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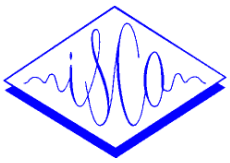

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Developments in Speech Science Curricula

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Abstract

Training students in phonetics or speech science involves much more than simply putting on a course of lectures. It requires careful planning of practical work, lecture-based teaching and small-group activities. The main components of this teaching are reviewed, and their place in a curriculum are discussed.

1. Introduction

Education in Phonetics and Speech Science requires a heavy investment in time by students and teachers. We need to think how this time is spent, and if it is spent effectively. A great deal of thinking has already gone into this question, as can be seen in [1], [2], and all I can do is to add some commentary based on my personal experience of over thirty years teaching and examining the subject. Although I can think of a number of ways in which my use of the two names *Phonetics* and *Speech Science* varies, for the time being I intend to use them interchangeably.

Since the surveys referred to above have done a very thorough job of looking at the picture across Europe, all I can add myself is some observations from my own experience. My experience in this area is perhaps a little more varied than that of some of my contemporaries. I have taught phonetics as part of undergraduate and MA courses in Linguistics departments; I have also worked in the teaching of English pronunciation to foreign learners, in the UK and overseas, and I have taught the subject over a number of years while working in a department of Psychology, principally to students studying for a BSc in Psychology.

All education consists of transmitting knowledge and skills. Here is what phonetics teachers transmit:

1. practical phonetic skills
2. technological competence
3. factual knowledge and terminology
4. understanding of theoretical issues

These headings are essentially similar to those listed in [1], but I would like to devote some space to considering how these components ought to fit together in a curriculum. In addition, I would like to look at what the student gains from studying them, and to discuss the problems that may be faced in the teaching of them. Items 1 and 2 are, of course, essentially practical, while 3 and 4 are what used to be called "book-learning". It is impossible work on all of these activities simultaneously, and in my experience most courses in phonetics usually start with 1 and 3, and go on to 2 and 4 later.

2. Practical phonetic skills

We have a special factor to take into account in educating students in phonetics, which is that practical work forms an essential part of the teaching. By 'practical phonetic skills' I mean what has traditionally been called "ear-training" and the corresponding training in the production of sounds. Curiously, I am not aware that any term equivalent to "ear-training" has ever caught on. I suppose "production training" would do. What other subjects have similar commitments? Most "hard" science subjects have substantial practical components (laboratory or workshop work, or fieldwork), but the parallel here is not exact, as some phonetic training is a training of perceptual or psycho-motor skills. This is to some extent a training in public performance: in this it is similar to subjects such as music, dancing, acting. It is also a training in perception, which is again similar to the training that music students receive. Let us now look in more detail at what is involved.

The traditional basis for this training is the chart of the IPA. This chart is felt to embody all the sounds and sound contrasts found or likely to be found in the world's languages. As evidence of this, the periodic revisions of the Chart have incorporated symbols for sounds newly discovered to be used in one or more languages. A relatively recent example is the velar lateral [L], which was until described in [3] believed simply to be a theoretical possibility. The value of the IPA Chart will be enormously enhanced with the publication of the IPA Handbook [4], which explains many points that students that find difficult to understand. The Chart forms an excellent basis for practical phonetic training, but it needs to be remembered that it is not a syllabus. The teacher of practical phonetics needs to select from the Chart what is most important, to grade the elements of the Chart in terms of the challenge they present to the student, and to plan the most effective way to present them. There is clearly a need for this guidance to be offered to teachers in order to avoid them having to work out their own solution; some guides have been published [5], [6], [7], and we should welcome the existence of such material. I do get the impression that in some classes, the mastery of relatively exotic items such as clicks or pharyngeal

consonants is allocated almost as much time as the basic learning of articulatory mechanisms and sound categories. Certainly it can easily happen that students become unnecessarily anxious about a few especially difficult items on the Chart. Emphasis in production training should be on bringing under conscious control such things as voicing and devoicing, independent movement of lips and tongue in vowel production and accurate control of the tongue in making consonants with different places of articulation. Similarly, ear-training should emphasise major variables such as the open / close axis and the front / back axis in vowels, and rounding / unrounding in vowels and consonants; detection of voicing and aspiration in plosives and identification of major spectral difference in fricatives.

What advantages does the student gain from this training? The original idea was that by freeing the learner from their native-language pronunciation habits, they would be better able to learn the pronunciation of another language. It would be interesting to know at what stage in the history of phonetics it was appropriate to teach practical phonetics without immediate reference to learning the pronunciation of individual languages. In present-day work, and for the purposes of most students studying in our field, the benefit of this training should be seen more as a way of opening the student's eyes and ears to the nature of speech and speech sounds, and of enabling them to use symbolic representation of speech sounds for various practical purposes. In my own experience, the insights into the nature of speech gained from this training are beneficial in all aspects of speech science; I have often found it difficult to make myself understood in talking to some speech technology specialists when talking about, for example, allophonic variation at word boundaries or effects of stress-shift – terms like *devoicing*, *glottalisation* or *vowel centralisation* don't seem to relate to anything in their experience.

