Universitat Autònoma de Barcelona

2023/2024

Acoustical Physics and Audiology

Code: 101708
ECTS Credits: 6

Degree	Type	Year	Semester
2500893 Speech therapy	FB	1	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

External teachers

Helen Rowson (Intervenció en veu)

Lorraine Baqué (Alteracions de la parla)

Prerequisites

There are no pre-requisites. The teaching methodology means that students from all backgrounds are able to acquire the required skills.

Objectives and Contextualisation

The general objective of this course is for the student to acquire basic competences in the analysis of voice, speech and hearing, three of the five areas of Speech-Language Therapy.

The specific objectives are:

- To understand what the voice is and how we generate it.

- To understand the acoustic cues that define the different sounds in voice and in speech.

- To become competent at analysing healthy and dysphonic vocal qualities using acoustic analysis methods.

- To understand the psychophysical basics of hearing and the mechanisms that take place during auditory transmission from sound wave to nervous signalling.

- To understand the most common audiometric tests and the information that can be obtained with each of them.

- To understand the basics of the most prevalent hearing conditions and the main corrective strategies.

Competences

- Analyse and synthesise information.
- Critically evaluate the techniques and instruments of evaluation and diagnosis in speech therapy, as well as its procedures of intervention.
- Demonstrate an understanding of disorders in communication, language, speech, hearing, voice and non-verbal oral functions.
- Evaluate the scientific production that supports speech therapists' professional development.
- Have a strategic and flexible attitude to learning.
- Innovate in the methods and processes of this area of knowledge in response to the needs and wishes of society.
- Integrate the foundations of biology (anatomy and physiology), psychology (evolutionary processes and development), language and teaching as these relate to speech-therapy intervention in communication, language, speech, hearing, voice and non-verbal oral functions.
- Students can apply the knowledge to their own work or vocation in a professional manner and have the powers generally demonstrated by preparing and defending arguments and solving problems within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills in order to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Understand, integrate and relate new knowledge deriving from autonomous learning.
- Use the exploratory techniques and instruments pertaining to the profession, and register, synthesise and interpret the data provided by integrating this into an overall information set.

Learning Outcomes

1. Analyse a situation and identify points for improvement.
2. Analyse and synthesise.
3. Analyse the sex- or gender-based inequalities and the gender biases present in one's own area of knowledge.
4. Apply knowledge of subjective and objective audiometric methods for interpreting the corresponding results.
5. Communicate in an inclusive manner avoiding the use of sexist or discriminatory language.
6. Describe the physical characteristics of normal and pathological voice.
7. Describe the relationship between the anatomical characteristics of the voice organs and the physical characteristics of vocal sound.
8. Describe the techniques and tools of the evaluation of voice and hearing, and critically evaluate their implications for speech therapy.
9. Explain the essential aspects of scientific production in the field of audiology and assess their implications for speech therapy.
10. Have a strategic and flexible attitude to learning.
11. Identify situations in which a change or improvement is needed.
12. Identify the physical basis for the production of voice and speech, and hearing.

13. Students can apply the knowledge to their own work or vocation in a professional manner and have the powers generally demonstrated by preparing and defending arguments and solving problems within their area of study.
14. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
15. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
16. Students must develop the necessary learning skills in order to undertake further training with a high degree of autonomy.
17. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
18. Understand, integrate and relate new knowledge deriving from autonomous learning.

Content

1.- Basics of voice acoustics

- The wave nature of sound.
- Acoustic analysis tools.
- Phonation. Generation of glottal sound.
- The harmonic as a unit of voice.
- Lab practice 1: *Introduction to acoustic tools for the analysis of voice and speech. The harmonic as a unit of voice*.
- Glottal sound as a pluripotent sound. Resonances in the vocal tract. Formants.
- Lab practice 2: *Glottal sound as pluripotent sound. Generation of vowel sounds*.
- Regulation of pitch. Regulation of intensity.

2.- Acoustic analysis of vocal qualities

- Limitations and errors in the perceptual evaluation of the voice.
- Class practice: GRBAS.
- Correlation of spectral information with the different perceptual categories used in Speech-Language Pathology.
- The vocal attack. Identification of the different types of vocal attacks.
- Ring resonances and efficient voice.
- Acoustic analysis of the different dysphonia disorders.
- Lab practice 3: *Acoustic analysis for voice assessment in Speech-Language therapy assessment (I)*.
- Practice 4: *Acoustic analysis for voice assessment in Speech-Language therapy assessment (II)*.
- Seminar 1: Helen Rowson, *Vocal qualities, perception, acoustics, intervention*.

3.- Acoustics of speech sounds

- The broad-band spectrogram as a tool for the analysis of speech.
- Canonical acoustic cues of recognition of the different sounds in the Catalan and Spanish languages.
- Lab practice 5: *Acoustic analysis of speech; canonical sounds and individual compensations*.
- Seminar 2: Lorraine Baqué, *Acoustic compensations in aphasia patients*.

