Universitat Autònoma de Barcelona

2019/2020

Acoustical Physics and Audiology

Code: 101708
ECTS Credits: 6

Degree	Type	Year	Semester
2500893 Speech therapy	FB	1	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

External teachers

Helen Rowson (Intervenció en veu)
Lorraine Baqué (Alteracions de la parla)
Pilar Calvo (Logopèdia de l'audició)

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.
- Develop critical thought and reasoning and be able to communicate them effectively, both in your own language and second or third languages.
- Evaluate the scientific production that supports speech therapists professional development.
- Have a strategic and flexible attitude to learning.
- 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.
- 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 and synthesise.
2. Apply knowledge of subjective and objective audiometric methods for interpreting the corresponding results.
3. Describe the physical characteristics of normal and pathological voice.
4. Describe the relationship between the anatomical characteristics of the voice organs and the physical characteristics of vocal sound.
5. Describe the techniques and tools of the evaluation of voice and hearing, and critically evaluate their implications for speech therapy.
6. Develop critical thought and reasoning and know how to communicate this effectively, both in ones own and in a foreign language.
7. Explain the essential aspects of scientific production in the field of audiology and assess their implications for speech therapy.
8. Have a strategic and flexible attitude to learning.
9. Identify the physical basis for the production of voice and speech, and hearing.
10. 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. Air conduction and bone conduction audiometries. Crossover. Masking. More prevalent hypoacusis.
- Biophysics of the auditory system. Outer, middle and inner ear. Tonotopic organisation of the basilar membrane and analysis of frequencies.
- Topodiagnostic audiometries. The timpanogram. Evoked Otoacoustic Emissions.
- Intervention. The modern hearing aid. Bone conduction hearing aids. Cochlear implant.
- Lab practice 6: *Audiology and audiometry*.
- Seminar 3: Pilar Calvo, *Paediatric 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 (24 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).

Essencial 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 (3 sessions, 1,5 h each).

(1) Helen Rowson, *voice coach*. (2) Dr. Lorraine Baqué, Speech-Language Pathologist, researcher in speech alterations. (3) Pilar Calvo, Speech-Language Pathologist,pediatric hearing alterations specialist.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Full group classes	36	1.44	2, 4, 3, 5, 7, 9
Seminars	4.5	0.18	1, 10, 6, 9, 8
Split group classes	12	0.48	1, 10, 3, 5, 6
Type: Supervised			
Field work	18	0.72	1, 10, 3, 5, 6, 8
Problem and question solving	11.5	0.46	1, 10, 6, 9, 8
Tutorials	4	0.16	1, 10, 6, 8
Type: Autonomous			
Studying	44	1.76	1, 2, 10, 3, 5, 7, 9, 8

Assessment

Evaluation activities

After the different tests are held, 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. Short, written, individual tests. Some face-to-face, some online. The final mark for EV1 is the mean of the EV1 tests that the student took. Minimum 3 tests. Less than 3 will contribute 0 to the average. 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 penalise -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. Week 15 or 16, to be determined by the School of Psychology. Individual, written, face-to-face test. Analysis of voice, speech and hearing. Students may bring all sorts of information, including their results from lab classes, books, and also browse the internet. For this reason, the time must be limiting.

Evidence 3 (EV3) - Field work. To be delivered weeks 15-16. Team research work, written report, submitted to the Moodle classroom. Described in the Methodology section. Integrated evaluation of all competences in the course.

Evidence 4 (EV4) - Integrated final evaluation. Weeks 17 or 18, to be determined by the School of Psychology. Individual, written, face-to-face single response test (errors penalise -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. In case one of the compulsory evidences is failed even after the referral exam (see below), the final mark of the course will be the highest mark of the failed evidence (either the original failed mark or the referral mark).

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 exam: 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 weeks 19 or 20, to be determined by the School of Psychology.

Synthesis exam: According to UAB rulings, after the second enrolment, the course may be evaluated in a single synthesis test as per the student's request. In this course the student must request such option before participation in any of evidences EV2, 3 or 4. The synthesis test will be an oral evaluation in which a committe with two instructors will evaluate all the essential competences in the course.

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.

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

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evidence 1 (EV1): Short tests	10%	1	0.04	1, 2, 10, 3, 5, 6, 7, 9, 8
Evidence 2 (EV2): Evaluation of practical competences	30%	2	0.08	1, 10, 3, 5, 6
Evidence 3 (EV3): Field work	30%	15	0.6	1, 10, 3, 5, 6, 9, 8

Evidence 4 (EV4): Integrated final evaluation	30%	2	0.08	1, 2, 10, 4, 3, 5, 6, 7, 9
Exceptional assignments and contributions	+ 10%	0	0	1, 2, 10, 4, 3, 5, 6, 7, 9, 8

Bibliography

All 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.