New Tools for Teaching Phonetics

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ABSTRACT

This paper deals with the integration of technical progress in the last decade into phonetics teaching at the undergraduate and the graduate levels, drawing on personal experience. Phonetics has profited most from such progress. Some points that I feel are most important are reviewed: the systematic use of PowerPoint and video projection during the class, with conduction of on-line experiments; access to more and more sounds, speech data base, film and video resources and availability of user-friendly speech analysis and multilingual speech synthesis software, and Webcam meeting. There is a general improvement in communication through access to local and international discussions lists, motoring search engines, specialized websites, on-line bibliographies with abstracts, articles, journals. To conclude, technical progress allowed for more engaging undergraduate courses, and broadened a lot the horizon of the graduate students. Basic pedagogy has not changed much and there are some new problems emerging.

1. INTRODUCTION

This paper deals with the integration of new technological progress into phonetic teaching in the last decade, drawing on personal experience at the University of the Sorbonne Nouvelle, in Paris. It is by no means a comprehensive list of what has been done by phonetics institutes worldwide-- or what could have been done: technical progress has been so rapid that many of us have been hard put to follow and take full advantage of it. To start with an example: the web links (underlined) initially included in the present paper will be lost after conversion to .pdf format; otherwise, if read directly on a computer that is connected to the net and has loudspeakers, it would have allowed the reader to start a very useful and easy navigation on the web.

This paper may be considered as a companion to a previous lecture entitled "Teaching acoustic phonetics", which was presented during an ICPhS session at Stockholm during a plenary organized by _Peter Ladefoged_ (Vol.1, pages 442-9). In 1995, I drew three conclusions: first, a deep understanding of Fant's _acoustic theory of speech production_ is a necessary step to understand what is going on in the vocal tract and what some of the acoustic-articulatory "phonetic constraints" really mean; second, the use of sophisticated computer tools (such as _Peter Ladefoged's_ pioneering _HyperCard_ stacks on Acoustic Phonetics and Maeda's articulatory modeling) are essential for facilitating the linguistics students' approach to the theory, making them aware of the link between articulatory profiles, the various steps in articulatory modelization, the resulting formant frequencies, and the sounds. The third conclusion was that using paper, eraser and pencil (and a pocket calculator) for computing the resonance frequencies in simple tubes representing basic vowels and consonants,

as was done in the good old days, was still essential for the students to get a deeper understanding of what is going on in the vocal tract and to be able to use aspects of the theory for their own research (the perturbation theory, in particular, which I believe is essential, but which is surprisingly absent of most phonetics handbooks). There are still many pitch-tracking errors in the figures published in conference proceedings (ICPhS included), that the authors do not seem to be aware of, and students should be taught to check the fundamental frequency from oscillograms and from narrow band spectrograms. They should be taught to be critical to the formant frequency values calculated by the computer, etc.

My talk is addressed to teachers faced with the problem of teaching phonetics in very large classrooms at the undergraduate level. It is also addressed to teachers of phonetics at the graduate level who have to transmit most efficiently the necessary background to students and professionals from various disciplines (linguists, engineers, professors from foreign universities, medical doctors, physiologists, computer scientists, speech pathologists, etc.). The courses in phonetics should allow them to formulate phonetic research questions for themselves and to solve the problems using the best tools available. Note that the demand of intensive phonetics courses is expanding globally.

Technological progress and price decreases have been considerable since ICPhS at Stockholm. Among linguists, phoneticians stand out as the most likely to profit from new technical progress, because of the natural link between phonetics and computer and sound facilities, of the phoneticians' natural inclination to try new methods of communication, new soft- and hardware, pressed by the need of solving the many unsolved problems in their discipline by connecting with other sciences. For example, it is now possible to obtain "truly" spontaneous speech by placing a small minidisk in the speaker's pocket, and recording him/her throughout the whole day. The dramatic increase in storage facilities (CD, Hard Disks) was much longed for, for storing sounds and images. In this paper, I review seven points that I feel are most important.

2. TECHNOLOGICAL ADVANCES

1) Bringing the lab into the classroom thanks to a portable computer and a video projector

In Rousselot's time the very few students of phonetics in Paris were acquiring the necessary notions by doing experiments in the phonetics lab under the supervision of their teacher. Thanks to the availability of laptops, a large part of the lab facilities can now be "transported" into larger classrooms. With a video-projector, it is possible to display the contents of the computer on very large screens. Note that only 8 years back, at Stockholm, only _Peter Ladefoged_ and _myself_ asked the organizers for a video-

projector! The conjunction of laptops and video-projection is a wonderful tool for demonstrating software, recording, analyzing, and hearing speech, and running perceptual tests, all in real time. As in many other places, courses in phonetics in Paris now standardly use *Microsoft PowerPoint*. What has also changed in 8 years is that more and more students have their own computer, have easy access to Internet and can view the course again at home.