4.- Audiology and Audiometry

- Psychophysical basis of intensity perception. Intensity level; the decibel scale; loudness level; equal-loudness contours; the phon scale.
- Immediate and long-term auditory damage.
- Audiometric test: the audiogram.
- Biophysics of the auditory system. Outer, middle and inner ear. Tonotopic organisation of the basilar membrane and analysis of frequencies.

- Topodiagnostic audiometries.
- Intervention. The modern hearing aid. Bone conduction hearing aids. Cochlear implant.
- Lab practice 6: *Audiology and audiometry.*

Methodology

The objective is for the student to acquire basic competences in the analysis of voice, speech and hearing. Competences cannot be listened to, take notes and memorize. Active learning is required from the student.

1.- DIRECTED LEARNING

Full group classes (25 sessions,1.5 h each):

- Each session starts with time to solve questions resulting from previous autonomous studying. Alternatively, to discuss a question posed by the instructor to prepare the class.
- Then, the instructor presents new information, which may include practical demos and also active participation by the students (which may give samples of their own voice or speech for in-class analysis).
- Team discussion and identification of doubts and conclusions (through *peer-learning,* a collaborative, horizontal learning strategy). General discussion.
- At the end of most sessions a short test to evaluate proper understanding will be carried out. Most of them will be unmarked self-evaluation, although on occasions the test may be part of evaluation evidence EV1.

Split group classes (6 sessions, 2 h each).

Essential part of competence-based learning. Laboratory practices, in teams of 2. Analysis of human voice, vocal qualities (efficiency items and dysphonic alterations) with the reference analysis software Praat. Analysis of acoustic cues of speech sounds, both canonical, altered and compensations.

Practices must be repeated at home, as part of individual autonomous work (Studying block).

Seminars, full group (2 sessions, 1,5 h each).

(1) Helen Rowson, *voice coach*. (2) Dr. Lorraine Baqué, Speech-Language Pathologist, researcher in speech alterations.

2.- SUPERVISED LEARNING

Question based learning proposed by the instructor either during a class or as previous preparation.

Field work. Team research work. Each team chooses a topic of interest that must be approved by the instructor. The assignment puts at work all the competences in the course, and involves collaborative learning and social learning. This is evalation evidence EV3.

Tutorials. Students are encouraged to request tutorials to solve doubts individually, identify weaknesses or to ask for guidance. Tutorials may be formulated either through Moodle classroom messaging or face-to-face (Biophysics Unit, School of Medicine). For face-to-face tutorials please send a Moodle message to get an appointment.

3.- AUTONOMOUS LEARNING

Weakly work. Essential part to properly progress. Includes:

(1) Studying class materials (notes, videos, demos...), complemented with search of informations, either books or reliable (academic) online resources. This is the basis to pose questions at the onset of each class session.

(2) Solving the questions proposed by the instructor.

(3) Free experimenting with one's own voice and speech with Praat analysis software.

4.- OTHER

Additional materials such as videos or links of interest, will be uploaded at the Moodle Classroom. Students are also free to upload materials or to ask questions to be investigated and discussed by the group.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Full group classes	36	1.44	4, 7, 6, 8, 9, 12
Seminars	4.5	0.18	2, 18, 12, 10
Split group classes	12	0.48	2, 18, 6, 8
Type: Supervised			
Field work	18	0.72	2, 18, 6, 8, 10
Problem and question solving	11.5	0.46	2, 18, 12, 10
Tutorials	4	0.16	2, 18, 10
Type: Autonomous			
Studying	44	1.76	2, 4, 18, 6, 8, 9, 12, 10

Assessment

1. CONTINUOUS EVALUATION

Evaluation activities

After the practical lessons and the different EV1 tests, the correct answers will be discussed by the instructor and doubts will be addressed. The objective is that evaluation is part of the learning process.

Evidence 1 (EV1) - Short tests. Can take place anytime from week 2 during the two assessment periods. Short, written, individual or team tests. Some face-to-face, some online. The final mark for EV1 is the mean of the EV1 tests that the student took multiplied by the ratio of the number of tests that the student took divided by the total number of tests carried out.

The tests can be of two types:

(I) Some of the tests at the end of the class for auto-evaluation of understanding will be part of EV1 without previous notice (single response test, errors penalize -0,25 points).

(II) Some of the autonomous learning exercises proposed by the instructor will be part of EV1.

Evidence 2 (EV2) - Evaluation of practical competences *(second assessment period)*. Individual, written, face-to-face test about analysis of voice, speech and hearing from audio files (errors penalize -0,25 points). Students may bring all sorts of information, including their results from lab classes and books (but no Internet).

Evidence 3 (EV3) - Field work *(second assessment period)*. Team research work, written report, submitted to the Moodle classroom. Described in the Methodology section. Integrated evaluation of all competences in the course. If considered necessary, control mechanisms will be applied to measure the degree of involvement of each student in the work, which will have an impact on the mark.

Evidence 4 (EV4) - Integrated final evaluation *(second assessment period)*. Weeks 17 or 18, to be determined by the School of Psychology. Individual, written, face-to-face single response test (errors penalize -0,25 points).No access to external information sources.

