

## CHAPTER 2

# PHONETICS

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# 1 Introduction

In 1997, the Phonetics working group carried out a survey of 89 phonetics institutes from 25 European countries in order to get an overview of the present state of phonetics education. Through this survey, detailed information was collected about staff and student numbers, the educational context within which phonetics was taught, the courses that were offered in each institute, the goals and philosophy behind the phonetics curricula and the emphasis put on different skills such as ear training or articulatory skills. The results were published in *The Landscape of Future Education in Speech Communication Sciences. 1 Analysis* (Bloothoof, van Dommelen, Espain, Green, Hazan, Huckvale and Wigforss 1997). In addition, the responses provided by each of the 89 institutes are available at the following web site: <http://www.kgw.tu-berlin.de/TN/results.html>.

The results of the survey led to two further initiatives that are reported in this chapter. The first was a classification of elements of phonetics knowledge which are seen as essential or desirable for students taking phonetics courses as part of different specialisations (Section 2). It is hoped that, following extensive consultation of people from the field, this classification eventually may lead to a set of recommendations regarding curriculum content. The second initiative was a follow-up survey to gather information about equipment and reading material used in teaching phonetics (Section 3).

## 2 Elements of Study

### 2.1 Background

A major aspect of the 1997 survey was concerned with the question of which topics of phonetics knowledge (or 'elements of study') were taught to students specialising in phonetics, linguistics, philology, speech and language therapy (SLT) and spoken language engineering (SLE). Respondents were asked which of the elements of study listed were definitely taught to students, might have been taught to some students or were not taught at all. In the *Landscape* book mentioned above, the elements of study were classified as 'core', 'peripheral' or 'minority' elements on the basis of the percentage of institutes in which they were taught to all students. In making that initial classification, no account was taken of the profile of the individual institutes. It is clear, however, that the teaching objectives and contents of a phonetics curriculum will vary quite significantly across the five specialisations that we are concerned with: the teaching objectives of a phonetics curriculum in an institute preparing students for a career in speech and language therapy, for example, are quite different from those of an institute specialising in spoken language engineering. The survey provides us with a unique opportunity of getting a detailed picture of the specific requirements of a phonetics curriculum for these different specialisations. Here, the 1997 survey data has been reanalysed to provide separate classification of elements of study for each of the five institute profiles.

## 2.2 Structure of classification

The elements of study included in the classification are those used in the 1997 survey. Descriptors for a small number of elements of study have been reworded where they appeared ambiguous. For practical purposes, elements of study are listed under sub-headings (e.g. Acoustic Phonetics, Speech Perception) although they may not necessarily be taught in a course of this name.

The descriptors used for classifying the elements of study were also slightly revised. They are as follows:

- *Core*: element of study that is seen as essential. In the 1997 study, these were offered by over 80% of institutes teaching students of this category.
- *Core-introductory*: element of study that is seen as highly relevant for students of this category but taught at more introductory/elementary level.
- *Peripheral*: element of study that is seen to be more specialised and which has been found in our survey to be taught in a minority of institutes.

The institute profile indicated the context within which phonetics courses are taught. The following classification was used:

- Dedicated Phonetics
- Phonetics applied to Linguistics
- Phonetics applied to Language/Philology or Psychology
- Phonetics applied to Speech Technology, Engineering or Speech Communication (SLE)
- Phonetics applied to Speech and Language Therapy (SLT)

## 2.3 Final goal

The current classification provides a useful starting point to the next phase of the work which is to elicit a wider discussion of elements of study that should be included in a phonetics curriculum for a given specialisation. This next phase will involve a process of consultation organised in two stages. The first stage will involve discussions with other working groups within the Thematic Network. As a result of these discussions, a set of draft recommendations will be produced. These draft recommendations will be made available on the Thematic Network web-site and widely circulated across institutes in order to elicit feedback. They will also be sent to external experts for further comments. These will be incorporated into a final set of recommendations that will be presented at the ESCA/Socrates workshop on Method and Tool Innovations for Speech Science Education (MATISSE) in April 1999 and published in the Thematic Network's third book.

### ELEMENTS OF STUDY

	Classification of student specialisation
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Elements of study	Phon	Ling	Phil	SLE	SLT
<b>Acoustic Phonetics</b>					
Basics	C	CI	CI	C	C
Fant's source-filter model	C	P	P	C	C
Acoustic properties of speech sounds	C	CI	CI	C	C
Suprasegmental	C	CI	C	C	C
<b>Speech Perception</b>					
Structure and function of the auditory system	C	P	P	CI	C
Psychoacoustics	C	P	P	P	CI
Perception of cues and units at segmental /suprasegmental level	C	CI	CI	C	C
Models of speech perception	C	P	P	P	C
Multimodal perception	CI	P	P	P	C
Perception of prosody	C	P	P	P	C
Disorders of speech perception	P	P	P	P	C
<b>Speech Production</b>					
Respiration	C	P	P	P	C
Anatomy and physiology of the larynx	C	CI	CI	P	C
Voice production theories	C	P	P	P	C
Anatomy and physiology of the vocal tract	C	CI	CI	C	C
Articulation (speech sounds, theories)	C	CI	CI	C	C
Disorders of speech production	P	P	P	P	C
Prosody	C	C	P	P	C
<b>Speech Acquisition</b>					
Theories of language acquisition	P	P	C	P	C
Development of speech perception	P	P	CI	P	C
Development of speech production	P	P	CI	P	C
Infant/child studies	P	P	P	P	C
Second language acquisition of speech perception and production	P	P	C	P	P