3. Technological competence

I would like to think that we will soon regard it as essential that all students learning phonetics should become competent at working with digitised speech signals on computer. Until recently this would have been impractical for large groups of students because of the cost and the lack of availability of suitable hardware and software. Recently many things have changed. The cost of suitable computers has now fallen well below the £1000 mark (and in the case of departments such as mine where the teaching is related to clinical courses, the price works out even lower because of our exemption from VAT). All the indications are that the prices will continue to fall. There has been a big growth in the availability of software that can handle tasks such as spectrography without the need for expensive add-on processors. Consequently there is a wide range of software available which will run on a PC with a standard domestic sound-card, or a Macintosh. It is still the case that a better quality recording can result from using a more specialised sound input-output card such as the OROS AU21/1, or the board supplied with the Kay CSL, but for educational purposes the difference is not crucial. The software need no longer be a serious expense, and indeed there is some excellent software available free. Suitable commercial software with a proper user manual is available for £100-200 per licence. Speech synthesis is also easily available.

I want to be clear about the difference between software for teaching about speech acoustics and software for carrying out acoustic analysis, and I am currently talking about the latter. Basic background skills that can be acquired during the use of such facilities are the following:

- making high quality recordings
- editing / manipulating sounds
- measuring acoustic properties of sounds
- speech database storage and retrieval

These are skills which can be of considerable value in a number of possible careers open to graduates. Many students have to make recordings as part of their studies in degree courses in our field, and I am sure I am not the only teacher to find that students often collect interesting data but reduce its value drastically by failing to think about simple factors such as control of recording level and background noise sources, position of microphone and choice of recording equipment. Students find it useful and interesting to learn how to do editing, and to explore the possibilities of "cut-and-paste" operation on recordings. Learning to measure and interpret spectrograms, F0 traces and amplitude-frequency spectra is not only useful experience in itself, but gives a much more profound insight into the nature of speech, and I am particularly keen on giving students the exercise of doing segmental transcription of recordings by attaching symbols in an interactive computer display. This is a possibility with many of the software packages now available. I myself have learned a great deal about speech from doing such transcriptions. Finally, there is an enormous wealth of speech database or corpus material now available, and students can learn a lot from exploring these, and exploiting the material in them for learning and research. For larger-scale student projects which involve the collection of substantial amounts of recorded material it is highly desirable that they should learn how to plan and archive their material in database form.

I would like to consider briefly what kind of material is available, or is likely to be available in the near future, which students might benefit from working with. One type of data is "raw" recorded data from which the student might select suitable passages. A typical example might be a corpus of recordings of children of different ages speaking. More useful would be material which in addition to the acoustic signal has annotations

attached to it. The most common such material has a phonetic transcription associated with it, enabling the user to search for particular segments, syllables or sound sequences. Such material is available for many different languages, and even for different speaking styles. There is, I believe, a need for some easy-to-use software for doing this sort of work – most of the software that I know and use is UNIX-based, and many institutions will prefer to work with PC/Mac machines for educational purposes. Finally, there is a growing amount of reference materials such as dictionaries which have a "talking" facility. I am convinced that future versions of pronunciation dictionaries will be accessible by computers and will offer a number of different pronunciations of each word, spoken by different speakers (different in age, sex, and geographical region or nationality, for example), and these will be a useful educational resource not only to language learners but also to students of phonetics or speech science.

4. Factual knowledge and terminology

Students often tell me that they like phonetics better than linguistics because it deals with facts and realities instead of theories and abstractions. I try to point out that there are many abstractions and theories in phonetics, too, but I have to admit that they have a point. The anatomy and physiology of the vocal tract, the variations in air flow and pressure in speech, the acoustic properties of the speech signal and the nature of the conversion of pressure variations into neural impulses by the inner ear are not subjects on which we regularly have to change our teaching to take account of swings of fashion such as we find in theoretical linguistics and phonology. If there is a negative side to this, it is that there is a very heavy load of technical terminology to be learned by the student. An exhaustive account of the anatomy and physiology of the vocal tract involves presenting so many terms that the beginner has trouble absorbing them all. In learning about speech acoustics, the student has to take in concepts such as frequency, amplitude, resonance, periodicity, harmonics, formants and many others. There are, of course, excellent textbooks to introduce students to these terms and concepts, or to reinforce what has been covered in lectures. But in this aspect of teaching, we are looking at the area which most strongly calls for the use of computer-based teaching. There is already quite a lot of such material in use, some of it "home-brewed" and some of it commercially produced, and it is evident that this can work extremely well. My experience of teaching undergraduates studying for BA in Linguistics or BSc in Linguistics and Language Pathology gives evidence of this: to follow up ten hours of my lectures on speech acoustics, the students spend some hours working individually on the Sensimetrics 'Speech Production and Perception' course, working on one of a set of multimedia PC's provided for student use in a quiet study room. The students have shown a lot of enthusiasm for this method of learning, and I feel we can look forward to much more material of this sort. Whether it will be delivered on disk or via the Internet is something that will have to be worked out in practice. The Internet route would be greatly preferable if it were not so slow. There is already a substantial amount of Internet material available for phonetics teaching, though I have to say that the quality of what I have seen is very variable.