One of my current goals is to create a library with a full collection of the PowerPoint files of others and mine with narration and corresponding video-recorded courses.

2) Easy circulation of materials for courses and research

a) Discussion lists within the class

Thanks to free website providers, we had to *create a web site* and a mailing list with the e-mail addresses of all the students attending a class and, through that channel, to transfer very fast to each enrolled student the *PowerPoint* file displayed during class, along with conference announcements, assignments, updates about online resources, links related to class discussions, to home pages of researchers and phonetics lab websites, Frequently Asked Questions, reading material, training for exams, phonetic *games*, etc.

b) International discussion lists, reading materials, and citations.

Browsing the online archives of international mailing lists, such as the *Linguist* list [1], *Prosody* list [2] and the *foNETiks* [3] network newsletter allow the student to be immersed in the phonetics world. For example, the *Linguist* list [1] runs a mailing list with over 16,500 subscribers worldwide.

An increasing number of journals such as *Phonetica, Journal of Phonetics, Journal of the Acoustical Society of America, Language and Speech, etc.*, individual articles, conference proceedings, dissertations [4] and dictionaries [5] are available on-line. LLBA (Linguistics and Language Behavior Abstracts) provides citations and abstracts of literature on linguistics, speech, communication, and related topics [6].

3) Downloading useful, user-friendly, cheap or free software

The third point has been the rapid development of phonetic resources other than reading material available from the web, a development that is being tracked in particular software ([7; 8; 9]).

a) Signal analysis

First of all, one has to mention the free software *Praat*[10]. *Praat* offers all the operations provided by the other software and is constantly improved. It features a manual that leads curious students to learn while putting theory in practice (articulatory synthesis, source-filter synthesis or Optimality Theory), and to discover the other areas also covered by *Praat* (the magic of scripting, and statistics). It has a very convivial forum that does not shove off beginners, with the authors in person replying to unanswered questions. *Praat* is available in multiple platforms, *de facto* setting up an international standard.

b) Multilingual speech synthesizer

The second indispensable program is the *Mbrola* program [11]. It is a speech synthesizer based on concatenation of diphones. A large number of diphones databases are available: *American English, British English Arabic, Brazilian Portuguese, Canadian French,* etc. *Mbrola* is the easiest way to create stimuli from a string of phonetic symbols, with the ability to modulate prosodic values at will and to listen to the result immediately. It is essential in pointing out what is not transmitted by using only F_0 and duration, i.e. voice quality.

A student of mine, *Cedric Gendrot* [12], will demonstrate how he has combined *Praat* and *Mbrola* (allowing to get an exact prosodic copy of an original sentence, and to synthesize it using one of the available diphones data base).

c) Exploration of annotated data during the class

Winsnoori offers a quick and easy way to explore annotated corpora automatically in the classroom, to display spectrograms, formants and Fo contour of the selected data, and filtering along several time x frequency trajectories [13].

d) Real-time pitch detection

Real-time pitch detectors are very useful for courses in prosody. The one I currently use is *WinPitchPro*, which also allows modification of Fo, duration and intensity, and easy automatic alignment.

Our next step would be to complete an interactive course on CD illustrating French prosodies (syntactic, pragmatic and attitudinal, stylistic, regional) with the help of the different programs.

4) Browsing sound resources

Another important improvement is the increasing availability of sounds on the web.

a) Illustration of the *IPA* sounds [14]

Acquiring phonetic skills is essential in the education of a phonetician. [15] contains audio files that accompany illustrations of the *IPA* that have been published in the *Journal of the International Phonetic Association* since 1998. [16] contains illustrations of the sounds of the *IPA* in a wide range of languages, and comes as a companion to "The Handbook of the International Phonetic Association" published by Cambridge University Press (1999). The University of Lausanne offers an *Online phonetics course* with sound files [17].

b) Sound materials from books and articles

The best example [18] is a web site with the same material as the CD that accompanies two books by *Peter Ladefoged : Vowels and Consonants, Blackwells 2001* and *A Course in Phonetics 4th Edition, Harcourt College Publishers, 2001*. More and more journals are also making available the sounds corresponding to articles. This development makes it much easier to get a feel for the research of others, which is very helpful (for students and researchers alike); it may also result in higher standards in data collection.

c) Getting whole speech data bases

One can get a large number of speech databases from the net (see for [7; 8], [9] for links). For example, illustrations of *sounds from 51 languages* can be obtained in [19], or 50 *different dialects of Norwegian* [20]. In Internet resources, however, some native speakers have obviously not been recorded in their native countries, and their speech can be considered as having a foreign accent, and should not serve as reference. Some caution should be exercised in selecting

material on the Internet. The positive side is that research students can quickly get a clear picture of the present state of phonetic documentation, allowing them to plan their own contribution to research and documentation (see section 7). The *LACITO Archive programme* (not designed specifically for phoneticians) provides free access to documents of connected, spontaneous speech in "rare" or endangered languages, recorded in their cultural context and transcribed in consultation with native speakers.