C = Core

CI = Core-introductory

P = Peripheral

Phon = Phonetics

Ling = Linguistics

Phil = Philology

SLE = Spoken Language Engineering

SLT = Speech and Language Therapy

Elements of study	Phon	Ling	Phil	SLE	SLT
<b>Speech technology</b>					
Signal processing	CI	P	P	C	P
Speech synthesis	CI	P	P	C	P
Speech recognition	P	P	P	C	P
Speech technology assessment methods	P	P	P	C	P
Applications	P	P	P	C	P
<b>Methods and Tools</b>					
Basics of research methodology and experimental design	C	P	P	C	C
Speech production measurements	C	P	P	C	C
Signal analysis	C	P	P	C	C
Statistical methods	C	P	P	C	C
Speech databases	P	P	P	C	P
<b>Phonology</b>					
Distinctive feature analysis	CI	C	C	CI	CI
Suprasegmental phonology	CI	C	CI	CI	CI
Phonemic analysis	CI	C	CI	P	P
Phonological processes	CI	C	CI	P	P
Phonological representations	CI	C	CI	P	P
<b>Sociophonetics/Dialectology</b>					
Regional variation	CI	C	C	P	C
Social variation	CI	C	C	P	C
Stylistic variation	CI	C	C	P	C
Nonphonetic aspects	P	C	C	P	C
Diachronic vs. synchronic	P	C	C	P	P
Standardization and multilinguality	P	C	C	P	C
<b>Transcription and Ear training</b>					
Broad transcription	C	C	C	C	C
Symbols for consonants	C	C	C	C	C
Symbols for vowels	C	C	C	C	C
Narrow transcription	C	C	C	C	C
Stress and tone	C	C	C	C	C
Transcription of pathological speech and voice	P	P	P	P	C

C = Core

CI = Core-introductory

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Phon = Phonetics

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Phil = Philology

SLE = Spoken Language Engineering

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It is likely that the final recommendations will differ from the current classification: some of the elements currently not taught may be seen as desirable additions to future curricula; others may no longer seem relevant in our fast-changing discipline. In discussing the importance of the various elements of study, it should be kept in mind that the aim is not to establish a standardised curriculum but to get a consensus on the elements of study which seem essential or desirable for a student who is acquiring phonetics knowledge within the scope of a given specialisation. It is likely that there is much more uniformity at the level of elements of study than at the level of courses or curricula which will vary widely across European institutions.

A set of recommendations as envisaged here may enable individual institutes to reflect on their own curricula and identify gaps in knowledge that could be filled. It may also spur the development of web-based material that could be made available to a large number of institutes. This would be most appropriate for 'core' elements that all institutes typically teach or for 'peripheral' elements which institutes would like to teach but may not because of the lack of local expertise. Finally, these recommendations could be used by postgraduate students new to the area as a guide to the knowledge they should aim to acquire via self-study or specific courses.

### **3 Survey of Textbooks and Equipment used in Phonetics Education**

#### **3.1 Aims and structure of the survey**

An important objective of our work is to disseminate information that may help improve the quality of courses offered in phonetics institutes and promote the use of shared resources. In spite of the increasing use of web-based teaching materials, students still rely heavily on background reading to support taught material. One outcome of our previous survey was that a useful resource for both teachers and students would be a listing of textbooks that are available for different topic areas and commonly used in institutes teaching phonetics. Respondents also indicated the need for more information about software and hardware that may be used to support teaching in laboratory classes for courses in speech production, speech perception and acoustic phonetics. A second questionnaire was therefore devised to gather information on both these issues.

In our follow-up survey, institutes were invited to complete a questionnaire made available on the web or in print. The questionnaire consisted of three parts. In Part A, basic information about the institute was collected (address and profile). In Part B, respondents were asked about the equipment that they use in the teaching of speech production, speech perception and acoustic phonetics. In Part C, they were given a list of textbooks for each of 11 topic areas (using the same topic classification as in the 1997 survey) and were asked to tick the five textbooks most used for teaching purposes (i.e. recommended to students). There was also the possibility of adding further titles if these were not included in the initial list.

It was hoped that the outcome of this survey would provide a clearer view of the textbooks most commonly used in teaching different elements of phonetics study and also give a better idea of the breadth of material available both in English and in other European languages. The full listing of textbooks for each topic area is a unique resource that is being made available on the web <http://pan.hf.ntnu.no/socrates/textbooks.html>. A further aim was to highlight areas of phonetic study for which users report a lack of availability of textbooks. This might point to the need for the development of new teaching material either in print or in web format.

An important point to be made is that this survey merely reflects current practice; the lists of most cited textbooks neither have the status of recommendations nor imply a quality judgment. Indeed, the choice of textbooks to be included in reading lists can be based on factors as diverse as availability in print, breadth, price, publisher, level (introductory or advanced) and ‘tradition’ within a given institution as well as quality.

The outcome of the study is presented as follows. Section 3.2 will include a summary of survey respondents classified in terms of their institute profiles and country of origin. In Section 3.3, the equipment used for phonetics teaching will be summarised. In Section 3.4, the books that are most often used are presented for each topic area. Listings are given separately for books in English and books available in other European languages.