Exceptional contributions may contribute 1 extra point to the final mark.

Definition of passed course. The following two conditions must be met. (I) To individually pass evidences EV2, 3 and 4 and to reach a final mark (including EV1) equal or greater than 5.0.

Definition of non-evaluable student. According to UAB rulings, a student will be considered non-evaluable when they participated in evidences accounting for less than 40 % of the total mark, independently of the mark they got.

Referral exams (EV2, EV3 and/or EV4). According to UAB rulings, students who participated in evaluations accounting for at least 2/3 of the total mark, and who failed to pass some of the compulsory evidences, may undertake a referral test for each of the failed evidences. Such referral tests will take place during the examination period. To pass the referral exam a mark equal or greater than 5.0 is needed. The mark of the evidence will be that obtained at the referral exam.

Synthesis exam. No unique final synthesis test for students who enrole for the second time or more is anticipated.

Misconduct. According to UAB rulings, if a student undergoes unethical behavior, such as cheating in an exam or plagiarising a work, the mark for that evidence will be 0. In case of reincidence the student will get a 0 mark for the whole course. The professor responsible for the course will communicate the misconduct to the Coordinatorof the SLP Degree.

Evaluation guidelines of the School of Psychology:
https://www.uab.cat/web/estudiar/graus/graus/avaluacions-1345722525858.html

In relation to the translation of the exams, the Criteria for the translation of evaluation tests will be followed. Facultat de Psicologia (approved in Junta Permanent de la Facultat de Psicologia on April 25, 2016).

2. SINGLE EVALUATION

It will take place on the day of the last exam of Acoustic physics and audiology during the second evaluation period. It will consist of four parts:

Evidence 1 (EV1) - Oral evaluation. Questions will be asked about any of the autonomous learning exercises proposed throughout the term.

Evidence 3 (EV3) - Field work. Individual, written report. It is described in the section of formative activities. It is a final integrated evaluation of the set of theoretical and practical competences of the subject, through a written report in the format of a scientific research work and the recorded samples.

And of the evidences EV2 and EV4 which are described in the continuous evaluation.

Definition of passed subject. To fulfill the following two conditions: to have passed individually the evidences EV2, EV3 and EV4 and to obtain an overall grade (including that of EV1) equal or higher than 5.0.

Definition of non-assessable student. According to University regulations, "any student who has submitted learning evidences with a weight of less than 40% of the grade, regardless of the grade obtained, is considered not evaluable."

Referral exams (EV2, EV3 and/or EV4). It will take place during the period of recoveries and on a single day, coinciding with the recovery of EV2 of the continuous evaluation. The evidence is recovered with a grade equalto or higher than5.0. The mark of the referral test will be the one obtained.

Misconduct. According to UAB rulings, if a student undergoes unethical behavior, such as cheating in an exam or plagiarising a work, the mark for that evidence will be 0. In case of reincidence the student will get a 0 mark for the whole course. The professor responsible for the course will communicate the misconduct to the Coordinator of the SLP Degree.

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Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
EV1-Evidence 1: Short tests	10%	1	0.04	2, 4, 18, 7, 6, 8, 9, 12, 17, 14, 10
EV2-Evidence 2: Evaluation of practical competences	30%	2	0.08	2, 3, 1, 4, 18, 6, 8, 11, 17, 16, 15, 13, 14, 10
EV3-Evidence 3: Field work	30%	15	0.6	2, 3, 1, 18, 5, 6, 8, 12, 11, 17, 16, 15, 13, 14, 10
EV4-Evidence 4: Integrated final evaluation	30%	2	0.08	2, 3, 1, 4, 18, 5, 7, 6, 8, 9, 12, 11, 17, 16, 15, 13, 14, 10
Exceptional assignments and contributions	+ 10%	0	0	2, 4, 18, 7, 6, 8, 9, 12, 10

Bibliography

All the main recommended books are available at the UAB libraries.

- Voice: Practical Vocal Acoustics. Kenneth Bozeman (2013). Pendragon Press.
- Speech: Phonetics for communication disorders. Martin Ball & Nicole Müller (2011). Routledge.
- Audiology and Audiometry: Tratado de Audiología. Enrique Salesa, Enrique Perelló y Alfredo Bonavida (2013). Elsevier-Masson.

Software

PRAAT program.

Praat (Dutch for "Speaking") is the program used in the practices and also the main tool for voice and speech analysis in fieldwork. In addition, it will serve to explore your own voice and speech (or that of others) as a result of the exercises proposed in class.

The Praat program is the international gold standard for voice and speech analysis. It was created by Paul Boersma and David Weenink of the Department of Phonetic Sciences at the University of Amsterdam, who distribute it free of charge. It is constantly evolving, so it incorporates new options following requests made to them from the academic and professional world, so it is convenient to update it every year.

The Praat has immense potential, which can serve you beyond this subject, in other subjects of the Degree and, if you choose these specialties, in your professional practice as speech and/or speech speech therapists.

There is a version for Windows, Mac, Linux ...

Link: http://www.fon.hum.uva.nl/praat/