic programming, specific 'motor commands' flow out through motor nerves to muscles in the chest, throat, mouth, etc. As a result, these muscles contract—in whole or in part, successively or simultaneously, more or less strongly.

We call this whole process of motor commands (the outflow of neural impulses from the central nervous system), together with the indissolubly related muscle contractions, the *neuromuscular* phase.

As a result of the muscular contractions occurring in this neuromuscular phase, the organs to which these muscles are attached adopt particular postures or make particular movements—the rib-cage may contract, the vocal folds in the larynx may be brought close together, the tongue adopt a particular configuration, and so on. In short, the sequel to the neuromuscular phase is a posturing or movement of whole organs in the vocal tract. We therefore call this the *organic* phase.

The movements of organs during the organic phase act upon the air contained within the vocal tract. They compress the air, or dilate it, and they set it moving in various ways—in rapid puffs, in sudden bursts, in a smooth flow, in a rough, eddying, turbulent stream, and so on. All of this constitutes the *aerodynamic* phase of speech.

As the air flows through the vocal tract during the aerodynamic phase the things that happen to it set the air molecules oscillating in ways that can be perceived by our sense of hearing. In other words, the aerodynamic events generate sound-waves, and these constitute the *acoustic* phase of speech. In the acoustic phase, an airborne sound-wave radiates from the speaker's mouth and reaches the ear of anyone within hearing distance, including the speaker himself.

The sound-wave, impinging on the hearer's ear-drum, sets it vibrating in step with the wave-form, and these vibrations are transmitted, by the little bones of the middle ear, to the inner ear, or cochlea, where they stimulate sensory endings of the auditory nerve. Neural impulses from the nerve-endings travel up the auditory nerve to the brain, where they give rise to sensations of sound. We call this whole process of peripheral stimulation and afferent neural transmission the *neuroreceptive* phase.

Finally, an interpretative process occurs in which the incoming neuroreceptive signals are identified as this or that particular vocal sound

or sound-sequence. This is the phase of *neurolinguistic identification*, which we can regard as more or less the obverse of the neurolinguistic programming phase with which the phonetic event began. Though there may always be some awareness of sound in this phase, the identification as particular speech-sounds is usually below the threshold of consciousness. In the actual exchange of conversation, attention is directed more to the meaning of what is said than to the sounds by which that meaning is manifested.

The final steps in the process—the hearer's decoding and ultimate conceptualization—are outside the domain of phonetics, just as were the matching conceptualization and encoding in the speaker.

We can now summarize the phases of speech as follows:

- (1) *Neurolinguistic programming*: the selection, sequencing, and timing of what follows.
- (2) *Neuromuscular phase*: transmission of outbound (motor) neural impulses and the contraction of individual muscles.
- (3) *Organic phase*: postures and movements of whole organs.
- (4) *Aerodynamic phase*: dilation, compression, and flow of air in and through the vocal tract.
- (5) *Acoustic phase*: propagation of sound-waves from speaker's vocal tract.
- (6) *Neuroreceptive phase*: peripheral auditory stimulation and transmission of inbound neural impulses.
- (7) *Neurolinguistic identification*: potential or actual identification of incoming signals as specific speech-sounds.

In addition to all this we must take note of two other phases, or aspects, of the speech process. These are the two kinds of feedback: *kinaesthetic feedback* and *auditory feedback*.

As the organs of speech posture and move about in the performance of speech, sensory nerve-endings within the muscles and on the surfaces of the organs are stimulated by muscle contraction and by contact and pressure. We may be, but often are not, conscious of this feedback as *proprioceptive sensations* (feelings of muscular contraction and tension) and *tactile sensations*. As a general name for these proprioceptive and tactile sensations we use the term 'kinaesthesia', hence *kinaesthetic feedback*.

The second type of feedback consists of the stimulation of the speaker's peripheral hearing organs by the sound-wave issuing from his own mouth

which reaches his ears both externally, by air conduction, and internally, by bone conduction. This is *auditory feedback*.

These feedback systems monitor and control speech by inserting into the motor system information concerning the continuing muscular, organic, aerodynamic, and acoustic events. Much of phonetic training involves making these feedbacks, especially kinaesthetic or proprioceptive feedback, *conscious*. Analysis, and conscious control, of the activities of speech must be based upon awareness of what the vocal organs are doing and this awareness is derived from the feedback systems.

Of the seven phases of speech described above only three lend themselves conveniently to categorization for general phonetic purposes: these are the organic phase, the aerodynamic phase, and the acoustic phase. Traditionally, phonetic classification has been based on the *organic* phase. This was the basis of classification of the earliest phoneticians—the Indian grammarians of 2,500 years ago—and also of the ancient Greek and Roman grammarians, the medieval Arab grammarians, and the English phoneticians from Elizabethan times onwards. The acoustic phase has only been fully accessible since the development in the twentieth century of electronic devices for acoustic analysis, such as the cathode-ray oscilloscope and the sound spectrograph in the 1930s and 1940s. Nevertheless, since such instruments became available an enormous amount has been learned about the acoustic phase, and the study of this phase of speech is known as *acoustic phonetics*. The aerodynamic phase is also accessible to instrumental investigation and aerodynamic data have been used since the nineteenth century, chiefly as a means of acquiring information about the preceding, organic, phase: by looking at variations in the rate of airflow out of the mouth, measuring intra-oral pressure, and so on, one can make many useful inferences about the organic activities that give rise to these aerodynamic effects. It is only recently that the suggestion has been made that there should be a more or less independent *aerodynamic phonetics*, parallel to acoustic phonetics.

General phonetic taxonomy, however—that is, the general or basic classification of speech sounds—is still based on the *organic phase*, with some contributions from aerodynamic and acoustic phonetics where helpful. This type of phonetics is often called *articulatory phonetics*, a term which is somewhat inaccurate, since, as we shall see, articulation is only one (though a very important one) of the components of speech sound production.