### 3.2 Profile of respondents

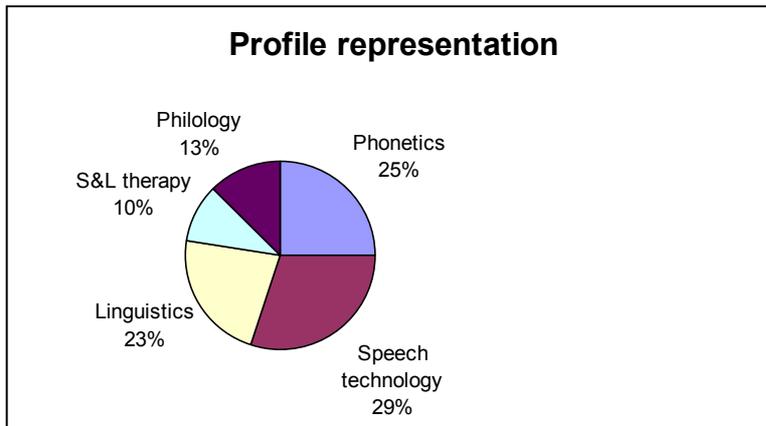
40 completed questionnaires were received from respondents in 14 European countries. The country distribution is shown in Table 2.1. It can be seen that the UK, Germany and Spain have the widest representation.

**Table 2.1:** Country representation in survey returns

UK	8
Germany	6
Spain	6
Italy	5
Finland	3
France	2
Slovenia	2
Sweden	2
Switzerland	1
Estonia	1
Norway	1
Lithuania	1
Poland	1
Netherlands	1

Institutes were classified in terms of their profile (for definition of institute profiles, see Section 2.2). A quarter of respondents defined themselves as dedicated

departments of phonetics but there was also a good representation of the other four profiles.



**Figure 2.1:** Profile representation of the 40 respondents

### 3.3 Equipment used in phonetics education

In this section an overview is given of standard equipment used for teaching and research in respondents' institutes.

Instruments and devices have been divided into five categories according to their usage:

- Respiration
- Phonation
- Supraglottal articulation
- Acoustic analysis
- Perception

**Table 2.2:** Number of different devices or software packages listed per category.

<b>Respiration</b>	<b>Phonation</b>	<b>Supraglottal articulation</b>	<b>Acoustic analysis</b>	<b>Perception</b>
4	7	9	41	12

As Table 2.2 shows, respondents listed more than 40 different items in the acoustic analysis category. Many of these were software packages for signal analysis. There was a smaller range of equipment available in other categories. In the tables below, the different systems cited are listed together with, wherever possible, a web site from which further information about the device or software can be found. <sup>1</sup> For each of the systems, the column "# Users" indicates the number of institutes reporting the use that type of equipment."

<sup>1</sup> The URLs given are correct at the time of printing but subject to change. These URLs are provided to guide the readers to further information about the devices listed and in no way imply an endorsement of any commercial products.

**Respiration**

<b>Device</b>	<b># Users</b>	<b>Web site information</b>
Frøkjær-Jensen Aerophone	4	<a href="http://www.kayelemetrics.com/aerophon.htm">www.kayelemetrics.com/aerophon.htm</a>
Rothenberg mask	2	
Electro-pneumograph EPG3	2	
Respirtrace	1	<a href="http://www.ctech.net/nims/products.html">www.ctech.net/nims/products.html</a>

**Phonation**

<b>Device</b>	<b># Users</b>	<b>Web site information</b>
Laryngograph	13	<a href="http://www.laryngograph.com">www.laryngograph.com</a>
F-J electroglottograph	5	
Fiberscope	3	
CSL	2	
Kay visipitch	1	<a href="http://www.kayelemetrics.com/visipitc.htm">www.kayelemetrics.com/visipitc.htm</a>
Phonetogram	1	
Dr Speech	1	<a href="http://www.drspeech.com/">www.drspeech.com/</a>

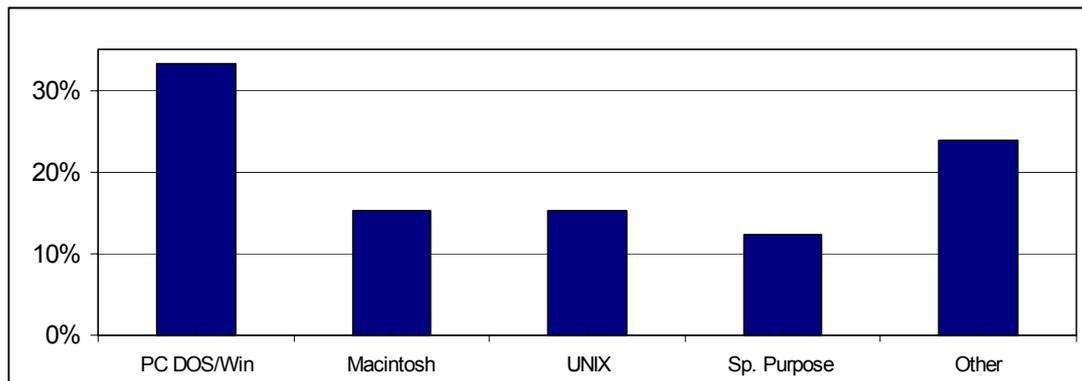
**Supraglottal articulation**

<b>Device</b>	<b># Users</b>	<b>Web site information</b>
Electropalatograph EPG2/3	10	<a href="http://www.linguistics.reading.ac.uk/research/speechlab/epg/">www.linguistics.reading.ac.uk/research/speechlab/epg/</a>
Carstens Articulograph AG100	4	<a href="http://www.articulograph.de/">www.articulograph.de/</a>
EMG	3	
FMRI	2	
Kay 6300 palatometer	1	<a href="http://www.kayelemetrics.com">www.kayelemetrics.com</a>
Kay nasometer	1	<a href="http://www.kayelemetrics.com">www.kayelemetrics.com</a>
SNORS nasal/airflow	1	
F-J manometer	1	
F-J aerometer	1	

**Acoustic analysis****a. Operating systems**

As for acoustic analysis products are mainly based on the integration of software and DSP hardware, it is of interest to classify the frequency of occurrence of the various operating systems under which they are used.