d) Conducting on-line experiments involving sounds
Some web sites make it possible to conduct perceptual experiments whether at home, in the lab or in the classroom. For example: the *categorical perception experiment* [21] and the *McGurk effect* [22].

e) Getting fonts
The diversity of phonetic fonts has always been a problem for phoneticians. Over the Internet, it is now easy to get at least three types of very useful fonts. First, there are a large number of *phonetic fonts,* such as ***IPA*** fonts with diacritics [23]. Second, *SAMPA* [for **S**peech **A**ssessment **M**ethods **P**honetic **A**lphabet] is a computer-readable phonetic alphabet [24]. Third, *Unicode* looks like the way forward for data circulation, allowing to insertion of ***IPA*** symbols in web documents [25].

6) Animations, films, video and demonstrations
More and more animations, films and video can be obtained from the web and display advantageously in the classroom. An animated drawing of the auditory system (its anatomy, physiology and pathophysiology) is available in . Still photos of the *vocal folds* [27], video demos of *vocal-fold vibration* [28], audio samples of *different phonation types* [29], video clips of the vocal tract in action [30], [31], demonstrations of *synthesized speech* [32] and *articulatory synthesis* [33] are also available.

7) Developing contacts between laboratories

a) Better research thanks to multidisciplinary and international collaboration
The Internet facilitates communication between laboratories. Each graduate student at our lab is greatly encouraged, after a while, to "voir ailleurs" and to establish collaboration with phonetic and non-phonetic research teams everywhere, for applying phonetic knowledge in other fields. The contact with specialists of other fields greatly improves the quality of their work and broaden their horizon.

International collaboration gives a sound basis to research. Bilingual speakers and listeners do not react in the same way as monolinguals. After one or two years in the U.S.A., a Frenchman generally develops an accent typical of a Frenchman living in America, and the young Japanese students at our place even get final lengthening and French-like continuation rises! To date, many experiments reported in the journals have involved foreigners who had long been away from their native country. Our lab is currently involved in recording French speakers and making perceptual tests with native speakers of French for a laboratory abroad, and such exchanges, which are greatly facilitated by the web, will hopefully become common practice.

b) Berkeley-Paris high-level conferencing by Webcam
The last but not the least positive experience we are having now is Webcam meeting, initiated by *John Ohala* from Berkeley University. Webcam technology permits the two sites at Berkeley and Paris to interact. During the Webcam meetings, graduate students from both universities present their work and answer questions. The puzzled students in Paris could even listen to a talk by *Ian Maddieson* speaking in perfect French, and to some of John's famous jokes. No need to say, being listened to and criticized once in a while by the people at Berkeley is very challenging for our research students, and I could not dream of a better pedagogical tool! Webcam meeting also allow weekly face-to-face contact with students abroad and open new lively ways of communicating.

3. CONCLUSION
Each graduate student here has to complement the written version of their master or PhD by a CD (it may soon be DVD) containing the same text, but with systematic, extensive links to original and processes data (including as many hypertext links as possible; see [34] for application to a paper presented during this congress). To any spectra or spectrograms, or mention corpora used for statistics, should correspond a link in the text to the corresponding sounds. "Reading" becomes really a pleasure for the ears.

For the teaching of prosody, in particular, by now I would be very hard put to write courses that would not incorporate links or software in the text. For the teaching of acoustic phonetics, however, I have not changed much my pedagogical approach since Stockholm: paper and eraser (and an articulatory model) remain the best tools.

Besides, concerning the use of the Internet in teaching, not everything is rosy. Anyone can create a website, without any control on information quality. Students actually need strong discipline to browse their way to the relevant resources and bring the information together. Much of the best, most reliable information is not available with search tools such as *Google* or *Copernic*. Some students get lost in the increasing amount of information; many spend too much time on the Internet, at the expense of the time spent on experiments, reflection and reading. Some students do not speak adequate English, which is a problem as most courses are in English. Web addresses change quickly; some interesting links become dead; others still work after a length of time but point to information that has become out-of-date. Some of the information is very interesting but cannot be referred to for want of the name of the author(s).

As for future developments, establishment of standards for shared data can be facilitated by the use of *Praat* There should be reviewed phonetics websites, for example under the auspices of ***IPA.*** There should be the possibility of exchanging courses on PowerPoint with narration, between universities, for example in the field of prosody or segmentals, each institute of phonetics providing a complete course with sound resources on its language (It is rather easy to attach narration in several languages to a PowerPoint file.) There should also be a new type of multimedia publication or course, on CD and on the web, with formal reviewing. Sharing physiological data that is difficult to acquire and measure should be especially encouraged. And why not create, in four years from now, under the auspice of ICPhS, a medal to be granted to the author whose contribution has been the most useful for facilitating the teaching of phonetics?