5. Theoretical issues

I mentioned in the previous section that phonetics is seen as essentially factual. Of course, this does not mean that there are not theoretical issues that a well-educated student of phonetics needs to be aware of. How much theory should be included is an open question, and depends on the importance given to the subject as a whole within a degree scheme. For some teachers, it is a matter of principle that phonetics teaching should not be regarded simply as the inculcation of some basic skills that places little intellectual demand on the student. To accept that would be to relegate it to a minor place in the curriculum, probably in the first year of a degree course. The majority of theoretical teaching in this subject in our degree courses takes place in the final year. Some of this is concerned with issues within the field itself, such as the nature of coarticulation, or questions concerning acoustic invariance. However, many important issues arise in considering new developments at the borders between phonetics and other disciplines; examples are phonology, cognitive psychology (including neuropsychology) and artificial intelligence. If one is talking about advanced level students, the criterion to be used in deciding whether something should be included in the syllabus for teaching theoretical issues is whether the major international journals demonstrate interest in the area. Students should, by the time they graduate, be able to read and understand (perhaps not completely) papers in such journals, and they should be prepared for the issues likely to be raised in them. Having attempted to apply this criterion to final-year undergraduates, I know from experience that it is not an easy target to set, but I believe it to be worthwhile.

6. Towards an integrated curriculum

I said earlier that it was not enough to list the various components of a curriculum for education in phonetics or speech science. These components must fit within an overall structure, with linkages and options for further study. I imagine my department is fairly typical of a fairly large linguistics department. I will describe briefly the kind of structure that we have (or hope shortly to have) for teaching phonetics. As a general principle all lecture courses have small-group "core seminars" to discuss and reinforce what has been presented in the lectures. Practical classes are regarded as separate components of the syllabus. In the first year, there is a series of 10 lectures giving an overview of phonetics

and basic phonology, and two hours of seminar accompany this. At this stage there is no practical phonetics. At the end of the first year there is a 10-hour course on speech acoustics, together with small-group introductions to the Sensimetrics package; there are also (separately) 10 hours of practical phonetics. In the second year there is a 10-hour lecture course on the articulation, anatomy and physiology of speech, and 20 more hours of practical phonetics. In the final year, there is a 10-hour course on speech perception, and another 10-hour course on current theoretical issues. The speech perception course includes some small-group work in which simple experiments on perception are worked on my the students; these include the McGurk effect, semantic priming and reaction-time measurements of the lexical decision task. Students also have the option, in their final year, of studying advanced practical phonetics, which is supposed to bring them up to the level of the IPA Certificate, and experimental phonetics, a 20-hour option which covers in a practical way most of the well-known laboratory techniques for investigating speech. While this provision seems to me to represent a pretty comprehensive coverage of the subject, I would like the interrelations between the various components to be much more clearly visible to our students, and for them to be more fully aware at any point in the course how all this fits together.

There are obvious practical problems in planning a syllabus of this sort. Probably the most problematic area is the ear-training and production training. We are lucky in having several phonetically-trained members of the teaching staff. Few departments these days would make the ability to teach practical phonetics a high priority in recruiting new staff, so it is clearly not always feasible to plan to do intensive practical phonetic teaching. Regrettable though this is, we have to recognise the facts of life. Some economies are possible: ear-training, for example, can be done in relatively large groups since the students are mainly occupied in listening and transcribing, but production training can only be done in small groups. It is one of the "public" activities that can cause a self-conscious student acute embarrassment, and the larger the group, the more difficult it is to make uncouth noises in front of others. Of the other practical activities, the Sensimetrics package is providing a good grounding in basic acoustics, but it needs to be supplemented by practical acoustic analysis and synthesis work which has yet to be fitted into our curriculum. The perception practicals are based on experiments that I designed for first year psychology students in my previous job. Students of linguistics and phonetics seem to enjoy these (one is careful to choose experiments which are fairly robust and easy to set up), and I would be enthusiastic about building up a bigger repertoire of such experiments to back up lectures on perception.

The challenge, in devising such a curriculum, is to preserve the best of traditional training, especially ear-training and production training, while bringing in imaginative new teaching that will excite the students and at the same time provide them with technical skills that will be useful to them after graduation.

References

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