**Figure 2.2:** Operating systems used for acoustic analysis systems.



As Fig. 2.2 shows DOS/Windows is the operating system most cited, at least for acoustic analysis software used for teaching. According to this survey, Macintosh and UNIX have an equal share of the remaining market. The 'Special Purpose' section is mainly represented by the KAY Elemetrics 5500 and 7800 models and Brüel & Kjær spectrum analysers and filters used by two other respondents. The "other" category is used to represent a number of devices available in more than one environment (i.e. MATLAB self-made applications), purely "purpose-built" tools, or unclassifiable equipment.

#### b. Top Twelve

Here follows the list of the twelve most used types of equipment in this category:

<b>Product</b>	<b># Users</b>	<b>Operating System</b>	<b>Web site information</b>
KAY CSL 4300	14	PC/DOS	<a href="http://www.kayelemetrics.com/">www.kayelemetrics.com/</a>
Signalize	10	Macintosh	<a href="http://agoralang.com/signalize.html">http://agoralang.com/signalize.html</a>
ESPS/Waves	10	UNIX	<a href="http://www.entropic.com/products/esps/esps.html">www.entropic.com/products/esps/esps.html</a>
KAY 5500	9	Special Purpose	<a href="http://www.kayelemetrics.com/">www.kayelemetrics.com/</a>
KAY Multispeech	5	PC/Win 3.x	<a href="http://www.kayelemetrics.com/">www.kayelemetrics.com/</a>
SFS	5	PC/Win or UNIX	<a href="http://www.phon.ucl.ac.uk/resource/sfs.html">www.phon.ucl.ac.uk/resource/sfs.html</a>
MATLAB	5	Various OS	<a href="http://www.mathworks.com/">www.mathworks.com/</a>
HTK/HMM	5	UNIX	<a href="http://www-white.media.mit.edu/~nuria/HTKV2.0/htk.html">www-white.media.mit.edu/~nuria/HTKV2.0/htk.html</a>
CSRE 3.0	3	PC/Win	<a href="http://www.avaaz.com/products.html">www.avaaz.com/products.html</a>
SoundScope	3	Macintosh	<a href="http://www.gwinst.com/web-pages/products.html">www.gwinst.com/web-pages/products.html</a>
KAY Visipitch 6087	3	PC/DOS	<a href="http://www.kayelemetrics.com/">www.kayelemetrics.com/</a>
PRAAT 3.7	2	PC/Various	<a href="http://fonsg3.let.uva.nl/praat/praat.html">http://fonsg3.let.uva.nl/praat/praat.html</a>

The remainder include a set of 5 unspecified "purpose-built tools" which, if added to the five listed as "MATLAB", bring up to ten the respondent laboratories that usually build analysis instruments of their own. SFS and PRAAT can be classified as non-commercial products as they are freely available on the Internet; it is encouraging to see that they are used for teaching and research in many laboratories.

### Perception

Product	# Users	Web site information
PsyScope	5	<a href="http://atila-www.uia.ac.be/psyscope/index.html">http://atila-www.uia.ac.be/psyscope/index.html</a>
Various implementations of Klatt synthesiser (e.g. Sensyn)	5	e.g. <a href="http://www.sens.com">www.sens.com</a>
SAILS	1	<a href="http://www.avaaz.com/products.html">www.avaaz.com/products.html</a>
UCLA vowel perception kit	1	

In this category also, a large number of purpose-built software packages for constructing and running speech perception experiments were listed.

### General considerations

It cannot be ascertained from the answers to the questionnaire whether the equipment listed is primarily used for teaching or research. It is likely that most are used for both purposes.

If the number of cited tools is considered as representative of the interests of various groups, we should conclude that speech acoustic analysis and perception are the main areas into which laboratories invest their resources. MATLAB is the general-purpose software package most used to easily develop tools in all the technical areas of phonetic interest.

### 3.4 Textbooks used in phonetics education

The aim of the part of the survey reported in this section was to obtain information about the availability and the use of textbooks in phonetics education in Europe. It was our hope that the survey would provide answers to the following questions:

- Which are the textbooks that are being used most frequently across institutes teaching Phonetics?
- Is the use of textbooks for the different knowledge areas confined to a few popular ones or is there a range of popular textbooks?
- To what extent are books written in languages other than English represented?
- Do teachers of phonetics feel the need for more textbooks in certain knowledge areas?

Taking the topic classification used in *The Landscape of Future Education in Speech Communication Sciences* (Bloothoof et al.; 1997) as a point of departure, the field of Phonetics was divided into the following different sub-areas.

1. General
2. Speech Acoustics
3. Speech Perception
4. Speech Production
5. First/Second Language Acquisition
6. Speech Technology
7. Methods and Tools
8. Phonology
9. Sociophonetics and Dialectology
10. Transcription and Ear Training
11. Speech Pathology

For each of these areas, a list of textbooks was provided based on those mentioned in *European Studies in Phonetics and Speech Communication* (Bloothoof, Hazan, Huber and Llisterri, eds.; 1995) and respondents were asked to tick off up to five readings most frequently recommended for students of phonetics. In addition, they were requested to add textbooks that were not included in each of the lists. In this connection, respondents were especially encouraged to mention textbooks in languages other than English.