To conclude, technical progress in the last decade allowed for more engaging undergraduate courses, and broadened a lot the horizon of the graduate students. But some cautions should be taken.

Acknowledgements

WEB SITES

[1]   LINGUIST List, http://www.linguistlist.org/
[2]   PROSODY List,
http://listserv.linguistlist.org/archives/prosody.html
[3]   foNETiks; A network newsletter,
http://www.jiscmail.ac.uk/lists/fonetiks.html
[4]   Digital dissertations abstracts,
http://wwwlib.umi.com/dissertations/gateway
[5]   Speech Internet Dictionary,
http://www.phon.ucl.ac.uk/home/johnm/sid/sidhome.htm
[6]   LLBA: Linguistics and Language Behavior Abstracts,
http://web5.silverplatter.com/
[7]   Phonetics links, by K. Bretonnel Cohen,
http://www.ling.ohio-state.edu/~kcohen/phoneticsLinks.html
[8]   Web Resources, by the dpt of Phonetics and Linguistics at University College London,
http://www.phon.ucl.ac.uk/courses/spsci/ish/resource.htm
[9]   Smith, J. Phonetics resources on the web, by Jennifer Smith, http://www.unc.edu/~jlsmith/pht-url.html
[10]   Program Praat, developped by Paul Boersma and David Weenink, http://fonsg3.hum.uva.nl/praat/praat.html
[11]   Mbrola software developped by Thierry Dutoit,
http://tcts.fpms.ac.be/synthesis/mbrola.html
[12]   Cedric Gendrot's home page, LPP-Paris Sorbonne Nouvelle,
http://www.cavi.univ-paris3.fr/ilpga/ED/student/stcg/index.htm
[13]   Winsnoori software, developed by Yves Laprie,
http://www.winpitch.com/
[14]   The IPA international phonetic association,
http://www.arts.gla.ac.uk/IPA/ipachart.html
[15]   Journal of the International Phonetic Association Illustrations,
http://web.uvic.ca/ling/resources/ipa/jipa.htm
[16]   Sounds illustrating the Handbook of the IPA, published by Cambridge University Press, 1999
http://web.uvic.ca/ling/resources/ipa/handbook.htm
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[19]   Ladefoged, P. Illustrations of the sounds for many languages,
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[20]   Norwegian text from over 50 different dialects, by Jørn Almberg and Kristian Skarbø,
http://www.ling.hf.ntnu.no/nos/
[21]   Categorical perception, on-line experiment, by Ola Andersson,
http://www.ling.umu.se/~rand/KatPer/index.eng.html
[22]   McGurk effect, on-line experiment
http://www.psych.ucr.edu/avspeech/VSMcGurk.html
[23]   Fonts: IPA,
http://www.arts.gla.ac.uk/IPA/ipafonts.html
[24]   SAMPA alphabet,
http://www.phon.ucl.ac.uk/home/sampa/home.htm
[25]   The IPA in Unicode,
http://www.phon.ucl.ac.uk/home/wells/ipa-unicode.htm
[26]   The general physiology of the human ear, by Rémy Pujol,
http://www.iurc.montp.inserm.fr/cric/audition/english/start2.htm
(English version),
http://www.iurc.montp.inserm.fr/cric/audition/start2.htm
(French version)
[27]   Still photos of vocal folds from Fred Cummins' phonetics   course."
http://cspeech.ucd.ie/~fred/courses/phonetics/glottis.html
[28]   "Video demos of vocal-fold vibration from the UCLA Phonetics Lab.",
http://www.humnet.ucla.edu/humnet/linguistics/faciliti/demos/vocalfolds/vocalfolds.htm
[29]   Audio samples of different phonation types, by K. Marasek, Experimental Phonetics Group, Stuttgart,
http://www.ims.uni-stuttgart.de/phonetik/EGG/page10.htm
[30]   Ladefoged, P., Tongue, jaw and larynx video
http://hctv.humnet.ucla.edu/departments/linguistics/VowelsandConsonants/vowels/chapter11/chapter11.html
[31]   Wood, S., X-ray motion film
http://www.ling.lu.se/persons/Sidney/coartdem/films.html
[32]   synthesized speech: demonstrations,
http://www.icp.inpg.fr/ICP_old/equipes/synthese/musee.en.html
[33]   Articulatory synthesis from Ph. Rubin and L. Goldstein at Haskins Labs,
http://www.haskins.yale.edu/Haskins/MISC/ASY/asy.html
[34]   Tzu-Ting Su's home page, LPP-Paris Sorbonne Nouvelle, http://www.cavi.univ-paris3.fr/ilpga/ED/student/stts/index.htm