### General Books

The 'General' category differed from others in that it listed textbooks that covered a range of topics pertinent to phonetics education. Respondents were asked to indicate the topic(s) for which they recommend them especially (*Production, Acoustics, Perception, Ear Training and Transcription*). The analysis of the data provided by 40 European Phonetics institutes first of all shows that the most popular general textbooks were:

- Ladefoged, P. (1975). *A Course in Phonetics*. (1993, 3<sup>rd</sup> ed.). New York: Harcourt, Brace, Jovanovich.
- Laver, J. (1994). *Principles of Phonetics*. Cambridge: Cambridge University Press.
- Denes, P.B. and Pinson, E.N. (1993, 2<sup>nd</sup> ed.). *The Speech Chain; the Physics and Biology of Spoken Language*. New York: Freeman.

**Table 2.3:** Number of citations for each of the four topic areas in the three most popular general text books.

	<b>Production</b>	<b>Acoustics</b>	<b>Perception</b>	<b>Ear Training</b>
Ladefoged	15	9	3	6
Laver	8	8	2	3
Denes and Pinson	4	4	2	2

A more detailed breakdown was carried out to see which general textbooks were most often cited for each of the four topic areas. Books are listed if they were cited by five or more respondents.

The most popular general textbooks used in teaching **Speech Production** were:

- Ladefoged, P. (1975). *A Course in Phonetics*. (1993, 3<sup>rd</sup> ed.). New York: Harcourt, Brace, Jovanovich.
- Clark, J. and Yallop, C. (1995). *An Introduction to Phonetics and Phonology*. 2nd Ed. Oxford: Blackwell.
- Laver, J. (1994). *Principles of Phonetics*. Cambridge: Cambridge University Press.
- Borden, G., Harris, K.S., and Raphael, L.J. (1994, 3<sup>rd</sup> ed.). *Speech science primer. Physiology, acoustics and perception of speech*. Baltimore: Williams and Wilkins.
- Catford, J.C. (1988). *A Practical Introduction to Phonetics*. Oxford: Clarendon.

The most popular general textbooks used in teaching **Acoustic Phonetics** were:

- Ladefoged, P. (1975). *A Course in Phonetics*. (1993, 3<sup>rd</sup> ed.). New York: Harcourt, Brace, Jovanovich.
- Clark, J. and Yallop, C. (1995). *An Introduction to Phonetics and Phonology*. 2nd Ed. Oxford: Blackwell.
- Laver, J. (1994). *Principles of Phonetics*. Cambridge: Cambridge University Press.
- Borden, G., Harris, K.S., and Raphael, L.J. (1994, 3<sup>rd</sup> ed.) *Speech science primer. Physiology, acoustics and perception of speech*. Baltimore: Williams and Wilkins.
- Lieberman, P. and Blumstein, S.E. (1988) *Speech Physiology, Speech Perception and Acoustic Phonetics*. Cambridge: Cambridge University Press.
- Lass, N.J. (Ed.) (1996) *Principles of Experimental Phonetics*. St. Louis: Mosby.

In **Speech Perception**, only two general textbooks were chosen more than five times (Lieberman and Blumstein, 1988; and Borden et al., 1994), and in **Ear training**, Ladefoged (1975) was the only book chosen more than five times.

### Specialised textbooks

In the following sections the answers provided by the 40 respondents are summarized in condensed form to give the "Top 5" specialised textbooks for each of the different areas. Rankings are based on the number of citations for each book and do not denote any judgment of quality. Note that the absolute numbers that formed the basis for calculation of the ranks vary between the different areas. In a number of cases, the same ranks for different textbooks appear due to ties in the results. All non-English books are listed in alphabetical order. Some of these may be translations of books published in English.

### Acoustic Phonetics

'Top 5':

1. Kent, R.D. and Read, C. (1992). *The Acoustic Analysis of Speech*. London: Whurr/ San Diego: Singular.
2. Ladefoged, P. (1996, 2<sup>nd</sup> ed.). *Elements of Acoustic Phonetics*. Chicago: The University of Chicago Press.
3. Johnson, K. (1997). *Acoustic and Auditory Phonetics*. Oxford: Blackwell.
4. Fry, D.B. (1979). *The Physics of Speech*. Cambridge: Cambridge University Press.

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5. 't Hart, J., Collier, R., and Cohen. A. (1990). *A Perceptual Study of Intonation*. Cambridge: Cambridge University Press.

*Non-English:*

- Borucki, H. (1989). *Einführung in die Akustik*. Mannheim: B.I. Wissenschaftsverlag.
- Ferrero, F., Genre, A., Boë, L.J., and Contini, M. (1979). *Nozioni di Fonetica Acustica*. Torino: Omega.
- Lindblad, P. (1998). *Talets Akustik och Perception*. Compendium, Göteborgs Universitet.
- Llisterri, J. (1996). "Los sonidos del habla". *Elementos de Linguística* (Martin Vide, Ed.). Barcelona: Octaedro universidad.
- Neppert, J. and Pétursson, M. (1986/1992). *Elemente einer akustischen Phonetik*. Hamburg: Buske.
- Quilis, A. (1981). *Fonetica acustica de la lengua española*. Madrid: Gredos.
- Zwicker, E. and Zollner, M. (1984). *Elektroakustik*. Berlin: Springer.

## Speech Perception

*'Top 5':*

1. Zwicker, E. and Fastl, H. (1990). *Psychoacoustics*. Berlin: Springer.
2. Jusczyk, P.W. (1997). *The Discovery of Spoken Language*. Cambridge, MA: The MIT Press.
2. Miller, J.L., Kent, R.D., and Atal, B.S. (Eds.) (1991). *Papers in Speech Communication: Speech Perception*. New York: Acoustical Society of America.
2. Moore, B.C.J. (1997). *An Introduction to the Psychology of Hearing* (4<sup>th</sup> ed.). New York: Academic.
2. Ryalls, J. (1996). *A Basic Introduction to Speech Perception*. San Diego: Singular.

*Non-English:*

- Lindner, G. (1969). *Einführung in die experimentelle Phonetik*. München: Hueber.

## Speech Production

*'Top 5':*

1. Laver, J. (1980). *The Phonetic Description of Voice Quality*. Cambridge: Cambridge University Press.
2. Hardcastle, W.J. (1976). *Physiology of Speech Production: An Introduction for Speech Scientists*. London - New York: Academic Press.
3. Ladefoged, P. (1971). *Preliminaries to Linguistic Phonetics*. Chicago: University of Chicago Press.
4. Levelt, W.J.M. (1989). *Speaking. From Intention to Articulation*. Cambridge, MA: The MIT Press.
5. Hardcastle, W.J. and Marchal, A. (Eds.) (1990). *Speech Production and Speech Modelling*. Dordrecht: Kluwer.
5. Titze, I.R. (1994). *Principles of Voice Production*. Englewood Cliffs, NJ: Prentice Hall.

*Non-English:*

- Bothorel, A. et al. (1986). *Cinéradiographie des voyelles et des consonnes du français*. Travaux de l'Institut de Phonétique de Strasbourg, Strasbourg.
- Croatto, L. (Ed.) (1983-86). *Trattato di foniatría e logopedia*. Padova: La Garangola.
- Léon, M. and Léon, P. (1997). *La prononciation du français*. Paris: Nathan.
- Léon, P.R. (1992). *Phonétisme et prononciations du français*. Paris: Nathan.
- Miller, G.A. (1985). *Lenguaje y Habla*. Madrid: Alianza Psicología.
- Pétursson, M. and Neppert, J. (1996). *Elementarbuch der Phonetik*. Hamburg: Buske Verlag.
- Rørbech, L. (1994). *Stemnbrugslære*. København: Reizel.
- Simon, P. (1967). *Les consonnes françaises, mouvements et positions articulatoires à la lumière de la radiocinématographie*. Série A: Manuel et études linguistiques XIV, Paris: Klincksiek.
- Sundberg, J. (1980). *Röslära*. Stockholm: Proprius.
- Waengler, H.-H. (1974). *Physiologische Phonetik*. Marburg: Elwert.

## Language Acquisition (L1 and L2)

*'Top 5':*

1. Vihman, M.M. (1996). *Phonological Development. The Origins of Language in the Child*. London: Blackwell.
2. Ingram, D. (1989). *First Language Acquisition*. Cambridge: Cambridge University Press.
3. Fletcher, P. and MacWhinney, B. (Eds.) (1995). *The Handbook of Child Language*. Oxford: Blackwell.
3. Jusczyk, P.W. (1997). *The Discovery of Spoken Language*. Cambridge, MA: The MIT Press.
3. Locke, J.L. (1993). *The Child's Path to Spoken Language*. Cambridge, MA: Harvard University Press.
6. Ellis, R. (1994). *The Study of Second Language Acquisition*. Oxford: Oxford University Press.

*Non-English:*

- Boysson-Bardies, B. (1996). *Comment la parole vient aux enfants*. Editions Odile Jacob.
- Muñoz Licerias, J. (1992). *Adquisición de segundas lenguas*. Madrid: Visor.

## Speech Technology

*'Top 5':*

1. Holmes, J. (1993). *Speech Synthesis and Recognition*. Chapman and Hall.
2. Keller, E. (Ed.) (1994). *Fundamentals of Speech Synthesis and Speech Recognition. Basic Concepts, State of the Art and Future Challenges*. Chichester: Wiley.
2. O'Shaughnessy, D. (1987). *Speech Communication: Human and Machine*. Addison Wesley.
2. Rabiner, L.R. and Shafer, R.W. (1978). *Digital Processing of Speech*. Englewood Cliffs, NJ: Prentice-Hall.
5. Markel, J.D. and Gray, A.H. (1976). *Linear Prediction of Speech*. Berlin: Springer.

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5. Rabiner, L.R. and Huang, B.H. (1993). *Fundamentals of Speech Recognition*. Prentice Hall.
  5. van Santen, J.P.H. et al. (Eds.) (1995). *Progress in Speech Synthesis*. Berlin: Springer.

(In addition, comprehensive suggestions for text books on speech technology from the view point of spoken language engineering curricula are presented in chapter 3)

*Non-English:*

- Calliope, (1989). *La parole et son traitement automatique*. CNET-ENST, Masson.
- Ruske, G. (1988). *Automatische Spracherkennung*. München: Oldenbourg.
- Schrüfer, E. (1990). *Signalverarbeitung*. München: Hanser.
- Sickert, K. (1983). *Automatische Spracheingabe und Sprachausgabe*. München: Markt and Technik.

## Methods and Tools

*'Top 5':*

1. Pullum, G.K. and Ladusaw, W.A. (1986). *Phonetic Symbol Guide*. Chicago: University of Chicago Press.
2. Rietveld, T. and van Hout, R. (1993). *Statistical Techniques for the Study of Language and Language Behaviour*. Berlin, New York: Mouton de Gruyter
3. Butler, C. (1985). *Statistics in Linguistics*. Oxford: Blackwell.
3. Hatch, E. and Lazaraton, A. (1991). *The Research Manual. Design and Statistics for Applied Linguistics*. New York: Newbury House.
3. Woods, A., Fletcher, P., and Hughes, A. (1986). *Statistics in Language Studies*. Cambridge: Cambridge University Press.

*Non-English:*

- Bortz, J. (1993). *Statistik für Sozialwissenschaftler*. (4. Aufl.). Berlin: Springer.
- Bronstein et al. (1995). *Taschenbuch der Mathematik für Studenten und Ingenieure*. Frankfurt am Main: Deutsch.
- Lienert (1986). *Verteilungsfreie Methoden der Biostatistik*. Königsstein: Hain.
- Llisterri, J. (1991). *Introducción a la fonética: el método experimental*. Barcelona: Anthropos.
- Machelett, K. (1994). *Das Lesen von Sonagrammen*. Magisterarbeit, München.
- Marinell (1990). *Multivariate Verfahren: Einführung für Studierende und Praktiker*. München: Oldenbourg.

## Phonology

*'Top 5':*

1. Katamba, F. (1989). *An Introduction to Phonology*. London: Longman.
2. Lass, R. (1984). *Phonology. An introduction to basic concepts*. Cambridge: University Press.
3. Carr, P. (1993). *Phonology*. Basingstoke: MacMillan.
3. Goldsmith, J. (1989). *Autosegmental and Metrical Phonology*. Oxford: Blackwell.
3. Grunwell, P. (1982). *Clinical Phonology*. London: Croom Helm.
3. Ladd, D.R. (1996). *Intonational Phonology*. Cambridge: Cambridge University Press.

*Non-English:*

- Contreras, H. and Lleo, C. (1982) *Aproximacion a la fonologia generativa. Principios teoricos y problemas*. Barcelona: Anagrama.
- Dell, F. (1985). *Les règles et les sons*. (2e édition revue et augmenté), Paris: Hermann.
- Duchet, J. L. (1981). *La phonologie. Que sais-je*, PUF. (BU: 2 2 221:).
- Guitart, J.M. and Roy, J. (1970). *La estructura fonologica de la lengua castellana*. Barcelona: Anagrama.
- Harris, J. W. (1975). *Fonologia generativa del español*. Barcelona: Planeta.
- Hagège, C. and Haudricourt, A. (1978). *La Phonologie Panchronique: comment les sons changent dans les langues*. PUF.
- Kohler, K. (1977). *Einführung in die Phonetik des Deutschen*. Berlin: Schmidt.
- Laks, B. and Rialland, A. (1993). *Architecture des représentations phonologiques*. Paris : CNRS.
- Léon, P.S.H. et al. (1977). *La phonologie: les écoles et les théories*. Paris: Klincksieck.
- Martinet, A. (1970). *Elements de linguistique generale*. Paris: Colin. Trad. it. *Elementi di Linguistica Generale*. Bari, Laterza (1967).
- Nespor, M. (1996). *La Fonologia*. Bologna: Il Mulino.
- Ramers, K-H. and Vater, H. (1995, 4<sup>th</sup> ed.). *Einführung in die Phonologie*. Huerth: Gabel Verlag.
- Santulli, F. (1996). *Lineamenti di fonetica fisiologica e di fonologia strutturale*. In: M. Negri (Ed.) *Navadhyayi*. Roma: il Calamo.
- Schane, S. A. (1967). *La phonologie générative*. Revue LANGAGES.
- Ternes, E. (1987). *Einführung in die Phonologie*. Darmstadt: Wissenschaftliche Buchgesellschaft.
- Trubetzkoy, N.S. (1958). *Grundzüge der Phonologie*. Vandenhoeck und Ruprecht, Göttingen.
- Trubetzkoy, N.S. (1958). *Anleitungen zu phonologischen Beschreibungen*. Vandenhoeck und Ruprecht; Göttingen.
- Trubetzkoy, N.S. (1967). *Principes de phonologie*. Paris: Klincksieck,
- Trubetzkoy, N.S. (1971). *Fondamenti di Fonologia*. Einaudi Editore, Torino.

## Sociophonetics / Dialectology

'Top 5':

1. Chamber, J.K. and Trudgill, P. (1980). *Dialectology*. Cambridge: Cambridge University Press.
1. Labov, W. (1972). *Sociolinguistic Patterns*. Philadelphia: Pennsylvania University Press / Oxford: Blackwell.
1. Labov, W. (1994). *Principles of Linguistic Change. V. 1: Internal factors*. Oxford: Blackwell.
1. Trudgill, B. (1974). *Sociolinguistics. An Introduction*. Harmondsworth: Penguin.
5. Hudson, R.A. (1980). *Sociolinguistics*. Cambridge University Press.

Non-English:

- Althaus, P. (1970). *Ergebnisse der Dialektologie*. Wiesbaden: Steiner.
- Alvar, M. (1996). *Manual de dialectologia hispanica. El español de España*. Barcelona: Ariel.
- Forschungsinstitut für Deutsche Sprache. *Deutscher Sprachatlas*. Marburg.
- Garcia Mouton, P. (1994). *Lenguas y dialectos de España*. Madrid: Arco Libros.
- Goeschel, J. (1980). *Dialekt und Dialektologie*. Wiesbaden: Steiner.
- Michelena, L. (1977, 2<sup>nd</sup> ed.). *Fonetica Historica Vasca*. San Sebastian: Diputacion de Guipuzcoa.

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Viereck, W. (Ed.) (1993). *Historische Dialektologie und Sprachwandel*. Stuttgart: Steiner.

## Transcription and Ear Training

'Top 5':

1. Pullum, G.K. and Ladusaw, W.A. (1996, 2<sup>nd</sup> ed.). *Phonetic Symbol Guide*. Chicago and London: University of Chicago Press.
2. Ball, M.J., Rahilly, J., and Tench, P. (1996). *The Phonetic Transcription of Disordered Speech*. San Diego: Singular.

Non-English:

- Almeida, A. and Braun, A. (Ed.) (1987). *Probleme der phonetischen Transkription*. Stuttgart: Franz Steiner.
- Lindblad, P. (1997). *Taltranskription*. Compendium, Göteborgs Universitet.
- Vieregge, W.H. (1985). *Transcriptie van spraak*. Dordrecht: Foris Publications.
- Vieregge, W.H. (1989). *Phonetische Transkription. Theorie und Praxis der Symbolphonetik*. (Zeitschrift für Dialektologie und Linguistik (ZDL), Beiheft 60). Stuttgart: Steiner.
- Vieregge, W.H. (1996). *Path-Symbolphonetik - Auditive Deskription pathologischer Sprache*. (Zeitschrift für Dialektologie und Linguistik (ZDL), Beiheft 100, inkl. 2 CDs). Stuttgart: Steiner.

## Pathology

'Top 5':

1. Crystal, D. (1981). *Clinical Linguistics*. Wien: Springer.
1. Crystal, D. (1980). *Introduction to Language Pathology*. London: Edward Arnold.
2. Ball, M. (1993). *Phonetics for Speech Pathology*. London: Whurr.
2. Grunwell, P. (1982). *Clinical Phonology*. London: Croom Helm.
4. Kent, R. D. (Ed.) (1992). *Intelligibility in Speech Disorders: Theory, Measurement and Management*. Amsterdam: Benjamins.
4. Shriberg, L.D. and Kent, R.D. (1982). *Clinical Phonetics*. Toronto: Wiley.

Non-English:

- Boehme, G. (1983). *Klinik der Sprach-, Sprech- und Stimmstörungen*. Stuttgart: Fischer.
- Seeman, M. (1974). *Sprachstörungen bei Kindern*. Berlin: Volk und Gesundheit.
- Spieker-Henke, M. and Kunow, J. (1977). *Zusammenhänge bei Atem-, Stimm- und Sprachstörungen bei Kindergarten-Kindern*. Hamburg: Buske.
- Vieregge, W. (1996). *Patho-Symbolphonetik*. Stuttgart: Steiner.

## The use of English vs. non-English textbooks

The following table gives the number of textbooks written in English that have been ticked off once or more. The category "Other languages" summarizes the books in Polish, Danish, Finnish, Italian, German, French, Spanish and Norwegian that were not contained in the original lists of textbooks and that were added by individual respondents.

**Table 2.4:** Number of books cited in English and in other languages for each topic area.

	English	Other languages
Acoustics	21	7
Perception	21	1
Production	22	10
Language Acquisition (L1andL2)	14	2
Speech Technology	27	4
Methods and Tools	18	7
Phonology	38	19
Sociophonetics and Dialectology	15	7
Transcription and Ear Training	4	5
Pathology	13	4

### Comments and desiderata

A number of respondents specifically commented on the lack of textbooks available at an appropriate level for teaching speech perception. Those available appear to be either too elementary or beyond the level of undergraduate students.

Another desideratum was for textbooks that would give much more practical information on how to carry out practical tasks in experimental phonetics: for example, how to construct a discrimination or identification task in speech perception, or how to construct a synthesis using the Klatt synthesiser.

Also mentioned was the need for a textbook or at least chapter on the uses or applications of Phonetics (e.g. forensic applications, speech technology applications, second language learning, clinical applications, etc) at elementary level. Finally, respondents expressed the need for more phonetics textbooks in languages other than English.

### Conclusions

When looking at the data presented above it should be kept in mind that the 40 respondent institutes represented only a part of the much larger community of European institutions involved in Phonetics teaching. As has been shown in Section 3.2, however, there was a good representation of the different institute profiles as well as of different European countries in the survey. Therefore, it can be assumed that the results reflect the teaching situation fairly well.

A general comment that may be made regarding all topics is the relative lack of recent textbooks (i.e. less than five years old) in the top ranked titles. For example, in ‘Speech Technology’, three of the most used textbooks are over ten years old in an area where progress is occurring at a rapid pace. This may be due to several factors. It is possible that fewer textbooks are now being produced in our fast changing field and that educators are making greater use of other materials such as collections of published research papers or even CD-ROM or web-based materials. It may also be that users are rather conservative in their use of textbooks and prefer

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to recommend an older but well-known and well-trying textbook rather than a more recently published one.

The long-established area of Phonology had the widest number of cited textbooks in both English (38) and other languages (19). Though being a relatively new area, Speech Technology was also well represented with a large number of textbooks in English (27) and other languages (4).

For other areas, however, the number of textbooks cited was relatively small. For example, there were relatively few textbooks dealing with phonetics applied to speech pathology. It should be pointed out, however, that according to the results of our first survey, Pathology is taught by a relatively small number of phonetics institutes which at least partly explains the small number of entries. In spite of the relatively strong emphasis on Ear Training and Transcription in phonetics teaching, relatively few textbooks were cited for this area. This may reflect the fact that this area is particularly well-suited to audio-visual applications and that greater use is being made of audio-tapes and computer-based materials than of traditional textbooks.

## **Acknowledgements**

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If you have ever heard a person learning English as a second language say, "I want to go to the bitch" (meaning "I want to go to the beach"), you might understand the importance of mastering phonetics when learning new languages. As such an example illustrates, few people in our society give conscious thought to the sounds they produce and the subtle differences they possess. It is unfortunate, but hardly surprising, that few language-learning books use technical terminology to describe foreign sounds